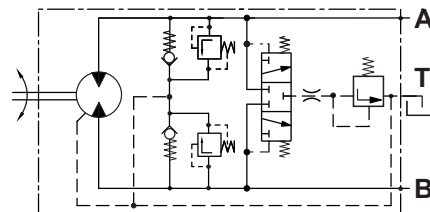
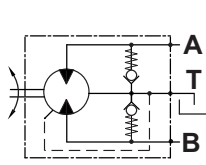
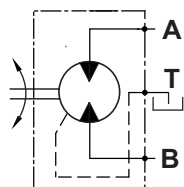




Hydraulic Motors Type MAP62

Heavy Duty Axial Piston Motors Fixed Displacement



open drain line is always required

APPLICATION

- » Agricultural machines
- » Road building machines
- » Mining machinery
- » Food industry machines
- » Swing drives
- » Hydraulic transmissions
- » Vibration machines
- » Fan drives
- » Special vehicles

OPTIONS

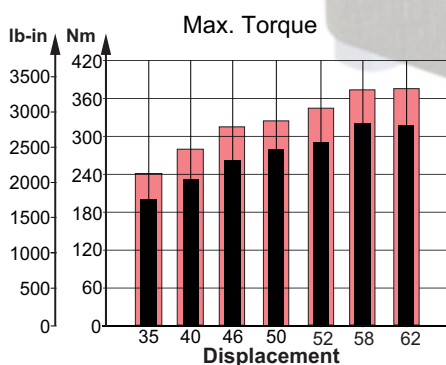
- » Port options
- » Shaft options
- » High pressure ports
- » Integrated valves

ADVANTAGES

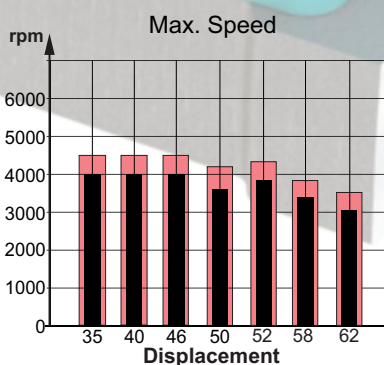
- » High starting torque
- » Smooth operation
- » Long service life
- » High power density

GENERAL

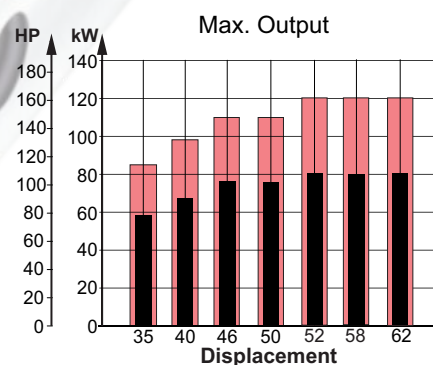
Displacement,	cm ³ /rev [in ³ /rev]	36.16÷62.4 [2.21÷3.81]
Max. Speed,	RPM	4000
Max. Torque,	Nm [lb-in]	320 [2832]
Max. Output,	kW [HP]	80 [107]
Max. Pressure Drop,	bar [PSI]	350 [5080]
Max. Oil Flow,	l/min [GPM]	200 [52.8]
Min. Speed,	RPM	500
Fluid	Mineral based- HLP(DIN 51524) or HM(ISO 6743/4)	
Temperature Range,	°C [°F]	-40÷82 [-40÷180]
Optimal Viscosity Range,	mm ² /s [SUS]	12÷68 [66÷311]
Filtration	ISO code 18/16/13 (Min. recommended fluid filtration of 10 micron)	

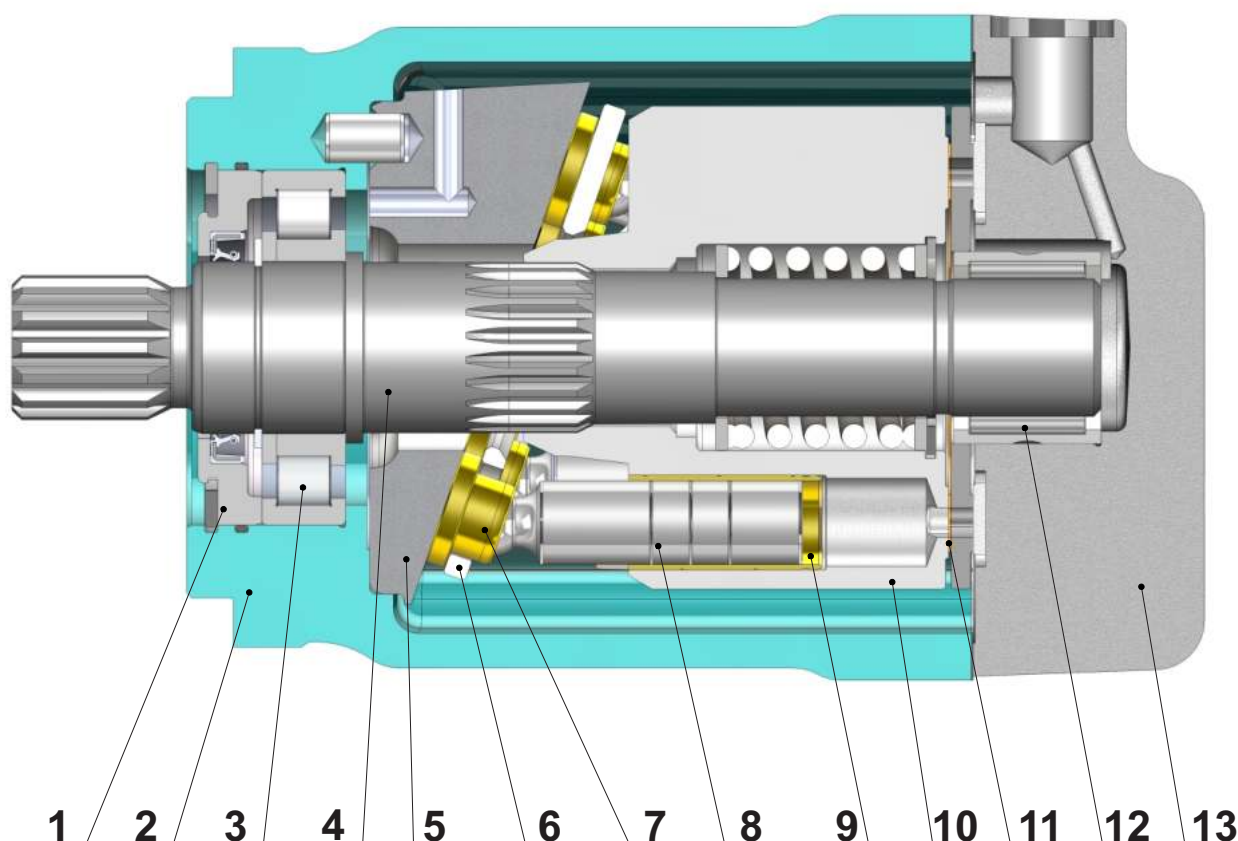


Intermittent values



Continuous values




SECTION VIEW


1. Front cover
2. Cast iron body
3. Robust radial - axial roller bearing
4. Hardened shaft
5. Solid swash plate
6. Retainer plate
7. Improved piston shoes
8. Improved pistons
9. Brass bushings
10. Hardened steel cylinder block
11. Bimetal distributor
12. Needle bearing
13. Solid end cover

The main advantages of the heavy duty design of the MAP motors over the typical swash plate motors are the higher starting torque and the higher total efficiency. In regards to these two parameters, under normal working mode, the MAP is comparable to the bent axis motors. The advantages of the MAP over the bent axis motors are the higher reliability and the lower degree of pulsation and vibration during operation.


SPECIFICATION DATA

Type		MAP 35	MAP 40	MAP 46	MAP 50	MAP 52	MAP 58	MAP 62
Displacement, cm ³ /rev [in ³ /rev]		36.16 [2.21]	41.59 [2.54]	47.13 [2.88]	49.94 [3.05]	51.95 [3.17]	58.8 [3.59]	62.4 [3.81]
Max. Speed, [RPM]	Cont.	4000	4000	4000	3600	3850	3398	3050
	Int.*	4500	4500	4500	4200	4330	3823	3500
Max. Torque,** Nm [lb-in]	Cont.	202 [1789]	232 [2053]	263 [2328]	278 [2460]	290 [2566]	320 [2832]	318 [2814]
	Int.**	242 [2142]	278 [2460]	315 [2788]	326 [2885]	347 [3071]	375 [3320]	377 [3337]
Output, kW [HP]	Cont.	58 [78]	67 [90]	76 [102]	76 [102]	80 [107]	80 [107]	80 [107]
	Int.**	84 [113]	97 [130]	110 [148]	110 [148]	120 [161]	120 [161]	120 [161]
Max. Pressure, bar [PSI]	Cont.	350 [5080]	350 [5080]	350 [5080]	350 [5080]	350 [5080]	340 [4930]	320 [4640]
	Int.**	420 [6100]	420 [6100]	420 [6100]	410 [5950]	420 [6100]	400 [5800]	380 [5510]
	Peak	450 [6527]	450 [6527]	450 [6527]	450 [6527]	450 [6527]	440 [6381]	410 [5950]
Max. Oil Flow, l/min [GPM]	Cont.	145 [38.3]	167 [44.1]	189 [50]	180 [47.5]	200 [52.8]	200 [52.8]	190 [50]
	Int.*	163 [43.1]	187 [49.4]	212 [56]	210[55.5]	225 [59.4]	225 [59.4]	215 [56.8]
Torque Constant ***** Nm/bar [lb-in/PSI]		0.52 [0.32]	0.6 [0.364]	0.68 [0.41]	0.72 [0.437]	0.75 [0.454]	0.85 [0.515]	0.9 [0.546]
Speed Constant ***** RPM/(l/min) [RPM/GPM]		26.3 [99.4]	22.84 [86.5]	20.2 [76.3]	19.02 [72]	18.28 [70.2]	16.13 [61.1]	15.23 [57.6]
Permissible Shaft Load max Axial**** N[lb]		Fa=2000 [450]						
max Radial**** N[lb]		Fr=3600 [810]				Fr=3200 [720]		
Min. Speed, [RPM]		500						
Max. Pressure in Drain Line,bar [PSI]		5 [70] open drain line is always required						
Weight, kg [lb]		17.65 [38.9] for SAE-B flange; 19.8 [43.7] for SAE-4C flange						

Peak pressure is the highest allowable pressure, may occur for max. 1% of every minute;

* Intermittent speed (flow): for pressure up to 150[2200] bar[PSI];

** Intermittent load: the permissible values may occur for max. 10% of motor lifetime;

*** Theoretical torque;

**** The calculated max values are based on the optimal direction of the forces Fr, Fa and optimal position of the shaft.

***** The constant values are used for calculation of torque and speed with motor efficiencies $\eta_v=0.95$ and $\eta_{mh}=0.9$.

1. The recommended output power for continuous operations should not be exceeded.
2. Recommended filtration as per ISO 4406 cleanliness code 18/16/13 or better. This filtration corresponds to SAE AS 4059 8A/7B/7C. Nominal filtration - 10 micron or better.
3. Recommended a premium quality, anti-wear type mineral based hydraulic oil, HLP(DIN51524) or HM(ISO6743/4).
4. Recommended oil viscosity - 12...68 cSt or see page [84](#).
5. Recommended maximum system operating temperature - 82°[180°] C[F].
6. To ensure optimum life of the motor, fill it up with fluid prior to load it and run with moderate load and speed for about 10-15 minutes.

Hint: Motor Torque = Torque Constant * Pressure Drop

Rotation Speed = Speed Constant * Oil Flow

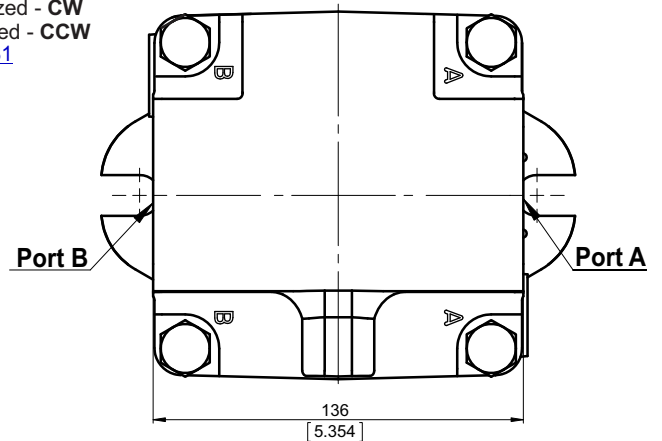
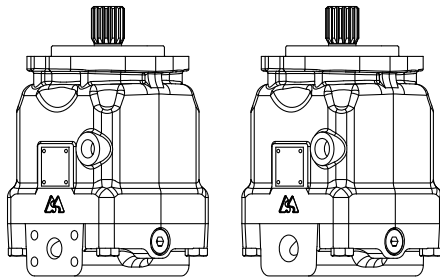
The constant values are approximate. Motor torque and rotation speed for a particular project are depending on the real operating conditions. For more detailed calculations please see efficiencies on page [74](#) and formulas on page [85](#).



