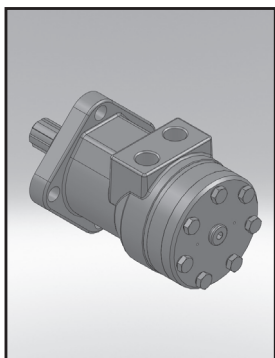
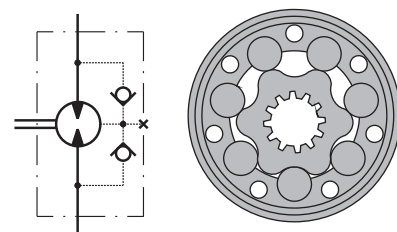


HYDRAULIC MOTORS MLHRL



APPLICATION

- » Conveyors
- » Feeding mechanism of robots and manipulators
- » Metal working machines
- » Textile machines
- » Agricultural machines
- » Food industries
- » Mining machinery etc.



CONTENTS

Specification data	52
Dimensions and mounting	53
Shaft extensions	49
Permissible shaft loads	50
Permissible shaft seal pressure	50
Order code	54

OPTIONS

- » Model - Spool valve, roll-gerotor
- » Antifriction needle bearing
- » Flange mount
- » Shafts - straight, splined and tapered
- » Metric and BSPP ports
- » Other special features

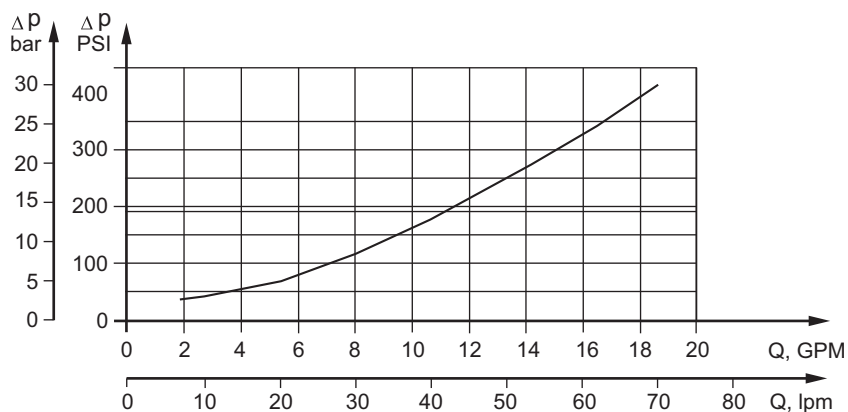
GENERAL

Max. Displacement, in ³ /rev [cm ³ /rev]	24.4 [397]	
Max. Speed, [RPM]	970	
Max. Torque, lb-in [daNm]	cont.: 5400 [61]	int.: 6100 [69]
Max. Output, HP [kW]	21.5 [16]	
Max. Pressure Drop, PSI [bar]	cont.: 2540 [175]	int.: 2900 [200]
Max. Oil Flow, GPM [lpm]	20 [75]	
Min. Speed, [RPM]	10	
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)	

Oil flow in drain line

Pressure drop PSI [bar]	Viscosity SUS [mm ² /s]	Oil flow in drain line GPM [lpm]
1450 [100]	98 [20]	.660 [2,5]
	164 [35]	.476 [1,8]
2030 [140]	98 [20]	.925 [3,5]
	164 [35]	.740 [2,8]

