Hydraulic Motors
M3 - M4 Series

Denison Vane Technology, fixed displacement

Parker

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.

Licensing for this image came with permission from the Parker Hannifin Media Manager collection.

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.

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.

Vanes are balanced to the axial and radial forces, are held against fluid film on cam ring by springs and centrifugal force.

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

Port B ramp unloaded vane moves inward for CW rotation.

The rotation is changed by reversing flow.

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

The rotor is of through-hardened high alloy steel.

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.

Parker Hannifin
Pump & Motor Division Europe
Vierzon - France

Installation and connection

	Mounting flange	Weight without connector and bracket - kg	Moment of inertia kgm² x 10⁻⁴	Option for inlet and outlet port
M3B	SAE J744c ISO/3019-1 SAE A	8,0	3,0	SAE threaded SAE 4 bolts J718c ISO/DIS 6162-1 - 3/4" BSPP threaded
M4C	SAE J744c ISO/3019-1 SAE B	15,4	7,9	SAE threaded SAE 4 bolts J718c ISO/DIS 6162-1 - 1"
M4D	SAE J744c ISO/3019-1 SAE C	27,0	21,8	SAE threaded SAE 4 bolts J718c ISO/DIS 6162-1 - 1.1/4"
M4E	SAE J744c ISO/3019-1 SAE C	45,0	58,5	SAE threaded SAE 4 bolts J718c ISO/DIS 6162-1 - 2"

Drain line option

All these motors may be equiped 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

Series	Size	Ring size	Theor. Displ. V_i	Theoretical Torque T	Power at 100 rpm	Torque T	Power P
						n = 2000 rpm at Δ p 175 bar	
			cm/rev.	Nm/bar	kW/bar	Nm	kW
M3	B	009	9,2	0,130	0,0015	19,7	4,3
		012	12,3	0,186	0,0020	26,7	5,8
		018	18,5	0,304	0,0032	46,6	10,0
		027	27,8	0,485	0,0050	77,4	16,3
		036	37,1	0,624	0,0065	102,0	21,1
M4	C	024	24,4	0,39	0,0040	60,5	12,7
		027	28,2	0,45	0,0047	70,0	14,7
		031	34,5	0,55	0,0058	86,8	18,0
		043	46,5	0,74	0,0078	120,0	25,1
		055	58,8	0,93	0,0098	149,0	31,2
		067	71,1	1,13	0,0120	170,0	35,6
		075	80,1	1,27	0,0130	198,0	41,5
	D	062	65,1	1,04	0,0110	165,0	34,6
		074	76,8	1,22	0,0130	200,0	41,9
		088	91,1	1,45	0,0150	236,0	49,4
		102	105,5	1,68	0,0180	264,0	55,3
		113	116,7	1,86	0,0200	300,0	62,8
		128	132,4	2,11	0,0220	340,0	71,2
		138	144,4	2,30	0,0240	372,0	77,9
	E	153	158,5	2,52	0,0260	398,0	83,4
		185	191,6	3,05	0,0320	484,0	101,4
		214	222,0	3,53	0,0370	567,0	118,8

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.

Parker Hannifin
Pump & Motor Division Europe
Vierzon - France

Maximum Speed and pressure

Series	Size	Displ.	Max. pressure HF-0 HF-2 bar	HF-6a HF-6b bar	HF-1 bar	HF-3 HF-5 bar	HF-4 bar	Operating pressure range drain bar	Max. speed for low loaded condition [1] rpm	HF-0, HF-2 Cont. rpm	HF-0, HF-2 Int. [2] rpm	HF-6a, HF6b Cont. rpm	HF-6a, HF6b Int. [2] rpm	HF-1 Cont. rpm	HF-1 Int. [2] rpm
M3	B	009	175					1.5	4000	3000	3600				
		012													
		018	210												
		027													
		036													
M4	C	024			175	175	140	3.5	4000	2500	3600	2500	3600	2000	2500
		027	230												
		031													
		043													
		055	210												
		067													
		075	175												
	D	062			140	140	140		4000	2500	3000	2500	3000	2000	2500
		074	230												
		088													
		102	210												
		113													
		128	190												
		138	175												
	E	153	190		140	140	140		3600	2500	3000	2500	3000	1800	2200
		185	180												
		214	175												

[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 equiped with internal drain. Then the model will be M3B1, M4C1, M4D1, M4E1.
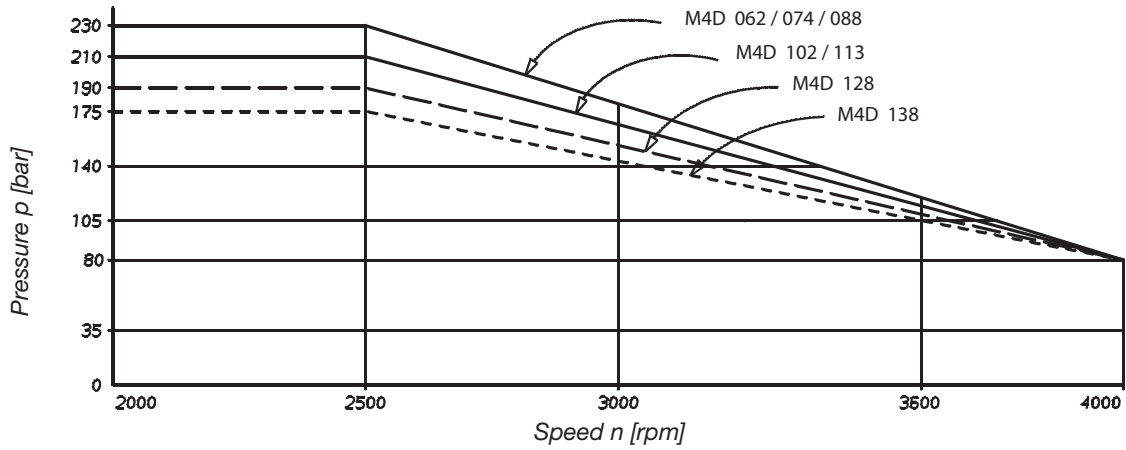
Maximum ratings M3B
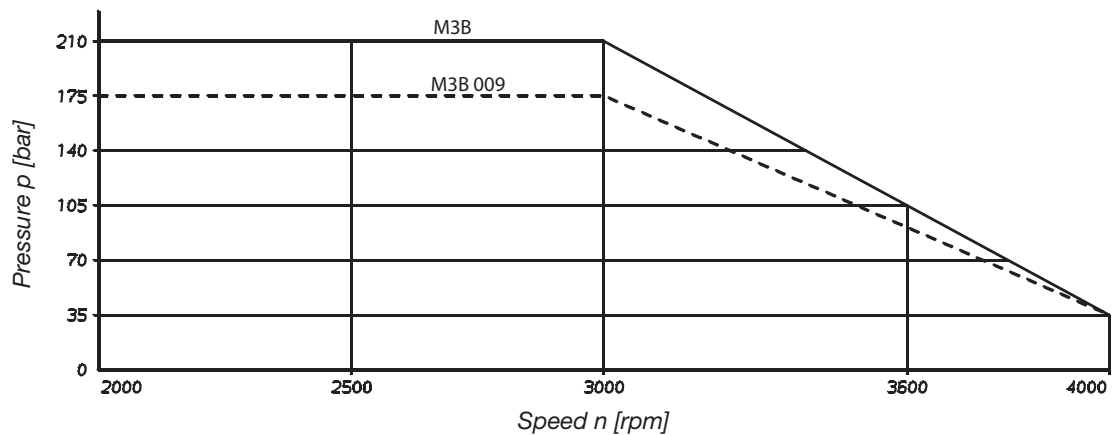
- Running condition limits - Typical curves at 26 cSt @ 45°.
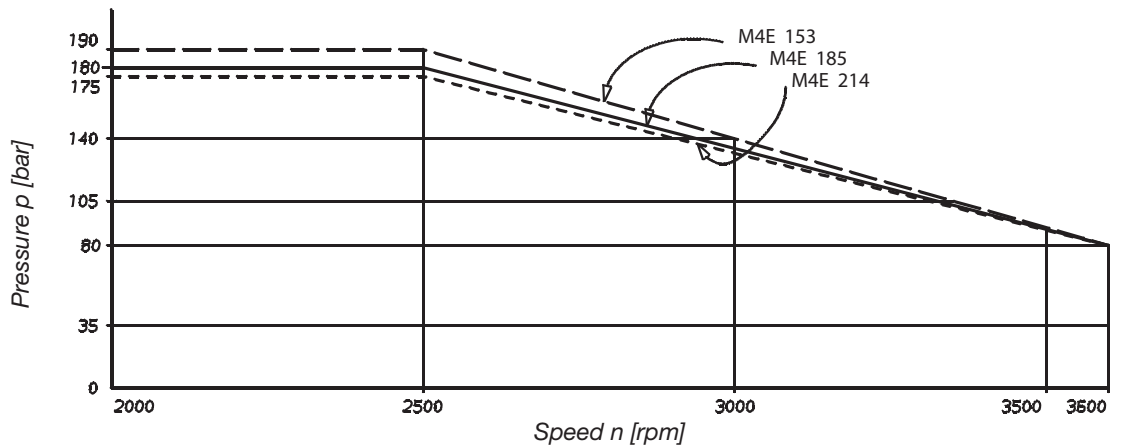- For higher specifications or for operating speed under < 100 rpm, please consult Parker.

Parker Hannifin
Pump & Motor Division Europe
Vierzon - France

Maximum ratings M4C
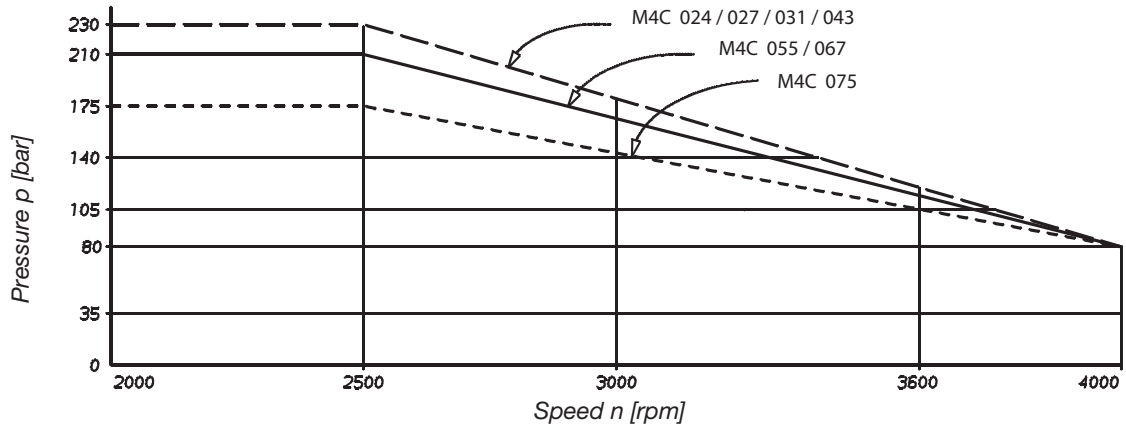
Maximum ratings M4D

Maximum ratings M4E

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

Parker Hannifin
Pump & Motor Division Europe
Vierzon - France

Model No.