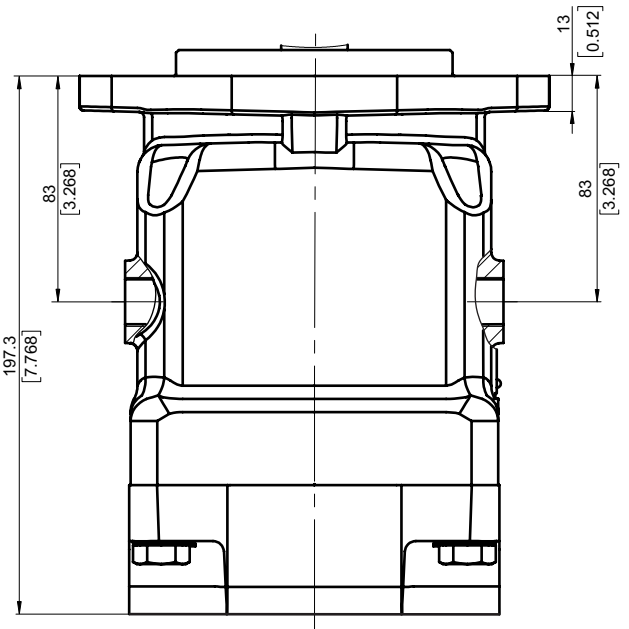
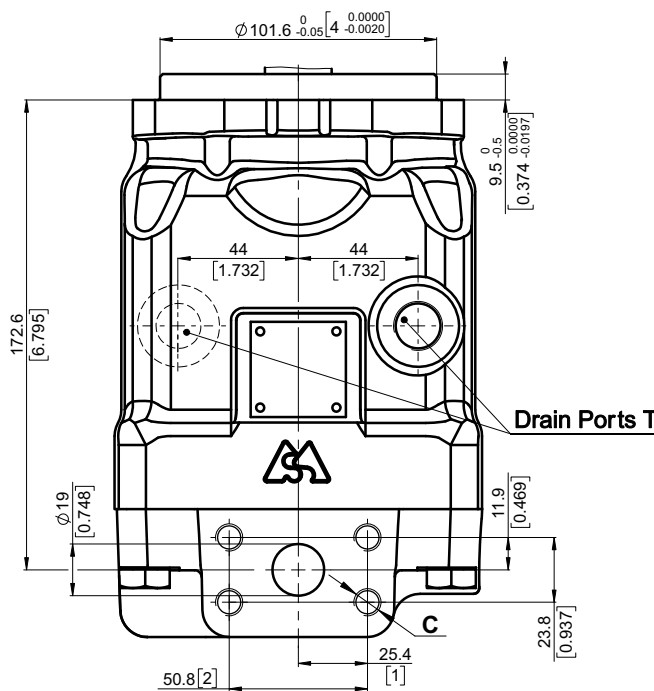
OVERALL DIMENSIONS AND PORTS

Side Ports - Default Mounting Flange - Type SAE-B

Standard Rotation
Viewed from shaft end
Port A Pressurized - CW
Port B Pressurized - CCW
see page 81

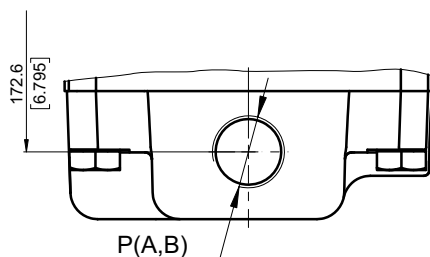


Side ports, port size default, 5 and 9

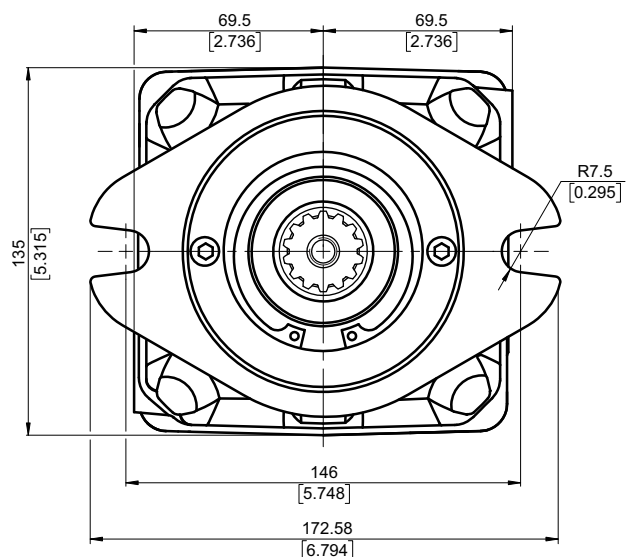


	Port Size		
	default	5	9
P _(A,B)	2xISO 6162-2 DN19	2xSAE J518 3/4" PSI6000	2xISO 6162-2 DN19
T	M18x1.5	7/8-14 UNF	G1/2
C	8xM10	8x3/8-16 UNC	8xM10

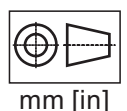
Side ports, port size 2,3 and 4



	Port Size		
	2	3	4
P _(A,B)	2xG 3/4	2xM27x2	2x1 1/16-12UN
T	G 1/2	M18x1.5	7/8-14UNF



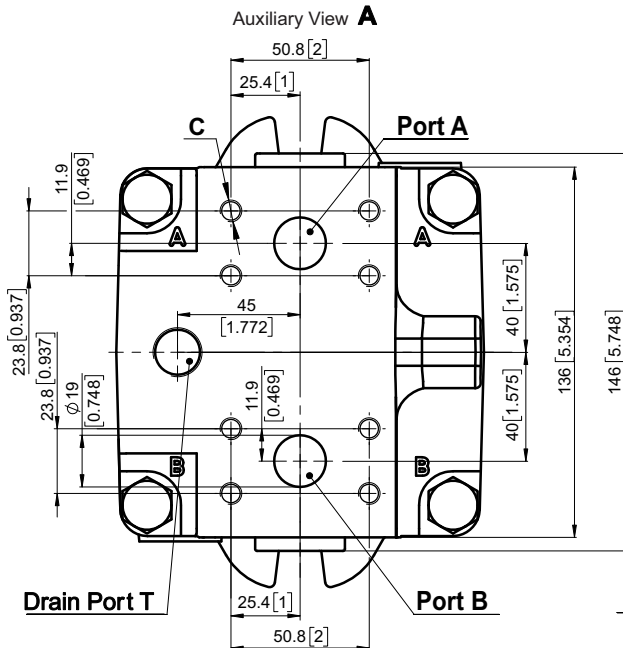
Shaft Mounting
see page 26



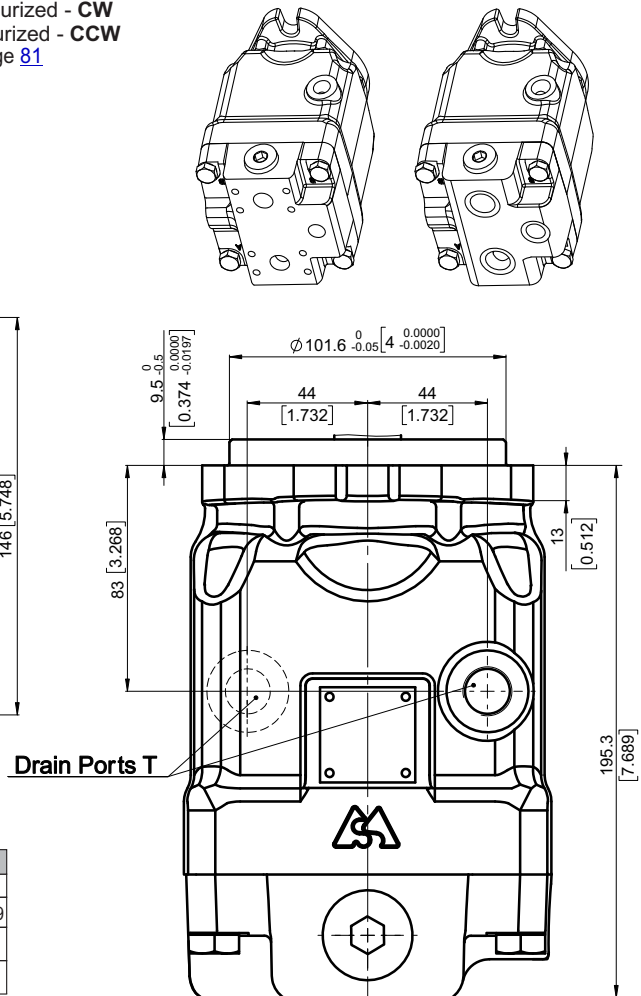
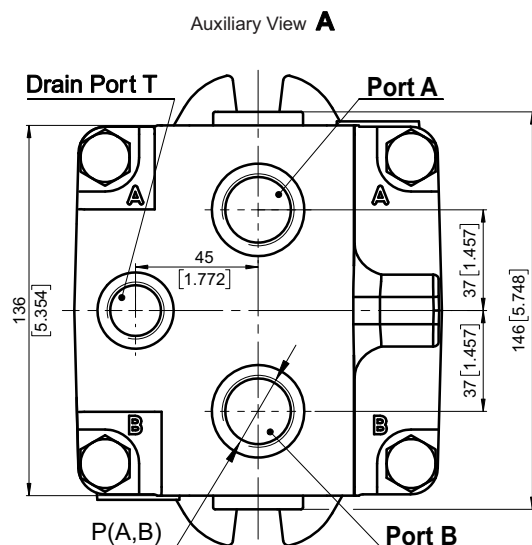
mm [in]


OVERALL DIMENSIONS AND PORTS
Rear Ports - Type E Mounting Flange - Type SAE-B

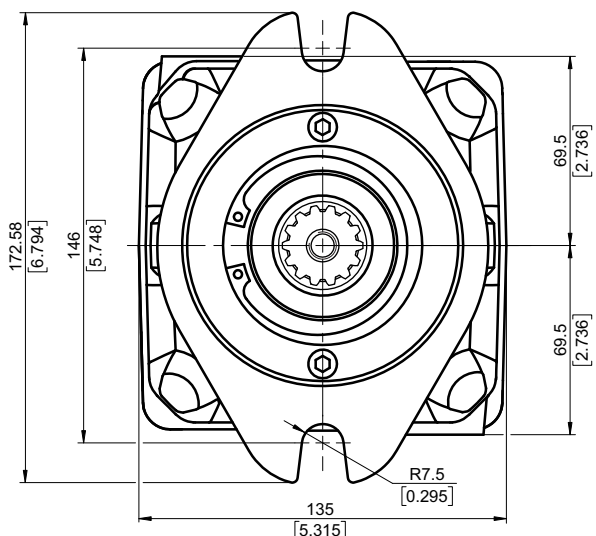
Standard Rotation
 Viewed from shaft end
 Port A Pressurized - CW
 Port B Pressurized - CCW
 see page 81

Rear ports E, port size default, 5 and 9


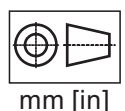
	Port Size		
	default	5	9
P _(A,B)	2xISO 6162-2 DN19	2xSAE J518 3/4" PSI6000	2xISO 6162-2 DN19
T	M18x1.5	7/8-14 UNF	G1/2
C	8xM10	8x3/8-16 UNC	8xM10


Rear ports E, port size 2,3,4,6,7 and 8


	Port Size					
	2	3	4	6	7	8
P _(A,B)	2xG 3/4	2xM27x2	2x1 1/16-12UN	2xG 1/2	2xM22x1.5	2x7/8-14UNF
T	G 1/2	M18x1.5	7/8-14UNF	G 1/2	M18x1.5	3/4-16UNF



Shaft Mounting
 see page 26

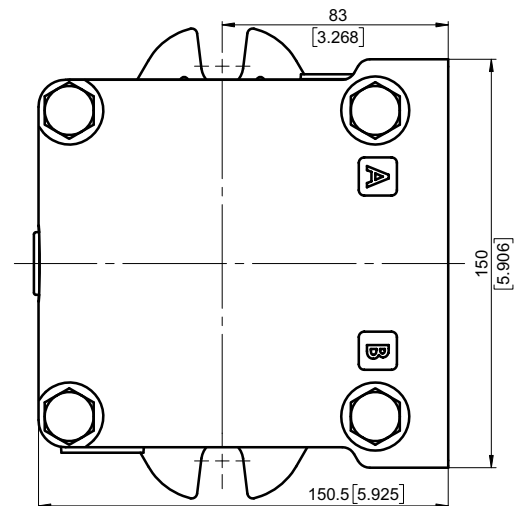
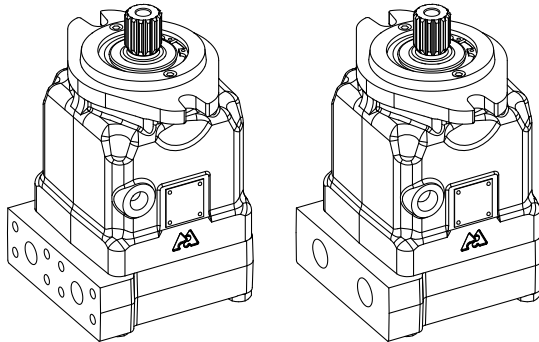


mm [in]

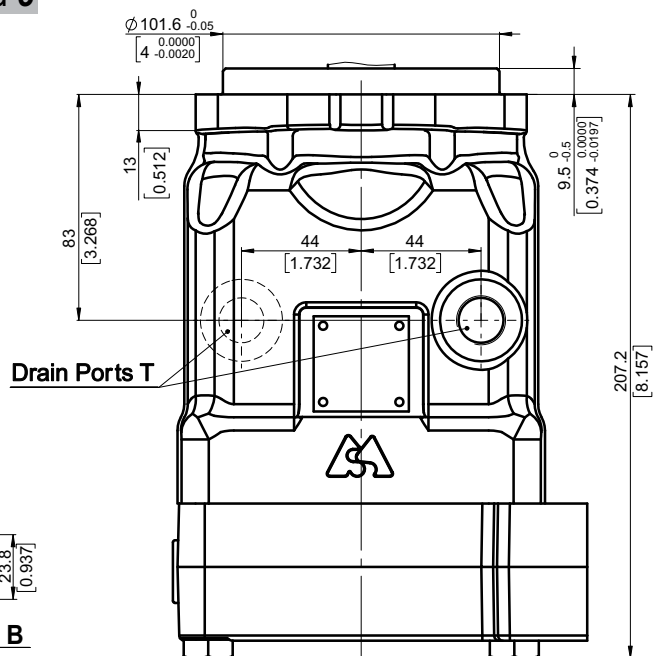
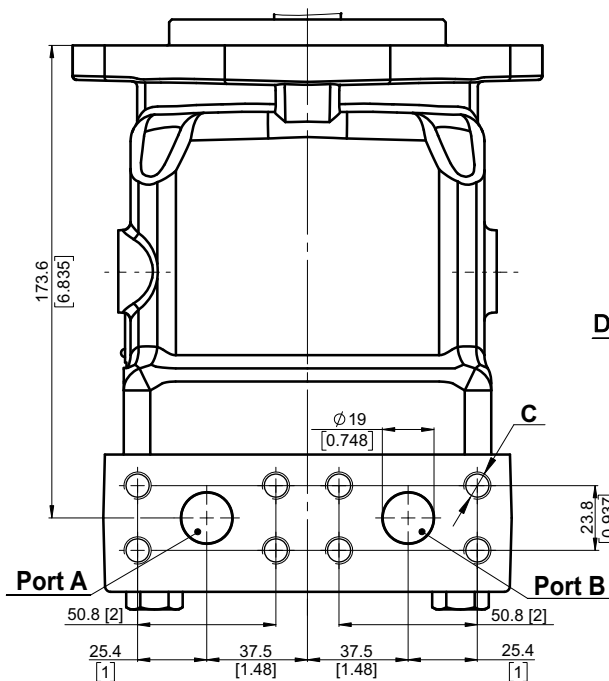


OVERALL DIMENSIONS AND PORTS

Standard Rotation
Viewed from shaft end
Port A Pressurized - CW
Port B Pressurized - CCW
see page 81

