Hydraulic Motors
M3 - M4 Series
Denison Vane Technology, fixed displacement
Hydraulic Motors, Fixed
M3 - M4, Denison Vane Motors

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The M3 - M4 hydraulic motors

Introduction
This wide range of hydraulic vane motors allows selection of a model to suit any particular application. They are used industrially where there is a need to provide a relatively high torque from a power source of small dimensions. The low moment of inertia of the rotating group admits high acceleration and deceleration resulting in rapid response to system control signals.

This catalogue describes the existing sizes of M3B and M4 hydraulic vane motors in their various standard construction types. Equipment manufacturers who may request additional options or have specific requests, are welcome to contact us for a tailored solution study.

Key features

Reliable performance
The M3 and M4 motors have been designed especially for severe duty applications which require long lasting medium pressure, high speed and reversing capabilities even with low fluid lubricity. Their performances remain stable over time.

Long lifetime
The fully pressure balanced concept increase the motor lifetime over its full speed range. Double lip vanes reduce the sensitivity to fluid pollution. The bearing capabilities are totally dedicated to the external loads on the shaft ends, whatever the operating pressures are.

Low noise
Simply silent! The Denison Vane Technology allows a very low noise level, whatever the speed.

Low torque ripple
Thanks to their 10 vanes, advanced cam ring profile, two torque cycles per revolution and low internal dead volumes, the M3 and M4 motors exhibit a very low torque ripple, even at low speeds.

Versatility and compactness
With several displacements for the same installation size, the M3 and M4 motors are very powerful and compact.
Hydraulic Motors, Fixed
M3 - M4, Denison Vane Motors

Description

Check valves are present in the M4 motors with internal drain.

The floating pressure port plate contains a shuttle valve which passes the highest pressure signal to the clamping area.

Port A ramp where unloaded vane moves outward for CW rotation.

Major arc where fluid works to push vane.

Minor arc where vane works to seal inlet pressure from outlet port.

The rotation is changed by reversing flow.

The rotor is of through-hardened high alloy steel.

The side grooves and radial holes cause undervane and overvane pressure to be equal.

Port B ramp unloaded vane moves inward for CW rotation.

The cam ring is interchangeable with others of different displacement. It has lub coating on inner surface.

Operation

• The motor shaft is driven by the rotor. The vanes, closely fitted into the rotor slots move radially to seal against the cam ring. The ring has two major and two minor radial sections joined by transitional sections called ramps. These contours and the pressures exposed to them are balanced diametrically.

• Light springs urge the vanes radially against the cam contour assuring a seal at zero speed so the motor can develop starting torque. The springs are assisted by centrifugal force at higher speeds. Radial grooves and holes through the vanes equalize radial hydraulic forces on the vanes at all times. Fluid enters and leaves the motor cartridge through opening in the side plates at the ramps. Each motor port connects to two diametrically opposed ramps. Pressurized fluid entering at Port A torques the rotor clockwise. The rotor transports it to the ramp openings which connect to Port B from which it returns to the low pressure side of the system. Pressure at Port B torques the rotor counter-clockwise.

• The rotor is axially separated from the sideplate surface by the fluid film. The front pressure port plate is clamped against the cam ring by the pressure, maintains optimum clearance as dimensions change with temperature and pressure. A 3-way shuttle valve in the port plate causes clamping pressure in Port A or B, whichever is the highest.

• Materials are chosen for long life efficiency. The vanes, rotor and cam ring are made out of hardened high alloy steels. The cast iron port plate and the end cap are chemically etched to offer a fine crystalline surface allowing a better lubrication at start-up.
## Hydraulic Motors, Fixed
### M3 - M4, Denison Vane Motors

