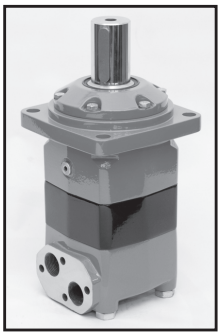
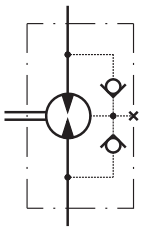
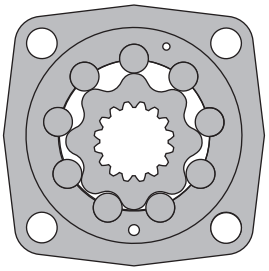
HYDRAULIC MOTORS MLHV



APPLICATION

» Conveyors
» Metal working machines
» Agricultural machines
» Road building machines
» Mining machinery
» Food industries
» Special vehicles
» Plastic and rubber machinery etc.





CONTENTS

OPTIONS

» Model - Disc valve, roll-gerotor
» Flange and wheel mount
» Short motor
» Tacho connection
» Speed sensoring
» Side ports
» Shafts - straight, splined and tapered
» SAE and BSPP ports
» Other special features

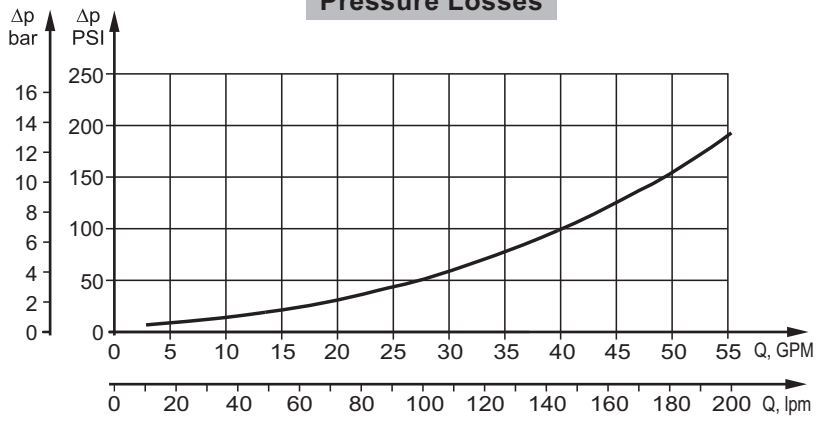
GENERAL

Max. Displacement, in^3/rev [cm^3/rev]	48.91 [801,8]
Max. Speed, [RPM]	630
Max. Torque, lb-in [daNm]	cont.: 16650 [188] int.: 18650 [211]
Max. Output, HP [kW]	85,8 [64]
Max. Pressure Drop, PSI [bar]	cont.: 2900 [200] int.: 3480 [240]
Max. Oil Flow, GPM [lpm]	63.4 [240]
Min. Speed, [RPM]	5
Permissible Shaft Loads lbs [daN]	P_a=3300 [1500]
Pressure fluid	Mineral based- HLP(DIN 51524) or HM(ISO 6743/4)
Temperature range, ^oF [^oC]	-40÷284 [-40÷140]
Optimal Viscosity range, SUS [mm^2/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]
2030 [140]	98 [20]	.793 [3]
	164 [35]	.528 [2]
3045 [210]	98 [20]	.1.585 [6]
	164 [35]	1.057 [4]

Pressure Losses



SPECIFICATION DATA

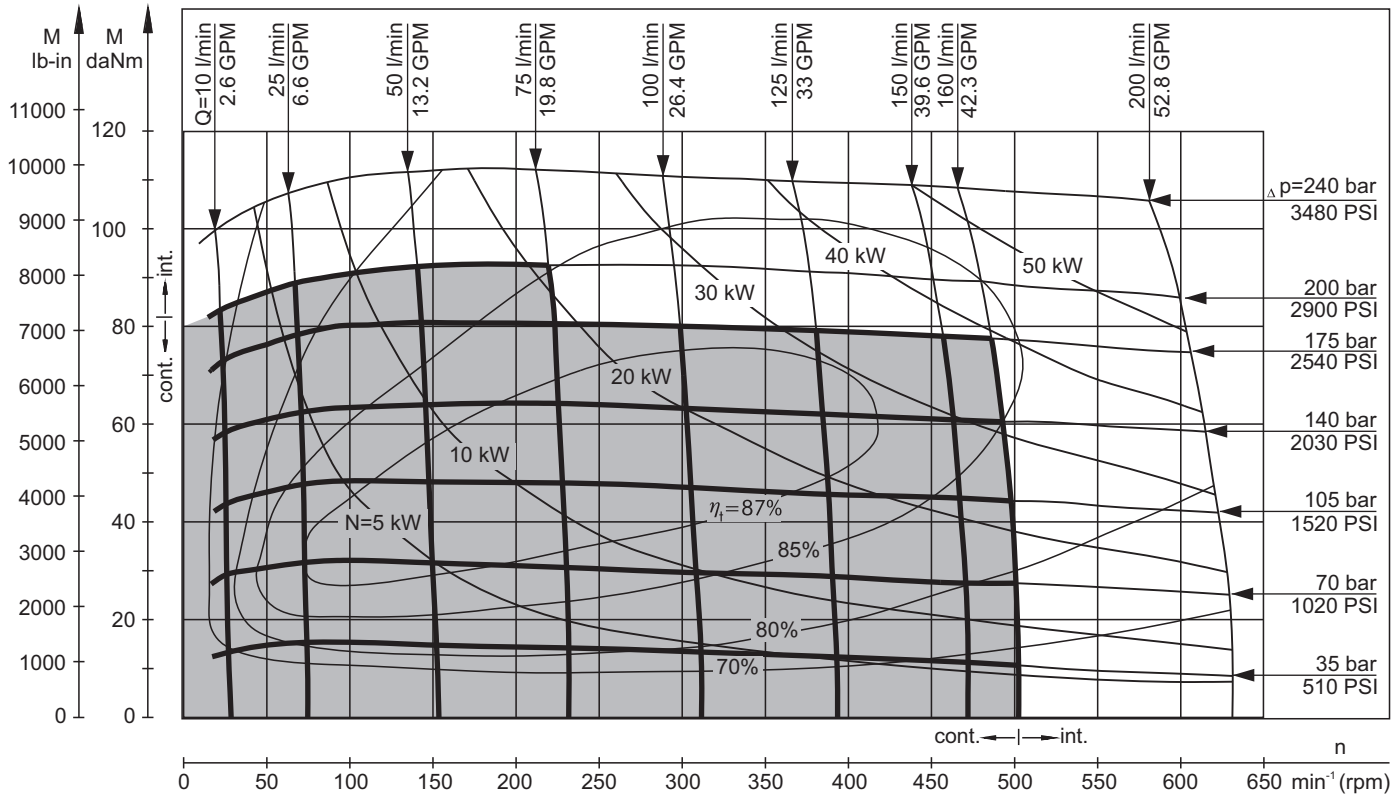
Type		MLHV 315	MLHV 400	MLHV 500	MLHV 630	MLHV 800
Displacement, in³/rev [cm³/rev]		19.18 [314,5]	24.45 [400,9]	30.48 [499,6]	38.38 [629,1]	48.91 [801,8]
Max. Speed, [RPM]	Cont.	510	500	400	320	250
	Int.*	630	600	480	380	300
Max. Torque lb-in [daNm]	Cont.	8150 [92]	10450 [118]	12950 [146]	14700 [166]	16650 [188]
	Int.*	9800 [111]	12500 [141]	15550 [176]	17150 [194]	18650 [211]
	Peak**	11400 [129]	14500 [164]	18150 [205]	19550 [221]	21850 [247]
Max. Output HP [kW]	Cont.	57 [42,5]	71.7 [53,5]	71.7 [53,5]	64.4 [48]	57 [42,5]
	Int.*	68,4 [51]	85.8 [64]	85.8 [64]	75 [56]	64.4 [48]
Max. Pressure Drop PSI [bar]	Cont.	2900 [200]	2900 [200]	2900 [200]	2600 [180]	2320 [160]
	Int.*	3480 [240]	3480 [240]	3480 [240]	3050 [210]	2610 [180]
	Peak**	4060 [280]	4060 [280]	4060 [280]	3480 [240]	3050 [210]
Max. Oil Flow GPM [lpm]	Cont.	42.3 [160]	52.8 [200]	52.8 [200]	52.8 [200]	52.8 [200]
	Int.*	52.8 [200]	63.4 [240]	63.4 [240]	63.4 [240]	63.4 [240]
Max. Inlet Pressure PSI [bar]	Cont.	3050 [210]	3050 [210]	3050 [210]	3050 [210]	3050 [210]
	Int.*	3620 [250]	3620 [250]	3620 [250]	3620 [250]	3620 [250]
	Peak**	4350 [300]	4350 [300]	4350 [300]	4350 [300]	4350 [300]
Max. Return Pressure with Drain Line PSI [bar]	Cont.	2040 [140]	2040 [140]	2040 [140]	2040 [140]	2040 [140]
	Int.*	2540 [175]	2540 [175]	2540 [175]	2540 [175]	2540 [175]
	Peak**	3050 [210]	3050 [210]	3050 [210]	3050 [210]	3050 [210]
Max. Starting Pressure with Unloaded Shaft, PSI [bar]		120 [8]	120 [8]	120 [8]	120 [8]	120 [8]
Min. Starting Torque lb-in [daNm]	At max. press. drop Cont.	6300 [71]	8100 [91]	10000 [113]	11800 [133]	13400 [151]
	At max. press. drop Int.*	7500 [85]	9600 [109]	12000 [136]	13700 [155]	15000 [170]
Min. Speed***, [RPM]		10	10	10	10	10
Weight, lb [kg]	MLHV	67.7 [30,7]	69.5 [31,5]	71.4 [32,4]	74.1 [33,6]	77.6 [35,2]
	MLHVW	69.2 [31,4]	71.0 [32,2]	73.0 [33,1]	75.6 [34,3]	79.2 [35,9]
	MLHVS	49.2 [22,3]	50.9 [23,1]	52.9 [24,0]	55.6 [25,2]	59.1 [26,8]

* 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.

