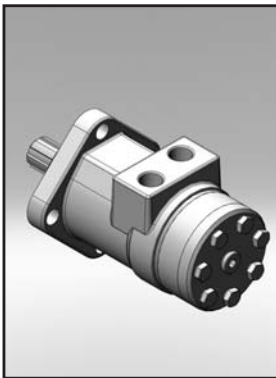
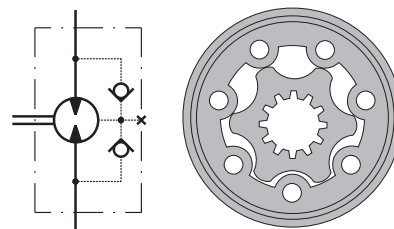


# HYDRAULIC MOTORS PL



## APPLICATION

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



## CONTENTS

Specification data ..... 66  
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 Shaft extensions ..... 68  
 Permissible shaft loads ..... 69  
 Order code ..... 69

## OPTIONS

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

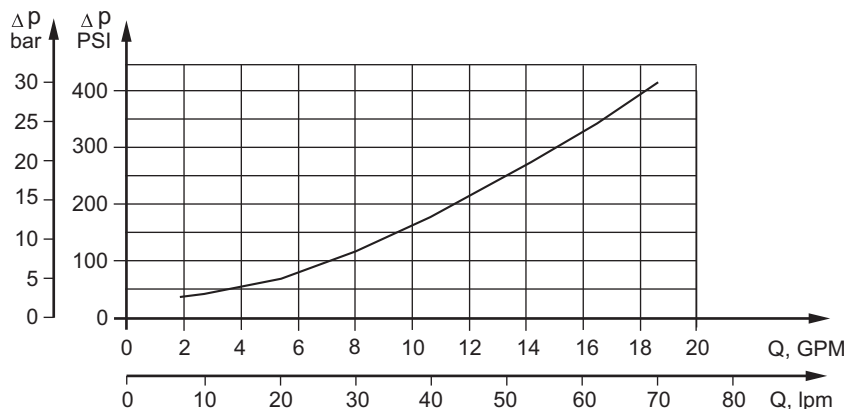
## GENERAL

<b>Max Displacement,</b> cm <sup>3</sup> /rev [in <sup>3</sup> /rev]	396 [24.16]
<b>Max. Speed,</b> [RPM]	1515
<b>Max. Torque,</b> daNm [lb-in]	cont.: 50 [4415] int.: 59 [5222]
<b>Max. Output,</b> kW [HP]	17,5 [23.5]
<b>Max. Pressure Drop,</b> bar [PSI]	cont.: 140 [2030] int.: 175 [2540]
<b>Max. Oil Flow,</b> lpm [GPM]	75 [20]
<b>Min. Speed,</b> [RPM]	10
<b>Pressure fluid</b>	Mineral based- HLP(DIN 51524) or HM(ISO 6743/4)
<b>Temperature range,</b> °C [°F]	-40÷140 [-40÷284]
<b>Optimal Viscosity range,</b> mm <sup>2</sup> /s [SUS]	20÷75 [98÷347]
<b>Filtration</b>	ISO code 20/16 (Min. recommended fluid filtration of 25 microns)