#### Main Technical Data

### Installation and connection

<table>
<thead>
<tr>
<th>Mounting flange</th>
<th>Weight without connector and bracket - kg</th>
<th>Moment of inertia km² x 10⁴</th>
<th>Option for inlet and outlet port</th>
</tr>
</thead>
<tbody>
<tr>
<td>M3B SAE J744c ISO/3019-1 SAE A</td>
<td>8,0</td>
<td>3,0</td>
<td>SAE threaded SAE 4 bolts J718c ISO/DIS 6162-1 - 3/4&quot; BSPP threaded</td>
</tr>
<tr>
<td>M4C SAE J744c ISO/3019-1 SAE B</td>
<td>15,4</td>
<td>7,9</td>
<td>SAE threaded SAE 4 bolts J718c ISO/DIS 6162-1 - 1&quot;</td>
</tr>
<tr>
<td>M4D SAE J744c ISO/3019-1 SAE C</td>
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<td>SAE threaded SAE 4 bolts J718c ISO/DIS 6162-1 - 1.1/4&quot;</td>
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<tr>
<td>M4E SAE J744c ISO/3019-1 SAE C</td>
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<td>58,5</td>
<td>SAE threaded SAE 4 bolts J718c ISO/DIS 6162-1 - 2&quot;</td>
</tr>
</tbody>
</table>

#### Drain line option

All these motors may be equipped with internal drain. Then the model numbers will be M3B1, M4C1, M4D1, M4E1.

- Externally drained motors M3B, M4C, M4D, M4E: These motors may be alternately pressurized at Ports A & B. Whichever port is at low pressure should not be subjected to more than 35 bar.
  
  If it is necessary to exceed these limitations, please contact your Parker representative for application assistance.

- Internally drained motors M3B1, M4C1, M4D1, M4E1: These motors may be alternately pressurized at Ports A & B. Whichever port is at low pressure must not be subjected to more than 1.5 bar for M3B, 3.5 bar for M4 (pressure peak 7 bar).

#### Displacement and specific Torque

<table>
<thead>
<tr>
<th>Series</th>
<th>Size</th>
<th>Ring size</th>
<th>Theor. Displ. Vᵢ</th>
<th>Theoretical Torque T</th>
<th>Power at 100 rpm</th>
<th>Torque T</th>
<th>Power P</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>cm/rev.</td>
<td>Nm/bar</td>
<td>kW/bar</td>
<td>Nm</td>
<td>kW</td>
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<tr>
<td>M3</td>
<td>B</td>
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<td>19,7</td>
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For further information or if the performance characteristics outlined above do not meet your own particular requirements, please consult your local Parker representative.

To insure maximum motor performance in conjunction with your specific application, consult your local Parker representative if your application requires, minimum speed of less than 100 rpm, indirect drive, overrunning loads, braking or retarding.
## Hydraulic Motors, Fixed

### M3 - M4, Denison Vane Motors

#### Main Technical Data

<table>
<thead>
<tr>
<th>Series</th>
<th>Size</th>
<th>Displ.</th>
<th>Max. pressure</th>
<th>Operating pressure range drain</th>
<th>Max. speed for low loaded condition</th>
<th>Max. speed for max. pressure ratings</th>
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<td>bar</td>
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<td>214</td>
<td>175</td>
<td>140</td>
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</tbody>
</table>

1) Low loaded condition 35 bar for M3, 80 bar max. for M4 (see page 8).
2) Intermittent speed - Do not exceed 6 seconds per minute of operation.

HF-0, HF-2 = Antiwear petroleum base.
HF-1 = Non antiwear petroleum base.
HF-3 = Water in oil emulsions.
HF-4 = Water glycols.
HF-5 = Synthetic fluids.
HF-6a = Saturated HEES Bio fluids.
HF-6b = Partially saturated HEES Bio fluids.

Internal drain: All these motors may be equipped with internal drain. Then the model will be M3B1, M4C1, M4D1, M4E1.

### Maximum ratings M3B

[Diagram showing pressure vs. speed relationship for M3B motor]

- Running condition limits - Typical curves at 26 cSt @ 45°.
- For higher specifications or for operating speed under < 100 rpm, please consult Parker.
Hydraulic Motors, Fixed
M3 - M4, Denison Vane Motors

Main Technical Data

Maximum ratings M4C

- Running condition limits - Typical curves at 26 cSt @ 45°.
- For higher specifications or for operating speed under < 100 rpm, please consult Parker.
**Hydraulic Motors, Fixed**

