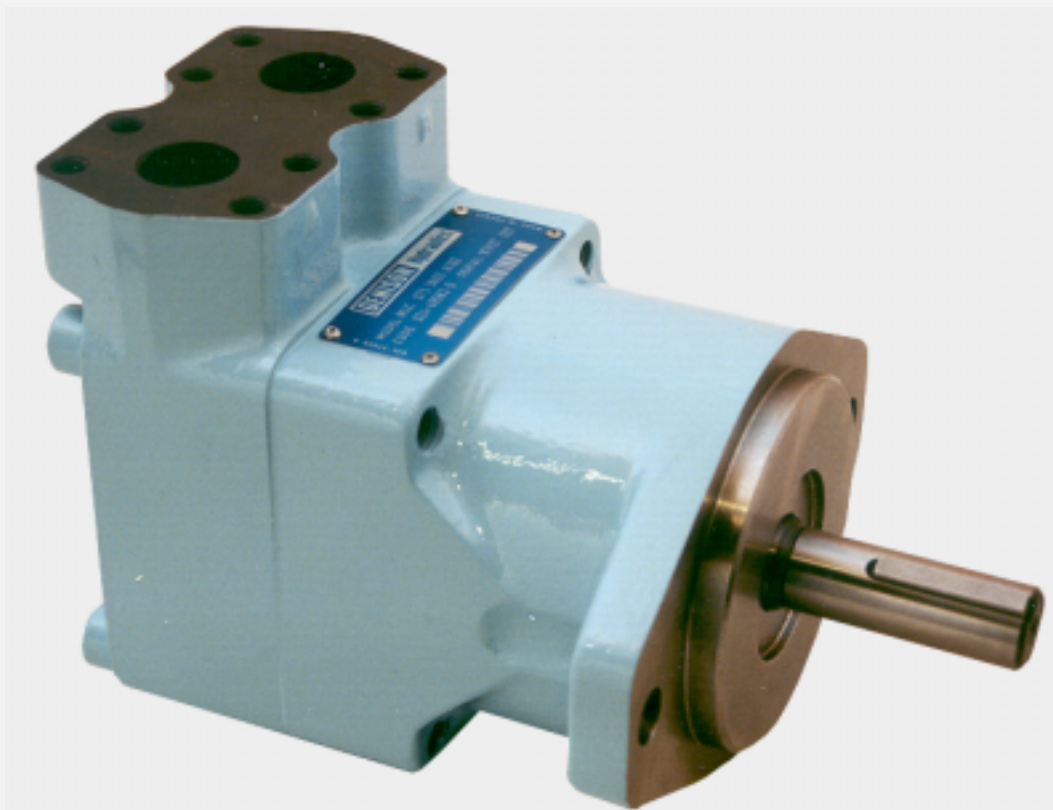




# Vane motors Single & double M3B - M4 / M4S series



Publ. 2 - AM 157 - B

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Replaces : 2 - AM 157 - A

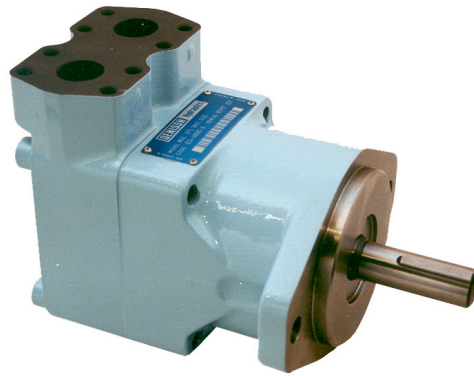
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**DENISON** Hydraulics



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**HIGH STARTING TORQUE EFFICIENCY**

The high starting torque efficiency of vane type motors makes them especially applicable in load hoist winch drives, swing drives and propulsion drives. This high starting torque efficiency allows the motor to start under high load without pressure overshoots, jerks and high instantaneous horsepower loads.

**HIGH VOLUMETRIC EFFICIENCY**

Vane motors begin life with high volumetric efficiency and maintain that efficiency throughout their operating life.

**LOW TORQUE RIPPLE AT LOW SPEED**

When operating at very low speeds on applications such as swing and load hoist drives, the vane motor exhibits very low torque ripple.

**2 AND 3-SPEED VERSIONS AVAILABLE**

The M4DC, because of its unequal size cartridges, allows the use of-3 speed operation. This makes them more applicable in traction drive circuits to replace manually shifted gear-boxes. 2-speed motors are available in a wider range of ratios than standard gear motors.

**BALANCED DESIGN**

Vane, rotor and cam ring are pressure balanced to increase life and efficiency over full speed range.

**INTERCHANGEABLE ROTATING GROUPS**

Rotating groups may be easily replaced to renew the motor or change displacement to suit altered requirements for speed or torque.

**REVERSIBLE ROTATION**

The motors may be stopped or reversed repeatedly and rapidly driving or braking the connected shaft load at controlled torque levels.

**WIDE SPEED RANGE**

Starting to maximum RPM, with full torque capability during acceleration.

**PORTS AND MOUNTING**

Conform fully to SAE J744c (ISO-3019-1) standards to simplify refitting and installation.

**FIRE RESISTANT FLUIDS**

Are easily used in the standard M3B and M4\* versions of these motors. These include phosphate or organic ester fluids and blends, water-glycol solutions and water-oil invert emulsions.

**M3B AND M4\* SERIES MOTORS**

The M3B and M4\* have been designed especially for severe duty applications which require high pressure up to 3400 PSI, high speed up to 4000 RPM and low fluid lubricity (HF-1, HF-2A, HF-3, HF-4, HF-5).

# TECHNICAL DATA - M3B AND M4\* SERIES

| Series | Size                     | Displ.                              | Theor. Displ.<br>V <sub>i</sub> | Torque T   | Power at<br>100 Rev/min | Torque T                               | Power P |
|--------|--------------------------|-------------------------------------|---------------------------------|------------|-------------------------|----------------------------------------|---------|
|        |                          |                                     | in <sup>3</sup> /rev.           | in.lbf/PSI | HP/100 PSI              | n = 2000 RPM at Δ p 2500 PSI<br>in.lbf | HP      |
| M3     | B<br>B1                  | 009                                 | .56                             | 0.08       | 0.014                   | 174.3                                  | 5.8     |
|        |                          | 012                                 | .75                             | 0.11       | 0.018                   | 236.3                                  | 7.8     |
|        |                          | 018                                 | 1.13                            | 0.19       | 0.030                   | 412.4                                  | 13.4    |
|        |                          | 027                                 | 1.70                            | 0.30       | 0.046                   | 680.5                                  | 21.8    |
|        |                          | 036                                 | 2.26                            | 0.38       | 0.060                   | 902.6                                  | 28.3    |
| M4     | C<br>C1<br>SC<br>SC1     | 024                                 | 1.49                            | 0.24       | 0.037                   | 535.4                                  | 17.0    |
|        |                          | 027                                 | 1.72                            | 0.28       | 0.043                   | 619.5                                  | 19.7    |
|        |                          | 031                                 | 2.11                            | 0.33       | 0.054                   | 768.0                                  | 24.1    |
|        |                          | 043                                 | 2.84                            | 0.45       | 0.072                   | 1062.0                                 | 33.6    |
|        |                          | 055                                 | 3.59                            | 0.57       | 0.091                   | 1318.6                                 | 41.8    |
|        |                          | 067                                 | 4.34                            | 0.69       | 0.111                   | 1504.5                                 | 47.7    |
|        |                          | 075                                 | 4.89                            | 0.78       | 0.120                   | 1752.2                                 | 55.6    |
|        | D<br>D1<br>SD<br>SD1     | 062                                 | 3.97                            | 0.63       | 0.102                   | 1460.0                                 | 46.4    |
|        |                          | 074                                 | 4.69                            | 0.75       | 0.120                   | 1770.0                                 | 56.2    |
|        |                          | 088                                 | 5.56                            | 0.88       | 0.139                   | 2088.5                                 | 66.2    |
|        |                          | 102                                 | 6.44                            | 0.96       | 0.166                   | 2336.3                                 | 74.1    |
|        |                          | 113                                 | 7.12                            | 1.13       | 0.185                   | 2655.0                                 | 84.2    |
|        |                          | 128                                 | 8.08                            | 1.28       | 0.203                   | 3009.0                                 | 95.5    |
|        |                          | 138                                 | 8.81                            | 1.40       | 0.222                   | 3292.0                                 | 104.5   |
|        | E<br>E1<br>SE/SE1        | 153                                 | 9.67                            | 1.54       | 0.240                   | 3522.0                                 | 111.8   |
|        |                          | 185                                 | 11.69                           | 1.86       | 0.296                   | 4283.2                                 | 136.0   |
|        |                          | 214                                 | 13.55                           | 2.16       | 0.342                   | 5017.7                                 | 159.3   |
|        | DC<br>DC1<br>SDC<br>SDC1 | See M4C/C1/SC/SC1 and M4D/D1/SD/SD1 |                                 |            |                         |                                        |         |