### Oil flow in drain line

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

### Pressure Losses



## SPECIFICATION DATA

Type	PL 50	PL 80	PL 100	PL 125	PL 160	PL 200	PL 250	PL 315	PL 400	
<b>Displacement, cm<sup>3</sup>/rev [in<sup>3</sup>/rev]</b>	49,5 [3.02]	79,2 [4.83]	99 [6.04]	123,8 [7.55]	158,4 [9.66]	198 [12.1]	247,5 [15.1]	316,8 [19.3]	396 [24.16]	
<b>Max. Speed, [RPM]</b>	Cont.	1210	755	605	485	378	303	242	190	150
	Int.*	1515	945	755	605	472	378	303	236	189
<b>Max. Torque daNm [lb-in]</b>	Cont.	9,4 [832]	15,1 [1336]	19,3 [1708]	23,7 [2100]	31,3 [2770]	36,6 [3240]	47 [4160]	48,6 [4300]	50 [4425]
	Int.*	11,9 [1054]	19,5 [1725]	23,7 [2097]	29,8 [2637]	37,8 [3345]	45,6 [4035]	58,3 [5160]	56 [4956]	59 [5222]
	Peak**	14,0 [1240]	22,0 [1947]	27,0 [2390]	36,5 [3230]	42 [3717]	53 [4700]	67 [5930]	85 [7523]	85,4 [7560]
<b>Max. Output kW [HP]</b>	Cont.	9,9 [13.3]	9,9 [13.3]	9,9 [13.3]	9,9 [13.3]	11,7 [15.7]	10,3 [13.8]	9,8 [13.1]	7,6 [10.2]	6,6 [8.9]
	Int.*	12,5 [16.8]	12,5 [16.8]	12,5 [16.8]	12,5 [16.8]	12,5 [16.8]	12,5 [16.8]	12,5 [16.8]	10,5 [14]	8,5 [11.4]
<b>Max. Pressure Drop bar [PSI]</b>	Cont.	140 [2030]	140 [2030]	140 [2030]	140 [2030]	140 [2030]	140 [2030]	140 [2030]	120 [1300]	95 [1015]
	Int.*	175 [2540]	175 [2540]	175 [2540]	175 [2540]	175 [2540]	175 [2540]	175 [2540]	140 [2030]	115 [1665]
	Peak**	225 [3260]	225 [3260]	225 [3260]	225 [3260]	225 [3260]	225 [3260]	225 [3260]	225 [3260]	180 [2610]
<b>Max. Oil Flow lpm [GPM]</b>	Cont.	60 [16]	60 [16]	60 [16]	60 [16]	60 [16]	60 [16]	60 [16]	60 [16]	60 [16]
	Int.*	75 [20]	75 [20]	75 [20]	75 [20]	75 [20]	75 [20]	75 [20]	75 [20]	75 [20]
<b>Max. Inlet Pressure bar [PSI]</b>	Cont.	175 [2540]	175 [2540]	175 [2540]	175 [2540]	175 [2540]	175 [2540]	175 [2540]	175 [2540]	175 [2540]
	Int.*	200 [2900]	200 [2900]	200 [2900]	200 [2900]	200 [2900]	200 [2900]	200 [2900]	200 [2900]	200 [2900]
	Peak**	225 [3260]	225 [3260]	225 [3260]	225 [3260]	225 [3260]	225 [3260]	225 [3260]	225 [3260]	225 [3260]
<b>Max. Return Pressure without Drain Line or Max. Pressure in Drain Line, bar [PSI]</b>	Cont. 0-100 RPM	100 [1450]	100 [1450]	100 [1450]	100 [1450]	100 [1450]	100 [1450]	100 [1450]	100 [1450]	100 [1450]
	Cont. 100-300 RPM	50 [725]	50 [725]	50 [725]	50 [725]	50 [725]	50 [725]	50 [725]	50 [725]	50 [725]
	Cont. 300-600 RPM	25 [365]	25 [365]	25 [365]	25 [365]	25 [365]	25 [365]	25 [365]	25 [365]	25 [365]
	Cont. >600 RPM	15 [220]	15 [220]	15 [220]	15 [220]	15 [220]	15 [220]	15 [220]	15 [220]	15 [220]
	Int.* 0-max. RPM	100 [1450]	100 [1450]	100 [1450]	100 [1450]	100 [1450]	100 [1450]	100 [1450]	100 [1450]	100 [1450]
<b>Max. Return Pressure with Drain Line bar [PSI]</b>	Cont.	175 [2540]	175 [2540]	175 [2540]	175 [2540]	175 [2540]	175 [2540]	175 [2540]	175 [2540]	175 [2540]
	Int.*	200 [2900]	200 [2900]	200 [2900]	200 [2900]	200 [2900]	200 [2900]	200 [2900]	200 [2900]	200 [2900]
	Peak**	225 [3260]	225 [3260]	225 [3260]	225 [3260]	225 [3260]	225 [3260]	225 [3260]	225 [3260]	225 [3260]
<b>Max. Starting Pressure with Unloaded Shaft, bar [PSI]</b>	10 [145]	10 [145]	10 [145]	9 [131]	8 [116]	7 [100]	6 [87]	5 [73]	5 [73]	
<b>Min. Starting Torque, daNm [lb-in]</b>	7,7 [681]	13 [1150]	16,8 [1487]	21,0 [1860]	28,0 [2478]	32,2 [2850]	41,4 [3665]	43,0 [3805]	44,0 [3900]	
<b>Min. Speed***, [RPM]</b>	10	10	10	10	10	10	10	10	10	
<b>Weight, kg [lb]</b>	6,8 [15]	7,0 [15.4]	7,1 [15.7]	7,2 [15.9]	7,4 [16.3]	7,6 [16.8]	7,8 [17.2]	8,2 [18]	8,6 [18.9]	

