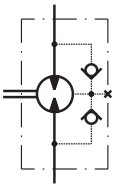
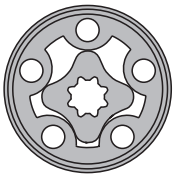
HYDRAULIC MOTORS MLHM

CONTENTS

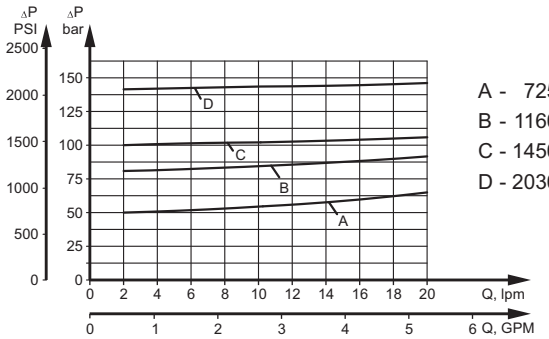




APPLICATION

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

Pressure Settings at Flow
Q=.53 GPM [2 lpm], 150 SUS [32 mm²/s], 122°F [50°C]

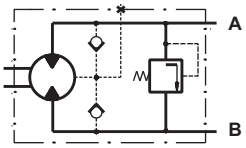


A - 725 PSI [50 bar]
B - 1160 PSI [80 bar]
C - 1450 PSI [100 bar]
D - 2030 PSI [140 bar]

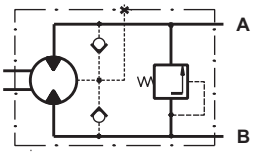
OPTIONS

» 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 sensoring;
» Other special features

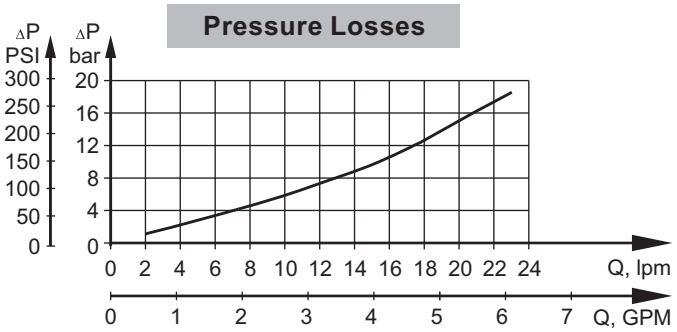
MLHMP Series with Integrated Internal Crossover Relief Valve
A⟶B,Δp=1450 or 725 PSI [100 or 50 bar]



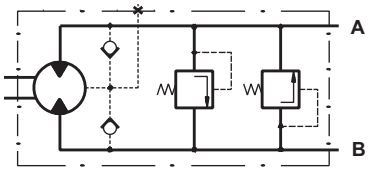
MLHMP Series with Integrated Internal Crossover Relief Valve
B⟶A,Δp=1450 or 725 PSI [100 or 50 bar]



Pressure Losses



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



GENERAL

Max. Displacement,	in³/rev [cm³/rev]	3.05 [50]
Max. Speed,	[RPM]	2440
Max. Torque,	lb-in [daNm]	cont.: 398 [4,5] int.: 513 [5,8]
Max. Output,	HP [kW]	4,3 [3,2]
Max. Pressure Drop,	PSI [bar]	cont.: 1500 [105] int.: 2030 [140]
Max. Oil Flow,	GPM [lpm]	6.6 [25]
Min. Speed,	[RPM]	20
Pressure fluid		Mineral based - HLP(DIN 51524) or HM(ISO 6743/4)
Temperature range,	°F [°C]	-40 ÷ 284 [-40 ÷ 140]
Optimal Viscosity range,	SUS [mm²/s]	98 ÷ 347 [20 ÷ 75]
Filtration		ISO code 20/16 (Min. recommended fluid filtration of 25 microns)

SPECIFICATION DATA

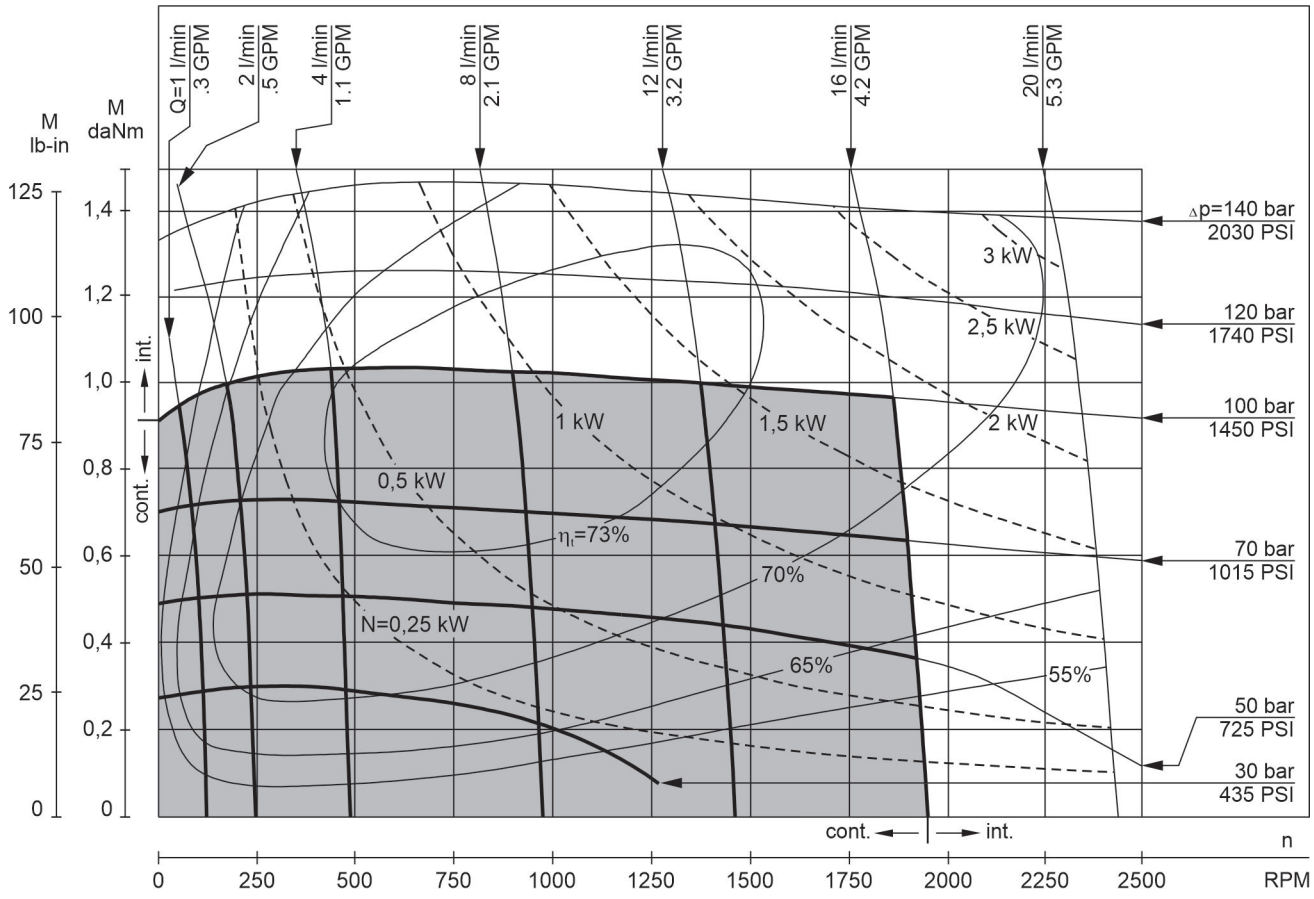
Type		MLHM 8	MLHM 12.5	MLHM 20	MLHM 32	MLHM 40	MLHM 50
Displacement, in^3/rev [cm^3/rev]		.50 [8,2]	.77 [12,5]	1.22 [19,9]	1.93 [31,6]	39,8 [39,8]	3.08 [50]
Max. Speed, [RPM]	Cont.	1950	1550	1000	630	500	400
	Int.*	2450	1940	1250	800	630	500
Max. Torque, lb-in [daNm]	Cont.	95 [1,1]	140 [1,6]	220 [2,5]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

* 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.

