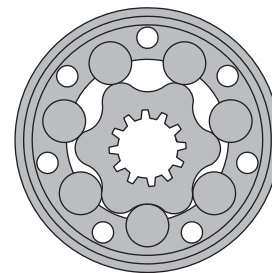


HYDRAULIC MOTORS MLHH



APPLICATION

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



CONTENTS

Specification data	79
Function diagrams	80÷82
Permissible shaft loads	82
Dimensions and mounting	83
Permissible shaft seal pressure	84
Shaft extensions	85
Order code	85

OPTIONS

- » Model - Spool valve, roll-gerotor
- » Flange mount
- » Shafts - straight, splined and tapered
- » SAE, Metric and BSPP ports
- » Speed sensing
- » Other special features

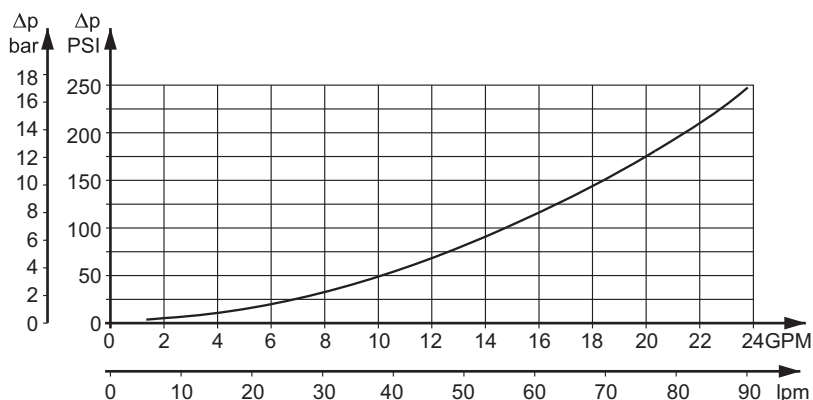
GENERAL

Max. Displacement, in ³ /rev [cm ³ /rev]	30.7 [502,4]
Max. Speed, [RPM]	445
Max. Torque, lb-in [daNm]	cont.: 7434 [84] int.: 9204 [104]
Max. Output, HP [kW]	24.8 [18,5]
Max. Pressure Drop, PSI [bar]	cont.: 2540 [175] int.: 2900 [200]
Max. Oil Flow, GPM [lpm]	23.9 [90]
Min. Speed, [RPM]	5
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		MLHH 200	MLHH 250	MLHH 315	MLHH 400	MLHH 500
Displacement, in3/rev [cm3/rev]		12.3 [201,3]	15.4 [252]	19.2 [314,9]	24.2 [396,8]	30.7 [502,4]
Max. Speed, [RPM]	Cont.	370	295	235	185	150
	Int.*	445	350	285	225	180
Max. Torque, lb-in [daNm]	Cont.	4510 [51]	5398 [61]	6548 [74]	7434 [84]	7257 [82]
	Int.*	5130 [58]	6195 [70]	7257 [82]	8673 [98]	9204 [104]
	Peak**	5064 [64]	6992 [79]	8673 [98]	9647 [109]	10350 [117]
Max. Output, HP [kW]	Cont.	21 [16]	21 [16]	18.7 [14]	16.7 [12,5]	14.7 [11]
	Int.*	24.8 [18,5]	24.8 [18,5]	20.7 [15,5]	20.1 [15]	18.7 [14]
Max. Pressure Drop, PSI [bar]	Cont.	2540 [175]	2540 [175]	2540 [175]	2240 [155]	1740 [120]
	Int.*	2900 [200]	2900 [200]	2900 [200]	2750 [190]	2100 [145]
	Peak**	3260 [225]	3260 [225]	3260 [225]	3045 [210]	2390 [165]
Max. Oil Flow, GPM [lpm]	Cont.	19.8 [75]	19.8 [75]	19.8 [75]	19.8 [75]	19.8 [75]
	Int.*	23.9 [90]	23.9 [90]	23.9 [90]	23.9 [90]	23.9 [90]
Max. Inlet Pressure, PSI [bar]	Cont.	2900 [200]	2900 [200]	2900 [200]	2900 [200]	2900 [200]
	Int.*	3260 [225]	3260 [225]	3260 [225]	3260 [225]	3260 [225]
	Peak**	3626 [250]	3626 [250]	3626 [250]	3626 [250]	3626 [250]
Max. Starting Pressure with Unloaded Shaft, PSI [bar]		72 [5]	72 [5]	72 [5]	72 [5]	72 [5]
Min. Starting Torque, lb-in [daNm]	At max.press. drop Cont.	3450 [39]	4600 [52]	5840 [66]	6370 [72]	6370 [72]
	At max.press. drop Int.*	3980 [45]	5221 [59]	6460 [73]	7788 [88]	7788 [88]
Min. Speed***, [RPM]		10	10	8	5	5
Weight, lb [kg]		23.2 [10,5]	24.3 [11]	25.4 [11,5]	27.1 [12,3]	28.7 [13]