Pressure Losses



SPECIFICATION DATA

Type		MLHRL 50	MLHRL 80	MLHRL 100	MLHRL 125	MLHRL 160	MLHRL 200	MLHRL 250	MLHRL 315	MLHRL 400
Displacement, in³/rev [cm³/rev]		3.14 [51,5]	4.90 [80,3]	6.09 [99,8]	7.67 [125,7]	9.74 [159,6]	12.19 [199,8]	15.26 [250,1]	19.26 [315,7]	24.4 [397]
Max. Speed, [RPM]	Cont.	775	750	600	475	375	300	240	190	150
	Int.*	970	940	750	600	470	375	300	240	190
Max. Torque, lb-in [daNm]	Cont.	900 [10,1]	1770 [20]	2125 [24]	2655 [30]	3450 [39]	4000 [45]	4780 [54]	4870 [55]	5400 [61]
	Int.*	1150 [13]	1947 [22,0]	2480 [28]	3010 [34]	3805 [43]	4425 [50]	5400 [61]	5580 [63]	6100 [69]
	Peak**	1505 [17]	2390 [27,0]	2832 [32]	3275 [37]	4070 [46]	4960 [56]	6280 [71]	7350 [83]	7700 [87]
Max. Output, HP [kW]	Cont.	9.5 [7]	17 [12,5]	17.4 [13]	16.8 [12,5]	15.4 [11,5]	14.8 [11]	13.4 [10]	12 [9]	10.5 [7,8]
	Int.*	11.9 [8,5]	20.1 [15]	20.1 [15]	21.5 [16]	18.8 [14]	17.4 [13]	16.1 [12]	14.8 [11]	14.2 [10,6]
Max. Pressure Drop, PSI [bar]	Cont.	2030 [140]	2540 [175]	2540 [175]	2540 [175]	2540 [175]	2540 [175]	2540 [175]	1960 [135]	1670 [115]
	Int.*	2540 [175]	2900 [200]	2900 [200]	2900 [200]	2900 [200]	2900 [200]	2900 [200]	2320 [160]	2030 [140]
	Peak**	3260 [225]	3260 [225]	3260 [225]	3260 [225]	3260 [225]	3260 [225]	3260 [225]	3045 [210]	2540 [175]
Max. Oil Flow, GPM [lpm]	Cont.	11 [40]	16 [60]	16 [60]	16 [60]	16 [60]	16 [60]	16 [60]	16 [60]	16 [60]
	Int.*	13 [50]	20 [75]	20 [75]	20 [75]	20 [75]	20 [75]	20 [75]	20 [75]	20 [75]
Max. Inlet Pressure, PSI [bar]	Cont.	2540 [175]	2540 [175]	2540 [175]	2540 [175]	2540 [175]	2540 [175]	2540 [175]	2540 [175]	2540 [175]
	Int.*	2900 [200]	2900 [200]	2900 [200]	2900 [200]	2900 [200]	2900 [200]	2900 [200]	2900 [200]	2900 [200]
	Peak**	3260 [225]	3260 [225]	3260 [225]	3260 [225]	3260 [225]	3260 [225]	3260 [225]	3260 [225]	3260 [225]
Max. Return Pres- sure without Drain Line or Max. Pres- sure in Drain Line, PSI [bar]	Cont. 0-100 RPM	1450 [100]	1450 [100]	1450 [100]	1450 [100]	1450 [100]	1450 [100]	1450 [100]	1450 [100]	1450 [100]
	Cont. 100-300 RPM	725 [50]	725 [50]	725 [50]	725 [50]	725 [50]	725 [50]	725 [50]	725 [50]	725 [50]
	Cont. 300-600 RPM	365 [25]	365 [25]	365 [25]	365 [25]	365 [25]	365 [25]	365 [25]	365 [25]	365 [25]
	Cont. >600 RPM	220 [15]	220 [15]	220 [15]	220 [15]	220 [15]	220 [15]	220 [15]	220 [15]	220 [15]
	Int.* 0-max. RPM	1450 [100]	1450 [100]	1450 [100]	1450 [100]	1450 [100]	1450 [100]	1450 [100]	1450 [100]	1450 [100]
Max. Return Pre- ssure with Drain Line, PSI [bar]	Cont.	2030 [140]	2540 [175]	2540 [175]	2540 [175]	2540 [175]	2540 [175]	2540 [175]	2540 [175]	2540 [175]
	Int.*	2540 [175]	2900 [200]	2900 [200]	2900 [200]	2900 [200]	2900 [200]	2900 [200]	2900 [200]	2900 [200]
	Peak**	3260 [225]	3260 [225]	3260 [225]	3260 [225]	3260 [225]	3260 [225]	3260 [225]	3260 [225]	3260 [225]
Max. Starting Pressure with Unloaded Shaft, PSI [bar]		145 [10]	145 [10]	145 [10]	130 [9]	100 [7]	73 [5]	58 [4]	44 [3]	44 [3]
Min. Starting Torque, lb-in [daNm]		710 [8]	1330 [15]	1770 [20]	2215 [25]	2835 [32]	3275 [37]	4000 [45]	4000 [45]	4340 [49]
Min. Speed***, [RPM]		10	10	10	10	10	10	10	10	10
Weight, lb [kg]		18.7 [8,5]	19 [8,6]	19.6 [8,9]	19.8 [9,0]	20.3 [9,2]	21.2 [9,6]	22.3 [10,1]	23.8 [10,8]	25.4 [11,5]