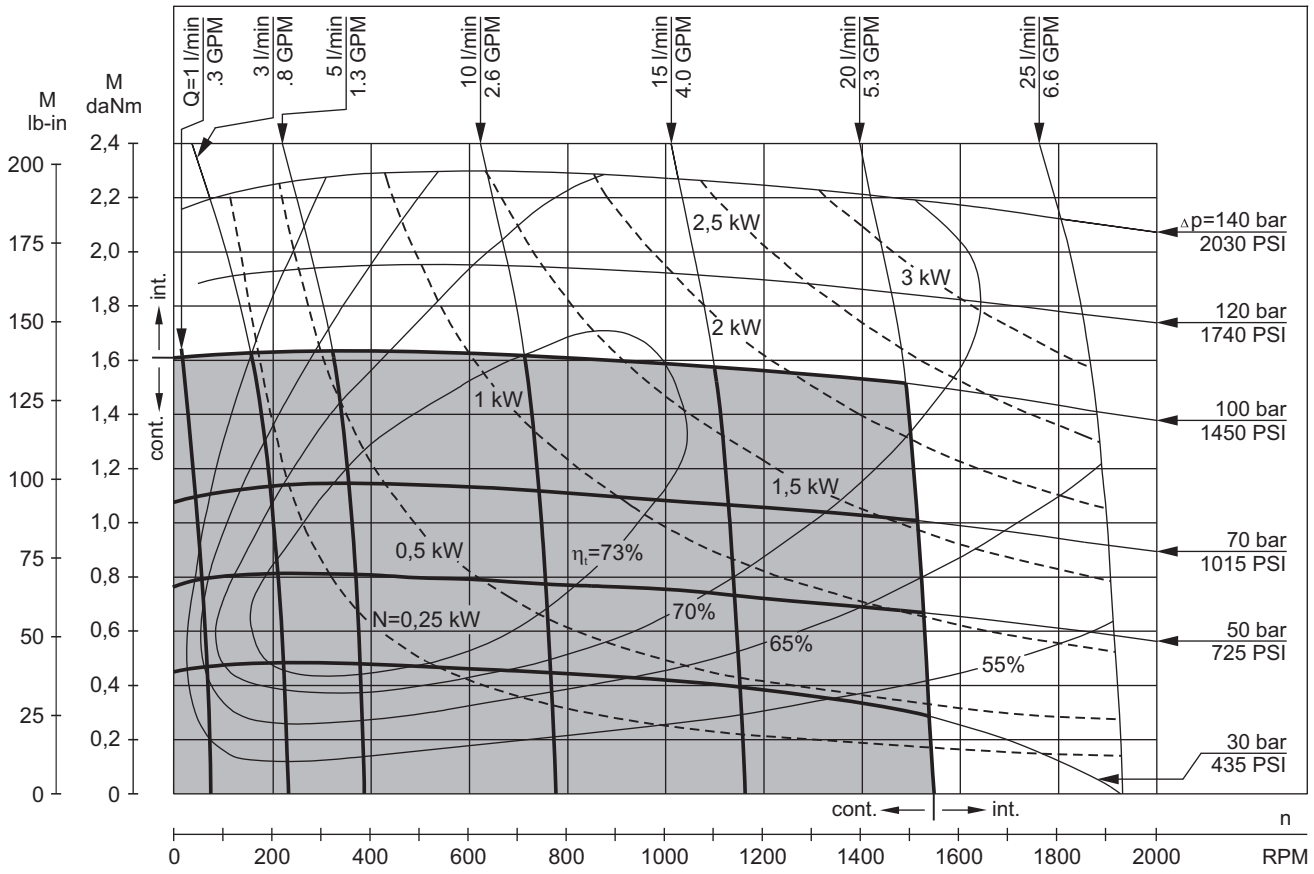
1. Intermittent speed and intermittent pressure must not occur simultaneously.
2. Recommended filtration is per ISO cleanliness code 20/16. A nominal filtration of 25 micron or better.
3. Recommend using a premium quality, anti-wear type mineral based hydraulic oil HLP (DIN51524) or HM (ISO 6743/4). If using synthetic fluids consult the factory for alternative seal materials.
4. Recommended minimum oil viscosity 70 SUS [13 mm^2/s] at 122°F [50°C].
5. Recommended maximum system operating temperature is 180°F [82°C].
6. To assure optimum motor life fill with fluid prior to loading and run at moderate load and speed for 10-15 minutes.