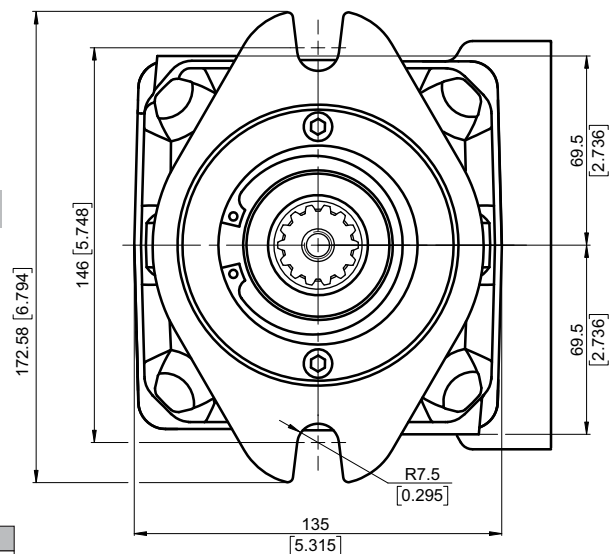
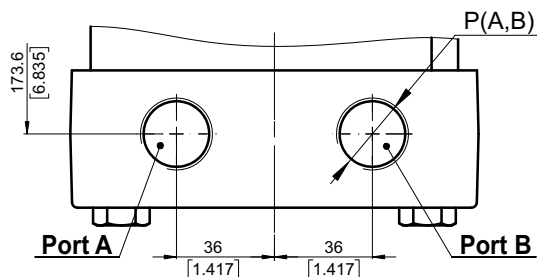


Twin side ports, port size default, 5 and 9



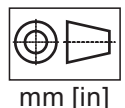
	Port Size		
	default	5	9
P _{A,B}	2xISO 6162-2 DN19	2xSAE J518 3/4" PSI6000	2xISO 6162-2 DN19
T	M18x1.5	7/8-14 UNF	G1/2
C	8xM10	8x3/8-16 UNC	8xM10

Twin side ports, port size 2,3,4,6,7 and 8



	Port Size					
	2	3	4	6	7	8
P _{A,B}	2xG 3/4	2xM27x2	2x1 ¹ / ₁₆ -12UN	2xG 1/2	2xM22x1.5	2x7/8-14UNF
T	G 1/2	M18x1.5	7/8-14UNF	G 1/2	M18x1.5	3/4-16UNF

Shaft Mounting
see next page

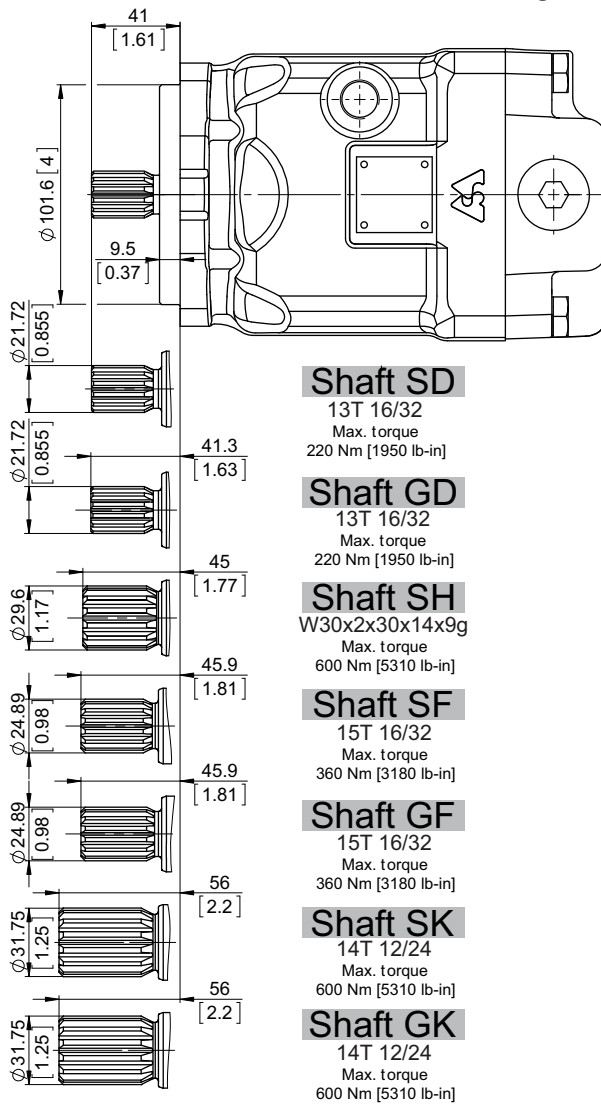


mm [in]



SHAFTS MOUNTING

Mounting Flange - Type SAE-B



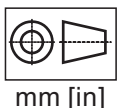
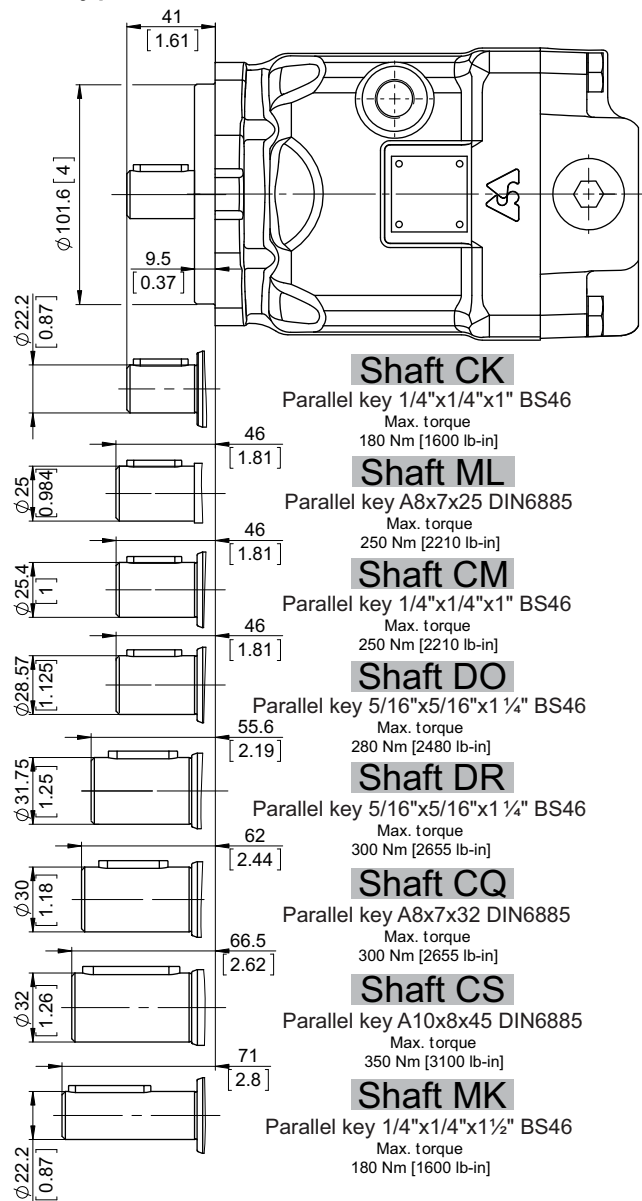
Shaft Dimensions
See Page [69+73](#)

PERMISSIBLE SHAFT LOAD

Permissible shaft load		
max Axial	N[lb]	Fa=2000 [450]
max Radial	N[lb]	Fr=3600 [810]

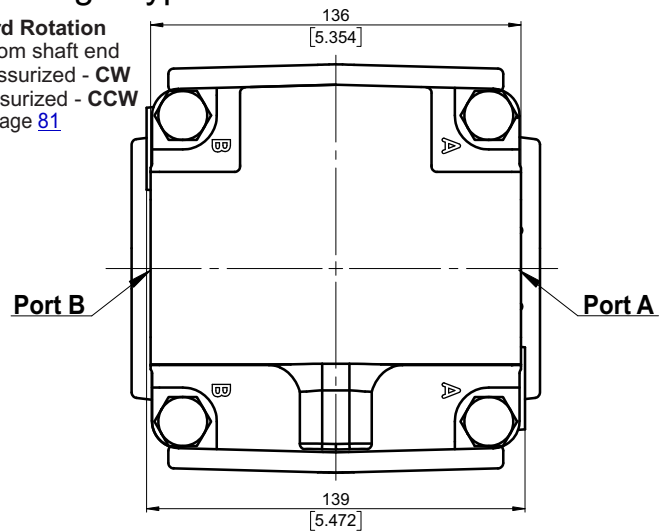
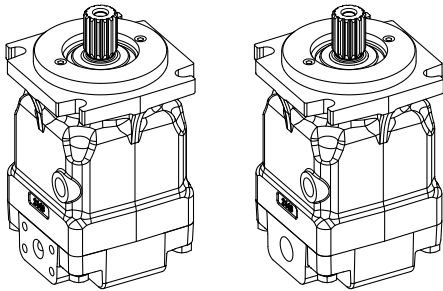
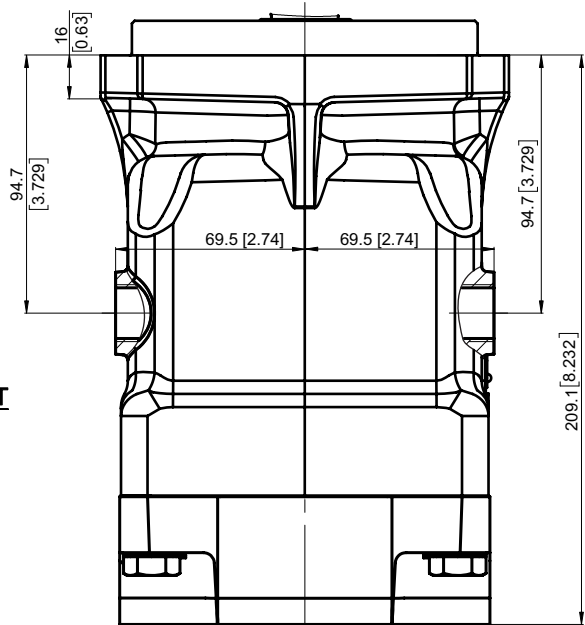
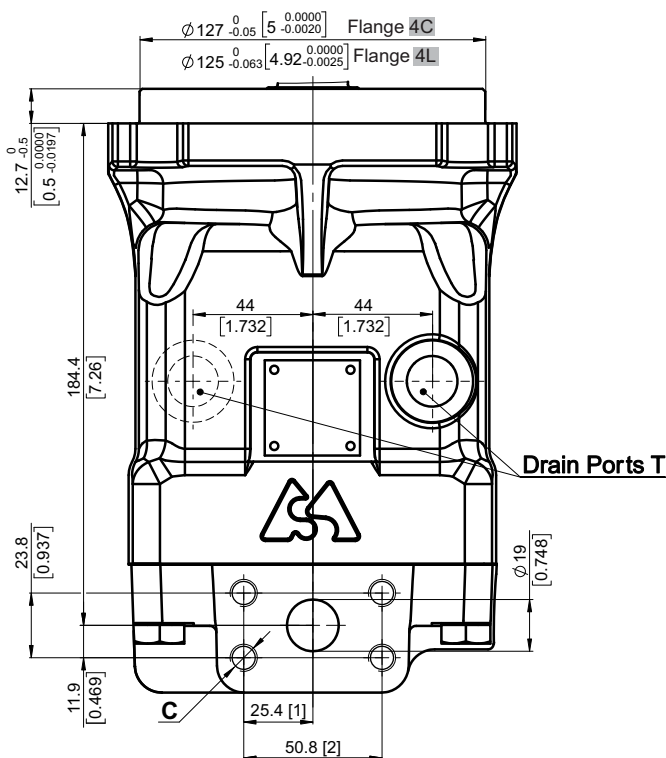
The calculated max values are based on the optimal direction of the forces Fr, Fa and optimal position of the shaft (see page [81](#)).

For more information, please, feel free to contact us.

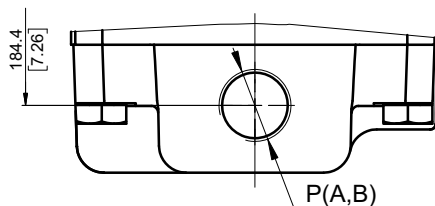



OVERALL DIMENSIONS AND PORTS
Side Ports - Default Mounting Flange Type - SAE 4C and 4L

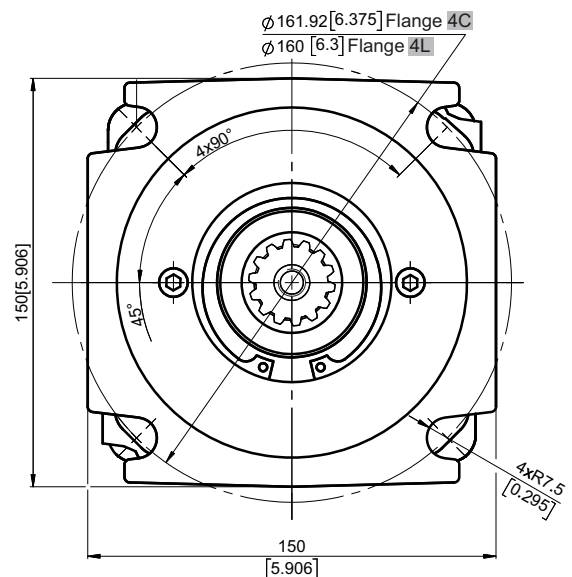
Standard Rotation
 Viewed from shaft end
 Port A Pressurized - CW
 Port B Pressurized - CCW
 see page [81](#)


Side ports, port size default, 5 and 9


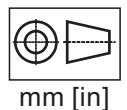
	Port Size		
	default	5	9
P _(A,B)	2xISO 6162-2 DN19	2xSAE J518 3/4" PSI6000	2xISO 6162-2 DN19
T	M18x1.5	7/8-14 UNF	G1/2
C	8xM10	8x3/8-16 UNC	8xM10

Side ports, port size 2,3 and 4


	Port Size		
	2	3	4
P _(A,B)	2xG 3/4	2xM27x2	2x1 1/16-12UN
T	G 1/2	M18x1.5	7/8-14UNF



Shaft Mounting
 see page [30](#)



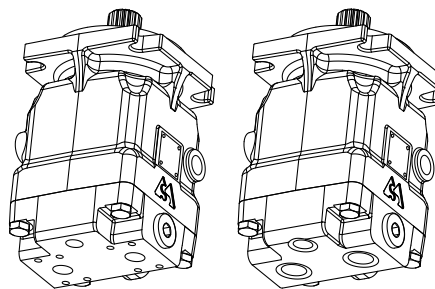
mm [in]