Internal drain : All these motors may be equipped with internal drain. Then the model numbers will be M3B1, M4C1, M4SC1, M4D1, M4SD1, M4E1, M4SE1, M4DC1, M4SDC1.

For further information or if the performance characteristics outlined above do not meet your own particular requirements, please consult your local DENISON Hydraulics office.

## GENERAL CHARACTERISTICS

|          | Mounting<br>standard          | Weight without<br>connector and<br>bracket - lbs | Moment of<br>inertia<br>lb.in <sup>2</sup> | Option for inlet and outlet port                                        |                   |
|----------|-------------------------------|--------------------------------------------------|--------------------------------------------|-------------------------------------------------------------------------|-------------------|
| M3B      | SAE J744c<br>ISO/3019-1 SAE A | 17.6                                             | 1.03                                       | SAE threaded<br>SAE 4 bolt J718c ISO/DIS 6162-1 - 3/4"<br>BSPP threaded |                   |
| M4C/SC   | SAE J744c<br>ISO/3019-1 SAE B | 34.0                                             | 2.7                                        | SAE threaded<br>SAE 4 bolt J718c ISO/DIS 6162-1 - 1"                    |                   |
| M4D/SD   | SAE J744c<br>ISO/3019-1 SAE C | 59.5                                             | 1.4                                        | SAE threaded<br>SAE 4 bolt J718c ISO/DIS 6162-1 - 1 1/4"                |                   |
| M4E/SE   | SAE J744c<br>ISO/3019-1 SAE C | 99.0                                             | 20.0                                       | SAE threaded<br>SAE 4 bolt J718c ISO/DIS 6162-1 - 2"                    |                   |
| M4DC/SDC | SAE J744c<br>ISO/3019-1 SAE C | 88.0                                             | 10.0                                       | SAE 4 bolt J718c<br>ISO/DIS 6162-1 - 1 1/4"                             | P2 = See M4C/M4SC |

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**MAXIMUM SPEED, PRESSURE RATINGS - M3B AND M4\* SERIES**

| Series | Size        | Displ.       | Max. pressure |       |      |              |      | Operating pressure range drain | Max. speed for low loaded condition <sup>1)</sup> | Max. speed for max. pressure ratings |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|--------|-------------|--------------|---------------|-------|------|--------------|------|--------------------------------|---------------------------------------------------|--------------------------------------|--------------------|-------|--------------------|-------|--------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
|        |             |              | HF-0<br>HF-2  | HF-2A | HF-1 | HF-3<br>HF-5 | HF-4 |                                |                                                   | HF-0, HF-2                           |                    | HF-2A |                    | HF-1  |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             |              | PSI           | PSI   | PSI  | PSI          | PSI  |                                |                                                   | Cont.                                | Int. <sup>2)</sup> | Cont. | Int. <sup>2)</sup> | Cont. | Int. <sup>2)</sup> |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             |              | RPM           | RPM   | RPM  | RPM          | RPM  | RPM                            | RPM                                               | RPM                                  | RPM                | RPM   | RPM                | RPM   | RPM                |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| M3     | B<br>B1     | 009          | 2500          |       |      |              |      |                                | 22                                                | 4000                                 | 3000               | 3600  |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             | 012          |               |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             | 018          |               |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             | 027          |               |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             | 036          |               |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| M4     | C<br>C1     | 024          | 2500          | 2500  | 2500 |              |      | 50                             | 4000                                              | 2500                                 | 3600               | 2500  | 3000               | 2000  | 2500               |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             | 027          |               |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             | 031          |               |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             | 043          |               |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             | 055          |               |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             | 067          |               |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             | 075          |               |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        | SC<br>SC1   | 024          | 3400          | 3000  | 2500 | 2500         | 2000 |                                |                                                   |                                      |                    |       |                    |       |                    | 4000 | 2500 | 3000 | 2500 | 2800 | 2000 | 2500 |      |      |      |      |      |      |      |
|        |             | 027          |               |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             | 031          |               |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             | 043          |               |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             | 055          |               |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             | 067          |               |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             | 075          |               |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        | D<br>D1     | 062          | 2500          | 2500  | 2000 |              |      |                                | 4000                                              | 2500                                 | 3000               | 2500  | 2800               | 2000  | 2500               |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             | 074          |               |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             | 088          |               |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             | 102          |               |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             | 113          |               |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             | 128          |               |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             | 138          |               |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        | SD<br>SD1   | 062          | 3400          | 2700  | 2000 | 2000         | 2000 |                                |                                                   |                                      |                    |       |                    |       |                    | 3600 | 2500 | 3000 | 2500 | 2800 | 1800 | 2200 |      |      |      |      |      |      |      |
|        |             | 074          |               |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             | 088          |               |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             | 102          |               |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             | 113          |               |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             | 128          |               |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             | 138          |               |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        | E<br>E1     | 153          | 2500          | 2500  | 2000 |              |      |                                | 4000                                              | 2500                                 | 3000               | 2500  | 2800               | 2000  | 2500               |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             | 185          |               |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             | 214          |               |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        | SE<br>SE1   | 153          | 2700          | 2500  | 2000 | 2000         | 2000 |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      | 4000 | 2500 | 3000 | 2500 | 2800 | 2000 | 2500 |
|        |             | 185          | 2600          |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             | 214          | 2500          |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        | DC<br>DC1   | All models   | 2500          | 2500  | 2000 |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        | SDC<br>SDC1 | D-062 at 088 | 3400          | 2700  | 2000 | 2000         | 2000 |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             | C-024 at 043 |               |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             | D-102        | 3000          | 2700  |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             | D-113        |               |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             | C-055        |               |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             | C-067        | 2500          | 2500  |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             | D-128        |               |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        |             | D-138        |               |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|        | C-075       |              |               |       |      |              |      |                                |                                                   |                                      |                    |       |                    |       |                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |

1) Low loaded condition 500 PSI for M3 and M4, 1160 PSI max. for M4S (see page 6).