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

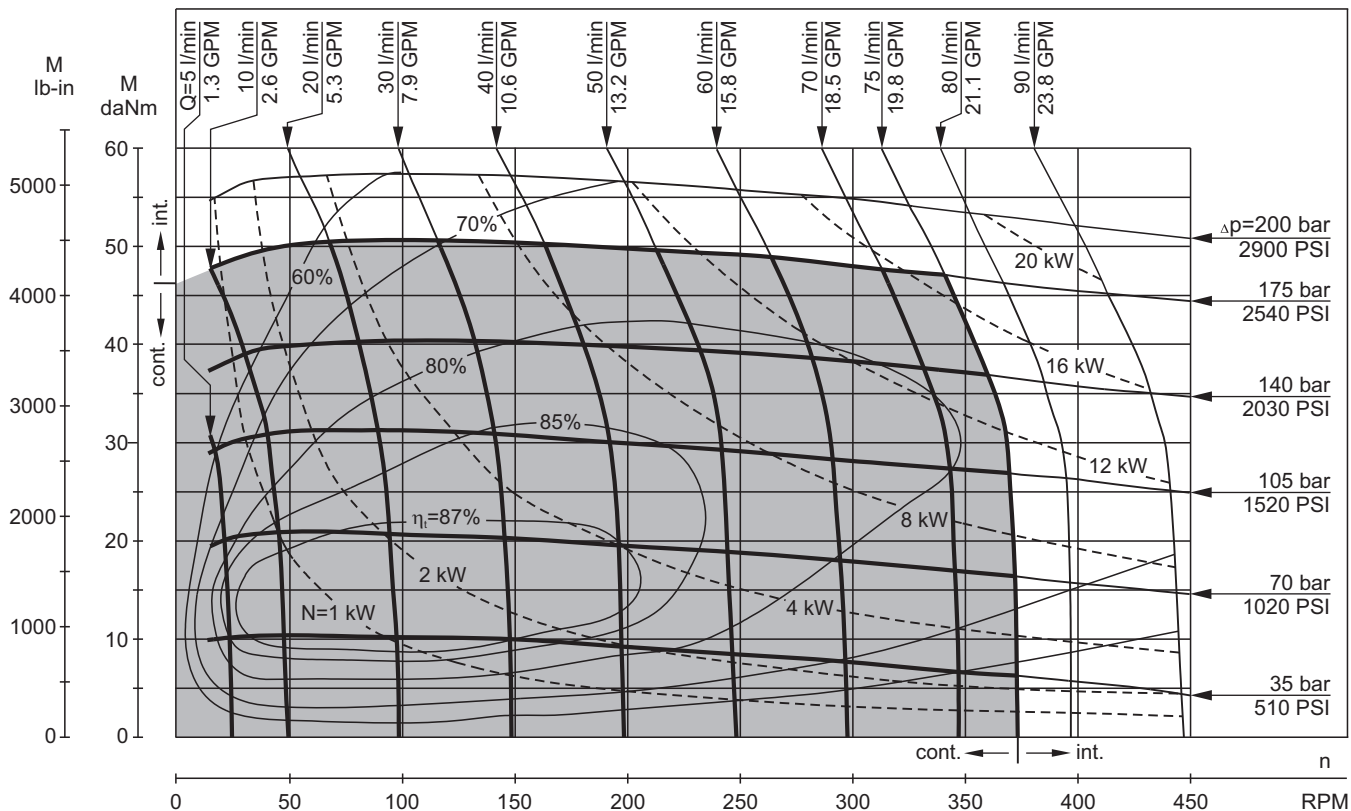
** Peak load: the permissible values may occur for max. 1% of every minute.

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

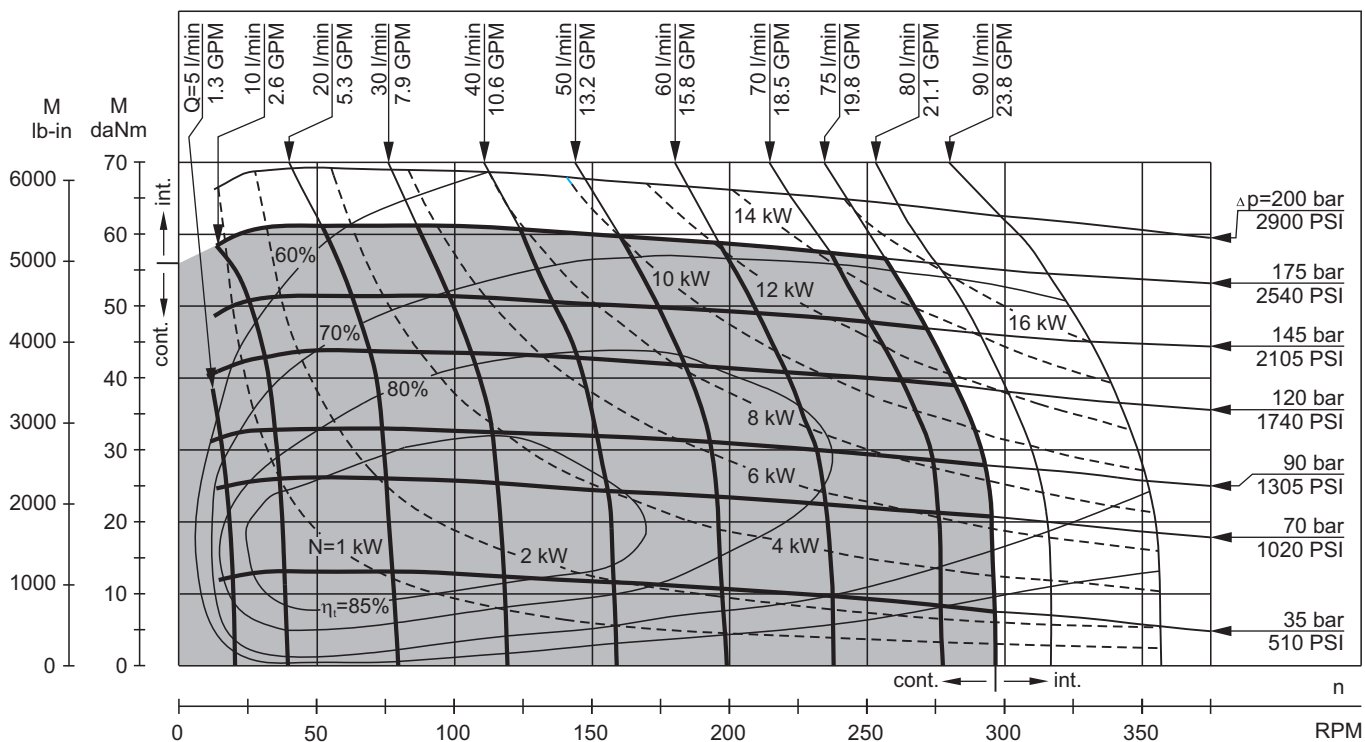
- Intermittent speed and intermittent pressure must not occur simultaneously.
- Recommended filtration is per ISO cleanliness code 20/16. A nominal filtration of 25 micron or better.
- Recommend using a premium quality, anti-wear type mineral based hydraulic oil, HLP(DIN51524) or HM(ISO6743/4).
If using 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.