FUNCTION DIAGRAMS

MLHM 8



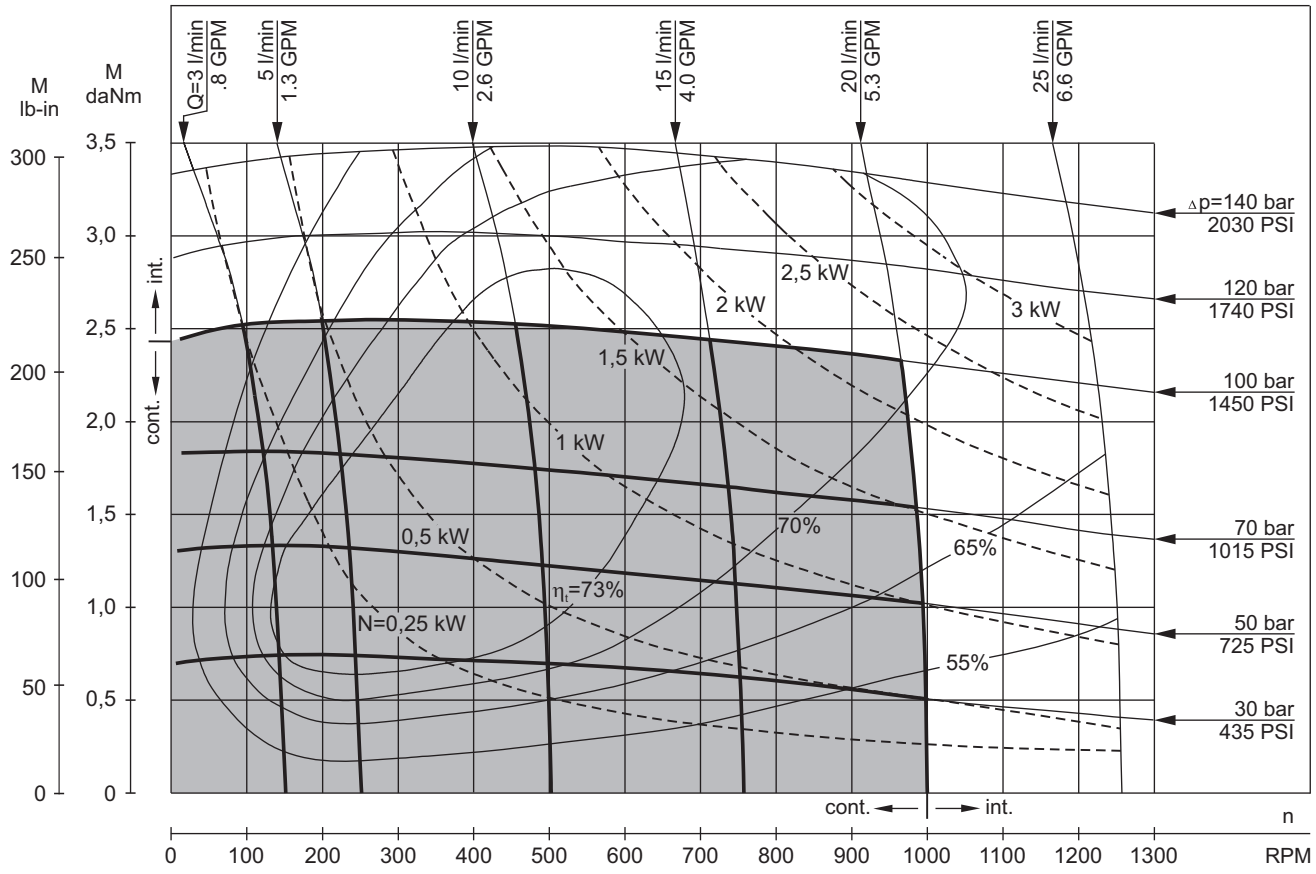
MLHM 12,5



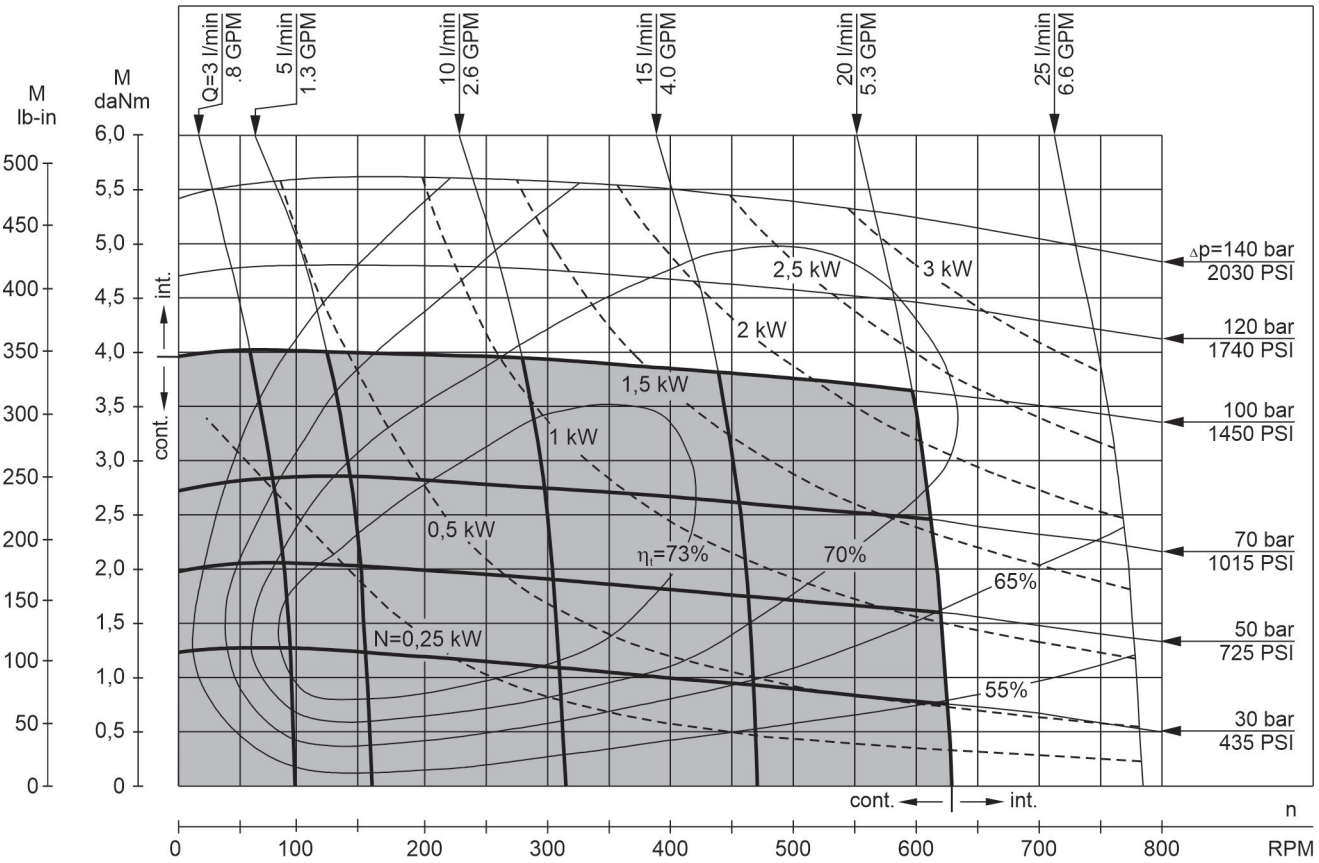
The function diagrams data is for average performance of randomly selected motors at back pressure 72.5 PSI÷145 PSI [5÷10 bar] and oil with viscosity of 150 SUS [32 mm²/s] at 122°F [50°C].