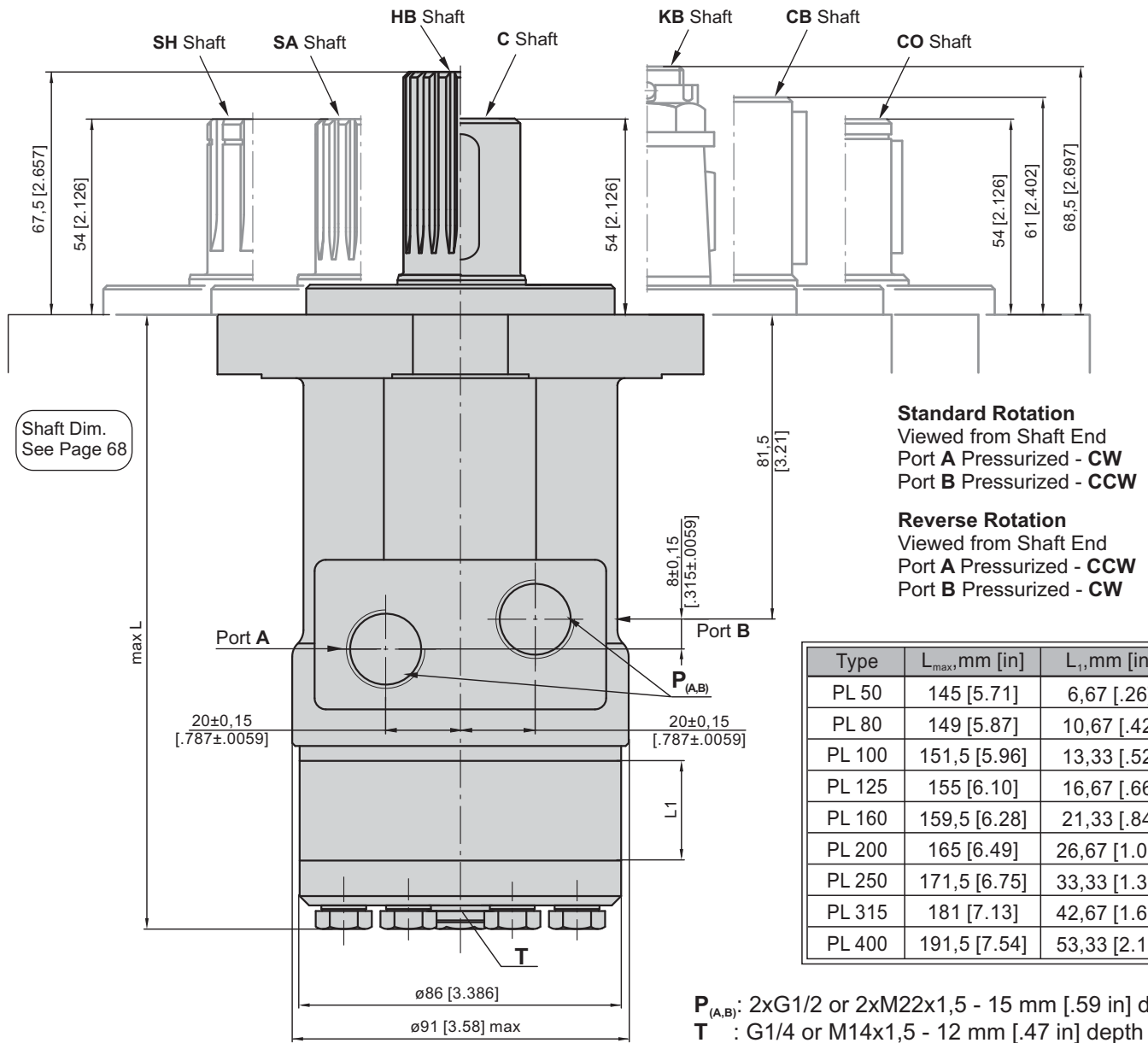
\* Intermittent operation: the permissible values may occur for max. 10% of every minute.