M3B1
M3B - 036 - 1 N 00 - B 1 01 -

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

Modifications

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

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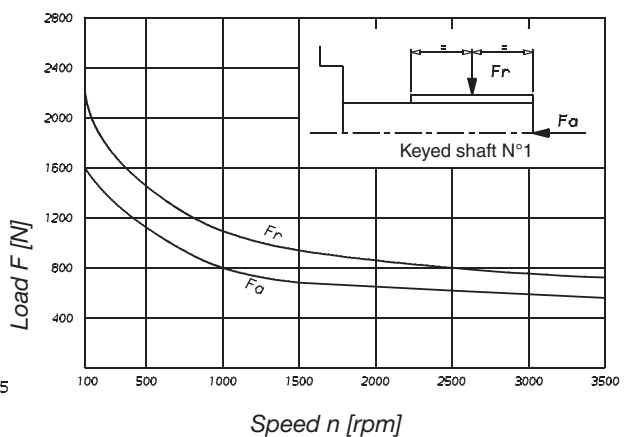
Design letter

Porting combination
00 = standard

B
A
00

A   B
01

Operating Characteristics - Typical [24 cSt]

Model	V_i Volumetric displacement	Input flow at n = 2000 rpm		Torque T at n = 2000 rpm	Power output at n = 2000 rpm
		Theoretical	at 175 bar Δ p	at 175 bar Δ p	at 175 bar Δ p
	cm³/rev.	l/min	l/min	Nm	kW
M3B 009	9,2	18,4	30,4	19,7	4,3
M3B 012	12,3	24,6	36,6	26,7	5,8
M3B 018	18,5	37,0	49,0	46,6	10,0
M3B 027	27,8	55,6	67,6	77,4	16,3
M3B 036	37,1	74,2	86,2	102,0	21,1

Overall Leakage (internal + external)

24 cSt
10 cSt

Overall leakage Qloss [l/min]

Pressure p [bar]

Permissible shaft loads

Fr
Fa
Keyed shaft N°1

Load F [N]

Fr
Fa

Speed n [rpm]

Do not apply Fr and Fa loads simultaneously

Parker Hannifin
Pump & Motor Division Europe
Vierzon - France
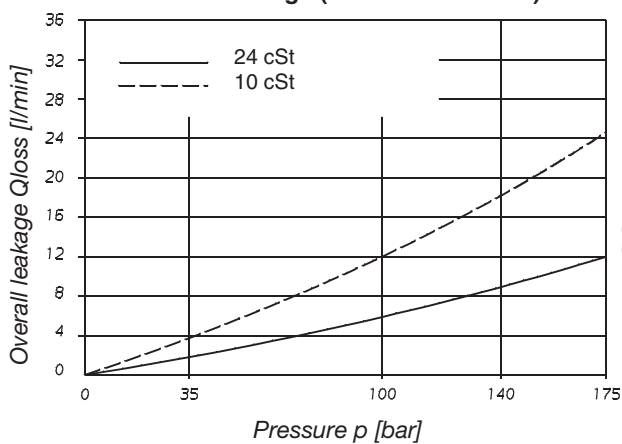
M3B - M3B1 motor

Weight : 8,0 kg

ø82.499
ø82.550
ø47.0
ø21.12 MAX
19.00
19.05
KEY 4.76/4.71
1.5 x 45°
0.8 x 45°
55.6
31.7
7.6
33.3
6.35 MAX
39.6
145.9
92
B
A
69.8
50.8

DRAIN PORT ø 3/8" B.S.P.P
(SAE 6-9/16"-18 UNF - 00 PORT CONNECTION)

Shaft code 1
(Keyed, non SAE)
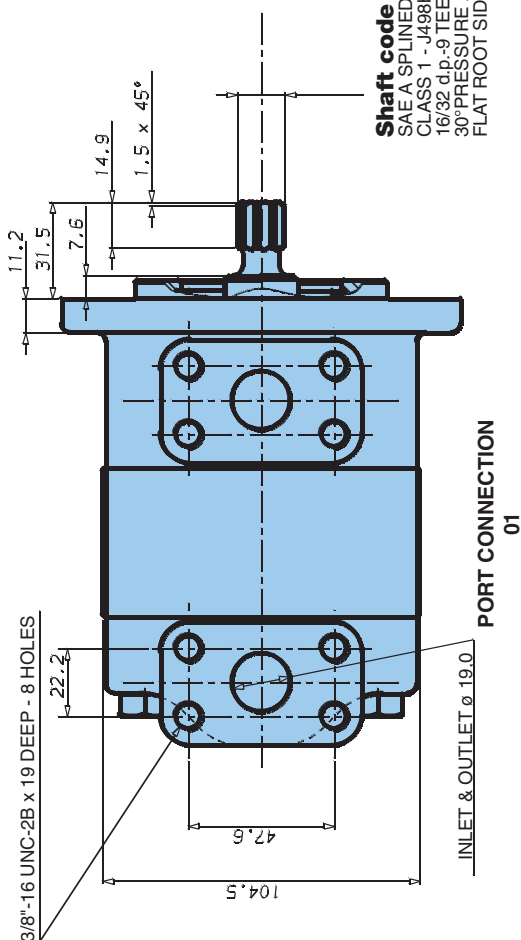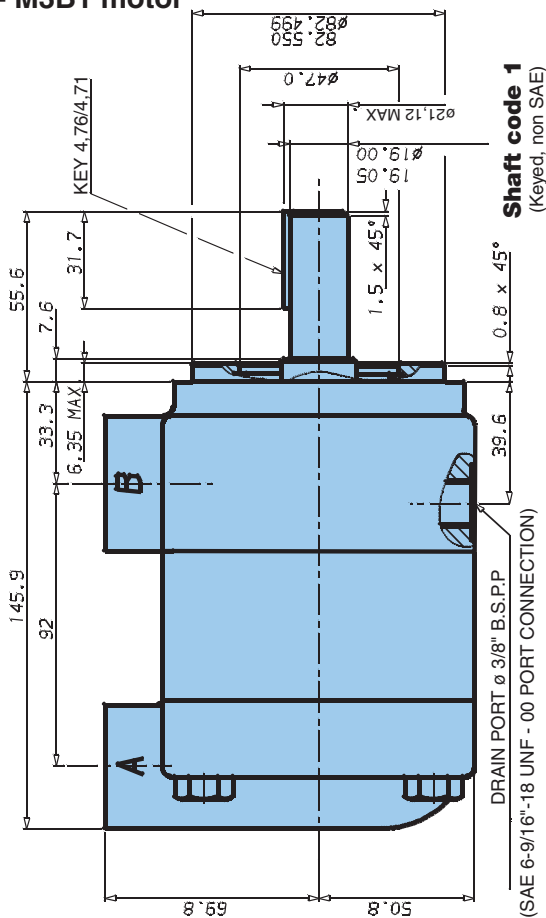
Shaft code 3
SAE A SPLINED SHAFT
CLASS 1 - J498b
16/32 d.p.-9 TEETH
30° PRESSURE ANGLE
FLAT ROOT SIDE FIT

11.2
31.5
7.6
14.9
1.5 x 45°

22.2
47.6
104.5

3/8"-16 UNC-2B x 19 DEEP - 8 HOLES

INLET & OUTLET ø 19.0

PORT CONNECTION 01

101.6
130.0
106.4
11.1

PORT CONNECTION 00

SAE 12
1.1/16"-12 UNF

Shaft code 4
SAE B SPLINED SHAFT
CLASS 1 - J498b
16/32 d.p.-13 TEETH
30° PRESSURE ANGLE
FLAT ROOT SIDE FIT

44.7
25.5
7.6
1.5 x 45°

PORT CONNECTION 02

3/4" BSPP x 19 deep

9
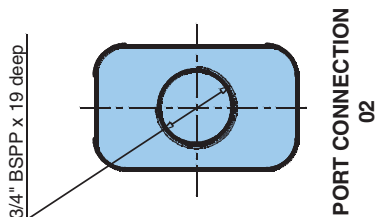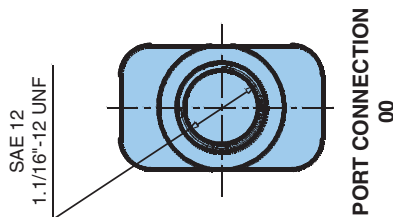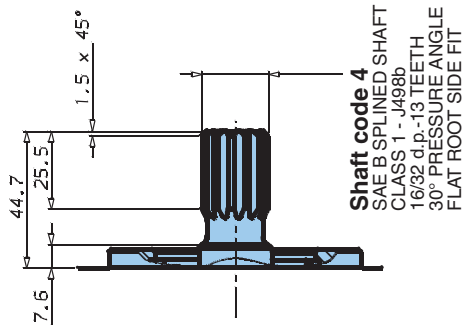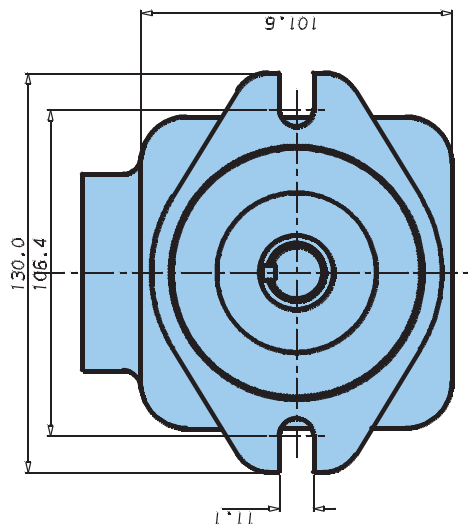
M4C1
Model No.   M4C - 067 - 1 N 00 - A 1 02 ..