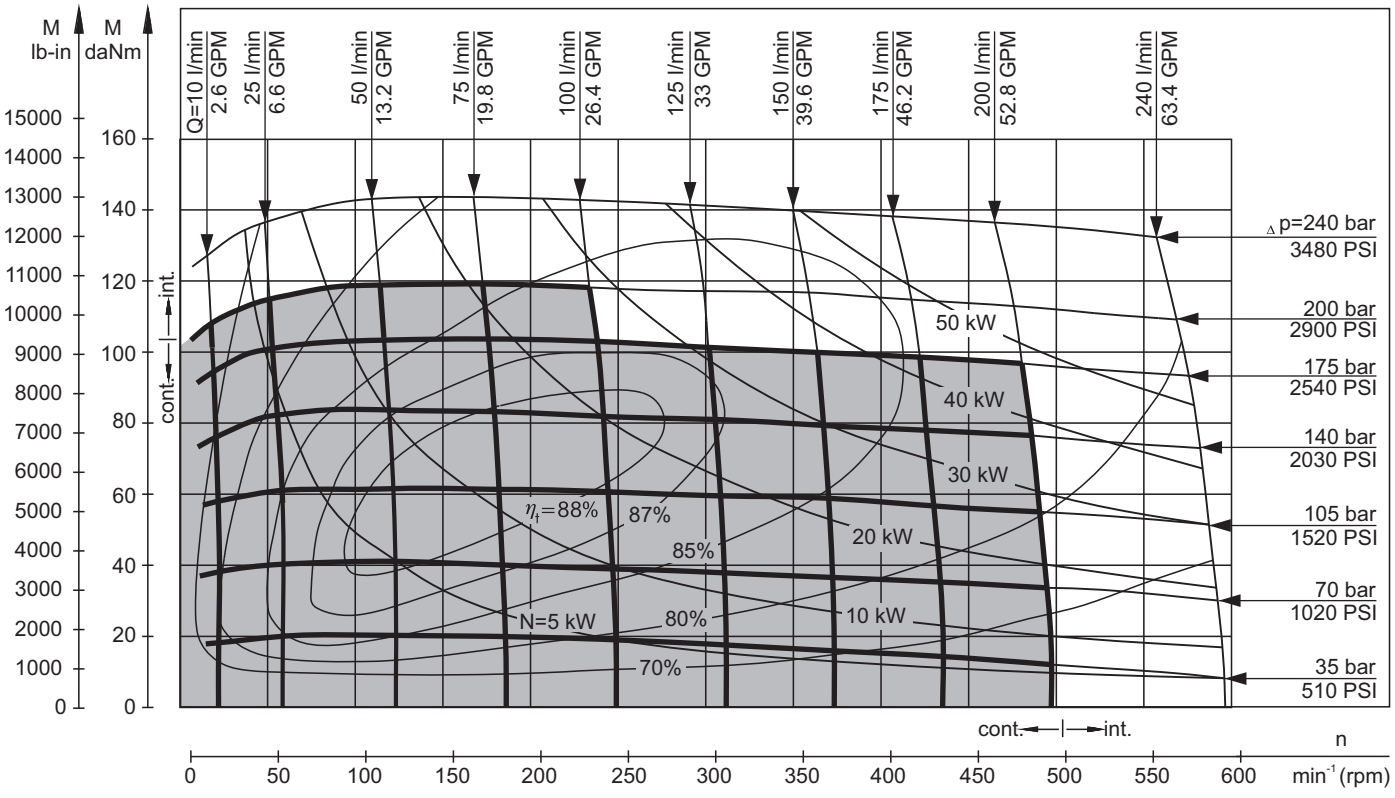
1. Intermittent speed and intermittent pressure drop must not occur simultaneously.
2. Recommended filtration is per ISO cleanliness code 20/16. A nominal filtration of 25 micron or better.
3. Recommend using a premium quality, anti-wear type mineral based hydraulic oil HLP(DIN51524) or HM (ISO 6743/4). If using synthetic fluids consult the factory for alternative seal materials.
4. Recommended minimum oil viscosity 70 SUS [13 mm²/s] at 122ºF [50ºC].
5. Recommended maximum system operating temperature is 180ºF [82ºC].
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

MLHV 315



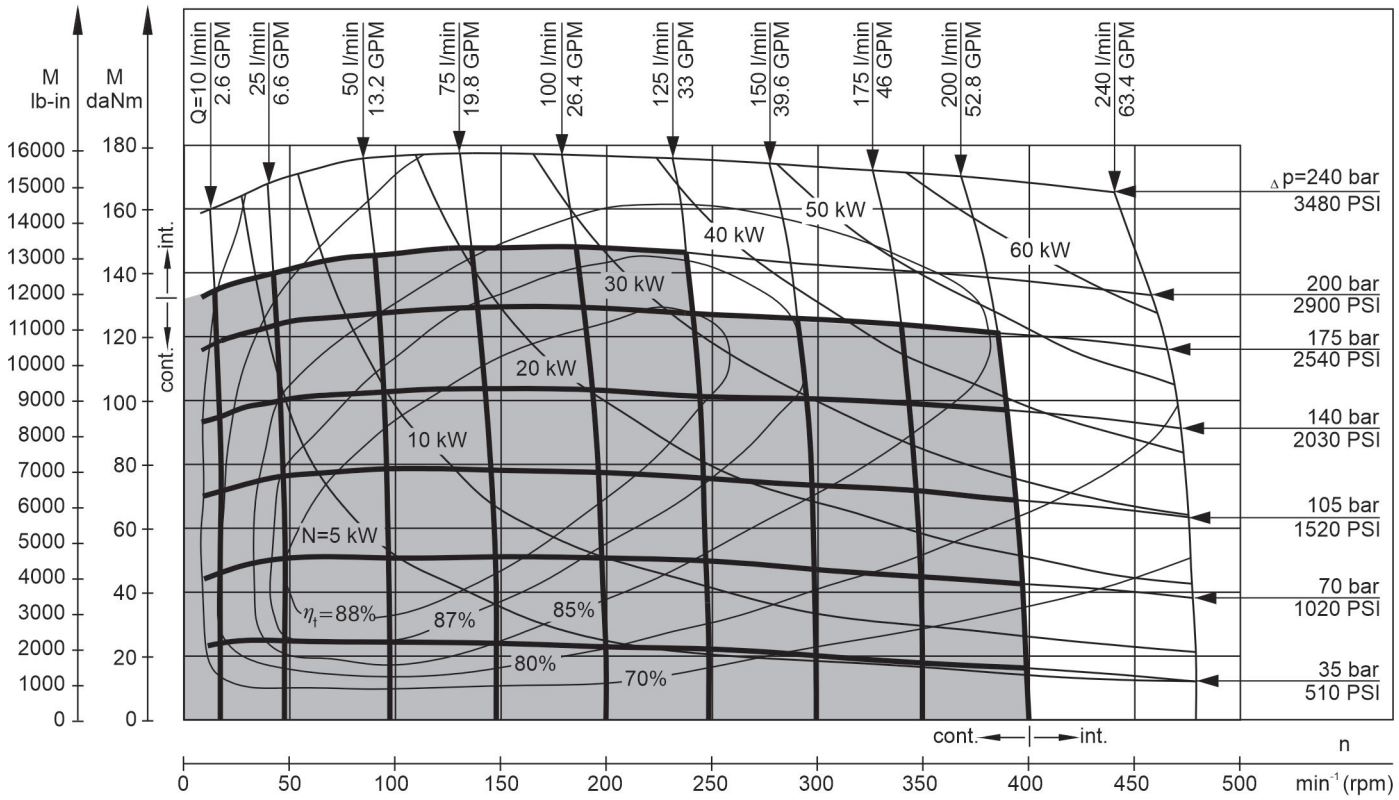
MLHV 400



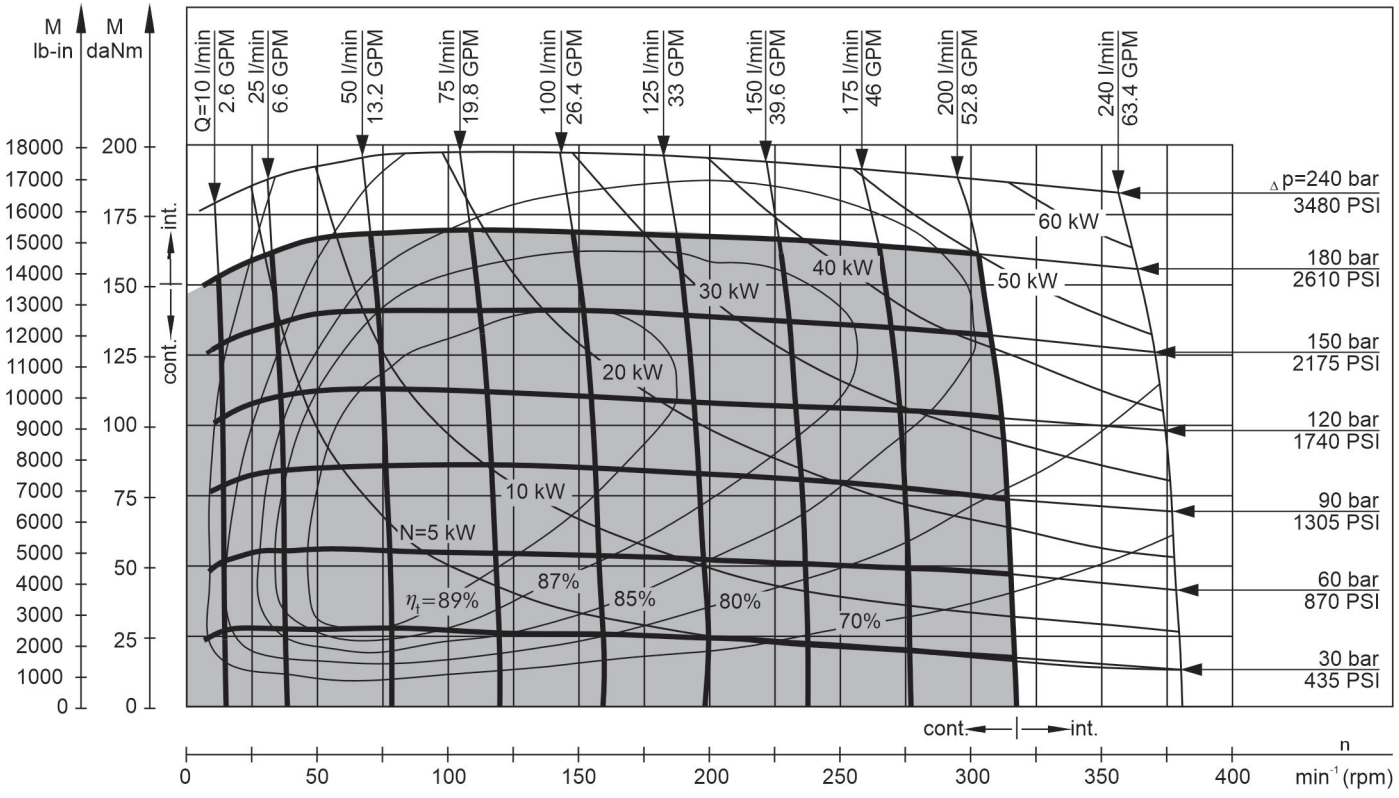
The function diagrams data is for average performance of randomly selected motors at back pressure 72.5÷145 PSI [5÷10 bar] and oil with viscosity of 150 SUS [32 mm²/s] at 122°F [50°C].