**M3 - M4, Denison Vane Motors**

### Ordering Code

#### Model No.
- **M3B** - Series external drain
- **M3B1** - Series internal drain

#### Torque
- 009 = 0.130 Nm/bar
- 012 = 0.186 Nm/bar
- 018 = 0.304 Nm/bar
- 027 = 0.485 Nm/bar
- 036 = 0.624 Nm/bar

#### Type of shaft
- 1 = keyed (non SAE)
- 3 = splined (SAE A)
- 4 = splined (SAE B)

#### Direction of rotation (shaft end view)
- N = bi-directional
  - CW rotation ⇒ A = inlet  B = outlet
  - CCW rotation ⇒ B = inlet  A = outlet

#### Ports
- 00 = SAE threaded port
- 01 = 4 bolts SAE flange with UNC threads
- 02 = BSPP threaded port
- 03 = BSPP drain

#### Seal class
- 1 = S1 - BUNA N
- 5 = S5 - VITON®

#### Design letter
- 00 = standard

#### Operating Characteristics - Typical [24 cSt]

<table>
<thead>
<tr>
<th>Model</th>
<th>V, Volumetric displacement</th>
<th>Input flow at n = 2000 rpm</th>
<th>Torque T at n = 2000 rpm</th>
<th>Power output at n = 2000 rpm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>cm³/rev.</td>
<td>l/min</td>
<td>I/min</td>
<td>175 bar p</td>
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<td>M3B 009</td>
<td>9.2</td>
<td>18.4</td>
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<td>37.1</td>
<td>74.2</td>
<td>86.2</td>
<td>102.0</td>
</tr>
</tbody>
</table>

#### Overall Leakage (internal + external)

- 24 cSt
- 10 cSt

#### Permissible shaft loads

Do not apply Fr and Fa loads simultaneously
Hydraulic Motors, Fixed

M3 - M4, Denison Vane Motors

Dimensions

M3B - M3B1 motor

Weight: 8.0 kg

Shaft code 1
- Keyed, non SAE
- SAE 6-9/16'-18 UNC - 2B x 19 Deep - 8 Holes
- 01 PORT CONNECTION

Shaft code 2
- SAE A Splined Shaft Class 1 - J498b 16/32 d.p. - 9 Teeth 30° Pressure Angle Flat Root Side Fit
- Inlet & Outlet 3/8" B.S.P.
- SAE 6-9/16’-18 UNF - 00 PORT CONNECTION

Shaft code 3
- SAE B Spline Shaft Class 1 - J498b 16/32 d.p. - 13 Teeth 30° Pressure Angle Flat Root Side Fit
- SAE 12
- 1.1/16’-12 UNF
- PORT CONNECTION

Shaft code 4
- SAE B Spline Shaft Class 1 - J498b 16/32 d.p. - 13 Teeth 30° Pressure Angle Flat Root Side Fit
- PORT CONNECTION

Key: 4,76/4,71

ø21,12 MAX

Shaft code 1
- 0,8 x 45°

Weight: 8.0 kg

Port Connection
- 01
- 00

Port Connection
- 02
Hydraulic Motors, Fixed
M3 - M4, Denison Vane Motors

Operating Characteristics - Typical [24 cSt]

<table>
<thead>
<tr>
<th>Model</th>
<th>V, Volumetric displacement cm³/rev.</th>
<th>Input flow at n = 2000 rpm l/min</th>
<th>Torque T at n = 2000 rpm Nm</th>
<th>Power output at n = 2000 rpm kW</th>
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<tr>
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<td>Theoretical at 175 bar Δp</td>
<td>at 175 bar Δp</td>
<td>at 175 bar Δp</td>
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<tr>
<td>M4C 027</td>
<td>28.2</td>
<td>56.0</td>
<td>74.0</td>
<td>70.0</td>
</tr>
<tr>
<td>M4C 031</td>
<td>34.5</td>
<td>69.0</td>
<td>87.0</td>
<td>86.8</td>
</tr>
<tr>
<td>M4C 043</td>
<td>46.5</td>
<td>93.0</td>
<td>110.0</td>
<td>120.0</td>
</tr>
<tr>
<td>M4C 055</td>
<td>58.8</td>
<td>118.0</td>
<td>136.0</td>
<td>149.0</td>
</tr>
<tr>
<td>M4C 067</td>
<td>71.1</td>
<td>142.0</td>
<td>160.0</td>
<td>170.0</td>
</tr>
<tr>
<td>M4C 075</td>
<td>80.1</td>
<td>160.0</td>
<td>178.0</td>
<td>198.0</td>
</tr>
</tbody>
</table>