M4C - Series external drain

M4C1 - Series internal drain

Torque
024 = 0,39 Nm/bar
027 = 0,45 Nm/bar
031 = 0,55 Nm/bar
043 = 0,74 Nm/bar
055 = 0,93 Nm/bar
067 = 1,13 Nm/bar
075 = 1,27 Nm/bar

Type of shaft
1 = keyed (SAE B)
2 = keyed (non SAE)
3 = splined (SAE B)

Direction of rotation (shaft end view)
N = bi-directional

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

Modifications

Ports
01 = SAE threaded port
    SAE drain
02 = 4 bolt SAE flange with UNC threads
    SAE drain
M4 = 4 bolt SAE flange with Metric threads
    BSPP drain

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

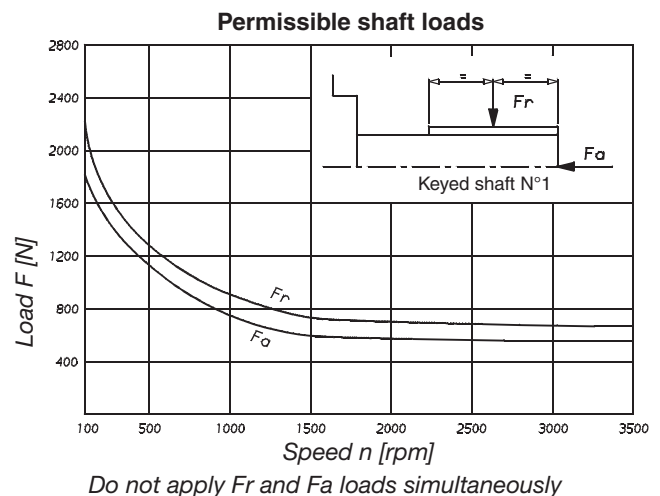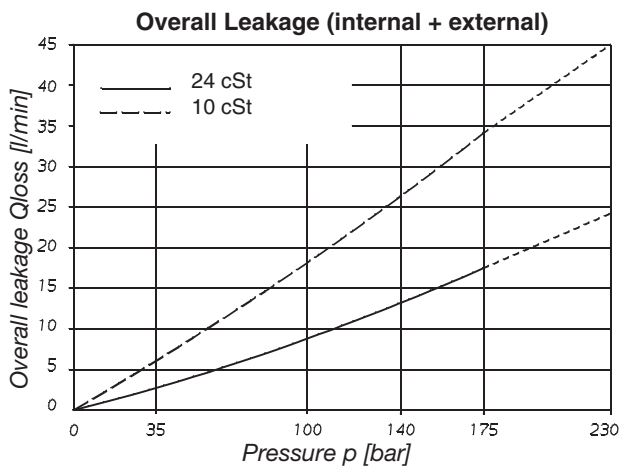**Design letter**

Porting combination
00 = standard

REAR PORT   SIDE PORTS

DRAIN

00   01   02

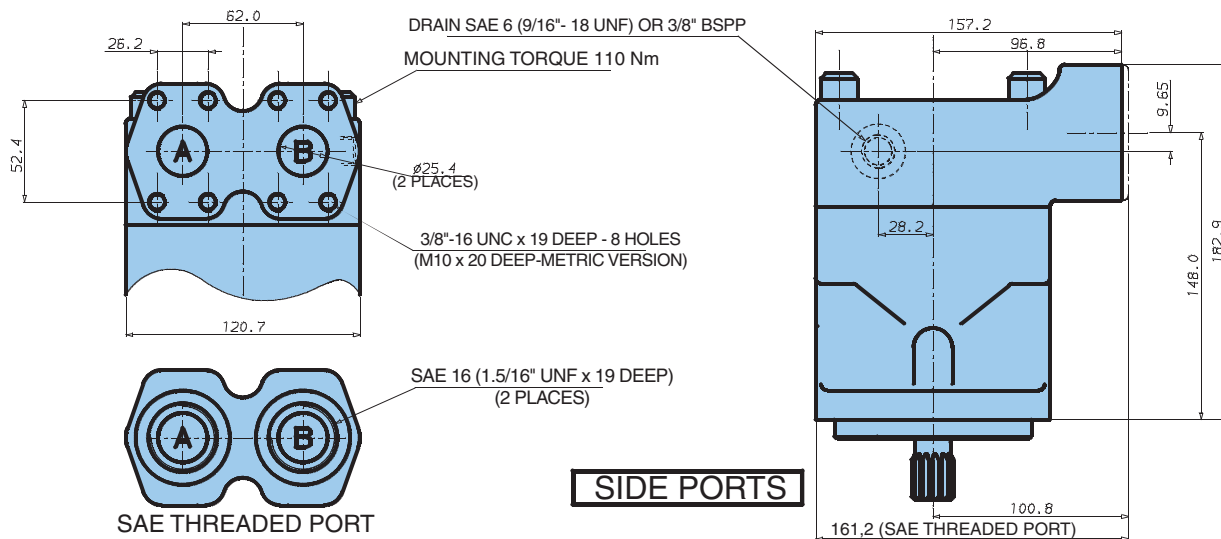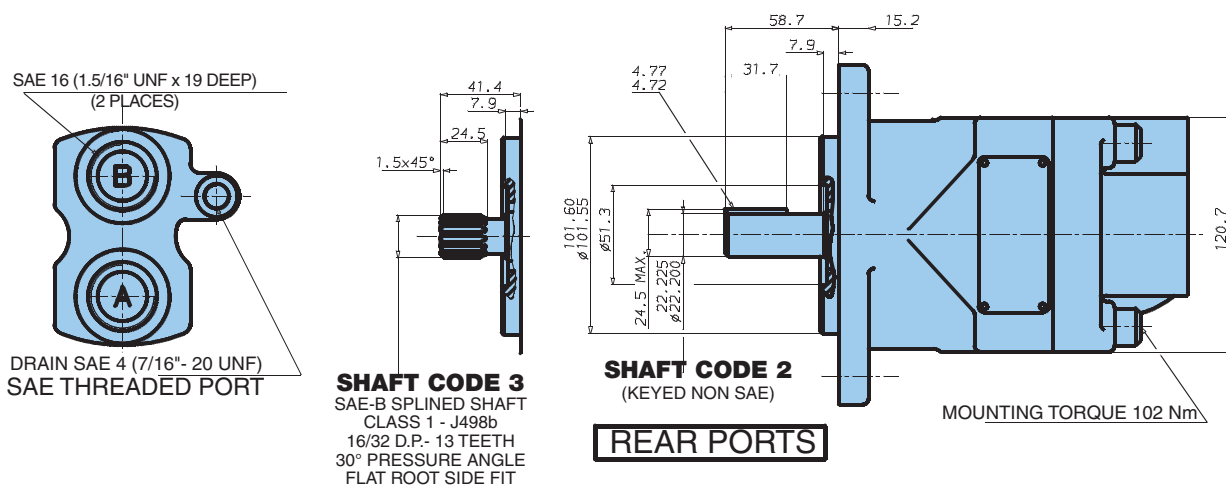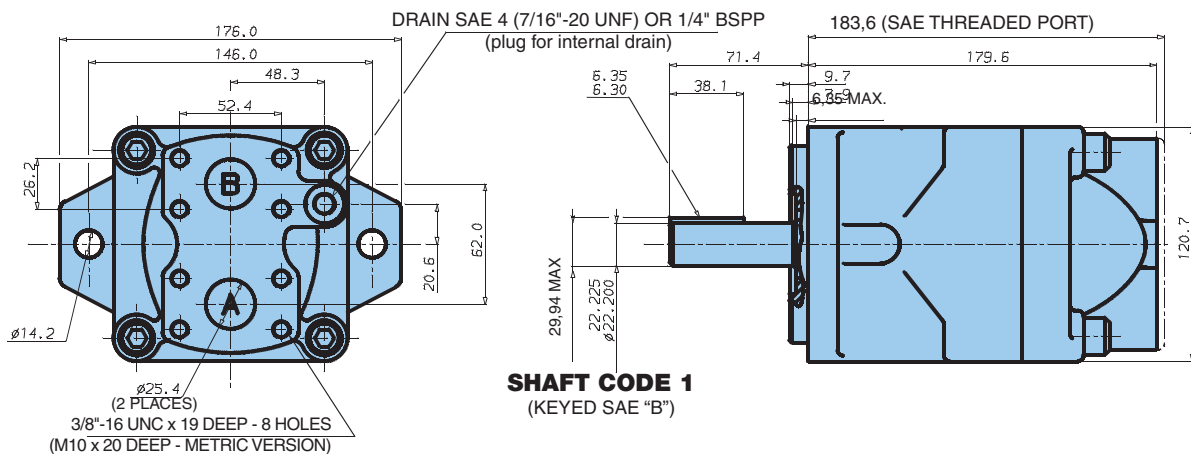*M4C1 : Drain port is plugged.*

Operating Characteristics - Typical [24 cSt]

Model	V_i Volumetric displacement	Input flow at n = 2000 rpm		Torque T at n = 2000 rpm	Power output at n = 2000 rpm
		Theoretical	at 175 bar Δ p	at 175 bar Δ p	at 175 bar Δ p
	cm³/rev.	l/min	l/min	Nm	kW
M4C 024	24,4	49,0	67,0	60,5	12,7
M4C 027	28,2	56,0	74,0	70,0	14,7
M4C 031	34,5	69,0	87,0	86,8	10,8
M4C 043	46,5	93,0	110,0	120,0	25,1
M4C 055	58,8	118,0	136,0	149,0	31,2
M4C 067	71,1	142,0	160,0	170,0	35,6
M4C 075	80,1	160,0	178,0	198,0	41,5

Overall Leakage (internal + external)

24 cSt
10 cSt

Permissible shaft loads

Keyed shaft N°1

Do not apply Fr and Fa loads simultaneously

M4C - M4C1 motor

Weight : 15,4 kg

DRAIN SAE 4 (7/16"-20 UNF) OR 1/4" BSPP
(plug for internal drain)

176.0
146.0
48.3
52.4
26.2
62.0
20.6
ø14.2
ø25.4
(2 PLACES)
3/8"-16 UNC x 19 DEEP - 8 HOLES
(M10 x 20 DEEP - METRIC VERSION)

183,6 (SAE THREADED PORT)
71.4
9.7
6.35
6.30
6.85 MAX.
38.1
179.6
120.7
29,94 MAX
22.225
ø22.200

SHAFT CODE 1
(KEYED SAE "B")

SAE 16 (1.5/16" UNF x 19 DEEP)
(2 PLACES)

DRAIN SAE 4 (7/16"- 20 UNF)
SAE THREADED PORT

41.4
7.9
24.5
1.5x45°

SHAFT CODE 3
SAE-B SPLINED SHAFT
CLASS 1 - J498b
16/32 D.P.- 13 TEETH
30° PRESSURE ANGLE
FLAT ROOT SIDE FIT

58.7
15.2
7.9
4.77
4.72
31.7
101.60
ø101.55
ø51.3
24.5 MAX.
22.225
ø22.200
120.7

SHAFT CODE 2
(KEYED NON SAE)

MOUNTING TORQUE 102 Nm

REAR PORTS

DRAIN SAE 6 (9/16"- 18 UNF) OR 3/8" BSPP
MOUNTING TORQUE 110 Nm

62.0
26.2
52.4
ø25.4
(2 PLACES)
3/8"-16 UNC x 19 DEEP - 8 HOLES
(M10 x 20 DEEP-METRIC VERSION)
120.7

157.2
96.8
9.65
28.2
182.9
148.0

SAE 16 (1.5/16" UNF x 19 DEEP)
(2 PLACES)

SAE THREADED PORT

SIDE PORTS

100.8
161,2 (SAE THREADED PORT)

Ordering Code

Hydraulic Motors, Fixed
M3 - M4, Denison Vane Motors

M4D1

Model No.   **M4D - 138 - 1 N 00 - B 1 02 ..**

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

Modifications

Ports
01 = SAE threaded port
    SAE drain
02 = 4 bolt SAE flange with UNC threads
    SAE drain
M4 = 4 bolt SAE flange with Metric
    threads
    BSPP drain

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

Design letter

Porting combination
00 = standard

DRAIN

00

M4D1 : Drain port is plugged.