FUNCTION DIAGRAMS

MLHV 500



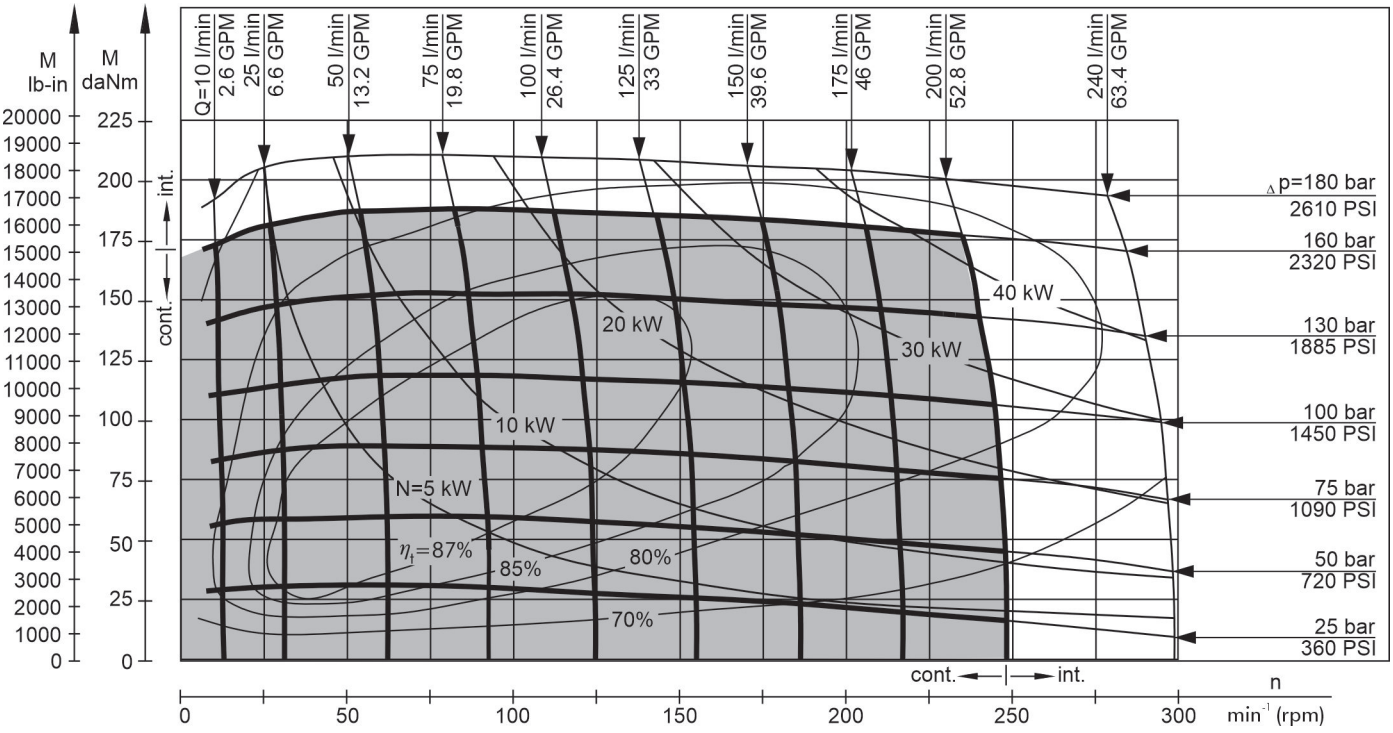
MLHV 630



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

FUNCTION DIAGRAMS

MLHV 800

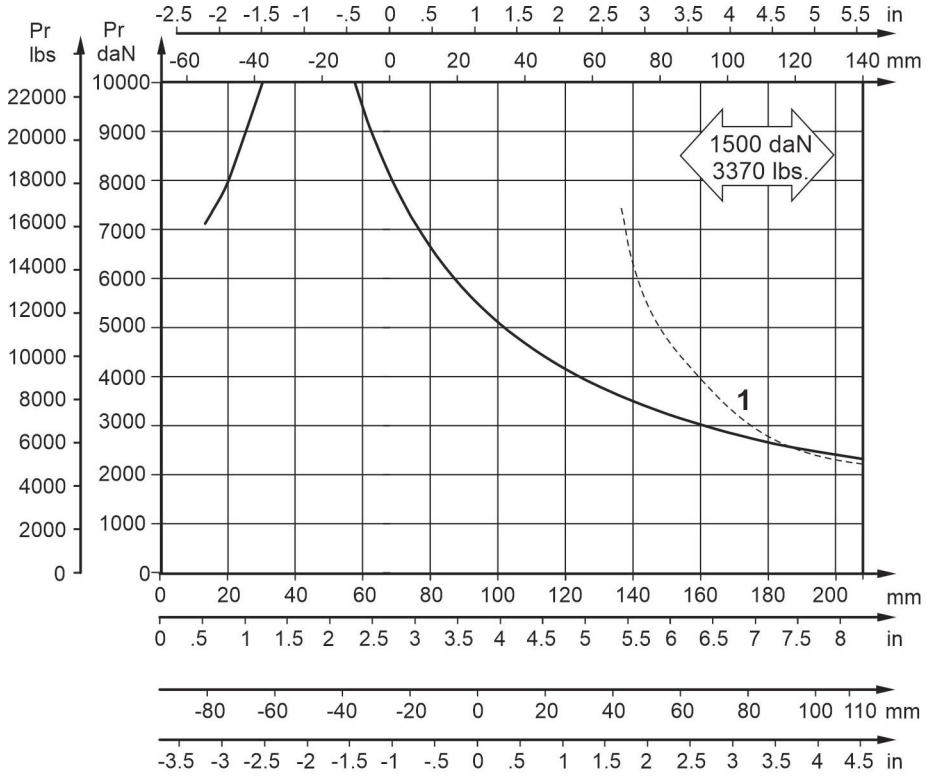


The function diagrams data is for average performance of randomly selected motors at back pressure 72.5÷145 PSI [5÷10 bar] and oil with viscosity of 150 SUS [32 mm²/s] at 122°F [50°C].

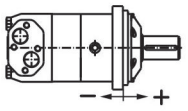
PERMISSIBLE SHAFT LOADS

The output shaft runs in tapered bearings that permit high axial and radial forces. The permissible radial load on the shaft is shown for an axial load of 0 N as function of the distance from the mounting flange to the point of load application. The curves apply to a B10 bearing life of 2000 hours at 100 RPM .

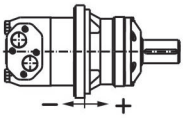
Curve "**1**" shows max. radial shaft load. Any shaft load exceeding the values shown by the curve will seriously reduce motor life.



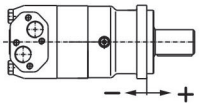
Mounting Flange:



Standard



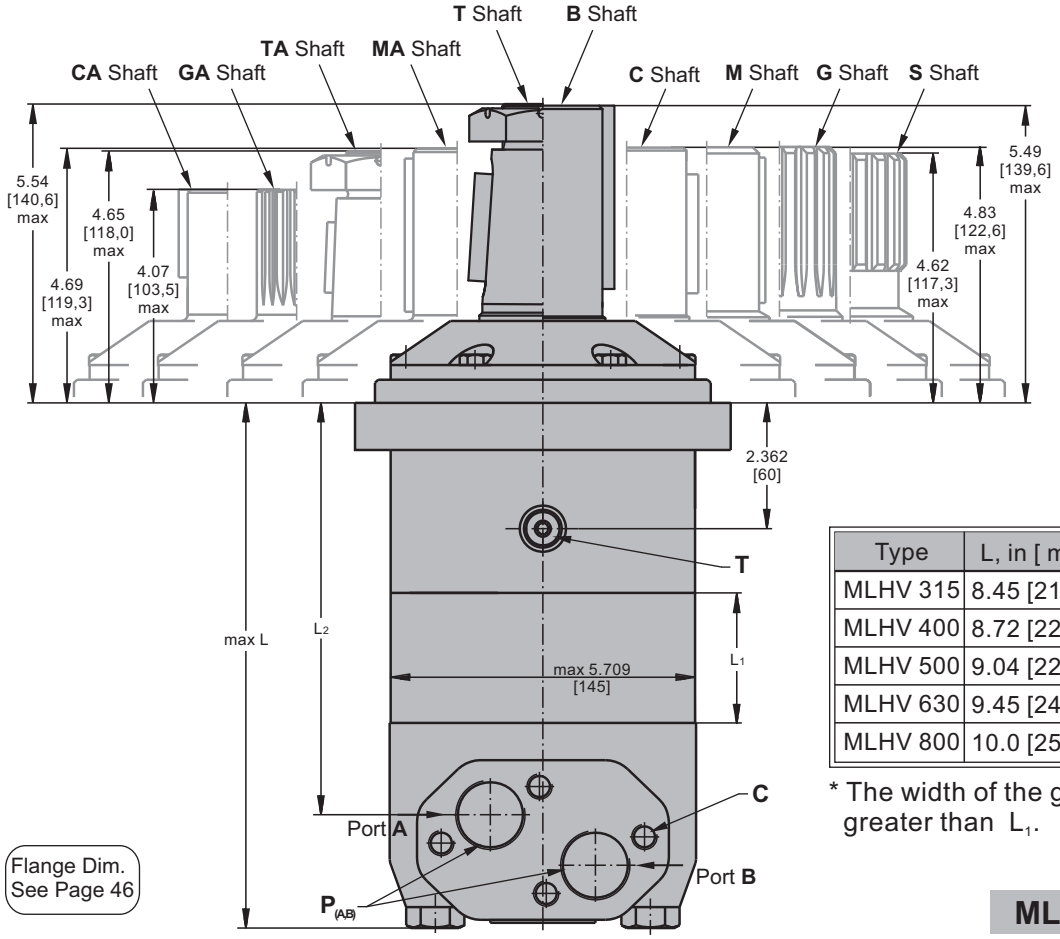
W - Wheel



C - Flange

M+S HYDRAULIC

DIMENSIONS AND MOUNTING DATA - MLHV



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**

Type	L, in [mm]	L_2, in [mm]	*L_1, in [mm]
MLHV 315	8.45 [214,5]	6.30 [160]	.87 [22,0]
MLHV 400	8.72 [221,5]	6.58 [167]	1.14 [29,0]
MLHV 500	9.04 [229,5]	6.89 [175]	1.46 [37,0]
MLHV 630	9.45 [240,0]	7.32 [186]	1.87 [47,5]
MLHV 800	10.0 [254,0]	7.87 [200]	2.42 [61,5]