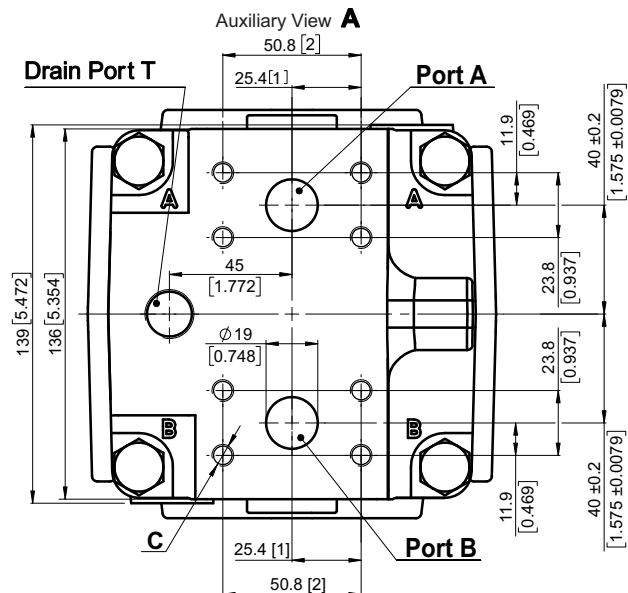
OVERALL DIMENSIONS AND PORTS

Rear Ports - Type E Mounting Flange Type - SAE 4C and 4L

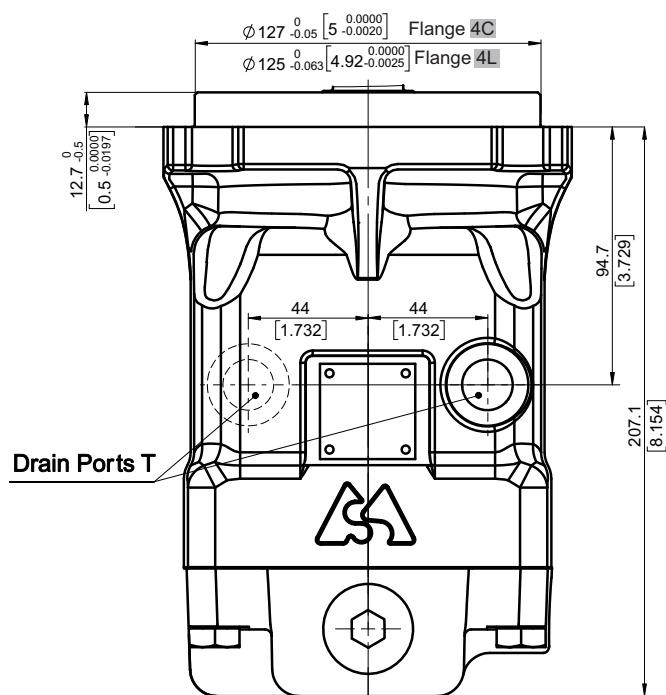
Standard Rotation
Viewed from shaft end
Port A Pressurized - **CW**
Port B Pressurized - **CCW**
see page [81](#)



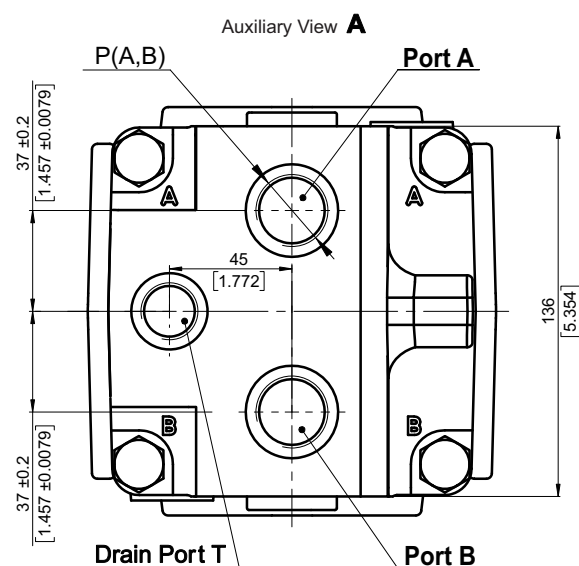
Rear ports, port size default, 5 and 9



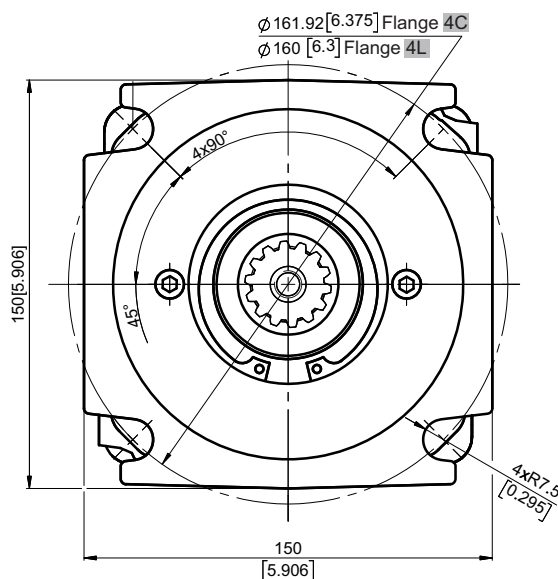
	Port Size		
	default	5	9
P _(A,B)	2xISO 6162-2 DN19	2xSAE J518 3/4" PSI6000	2xISO 6162-2 DN19
T	M18x1.5	7/8-14 UNF	G1/2
C	8xM10	8x3/8-16 UNC	8xM10



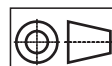
Rear ports, port size 2,3,4,6,7 and 8



	Port Size					
	2	3	4	6	7	8
P _(A,B)	2xG 3/4 2xM27x2	2x1 1/16-12UN	2xG 1/2	2xM22x1.5	2x7/8-14UNF	3/4-16UNF
T	G 1/2	M18x1.5	7/8-14UNF	G 1/2	M18x1.5	3/4-16UNF



Shaft Mounting
see page [30](#)



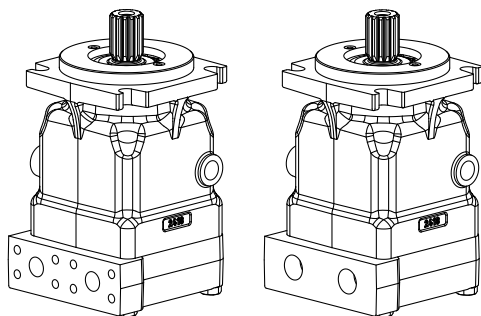
mm [in]



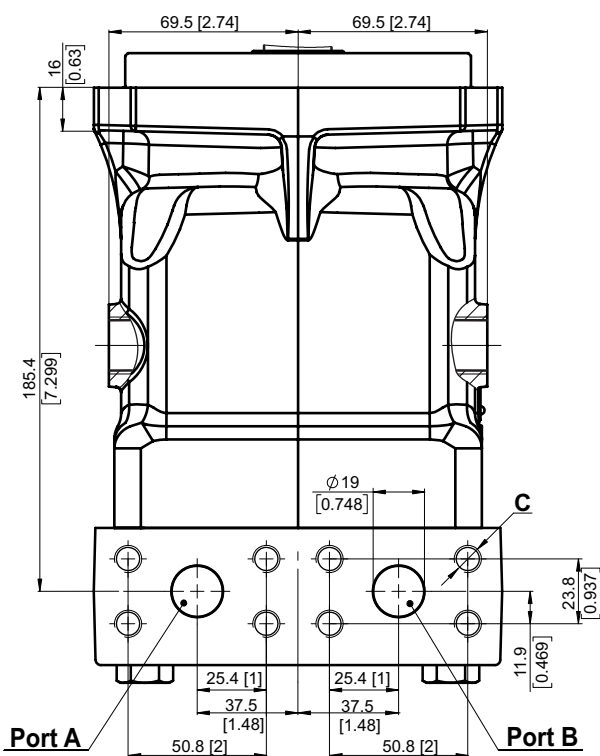
OVERALL DIMENSIONS AND PORTS

Twin Ports - Type T Mounting Flange Type - SAE 4C and 4L

Standard Rotation
Viewed from shaft end
Port A Pressurized - CW
Port B Pressurized - CCW
see page [81](#)

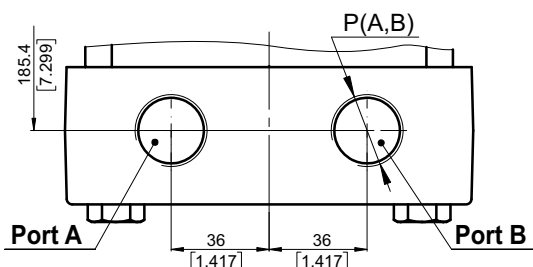


Twin ports, port size default, 5 and 9

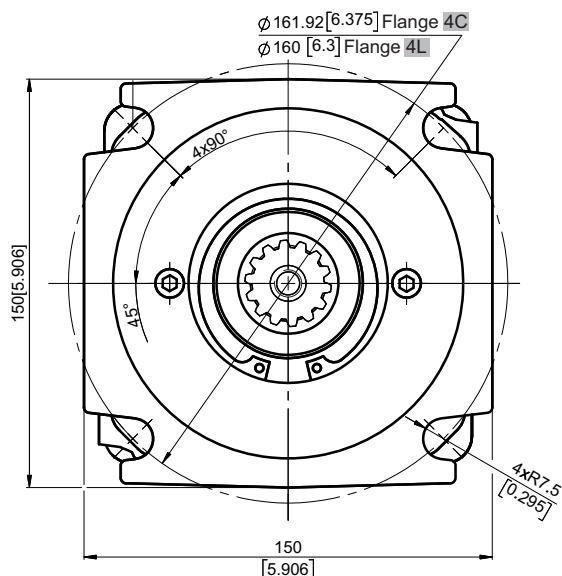
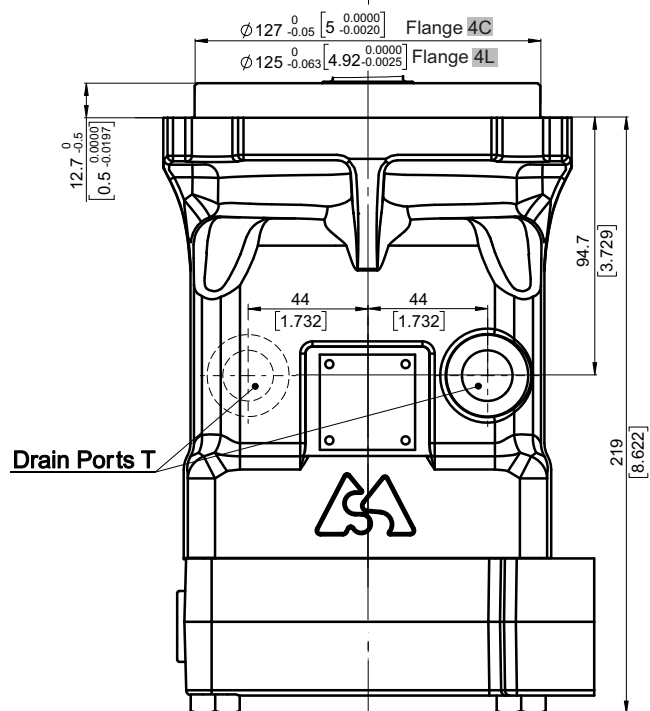
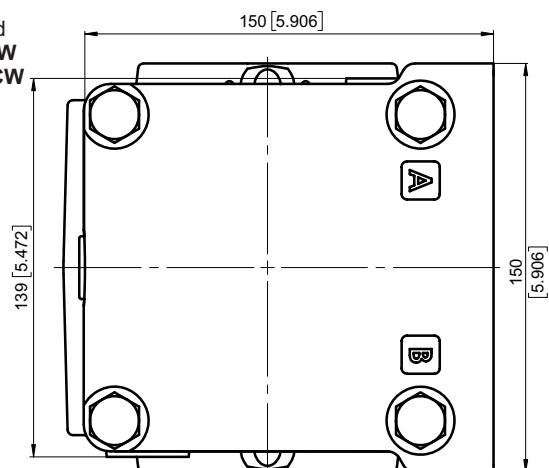


	Port Size		
	default	5	9
P _(A,B)	2xISO 6162-2 DN19	2xSAE J518 3/4" PSI6000	2xISO 6162-2 DN19
T	M18x1.5	7/8-14 UNF	G1/2
C	8xM10	8x3/8-16 UNC	8xM10

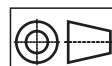
Twin ports, port size 2,3,4,6,7 and 8



	Port Size					
	2	3	4	6	7	8
P _(A,B)	2xG 3/4	2xM27x2	2x1 1/16-12UN	2xG 1/2	2xM22x1.5	2x7/8-14UNF
T	G 1/2	M18x1.5	7/8-14UNF	G 1/2	M18x1.5	3/4-16UNF



Shaft Mounting
see page [30](#)

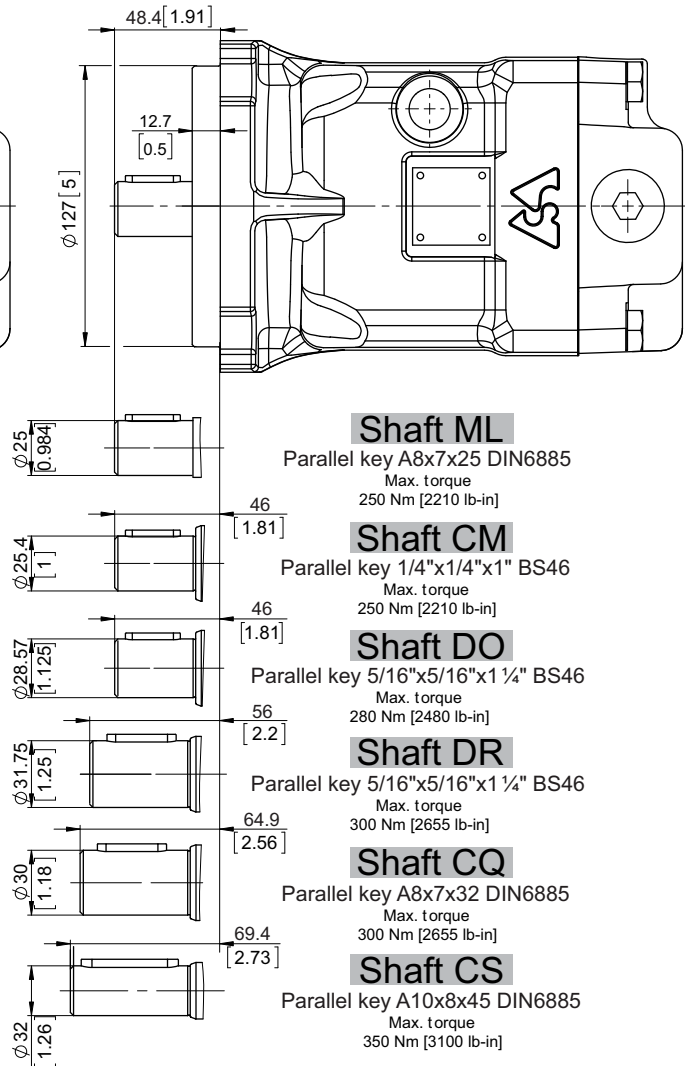
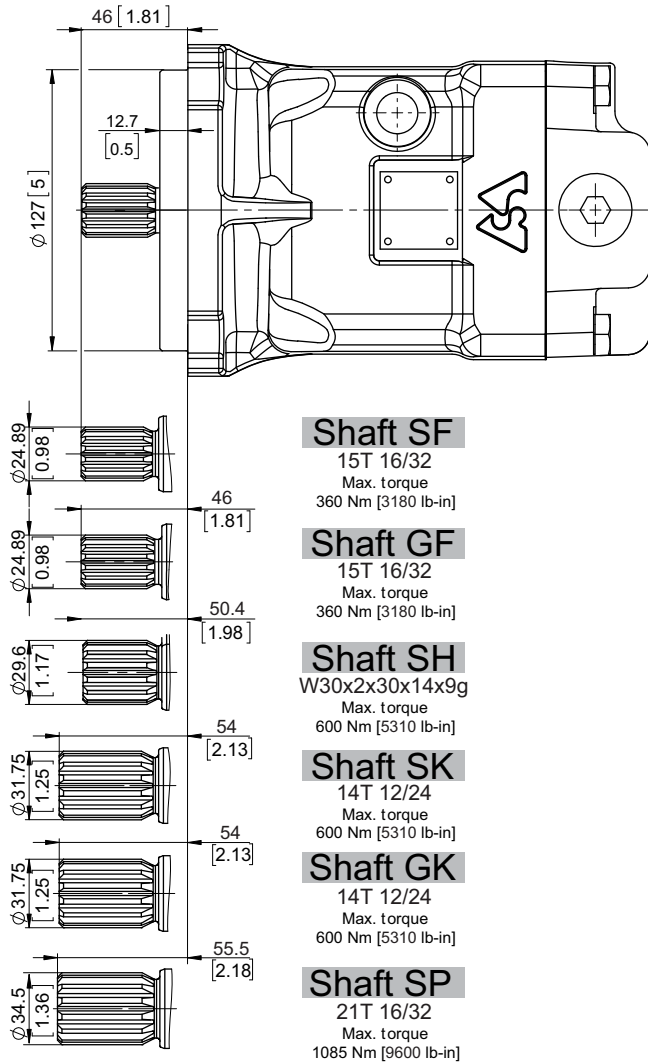


mm [in]