2) Intermittent speed - Do not exceed 6 seconds per minute of operation.

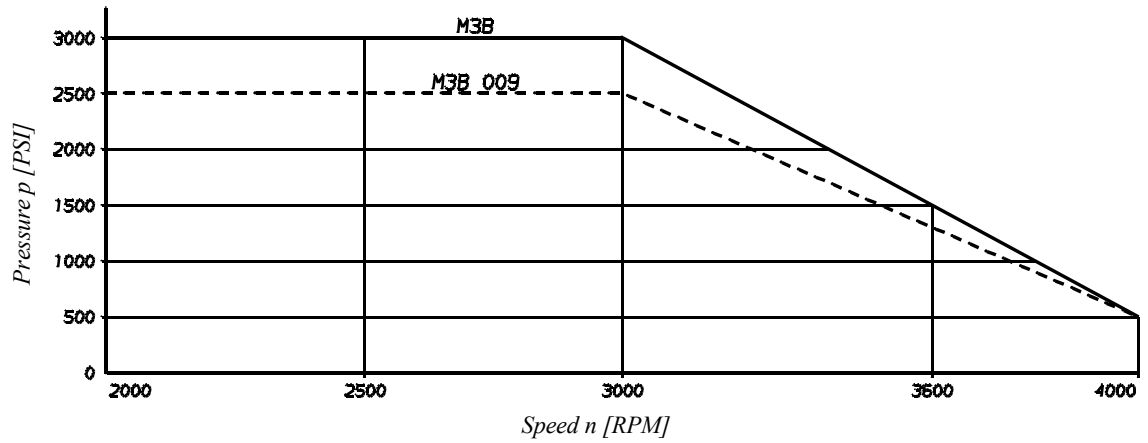
HF-0, HF-2 = Antiwear petroleum base. HF-2A = Crankcase. HF-1 = Non antiwear petroleum base. HF-5 = Synthetic fluids.

HF-3 = Water in oil emulsions. HF-4 = Water glycols.

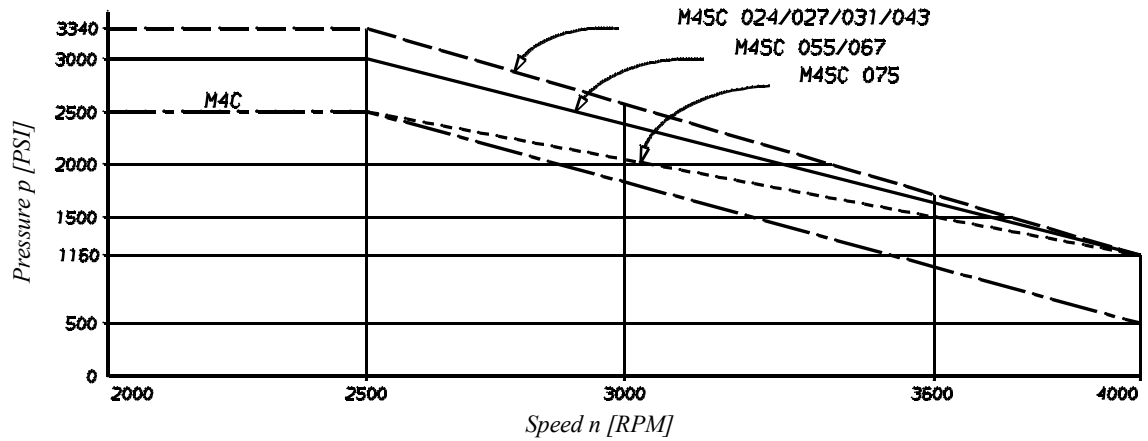
Internal drain : All these motors may be equipped with internal drain. Then the model numbers will be M3B1, M4C1, M4SC1, M4D1, M4SD1, M4E1, M4SE1, M4DC1, M4SDC1.

# MAX. SPEED AND MAX. CONTINUOUS PRESSURE - M3B AND M4\* SERIES

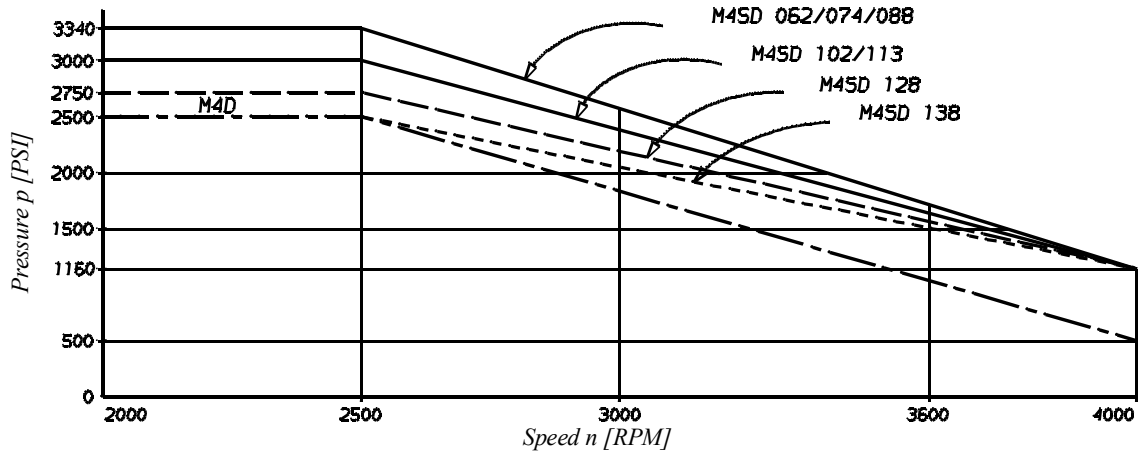
## M3B



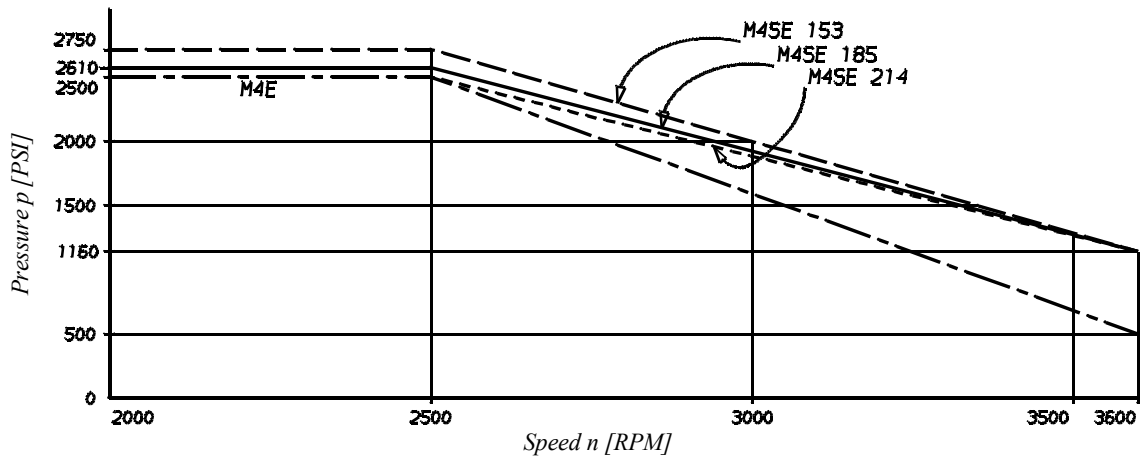
## M4C/M4SC



## M4D/M4SD



## M4E/M4SE



*Performances required*

|                                     |          |          |      |
|-------------------------------------|----------|----------|------|
| Torque                              | $T$      | [in.lbf] | 1240 |
| Pump flow (available)<br>at 115 SUS | $q_{ve}$ | [GPM]    | 30.4 |
| Speed                               | $n$      | [RPM]    | 1500 |
| Pressure                            | $p$      | [PSI]    | 2500 |