Operating Characteristics - Typical [24 cSt]

Model	V$_i$ Volumetric displacement	Input flow at n = 2000 rpm		Torque T at n = 2000 rpm	Power output at n = 2000 rpm
		Theoretical	at 175 bar △ p	at 175 bar △ p	at 175 bar △ p
	cm³/rev.	l/min	l/min	Nm	kW
M4D 062	65,1	130,0	154,0	165,0	34,6
M4D 074	76,8	154,0	178,0	200,0	41,9
M4D 088	91,0	182,0	206,0	236,0	49,4
M4D 102	105,5	211,0	241,0	264,0	55,3
M4D 113	116,7	233,0	257,0	300,0	62,8
M4D 128	132,4	265,0	289,0	340,0	71,2
M4D 138	144,4	289,0	313,0	372,0	77,9

Overall Leakage (internal + external)

24 cSt
10 cSt

Overall leakage Qloss [l/min]

Pressure p [bar]

Permissible shaft loads

Fr

Fa

Keyed shaft N°1

Load F [N]

Fr

Fa

Speed n [rpm]
Do not apply Fr and Fa loads simultaneously

Parker Hannifin
Pump & Motor Division Europe
Vierzon - France
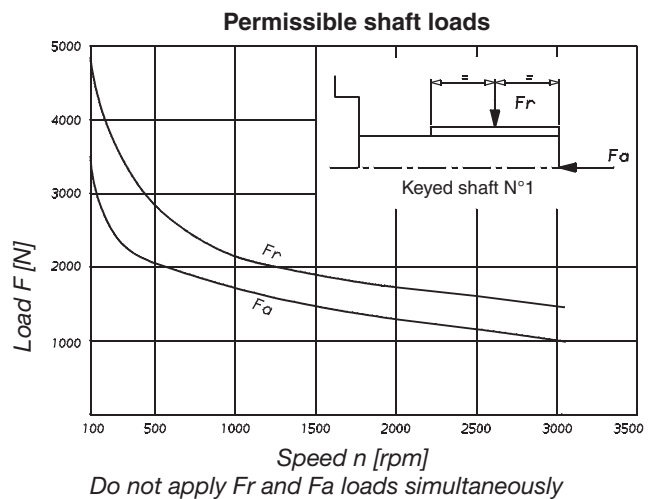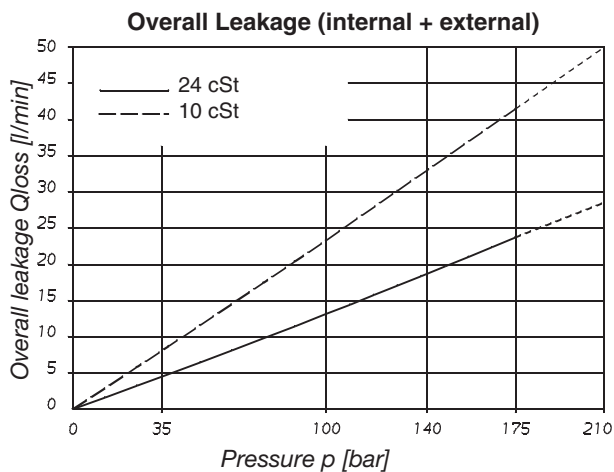
M4D - M4D1 motor

Weight : 27,0 kg

MOUNTING TORQUE: 180 N.m

55.6

203,5 (SAE THREADED PORT)

17.0

12.7

38.10

1.5 x 45°

ø63.5

35.28 MAX

31.75

ø31.7

SHAFT CODE 1
(KEYED SAE-C)

6,35 MAX

7.9

212.3

181

114.5

114.5

7.94
7.89

ø 17,5 (2 PLACES)

ø 14,3 (4 PLACES)

254

55.6

198.4

7.9

38.10

2.3 x 45°

127.00

ø126.95

SHAFT CODE 3
SAE-C SPLINED SHAFT
CLASS 1 - J498b
12/24 d.p. - 14 TEETH
PRESSURE ANGLE 30°
FLAT ROOT SIDE FIT
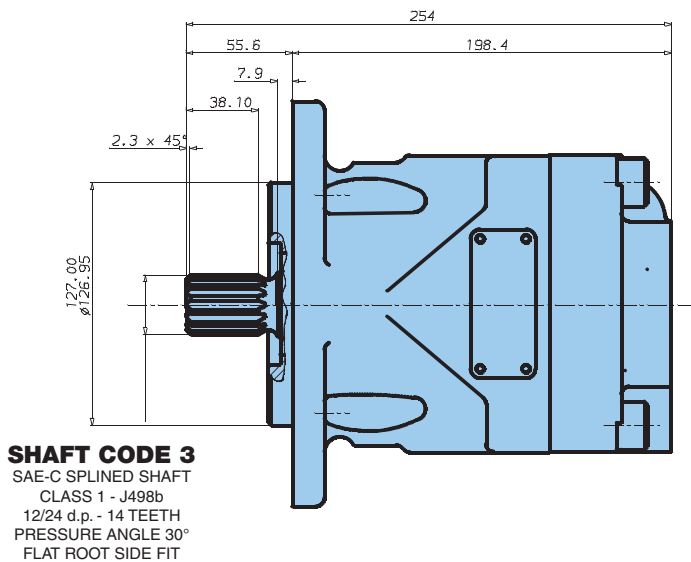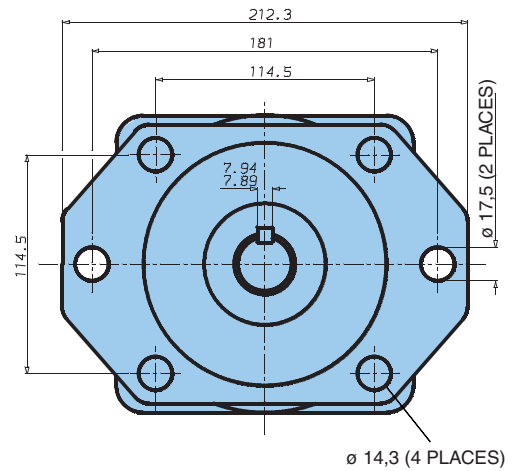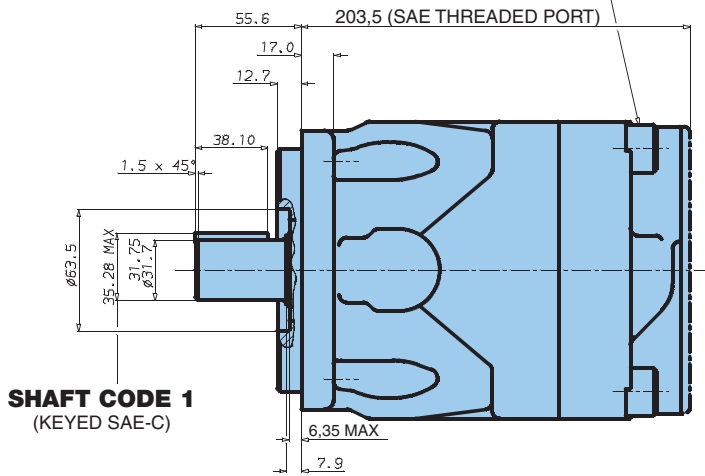
7/16"-14 UNC x 22 DEEP - 8 HOLES
(M12 x 22,1 DEEP-METRIC VERSION)

DRAIN SAE 8 (3/4"-16 UNF) OR 3/8" BSPP

B

A

ø31.8

31.75

85.85

42.9

30.2

58.7

60.45

155.45
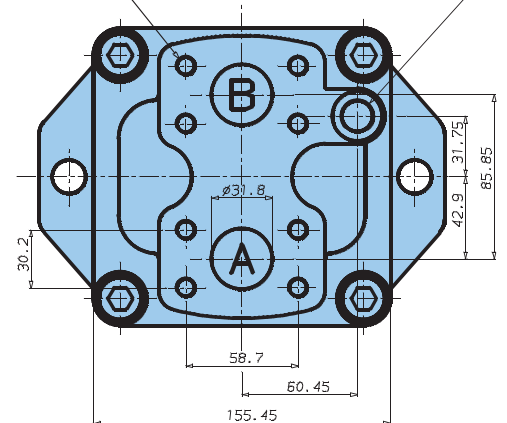
DRAIN SAE 8 (3/4" 16 UNF) 14,2 DEEP

60.45

B

31.75

85.85

42.9

SAE 20 (1" 5/8-16 UNF) x 19 DEEP-2 HOLES

A

SAE THREADED PORT
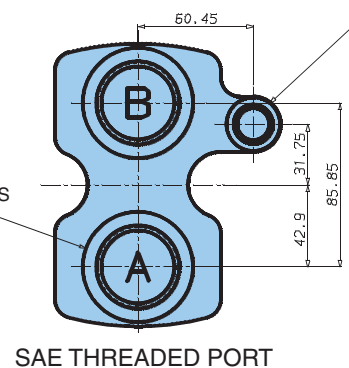
Model No.