Overall Leakage (internal + external)

Permissible shaft loads

Do not apply Fr and Fa loads simultaneously
Hydraulic Motors, Fixed
M3 - M4, Denison Vane Motors

Dimensions

M4C - M4C1 motor

- **Dimensions**
  - Drain: SAE 4 (7/16"-20 UNF) or 1/4" BSPP (plug for internal drain)
  - DRAIN 183,6 (SAE THREADED PORT)
  - SHAFT CODE 1 (KEYED SAE "B")
  - SHAFT CODE 2 (KEYED NON SAE)
  - SHAFT CODE 3 (SAE-SPLINED SHAFT CLASS 1 - J498b)
  - Pressure Angle: 30°
  - Root Side Fit: Flat

- **Shaft Codes**
  - SHAFT CODE 1: 3/8"-16 UNC x 19 DEEP - 8 HOLES
  - SHAFT CODE 2: 3/8"-16 UNC x 19 DEEP - 8 HOLES
  - SHAFT CODE 3: SAE 16 (1.5/16" UNF x 19 DEEP)

- **Mounting Torque**
  - M4C - M4C1 motor: 110 Nm
  - Rear Ports: 102 Nm

- **Weight**: 15.4 kg
Hydraulic Motors, Fixed

M3 - M4, Denison Vane Motors

Model No.

M4D - Series external drain

M4D1 Series internal drain

Torque

062 = 1,04 Nm/bar
074 = 1,22 Nm/bar
088 = 1,45 Nm/bar
102 = 1,68 Nm/bar
113 = 1,86 Nm/bar
128 = 2,11 Nm/bar
138 = 2,30 Nm/bar

Type of shaft

1 = keyed (SAE C)
3 = splined (SAE C)

Direction of rotation (shaft end view)

N = bi-directional

CW rotation => A = inlet  B = outlet
CCW rotation => B = inlet  A = outlet

Ordering Code

Pressure p [bar]  Speed n [rpm]

Load F [N]

Overall Leakage (internal + external)

Overall Leakage Q_loss [l/min]

Permissible shaft loads

Keyed shaft N°1

Fr  Fa

Do not apply Fr and Fa loads simultaneously

Operating Characteristics - Typical [24 cSt]

<table>
<thead>
<tr>
<th>Model</th>
<th>V_j Volumetric displacement cm³/rev.</th>
<th>Input flow at n = 2000 rpm l/min</th>
<th>Torque T at n = 2000 rpm Nm</th>
<th>Power output at n = 2000 rpm kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>M4D 062</td>
<td>65,1</td>
<td>130,0 154,0</td>
<td>165,0</td>
<td>34,6</td>
</tr>
<tr>
<td>M4D 074</td>
<td>76,8</td>
<td>154,0 178,0</td>
<td>200,0</td>
<td>41,9</td>
</tr>
<tr>
<td>M4D 088</td>
<td>91,0</td>
<td>182,0 206,0</td>
<td>236,0</td>
<td>49,4</td>
</tr>
<tr>
<td>M4D 102</td>
<td>105,5</td>
<td>211,0 241,0</td>
<td>264,0</td>
<td>55,3</td>
</tr>
<tr>
<td>M4D 113</td>
<td>116,7</td>
<td>233,0 257,0</td>
<td>300,0</td>
<td>62,8</td>
</tr>
<tr>
<td>M4D 128</td>
<td>132,4</td>
<td>265,0 289,0</td>
<td>340,0</td>
<td>71,2</td>
</tr>
<tr>
<td>M4D 138</td>
<td>144,4</td>
<td>289,0 313,0</td>
<td>372,0</td>
<td>77,9</td>
</tr>
</tbody>
</table>

M4D1 : Drain port is plugged.
Hydraulic Motors, Fixed
M3 - M4, Denison Vane Motors

Dimensions

### M4D - M4D1 motor

- **Shaft Code 1** (Keyed SAE-C)
  - MOUNTING TORQUE: 180 N.m
  - SHAFT CODE 3 (SAE-C Splined Shaft
    - CLASS 1 - J498b
    - 12/24 d.p. - 14 TEETH
    - PRESSURE ANGLE 30°
    - FLAT ROOT SIDE FIT
  - Ø 17.5 (2 PLACES)
  - Ø 14.3 (4 PLACES)