FUNCTION DIAGRAMS

MLHH 200



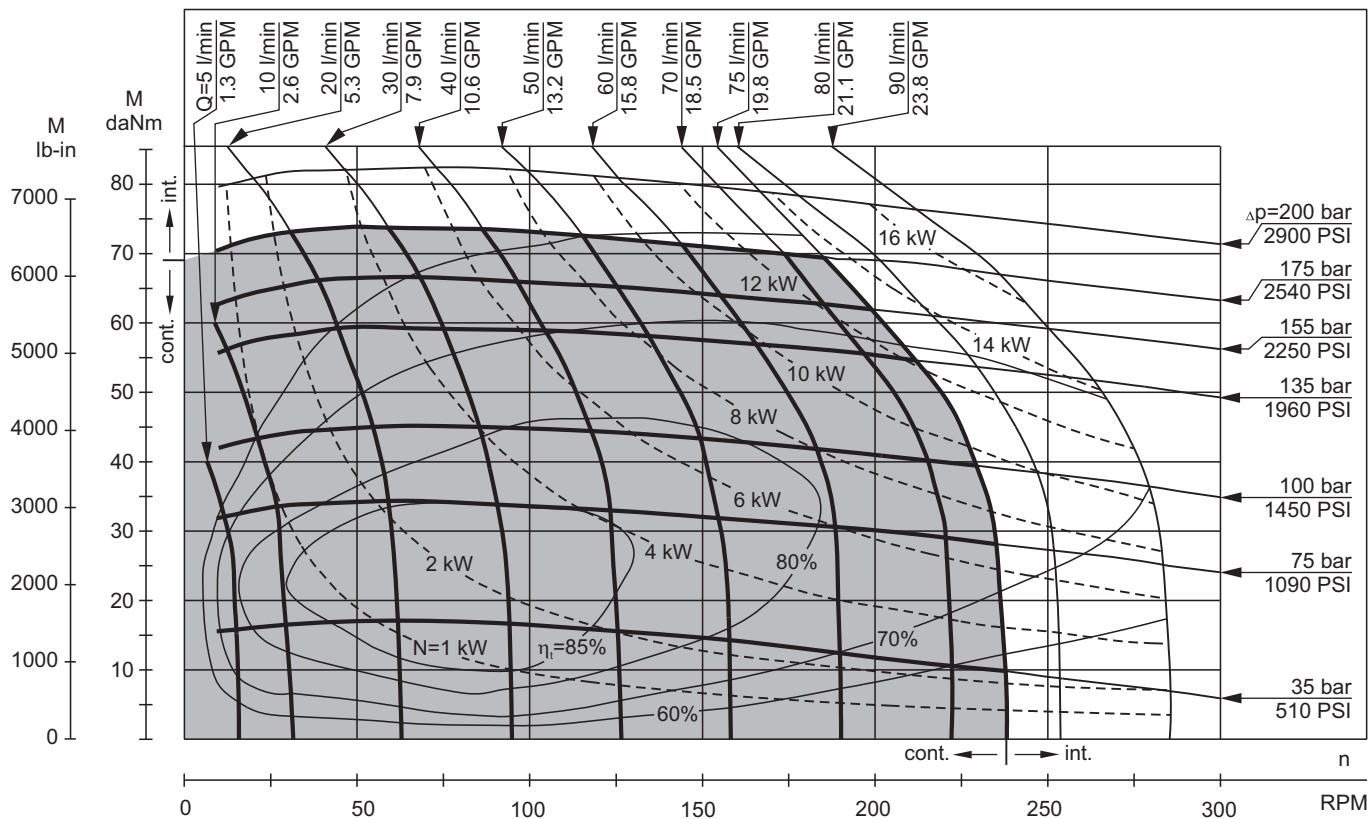
MLHH 250



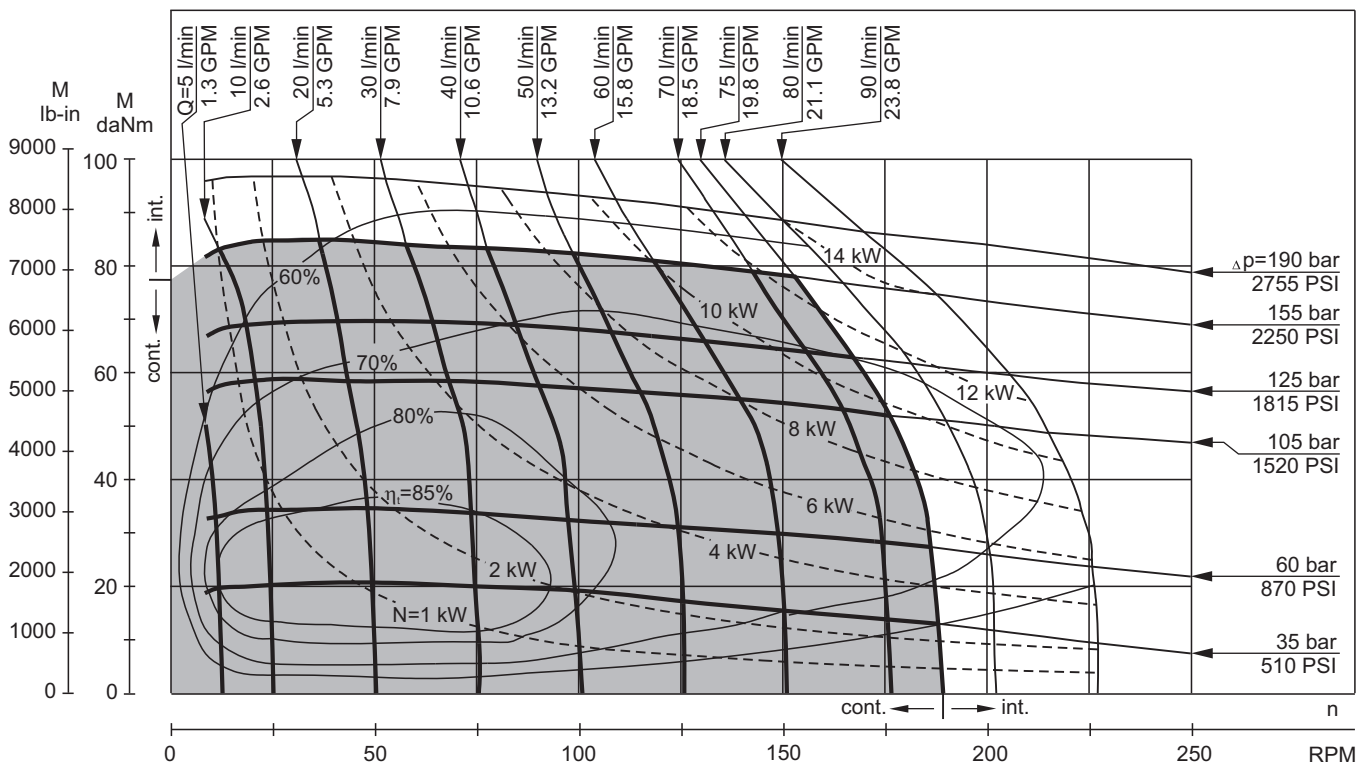
The function diagrams data is for average performance of randomly selected motors at back pressure 72.5 PSI÷145 PSI [5÷10 bar] and oil with viscosity of 150 SUS [32 mm²/s] at 122°F [50°C].