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

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

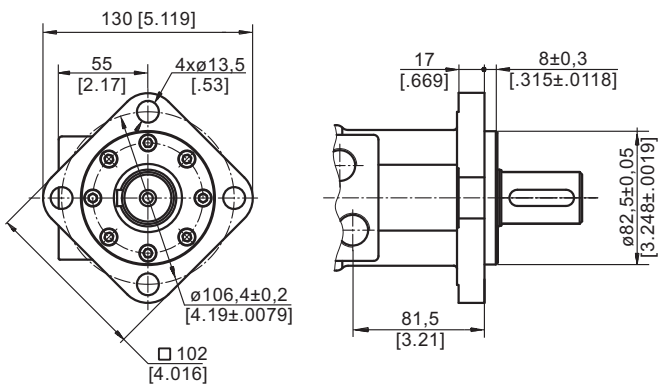
- Intermittent speed and intermittent pressure must not occur simultaneously.
- Recommended filtration is per ISO cleanliness code 20/16. A nominal filtration of 25 micron or better.
- Recommend using a premium quality, anti-wear type mineral based hydraulic oil HLP(DIN51524) or HM ( ISO 6743/4).  
If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

**DIMENSIONS AND MOUNTING DATA**

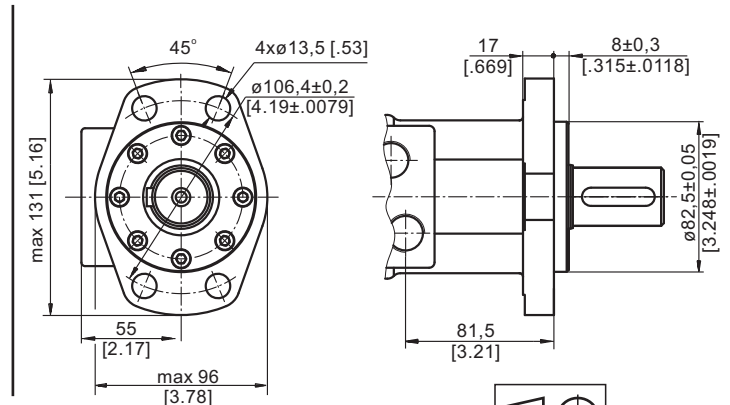


**MOUNTING**

Square Mount (4 Holes)