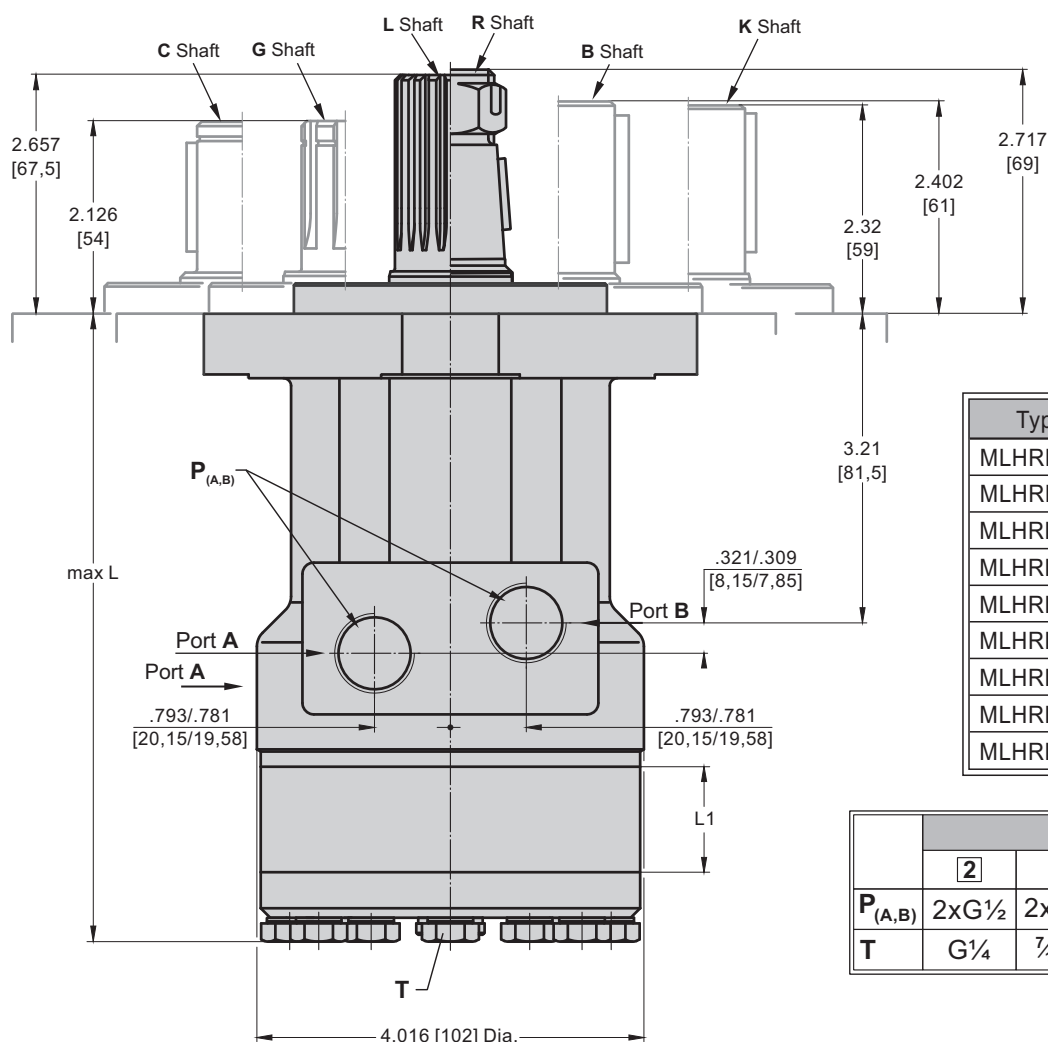
* Intermittent operation: the permissible values may occur for max. 10% of every minute.

** 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 70 SUS [13 mm²/s] at 122°F [50°C].
- Recommended maximum system operating temperature is 180°F [82°C].
- To assure optimum motor life fill with fluid prior to loading and run at moderate load and speed for 10-15 minutes.

DIMENSIONS and MOUNTING DATA



Shaft Dim.
See Page 49

Type	L _{max} in [mm]	L ₁ in [mm]
MLHRL 50	8.80 [147,5]	.35 [9,0]
MLHRL 80	6.00 [152,5]	.55 [14,0]
MLHRL 100	6.12 [155,5]	.69 [17,4]
MLHRL 125	6.30 [160,0]	.86 [21,8]
MLHRL 160	6.54 [166,0]	1.09 [27,8]
MLHRL 200	6.81 [173,0]	1.37 [34,8]
MLHRL 250	7.15 [181,5]	1.71 [43,5]
MLHRL 315	7.60 [193,0]	2.16 [54,8]
MLHRL 400	8.17 [207,5]	2.73 [69,4]

Versions			
	2	4	5
P _(A,B)	2xG $\frac{1}{2}$	2x $\frac{7}{8}$ - 14 UNF	2x $\frac{1}{2}$ - 14 NPTF
T	G $\frac{1}{4}$	$\frac{7}{16}$ - 20 UNF	$\frac{7}{16}$ - 20 UNF

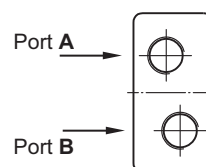
Standard Rotation
Viewed from Shaft End
Port A Pressurized - CW
Port B Pressurized - CCW

