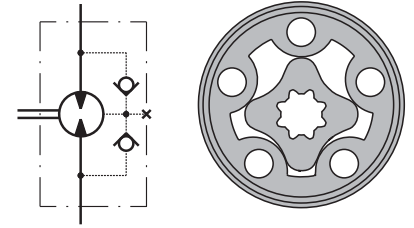


HYDRAULIC MOTORS MM



APPLICATION

- » Conveyors
- » Textile machines
- » Mining machinery
- » Machine tools
- » Ventilators
- » Construction plant equipment and access platforms etc.



CONTENTS

Specification data	5
Function diagrams	6÷8
Dimensions and mounting ...	9÷10
Shaft extensions	11
Permissible shaft loads	11
Order code	12

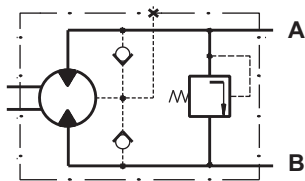
OPTIONS

- » Model - Spool valve, gerotor
- » With or without flange
- » Side and rear ports
- » Series with pressure valve(s)
- » Shafts - straight and splined
- » Metric and BSPP ports
- » Speed sensing;
- » Other special features

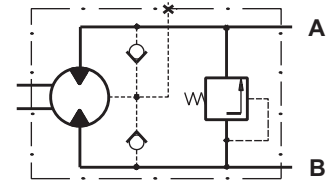
GENERAL

Max. Displacement, cm ³ /rev [in ³ /rev]	50 [3.05]	
Max. Speed, [RPM]	2440	
Max. Torque, daNm [lb-in]	cont.: 4,5 [398]	int.: 5,8 [513]
Max. Output, kW [HP]	3,2 [4.3]	
Max. Pressure Drop, bar [PSI]	cont.: 105 [1500]	int.: 140 [2030]
Max. Oil Flow, lpm [GPM]	25 [6.6]	
Min. Speed, [RPM]	20	
Pressure fluid	Mineral based- HLP(DIN 51524) or HM(ISO 6743/4)	
Temperature range, °C [°F]	-40÷140 [-40÷284]	
Optimal Viscosity range, mm ² /s [SUS]	20÷75 [98÷347]	
Filtration	ISO code 20/16 (Min. recommended fluid filtration of 25 microns)	

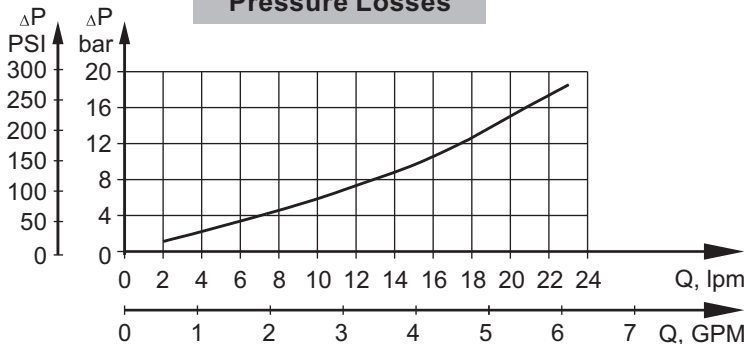
MMP Series with Integrated Internal Crossover Relief Valve
A → B, Δp=100 or 50 bar [1450 or 725 PSI]



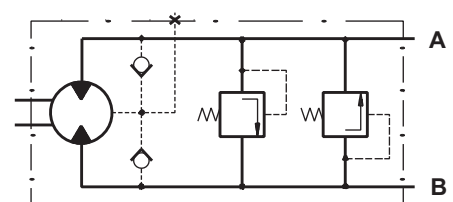
MMP Series with Integrated Internal Crossover Relief Valve
B → A, Δp=100 or 50 bar [1450 or 725 PSI]



Pressure Losses



MMD Series with Integrated Internal Crossover Relief Valves
A ↔ B, Δp=100 or 50 bar [1450 or 725 PSI]



SPECIFICATION DATA

Type		MM 8	MM 12.5	MM 20	MM 32	MM 40	MM 50
Displacement, cm³/rev [in³/rev]		8,2 [50]	12,5 [77]	19,9 [1.22]	31,6 [1.93]	39,8 [2.43]	50 [3.08]
Max. Speed, [RPM]	Cont.	1950	1550	1000	630	500	400
	Int.*	2450	1940	1250	800	630	500
Max. Torque daNm [lb-in]	Cont.	1,1 [95]	1,6 [140]	2,5 [220]	4,0 [350]	4,5 [400]	4,6 [410]
	Int.*	1,5 [135]	2,3 [200]	3,5 [310]	5,7 [500]	7,0 [620]	8,8 [780]
	Peak**	2,1 [187]	3,3 [293]	5,1 [453]	6,4 [568]	8,2 [725]	10,0 [885]
Max. Output kW [HP]	Cont.	1,8 [2.4]	2,4 [3.2]	2,4 [3.2]	2,4 [3.2]	2,2 [3.0]	1,8 [2.4]
	Int.*	2,6 [3.5]	3,2 [4.3]	3,2 [4.3]	3,2 [4.3]	3,2 [4.3]	3,2 [4.3]
Max. Pressure Drop bar [PSI]	Cont.	100 [1450]	100 [1450]	100 [1450]	100 [1450]	90 [1310]	70 [1020]
	Int.*	140 [2030]	140 [2030]	140 [2030]	140 [2030]	140 [2030]	140 [2030]
	Peak**	200 [2900]	200 [2900]	200 [2900]	160 [2320]	160 [2320]	160 [2320]
Max. Oil Flow lpm [GPM]	Cont.	16 [4.2]	20 [5.3]	20 [5.3]	20 [5.3]	20 [5.3]	20 [5.3]
	Int.*	20 [5.3]	25 [6.6]	25 [6.6]	25 [6.6]	25 [6.6]	25 [6.6]
Max. Inlet Pressure bar [PSI]	Cont.	140 [2030]	140 [2030]	140 [2030]	140 [2030]	140 [2030]	140 [2030]
	Int.*	175 [2540]	175 [2540]	175 [2540]	175 [2540]	175 [2540]	175 [2540]
	Peak**	225 [3260]	225 [3260]	225 [3260]	225 [3260]	225 [3260]	225 [3260]
Max. Return Pressure without Drain Line or Max. Pressure in Drain Line, bar [PSI]	Cont. 0-100 RPM	140 [2030]	140 [2030]	140 [2030]	140 [2030]	140 [2030]	140 [2030]
	Cont. 100-400 RPM	105 [1500]	105 [1500]	105 [1500]	105 [1500]	105 [1500]	105 [1500]
	Cont. 400-800 RPM	50 [725]	50 [725]	50 [725]	50 [725]	50 [725]	50 [725]
	Cont. >800 RPM	20 [290]	20 [290]	20 [290]	-	-	-
Int.* 0-max. RPM	140 [2030]	140 [2030]	140 [2030]	140 [2030]	140 [2030]	140 [2030]	
Max. Return Pressure with Drain Line bar [PSI]	Cont.	140 [2030]	140 [2030]	140 [2030]	140 [2030]	140 [2030]	140 [2030]
	Int.*	175 [2540]	175 [2540]	175 [2540]	175 [2540]	175 [2540]	175 [2540]
	Peak**	225 [3260]	225 [3260]	225 [3260]	225 [3260]	225 [3260]	225 [3260]
Max. Starting Pressure with Unloaded Shaft, bar [PSI]		4 [60]	4 [60]	4 [60]	4 [60]	4 [60]	4 [60]
Min. Starting Torque daNm [lb-in]	At max. press. drop Cont.	0,7 [60]	1,2 [105]	2,1 [185]	3,4 [300]	3,8 [335]	4,1 [365]
	At max. press. drop Int.*	1,0 [90]	1,7 [150]	2,9 [255]	4,8 [425]	6,2 [550]	7,9 [700]
Min. Speed***, [RPM]		50	40	30	30	25	20
Weight, kg [lb] For "F" flange: + 0,200 [.441]	MM	1,9 [4.2]	2,0 [4.41]	2,1 [4.63]	2,2 [4.85]	2,3 [5.07]	2,5 [5.51]
	MMF(S)	2,0 [4.41]	2,1 [4.63]	2,2 [4.85]	2,3 [5.07]	2,4 [5.29]	2,6 [5.73]
	MMP	2,2 [4.85]	2,3 [5.07]	2,4 [5.29]	2,5 [5.51]	2,6 [5.73]	2,8 [6.17]
	MMD	2,6 [5.73]	2,7 [5.95]	2,8 [6.17]	2,9 [6.39]	3,0 [6.61]	3,2 [7.05]

* Intermittent operation: the permissible values may occur for max. 10% of every minute.