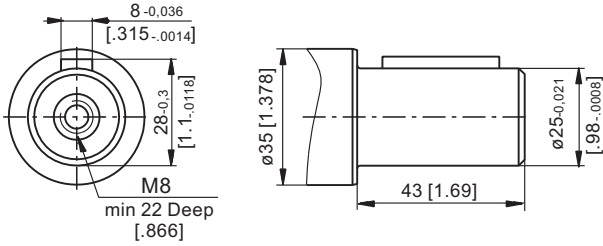


**F** Oval Mount (4 Holes)

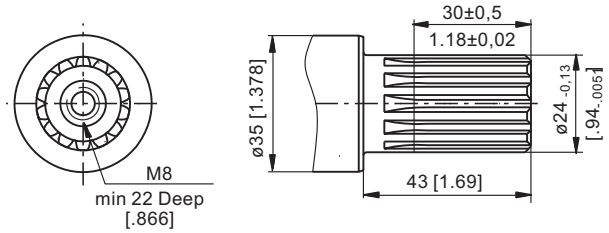


**SHAFT EXTENSIONS**

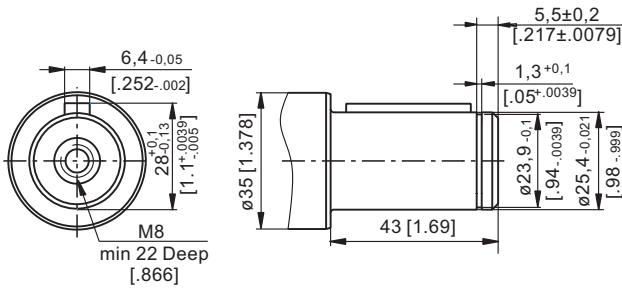
**C** -  $\varnothing 25$  straight, Parallel key A8x7x30 DIN 6885  
Max. Torque 34 daNm [3010 lb-in]



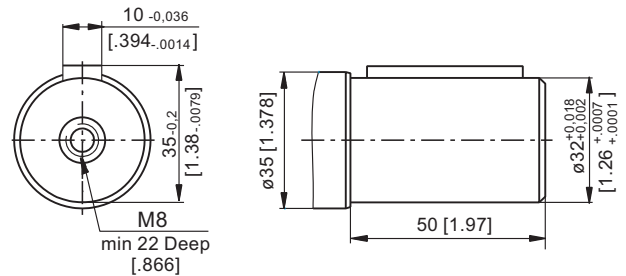
**SA** - splined B25x22 DIN 5482  
Max. Torque 40 daNm [3540 lb-in]



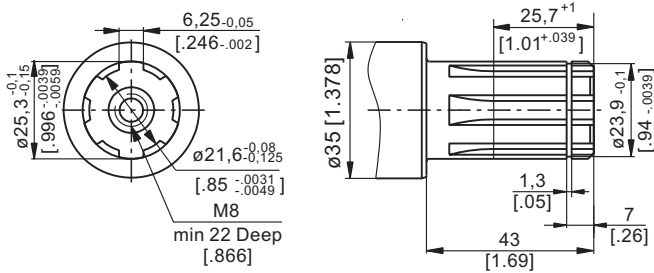
**CO** -  $\varnothing 1$ " straight, Parallel key  $\frac{1}{4}$ "x $\frac{1}{4}$ "x $\frac{1}{4}$ " BS46  
Max. Torque 34 daNm [3010 lb-in]



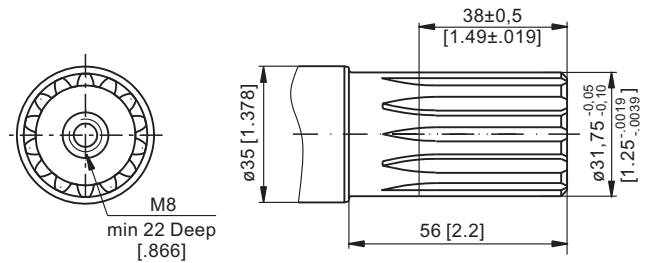
**CB** -  $\varnothing 32$  straight, Parallel key A10x8x40 DIN 6885  
Max. Torque 77 daNm [6815 lb-in]



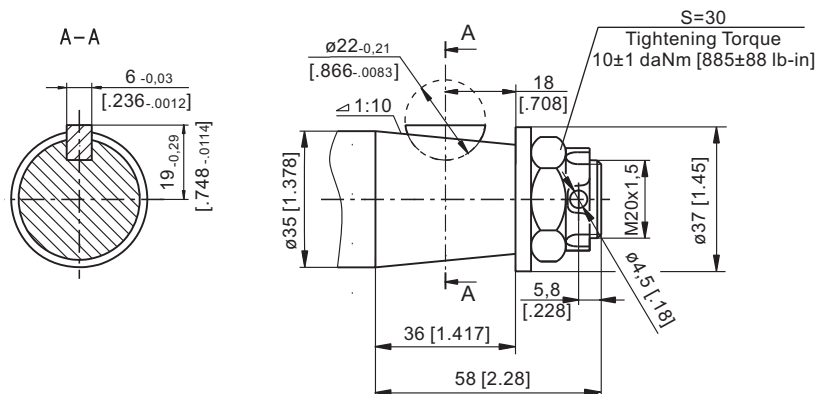
**SH** - splined, BS 2059 (SAE 6B)  
Max. Torque 40 daNm [3540 lb-in]