FUNCTION DIAGRAMS

MLHM 20



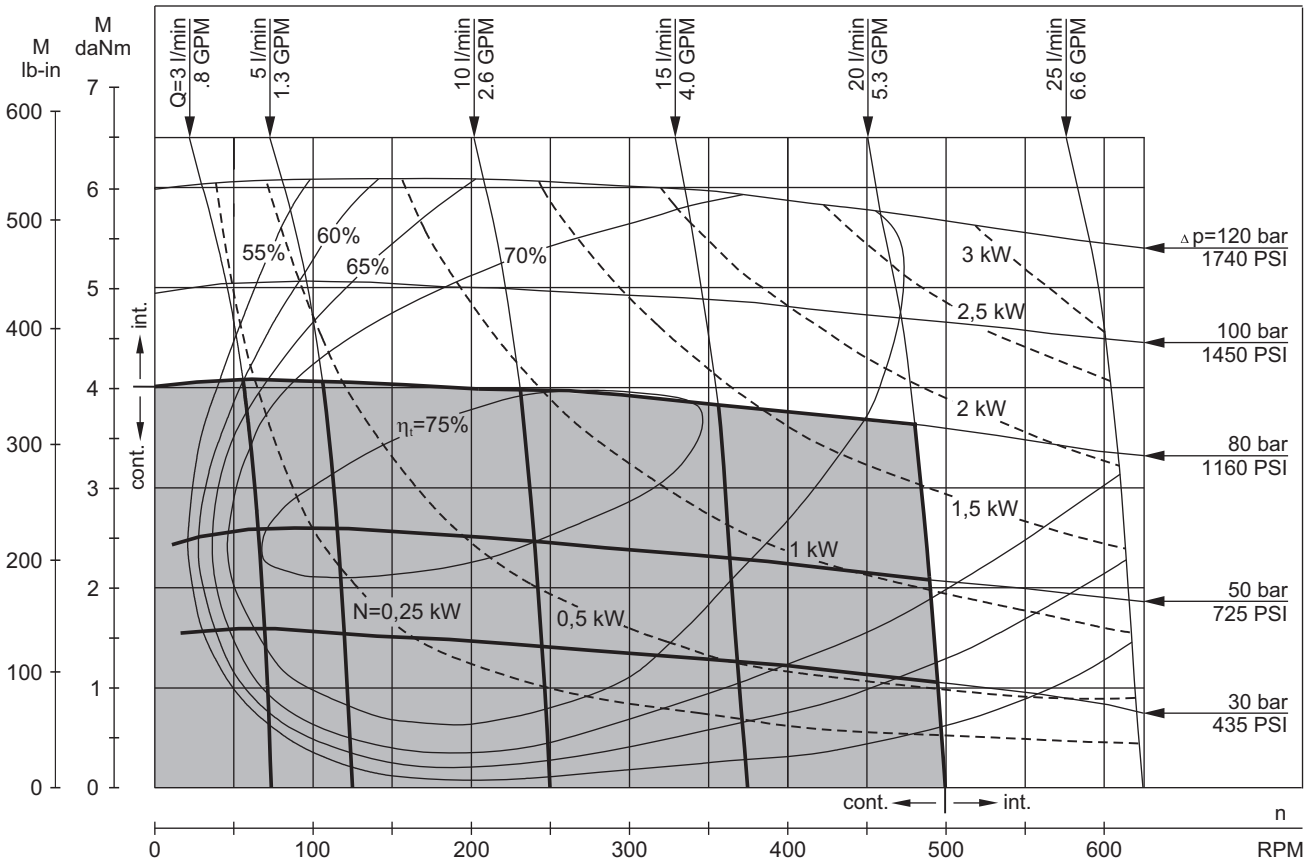
MLHM 32



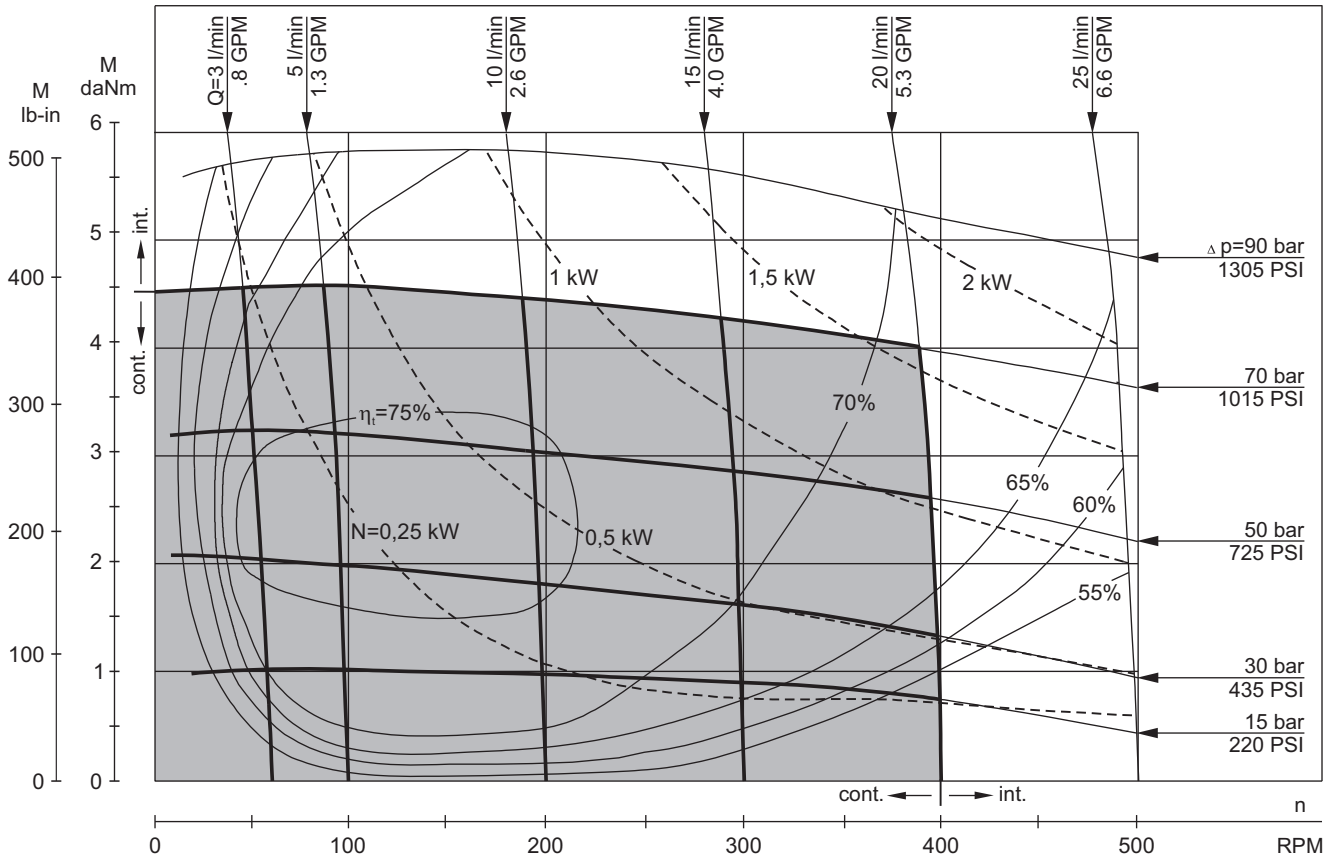
The function diagrams data is for average performance of randomly selected motors at back pressure 72.5 PSI÷145 PSI [5÷10 bar] and oil with viscosity of 150 SUS [32 mm²/s] at 122°F [50°C].

FUNCTION DIAGRAMS

MLHM 40



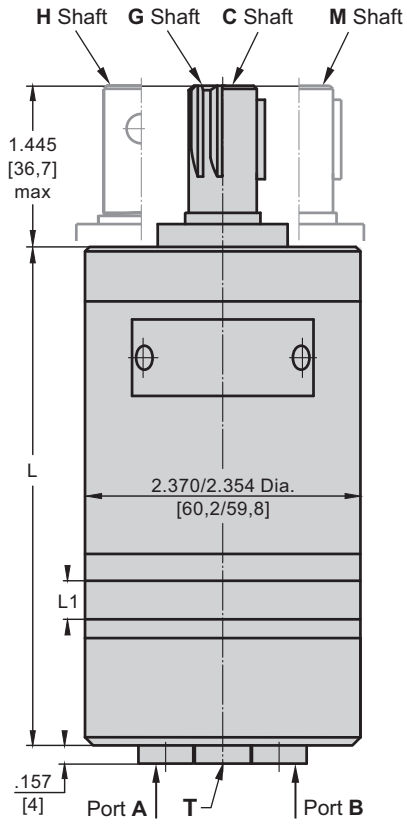
MLHM 50



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

DIMENSIONS and MOUNTING DATA MLHM, MLHMP, MLHMD

Three Bolts Mount



Shaft Dim. See Page 11

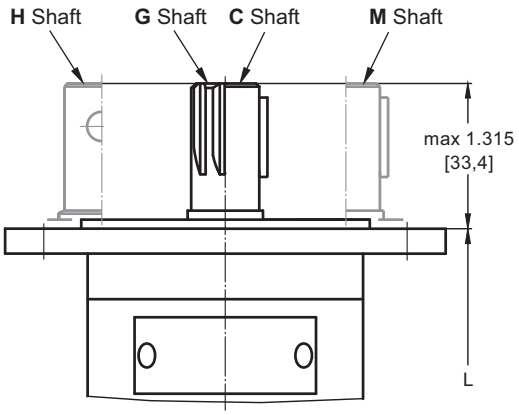
Flange Dim. See Page 10

Port Dim. See Page 10

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

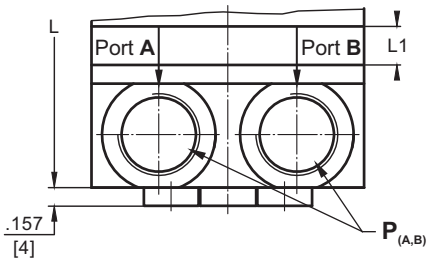
Reverse Rotation
Viewed from Shaft End
Port **A** Pressurized - **CCW**
Port **B** Pressurized - **CW**

F Oval Mount (2 Holes)



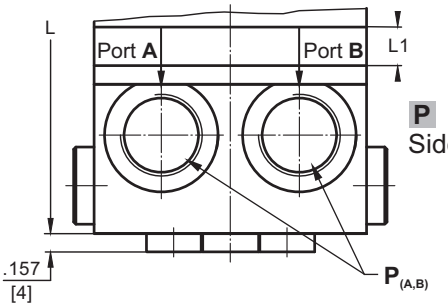
	Versions		
	2 , 6	3 , 9	4 , 7
$P_{(A,B)}$	2xG⅜	2xM18x1,5	2x 9/16-18 UNF
T	2xG⅛	M10x1	⅜ - 24 UNF

Rear Ports
Version
6 7 9

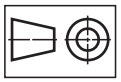


Type	Side Ports L, in [mm]	Rear Ports L, in [mm]	L1, in [mm]
MLHM(M) 8	4.189 [106,4]	4.134 [105,0]	.138 [3,5]
MLHM(M) 12,5	4.268 [108,4]	4.213 [107,0]	.217 [5,5]
MLHM(M) 20	4.386 [111,4]	4.331 [110,0]	.335 [8,5]
MLHM(M) 32	4.583 [116,4]	4.528 [115,0]	.531 [13,5]
MLHM(M) 40	4.720 [119,9]	4.665 [118,5]	.669 [17,0]
MLHM(M) 50	4.878 [123,9]	4.823 [122,5]	.828 [21,0]