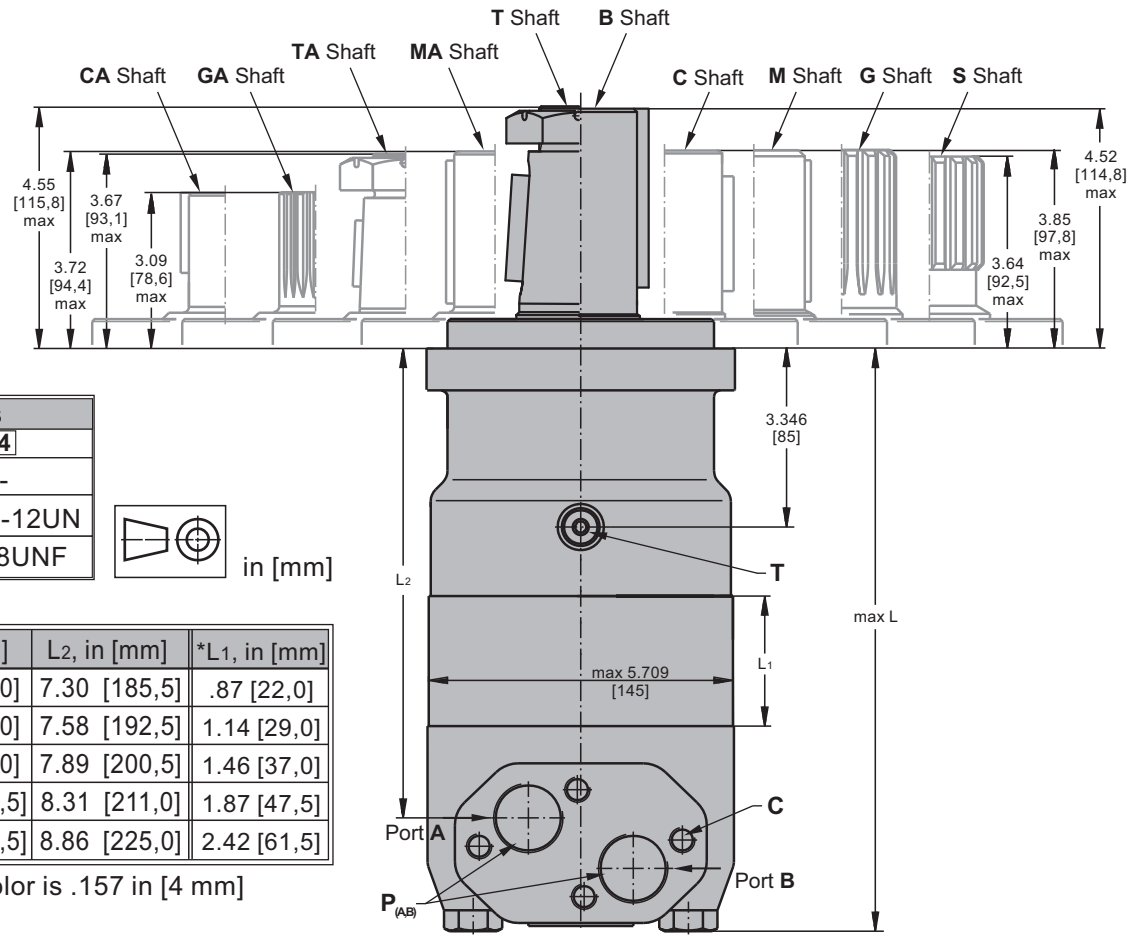
* The width of the gerolor is .157 in [4 mm] greater than L_1.

Flange Dim. See Page 46

Port Dim. See Page 46

Shaft Dim. See Page 50

MLHVC



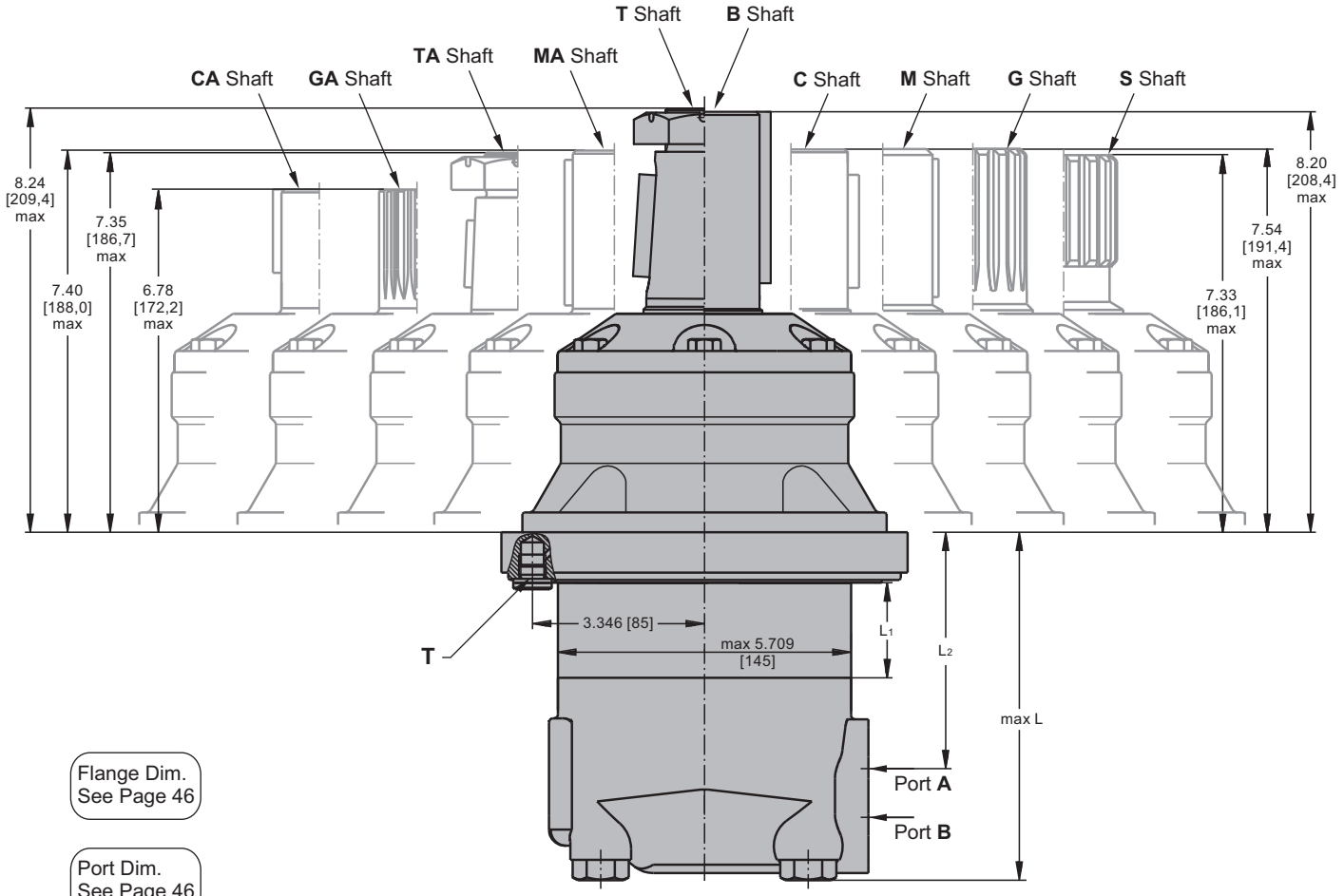
	Versions	
	2	4
C	4xM12	-
P (A,B)	2xG1	2x1 5/16-12UN
T	G1/4	9/16-18UNF

in [mm]

Type	L, in [mm]	L_2, in [mm]	*L_1, in [mm]
MLHVC 315	9.41 [239,0]	7.30 [185,5]	.87 [22,0]
MLHVC 400	9.68 [246,0]	7.58 [192,5]	1.14 [29,0]
MLHVC 500	10.0 [254,0]	7.89 [200,5]	1.46 [37,0]
MLHVC 630	10.41 [264,5]	8.31 [211,0]	1.87 [47,5]
MLHVC 800	10.96 [278,5]	8.86 [225,0]	2.42 [61,5]

* The width of the gerolor is .157 in [4 mm] greater than L_1.

DIMENSIONS AND MOUNTING DATA - MLHVW



Flange Dim.
See Page 46

Port Dim.
See Page 46

Shaft Dim.
See Page 50

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	4
C	4xM12	-
P (A,B)	2xG1	2x1 5/16-12UN
T	G¼	9/16-18UNF

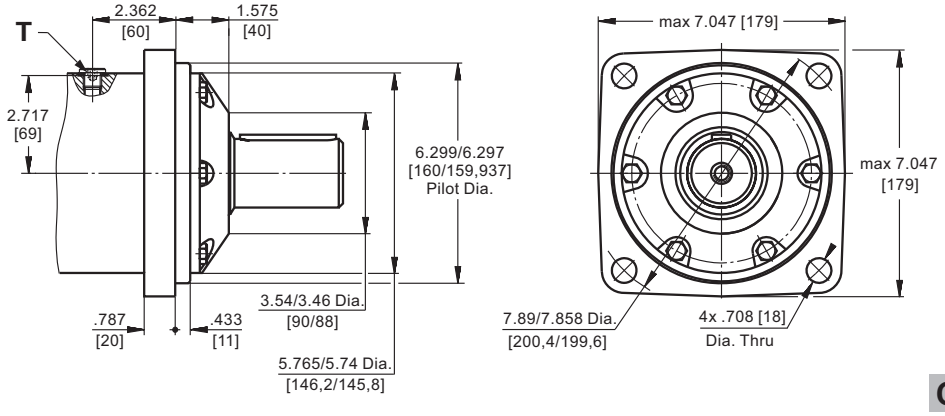
in [mm]

Type	L, in [mm]	L2, in [mm]	*L1, mm [in]
MLHVW 315	5.75 [146]	3.57 [90,6]	22,0 [.87]
MLHVW 400	6.02 [153]	3.84 [97,6]	29,0 [1.14]
MLHVW 500	6.34 [161]	4.16 [105,6]	37,0 [1.46]
MLHVW 630	6.77 [172]	4.57 [116,1]	47,5 [1.87]
MLHVW 800	7.28 [185]	5.12 [130,1]	61,5 [2.42]

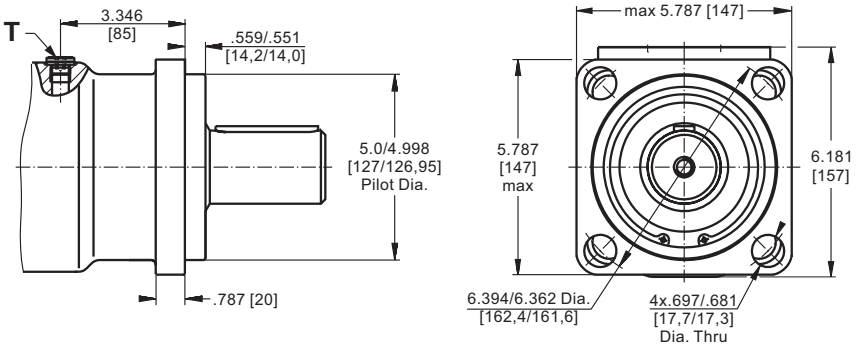
* The width of the gerotor is .157 in. [4 mm] greater than L_1.