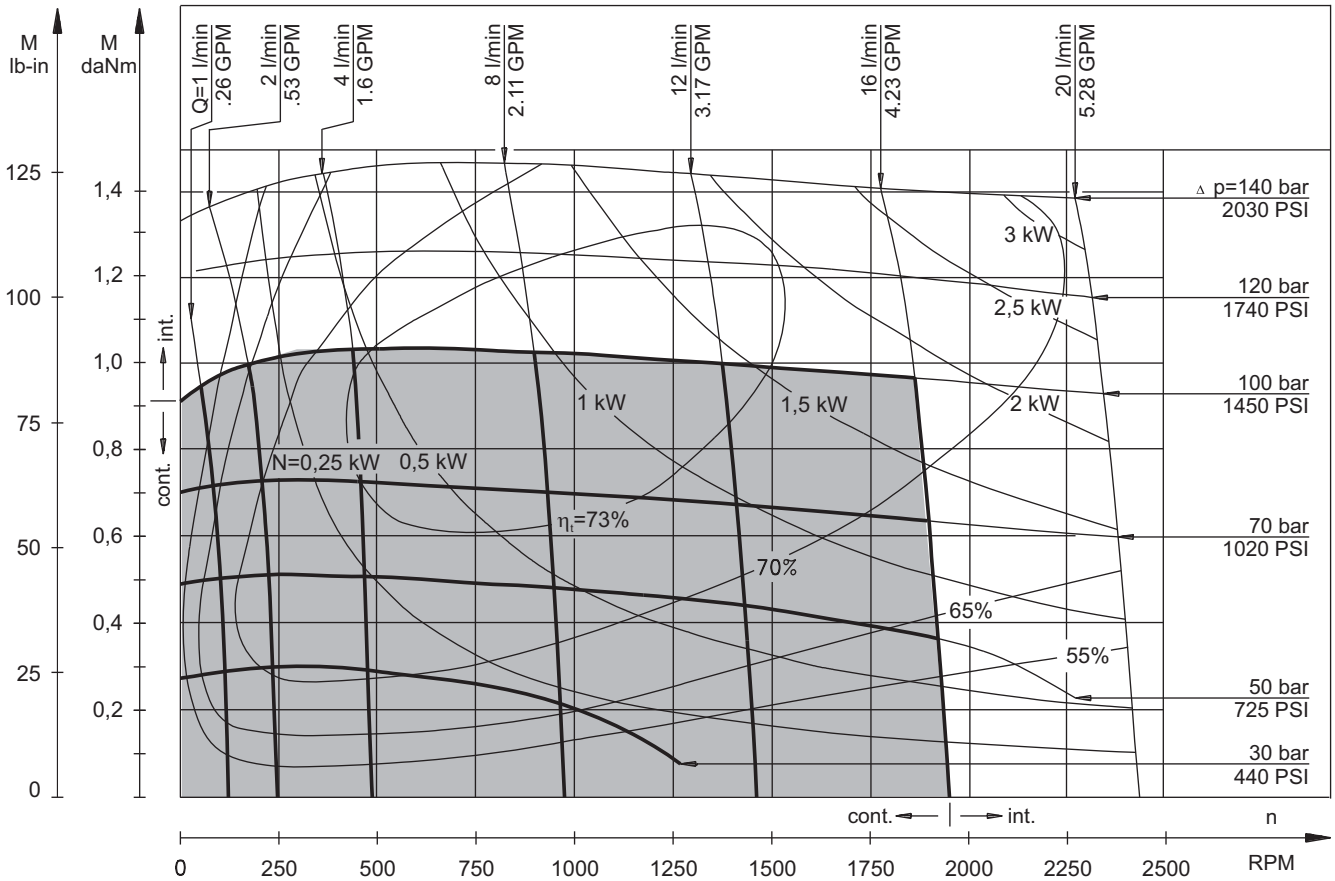
** Peak load: the permissible values may occur for max. 1% of every minute.

*** For speeds lower than given, consult factory or your regional manager.

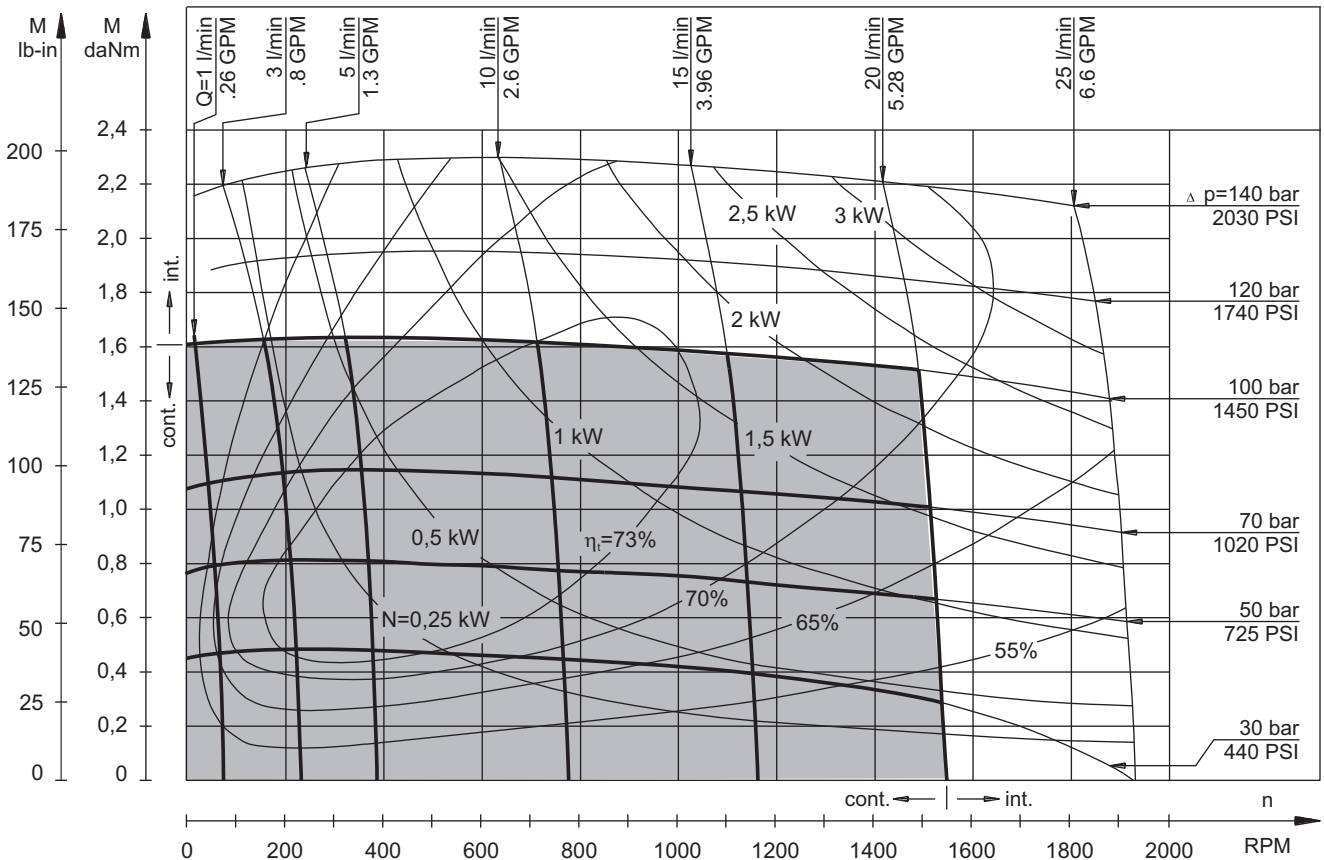
- Intermittent speed and intermittent pressure must not occur simultaneously.
- Recommended filtration is per ISO cleanliness code 20/16. A nominal filtration of 25 micron or better.
- Recommend using a premium quality, anti-wear type mineral based hydraulic oil HLP(DIN51524) or HM (ISO 6743/4).
If using synthetic fluids consult the factory for alternative seal materials.
- Recommended minimum oil viscosity 13 mm²/s [70 SUS] at 50°C [122°F].
- Recommended maximum system operating temperature is 82°C [180°F].
- To assure optimum motor life fill with fluid prior to loading and run at moderate load and speed for 10-15 minutes.