1. Check if available power is compatible with required power (0.85 estimated overall efficiency).

$$0.85 \times \frac{Q_{ve} \times p}{1714} \geq \frac{T \times RPM}{63025}$$

$$0.85 \times \frac{30.4 \times 2500}{1714} \geq \frac{1240 \times 1500}{63025}$$

$$37.7 > 29.5$$

Two ways of calculation :

2a. Calculate  $V_i$  from  $T$  required torque

$$V_i = \frac{2 \pi \times T}{p} = \frac{2 \pi \times 1240}{2500} = 3.12 \text{ in}^3/\text{rev.}$$

3a. Motor choose from  $V_i$  immediately greater

$$M4C 055 V_i = 3.59 \text{ in}^3/\text{rev.}$$

4a. Check real motor pressure for

$T = 1240 \text{ in.lbf}$  around 1500 RPM

M4C 055  $T = 1240 \text{ in.lbf}$   $n = 1500 \text{ RPM}$

$p = 2370 \text{ PSI}$  (see page 15)

5a. Flow loss M4C 055 at 2370 PSI at 115 SUS

$q_{vs} = 4.2 \text{ GPM}$  (see page 22)

Real flow used by the motor :

$$q_v = q_{ve} - q_{vs} = 30.4 - 4.2 = 26.2 \text{ GPM}$$

6a. Real speed of the motor :

$$n = \frac{q_v \times 231}{V_i} = \frac{26.2 \times 231}{3.59} = 1686 \text{ RPM}$$

Real performances

$$\left. \begin{array}{l} V_i = 3.59 \text{ in}^3/\text{rev.} \\ n = 1680 \text{ RPM} \\ T = 1240 \text{ in.lbf} \\ p = 2370 \text{ PSI} \end{array} \right\} M4C 055$$

2b. Calculate  $V_i$  from  $q_{ve}$  available flow

$$V_i = \frac{30.4 \times 231}{1500} = 4.68 \text{ in}^3/\text{rev.}$$

3b. Motor choose from  $V_i$  immediately smaller

$$M4C 067 V_i = 4.34 \text{ in}^3/\text{rev.} \text{ (see page 22)}$$

4b. Check motor press. with  $T = 1240 \text{ in.lbf}$  at 1500 RPM

M4C 067  $T = 1240 \text{ in.lbf}$   $n = 1500 \text{ RPM}$

$p = 2030 \text{ PSI}$  (see page 15)

5b. Flow loss of M4C 067 at 2030 PSI at 115 SUS

$q_{vs} = 3.7 \text{ GPM}$  (see page 22)

Real flow used by the motor :

$$q_v = q_{ve} - q_{vs} = 30.4 - 3.7 = 26.7 \text{ GPM}$$

6b. Real speed of the motor :

$$n = \frac{q_v \times 231}{V_i} = \frac{26.7 \times 231}{4.34} = 1420 \text{ RPM}$$

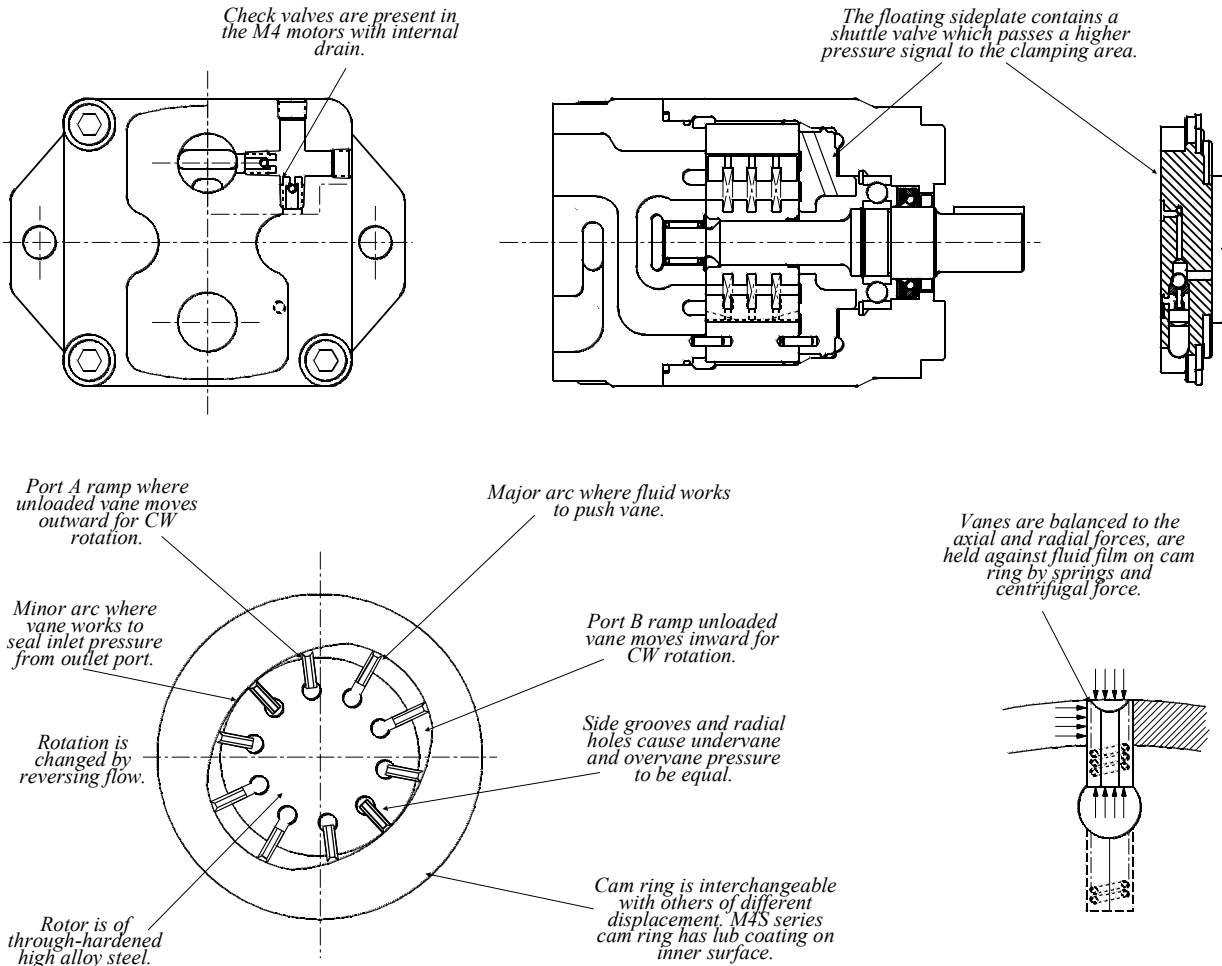
Real performances

$$\left. \begin{array}{l} V_i = 4.34 \text{ in}^3/\text{rev.} \\ n = 1420 \text{ RPM} \\ T = 1240 \text{ in.lbf} \\ p = 2030 \text{ PSI} \end{array} \right\} M4C 067$$

In each case always choose the smallest motor which will operate at the highest speed and pressure, and offers the most efficient solution.