MOUNTING

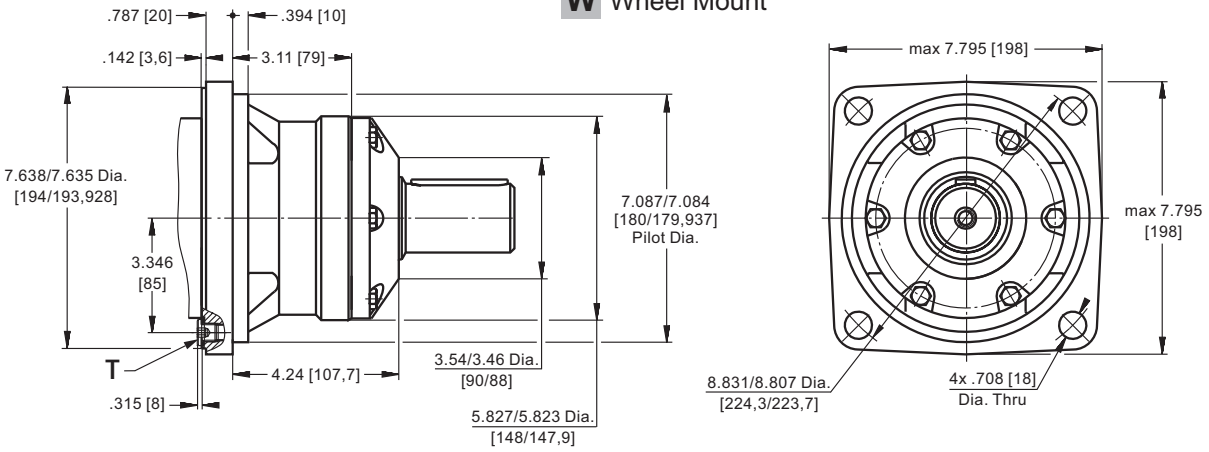
Square Mount (4 Holes)



C Mount

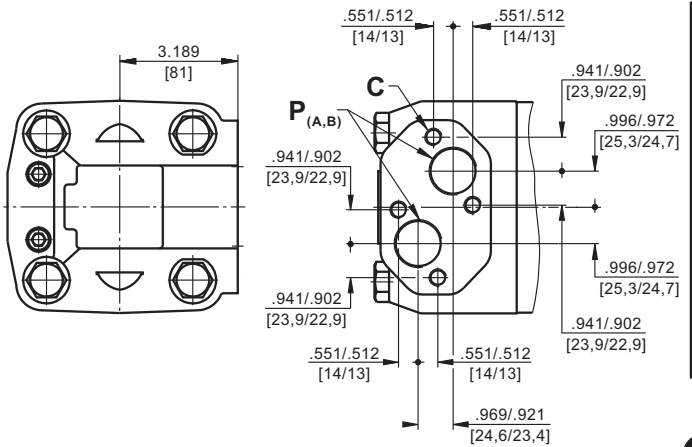


W Wheel Mount

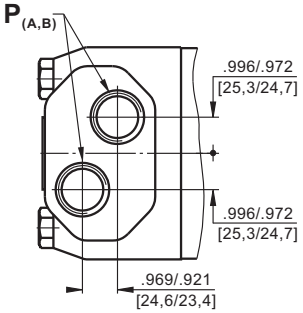


PORTS

Version 2



Version 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**

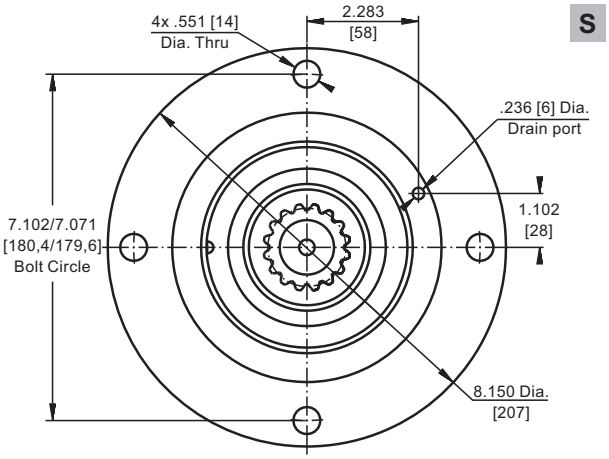
	Versions	
	2	4
C	4xM12	-
P (A,B)	2xG1	2x1 5/16-12UN
T	G¼	9/16-18UNF

in [mm]

M+S HYDRAULIC

DIMENSIONS AND MOUNTING DATA

S Short Mount



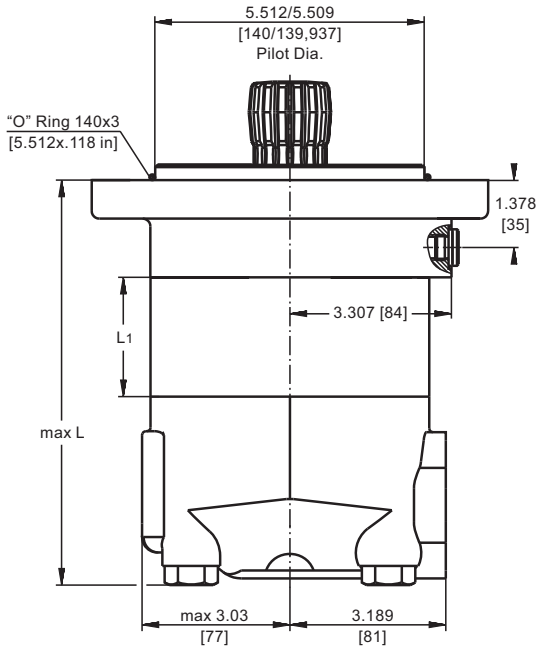
Type	L, in [mm]	L_2, in [mm]	*L_1, in [mm]
MLHVS 315	6.73[171]	4.61 [117]	.87 [22,0]
MLHVS 400	7.05[179]	4.88 [124]	1.14 [29,0]
MLHVS 500	7.32[186]	5.20 [132]	1.46 [37,0]
MLHVS 630	7.76[197]	5.63 [143]	1.87 [47,5]
MLHVS 800	8.31[211]	6.18 [157]	2.42 [61,5]

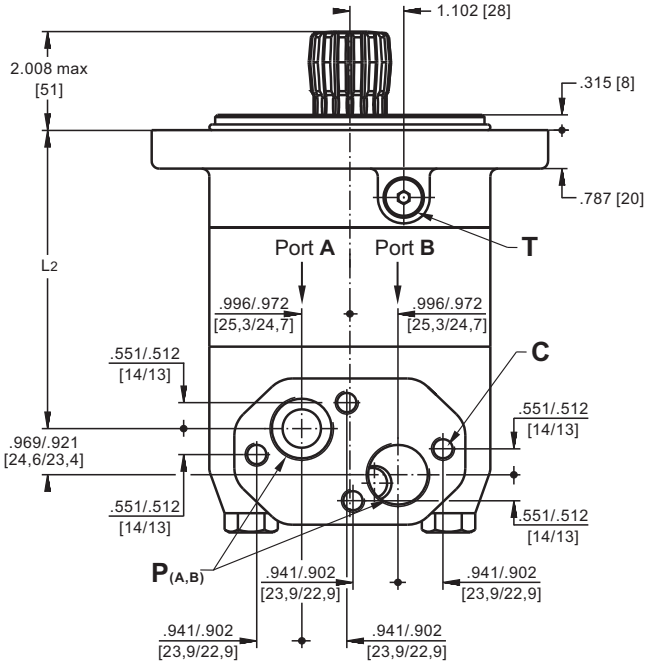
* The width of the gerolor is .157 in [4 mm] greater than L_1

	Versions	
	2	4
C	4xM12	-
P (A,B)	2xG1	2x1 5/16-12UN
T	G¼	9/16-18UNF

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

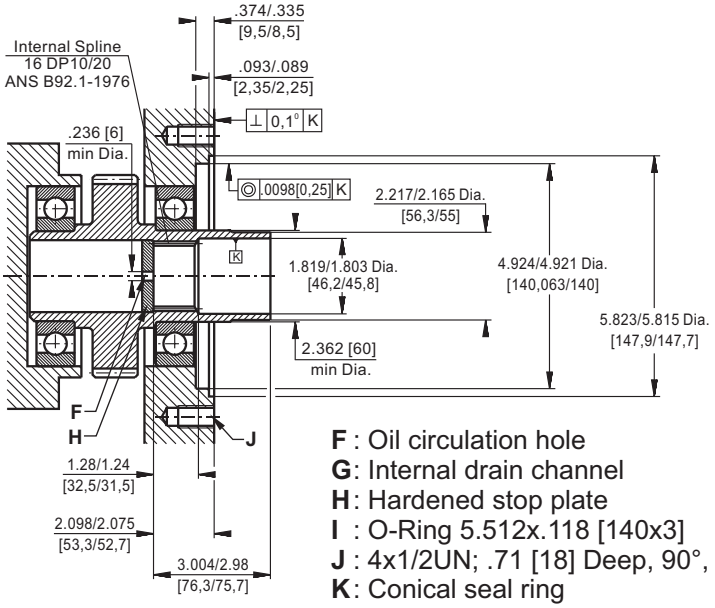
Reverse Rotation
Viewed from Shaft End
Port **A** Pressurized - **CCW**
Port **B** Pressurized - **CW**