- **Shaft Code 2** (SAE-C Splined Shaft
  - CLASS 1 - J498b
  - 7/16"-14 UNC x 22 DEEP - 8 HOLES
  (M12 x 22.1 DEEP-Metric Version)

- **Dimensions**
  - SAE 20 (1" 5/8-16 UNF) x 19 DEEP-2 HOLES
  - DRAIN SAE 8 (3/4"-16 UNF) OR 3/8" BSPP
  - MOUNTING TORQUE: 203.5 (SAE Threaded Port)
  - MOUNTING TORQUE: 180 N.m

- **Weight**: 27.0 kg

---

Parker Hannifin
Pump & Motor Division Europe
Vierzòn - France
Hydraulic Motors, Fixed
M3 - M4, Denison Vane Motors

Model No.

M4E - Series external drain
M4E1 - Series internal drain

Torque
153 = 2.52 Nm/bar
185 = 3.05 Nm/bar
214 = 3.53 Nm/bar

Type of shaft
1 = keyed (SAE C)
3 = splined (SAE C)

Direction of rotation (shaft end view)
N = bi-directional
CW rotation => A = inlet  B = outlet
CCW rotation => B = inlet  A = outlet

Ordering Code

M4E1
M4E -
214 - 1 N 00 - B 5 02 ..

Modifications
Ports
01 = SAE threaded port
SAE drain
02 = 4 bolt SAE flange with UNC threads
SAE drain
Seal class
5 = S5 - VITON®

Design letter
Porting combination
00 = standard

M4E1 : Drain port is plugged.

Operating Characteristics - Typical [24 cSt]

<table>
<thead>
<tr>
<th>Model</th>
<th>V_i Volumetric displacement</th>
<th>Input flow at n = 2000 rpm</th>
<th>Torque T at n = 2000 rpm</th>
<th>Power output at n = 2000 rpm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>cm³/rev.</td>
<td></td>
<td>at 175 bar Δp</td>
<td>at 175 bar Δp</td>
</tr>
<tr>
<td></td>
<td>cm³/rev.</td>
<td>l/min</td>
<td>l/min</td>
<td>Nm</td>
</tr>
<tr>
<td>M4E 153</td>
<td>158,5</td>
<td>317,0</td>
<td>343,0</td>
<td>398,0</td>
</tr>
<tr>
<td>M4E 185</td>
<td>191,6</td>
<td>383,0</td>
<td>409,0</td>
<td>484,0</td>
</tr>
<tr>
<td>M4E 214</td>
<td>222,0</td>
<td>444,0</td>
<td>470,0</td>
<td>567,0</td>
</tr>
</tbody>
</table>

Overall Leakage (internal + external)

Permissible shaft loads

Do not apply Fr and Fa loads simultaneously
Hydraulic Motors, Fixed
M3 - M4, Denison Vane Motors

M4E - M4E1 motor

Weight: 45.0 kg

Dimensions

- Diameter: ø 17.5
- Drain: SAE 8 (3/4" - 16 UNF) or 1/2" BSPP
- Mounting Torque: 235 N.m
- Shaft Code 1: SAE-C Splined Shaft
- Shaft Code 3: SAE-C Splined Shaft, Class 1 - J498b

8 threaded holes: 1/2"-13 UNC x 26.9 deep

Drain SAE 8 (3/4" - 16 UNF) x 14.2 deep

SAE threaded port

SAE threaded port

SAE 32 (2 1/2" 12 UNF) x 19 deep - 2 holes

Parker Hannifin
Pump & Motor Division Europe
Vierzon - France
Hydraulic Motors, Fixed

M3 - M4, Denison Vane Motors

Performance charts

- Running condition limits - Typical curves at 26 cSt @ 45°.
- For higher specifications or for operating speed under < 100 rpm, please consult Parker.
Hydraulic Motors, Fixed

M3 - M4, Denison Vane Motors

Performance charts

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M3 - M4, Denison Vane Motors

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Hydraulic Motors, Fixed
M3 - M4, Denison Vane Motors

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M3 - M4, Denison Vane Motors

Performance charts

- Running condition limits - Typical curves at 26 cSt @ 45°.
- For higher specifications or for operating speed under < 100 rpm, please consult Parker.