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## OPERATION - SINGLE CARTRIDGE

- The motor shaft is driven by the rotor. 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 separated axially from the sideplate surfaces by the fluid film. The front sideplate 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 sideplate causes clamping pressure in Port A or B, whichever is the highest.
- Materials are chosen for long life efficiency. Vanes, rotor and cam ring are made out of hardened high alloy steels. Cast semi-steel sideplates are chemically etched to have a fine crystalline surface for good lubrication at start-up.

**PORTS  
EXTERNALLY DRAINED  
SINGLE CARTRIDGE MOTORS**

These motors may be alternately pressurized at Ports A & B to 3400 PSI max. Whichever port is at low pressure should not be subjected to more than 500 PSI. If it is necessary to exceed these limitations, please contact DENISON Hydraulics for application assistance.

**INTERNALLY DRAINED  
TANDEM CARTRIDGE MOTORS**

These motors must have a drain line connected to the center housing drain connection of sufficient size to prevent back pressure in excess of 50 PSI, and returned to the reservoir below the surface of the oil as far away from the supply pump suction as possible. Model M4DC1 does not require an external drain line, however the outlet pressure must not exceed 50 PSI.

**INTERNALLY DRAINED MOTORS  
(M4C1, M4D1, M4E1, M4DC1)**

May be alternately pressurized at Ports A & B to 3400 PSI max. Whichever port is at low pressure must not be subjected to more than 22 PSI for M3B, 50 PSI for M4\* (pressure peak 100 PSI).

To insure maximum motor performance in conjunction with your specific application, consult your DENISON Hydraulics Representative if your application requires :

- minimum speed of less than 100 RPM,
- indirect drive,
- overrunning loads,
- braking or retarding.

**M4S SEVERE DUTY MOTORS**

M4S motors are recommended to be used when back pressure is over 2000 PSI and speed is over 2000 RPM. They are also recommended when fluid viscosity can be under 115 SUS and speed over 2000 RPM. For such severe duty applications M4S motors will exhibit longer life time at high efficiency.

**RECOMMENDED FLUIDS**

Petroleum based antiwear R & O fluids.

These fluids are the recommended fluids for M3B and M4\* series motors. Maximum catalog ratings and performance data are based on operation with these fluids. These fluids are covered by DENISON Hydraulics HF-0 and HF-2 specifications.

Acceptable alternate fluids :

**ACCEPTABLE ALTERNATE  
FLUIDS**

The use of fluids other than petroleum based antiwear R & O fluids requires that the maximum ratings of the motors will be reduced. In some cases, the minimum replenishment pressures must be increased. Refer to the following chart and the operating characteristics chart for each M3B and M4\* motor model for specific details of the reduced ratings.

**VISCOSITY**

|                                                     |          |
|-----------------------------------------------------|----------|
| Max. (cold start, low speed & pressure)             | 3900 SUS |
| Max. (full speed & pressure)                        | 500 SUS  |
| Optimum (max. life)                                 | 140 SUS  |
| Min. (full speed & pressure for HF-1 fluid)         | 89 SUS   |
| Min. (full speed & pressure for HF-0 & HF-2 fluids) | 59 SUS   |

**VISCOSITY INDEX**

90° min. Higher values extend range of operating temperatures and life time.

Maximum fluid temperature (θ) °F

HF-0, HF-1, HF-2 \_\_\_\_\_ + 176°

Minimum fluid temperature (θ) °F

HF-0, HF-1, HF-2 \_\_\_\_\_ - 0.4°

**FLUID CLEANLINESS**

The fluid must be cleaned before and during operation to maintain contamination level of NAS 1638 class 8 (or ISO 18/14) or better. Filters with 25 micron (or better, β10 ≥ 100) nominal ratings may be adequate but do not guarantee the required cleanliness levels.

**OPERATING TEMPERATURES  
AND VISCOSITIES**

Operating temperatures are a function of fluid viscosities, fluid type, and the pump. Fluid viscosity should be selected to provide optimum viscosity at normal operating temperatures. For cold starts the pumps should be operated at low speed and pressure until fluid warms up to an acceptable viscosity for full power operation.

**WATER CONTAMINATION IN  
THE FLUID**

Maximum acceptable content of water.

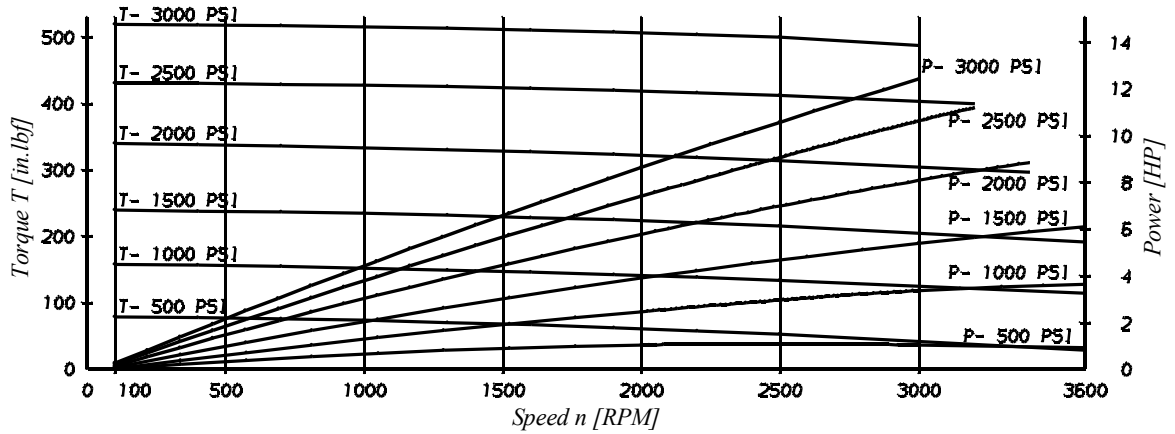
- 0,10 % for mineral base fluids.
  - 0,05 % for synthetic fluids, crankcase oils, biodegradable fluids.
- If amount of water is higher then it should be drained off the circuit.