Side Ports
Version
2 3 4



Type	Side Ports L, in [mm]	Rear Ports L, in [mm]	L1, in [mm]
MLHMF 8	4.327 [109,9]	4.272 [108,5]	.138 [3,5]
MLHMF 12,5	4.406 [111,9]	4.350 [110,5]	.217 [5,5]
MLHMF 20	4.524 [114,9]	4.469 [113,5]	.335 [8,5]
MLHMF 32	4.720 [119,9]	4.665 [118,5]	.531 [13,5]
MLHMF 40	4.858 [123,4]	4.803 [122,0]	.669 [17,0]
MLHMF 50	5.016 [127,4]	4.961 [126,0]	.828 [21,0]

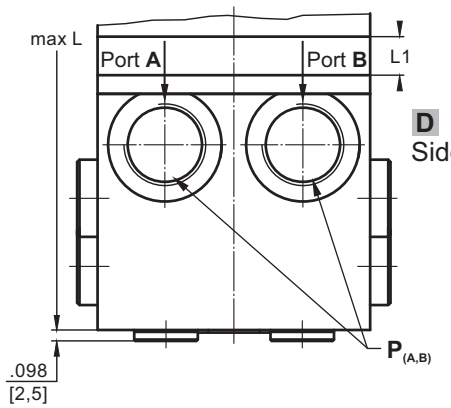


in [mm]

P Side Ports

Type	L, in [mm]	Type	L, in [mm]	L1, in [mm]
MLHM(M) 8 ...P	4.567 [116,0]	MLHMF 8 ...P	4.665 [118,5]	.138 [3,5]
MLHM(M) 12,5...P	4.646 [118,0]	MLHMF 12,5...P	4.783 [121,5]	.217 [5,5]
MLHM(M) 20 ...P	4.764 [121,0]	MLHMF 20 ...P	4.902 [124,5]	.335 [8,5]
MLHM(M) 32 ...P	4.961 [126,0]	MLHMF 32 ...P	5.059 [128,5]	.531 [13,5]
MLHM(M) 40 ...P	5.079 [129,0]	MLHMF 40 ...P	5.236 [133,0]	.669 [17,0]
MLHM(M) 50 ...P	5.256 [133,5]	MLHMF 50 ...P	5.394 [137,0]	.828 [21,0]

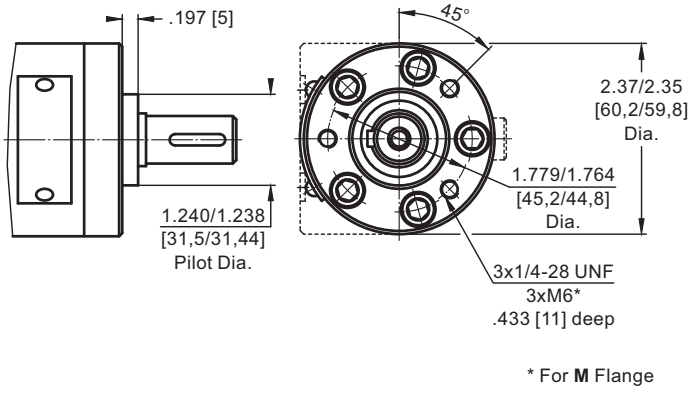
D Side Ports



Type	L, in [mm]	Type	L, in [mm]	L1, in [mm]
MLHM(M) 8 ...D	5.319 [135,1]	MLHMF 8 ...D	5.457 [138,6]	.138 [3,5]
MLHM(M) 12,5...D	5.398 [137,1]	MLHMF 12,5...D	5.535 [140,6]	.217 [5,5]
MLHM(M) 20 ...D	5.516 [140,1]	MLHMF 20 ...D	5.654 [143,6]	.335 [8,5]
MLHM(M) 32 ...D	5.713 [145,1]	MLHMF 32 ...D	5.850 [148,6]	.531 [13,5]
MLHM(M) 40 ...D	5.850 [148,6]	MLHMF 40 ...D	5.988 [152,1]	.669 [17,0]
MLHM(M) 50 ...D	6.008 [152,6]	MLHMF 50 ...D	6.146 [156,1]	.828 [21,0]

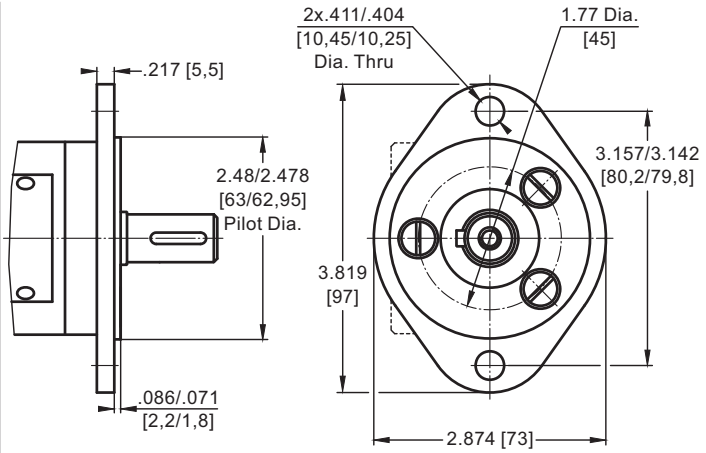
MOUNTING

Three Bolts Mount



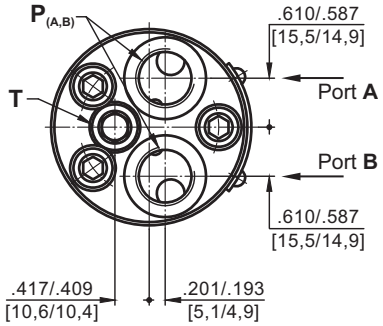
* For **M** Flange

F Oval Mount (2 Holes)

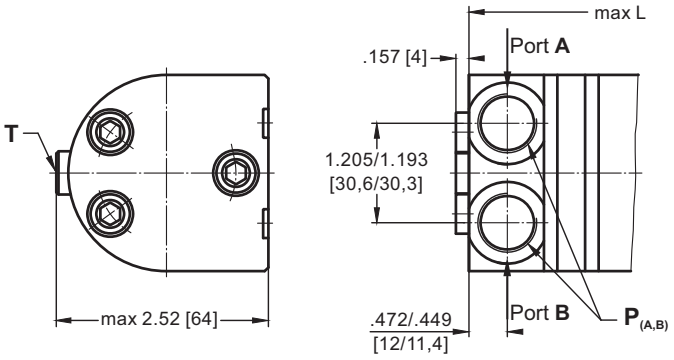


PORTS

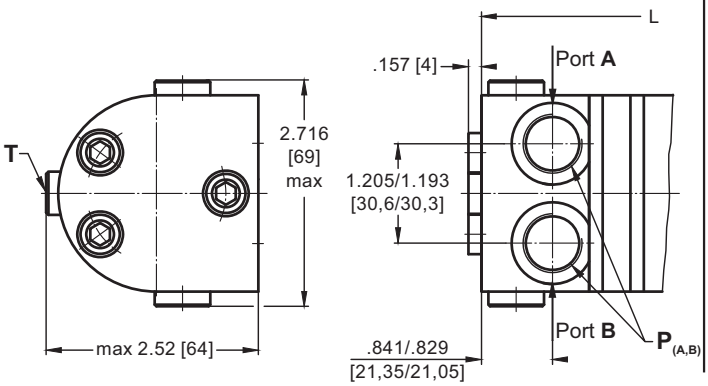
Rear Ports
Version 6 7 9



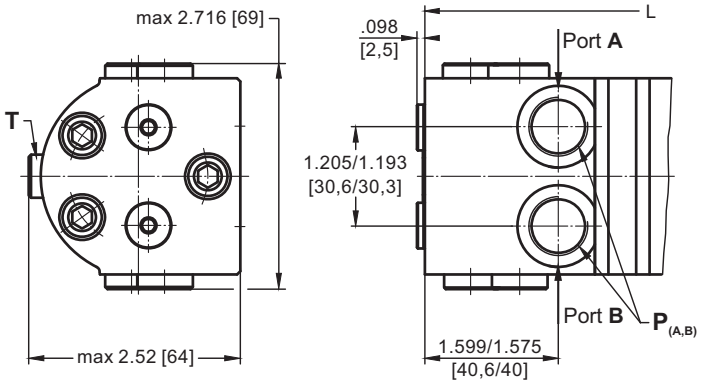
Side Ports, without valves
Version 2 3 4