FUNCTION DIAGRAMS

MLHH 315



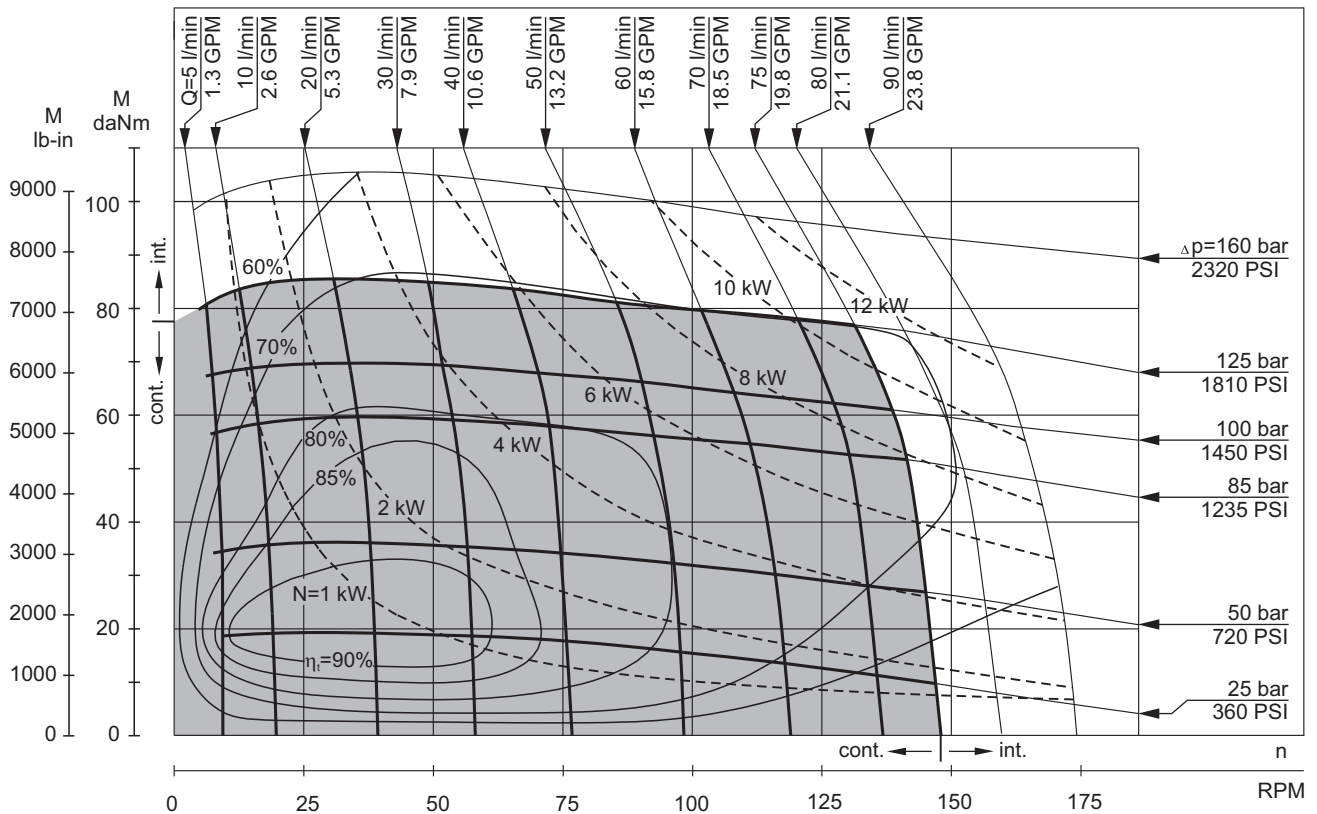
MLHH 400



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

MLHH 500



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].

PERMISSIBLE SHAFT LOADS

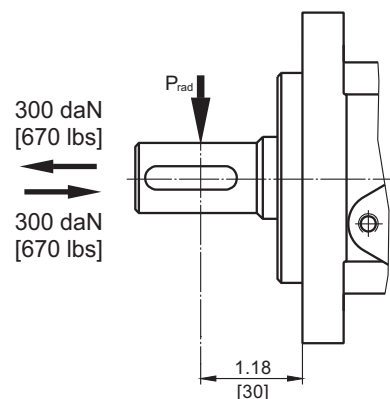
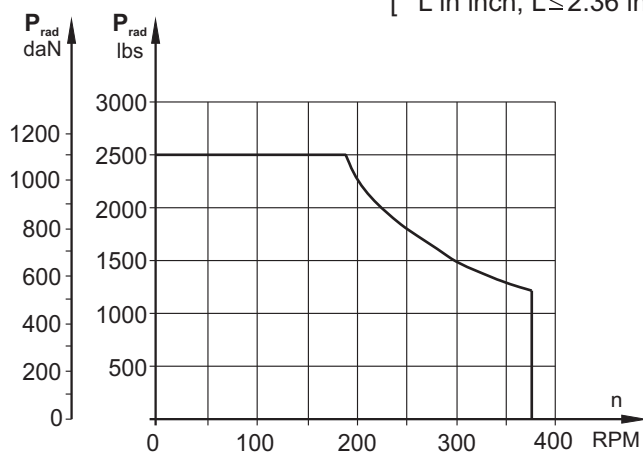
The permissible radial shaft load P_{rad} depends on the speed (RPM) and distance (L) from the point of load to the mounting flange.

$$\text{Radial Shaft Load } P_{rad} = \frac{1100}{n} \times \frac{25000}{103.5 + L}, \text{ daN}^*$$

[*L in mm; $L \leq 60$ mm; $n \geq 200$ RPM]

$$\text{Radial Shaft Load } P_{rad} = \frac{1100}{\text{RPM}} \times \frac{2215}{4.075 + L}, \text{ lbs}^{**}$$