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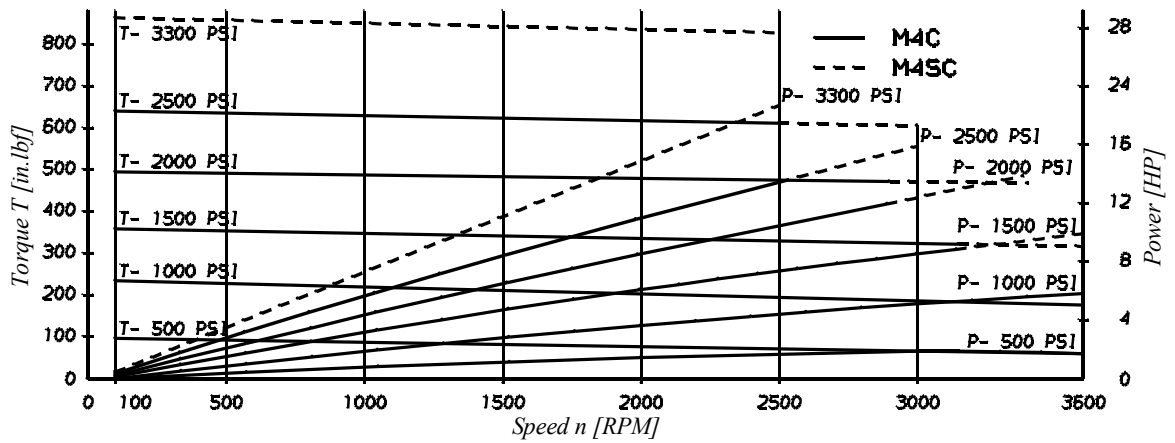
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# PERFORMANCE CURVES - OIL VISCOSITY : 115 SUS (45°) - M4\* SERIES