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

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

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

DRAIN

00
M4E1 : Drain port is plugged.

Operating Characteristics - Typical [24 cSt]

Model	V_i Volumetric displacement	Input flow at n = 2000 rpm		Torque T at n = 2000 rpm	Power output at n = 2000 rpm
		Theoretical	at 175 bar Δ p	at 175 bar Δ p	at 175 bar Δ p
	cm³/rev.	l/min	l/min	Nm	kW
M4E 153	158,5	317,0	343,0	398,0	83,4
M4E 185	191,6	383,0	409,0	484,0	101,4
M4E 214	222,0	444,0	470,0	567,0	188,8

Overall Leakage (internal + external)

24 cSt
10 cSt

Permissible shaft loads

Fr
Fa
Keyed shaft N°1

Do not apply Fr and Fa loads simultaneously

Parker Hannifin
Pump & Motor Division Europe
Vierzon - France

M4E - M4E1 motor

Weight : 45,0 kg

212.9
114.5
Ø 17.5 (2 PLACES)
114.5
181
14,22 (4 PLACES)

DRAIN SAE 8 (3/4" - 16 UNF) OR 1/2" BSPP

351.6
267.5
84.1
7.9
49.27
7.94
7.89
1.5 x 45°
31.75
Ø31.70
35.28 MAX
270,8 (SAE THREADED PORT)

SHAFT CODE 1
(KEYED SAE-C)

MOUNTING TORQUE: 235 N.m

172.7
63.5
B
99.2
187.5
49.6
42.9
A
Ø50
77.8

8 THREADED HOLES
1/2"-13 UNC x 26,9 DEEP

12.7
7.9
1.5 x 45°
25.15
Ø89.9
127.00
Ø126.95
2.3 x 45°
6,5 MAX
15.7
55.7
323.2

SHAFT CODE 3
SAE-C SPLINED SHAFT
CLASS 1 - J498b
12/24 d.p. - 14 TEETH
PRESSURE ANGLE 30°
FLAT ROOT SIDE FIT

63.50
B
99.2
49.6
A

DRAIN SAE 8 (3/4" 16 UNF) x 14.2 DEEP

SAE 32 (2 1/2" 12 UNF) x 19 DEEP-2 HOLES

SAE THREADED PORT

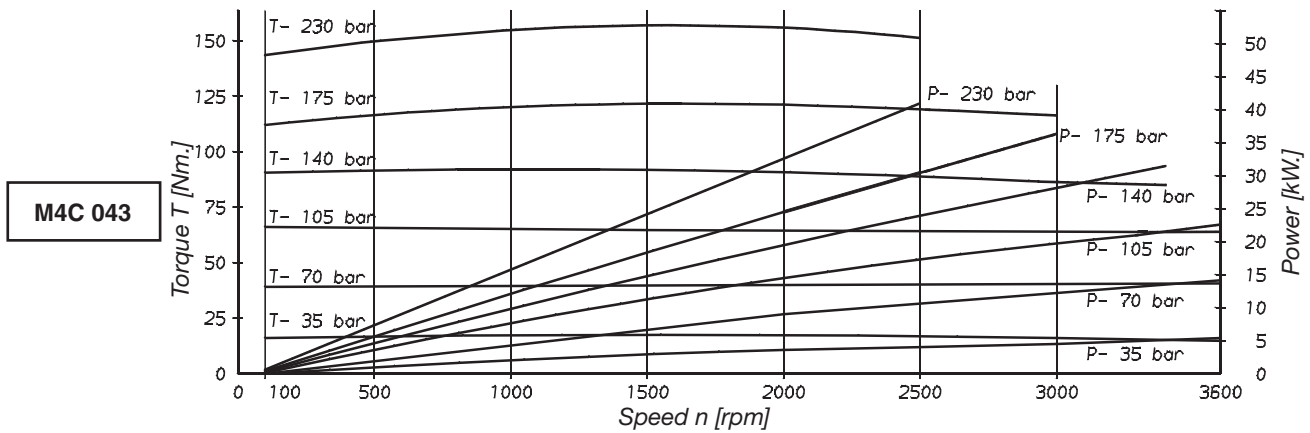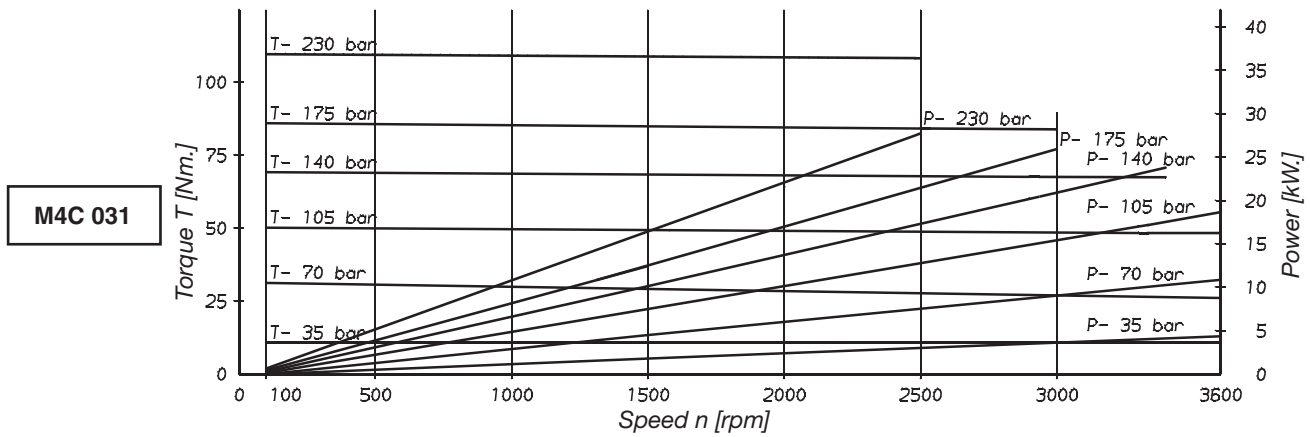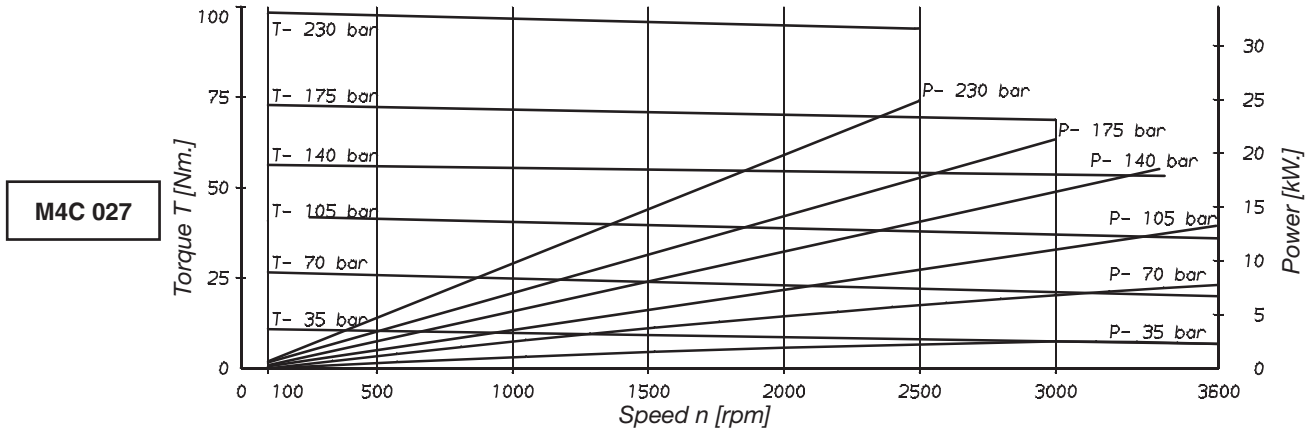## Performance charts
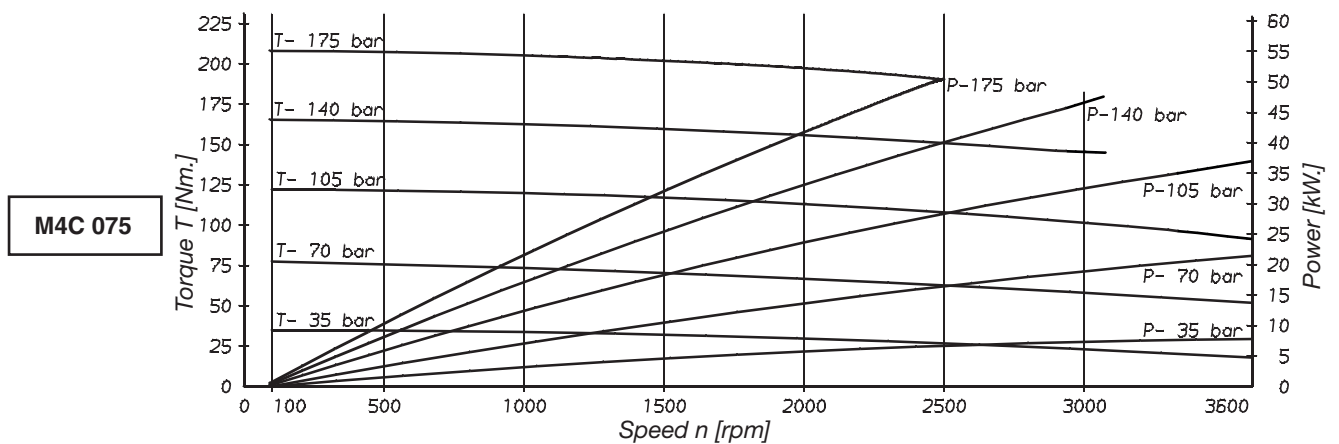