SHAFTS MOUNTING

Mounting Flange - Type - SAE 4C and 4L



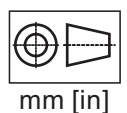
Shaft Dimensions
See Page [69÷73](#)

PERMISSIBLE SHAFT LOAD

Permissible shaft load		
max Axial	N[lb]	Fa=2000 [450]
max Radial	N[lb]	Fr=3200 [720]

The calculated max values are based on the optimal direction of the forces Fr, Fa and optimal position of the shaft (see page [81](#)).

For more information, please, feel free to contact us.





ORDERING CODE

	1	2	3	4	5	6	7	8	9	10	11	12	13	13	13
M A P													[		]

Pos.1 - Mounting Flange

- B** - SAE B - 2-Bolt flange
spigot diam. 101.6 [4"] - BC 146 [5.75"]
- 4L** - 4-Bolt flange spigot diam. 125 [4.92"] - BC 160 [6.3"]
- 4C** - SAE C - 4-Bolt flange
spigot diam. 127 [5"] - BC 161.92 [6.375"]

Pos.2 - Port Type

- omit - Side ports on opposite sides
- T** - Twin (Two) side ports on one side
- E** - Rear ports

Pos.3 - Displacement Code

- 35** - 36.16 cm³/rev [2.21 in³/rev]
- 40** - 41.59 cm³/rev [2.54 in³/rev]
- 46** - 47.13 cm³/rev [2.88 in³/rev]
- 50** - 49.94 cm³/rev [3.05 in³/rev]
- 52** - 51.95 cm³/rev [3.17 in³/rev]
- 58** - 58.8 cm³/rev [3.59 in³/rev]
- 62** - 62.4 cm³/rev [3.81 in³/rev]

Pos.4 - Shaft Extensions**

- SD** - ø21.72 [0.855"] Spline SAE 13T 16/32 DP, M8
- GD** - ø21.72 [0.855"] Spline SAE 13T 16/32 DP,
5/16-18 UNC thread
- SF** - ø24.9 [0.98"] Spline SAE 15T 16/32, M8
- GF** - ø24.9 [0.98"] Spline SAE 15T 16/32, 3/8-16UNC
- SH** - ø29.6 [1.165"] Spline W30x2x30x14x9g, M10
- SK** - ø31.75 [1.25"] Spline SAE 14T 12/24 DP, M10
- GK** - ø31.75 [1.25"] Spline SAE 14T 12/24 DP,
7/16-14UNC thread
- SP** - ø34.5 [1.358"] Spline SAE 21T 16/32 DP, M12
- CK** - ø22.2 [7/8"] Straight, M8 thread
Parallel key 1/4"x1/4"x1" BS46
- MK** - ø22.2 [7/8"] Straight, M8 thread
Parallel key 1/4"x1/4"x1 1/2" BS46
- ML** - ø25 [0.984"] Straight, M8 thread
Parallel key A8x7x25 DIN6885
- CM** - ø25.4 [1"] Straight, M8 thread
Parallel key 1/4"x1/4"x1" BS46
- DO** - ø28.75 [1.125"] Straight, 3/8-16UNC
Parallel key 5/16"x5/16"x1 1/4" BS46
- CQ** - ø30 [1.181"] Straight, M8 thread
Parallel key A8x7x32 DIN6885
- DR** - ø31.75 [1.25"] Straight, 3/8-16UNC
Parallel key 5/16"x5/16"x1 1/4" BS46
- CS** - ø32 [1.26"] Straight, M8 thread
Parallel key A10x8x45 DIN6885
- TD** - ø22.22 [7/8"] Tapered 1:8 [125:1000],
Parallel key 1/4"x1/4"x1", 5/8-18 UNF
- TH** - ø25.4 [1"] Tapered 1:8 [125:1000],
Parallel key 1/4"x1/4"x1", 3/4-16 UNF
- KH** - ø25.4 [1"] Tapered 1:8 [125:1000],
Parallel key 1/4"x1/4"x1", M16x1.5
- Shaft type SP is available only for Pos.1 option 4C and 4L

Pos.5 - Port Size

- omit - 2xISO 6162-2 DN19, drain port M18x1.5
- 2** - 2xG3/4, drain ports G1/2
- 3** - 2xM27x2, drain ports M18x1.5
- 4** - 2x1 1/16 -12 UN, drain ports 7/8-14 UNF
- 5** - 2xSAE 3/4" PSI6000, drain port 7/8-14 UNF
- 6** - 2xG1/2, drain ports G1/2
- 7** - 2xM22x1.5, drain ports M18x1.5
- 8** - 2x7/8-14 UNF Ports, drain ports 3/4-16 UNF
- 9** - 2xISO 6162-2 DN19, drain port G1/2

Option 6;7 and 8 are not available for Pos.2 option omit

Pos.6 - Seal, Corrosion Resistant Seal Surface

- omit - NBR seal type material
- V** - FKM seal type material

Pos.7 - Integrated Valves

See page [77÷78](#) for information about valves

- omit - None
- HR** - Single anti-cavitation valve
- AR** - Dual anti-cavitation valve
- PU** - Purge valve - default - 6±2 l/min
- FLU** - Flush valve - default - 6±2 l/min at 20 bar
- SAR** - Single anti-cavitation and relief valve
- DAR** - Dual anti-cavitation and relief valve
- DARP** - Dual anti-cavitation, relief and purge
valve, default flow - 6±2 l/min
- DARF** - Dual anti-cavitation, relief and flush
valve, default flow - 6±2 l/min at 20 bar

Option DAR,DARF,DARP,SAR, AR and HR are not available for Pos.2 option E
Option DARF and DARP are not available for Pos.2 option omit

Pos.8 - Valve's Port for Single Valves

- omit - None
- A** - Port A
- B** - Port B

Pos.9 - Pressure Setting of Integrated Valves

- omit - None
- x** -

250	300	350
-----	-----	-----

for more information see page [77÷78](#)

Pos.10 - Flow Setting of Integrated Valves

- omit - None
- Lx** - For value - see page [77÷78](#)

Pos.11 - Special Features*

- omit - None
- R2S** - Speed Sensor Two Directional (see page [79](#))
- R** - Reverse Rotation (see page [81](#))

Pos.12 - Paint and Coating

- omit - No paint or coating
- P** - Painted
- PC** - Corrosion protected paint

If a painting option is required, the standard color is black-Alkyd-Styrenated Enamel, Black RAL 9005.
Other color by customer's request.

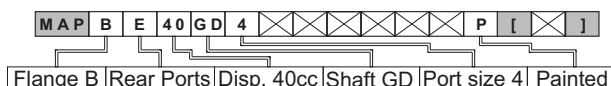
Pos.13 - Design Series

- omit - Factory specified

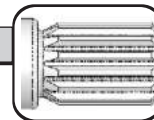
**The permissible output torque for shafts must not be exceeded!

EXAMPLE

M A P B E 40 G D 4 P

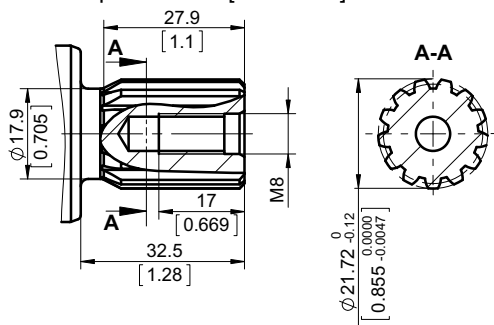


SHAFT TYPES AND DIMENSIONS



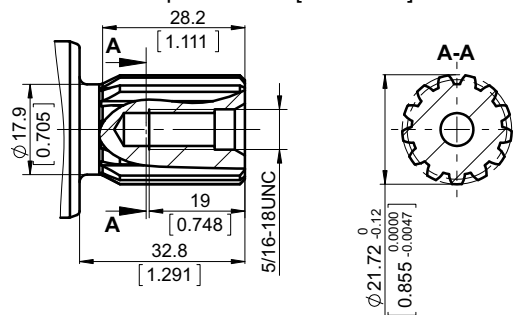
SD

$\varnothing 21.72$ [0.855], M8 thread
13T 16/32 DP splined ANSI B92.1-1970
 Max. torque 220 Nm [1950 lb-in]



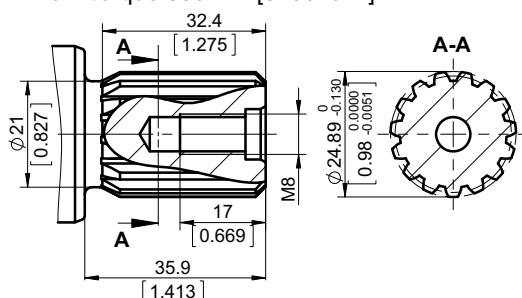
GD

$\varnothing 21.72$ [0.855], 5/16-18 UNC thread
13T 16/32 DP splined ANSI B92.1-1970
 Max. torque 220 Nm [1950 lb-in]



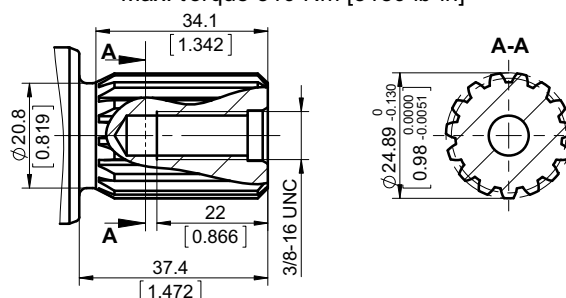
SF

$\varnothing 24.89$ [0.98], M8 thread
15T 16/32 DP splined ANSI B92.1-1970
 Max. torque 330 Nm [3180 lb-in]



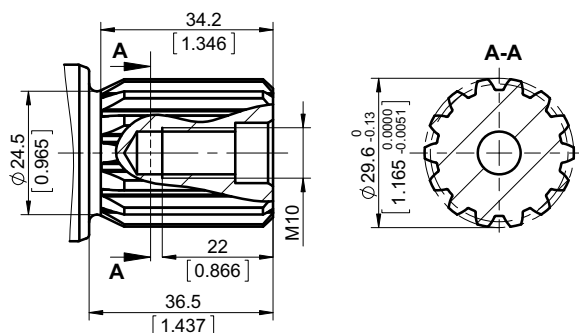
GF

$\varnothing 24.89$ [0.98], 3/8-16 UNC thread
15T 16/32 DP splined ANSI B92.1-1970
 Max. torque 310 Nm [3180 lb-in]



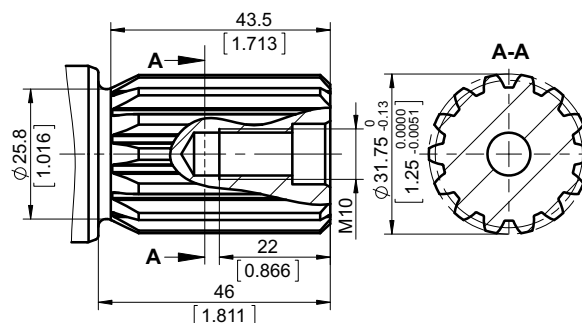
SH

$\varnothing 29.6$ [1.165], M10 thread
W30x2x30x14x9g splined DIN 5480
 Max. torque 500 Nm [5310 lb-in]

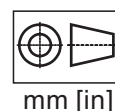


SK

$\varnothing 31.75$ [1.25], M10 thread
14T 12/24 DP splined ANSI B92.1-1970
 Max. torque 600 Nm [5310 lb-in]

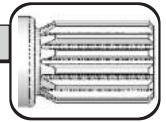


The required max. torque
 must not be exceeded



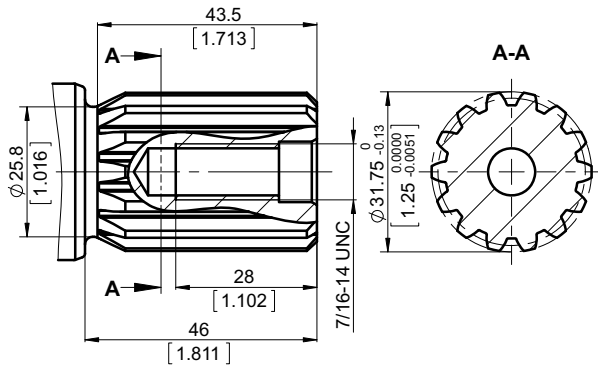
mm [in]

SHAFT TYPES AND DIMENSIONS



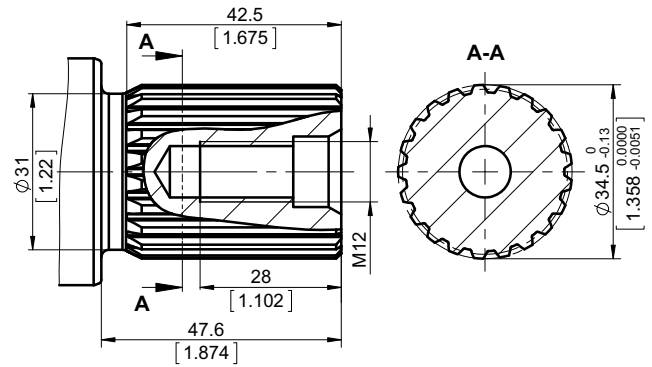
GK

$\phi 31.75$ [1.25], 7/16-14 UNC thread
 14T 12/24 DP splined ANSI B92.1-1970
 Max. torque 600 Nm [5310 lb-in]