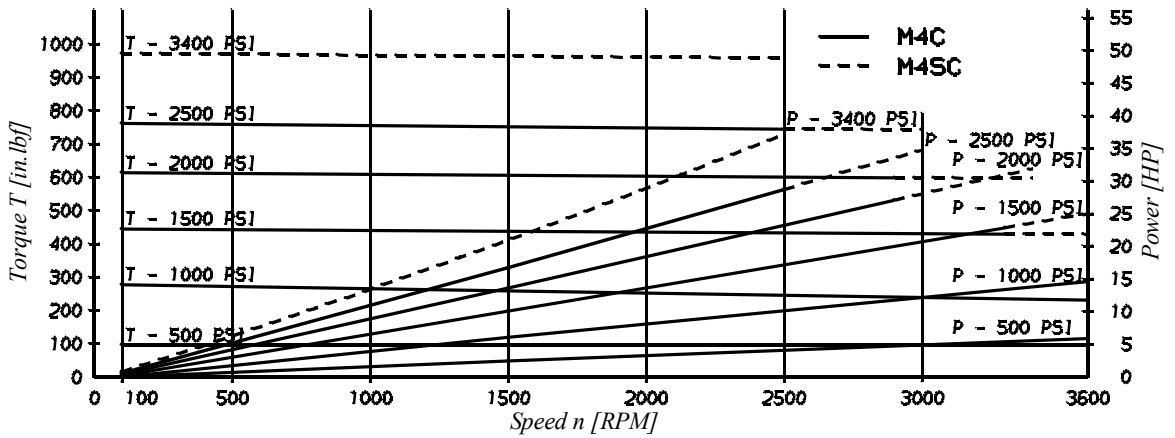
M4C 024



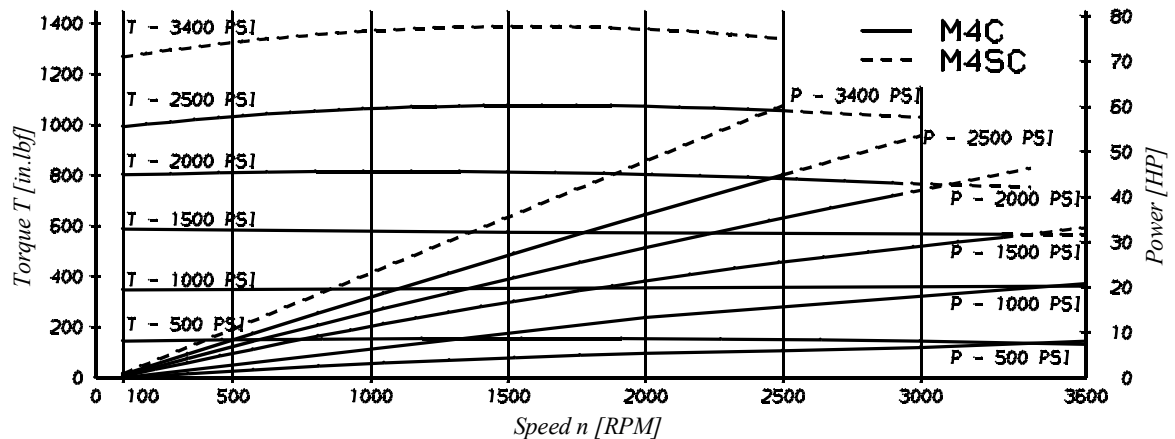
M4C 027



M4C 031

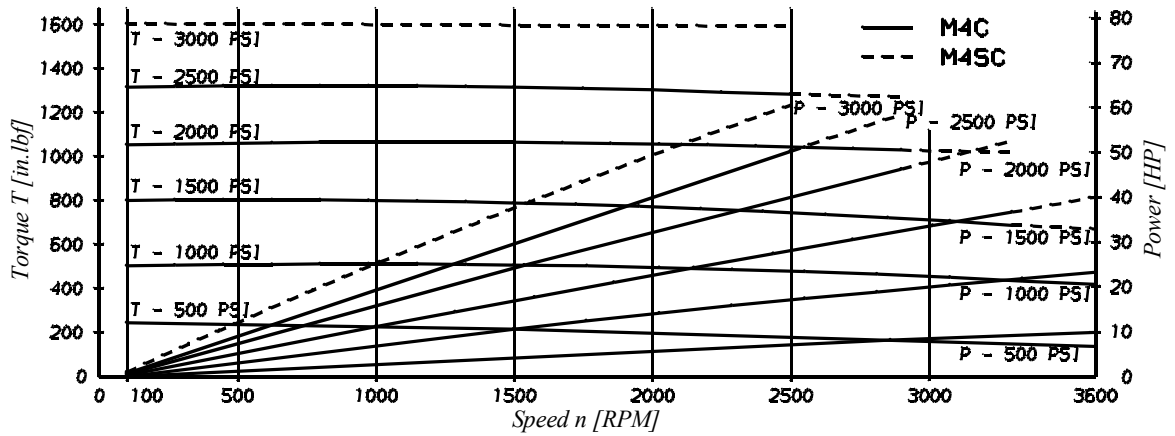


M4C 043

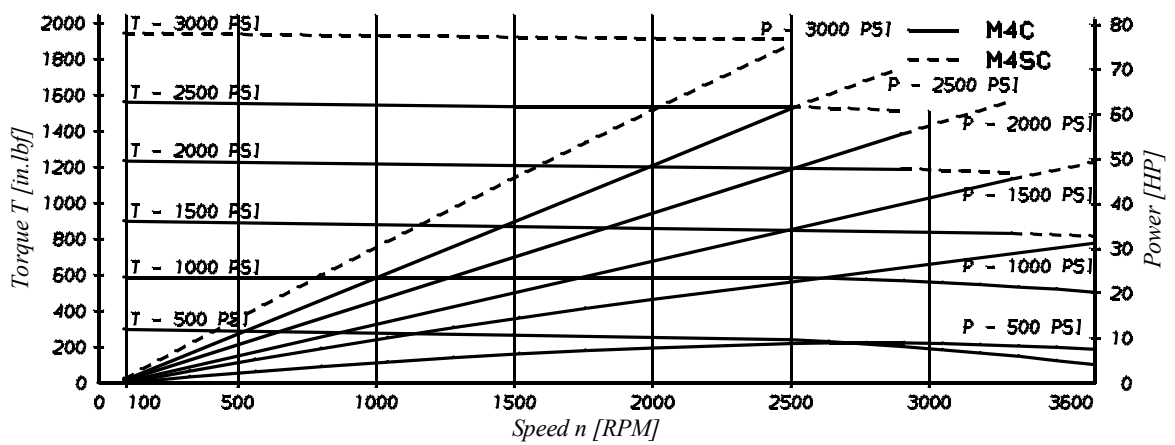


# PERFORMANCE CURVES - OIL VISCOSITY : 115 SUS (45°) - M4\* SERIES

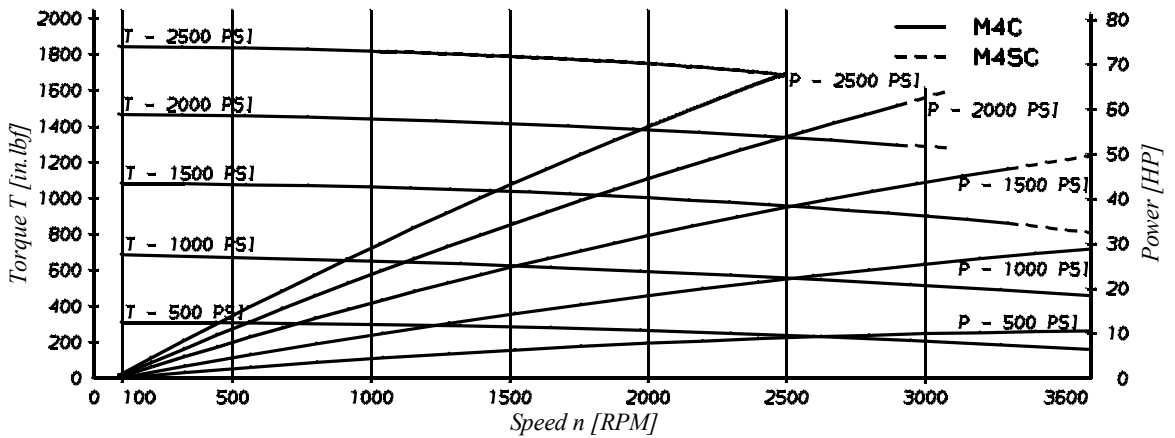
M4C 055



M4C 067



M4C 075



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## ORDERING CODE - M4C - M4SC SERIES

|                              |                                                        |                                                        |
|------------------------------|--------------------------------------------------------|--------------------------------------------------------|
| <b>Model No.</b>             | <b>M4*C1</b><br><b>M4*C</b> - 067 - 1 N 00 - A 1 02 .. |                                                        |
| <b>Series external drain</b> |                                                        | <b>Modification</b>                                    |
| <b>Series internal drain</b> |                                                        | <b>Port connections</b>                                |
| <b>Torque</b>                |                                                        | 01 = SAE threaded port<br>SAE drain                    |
| 024 = .24 in.lb/PSI          |                                                        | 02 = SAE 4 bolt flange<br>UNC threaded - SAE drain     |
| 027 = .28 in.lb/PSI          |                                                        | 04 = SAE 4 bolt flange<br>UNC threaded - BSPP drain    |
| 031 = .33 in.lb/PSI          |                                                        | M4 = SAE 4 bolt flange<br>metric threaded - BSPP drain |
| 043 = .45 in.lb/PSI          |                                                        |                                                        |
| 055 = .57 in.lb/PSI          |                                                        | <b>Seal class</b>                                      |
| 067 = .69 in.lb/PSI          |                                                        | 1 = S1 (M4C)                                           |
| 075 = .78 in.lb/PSI          |                                                        | 5 = S5 (M4SC)                                          |
| <b>Type of shaft</b>         |                                                        | <b>Design letter</b>                                   |
| 1 = keyed (SAE B)            |                                                        |                                                        |
| 2 = keyed (non SAE)          |                                                        | <b>Porting combination</b>                             |
| 3 = splined (SAE B)          |                                                        | 00 = standard                                          |
| <b>Rotation</b>              |                                                        |                                                        |
| N = bi-directional           |                                                        |                                                        |

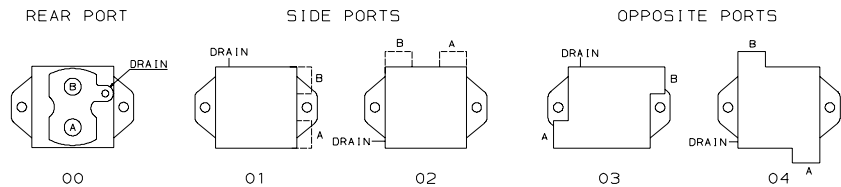
\* = S = Severe duty motor.

M4C1 - M4SC1 : Drain port is plugged.

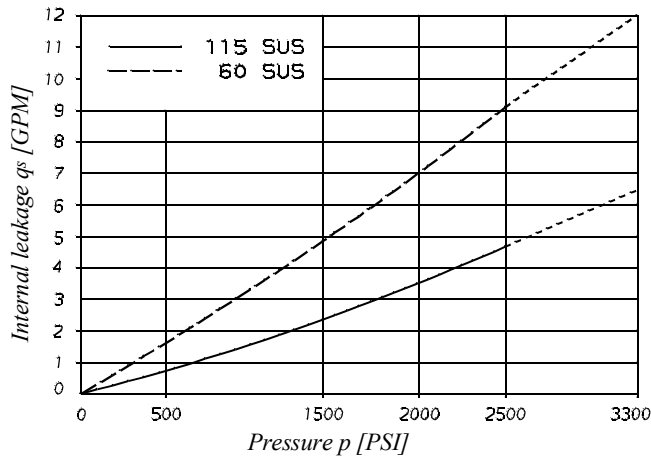
### Porting combination

#### View from shaft end :

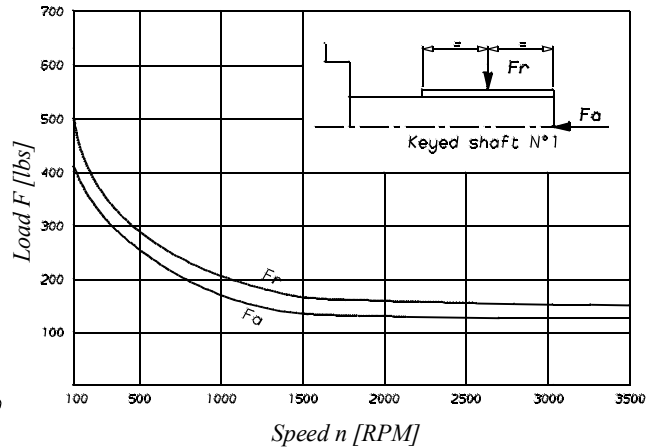
CW rotation A = inlet  
B = outlet  
CCW rotation A = outlet  
B = inlet