M3B 009

M3B 012

M3B 018

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

Parker Hannifin
Pump & Motor Division Europe
Vierzon - France

Performance charts
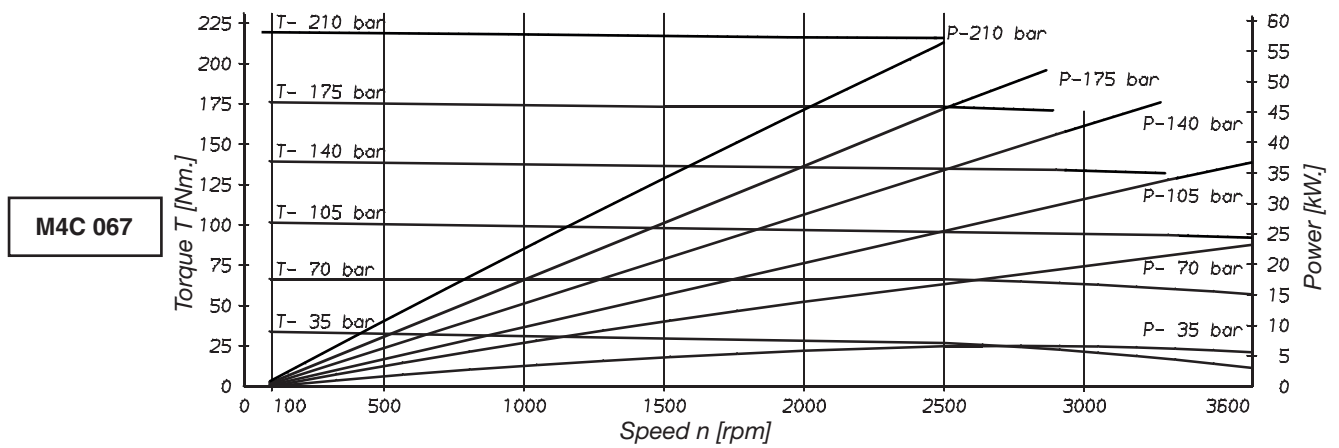
M3B 027

M3B 036

M4C 024

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

17

Performance charts

M4C 027

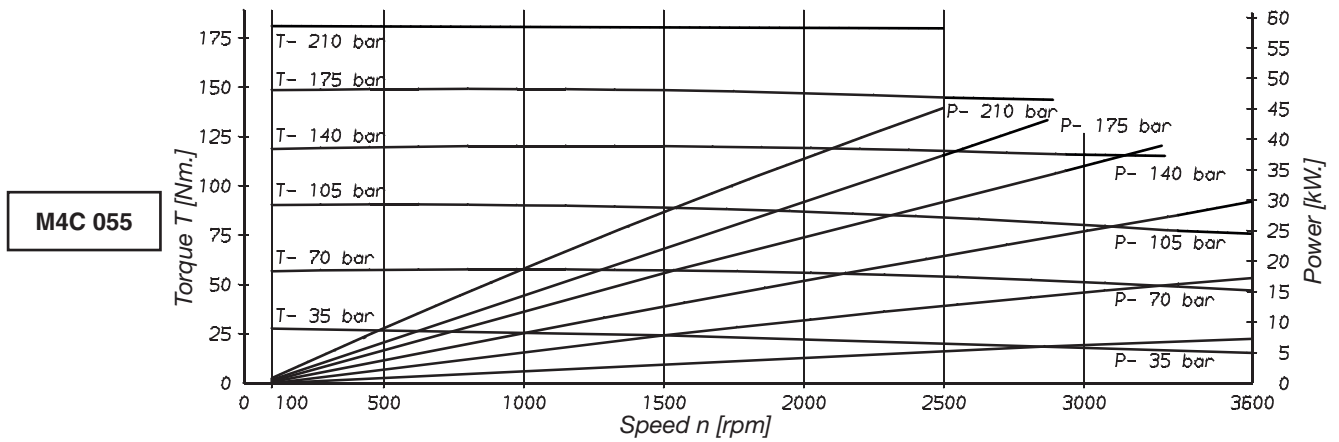

M4C 031

M4C 043

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

Performance charts
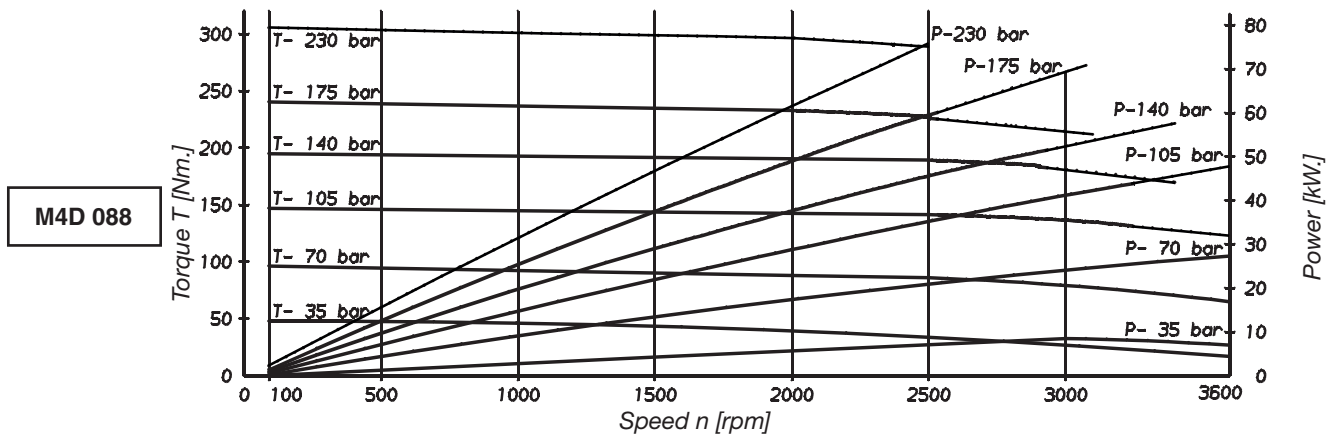
M4C 055

M4C 067

M4C 075

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

Parker Hannifin
Pump & Motor Division Europe
Vierzon - France

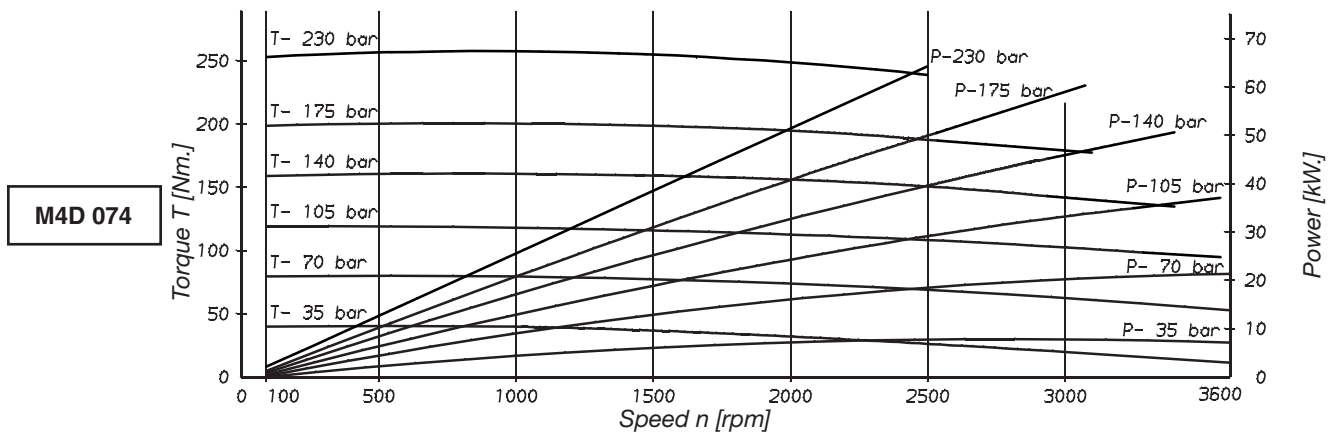## Performance charts
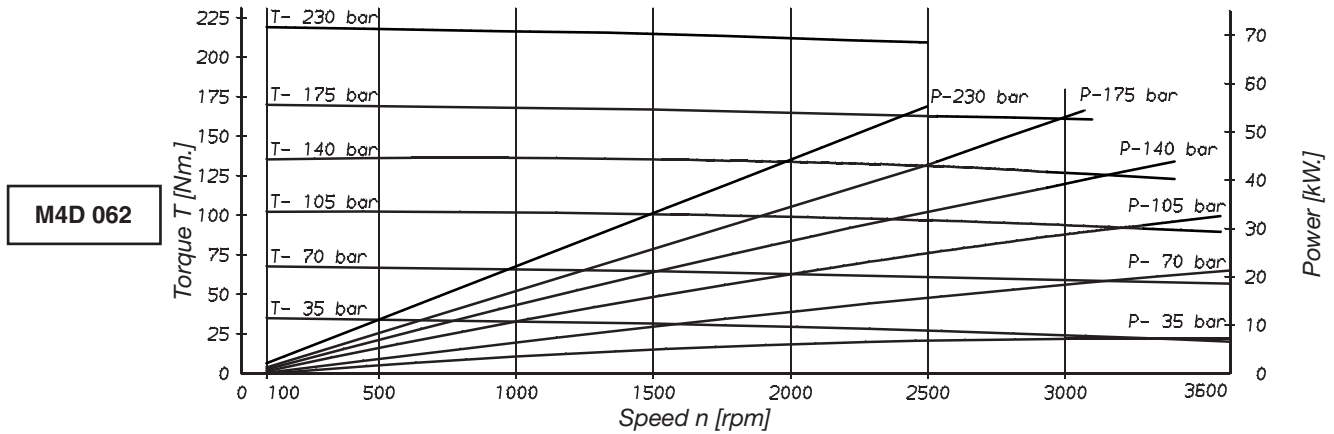