Minimum replenishment pressure during deceleration
The hydraulic circuit should be designed in a way that when switching off the hydraulic motor, it remains supplied with fluid, without risk of cavitation (anti-cavitation valve may to be needed).
The inlet port of the fluid motor must be supplied with replenishment pressure as listed below to prevent cavitation during dynamic braking. These pressures should be multiplied by a coefficient of 1,5 for M4 motors used with fire resistant fluids (HF-3, HF-4, HF-5).

<table>
<thead>
<tr>
<th>Series</th>
<th>Speed [rpm] - Oil viscosity = 32 cSt</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>500</td>
</tr>
<tr>
<td>M3B</td>
<td>0,6</td>
</tr>
<tr>
<td>M4C</td>
<td>0,7</td>
</tr>
<tr>
<td>M4D</td>
<td>0,7</td>
</tr>
<tr>
<td>M4E</td>
<td>1,4</td>
</tr>
</tbody>
</table>

Reverse cycles for fan drives
The motor must be decelerated from its (max.) rotation speed to less than 500 rpm in no less than 4 seconds time before energizing the solenoid of the reverse valve.
In the same way the motor must be ramped up to its (max.) reverse rotation speed in no less than 4 seconds time.
There should be no signs of cavitation during the reverse cycle (abnormal noise or lack of replenishment pressure).

Connection of several motors in the same circuit
For application requiring several motors to be driven simultaneously, we recommend to connect these in parallel circuits.
The use of several motors connected in series is not recommended. Depending on the different inertia of the loads, the displacements and torque requirements, the motors may be subjected to pressure instability and noise. Also hydraulic pressure valves will not admit high levels of back pressure, restricting this use to motors without pressure valves. Please consult Parker.
Motor selection example

Motor performances required
Torque \( T \) [Nm] 140
Speed \( n \) [rpm] 1500

Flow available data
\[ \frac{Q}{\Delta p} \] [l/min] 115

1. Check if available power is greater than required power (0.85 estimated overall efficiency).
\[
0.85 \times \frac{Q \times p}{600} \geq \frac{T \times \pi \times n}{30 \times 1000}
\]
\[
28.5 > 22 \text{ kW}
\]

2. Two ways of calculation: Calculate \( V_i \) from \( T \) required torque, or from \( Q \) available flow.

2a. Calculate \( V_i \) from \( T \) required torque
\[
V_i = \frac{20 \times \pi \times T}{p} = \frac{20 \times \pi \times 140}{p} = 50.26 \text{ cm}^3/\text{rev.}
\]

2b. Calculate \( V_i \) from \( Q \) available flow
\[
V_i = \frac{1000 \times 175}{1500} = 76.7 \text{ cm}^3/\text{rev.}
\]

3a. Choose motor from \( V_i \) immediately greater

M4C 055 \( V_i = 58.8 \text{ cm}^3/\text{rev.} \) (see page 10)

3b. Choose motor from \( V_i \) immediately smaller

M4C 067 \( V_i = 71.1 \text{ cm}^3/\text{rev.} \) (see page 10)

4a. Check real motor pressure for \( T = 140 \text{ Nm. at around 1500 rpm} \)

M4C 055 \( T = 140 \text{ Nm.} \) \( n = 1500 \text{ rpm} \)
\( p = 160 \text{ bar} \) (see M4C 055 curve on page 19)

4b. Check motor pressure with \( T = 140 \text{ Nm. at 1500 rpm} \)

M4C 067 \( T = 140 \text{ Nm.} \) \( n = 1500 \text{ rpm} \)
\( p = 140 \text{ bar} \) (see M4C 067 curve on page 19)

5a. Flow loss at this pressure : 16 l/min

Real flow used by the motor :
\[
Q_{\text{eff.}} = 115 - 16 = 99 \text{ l/min}
\]

5b. Flow loss at this pressure : 14 l/min

Real flow used by the motor :
\[
Q_{\text{eff.}} = 115 - 14 = 101 \text{ l/min}
\]

6a. Real speed of the motor :
\[
\eta_{\text{eff.}} = \frac{Q_{\text{eff.}} \times 1000}{V_i} = 99 \times 1000 = 1683 \text{ rpm}
\]