**HB** -  $\varnothing 1\frac{1}{4}$ " splined 14T, DP12/24 ANSI B92.1-1976  
Max. Torque 95 daNm [8410 lb-in]

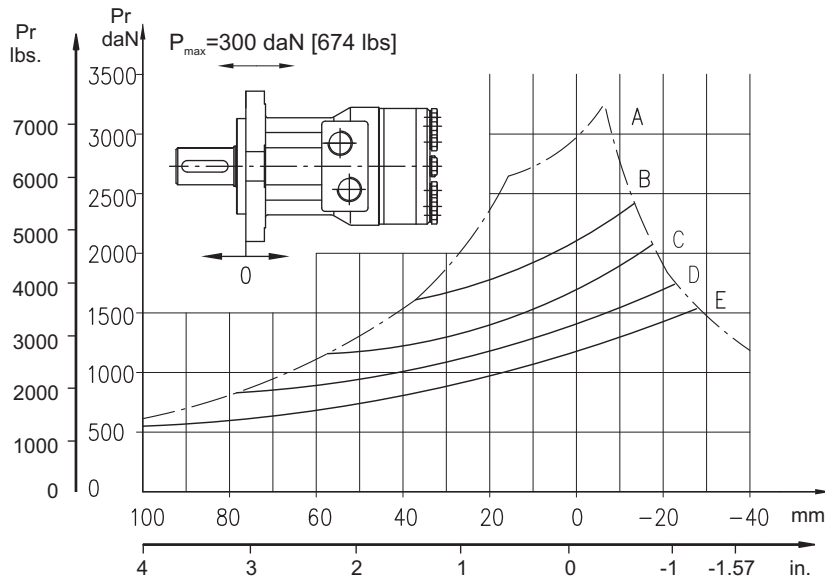


**KB** - tapered 1:10, Woodruff key 6x9 DIN6888  
Max. Torque 95 daNm [8410 lb-in]



**Permissible Shaft Loads PL and RL**

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	7
<b>PL</b>							

**Pos.1 - Mounting Flange**

omit - Square mount, four holes

**F** - Oval mount, four holes

**Pos.2 - Displacement code\***

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

**Pos.3 - Shaft Extensions\*\***

- C** -  $\varnothing 25$  straight, Parallel key A8x7x30 DIN6885
- CO** -  $\varnothing 1"$  straight, Parallel key  $\frac{1}{4}" \times \frac{1}{4}" \times \frac{1}{4}"$  BS46
- SH** -  $\varnothing 25,3$  splined, BS 2059 (SAE 6B)
- SA** -  $\varnothing 24$  splined, B 25x22 DIN 5482
- CB** -  $\varnothing 32$  straight, Parallel key A10x8x40 DIN6885
- HB** -  $\varnothing 1\frac{1}{4}"$  splined 14T ANSI B92.1-1976
- KB** -  $\varnothing 35$  tapered 1:10, Woodruff key 6x9 DIN6888

**Pos.4 - Shaft Seal Version**

- omit - Standard shaft seal
- U** - High pressure shaft seal

**Pos.5 - Ports**

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

**Pos.6 - Special Features (see page 119)**

**Pos.7 - Design Series**

- omit - Factory specified

**NOTES:**

- \* For the Function Diagrams data please look at "M+S Hydraulic" Catalogue for MP motors, pages 19+23.
- \*\* The permissible output torque for shafts must not be exceeded!

The hydraulic motors are mangano-phosphatized as standard.