FUNCTION DIAGRAMS

MM 8



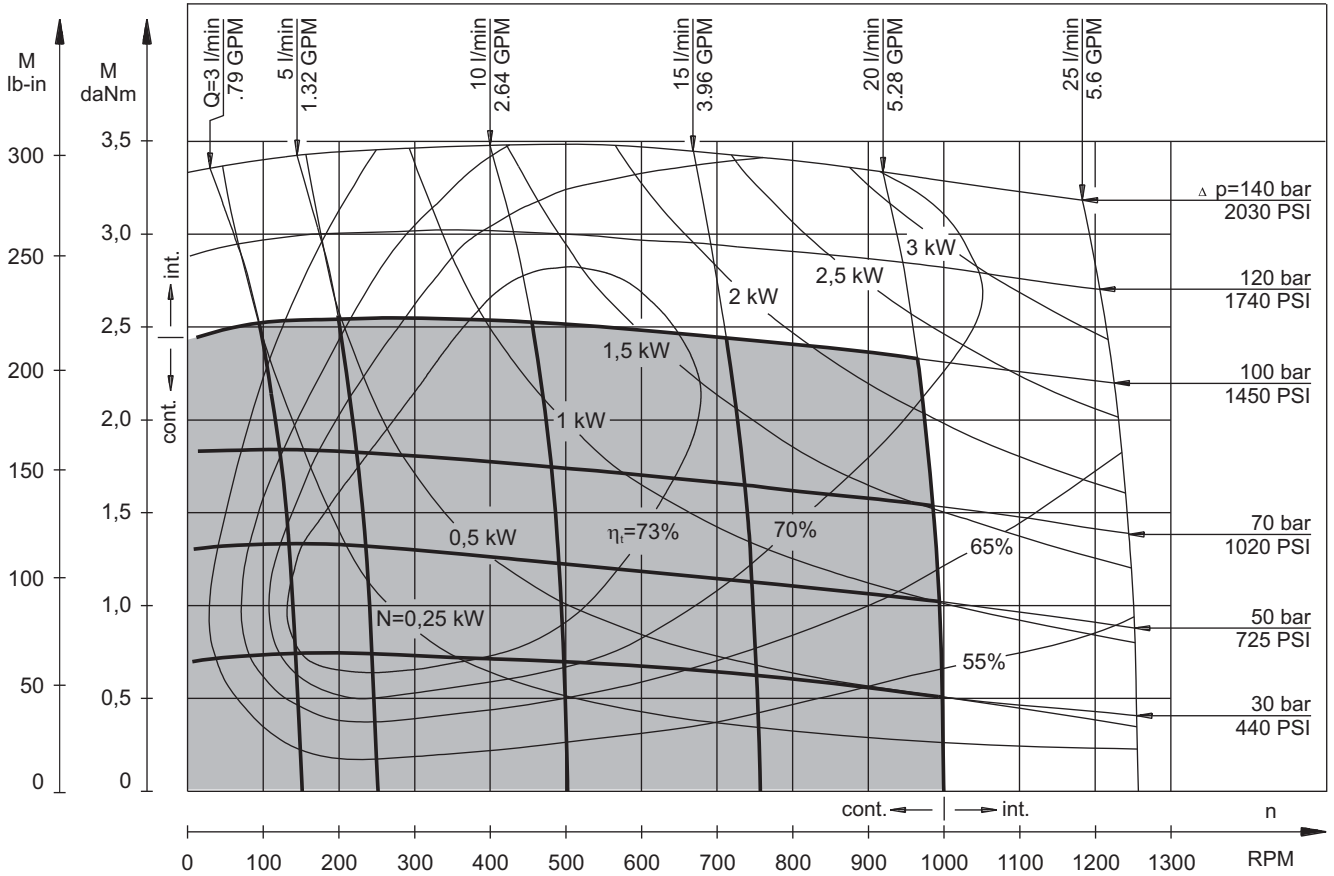
MM 12,5



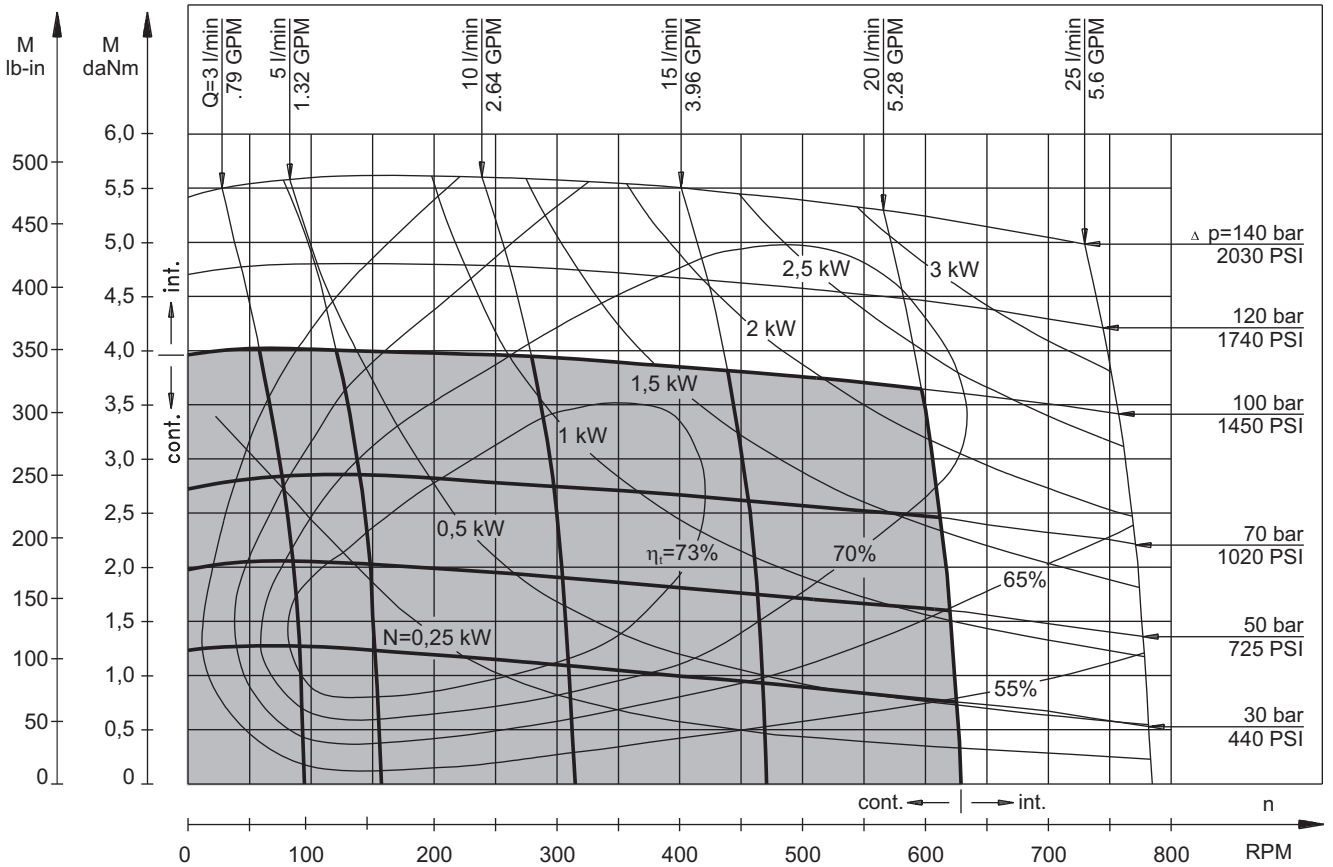
The function diagrams data is for average performance of randomly selected motors at back pressure 5÷10 bar [72.5÷145 PSI] and oil with viscosity of 32 mm²/s [150 SUS] at 50°C [122°F].