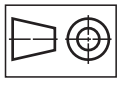


P Side Ports with Single Crossover Relief Valve



D Side Ports with Dual Crossover Relief Valve




in [mm]

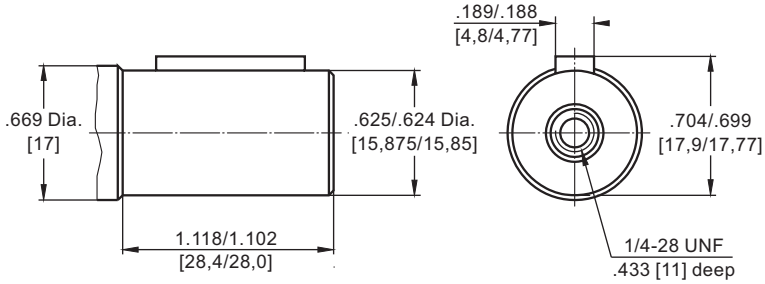
	Versions		
	2, 6	3, 9	4, 7
$P_{(A,B)}$	2xG⅜	2xM18x1,5	2x⅞-18 UNF
T	2xG⅛	M10x1	⅜ - 24 UNF

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

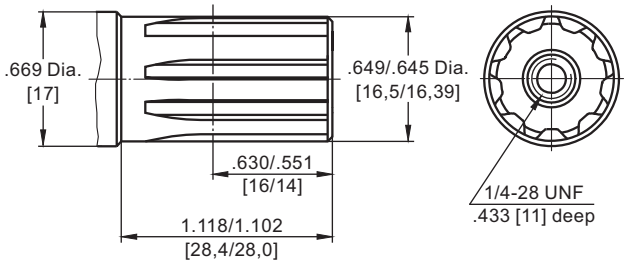
Reverse Rotation
Viewed from Shaft End
Port **A** Pressurized - **CCW**
Port **B** Pressurized - **CW**

SHAFT EXTENSIONS

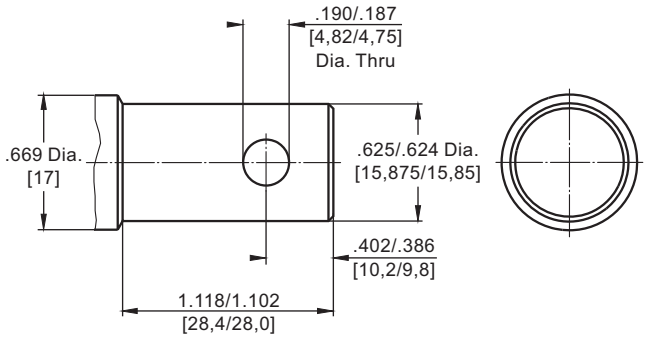
C - 5/8" [15,8] straight, Parallel key 3/16"x3/16"x3/4" BS46
Max. Torque 345 lb-in [3,9 daNm]



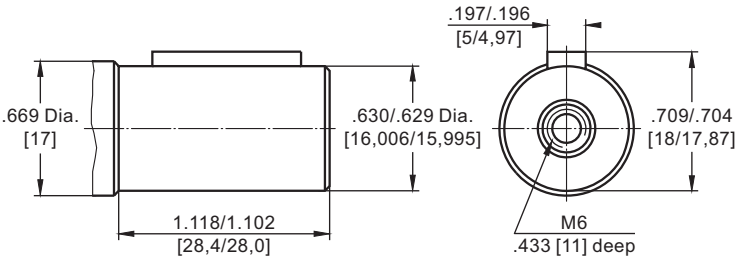
G - splined - metric B17x14 DIN 5482
Max. Torque 390 lb-in [4,4 daNm]



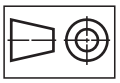
H - 5/8" [15,8] straight, w/ .19 [4,82] Crosshole
Max. Torque 345 lb-in [3,9 daNm]



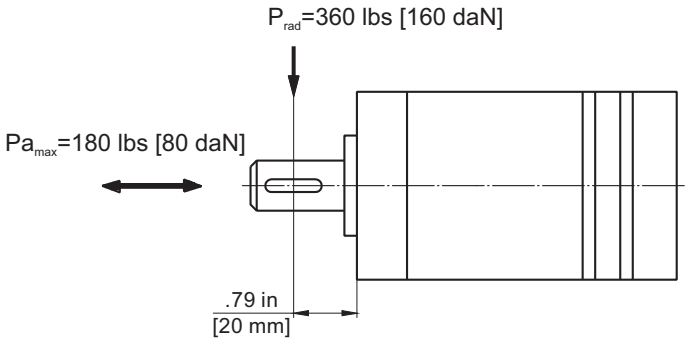
M - ø16 straight, Parallel key A5x5x16 DIN 6885
Max. Torque 345 lb-in [3,9 daNm]



Requirement max. Torque must be not exceeded.


in [mm]

PERMISSIBLE SHAFT LOAD



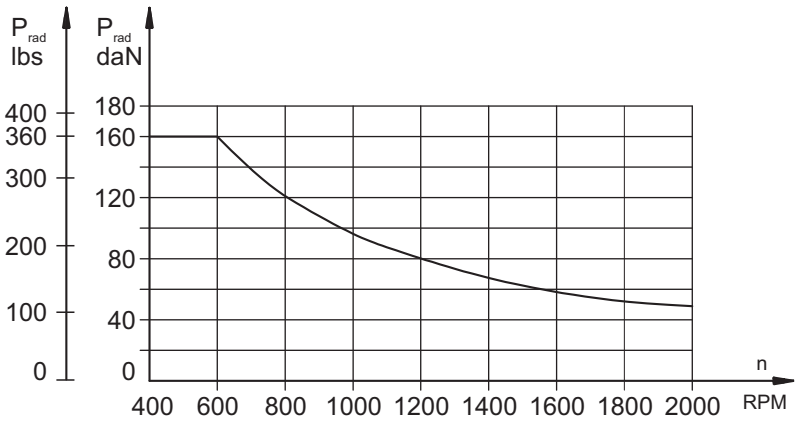
The permissible radial shaft load [Prad] is calculated from the distance [L] between the point of load application and the mounting surface:

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

[L in mm; L≤ 80 mm]

$$\mathbf{P_{rad}} = \frac{600}{n} X \frac{1155}{2.42 + L}\ , \text{[lbs]}$$

[L in inch; L≤ 3.15 in]



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

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
M L H M									

Pos.1 - Mounting Flange

omit - round, three bolts 1/4-28 UNF
F - flange, two holes
M - round metric, three bolts M6

Pos.2 - Displacement code

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

Pos.3 - Shaft Extensions* [for dimensions data see page 11]

C - 5/8" [15,8] straight, Parallel key
VC - 5/8" [15,8] straight, Parallel key w/ corrosion resistant protection
G - Involute Splined- Metric B17x14 DIN5482
H - 5/8" [15,8] straight, Parallel key w/ .19 [4,82] Crosshole
M - 16 mm straight, Parallel key
VM - 16 mm straight, Parallel key w/ corrosion resistant protection

Pos.4 - Port Size/Type [standard manifold to each]

2 - side ports, 2xG3/8, G1/8, BSP thread, ISO 228
3 - side ports, 2xM18x1,5; M10x1; metric, ISO 262
4 - side ports, 2x9/16-18 UNF, O-ring, 3/8-24 UNF
6 - rear ports, 2xG3/8, G1/8, BSP thread, ISO 228
7 - rear ports, 2x9/16-18 UNF, O-ring, 3/8-24 UNF
9 - rear ports, 2xM18x1,5; M10x1; metric, ISO 262

Pos.5 - Option**

omit - without valves
D - side ports with dual crossover relief valve
P - side ports with single crossover relief valve