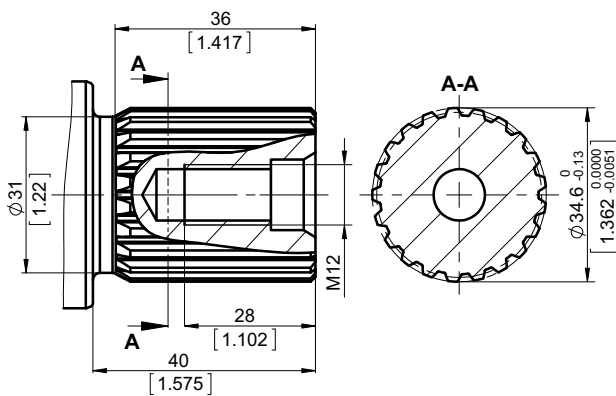
SP

$\phi 34.5$ [1.358], M12 thread
 21T 16/32 DP splined ANSI B92.1-1970
 Max. torque 1085 Nm [9600 lb-in]



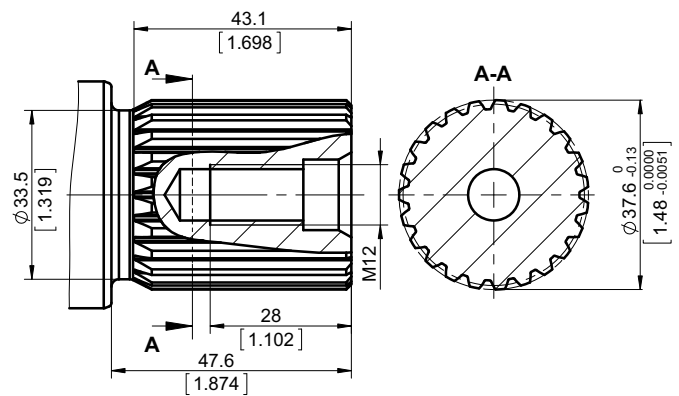
QH

$\phi 34.6$ [1.36], M12 thread
 W35x2x30x16x9g splined DIN 5480
 Max. torque 1085 Nm [9600 lb-in]



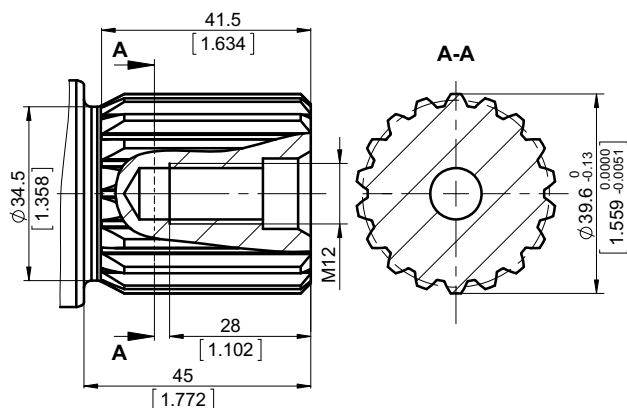
SR

$\phi 37.6$ [1½], M12 thread
 23T 16/32 DP splined ANSI B92.1-1970
 Max. torque 1300 Nm [11500 lb-in]



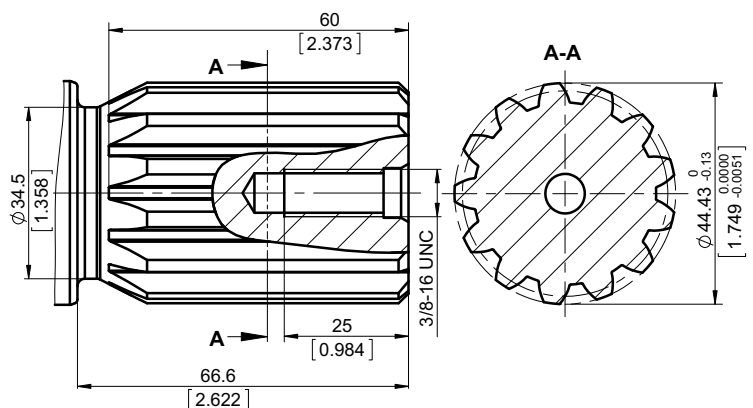
ST

$\phi 39.6$ [1.559], M12 thread
 W40x2x30x18x9g splined DIN 5480
 Max. torque 1400 Nm [12400 lb-in]

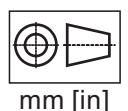


GU

$\phi 44.43$ [1¾], 3/8-16 UNC thread
 13T 8/16 DP splined ANSI B92.1-1970
 Max. torque 1400 Nm [17700 lb-in]



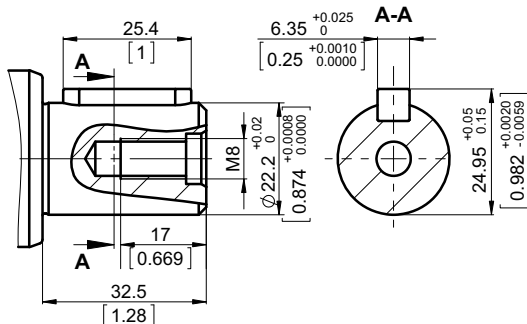
The required max. torque
 must not be exceeded



SHAFT TYPES AND DIMENSIONS

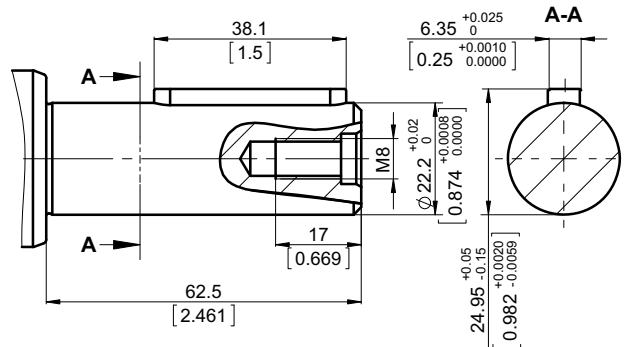
CK

ø22.2 [7/8] straight, M8 thread
Parallel key 1/4"x1/4"x1" BS46
Max. torque 180 Nm [1600 lb-in]



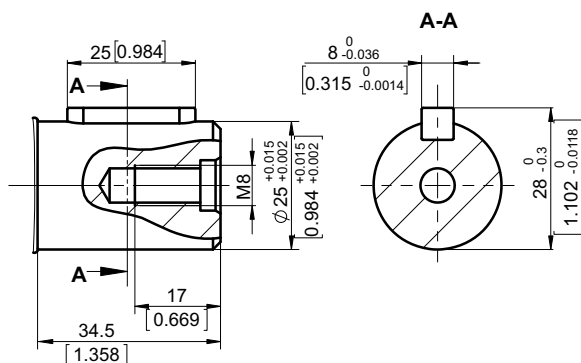
MK

ø22.2 [7/8] straight, M8 thread
Parallel key 1/4"x1/4"x1½" BS46
Max. torque 180 Nm [1600 lb-in]



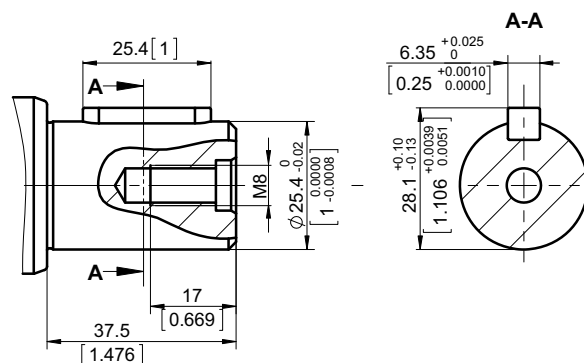
ML

ø25 [0.984] straight, M8 thread
Parallel key A8x7x25 DIN6885
Max. torque 250 Nm [2210 lb-in]



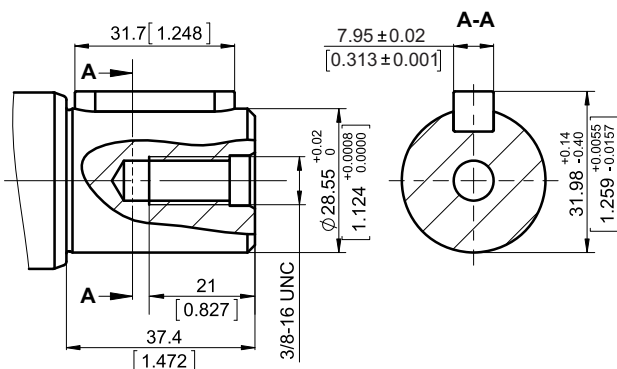
CM CMN

ø25.4 [1] straight, M8 thread
Parallel key 1/4"x1/4"x1" BS46
Max. torque 250 Nm [2210 lb-in]



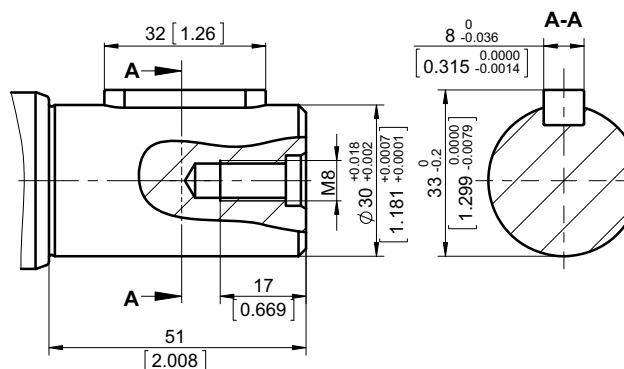
DO

ø28.55 [1.125] straight, 3/8-16 UNC thread
Parallel key 5/16"x5/16"x1¼"
Max. torque 280 Nm [2480 lb-in]

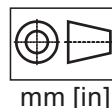


CQ

ø30 [1.181] straight, M8 thread
Parallel key A8x7x32 DIN6885
Max. torque 300 Nm [2655 lb-in]



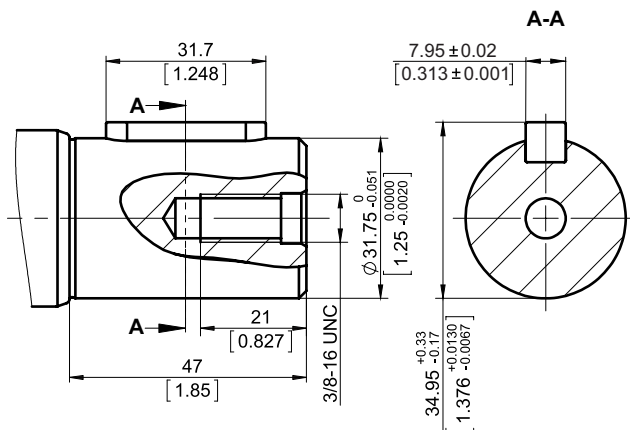
The required max. torque
must not be exceeded



SHAFT TYPES AND DIMENSIONS

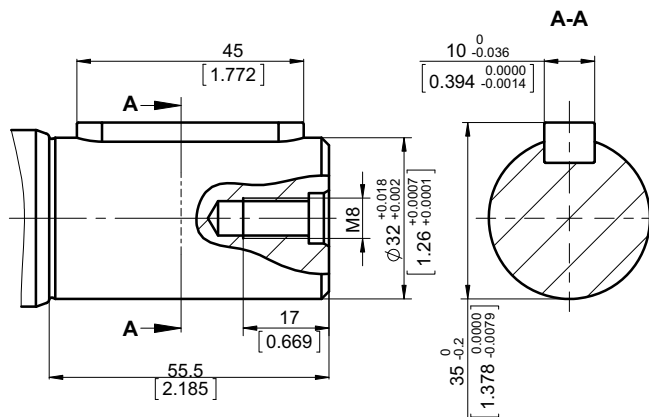
DR

ø31.75 [1.25] straight, 3/8-16 UNC thread
Parallel key 5/16"x5/16"x1 1/4"
Max. torque 300 Nm [2655 lb-in]



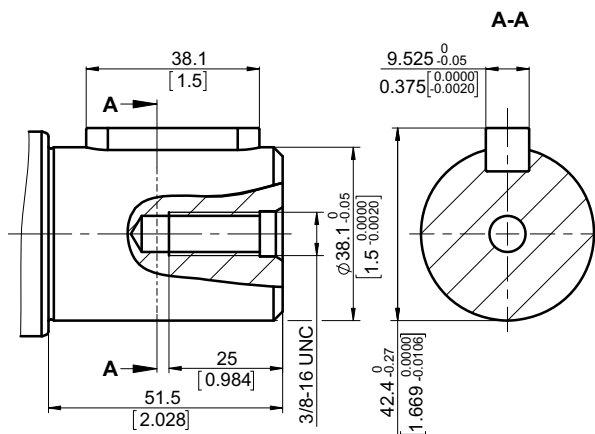
CS

ø32 [1.26] straight, M8 thread
Parallel key A10x8x45 DIN6885
Max. torque 350 Nm [3100 lb-in]



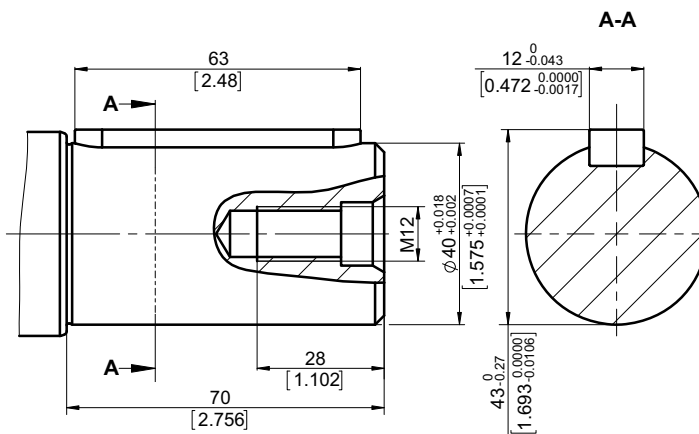
DU

ø38.1 [1 1/2] straight, 3/8-16 UNC thread
Parallel key 3/4"x3/4"x1 1/2" BS46
Max. torque 1000 Nm [8850 lb-in]

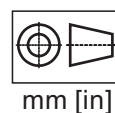


CV

ø40 [1.575] straight, M12 thread
Parallel key A12x8x63 DIN6885
Max. torque 1100 Nm [9735 lb-in]