# MOTOR SPECIAL FEATURES

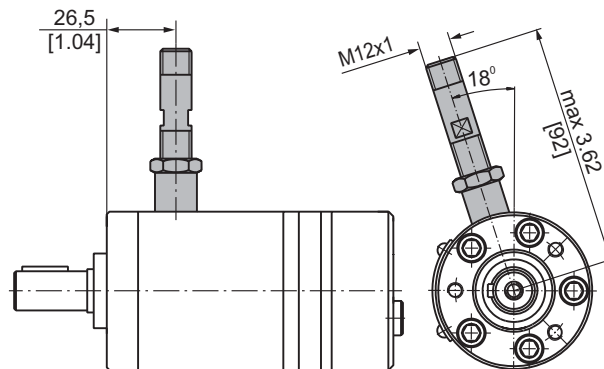
Special Feature Description	Order Code	Motor type												
		MM	MP	MP(W)N, MRN	MPW	MR	MRB	SP, SR	PL, RL	PK, RK	PKQ	RW	MH	HW
Speed Sensor*	RS	O	O	-	-	O	-	-	-	-	-	-	O	-
Tacho connection	T	-	-	-	-	O	-	-	-	-	-	-	O	-
Low Leakage	LL	O	O	-	O	O	-	-	O	O	O	O	O	O
Low Speed Valving	LSV	-	-	-	O	O	-	-	-	-	O	O	O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

<b>O</b>	Optional
<b>-</b>	Not applicable
<b>S</b>	Standard

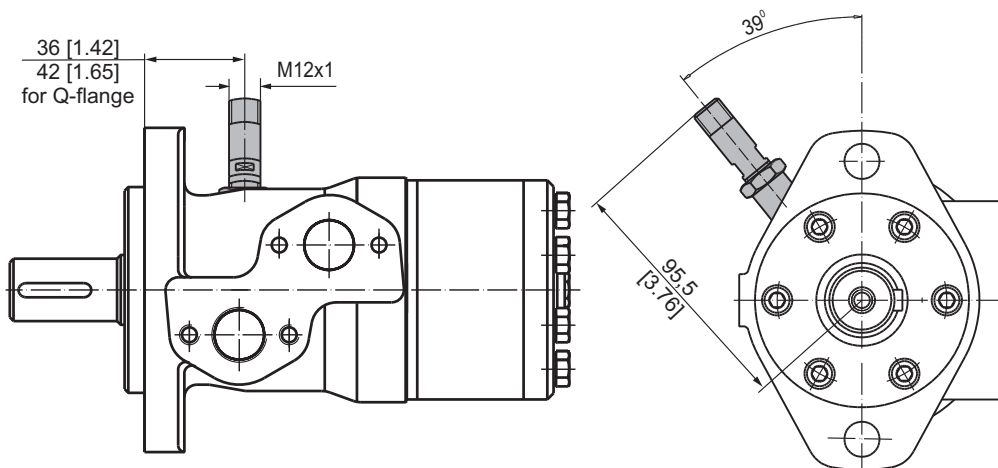
- \* For sensor ordering see pages 120÷121.
- \*\* Colour at customer's request.
- \*\*\* Non painted feeding surfaces, colour at customer's request.
- \*\*\*\* Without check valves for "U" shaft seal versions.