FUNCTION DIAGRAMS

MM 20



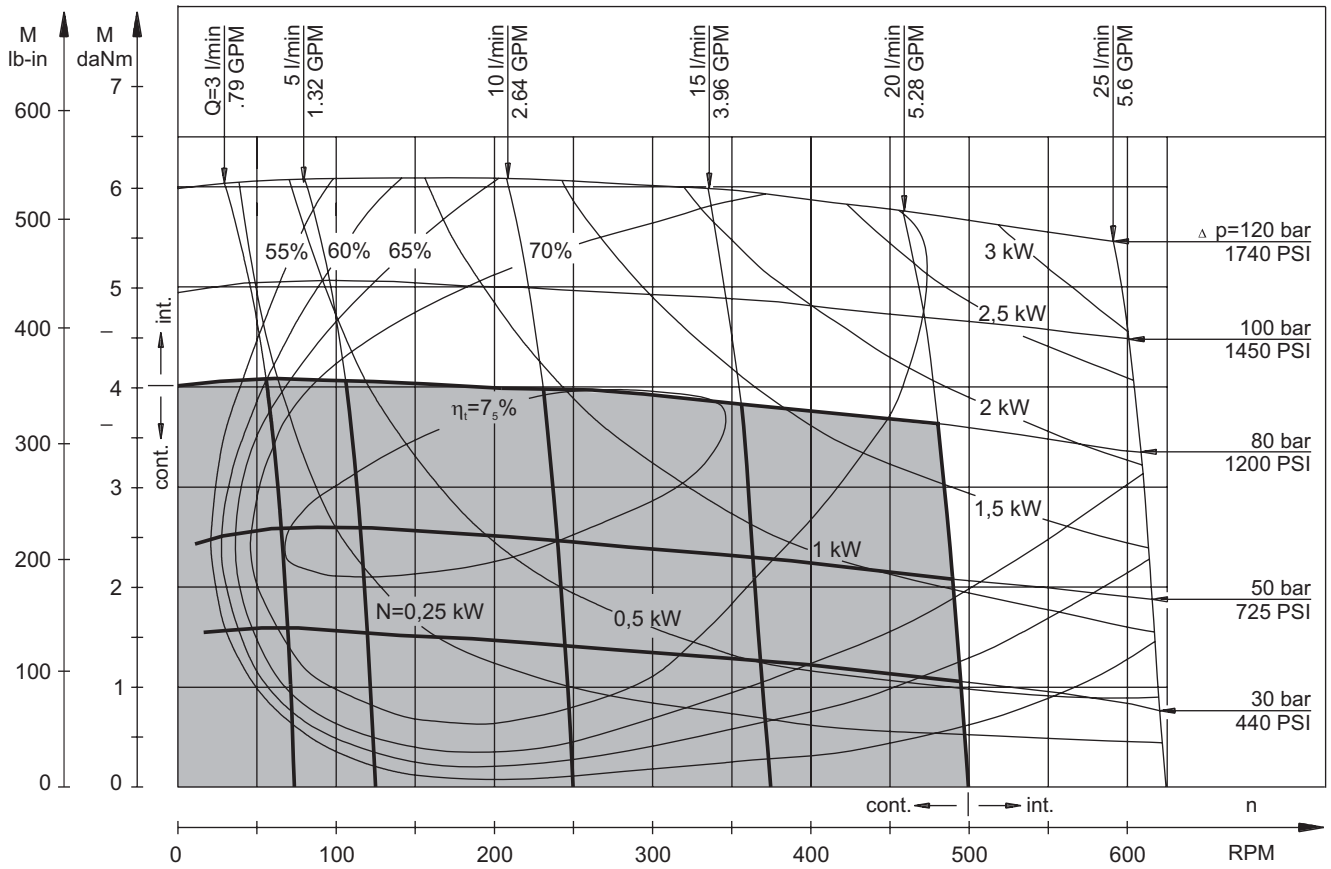
MM 32



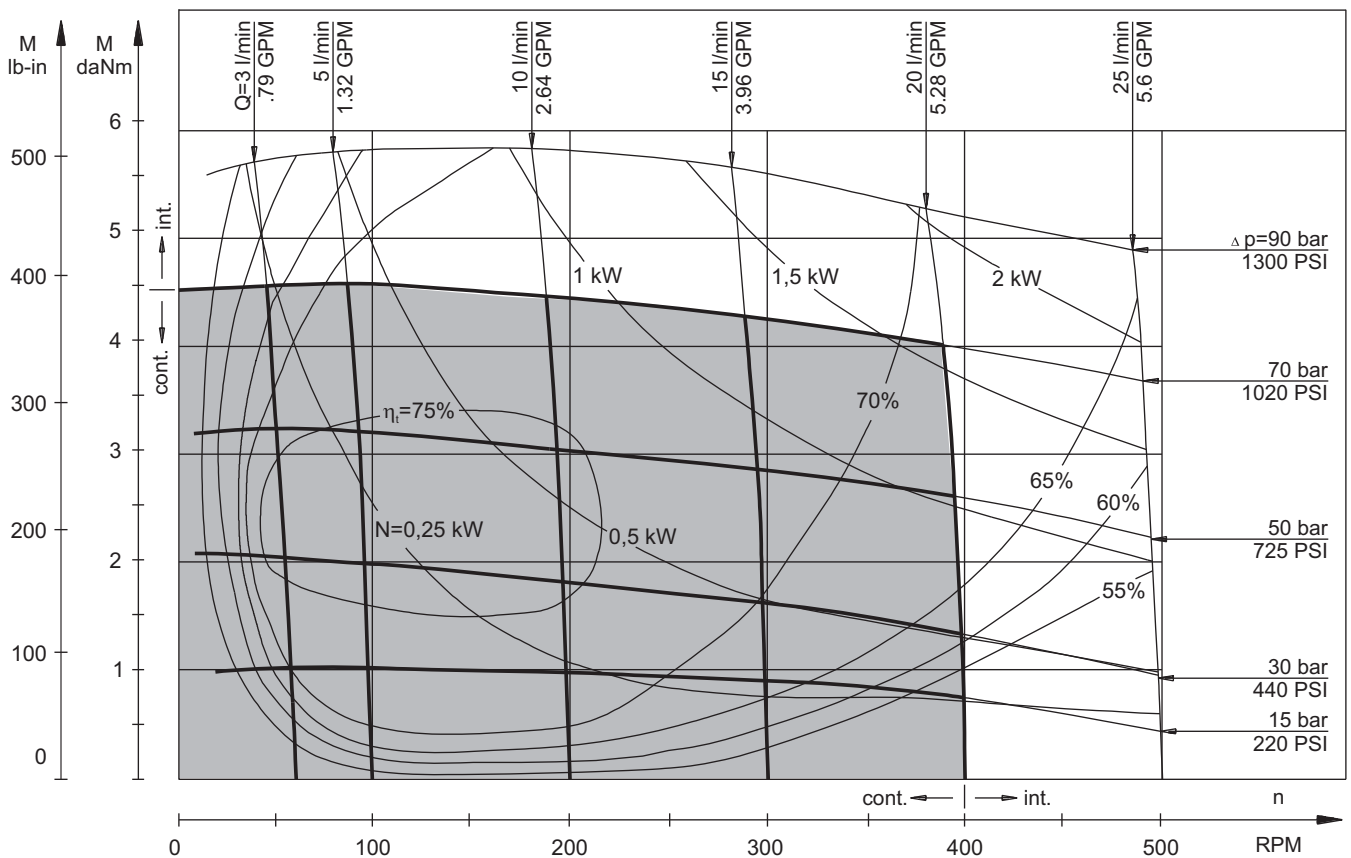
The function diagrams data is for average performance of randomly selected motors at back pressure 5÷10 bar [72.5÷145 PSI] and oil with viscosity of 32 mm²/s [150 SUS] at 50°C [122°F].