The required max. torque
must not be exceeded

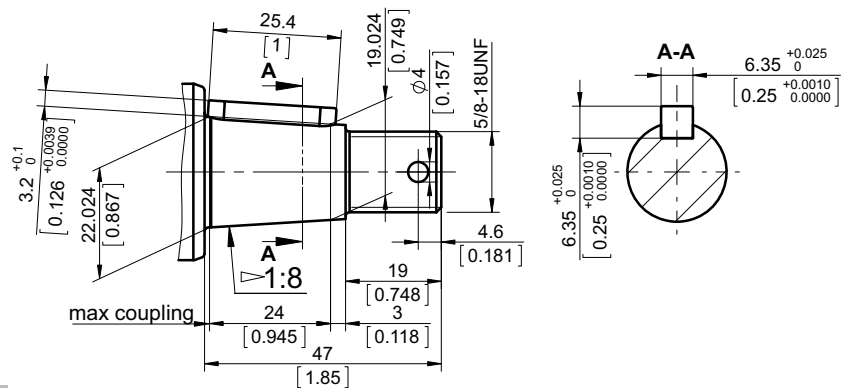




SHAFT TYPES AND DIMENSIONS

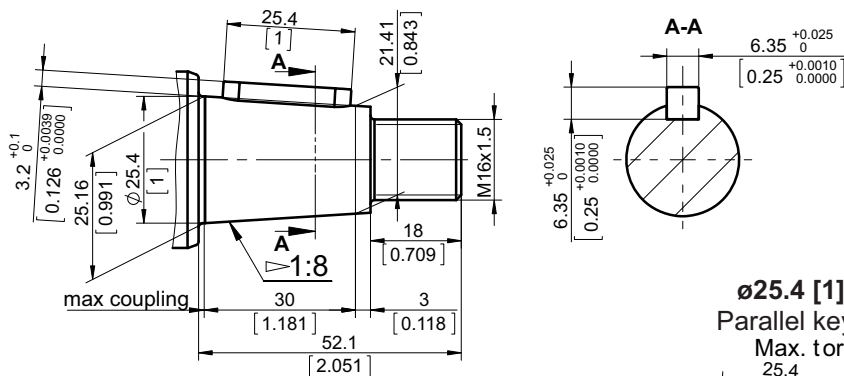
TD

ø22.22 [7/8] Tapered 1:8 [125:1000],
Parallel key 1/4"x1/4"x1", 5/8-18 UNF
Max. torque 220 Nm [1950 lb-in]



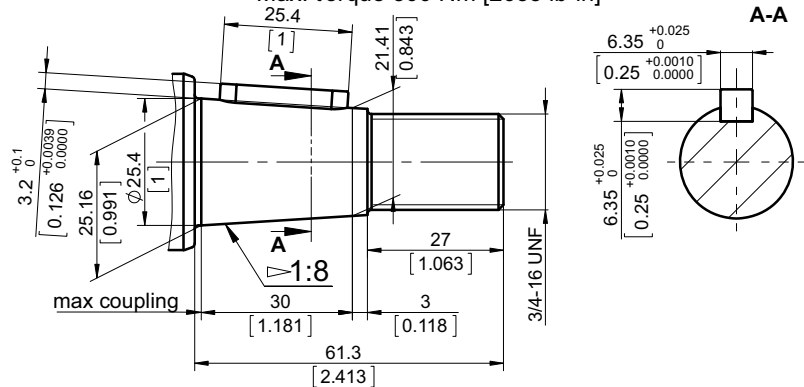
KH

ø25.4 [1] Tapered 1:8 [125:1000],
Parallel key 1/4"x1/4"x1", M16x1.5
Max. torque 300 Nm [2655 lb-in]



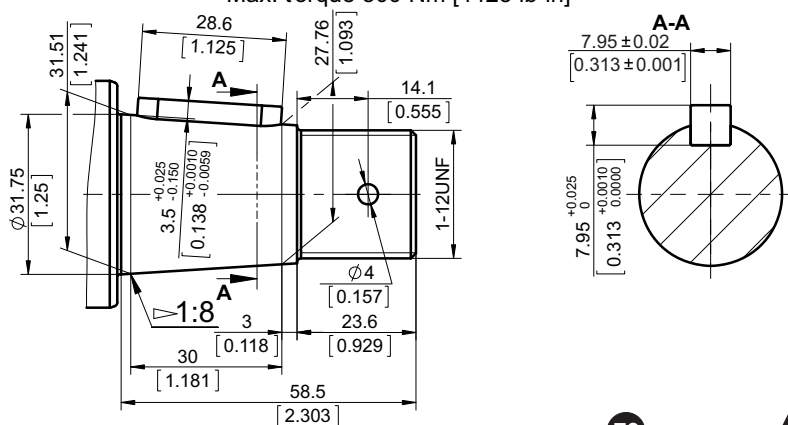
TH

ø25.4 [1] Tapered 1:8 [125:1000],
Parallel key 1/4"x1/4"x1", 3/4-16 UNF
Max. torque 300 Nm [2655 lb-in]

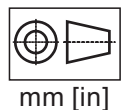


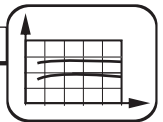
TN

ø31.75 [1 1/4] Tapered 1:8 [125:1000],
Parallel key 5/16"x5/16"x1 1/8", 1-12 UNF
Max. torque 500 Nm [4425 lb-in]



The required max. torque
must not be exceeded

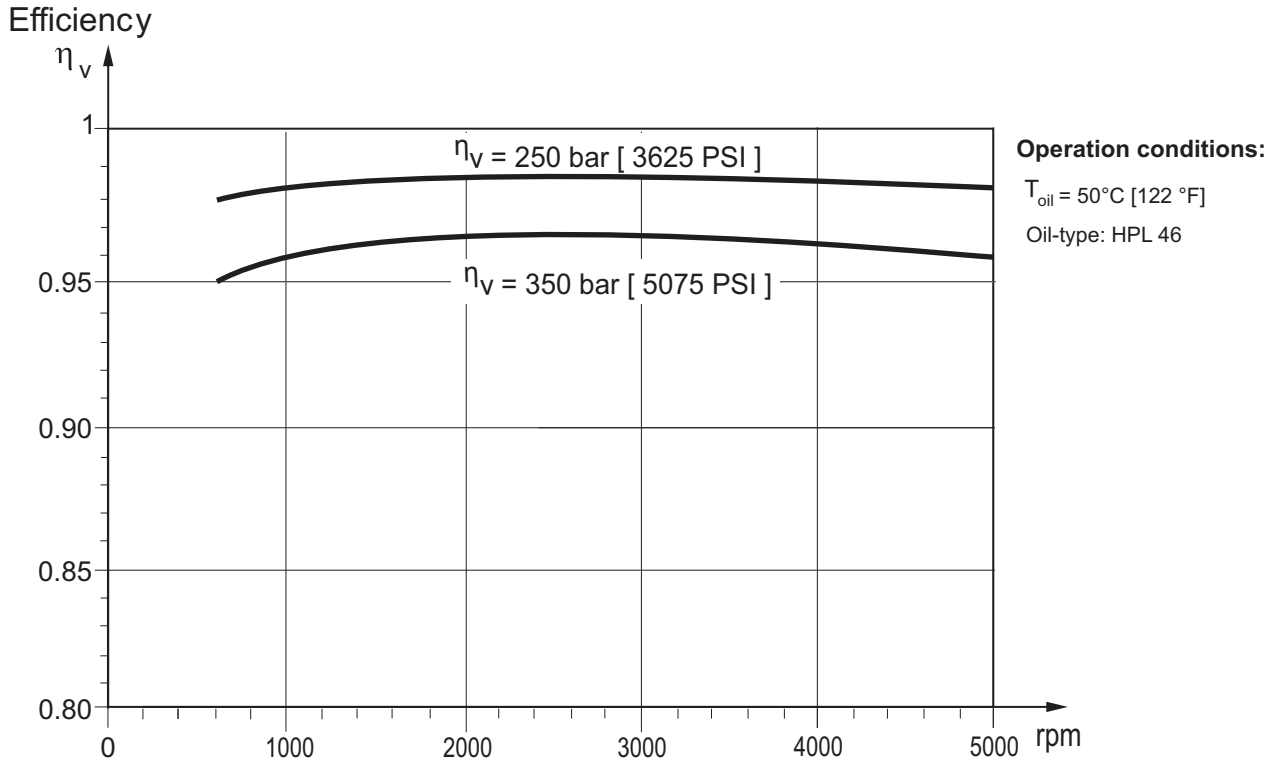




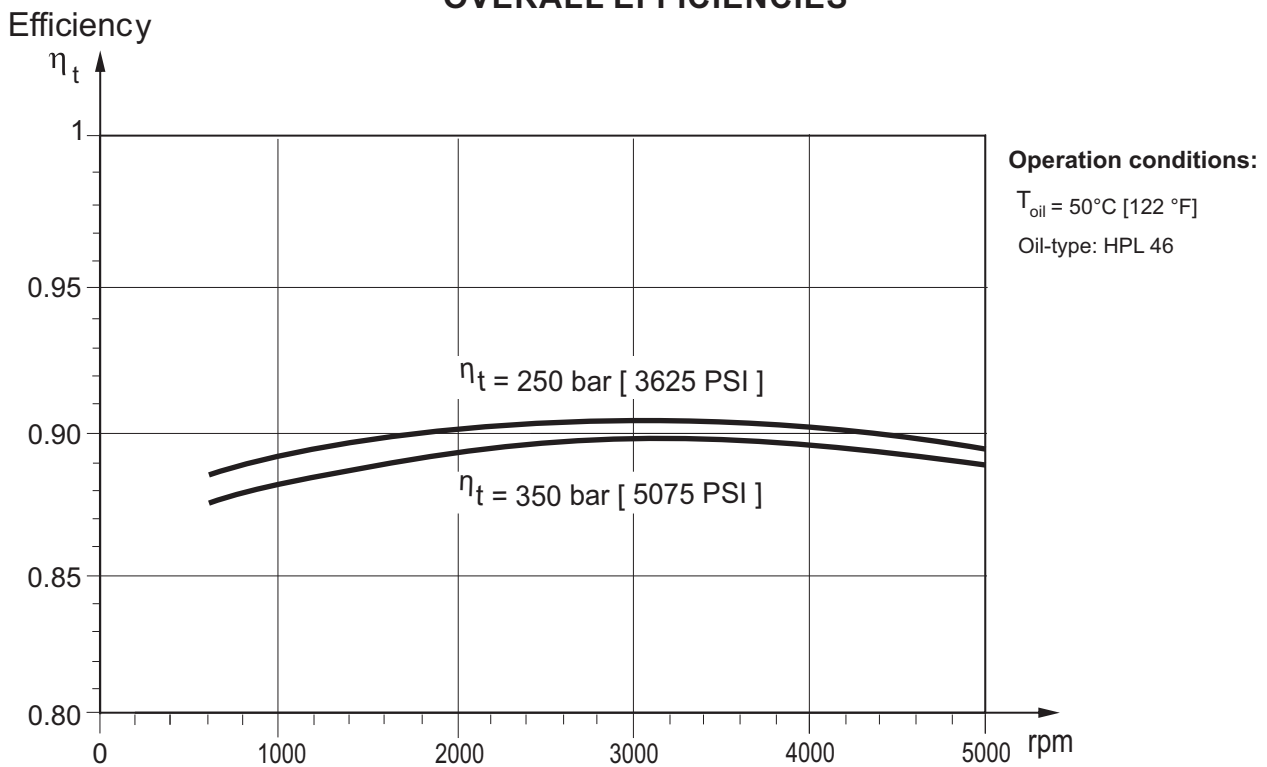
MOTOR FUNCTION DIAGRAMS

The below efficiencies are applied for all motor displacements.

VOLUMETRIC EFFICIENCIES



OVERALL EFFICIENCIES



The motor size, pressure, torque, speed of rotation and flow rate required for a specific application can be calculated using the formulas on page [85](#)

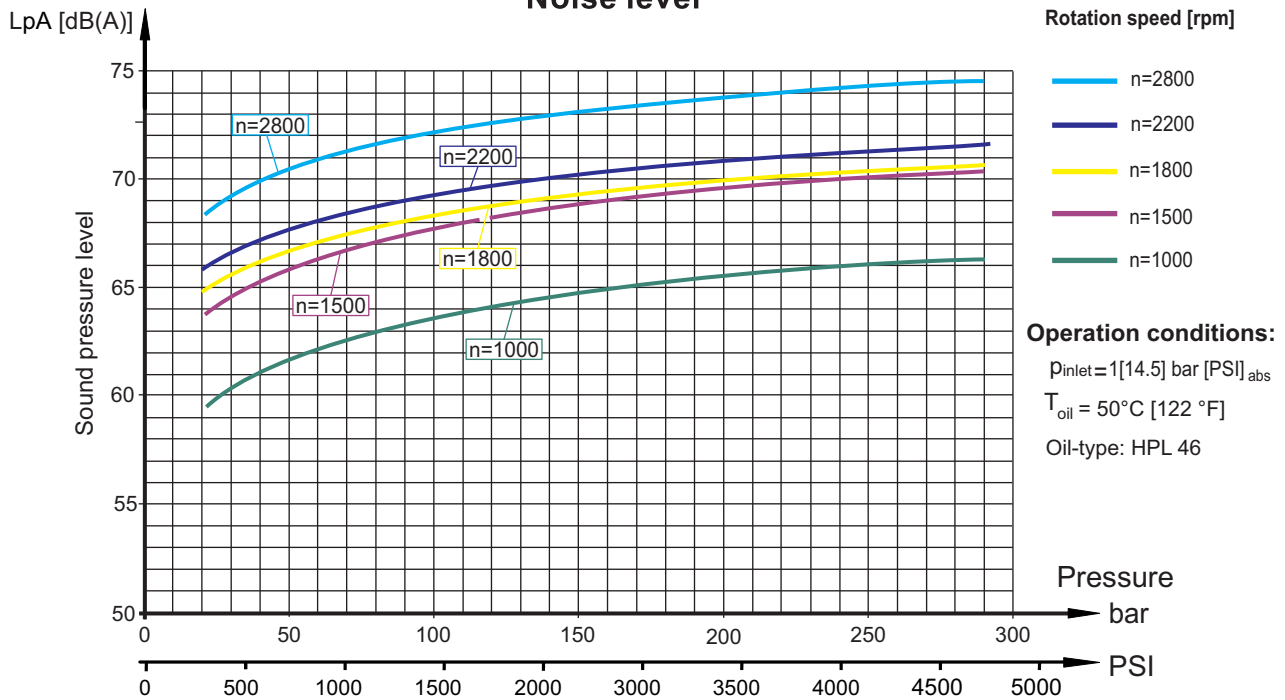
Efficiencies for a particular motor may vary from the shown in the diagram depending on the operating conditions.

PUMP FUNCTION DIAGRAMS

The diagram is applied for all pump displacements.

Sound pressure level (noise) is measured in acoustic chamber according to DIN 45635 Part 1 and Part 26. These .