[**L in inch; $L \leq 2.36$ in; $n \geq 200$ RPM]



DIMENSIONS and MOUNTING DATA

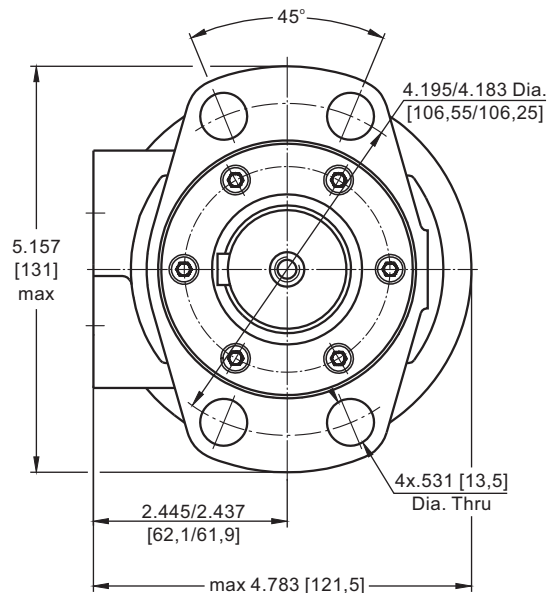
Magneto mount (4 holes)

Type	L, in [mm]	L ₁ , in [mm]
MLHH 200	6.65 [169]	1.09 [27,8]
MLHH 250	6.93 [176]	1.37 [34,8]
MLHH 315	7.24 [184]	1.71 [43,5]
MLHH 400	7.72 [196]	2.16 [54,8]
MLHH 500	8.31 [211]	2.73 [69,4]

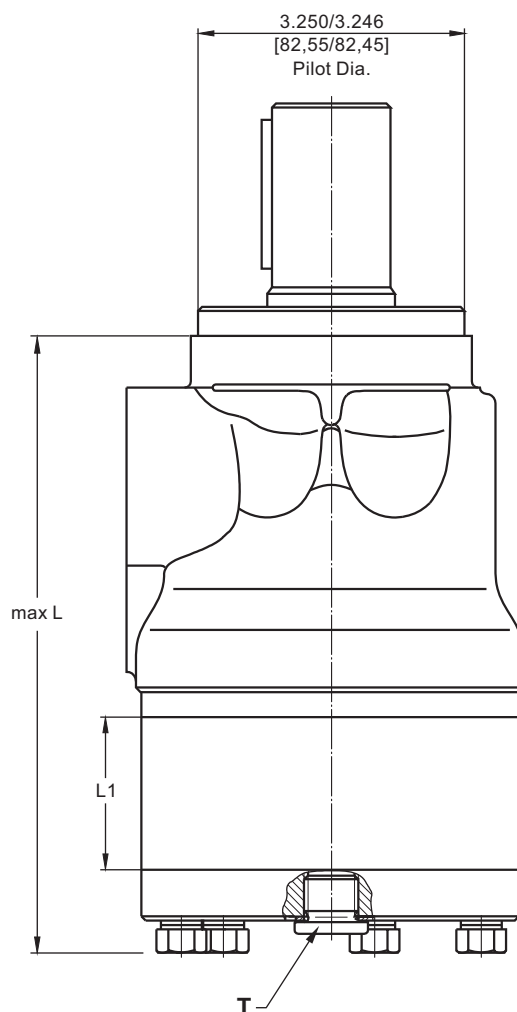
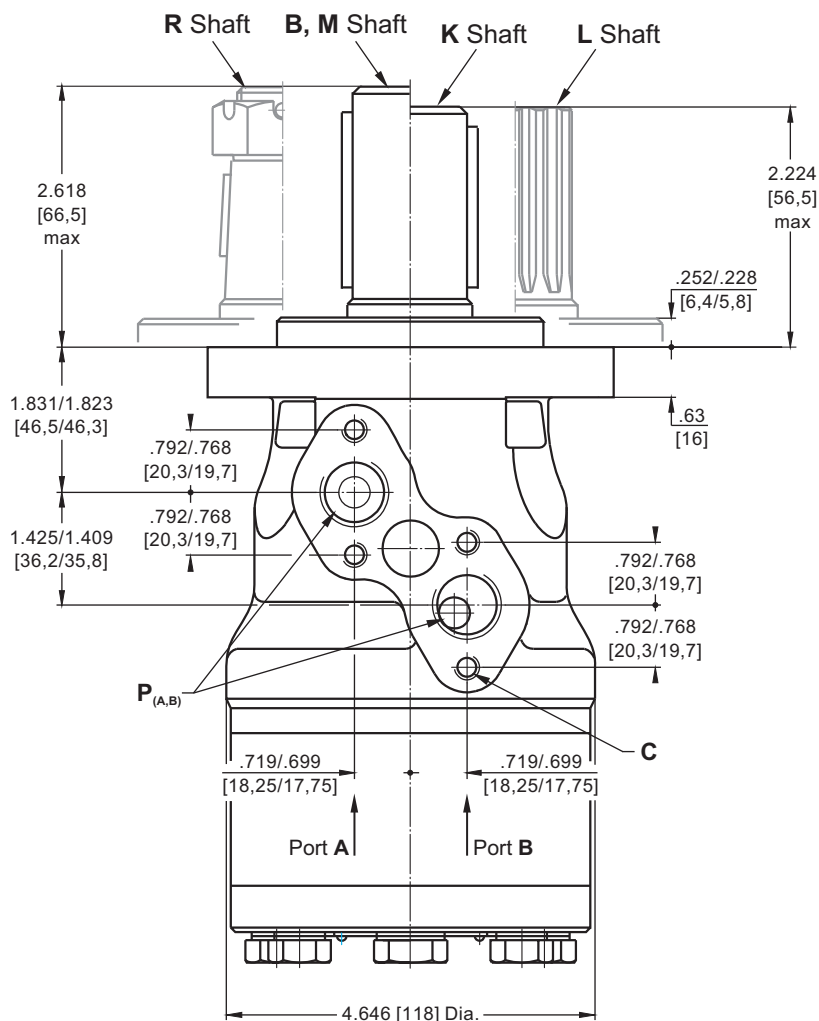
Standard Rotation
Viewed from Shaft End
Port **A** Pressurized - **CW**
Port **B** Pressurized - **CCW**