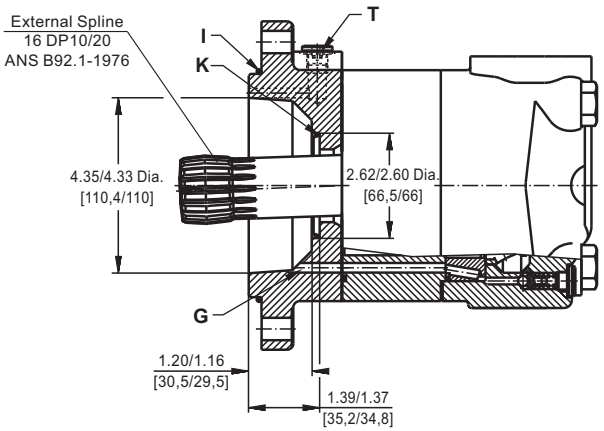




DIMENSIONS OF THE ATTACHED COMPONENT

in [mm]

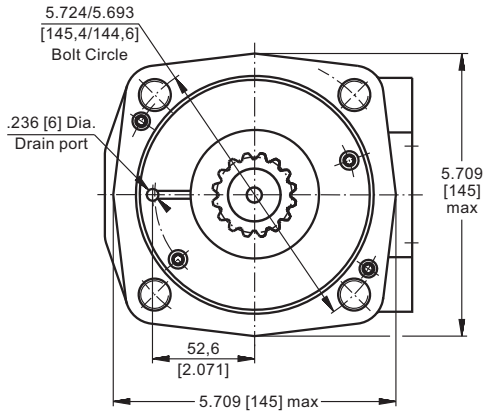




F : Oil circulation hole
G: Internal drain channel
H: Hardened stop plate
I : O-Ring 5.512x.118 [140x3]
J : 4x1/2UN; .71 [18] Deep, 90°, 7.087 [180] Dia. B. C.
K: Conical seal ring
T : Drain connection G1/4 or 9/16 - 18UNF

DIMENSIONS AND MOUNTING DATA

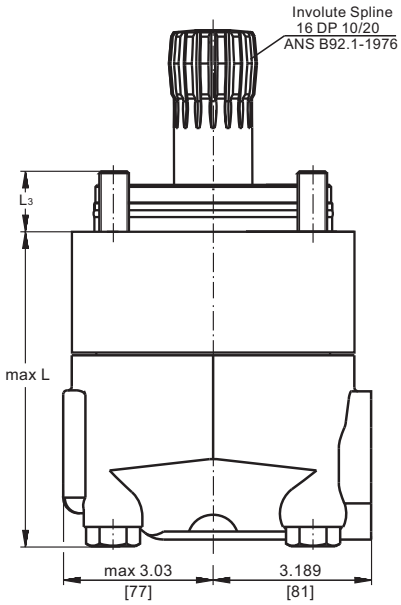
V Very Short Mount

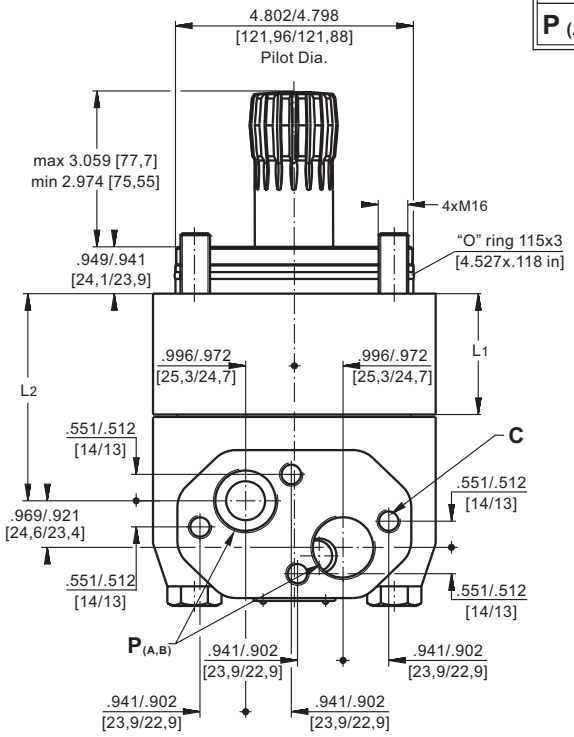


Type	L, in [mm]	L_2, in [mm]	L_3, in [mm]	*L_1, in [mm]
MLHVV 315	4.78 [121,5]	2.68 [68]	1.16 [29,5]	.87 [22,0]
MLHVV 400	5.06 [128,5]	2.95 [75]	1.28 [32,5]	1.14 [29,0]
MLHVV 500	5.37 [136,5]	3.27 [83]	1.36 [34,5]	1.46 [37,0]
MLHVV 630	5.79 [147,0]	3.66 [93]	1.34 [34,0]	1.87 [47,5]
MLHVV 800	6.34 [161,0]	4.23 [107,5]	1.18 [30,0]	2.42 [61,5]

* The width of the gerolor is .157 in [4 mm] greater than L_1.

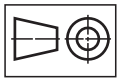
	Versions	
	2	4
C	4xM12	-
P (A,B)	2xG1	2x1⁵⁄₁₆-12UN





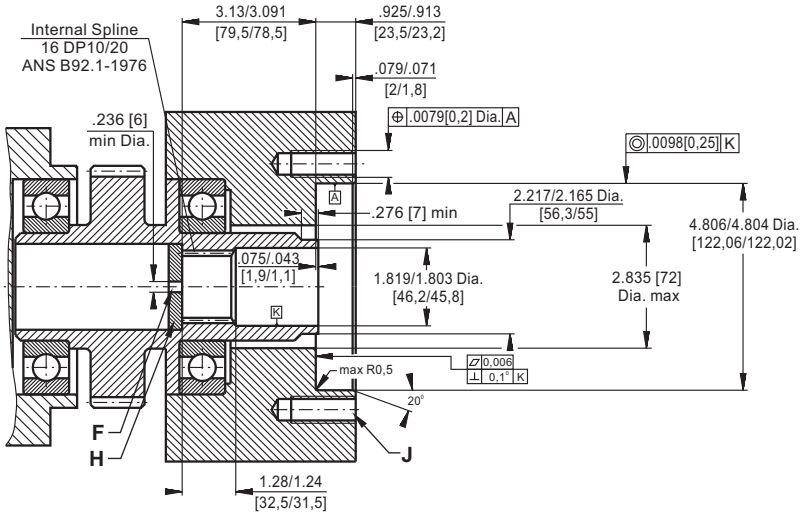
Standard Rotation
Viewed from Shaft End
Port **A** Pressurized - **CW**
Port **B** Pressurized - **CCW**

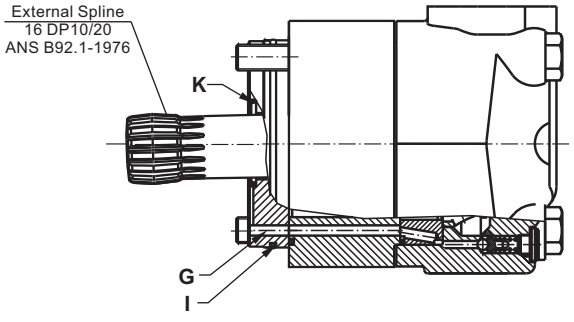
Reverse Rotation
Viewed from Shaft End
Port **A** Pressurized - **CCW**
Port **B** Pressurized - **CW**



in [mm]

DIMENSIONS OF THE ATTACHED COMPONENT





F : Oil circulation hole
G: Internal drain channel
H: Hardened stop plate
I : O- Ring 4.528x.118 in [115x3 mm]
J : 4xM16; 1.42 [36] Deep, 90°, 5.709 [145] Dia. B. C.
K: Conical seal ring

DRAIN CONNECTION

A drain line has to be used when pressure in the return line can exceed the permissible pressure. It can be connected:

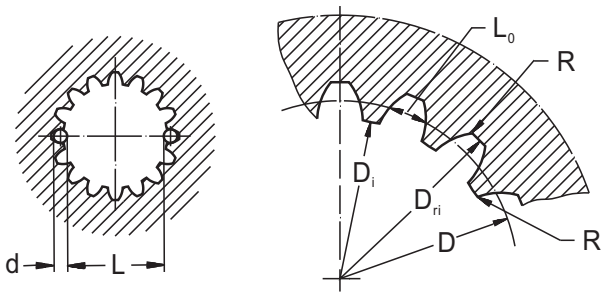
- For MLHVS at the drain port of the motor;
- For MLHVV at the drain connection of the attached component. The maximum pressure in the drain line is limited by the attached component and its shaft seal.

The drain line must be possible for oil to flow freely between motor and attached component and must be led to the tank. The maximum pressure in the drain line is limited by the attached component and its seal.

INTERNAL SPLINE DATA FOR THE ATTACHED COMPONENT

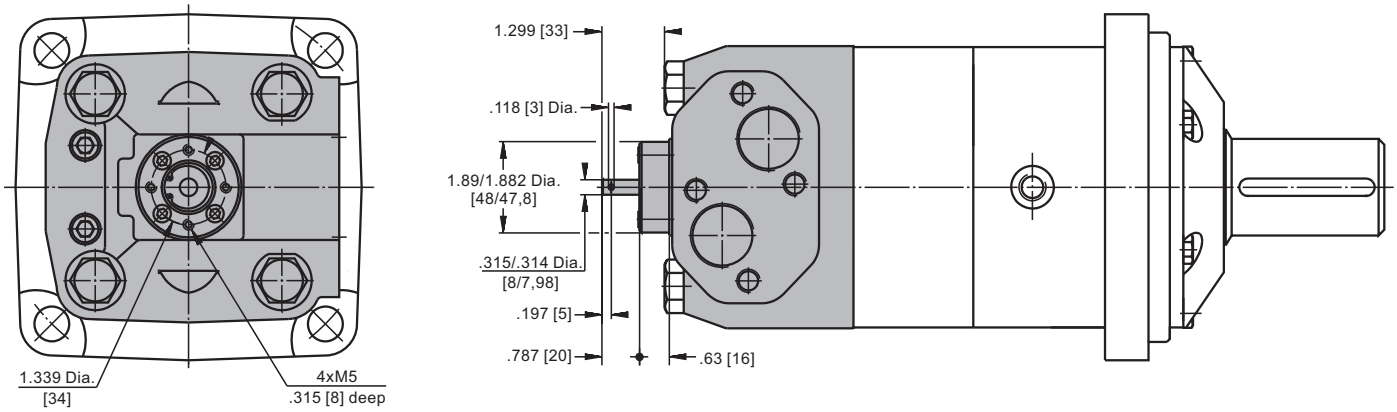
Standard ANS B92.1-1976, class 5
[m=2.54; corrected x.m=1]