FUNCTION DIAGRAMS

MM 40



MM 50

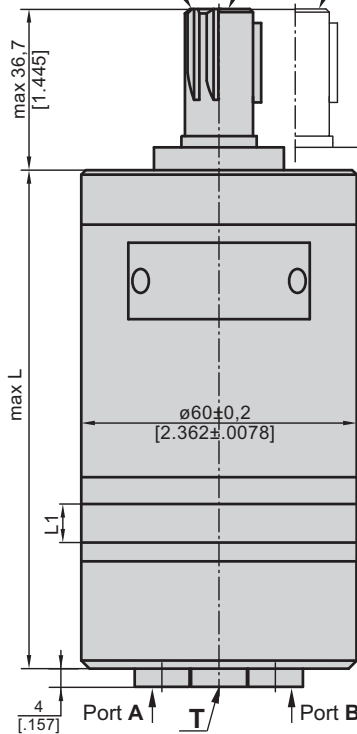


The function diagrams data is for average performance of randomly selected motors at back pressure 5÷10 bar [72.5÷145 PSI] and oil with viscosity of 32 mm²/s [150 SUS] at 50°C [122°F].

DIMENSIONS AND MOUNTING DATA
MM, MMS, MMP, MMD

Three Bolts Mount

SH Shaft C Shaft CK Shaft



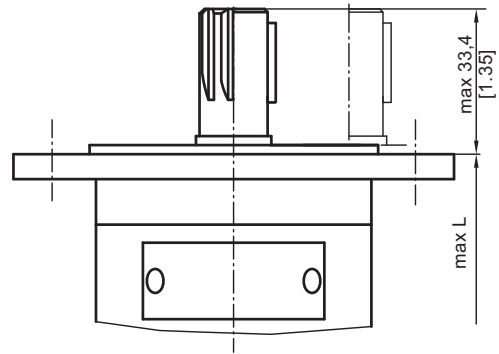
Rear Ports

Shaft Dim.
See Page 11

Flange Dim.
See Page 10

Port Dim.
See Page 10

F Oval Mount (2 Holes)



Standard Rotation

Viewed from Shaft End

Port A Pressurized - **CW**

Port B Pressurized - **CCW**

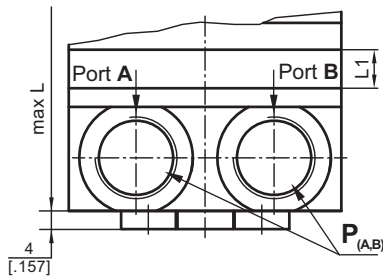
Reverse Rotation

Viewed from Shaft End

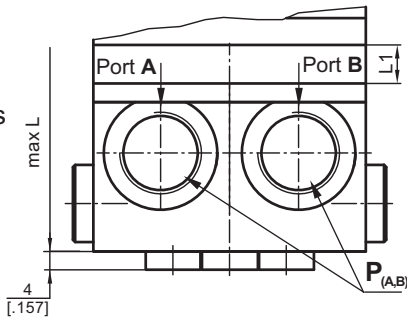
Port A Pressurized - **CCW**

Port B Pressurized - **CW**

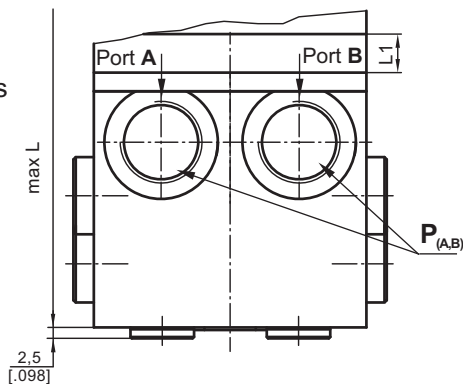
S Side Ports



P Side Ports



D Side Ports



$P_{(A,B)}$: 2xG3/8 or 2xM18x1,5 - 12 mm [.47 in] depth

T : G1/8 or M10x1 - 10 mm [.39 in] depth

Type	L,mm [in.]	Type	L,mm [in.]	L ₁ ,mm [in.]
MM 8	104 [4.094]	MMS 8	105 [4.134]	3,5 [.138]
MM 12,5	106 [4.173]	MMS 12,5	107 [4.213]	5,5 [.217]
MM 20	109 [4.291]	MMS 20	110 [4.331]	8,5 [.335]
MM 32	114 [4.488]	MMS 32	115 [4.528]	13,5 [.531]
MM 40	117,5 [4.626]	MMS 40	118,5 [4.665]	17 [.669]
MM 50	121,5 [4.783]	MMS 50	122,5 [4.823]	21 [.827]

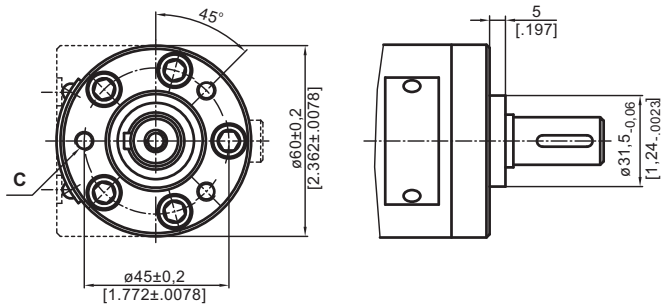
Type	L,mm [in.]	Type	L,mm [in.]	L ₁ ,mm [in.]
MMP 8	115 [4.528]	MMD 8	134 [5.276]	3,5 [.138]
MMP 12,5	117 [4.606]	MMD 12,5	136 [5.354]	5,5 [.217]
MMP 20	120 [4.724]	MMD 20	139 [5.472]	8,5 [.335]
MMP 32	125 [4.921]	MMD 32	144 [5.669]	13,5 [.531]
MMP 40	128,5 [5.039]	MMD 40	147,5 [5.807]	17 [.669]
MMP 50	132,5 [5.217]	MMD 50	151,5 [5.965]	21 [.827]

For "F" Flange +3,5 mm

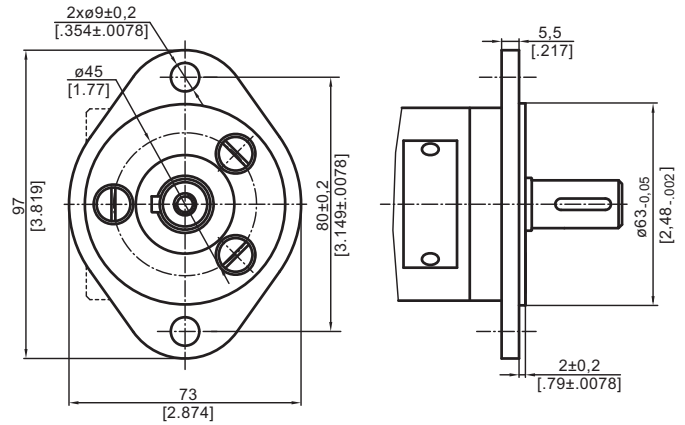


MOUNTING

Three Bolts Mount

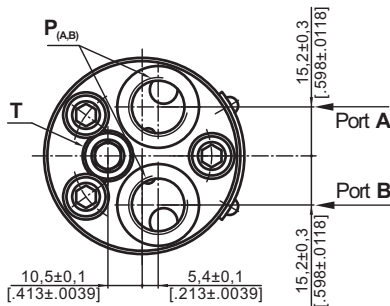


F Oval Mount (2 Holes)