M4D 062

M4D 074

M4D 088

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

Performance charts

M4D 102

M4D 113

M4D 128

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

Performance charts
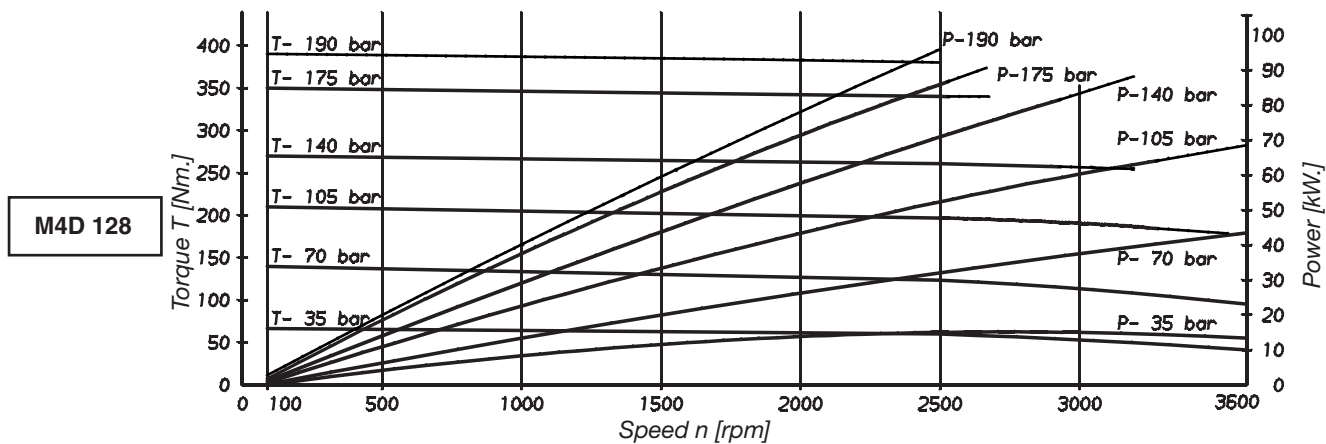
M4D 138

M4E 153

M4E 185

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

Performance charts
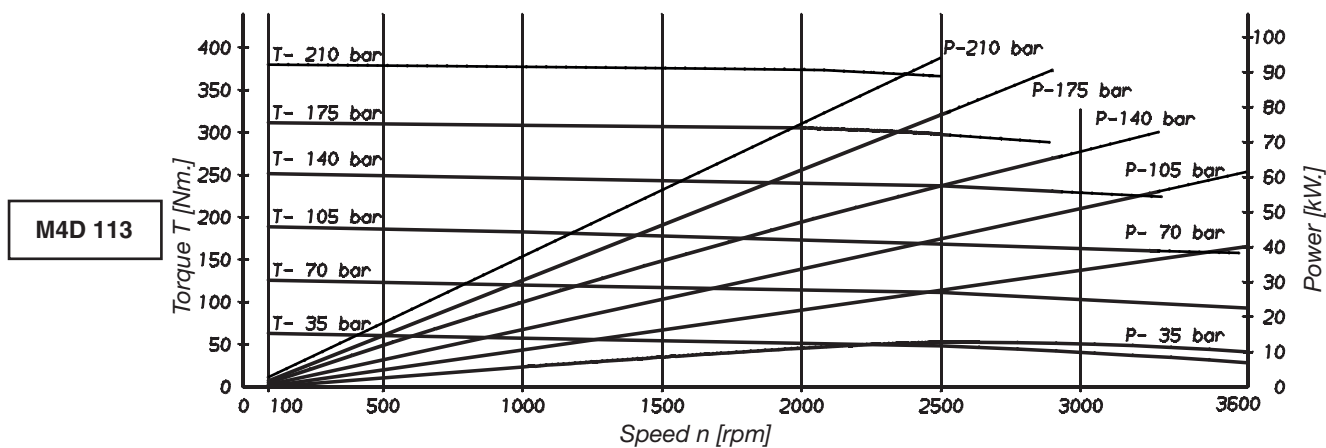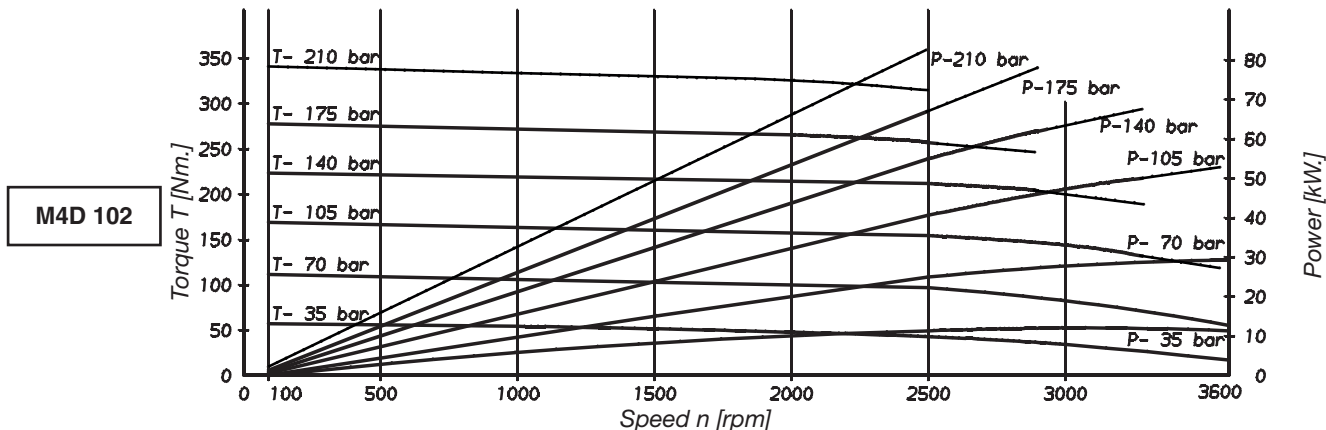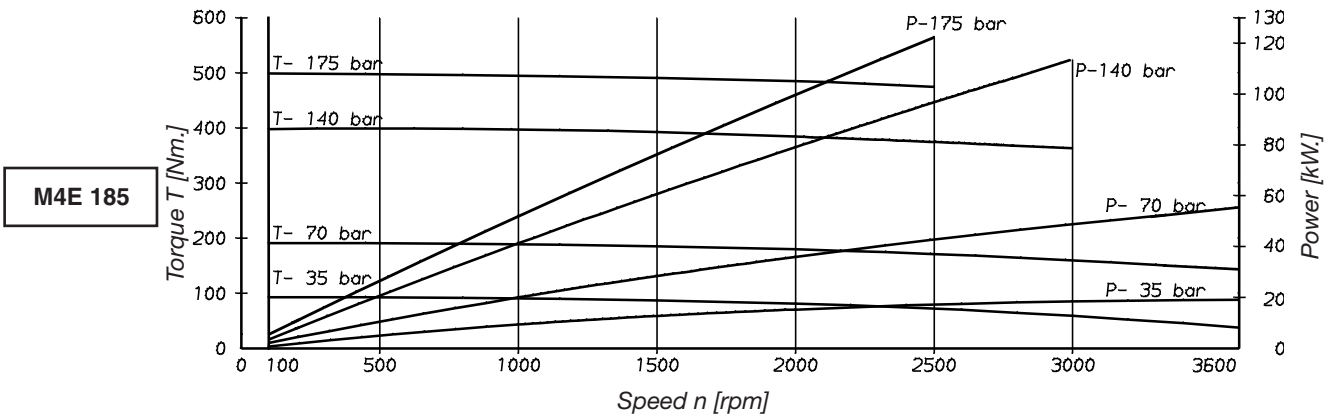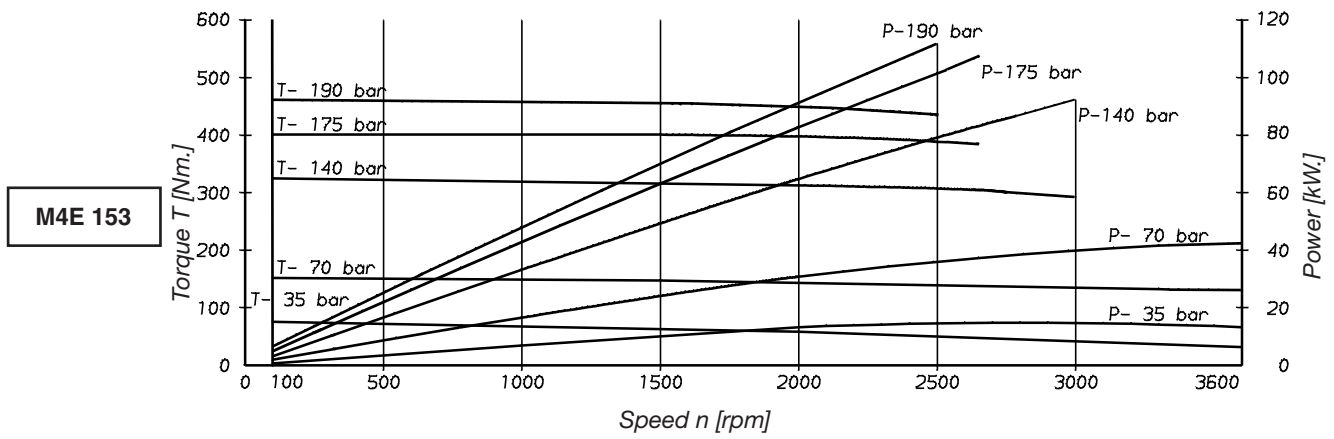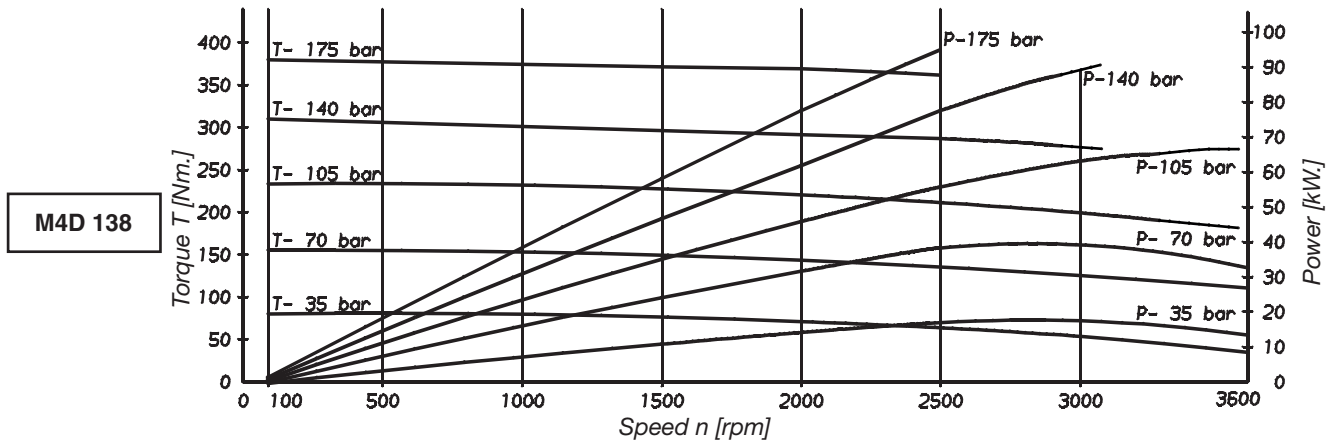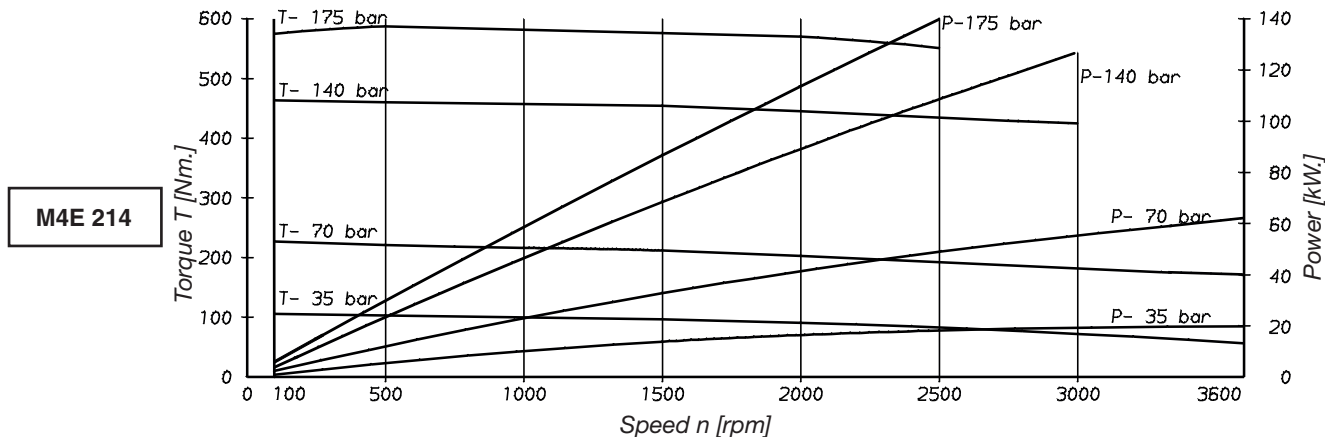

- Running condition limits - Typical curves at 26 cSt @ 45°.

- For higher specifications or for operating speed under < 100 rpm, please consult Parker.

Minimum replenishment pressure during decelaration

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).