Pos.6 - Directions for Control [for "P" option only]

/L - B → A (left control)
/R - A → B (right control)

Pos.7 - Valve Rated Pressure [for "P" and "D" option only]

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

Pos.8 - Additional Options [see page 110]

Pos.9 - Design Series

omit - Factory specified

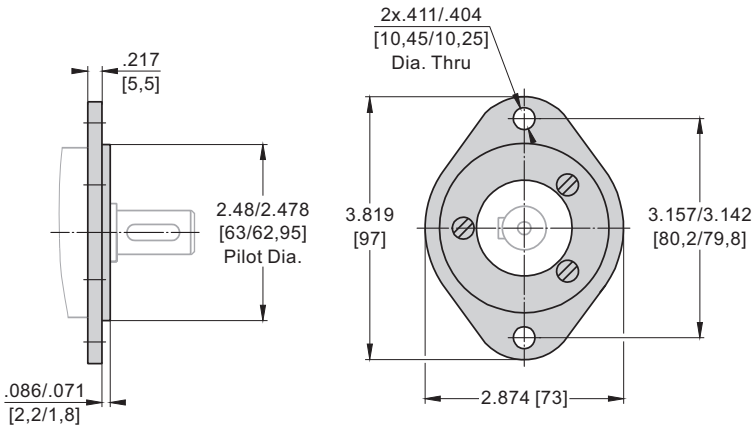
NOTES: * The permissible output torque for shafts must not be exceeded!
** Options **P**, **D** - for side ports (2, 3, 4) only.

The hydraulic motors are mangano-phosphatized as standard.

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

F - Flange (2 Holes)

Order No for Flange:48443 029 00



F Flange is mounted to the motor with 3 screws - 1/4-28 UNF.
Tightening Torque: 45÷53 lb-in [5÷6 Nm].

MOTOR ADDITIONAL OPTIONS

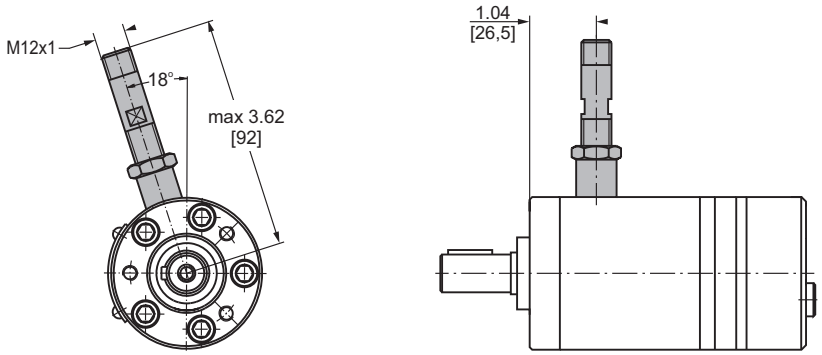
Additional Options Description	Order Code	Motor type											
		MLHM	MLHP	MLHPW, MLHP(W)N	HP	MLHR	MLHRN	HR	MLHPL	MLHRL	MLHRW	MLHH	HW
Speed Sensor*	**RS**	O	O	-	O	O	-	O	-	-	-	O	O*****
Low Leakage	**LL**	O	-	-	-	O	O	O	-	O	O	O	O
Low Speed Valving	**LSV**	-	-	-	-	O	-	-	-	-	-	O	O
Free Running	**FR**	O	O	O	O	O	O	O	O	O	O	O	O
Reverse Rotation	**R**	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
Corrosion Protected Paint**	**PC**	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												
Check Valves		S	S****	S	O	S****	S	O	S	S	S****	S****	S

O	Optional
-	Not applicable
S	Standard

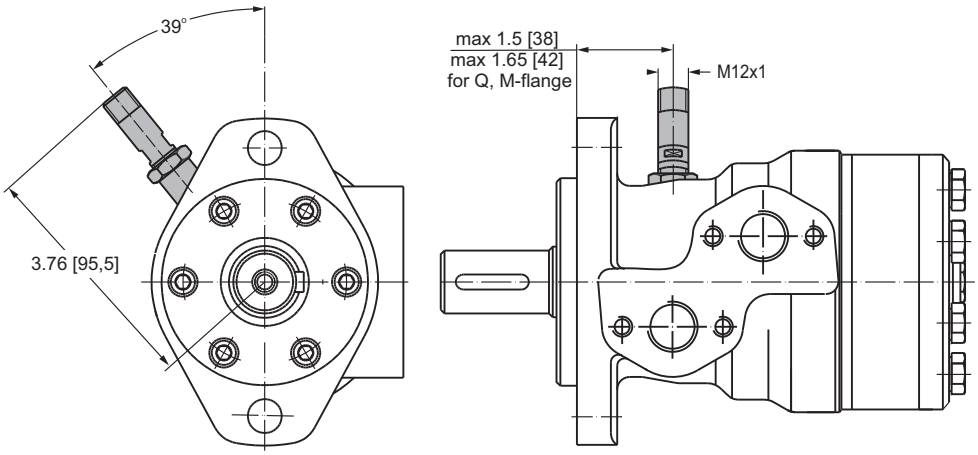
* For sensor ordering see pages 111÷112.
** Colour at customer's request.
*** Non painted feeding surfaces, colour at customer's request.
**** Without check valves for "**U**" shaft seal versions.
***** RS option is not available at HW...R (with relief valves).