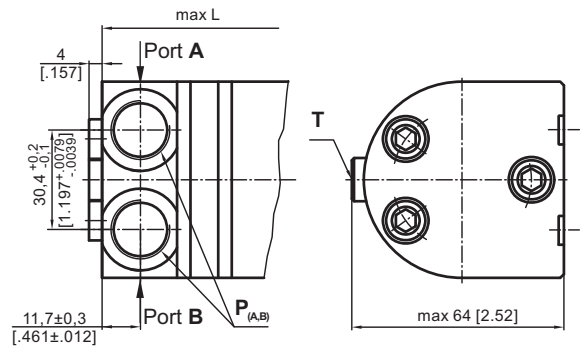


PORTS

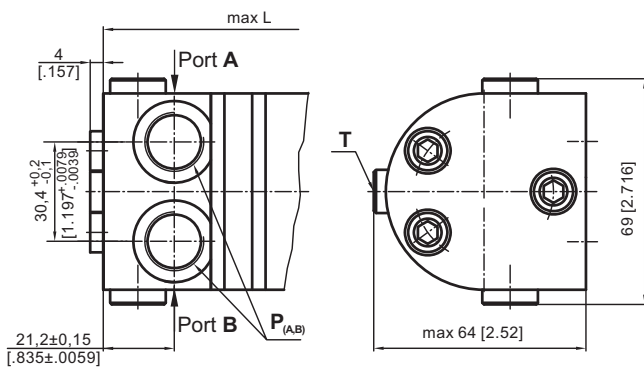
Rear Ports



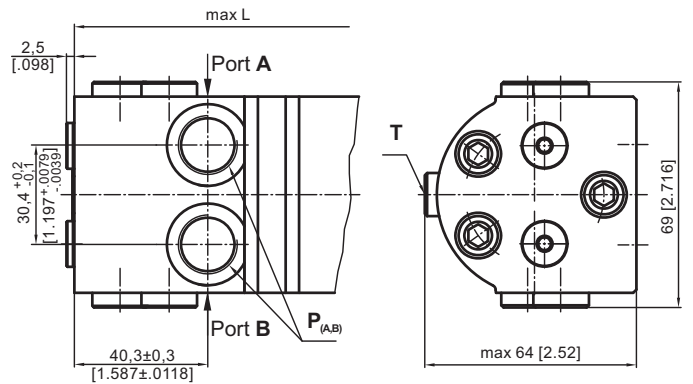
S Side Ports



P Side Ports with Single Crossover Relief Valve



D Side Ports with Dual Crossover Relief Valve



Standard Rotation
Viewed from Shaft End
Port A Pressurized - CW
Port B Pressurized - CCW

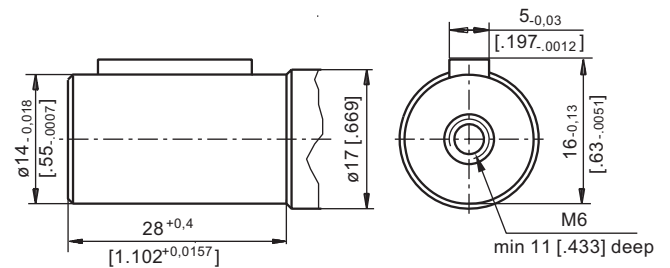
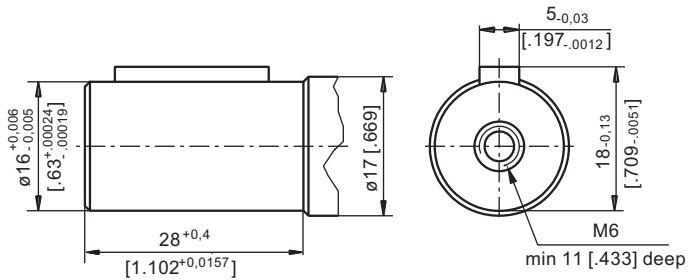
Reverse Rotation
Viewed from Shaft End
Port A Pressurized - CCW
Port B Pressurized - CW

C : 3xM6 - 12 mm [.47 in] depth
P_(A,B) : 2xG3/8 or 2xM18x1,5 - 12 mm [.47 in] depth
T : G1/8 or M10x1 - 10 mm [.39 in] depth

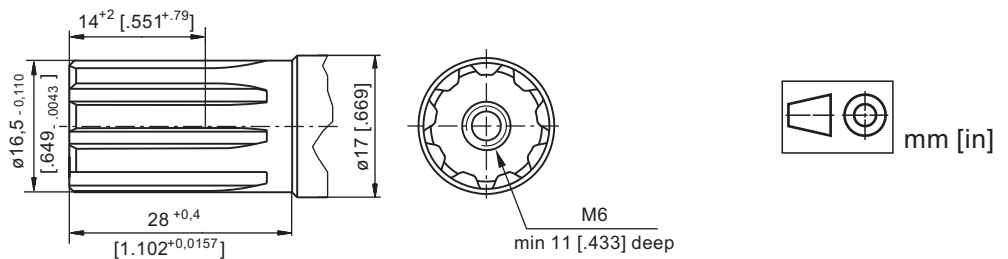
SHAFT EXTENSIONS

C - $\varnothing 16$ straight, Parallel key 5x5x16 DIN 6885
Max. Torque 3,9 daNm [345 lb-in]

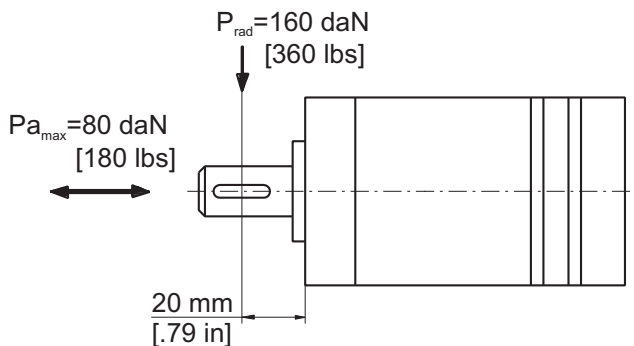
CK - $\varnothing 14$ straight, Parallel key 5x5x16 DIN 6885
Max. Torque 3 daNm [265 lb-in]



SH - $\varnothing 16,5$ Splined, B17x14 DIN 5482
Max. Torque 4,4 daNm [390 lb-in]



PERMISSIBLE SHAFT LOAD



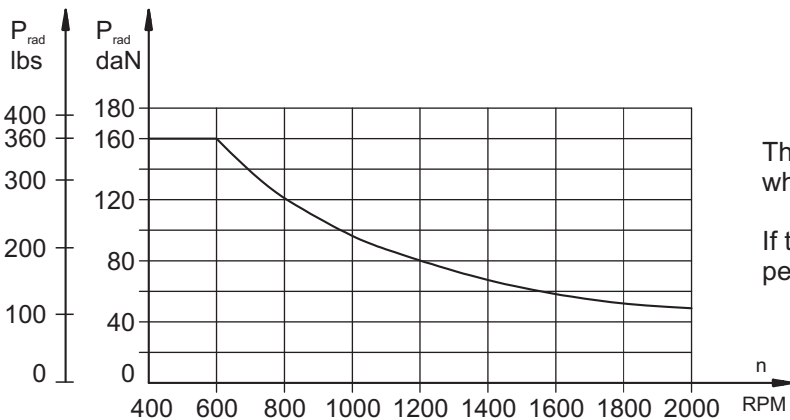
The permissible radial shaft load [Prad] is calculated from the distance [L] between the point of load application and the mounting surface:

$$P_{rad} = \frac{600}{n} \times \frac{13040}{61,5+L}, \text{ [daN]}$$

[L in mm; L ≤ 80 mm]

$$P_{rad} = \frac{600}{n} \times \frac{1155}{2,42+L}, \text{ [lbs]}$$

[L in inch; L ≤ 3.15 in]



The drawing shows the permissible radial load when L=20 mm [.79 in].

If the calculated shaft load exceeds the permissible, a flexible coupling must be used.