6b. Real speed of the motor :
\[
\eta_{\text{eff.}} = \frac{Q_{\text{eff.}} \times 1000}{V_i} = 101 \times 1000 = 1420 \text{ rpm}
\]

Real performances
\[
\begin{align*}
V_i & = 58.8 \text{ cm}^3/\text{rev.} \\
\eta_{\text{eff.}} & = 1683 \text{ rpm} \\
T & = 140 \text{ Nm.} \\
\Delta p_{\text{eff.}} & = 160 \text{ bar}
\end{align*}
\]

M4C 055

\[
\begin{align*}
V_i & = 71.1 \text{ cm}^3/\text{rev.} \\
\eta_{\text{eff.}} & = 1420 \text{ rpm} \\
T & = 140 \text{ Nm.} \\
\Delta p_{\text{eff.}} & = 140 \text{ bar}
\end{align*}
\]

M4C 067

Fluid power formulas

Volumetric efficiency
\[
1
\frac{1}{1 + \frac{\text{total leakage \times 1000}}{\text{speed \times displacement}}}
\]

Mechanical efficiency
\[
\frac{1}{\frac{\text{torque loss \times 20 \times p}}{\Delta \text{pressure \times displacement}}}
\]

Fluid motor speed
\[
1000 \times \text{flow rate} \times \text{volumetric eff.} \] displacement

Fluid motor torque
\[
\frac{\Delta \text{pressure \times displacement \times mech. eff.}}{20 \times p}
\]

Fluid motor power
\[
\frac{\text{speed \times displacement \times \Delta pressure \times overall eff.}}{600 000}
\]
or
\[
\frac{\text{torque \times speed \times 20 \times p}}{600 000}
\]
Hydraulic Motors, Fixed
M3 - M4, Denison Vane Motors

Hydraulic fluids

Recommended fluids
Petroleum base anti-wear, anti-rust and anti-oxidation fluids (covered by Parker Denison HF-0 and HF-2 specifications).

Maximum catalogue ratings and performance data are based on operation with these fluids.

Acceptable alternate fluids
The use of fluids other than petroleum base anti-wear R & O fluids requires that the maximum ratings of the motor will be reduced. In some cases, the minimum replenishment pressure must be increased.

HF-1 : non antiwear petroleum base
HF-4 : water glycols solutions
HF-5 : synthetic fluids
HF-6a, HF-6b : HEES Bio fluids

Fluids viscosity
The minimum Viscosity Index is 90. The kinematic viscosity range is as below. Over or under these values, please contact Parker.

Max. (cold start, low speed & pressure) 2000 cSt
Max. (full speed & pressure) 108 cSt
Optimum (max. lifetime) 30 cSt

Fluids temperatures
The usual limiting factor of temperature (low or high) comes from the obtained viscosity. The seals are sometimes the limit.

Maximum fluid temperature (also depends on min. viscosity). Minimum fluid temperature (also depends on max. viscosity).

° C  ° F
HF-0, HF-1, HF-2 + 100 (+ 212)
HF-4 + 50 (+ 122)
HF-5 + 70 (+ 158)
HF-6a, HF-6b + 80 (+ 176)

Filtration requirements
The fluid must be cleaned before and during operation to maintain a contamination level of ISO 18/16/13 (NAS 1638 class 7) for motors with proportional pressure valve and ISO 19/17/14 (NAS 1638 class 8) or better for others. Filters must be installed accordingly.

Water contamination in fluid
The maximum acceptable content of water shall be limited to 0,10 % for mineral base fluids, and 0,05 % for synthetic fluids, crankcase oils, and biodegradable fluids. The eventual excess of water must be drained off the circuit.

Types of seals
Seals type 1 (S1) : Use this seal type for applications with mineral oil and fluid temperature less than + 90° C (+ 194° F).
S1 seals temperature range : - 40°C to + 107° C (- 40° F to + 225° F).

Seals type 5 (S5) : Use this seal type with some fire resistant fluids and/or fluid temperature higher than + 90° C (+194° F).
S5 seal temperature range : - 29° C to + 204° C (- 20° F to + 400° F).

Motor installation
The Motor may be installed in any position providing that its drain line is correctly laid and that the loads on the shaft are clearly identified and acceptable. Motors fitted with valves will require some light back pressure.