Minimum replenishment pressure (bar)					
Series	Speed [rpm] - Oil viscosity = 32 cSt				
	500	1000	2000	3000	3600
M3B	0,6	1,0	1,9	3,5	5,8
M4C	0,7	1,4	3,1	5,5	9,3
M4D	0,7	1,4	3,1	5,5	9,3
M4E	1,4	2,8	5,2	11,0	

Reverse cycles for fan drives
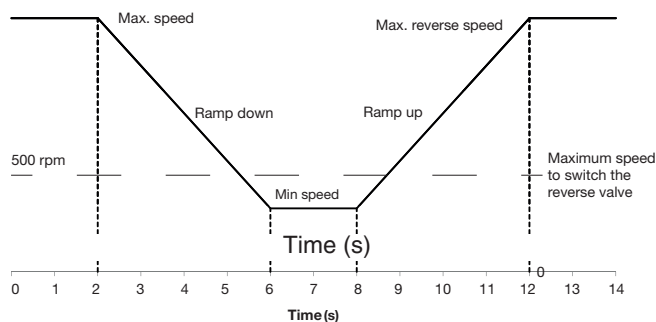
The motor must be decelerated from its (max.) rotation speed to less than 500 rpm in no less than 4 seconds time before energizing the solenoid of the reverse valve.

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*

Pump available data
Flow _____ *Q*   *[l/min] 115*
Δ Pressure _____ *Δ p [bar]*   *175*

1*. Check if available power is greater than required power (0.85 estimated overall efficiency).*

$$0,85 \times \frac{Q \times p}{600} \geqslant \frac{T \times \pi \times n}{30 \times 1000}$$

$$0,85 \times \frac{115 \times 175}{600} \geqslant \frac{140 \times \pi \times 1500}{30 \times 1000}$$

28,5 > 22 kW

2. <u>Two ways of calculation :</u> *Calculate V_i from T required torque, or from Q available flow.*

2a*.Calculate Vi from T required torque*
$$V_i = \frac{20 \, \pi \times T}{p} = \frac{20 \, \pi \times 140}{175} = 50,26 \ cm^3/rev.$$

2b*. Calculate Vi from Q available flow*
$$V_i = \frac{1000 \times 175}{1500} = 76,7 \ cm^3/rev.$$

3a*. Choose motor from Vi immediately greater*
M4C 055   Vi = 58,8 cm³/rev. (see page 10)

3b*. Choose motor from Vi immediately smaller*
M4C 067   Vi = 71,1 cm³/rev. (see page 10)

4a*. Check real motor pressure for T = 140 Nm. at around 1500 rpm*
M4C 055   T = 140 N.m   n = 1500 rpm
p = 160 bar (see M4C 055 curve on page 19)

4b*. Check motor pressure with T = 140 Nm. at 1500 rpm*
M4C 067   T = 140 Nm.   n = 1500 rpm
p = 140 bar (see M4C 067 curve on page 19)

5a*. Flow loss at this pressure : 16 l/min*
(see page 10)
Real flow used by the motor :
$Q_{eff.}$ = 115 - 16 = 99 l/min

5b*. Flow loss at this pressure : 14 l/min*
(see page 10)
Real flow used by the motor :
$Q_{eff.}$ = 115 - 14 = 101 l/min

6a*. Real speed of the motor :*
$$n_{eff.} = \frac{Q_{eff.} \times 1000}{V_i} = \frac{99 \times 1000}{58,8} = 1683 \ rpm$$

6b*. Real speed of the motor :*
$$n_{eff.} = \frac{Q_{eff.} \times 1000}{V_i} = \frac{101 \times 1000}{71,1} = 1420 \ rpm$$

Real performances
Vi   =   58,8 cm³/rev.
$n_{eff.}$ =   1683 rpm
T   =   140 Nm.
$Δ p_{eff.}$=   160 bar   } *M4C 055*

Real performances
Vi   =   71,1 cm³/rev.
$n_{eff.}$ =   1420 rpm
T   =   140 Nm.
$Δ p_{eff.}$ =   140 bar   } *M4C 067*

Fluid power formulas

Volumetric efficiency	$\dfrac{1}{1 + \dfrac{total\ leakage \times 1000}{speed \times displacement}}$	Speed [rpm] Displacement [cm³/rev] Pressure [bar]
Mechanical efficiency	$1 - \dfrac{torque\ loss \times 20 \times p}{\Delta\ pressure \times displacement}$	Flow rate [l/min] Leakage [l/min] Torque [Nm]
Fluid motor speed	$\dfrac{1000 \times flow\ rate \times volumetric\ eff.}{displacement}$	Torque loss [Nm] Power [kW]
Fluid motor torque	$\dfrac{\Delta\ pressure \times displacement \times mech.\ eff.}{20 \times p}$	
Fluid motor power	$\dfrac{speed \times displacement \times \Delta\ pressure \times overall\ eff.}{600\ 000}$ or $\dfrac{torque \times speed \times 20 \times p}{600\ 000}$	

Hydraulic fluids

Recommended fluids

Petroleum base anti-wear, anti-rust and anti-oxydation 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	Min. (full speed & pressure for HF-1, HF-4 & HF-5 fluids) 18 cSt	
Max. (full speed & pressure) _____ 108 cSt	Min. (full speed & pressure for HF-0 & HF-2 fluids) 10 cSt	
Optimum (max. lifetime)_____ 30 cSt		

Fluids temperatures

The usual limitating 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		° C	° F
HF-0, HF-1, HF-2 _____	+ 100	(+ 212)	HF-0, HF-1, HF-2, HF-5, HF-6a, HF-6b _____	- 18	(- 0.4)
HF-4 _____	+ 50	(+ 122)	HF-4 _____	+ 10	(+ 50)
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.

This document and other information from Parker-Hannifin Corporation, its subsidiaries and authorized distributors provide product or system options for further investigation by users having technical expertise.

The user, through its own analysis and testing, is solely responsible for making the final selection of the system and components and assuring that all performance, endurance, maintenance, safety and warning requirements of the application are met. The user must analyze all aspects of the application, follow applicable industry standards, and follow the information concerning the product in the current product catalog and in any other materials provided from Parker or its subsidiaries or authorized distributors.

To the extent that Parker or its subsidiaries or authorized distributors provide component or system options based upon data or specifications provided by the user, the user is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the components or systems.

Offer of Sale

Please contact your Parker representation for a detailed "Offer of Sale".

Parker Hannifin
Pump & Motor Division Europe
Vierzon - France

Parker Worldwide

Europe, Middle East, Africa

AE – United Arab Emirates, Dubai
Tel: +971 4 8127100
parker.me@parker.com

AT – Austria, St. Florian
Tel: +43 (0)7224 66201
parker.austria@parker.com

AZ – Azerbaijan, Baku
Tel: +994 50 2233 458
parker.azerbaijan@parker.com

BE/NL/LU – Benelux,
Hendrik Ido Ambacht
Tel: +31 (0)541 585 000
parker.nl@parker.com

BG – Bulgaria, Sofia
Tel: +359 2 980 1344
parker.bulgaria@parker.com

BY – Belarus, Minsk
Tel: +48 (0)22 573 24 00
parker.poland@parker.com

CH – Switzerland, Etoy
Tel: +41 (0)21 821 87 00
parker.switzerland@parker.com

CZ – Czech Republic, Klecany
Tel: +420 284 083 111
parker.czechrepublic@parker.com

DE – Germany, Kaarst
Tel: +49 (0)2131 4016 0
parker.germany@parker.com

DK – Denmark, Ballerup
Tel: +45 43 56 04 00
parker.denmark@parker.com

ES – Spain, Madrid
Tel: +34 902 330 001
parker.spain@parker.com

FI – Finland, Vantaa
Tel: +358 (0)20 753 2500
parker.finland@parker.com

FR – France, Contamine s/Arve
Tel: +33 (0)4 50 25 80 25
parker.france@parker.com

GR – Greece, Piraeus
Tel: +30 210 933 6450
parker.greece@parker.com

HU – Hungary, Budaörs
Tel: +36 23 885 470
parker.hungary@parker.com

IE – Ireland, Dublin
Tel: +353 (0)1 466 6370
parker.ireland@parker.com

IL – Israel
Tel: +39 02 45 19 21
parker.israel@parker.com

IT – Italy, Corsico (MI)
Tel: +39 02 45 19 21
parker.italy@parker.com

KZ – Kazakhstan, Almaty
Tel: +7 7273 561 000
parker.easteurope@parker.com

NO – Norway, Asker
Tel: +47 66 75 34 00
parker.norway@parker.com

PL – Poland, Warsaw
Tel: +48 (0)22 573 24 00
parker.poland@parker.com

PT – Portugal
Tel: +351 22 999 7360
parker.portugal@parker.com

RO – Romania, Bucharest
Tel: +40 21 252 1382
parker.romania@parker.com

RU – Russia, Moscow
Tel: +7 495 645-2156
parker.russia@parker.com

SE – Sweden, Borås
Tel: +46 (0)8 59 79 50 00
parker.sweden@parker.com

SK – Slovakia, Banská Bystrica
Tel: +421 484 162 252
parker.slovakia@parker.com

SL – Slovenia, Novo Mesto
Tel: +386 7 337 6650
parker.slovenia@parker.com

TR – Turkey, Istanbul
Tel: +90 216 4997081
parker.turkey@parker.com

UA – Ukraine, Kiev
Tel: +48 (0)22 573 24 00
parker.poland@parker.com

UK – United Kingdom, Warwick
Tel: +44 (0)1926 317 878
parker.uk@parker.com

ZA – South Africa, Kempton Park
Tel: +27 (0)11 961 0700
parker.southafrica@parker.com

North America

CA – Canada, Milton, Ontario
Tel: +1 905 693 3000

US – USA, Cleveland
Tel: +1 216 896 3000

Asia Pacific

AU – Australia, Castle Hill
Tel: +61 (0)2-9634 7777

CN – China, Shanghai
Tel: +86 21 2899 5000

HK – Hong Kong
Tel: +852 2428 8008

IN – India, Mumbai
Tel: +91 22 6513 7081-85

JP – Japan, Tokyo
Tel: +81 (0)3 6408 3901

KR – South Korea, Seoul
Tel: +82 2 559 0400

MY – Malaysia, Shah Alam
Tel: +60 3 7849 0800

NZ – New Zealand, Mt Wellington
Tel: +64 9 574 1744

SG – Singapore
Tel: +65 6887 6300

TH – Thailand, Bangkok
Tel: +662 186 7000

TW – Taiwan, Taipei
Tel: +886 2 2298 8987

South America

AR – Argentina, Buenos Aires
Tel: +54 3327 44 4129

BR – Brazil, Sao Jose dos Campos
Tel: +55 800 727 5374

CL – Chile, Santiago
Tel: +56 2 623 1216

MX – Mexico, Toluca
Tel: +52 72 2275 4200

European Product Information Centre
Free phone: 00 800 27 27 5374
(from AT, BE, CH, CZ, DE, DK, EE, ES, FI,
FR, IE, IL, IS, IT, LU, MT, NL, NO, PL, PT, RU,
SE, SK, UK, ZA)

Parker Hannifin Ltd.
Tachbrook Park Drive
Tachbrook Park, Warwick CV34 6TU
United Kingdom
Tel.: +44 (0) 1926 317 878
Fax: +44 (0) 1926 317 855
www.parker.com

Your local authorized Parker distributor