### INTERNAL LEAKAGE



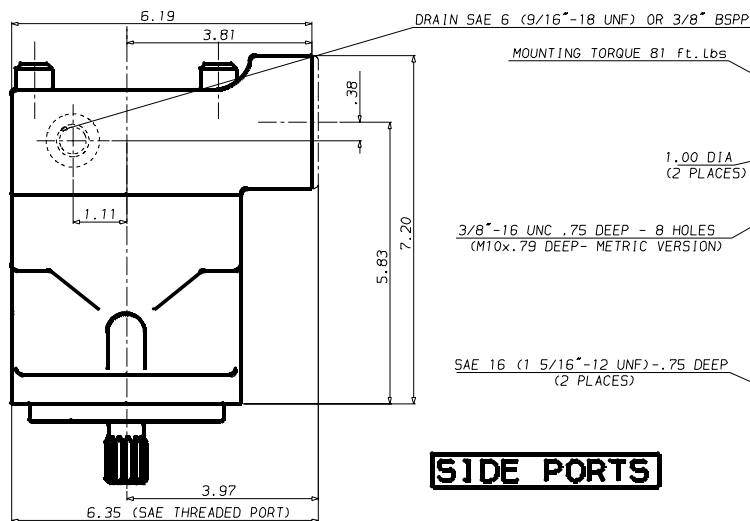
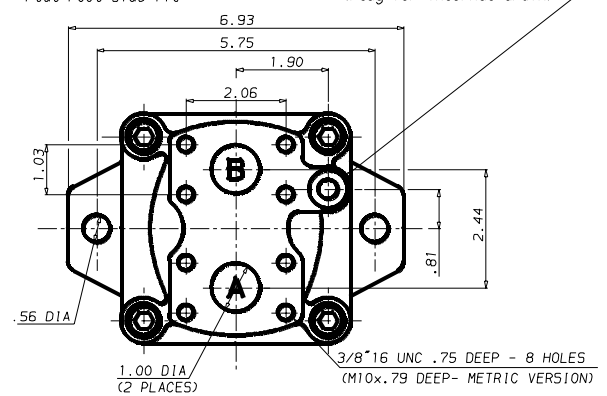
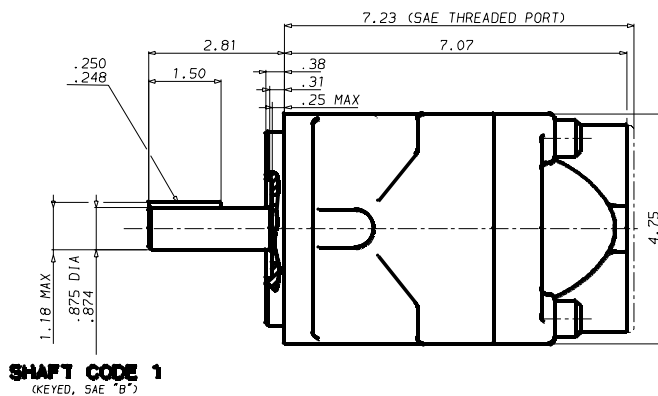
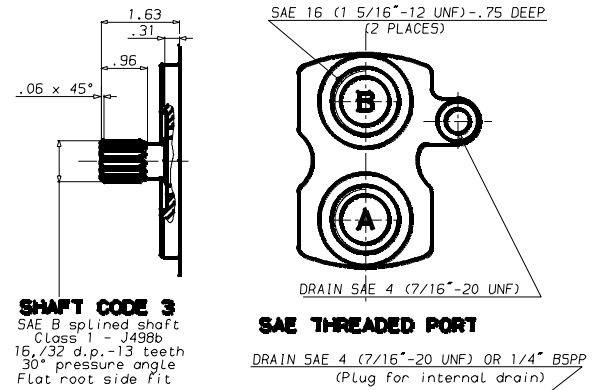
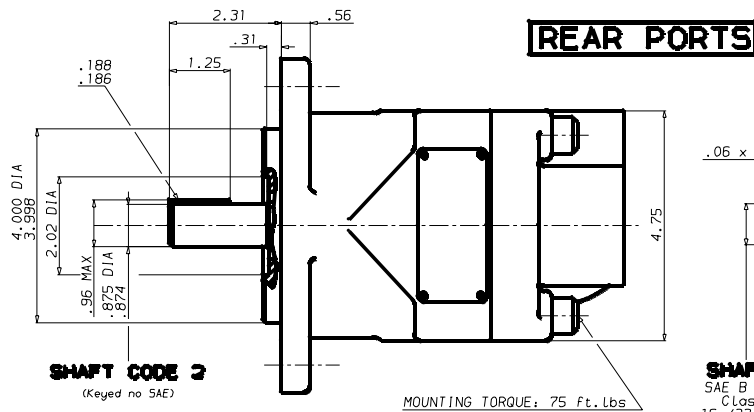
### PERMISSIBLE RADIAL AND AXIAL LOADS



Do not apply Fr and Fa loads simultaneously

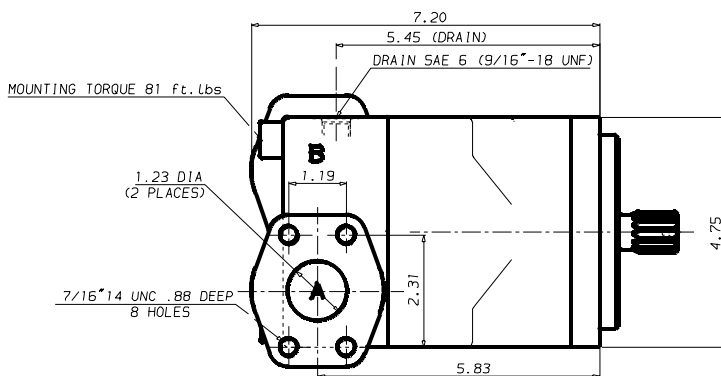
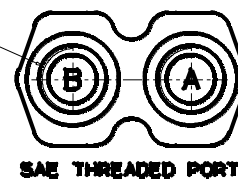
### OPERATING CHARACTERISTICS - TYPICAL [115 SUS]

| Model          | Volumetric displacement $V_i$<br>in <sup>3</sup> /rev. | Input flow at n = 2000 RPM |                        | Torque T<br>at n = 2000 RPM | Power output<br>at n = 2000 RPM |
|----------------|--------------------------------------------------------|----------------------------|------------------------|-----------------------------|---------------------------------|
|                |                                                        | Theoretical                | at 2500 PSI $\Delta p$ | at 2500 PSI $\Delta p$      | at 2500 PSI $\Delta p$          |
|                |                                                        | GPM                        | GPM                    | in.lbf                      | HP                              |
| M4C - M4SC 024 | 1.49                                                   | 13.0                       | 17.7                   | 535.4                       | 17.0                            |
| M4C - M4SC 027 | 1.72                                                   | 14.8                       | 19.5                   | 619.5                       | 19.7                            |
| M4C - M4SC 031 | 2.11                                                   | 18.5                       | 23.2                   | 768.0                       | 24.0                            |
| M4C - M4SC 043 | 2.84                                                   | 24.6                       | 29.3                   | 1062.0                      | 33.6                            |
| M4C - M4SC 055 | 3.59                                                   | 31.2                       | 36.0                   | 1318.6                      | 41.8                            |
| M4C - M4SC 067 | 4.34                                                   | 37.5                       | 42.3                   | 1504.5                      | 47.7                            |
| M4C - M4SC 075 | 4.89                                                   | 42.3                       | 47.0                   | 1752.2                      | 55.6                            |



**SIDE PORTS**

SAE 16 (1 5/16\"-12 UNF) - .75 DEEP (2 PLACES)



**OPPOSITE PORTS**