Flat Root Side Fit		inch	mm
Number of Teeth	z	16	16
Diametral Pitch	DP	10/20	10/20
Pressure Angle		30^0	30^0
Pitch Dia.	D	1.6	40,640
Major Dia.	Dri	1.796÷1.780	$45{,}2^{+0{,}4}$
Minor Dia.	Di	1.5175÷1.516	$38{,}5^{+0{,}039}$
Space Width [Circular]	Lo	.2055÷.2025	5,18±0,037
Fillet Radius	R	.015	0,4
Max. Measurement between Pins	L	1.284÷1.278	$32{,}47^{+0{,}15}$
Pin Dia.	d	.22051÷.22043	5,6±0,001



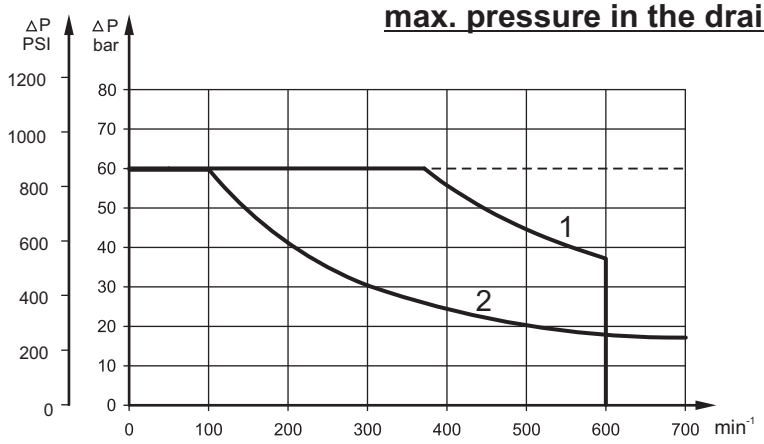
Hardening Specification:
HV=750±50 on the surface.
HV=560 at .035-.019 [0,7±0,2] case depth
Material: 20 MoCr4 DIN 17210 or SAE8620.

MOTOR WITH TACHO CONNECTION



MAX. PERMISSIBLE SHAFT SEAL PRESSURE

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

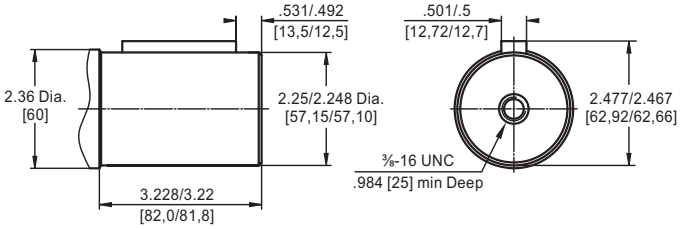


1: Drawing for High Pressure Seal ("U" Seal)
2: Drawing for Standard Shaft Seal

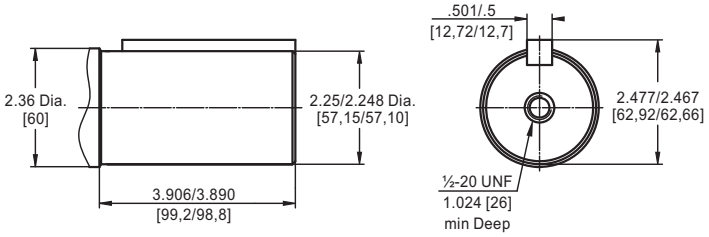
——— - continuous operations
- - - - - - intermittent operations

SHAFT EXTENSIONS

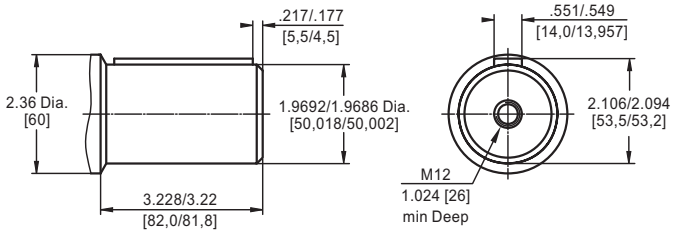
C - 2¼"[57,15] straight, Parallel key ½"x½"x 2¼" BS46
Max. Torque 24000 lb-in [271,2 daNm]



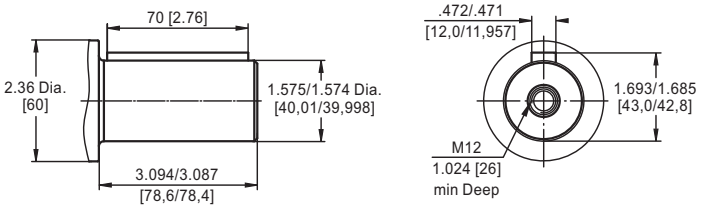
B - 2¼"[57,15] straight, Parallel key ½"x½"x 2¼" BS46
Max. Torque 24000 lb-in [271,2 daNm]



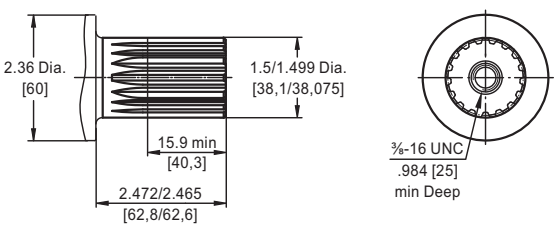
M - ø50 straight, Parallel key A14x9x70 DIN 6885
Max. Torque 24000 lb-in [271,2 daNm]



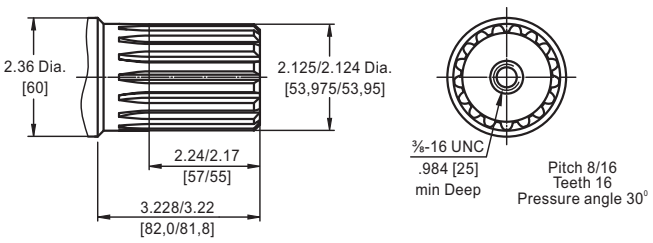
MA - ø40 straight, Parallel key A12x8x70 DIN 6885
Max. Torque 11755 lb-in [132,8 daNm]



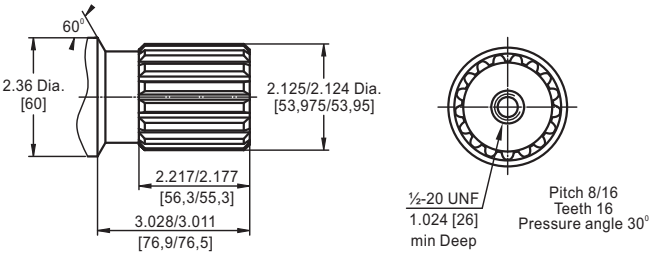
GA - ø1½" splined 17T, DP 12/24 ANSI B92.1-1976
Max. Torque 11755 lb-in [132,8 daNm]



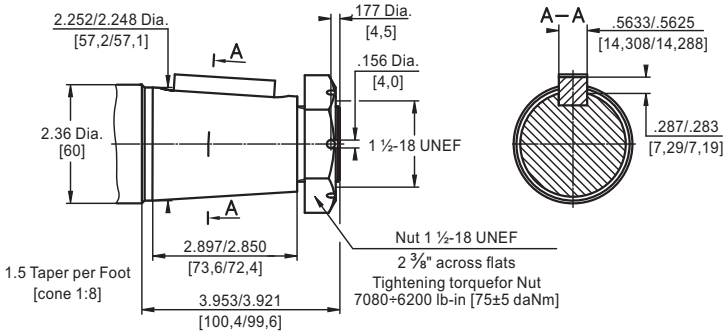
G - 16T Splined, 2⅛" [53,975] ANS B92.1-1976
Max. Torque 24000 lb-in [271,2 daNm]



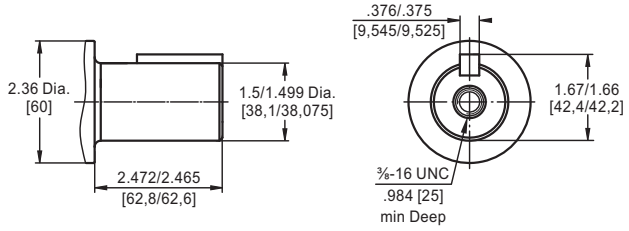
S - 16T Splined, 2⅛" [53,975] ANS B92.1-1976
Max. Torque 24000 lb-in [271,2 daNm]



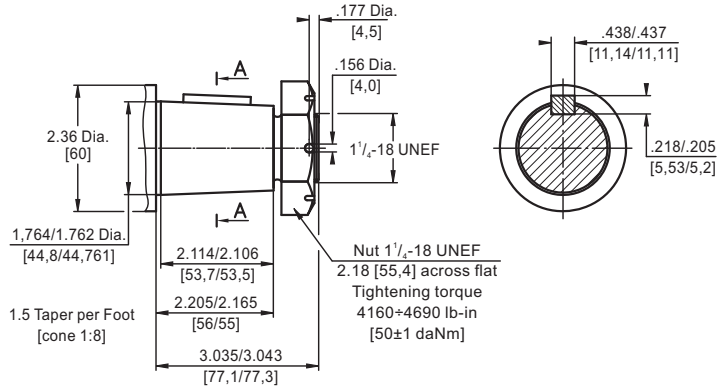
T - 2¼" [57,15] SAE J501 Tapered 1:8, Parallel key 9/16"x9/16"x 2" BS46
Max. Torque 24000 lb-in [271,2 daNm]



CA - ø1½" straight, Parallel key ⅜"x ⅜"x1 5/8" BS46
Max. Torque 11755 lb-in [132,8 daNm]



TA - SAE J501 Tapered 1:8 Parallel key 7/16"x7/16"x 1¼ " BS46
Max. Torque 18650 lb-in [210 daNm]



in [mm]

ORDER CODE

	1	2	3	4	5	6	7
M L H V							

Pos.1 - Mounting Flange

omit - Square, 4 holes
C - C Flange, 4 holes
W - Wheel mount
S - Short
V - Very short

Pos.2 - Displacement code

315 - 19.18 in^3/rev [314,5 cm^3/rev]
400 - 24.45 in^3/rev [400,9 cm^3/rev]
500 - 30.48 in^3/rev [499,6 cm^3/rev]
630 - 38.38 in^3/rev [629,1 cm^3/rev]
800 - 48.91 in^3/rev [801,8 cm^3/rev]

Pos.3 - Shaft Extensions*

omit - for **S** and **V** mounting flange
C - 2¼" [57,15] straight, Parallel key
B - 2¼" [57,15] straight, Parallel key
M - 50 mm straight, Parallel key
G - 2⅛" [53,975] 16T Splined
S - 2⅛" [53,975] 16T Splined
T - 2¼" [57,15] SAE J501 Tapered
CA - $1^1/_2$" straight, Parallel key
MA - 40 mm straight, Parallel key
GA - $1^1/_2$" 17T Splined
TA - $1^3/_4$" [44,50] J501 Tapered

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

2 - side ports, 2xG1, G¼, BSP thread, ISO 228
4 - side ports, 2x1⅝-12 UN, O-ring, ⅝-18 UNF

Pos.5 - Shaft Seal Version** [see page 50]

omit - Low pressure shaft seal
U - High pressure shaft seal

Pos.6 - Additional Options [see page 58]

Pos.7 - Design Series

omit - Factory specified

NOTES:

* The permissible output torque for shafts must not be exceeded!
** Shaft seal is available with the “omit” and “W” mounting flange only!