MOTORS WITH SPEED SENSOR

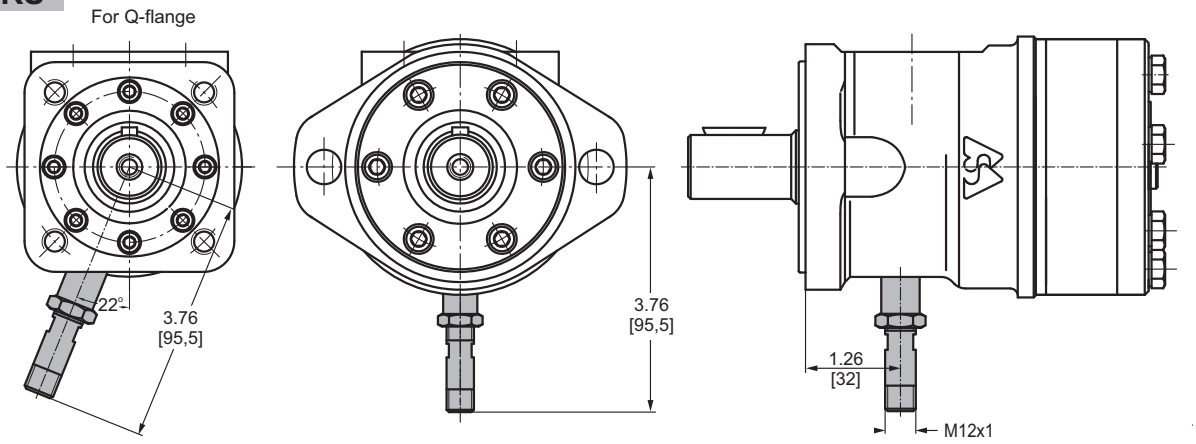
MLHM...RS



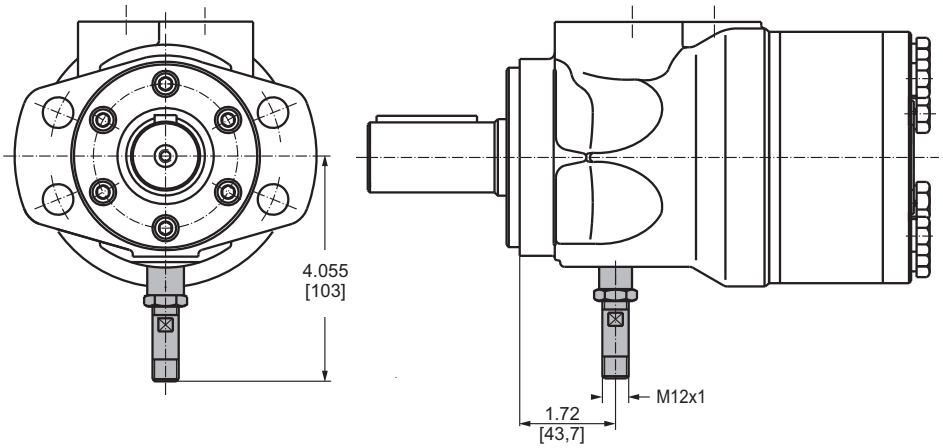
MLHP...RS
MLHR...RS



HP...RS
HR...RS



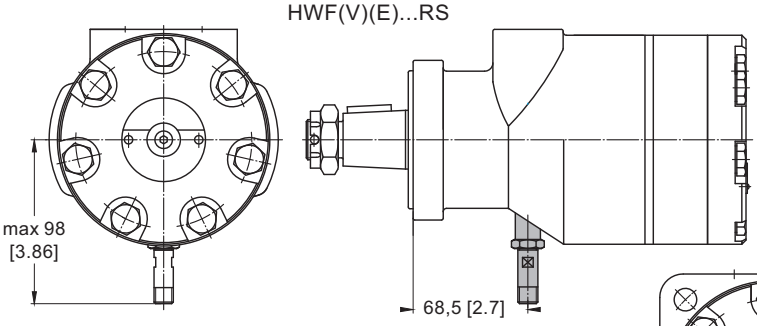
MLHH...RS



in [mm]

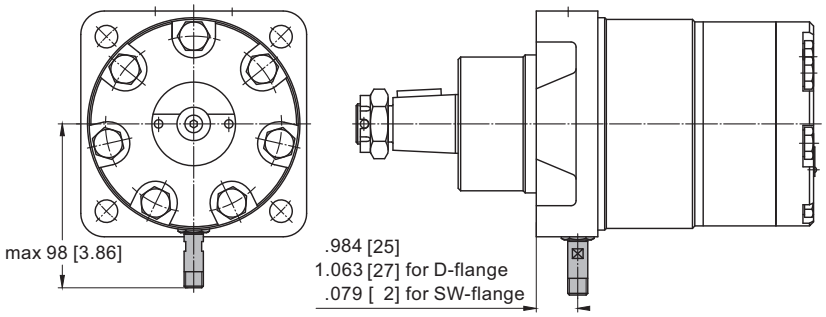
HW...RS

HWF(V)(E)...RS



RS option is not available at HW...R (with relief valves).

HW(S)(D)(SW)(V)(E)...RS



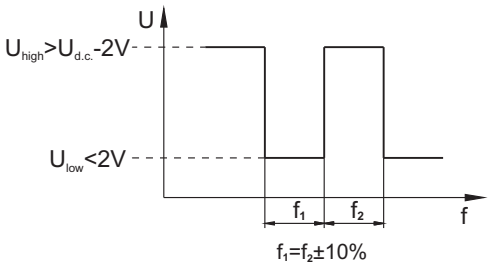
in [mm]

TECHNICAL DATA of the SPEED SENSOR

Technical data

Frequency range	0...15 000 Hz
Output	Universal PUSH PULL
Power supply	10-30 VDC
Current input	<20 mA (@24 VDC)
Maximum output current	500 mA
Ambient Temperature	-40...+125^{0}C [-40...+257^{0}F]
Protection	IP 67
Plug connector	M12-Series
Mounting principle	ISO 6149

Output signal

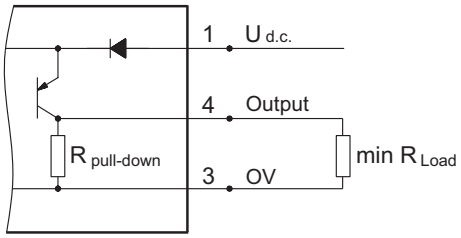


Load max.:$I_{high}=I_{low}$<50mA

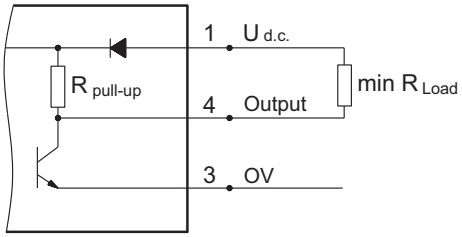
Motor type	MLHM	MLHP	MLHR	HP, HR	MLHH	HW
Pulses per revolution	30	36	36	36	42	12

Wiring diagrams

PNP

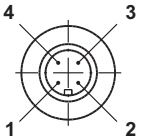


NPN



R_{Load} [kΩ]=$U_{d.c.}$ [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	Electric connection
RS	Connector BINDER 713 series
RSL2,5	Cable output 3x0,25; 98 in [2,5 m] long
RSL3,5	Cable output 3x0,25; 138 in [3,5 m] long
RSL5	Cable output 3x0,25; 196 in [5 m] long
RSL10	Cable output 3x0,25; 394 in [10 m] 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

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

v_{km} - vehicle speed, km/h;
v_{mi} - vehicle speed, mile/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, lbs [daN]
The resistance force resulted in wheels contact with different surfaces:

$$RR = G \times \rho$$

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

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

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, lbs [daN]
Force **FA** necessary for acceleration from 0 to maximum speed **v** and time **t** can be calculated with a formula:

$$FA = \frac{v_{mi} \times G}{22 \times t}, \text{[lbs]}; \qquad FA = \frac{v_{km} \times G}{36 \times t}, \text{[daN]}$$

FA- acceleration force, lbs [daN];
t- time, [s].

5.Tractive effort: DP, lbs [daN]
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, lbs [daN]
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, lb-in [daNm]
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, lb-in [daNm]

$$M_W = \frac{G_W \times f \times R_{in}[R_m]}{i \times \eta_M}$$

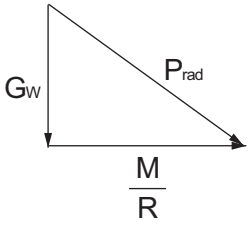
To avoid wheel slipping, the following condition should be observed $M_W > M$
f - frictional factor;
G_w - total weight over the wheels, lbs [daN].

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} , lbs [daN]

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.



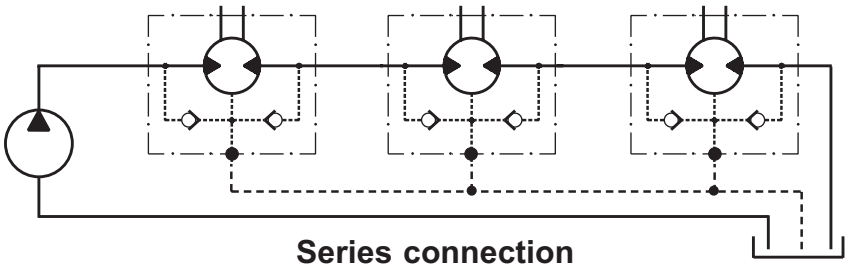
$$P_{rad}=\sqrt{G_w^2+\left(\frac{M}{R}\right)^2}$$

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

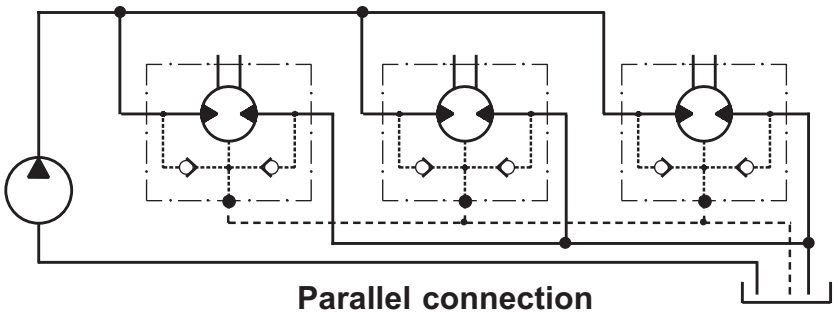
In accordance with calculated loadings the suitable motor from the catalogue is selected.

DRAINAGE SPACE AND DRAINAGE PRESSURE

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



Series connection



Parallel connection