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

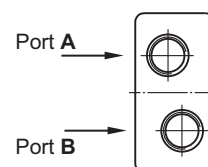


Side Ports

Version 2, 5

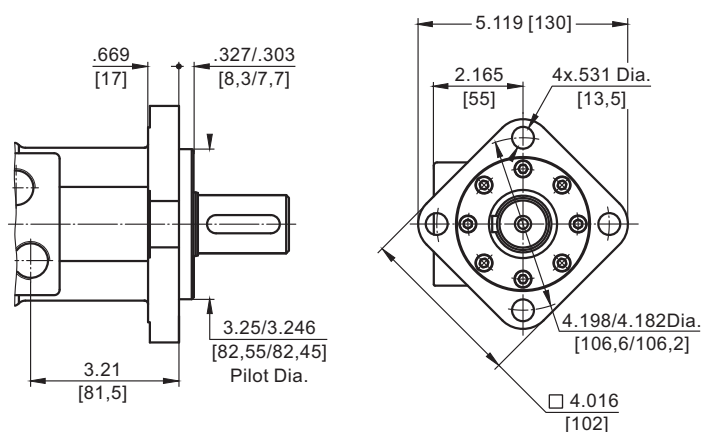


Version 4

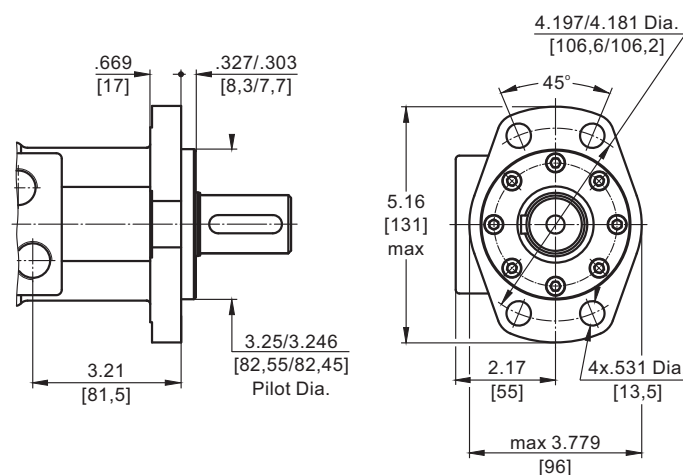


MOUNTING

Square Mount (4 Holes)

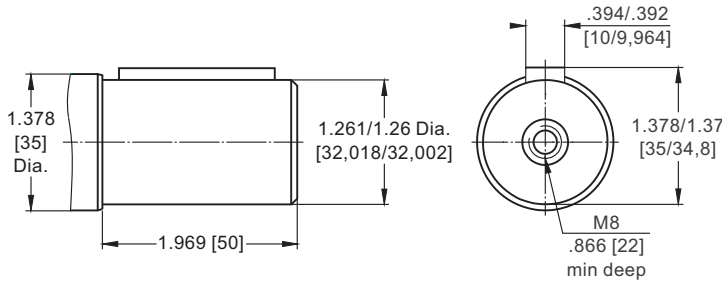


F - Oval Mount (four Holes)

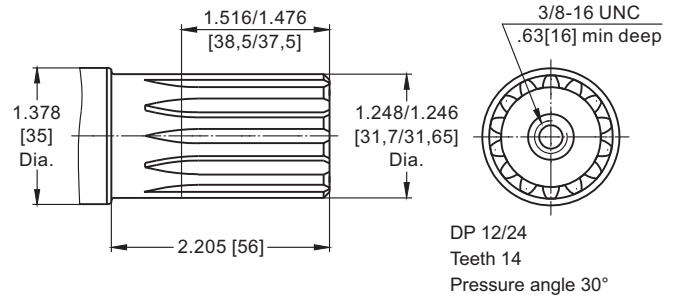


SHAFT EXTENSIONS for MLHPL and MLHRL

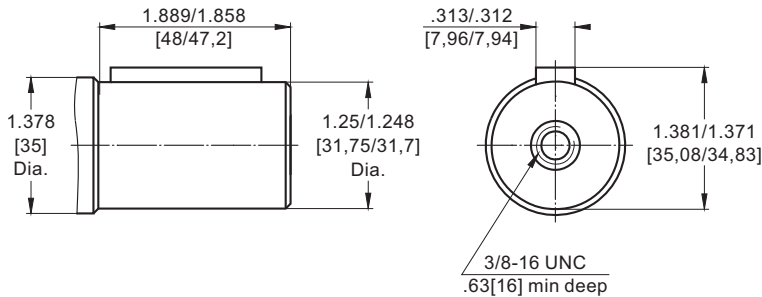
B - $\varnothing 32$, Parallel key A10x8x40 DIN 6885
Max. Torque 6815 lb-in [77 daNm]