The hydraulic motors are mangano-phosphatized as standard.

MOTOR ADDITIONAL OPTIONS

Additional Options Description	Order Code	Motor type			
		MLHS	MLHT	MLHV	MLHHW
Speed Sensor*	RS	O	O	O	O
Tacho Connection**	T	O	O	O	O
Reinforced motor	HD	–	O	O	O
Reinforced motor (with check valves)	1HD	–	O	O	O
Low Leakage	LL	O	O	O	O
Low Speed Valving	LSV	O	O	O	O
Free Running	FR	O	O	O	O
Reverse Rotation	R	O	O	O	O
Paint***	P	O	O	O	O
Corrosion Protected Paint***	PC	O	O	O	O
Special Paint******	PS	O	O	O	O
	PCS				

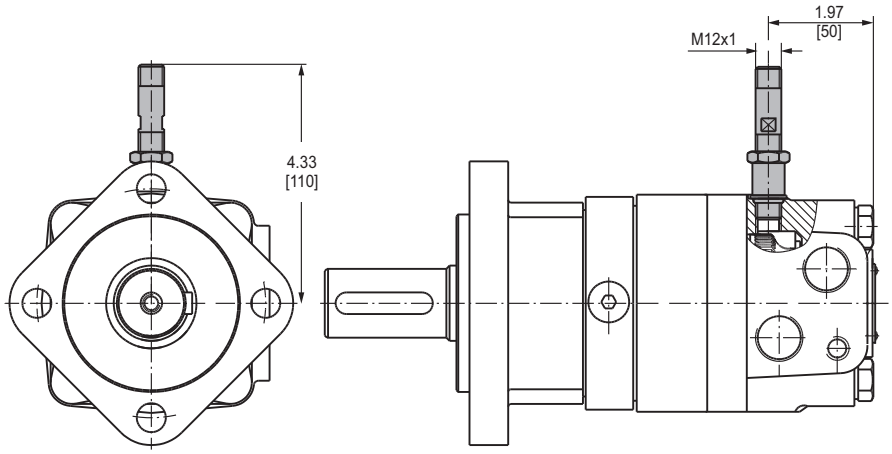
O	Optional
–	Not applicable

* For sensor ordering see pages 59÷60.
** For side ports only!
*** Colour at customer's request.
**** Non painted feeding surfaces, colour at customer's request.

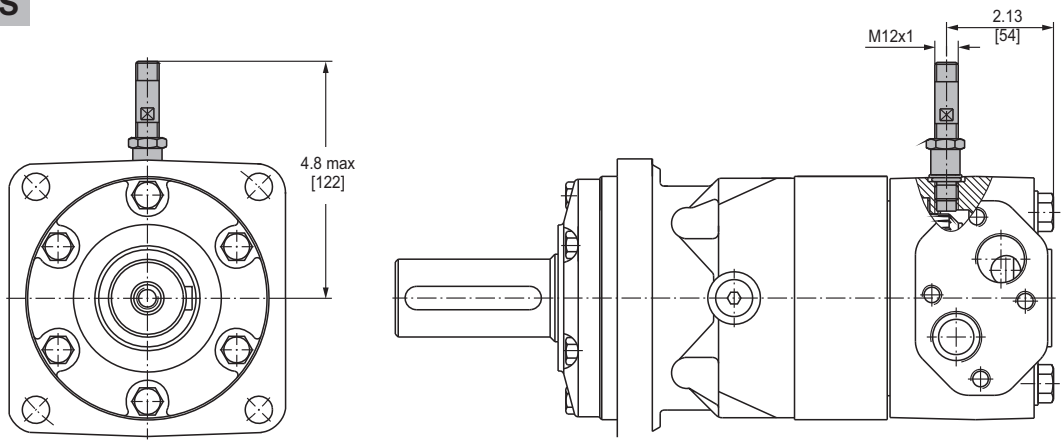
⚠ For more information about HD option please contact with "M+S Hydraulic".

MOTORS WITH SPEED SENSOR

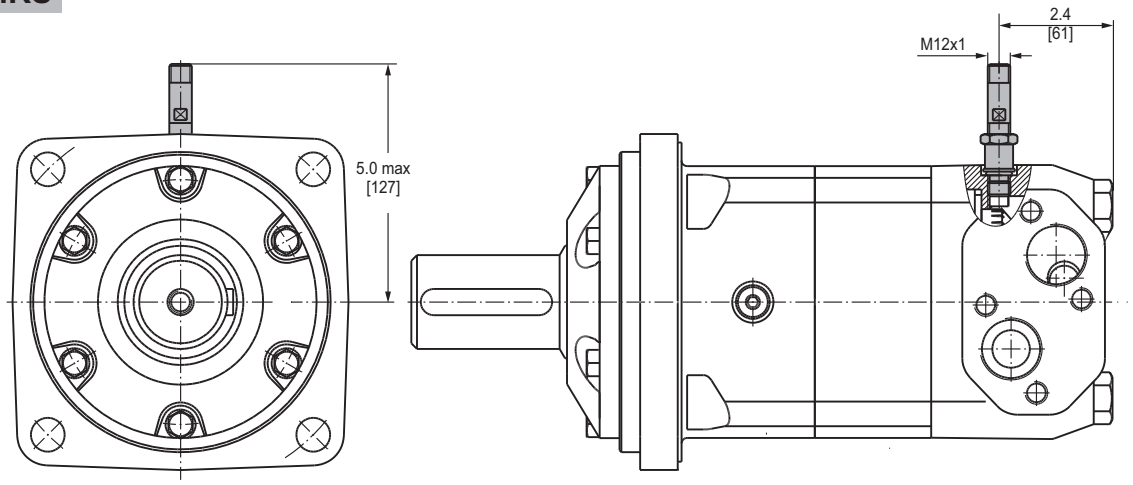
MLHS...RS



MLHT...RS



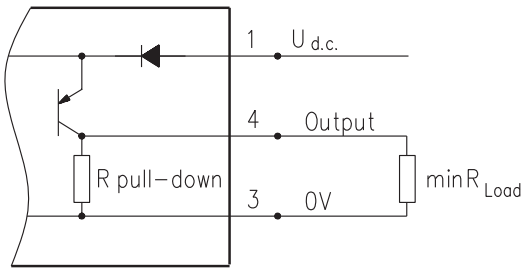
MLHV...RS



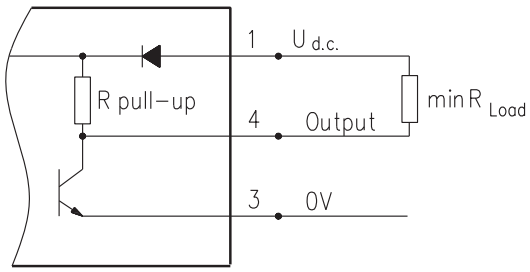
TECHNICAL DATA OF THE SPEED SENSOR

Wiring diagrams

PNP



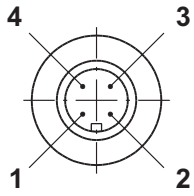
NPN



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

Motor type	MLHS	MLHT	MLHV
Pulses per revolution	54	84	102

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:

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

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]

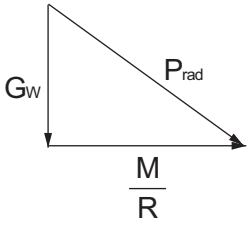
$$M_W = \frac{G_W \times f \times R_{in}[R_m]}{i \times \eta_M}$$

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.



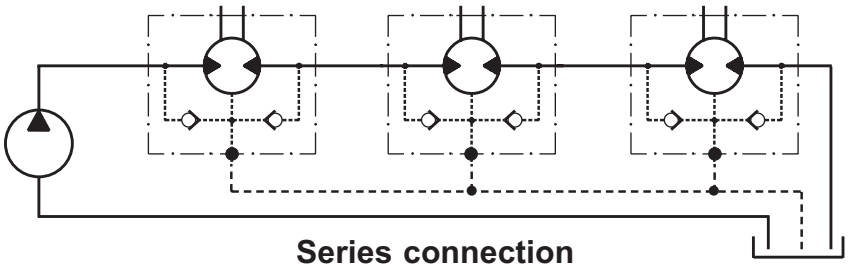
$$P_{rad}=\sqrt{G_w^2+\left(\frac{M}{R}\right)^2}$$

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

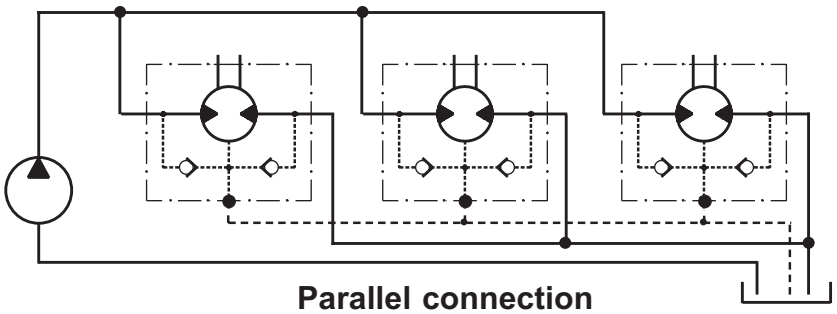
In accordance with calculated loadings the suitable motor from the catalogue is selected.

DRAINAGE SPACE AND DRAINAGE PRESSURE

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



Series connection



Parallel connection