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

	Versions			
	2	3	4	5
C	4xM8	4xM8	4x $\frac{5}{16}$ -18 UNC	4x $\frac{5}{16}$ -18 UNC
P_(A,B)	2xG $\frac{1}{2}$	2xM22x1,5	2x $\frac{7}{8}$ -14 UNF	2x $\frac{1}{2}$ -14 NPTF
T	G $\frac{1}{4}$	M14x1,5	$\frac{7}{16}$ -20 UNF	$\frac{7}{16}$ -20 UNF



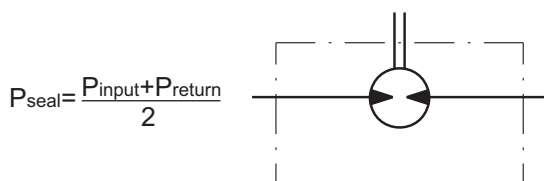
Shaft Dim.
See Page 85



MAX. PERMISSIBLE SHAFT SEAL PRESSURE

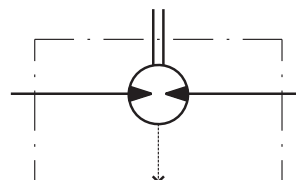
MLHH...U1 motors with high pressure seal and without drain connection:

The shaft seal pressure equals the average of input pressure and return pressure.



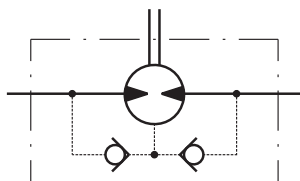
MLHH...U motors with high pressure seal and drain connection:

The shaft seal pressure equals the pressure in the drain line.



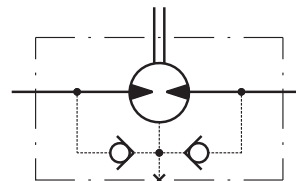
MLHH...1 motors with standard shaft seal and without drain connection:

The shaft seal pressure never exceeds the pressure in the return line.

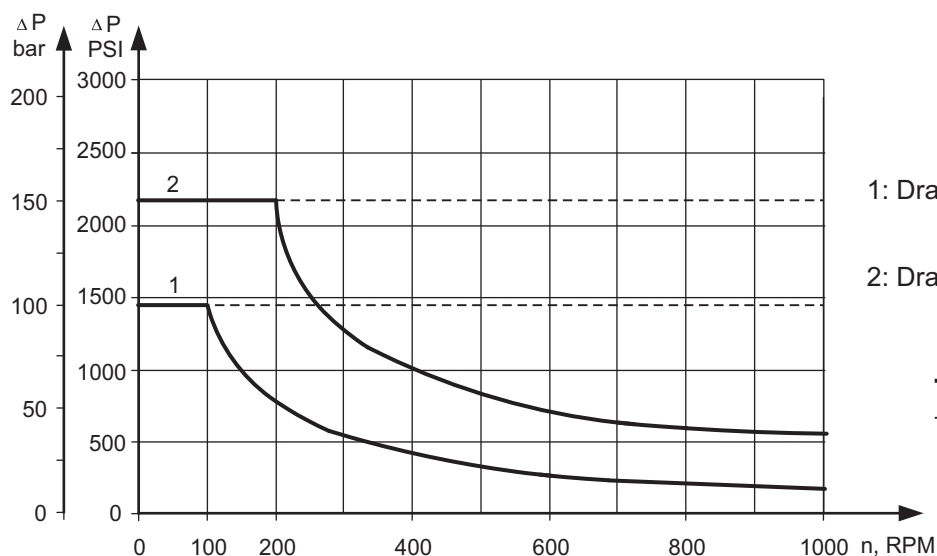


MLHH... motors with standard shaft seal and with drain connection:

The shaft seal pressure equals the pressure in the drain line.



Max. return pressure without drain line or max. pressure in the drain line



1: Drawing for Standard Shaft Seal

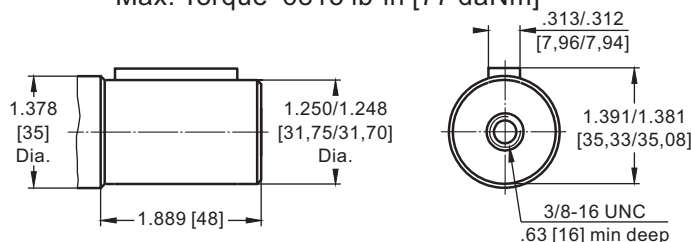
2: Drawing for High Pressure Seal ("U" Seal)

— - continuous operations
- - - - intermittent operations

SHAFT EXTENSIONS

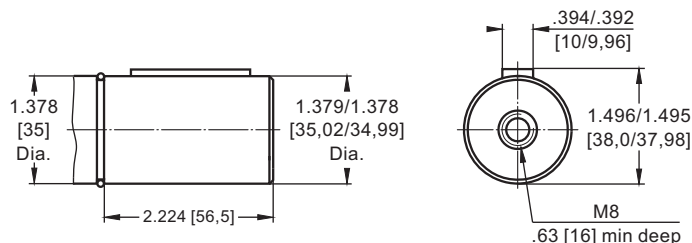
K

1 1/4" [31,75] straight, Parallel key 5/16"x 5/16"x1 1/4" BS 46
Max. Torque 6815 lb-in [77 daNm]



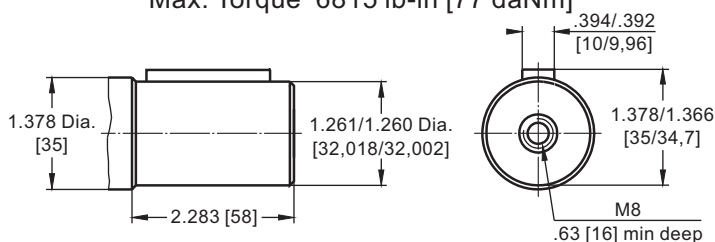
B

ø35 straight, Parallel key A10x8x45 DIN 6885
Max. Torque 8400 lb-in [95 daNm]