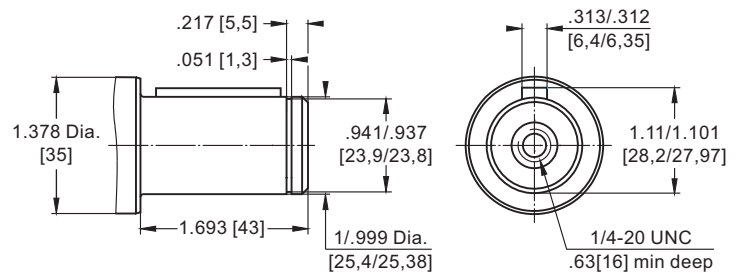
L - 14T splined, $1\frac{1}{4}$ " [31,75], ANS B92.1-1976
Max. Torque 8410 lb-in [95 daNm]



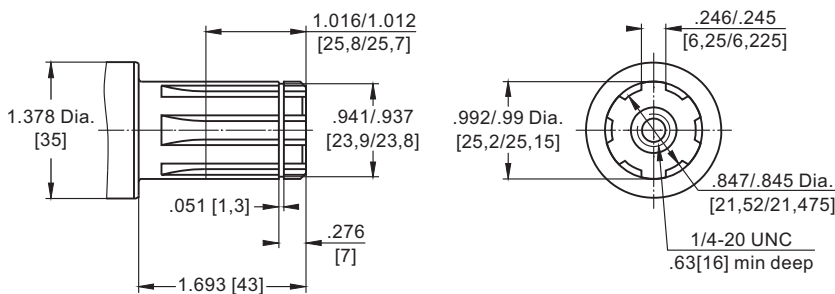
K - $1\frac{1}{4}$ " [31,75] straight, Parallel key $\frac{5}{16}$ "x $\frac{5}{16}$ "x $1\frac{1}{4}$ " BS46
Max. Torque 6815 lb-in [77 daNm]



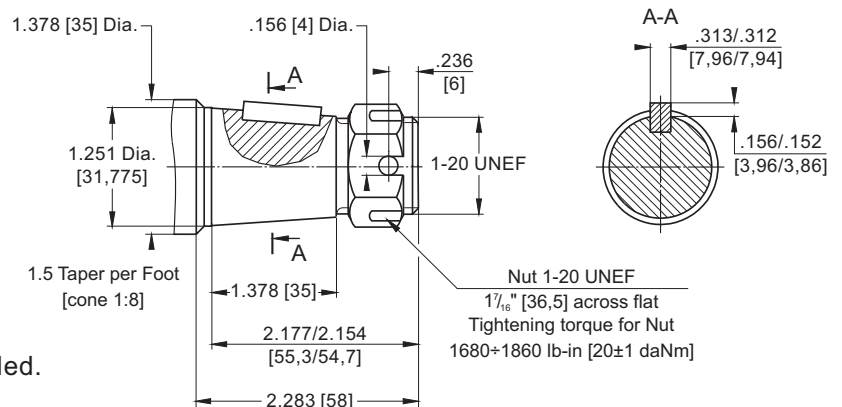
C - 1" [25,4] straight, Parallel key $\frac{1}{4}$ "x $\frac{1}{4}$ "x $1\frac{1}{4}$ " BS46
Max. Torque 3010 lb-in [34 daNm]



G - 1" [25,4] splined Bs2059 (SAE 6B)
Max. Torque 3010 lb-in [34 daNm]



R - $1\frac{1}{4}$ " [31,75] tapered, SAE J501,
Parallel key $\frac{5}{16}$ "x $\frac{5}{16}$ "x 1 " BS46
Max. Torque 34 daNm [3010 lb-in]



▽ - Motor Mounting Surface

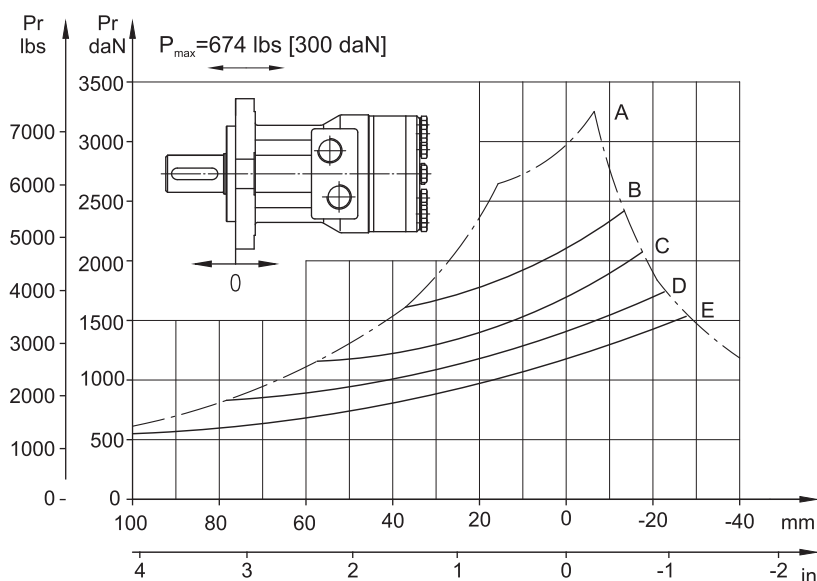


in [mm]

Requirement max. Torque must be not exceeded.