The externally drained motors must have a drain line connected to their housing drain port. It must be of a sufficient size to prevent back pressure in excess of 3,5 bar (50 PSI), and return directly to the reservoir below the minimum fluid level, as far away as possible from the suction pipe of the pump.

It is preferable to install the housing with its drain port upward to facilitate the purge of the motor. If the motor is mounted vertically with the shaft pointing up, then the drain line must have a bend above the motor to purge it fully and to be sure that the shaft seal is well lubricated.
Shaft and coupling data

- **Keyed shafts**: Parker supplies its keyed shaft M3 - M4 motors with high strength heat-treated keys. Therefore, when installing or replacing these motors, the heat-treated keys must be used in order to ensure maximum life in the application. If the key is replaced, it must be a heat-treated key between 27 and 34 R.C. hardness. The corners of the keys must be chamfered by 0.76 mm to 1.02 mm (0.03 to 0.04) at 45° to clear the radii in the key way.

The alignment of the keyed shafts must be within the tolerances given for the splined shafts here below.

- **Couplings and female splines**: The coupling must be selected to minimize the load on the shaft (weight, misalignment).

The female spline must be made to conform to the Class 1 fit as described in SAE-J498b (1971). This is described as a Flat Root Side Fit.

The mating female spline should be free to float and find its own center. If both members are rigidly supported, they must be aligned within 0.15 TIR (0.006” TIR) or less to reduce fretting. The angular alignment of two splines axes must be less than ±0.05 per 25.4 radius (±0.002” per 1” radius).

The coupling must be hardened to a hardness between 29 and 45 HRC.

The coupling spline must be lubricated with a lithium molydisulfide grease, disulfide of molybdenum or a similar lubricant.

Start-up instructions

All Parker hydraulic vane motors are individually factory tested to provide the best quality & reliability. They are to be used within the operation limits indicated in our documentation. Only qualified personnel who is competent and familiar with the installation and operation of hydraulic drives and has hydraulic circuits and hydraulic equipment knowledge is allowed to put the equipment into operation. Make sure to have all necessary documentation available and always conform yourself to the valid regulations (safety, electrical, environment...).

Pre-start checks

- Before the initial installation of the motor, please remove the protective covers or plugs from the connection ports and pour some clean and suitable hydraulic fluid in all ports.

- Before the initial starting of the motor, the following checks should be made:

  a. Check the requested rotation way of the driven device and make sure that the hydraulic motor shaft will rotate accordingly.
  b. Check entry, outlet and drain lines to be sure all connections are tight and properly connected.
  c. Check the cleanliness of the piping, the hydraulic fluid type, its cleanliness and level. Make sure it can reach the motor entry port.
  d. Check the correct fixture of the hydraulic motor mounting flange and of its driven device. Check their correct coupling.
  e. For hydraulic motors with built-in solenoid valves, check the electrical wiring and the connections.

First start and air removing

- The pressure relief valve of the circuit should be backed off to its minimum setting value to keep the hydraulic motor unloaded when first started. Circuit priming and air bleed off have to be performed before resetting the pressure relief valve.

- Start the hydraulic motor rotation in a jogging manner until a prime is picked up, and increase its speed from 500 to 1000 rpm. Check that there is no leakage or air suction neither at the ports (inlet, outlet, drain), nor at the shaft end.

- It is important to bleed the air off the circuit, and off the hydraulic motor itself. Purge the air off, preferably using air bleed off valves or pressure test points. Let the hydraulic motor rotate several minutes unloaded.

- Hydraulic motors equipped with a proportional pressure relief valve have to purge the air off the pressure valve in the following way: energize and de-energize the coil 5 times from 0 Amp to max current. Check that the proportional pressure relief valve is properly air bled off by running the hydraulic motor at full speed. It should rotate without vibrations or pulses.

Notes

- In case of very cold temperature, the hydraulic motor should be kept at low pressure and low speed until the fluid warms up, before running it at high pressure or speed.

- If the motor does not work properly or pressure cannot be obtained within seconds, it should be shut down and conditions corrected. Refer to the machine/vehicle manufacturer instructions and motor catalogue.
WARNING – USER RESPONSIBILITY

FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.

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