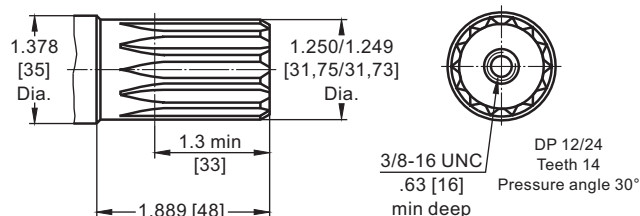
M

ø32 straight, Parallel key A10x8x45 DIN 6885
Max. Torque 6815 lb-in [77 daNm]



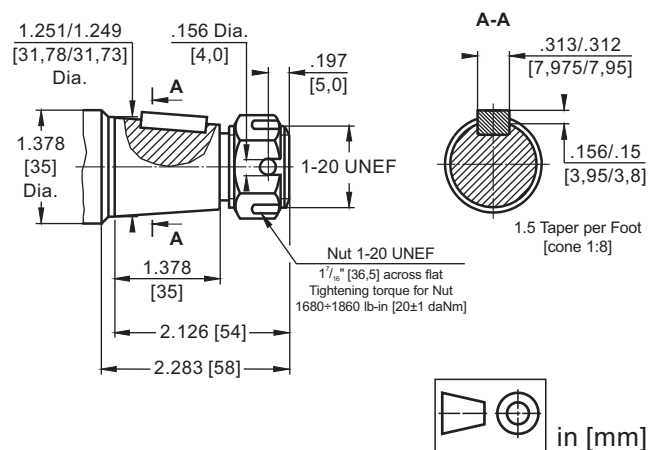
L

14T Splined, 1 1/4" [31,75], ANS B 92.1-1976
Max. Torque 8400 lb-in [95 daNm]



R

1 1/4" [31,75], SAE J501 Tapered, Parallel key 5/16"x 5/16"x1"
Max. Torque 8400 lb-in [95 daNm]



Requirement max. Torque must be not exceeded.

ORDER CODE

1	2	3	4	5	6	7
MLHH						

Pos.1 - Displacement code

200	- 12.3 in ³ /rev [201,3 cm ³ /rev]
250	- 15.4 in ³ /rev [252,0 cm ³ /rev]
315	- 16.4 in ³ /rev [314,9 cm ³ /rev]
400	- 24.2 in ³ /rev [396,8 cm ³ /rev]
500	- 30.7 in ³ /rev [502,4 cm ³ /rev]

Pos.2 - Shaft Extensions*

K	- 1 1/4" [31,75] straight, Parallel key
L	- 1 1/4" [31,75] Splined 14T ANS B92.1-1970
B**	- ø35 straight, Parallel key
R	- 1 1/4" [31,75] SAE J501 Tapered
M	- ø32 straight, Parallel key

Pos.3 - Port Size/Type [standard manifold to each]

2	- side ports, 2xG1/2, G1/4, BSP thread, ISO 228
3	- side ports, 2xM22x1,5, M14x1,5, metric thread, ISO 262
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.4 - Shaft Seal Version

omit	- Standard shaft seal
U	- High pressure shaft seal (without check valves)

Pos.5 - Drain Port

omit	- with drain port
1	- without drain port

Pos.6 - Additional Options [see page 110]

Pos.7 - Design Series

omit	- Factory specified
------	---------------------

NOTES:

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

** The following combination is not allowed: **B** shaft with **U** shaft seal.

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.

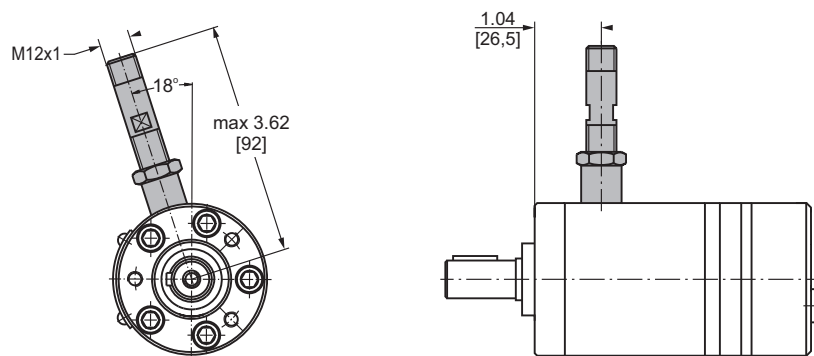
*** Non painted feeding surfaces, colour at customer's request.

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

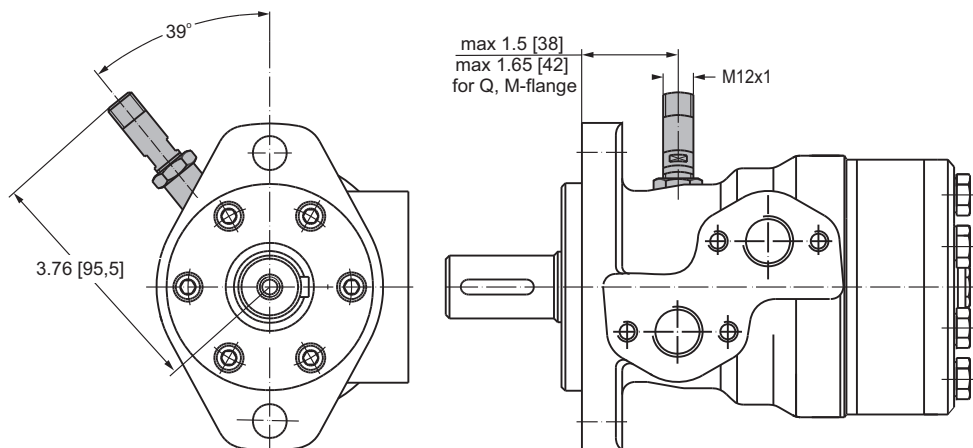
***** RS option is not available at HW...R (with relief valves).