PERMISSIBLE SHAFT LOADS for MLHPL and MLHRL

The curves apply to a B10 bearings life of 2000 hrs



A - Max. radial shaft load.
B - $n=50 \text{ min}^{-1}$
C - $n=100 \text{ min}^{-1}$
D - $n=200 \text{ min}^{-1}$
E - $n=400 \text{ min}^{-1}$

ORDER CODE

	1	2	3	4	5	6
MLHPL						

Pos.1 - Mounting Flange

omit - Square mount, four holes

F - Oval mount, four holes

Pos.2 - Displacement code*

50	- 3.02 in ³ /rev [49,5 cm ³ /rev]
80	- 4.83 in ³ /rev [79,2 cm ³ /rev]
100	- 6.04 in ³ /rev [99,0 cm ³ /rev]
125	- 7.55 in ³ /rev [123,8 cm ³ /rev]
160	- 9.66 in ³ /rev [158,4 cm ³ /rev]
200	- 12.10 in ³ /rev [198,0 cm ³ /rev]
250	- 15.10 in ³ /rev [247,5 cm ³ /rev]
315	- 19.30 in ³ /rev [316,8 cm ³ /rev]
400	- 24.16 in ³ /rev [396,0 cm ³ /rev]

Pos.3 - Shaft Extensions**

B	- ø32 straight, Parallel key
K	- 1¼" [31,75] straight, Parallel key
L	- 1¼" [31,75] splined 14T ANS B 92.1-1976
R	- 1¼" [31,75] tapered SAE J 501
C	- ø25,4 straight, Parallel key
G	- ø25,4 splined BS 2059 (SAE 6B)

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

2	- side ports, 2xG1/2, G1/4, BSP thread, ISO 228
4	- side ports, 2x7/8-14 UNF, O-ring, 7/16-20 UNF
5	- side ports, 2x1/2-14 NPTF, 7/16-20 UNF

Pos.5 - Additional Options [see page 110]

Pos.6 - Design Series

omit - Factory specified

NOTES:

* For the Function Diagrams please look at "M+S Hydraulic" Catalogue for MLHP motors, pages 19÷23.

** The permissible output torque for shafts must not be exceeded!

The hydraulic motors are mangano-phosphatized as standard.

ORDER CODE

	1	2	3	4	5	6
MLHRL						

Pos.1 - Mounting Flange

omit - Square mount, four holes

F - Oval mount, four holes

Pos.2 - Displacement code*

50 - 3.14 in³/rev [51,5 cm³/rev]

80 - 4.90 in³/rev [80,3 cm³/rev]

100 - 6.09 in³/rev [99,8 cm³/rev]

125 - 7.67 in³/rev [125,7 cm³/rev]

160 - 9.74 in³/rev [159,6 cm³/rev]

200 - 12.19 in³/rev [199,8 cm³/rev]

250 - 15.26 in³/rev [250,1 cm³/rev]

315 - 19.26 in³/rev [315,7 cm³/rev]

400 - 24.40 in³/rev [397,0 cm³/rev]

Pos.3 - Shaft Extensions** [see page 49]

B - ø32 straight, Parallel key

K - 1¼" [31,75] straight, Parallel key

L - 1¼" [31,75] splined 14T ANS B 92.1-1976

R - 1¼" [31,75] tapered SAE J 501

C - ø25,4 straight, Parallel key

G - ø25,4 splined BS 2059 (SAE 6B)

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

2 - side ports, 2xG1/2, G1/4, BSP thread, ISO 228

4 - side ports, 2x7/8-14 UNF, O-ring, 7/16-20 UNF

5 - side ports, 2x1/2-14 NPTF, 7/16-20 UNF

Pos.5 - Additional Options [see page 110]

Pos.6 - Design Series

omit - Factory specified

NOTES:

* For the Function Diagrams please look at "M+S Hydraulic" Catalogue for MLHR motors, [pages 36÷40](#).

** The permissible output torque for shafts must not be exceeded!

The hydraulic motors are mangano-phosphatized as standard.

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.