# MOTORS WITH SPEED SENSOR

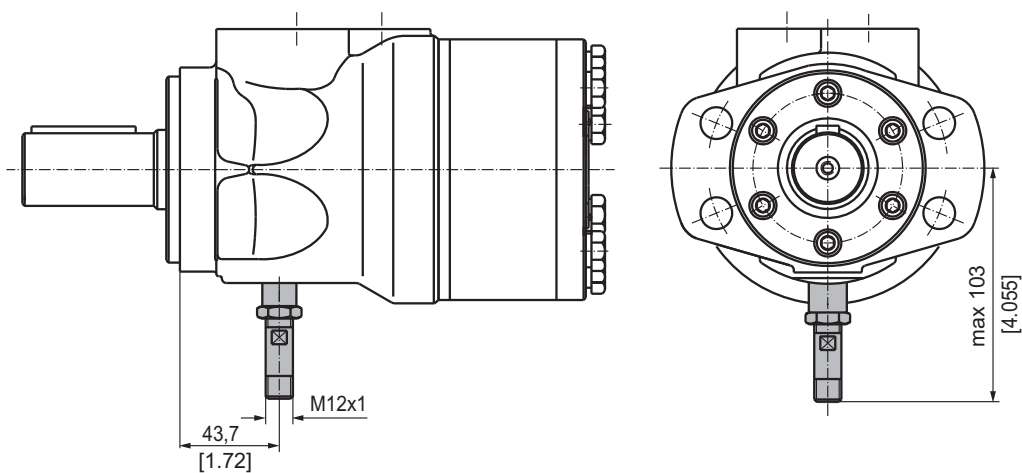
## MM...RS



## MP...RS and MR...RS



## MH...RS

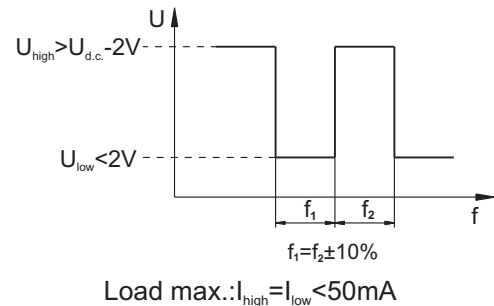


**TECHNICAL DATA OF THE SPEED SENSOR**

**Technical data**

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

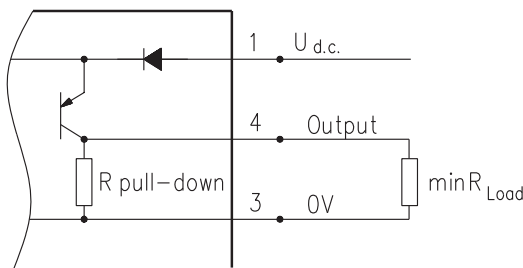
**Output signal**



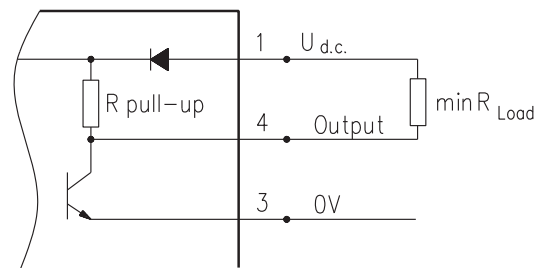
Motor type	MM	MP	MR	MH
Pulses per revolution	30	36	36	42

**Wiring diagrams**

**PNP**

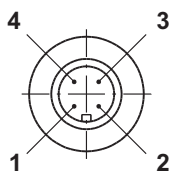


**NPN**



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

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

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



# APPLICATION CALCULATION

## VEHICLE DRIVE CALCULATIONS

### 1. Motor speed: n, RPM

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

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

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

$R_m$ - wheel rolling radius, m;

$R_m$ - wheel rolling radius, in;

$i$ - gear ratio between motor and wheels.

If no gearbox, use  $i=1$ .

### 2. Rolling resistance: RR, daN [lbs]

The resistance force resulted in wheels contact with different surfaces:

$$RR = G \times \rho$$

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

$\rho$ - rolling resistance coefficient (Table 1).

Table 1

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

### 3. Grade resistance: GR, daN [lbs]

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

$\alpha$ - gradient negotiation angle (Table 2)

Table 2

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

### 4. Acceleration force: FA, daN [lbs]

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

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

$FA$ - acceleration force, daN [lbs];

$t$ - time, [s].

### 5. Tractive effort: DP, daN [lbs]

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

-acc.to constructor's assessment;

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

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

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

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

$RR$ - force acquired to overcome the rolling resistance;

$GR$ - force acquired to slope upwards;

$FA$ - force acquired to accelerate (acceleration force);

$DP$ - additional tractive effort (trailer).

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

Necessary torque moment for every hydraulic motor:

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

$N$ - motor numbers;

$\eta_m$ - mechanical gear efficiency (if it is available).

### 8. Cohesion between tire and road covering: M<sub>w</sub>, daNm [in-lb]

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

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

$f$  - frictional factor;

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

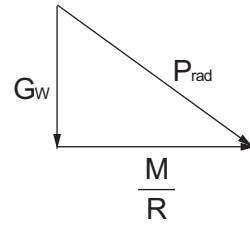
Table 3

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

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

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

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



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

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

**DRAINAGE SPACE AND DRAINAGE PRESSURE**

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