MOTORS WITH SPEED SENSOR

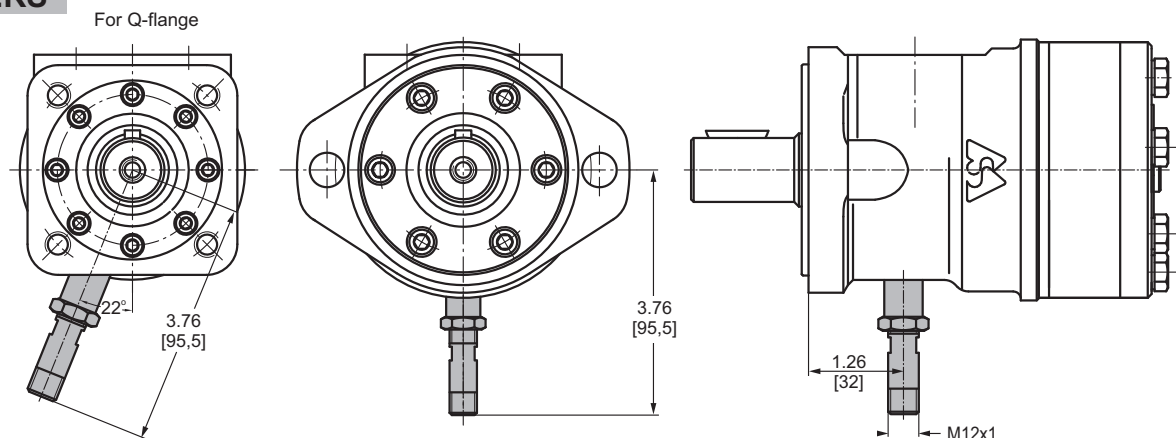
MLHM...RS



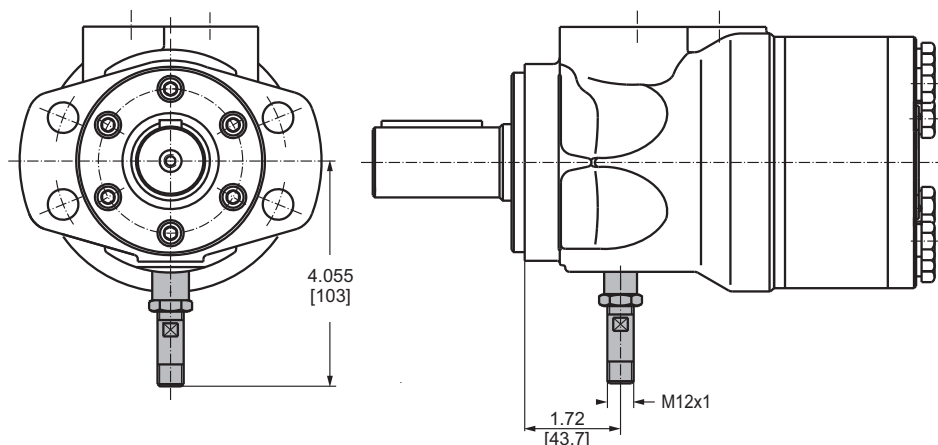
MLHP...RS MLHR...RS

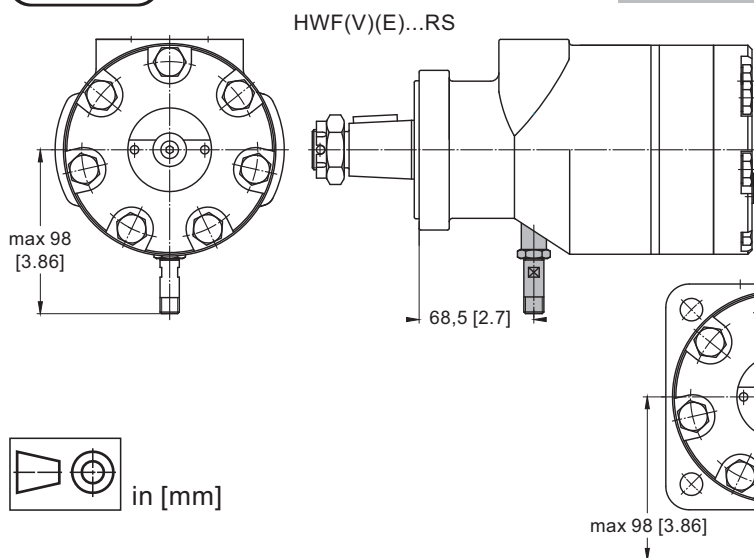


HP...RS HR...RS



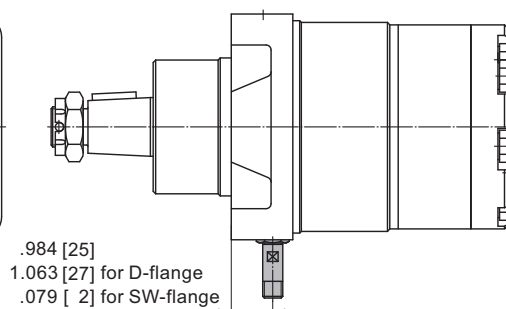
MLHH...RS





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

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

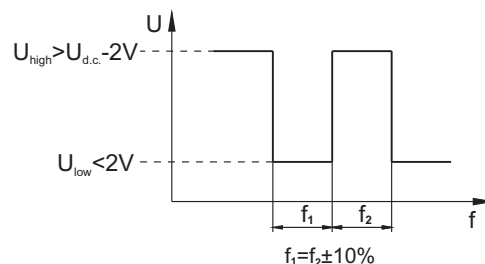


TECHNICAL DATA of the SPEED SENSOR

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

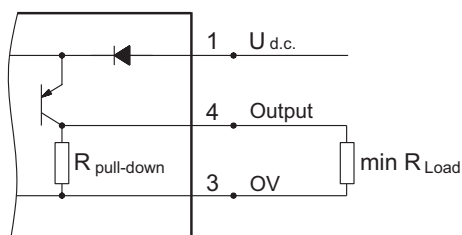


Load max.: $I_{high} = I_{low} < 50 \text{ mA}$

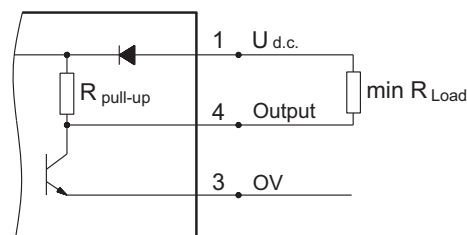
Motor type	MLHM	MLHP	MLHR	HP, HR	MLHH	HW
Pulses per revolution	30	36	36	36	42	12

Wiring diagrams

PNP

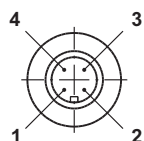


NPN



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

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

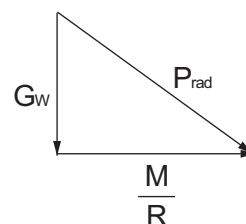
9.Radial motor loading: P_{rad} , lbs [daN]

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.