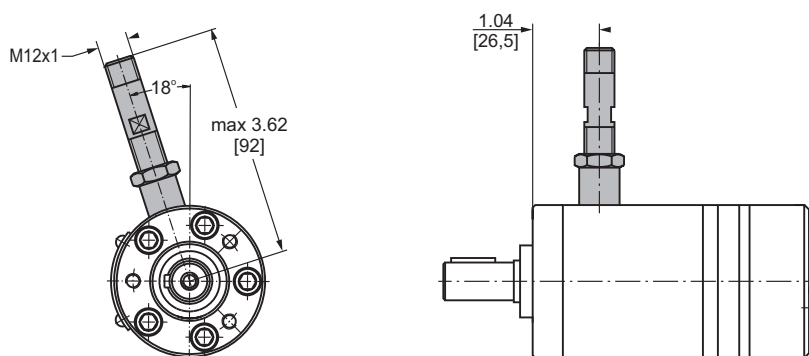
*** Non painted feeding surfaces, colour at customer's request.

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

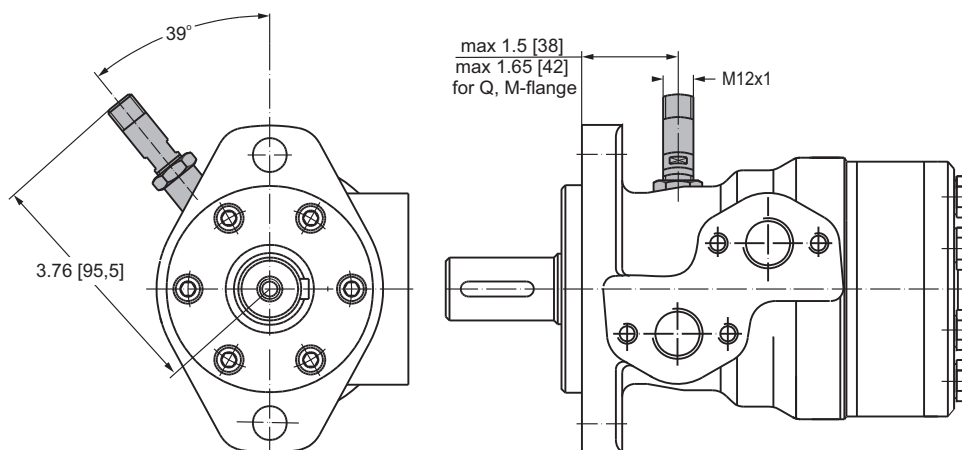
***** RS option is not available at HW...R (with relief valves).