ORDER CODE

	1	2	3	4	5	6	7	8	9	10
M M										

Pos.1 - Adjustment Option

- omit - without valve
- P*** - Side ports with single crossover relief valve
- D*** - Side ports with dual crossover relief valve

Pos.2 - Mounting Flange

- omit - Three bolts mount
- F** - Oval mount, two holes

Pos.3 - Port type (not valid for P and D version)

- omit - Rear ports
- S** - Side ports

Pos.4 - Displacement code

- 8** - 8,2 cm³/rev [.5 in³/rev]
- 12.5** - 12,9 cm³/rev [.79 in³/rev]
- 20** - 20,0 cm³/rev [1.22 in³/rev]
- 32** - 31,8 cm³/rev [1.93 in³/rev]
- 40** - 40,0 cm³/rev [2.44 in³/rev]
- 50** - 50,0 cm³/rev [3.05 in³/rev]

Pos. 5 - Shaft Extensions*

- C** - ø16 straight, Parallel key A5x5x16 DIN6885
- VC** - ø16 straight, Parallel key A5x5x16 DIN6885 with corrosion resistant bushing
- CK** - ø14 straight, Parallel key 5x5x16 DIN6885
- SH** - ø16,5 splined, B17x14 DIN 5482

Pos. 6 - Ports

- omit - BSPP (ISO 228)
- M** - Metric (ISO 262)

Pos. 7 - Line to control (see page 4)**

- /L** - B → A (left running)
- /R** - A → B (right running)

Pos. 8 - Valve Rated Pressure***

- /50** - Δp=50 bar [725 PSI]
- /80** - Δp=80 bar [1160 PSI]
- /100** - Δp=100 bar [1450 PSI]
- /140** - Δp=140 bar [2030 PSI]

Pos. 9 - Special Features (see page 119)

Pos.10 - Design Series

- omit - Factory specified

NOTES:

- * The permissible output torque for shafts must not be exceeded!
- ** For **P** option useful only.
- *** For **P** and **D** option useful only.

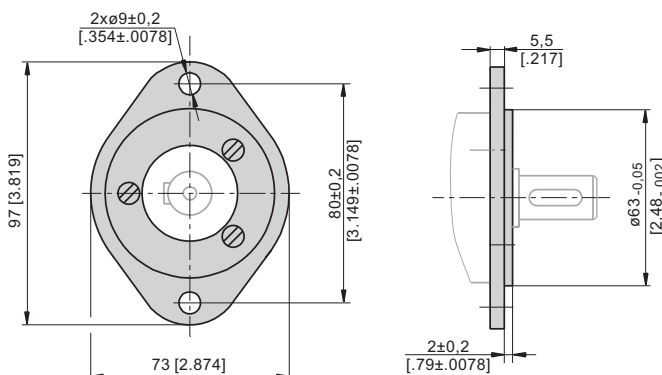
! **MMP** and **MMD** are available with new crossover relief valves with improved characteristics. The new valves allow easier pressure setting in a wider range: from 50 bar [725 PSI] to 140 bar [2030 PSI]. For more information about MMP and MMD - series 2 please contact with "M+S Hydraulic".

The Valve pressure setting must be at flow rate of 2 lpm [.53 GPM].

The hydraulic motors are mangan - phosphatized as standard.

F - FLANGE (2 Holes)

Order No for Flange:48443 014 00



F Flange is mounted to the motor with 3 screws - M6x14. Tightening Torque: 5-6 Nm [44-53 lb-in].

MOTOR SPECIAL FEATURES

Special Feature Description	Order Code	Motor type												
		MM	MP	MP(W)N, MRN	MPW	MR	MRB	SP, SR	PL, RL	PK, RK	PKQ	RW	MH	HW
Speed Sensor*	RS	O	O	-	-	O	-	-	-	-	-	-	O	-
Tacho connection	T	-	-	-	-	O	-	-	-	-	-	-	O	-
Low Leakage	LL	O	O	-	O	O	-	-	O	O	O	O	O	O
Low Speed Valving	LSV	-	-	-	O	O	-	-	-	-	O	O	O	O
Free Running	FR	O	O	-	-	O	-	-	O	O	-	O	O	O
Reverse Rotation	R	O	O	O	O	O	O	O	O	O	O	O	O	O
Paint**	P	O	O	O	O	O	O	O	O	O	O	O	O	O
Corrosion Protected Paint**	PC	O	O	O	O	O	O	O	O	O	O	O	O	O
Special Paint***	PS	O	O	O	O	O	O	-	O	O	O	O	O	O
	PCS	O	O	O	O	O	O	-	O	O	O	O	O	O
Check Valves		S	S****	S	S****	S****	S	S	S	S	S	S	S****	S

O	Optional
-	Not applicable
S	Standard

* For sensor ordering see pages 120÷121.

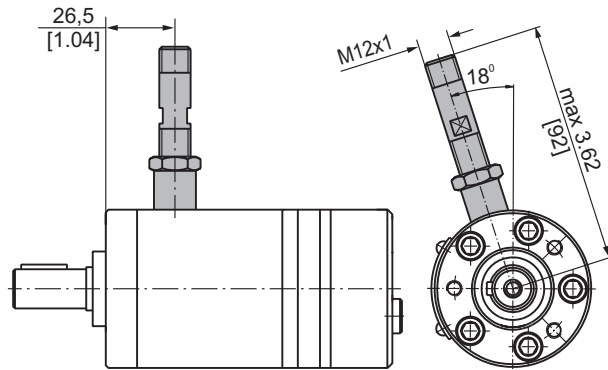
** Colour at customer's request.

*** Non painted feeding surfaces, colour at customer's request.

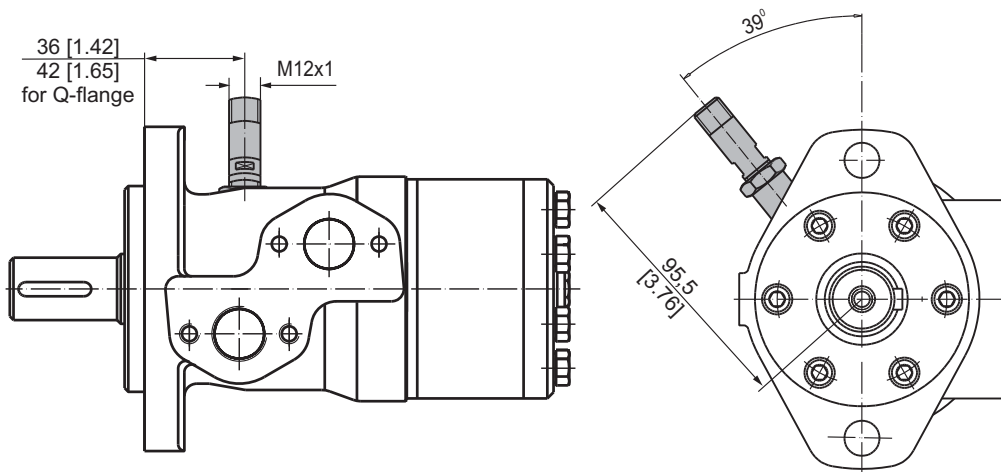
**** Without check valves for "U" shaft seal versions.