MOTORS WITH SPEED SENSOR

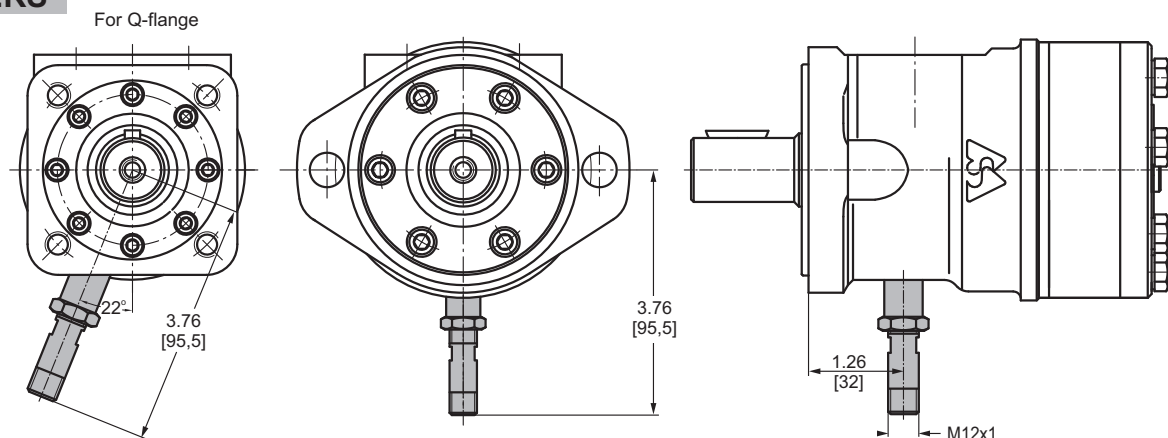
MLHM...RS



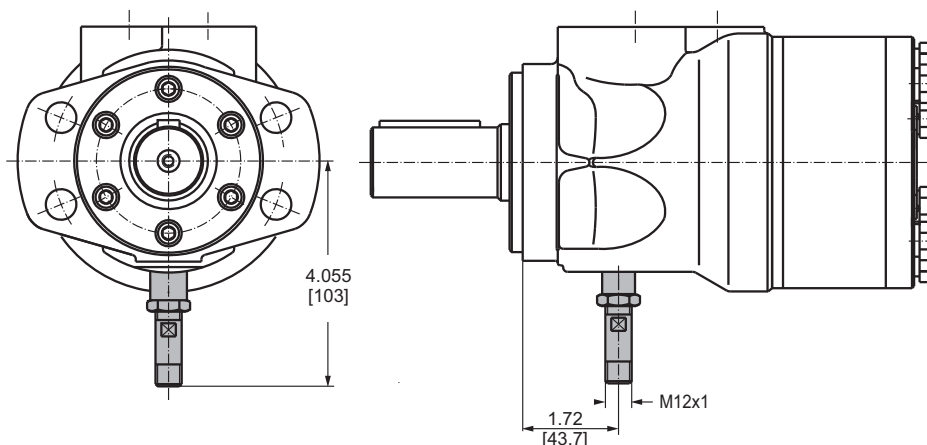
MLHP...RS MLHR...RS

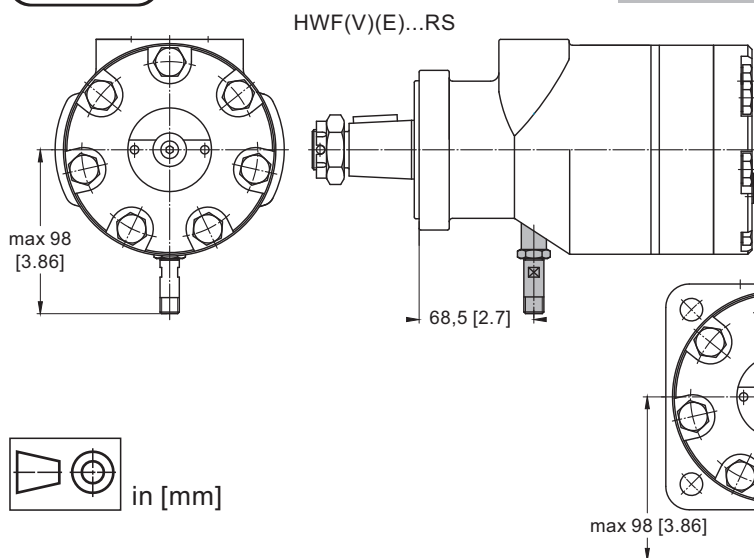


HP...RS HR...RS



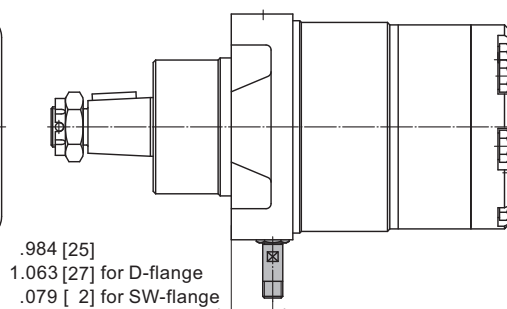
MLHH...RS





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

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

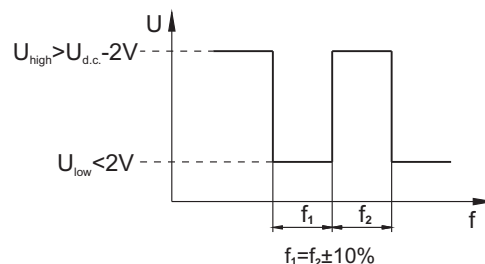


TECHNICAL DATA of the SPEED SENSOR

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°C [-40...+257°F]
Protection	IP 67
Plug connector	M12-Series
Mounting principle	ISO 6149

Output signal

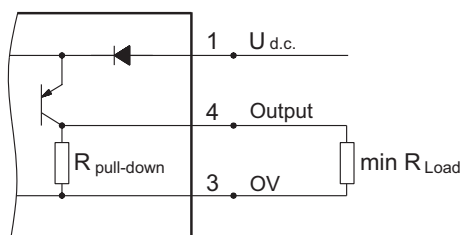


Load max.: $I_{high} = I_{low} < 50\text{mA}$

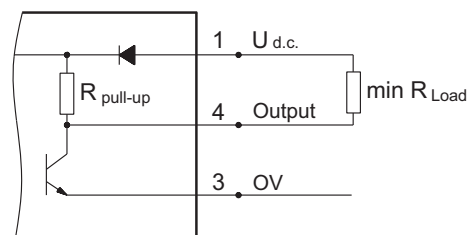
Motor type	MLHM	MLHP	MLHR	HP, HR	MLHH	HW
Pulses per revolution	30	36	36	36	42	12

Wiring diagrams

PNP

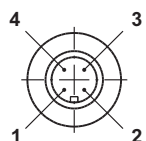


NPN



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

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

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

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:

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

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

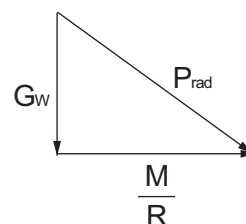
9.Radial motor loading: P_{rad} , lbs [daN]

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.

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.