MOTORS WITH SPEED SENSOR

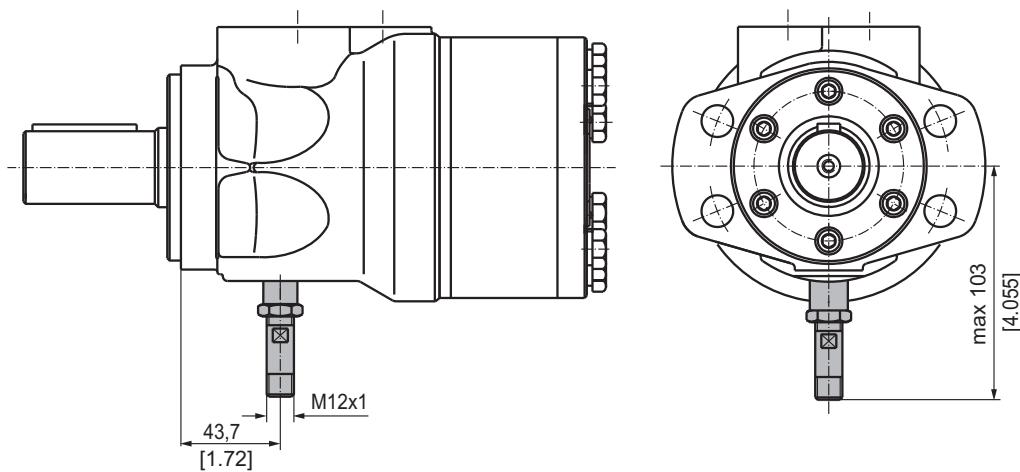
MM...RS



MP...RS and MR...RS



MH...RS

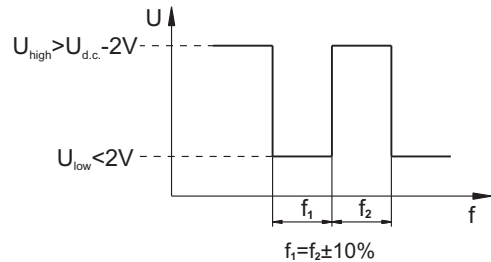


TECHNICAL DATA OF THE SPEED SENSOR

Technical data

Frequency range	0...15 000 Hz
Output	PNP, NPN
Power supply	10...36 VDC
Current input	20 mA (@24 VDC)
Ambient Temperature	-40...+125°C [-40...+257°F]
Protection	IP 67
Plug connector	M12-Series
Mounting principle	ISO 6149

Output signal

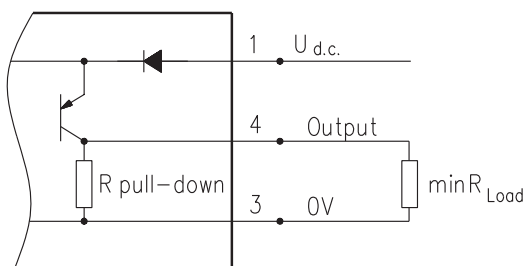


Load max.: $I_{high} = I_{low} < 50mA$

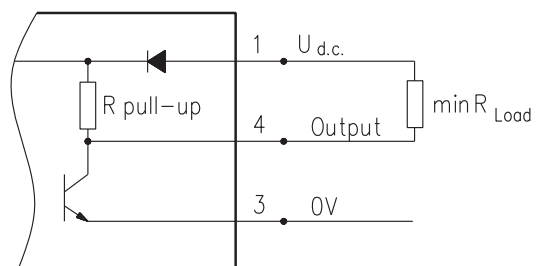
Motor type	MM	MP	MR	MH
Pulses per revolution	30	36	36	42

Wiring diagrams

PNP

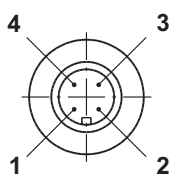


NPN



$$R_{Load} [k\Omega] = U_{d.c.} [V] / I_{max} [mA]$$

Stick type



Terminal No.	Connection	Cable Output
1	$U_{d.c.}$	Brown
2	No connection	White
3	0V	Blue
4	Output signal	Black

Order Code for Speed Sensor

Sensor Code	Output type	Electric connection
RSN	NPN	Connector BINDER 713 series
RSP	PNP	Connector BINDER 713 series
RSNL5	NPN	Cable output 3x0,25; 5 m [196 in] long
RSPL5	PNP	Cable output 3x0,25; 5 m [196 in] long

NOTE: *- The speed sensor is not fitted at the factory, but is supplied in a plastic bag with the motor. For installation see enclosed instructions.

APPLICATION CALCULATION

VEHICLE DRIVE CALCULATIONS

1. Motor speed: n, RPM

$$n = \frac{2,65 \times v_{km} \times i}{R_m} \quad n = \frac{168 \times v_{mi} \times i}{R_{in}}$$

v_{km} - vehicle speed, km/h;

v_{mi} - vehicle speed, mil/h;

R_m - wheel rolling radius, m;

R_{in} - wheel rolling radius, in;

i - gear ratio between motor and wheels.

If no gearbox, use $i=1$.

2. Rolling resistance: RR, daN [lbs]

The resistance force resulted in wheels contact with different surfaces:

$$RR = G \times \rho$$

G - total weight loaded on vehicle, daN [lbs];

ρ - rolling resistance coefficient (Table 1).

Table 1

Rolling resistance coefficient In case of rubber tire rolling on different surfaces	
Surface	ρ
Concrete- faultless	0.010
Concrete- good	0.015
Concrete- bad	0.020
Asphalt- faultless	0.012
Asphalt- good	0.017
Asphalt- bad	0.022
Macadam- faultless	0.015
Macadam- good	0.022
Macadam- bad	0.037
Snow- 5 cm	0.025
Snow- 10 cm	0.037
Polluted covering- smooth	0.025
Polluted covering- sandy	0.040
Mud	0.037÷0.150
Sand- Gravel	0.060÷0.150
Sand- loose	0.160÷0.300

3. Grade resistance: GR, daN [lbs]

$$GR = G \times (\sin \alpha + \rho \times \cos \alpha)$$

α - gradient negotiation angle (Table 2)

Table 2

Grade %	α Degrees	Grade %	α Degrees
1%	0° 35'	12%	6° 5'
2%	1° 9'	15%	8° 31'
5%	2° 51'	20%	11° 19'
6%	3° 26'	25%	14° 3'
8%	4° 35'	32%	18°
10%	5° 43'	60%	31°

4. Acceleration force: FA, daN [lbs]

Force FA necessary for acceleration from 0 to maximum speed v and time t can be calculated with a formula:

$$FA = \frac{v_{km} \times G}{3,6 \times t}, [daN] \quad FA = \frac{v_{mi} \times G}{22 \times t}, [lbs];$$

FA - acceleration force, daN [lbs];

t - time, [s].

5. Tractive effort: DP, daN [lbs]

Tractive effort DP is the additional force of trailer. This value will be established as follows:

-acc.to constructor's assessment;

-as calculating forces in items 2, 3 and 4 of trailer; the calculated sum corresponds to the tractive effort requested.

6. Total tractive effort: TE, daN [lbs]

Total tractive effort TE is total effort necessary for vehicle motion; that the sum of forces calculated in items from 2 to 5 and increased with 10 % because of air resistance.

$$TE = 1,1 \times (RR + GR + FA + DP)$$

RR - force acquired to overcome the rolling resistance;

GR - force acquired to slope upwards;

FA - force acquired to accelerate (acceleration force);

DP - additional tractive effort (trailer).

7. Motor Torque moment: M, daNm [in-lb]

Necessary torque moment for every hydraulic motor:

$$M = \frac{TE \times R_{in} [R_m]}{N \times i \times \eta_m}$$

N - motor numbers;

η_m - mechanical gear efficiency (if it is available).

8. Cohesion between tire and road covering: M_w , daNm [in-lb]

$$M_w = \frac{G_w \times f \times R_{in} [R_m]}{i \times \eta_m}$$

To avoid wheel slipping, the following condition should be observed $M_w > M$

f - frictional factor;

G_w - total weight over the wheels, daN [lbs].

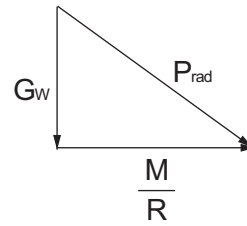
Table 3

Surface	Frictional factor f
Steel on steel	0.15 ÷ 0.20
Rubber tire on polluted surface	0.5 ÷ 0.7
Rubber tire on asphalt	0.8 ÷ 1.0
Rubber tire on concrete	0.8 ÷ 1.0
Rubber tire on grass	0.4

9.Radial motor loading: P_{rad} , daN [lbs]

When motor is used for vehicle motion with wheels mounted directly on motor shaft, the total radial loading of motor shaft P_{rad} is a sum of motion force and weight force acting on one wheel.

- G_w - Weight held by wheel;
- P_{rad} - Total radial loading of motor shaft;
- M/R - Motion force.



$$P_{rad} = \sqrt{G_w^2 + \left(\frac{M}{R}\right)^2}$$

In accordance with calculated loadings the suitable motor from the catalogue is selected.

DRAINAGE SPACE AND DRAINAGE PRESSURE

Advantages in oil drainage from drain space: Cleaning; Cooling and Seal lifetime prolonging.