Noise level

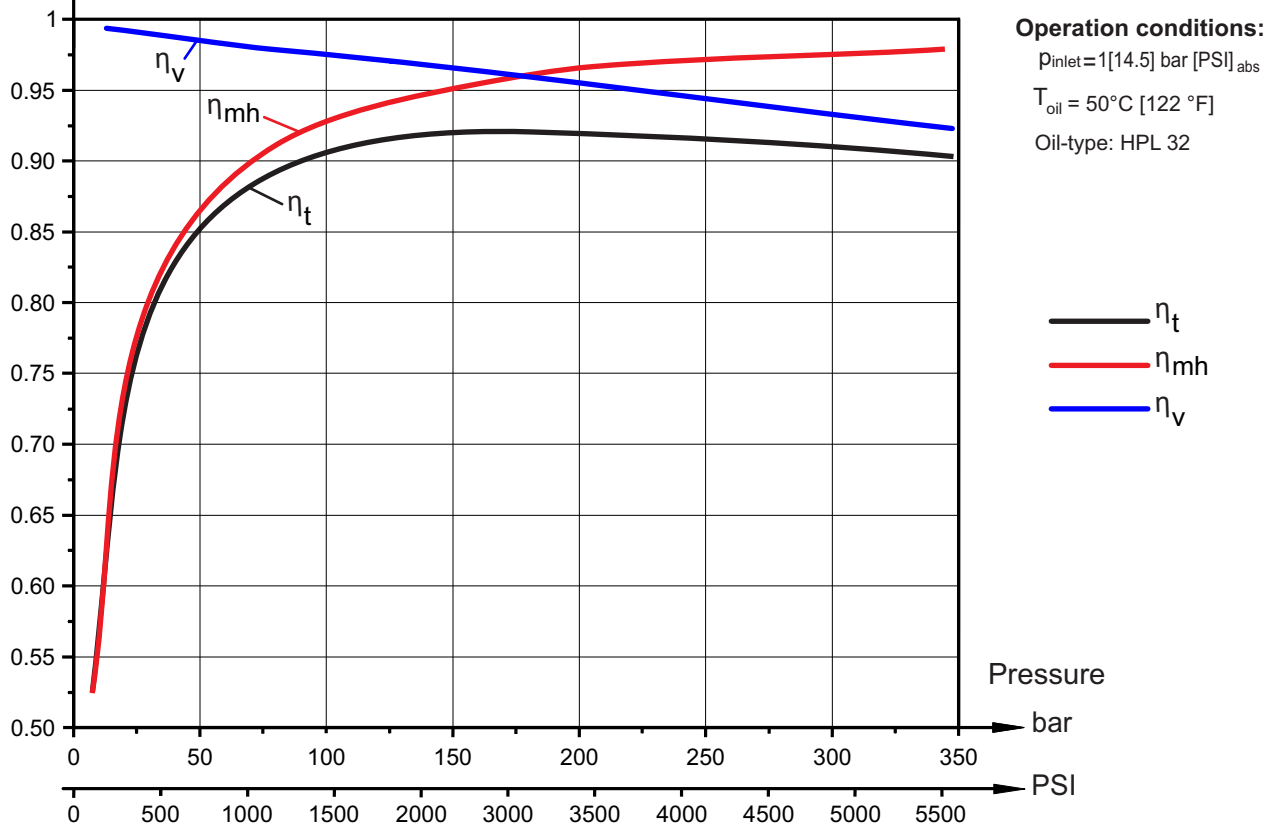


The sound pressure level for a particular pump may vary $\pm 2 \text{ dB(A)}$ compared to what is shown in the diagram.

Efficiency
 η_t η_{mh} η_v

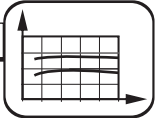
The below efficiencies are applied for all displacements.

Efficiencies at 1000 rpm

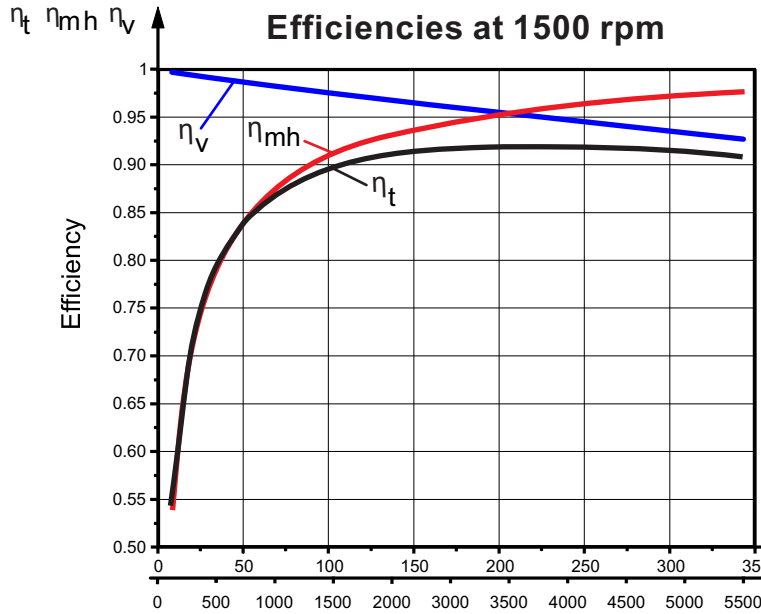


The pump size, pressure, torque, speed of rotation and flow rate required for a specific application can be calculated using the formulas on page [85](#)

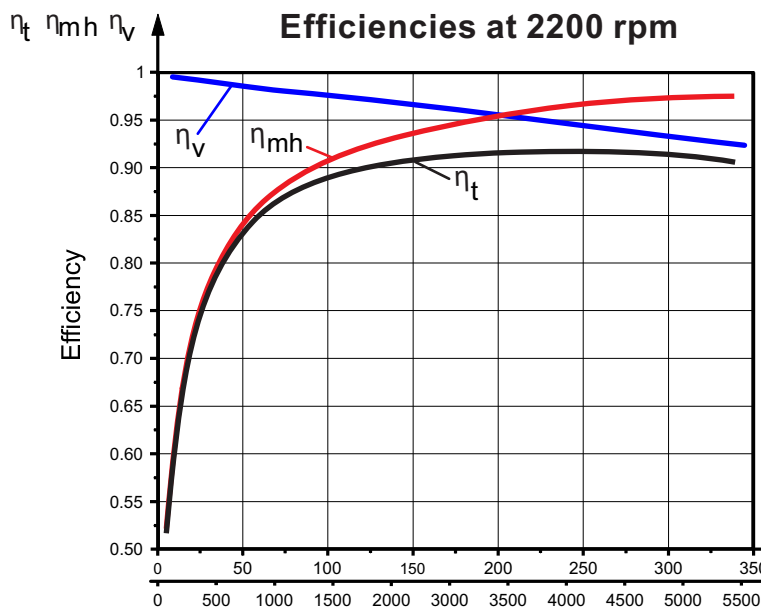
Efficiencies for a particular pump may vary from the shown in the diagram depending on the operating conditions.



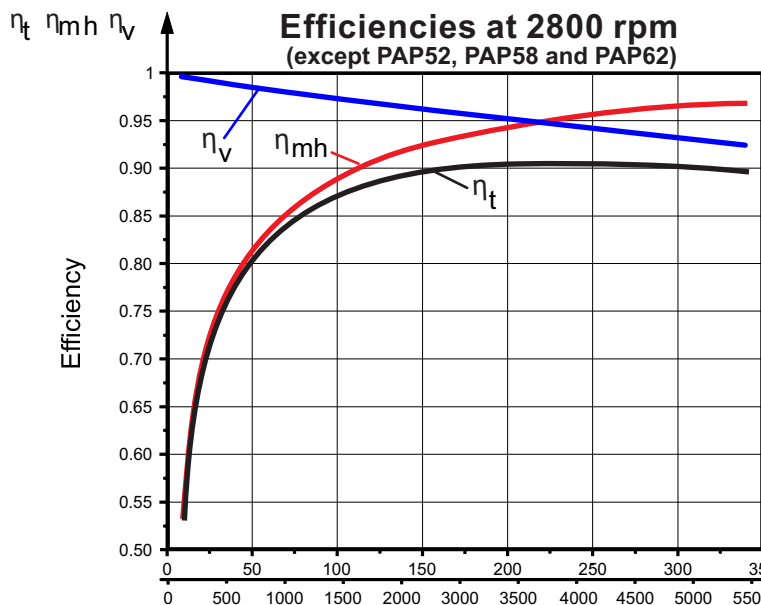
PUMP FUNCTION DIAGRAMS

**Operation conditions:** $p_{inlet} = 1[14.5] \text{ bar [PSI]}_{abs}$ $T_{oil} = 50^\circ\text{C} [122^\circ\text{F}]$

Oil-type: HPL 32

**Operation conditions:** $p_{inlet} = 1[14.5] \text{ bar [PSI]}_{abs}$ $T_{oil} = 50^\circ\text{C} [122^\circ\text{F}]$

Oil-type: HPL 32

**Operation conditions:** $p_{inlet} = 1[14.5] \text{ bar [PSI]}_{abs}$ $T_{oil} = 50^\circ\text{C} [122^\circ\text{F}]$

Oil-type: HPL 32

The pump size, pressure, torque, speed of rotation and flow rate required for a specific application can be calculated using the formulas on page [85](#)

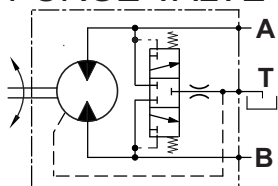
Efficiencies for a particular pump may vary from the shown in the diagram depending on the operating conditions.

VALVE OPTIONS



The overall dimensions of the motor with integrated valves could vary compared to the standard motors.

Option PU PURGE VALVE



- Mainly used in open loop circuit;
- Used for cooling purpose or oil cleanliness requirements;
- Flow rate by **default** :

Motors	MAP28	MAP62	MAP100	MAPW62
default	5±2 l/min	6±2 l/min	7±2 l/min	6±2 l/min

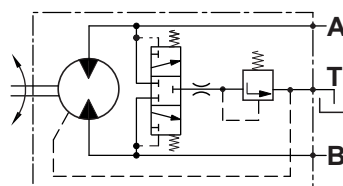
- For other options, please see Flow Setting of ordering code, considering the following possible values:

Flow setting → flow rate

EXAMPLE

MAPB50SH2PU purge valve flow rate 6±2 l/min
 MAPB50SH2PUL3.5 purge valve flow rate 3.5±1 l/min
 MAPB50SH2PUL5.5 purge valve flow rate 5.5±1 l/min

Option FLU FLUSH VALVE



- Mainly used in close loop circuit;
- The valve is a combination between a purge valve and check valve;
- Flow rate by **default**

Motors	MAP28	MAP62	MAP100	MAPW62
default	5±2 l/min	6±2 l/min	7±2 l/min	6±2 l/min

- and charge (opening) pressure 16 bar with 20 bar feed pressure for close loop circuit;

- For other options, please see Pressure Setting and Flow Setting of ordering code, considering the following possible values:

Pressure setting → pressure
 Flow setting → flow rate

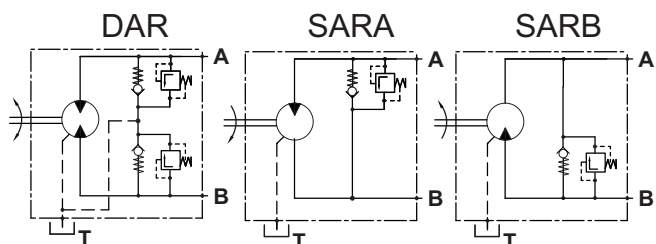
EXAMPLE

MAPB50SH2FLU flow rate 6±2 l/min, charge pressure 16 bar
 MAPB50SH2FLU10L5.5 flow rate 5.5±1 l/min, charge pressure 10 bar
 MAPB50SH2FLUL3.5 flow rate 3.5±1 l/min, charge pressure 16 bar

Option DAR, SARA, SARB

Combined Anti-Cavitation and Relief Valve

- Anti-cavitation check valve is used for applications such as Fan drive control;
- Pressure relief valves prevent excessive pressures in the high pressure loop.



Please, consider the following possible values:

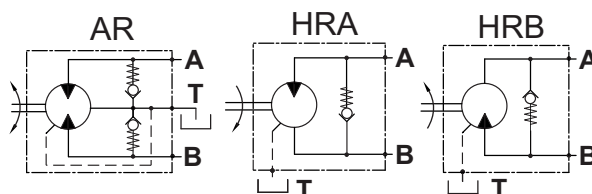
Pressure setting → pressure

EXAMPLE

MAPB50SH2DAR350
 Double Anti-Cavitation and Relief Valve, relief valve setting 350 bar
 MAPB50SH2SARA250
 Single Anti-Cavitation and Relief Valve, relief valve setting 250 bar
 The valve is placed on port A
 MAPB50SH2SARB300
 Single Anti-Cavitation and Relief Valve, relief valve setting 300 bar
 The valve is placed on port B

Option AR, HRA, HRB Anti-Cavitation Valve

- Anti-cavitation check valve is used for applications such as Fan drive control.



EXAMPLE

MAPB50SH2AR
 Double Anti-Cavitation Valve
 MAPB50SH2HRA
 Single Anti-Cavitation Valve, the valve is placed on port A
 MAPB50SH2HRB
 Single Anti-Cavitation Valve, the valve is placed on port B

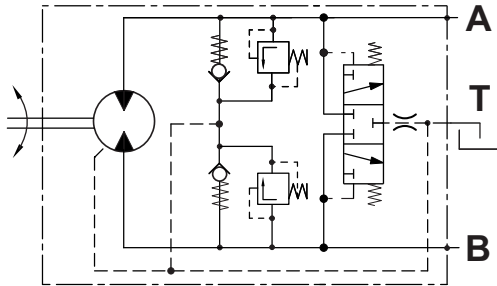
VALVE OPTIONS



The overall dimensions of the motor with integrated valves could vary compared to the standard motors.

Option **DARP**

Dual Anti-Cavitation, Relief and Purge Valve



- Mainly used in open loop circuit;
- The valve is a combination between a dual anti-cavitation, relief and purge valve;
- Purge Valve is used for cooling purpose or cleanliness requirements;
- Anti-Cavitation Check Valve is used for applications such as Fan drive control;
- Pressure relief valves prevent excessive pressures in the high pressure loop;
- Please, consider the following possible values for pressure set of the relief valve:

Pressure setting **250 300 350** → pressure

- Flow rate of purge valve by **default**

Motors	MAP28	MAP62	MAP100	MAPW62
default	5±2 l/min	6±2 l/min	7±2 l/min	6±2 l/min

The possible values are as follow:

Flow setting **omit L3.5 L5.5** → flow rate

EXAMPLE

MAPB50SH2DARP350

Double Anti-Cavitation, Relief and Purge Valve, relief valve setting 350 bar, purge valve flow rate 6±2 l/min

MAPB50SH2DARP250L3.5

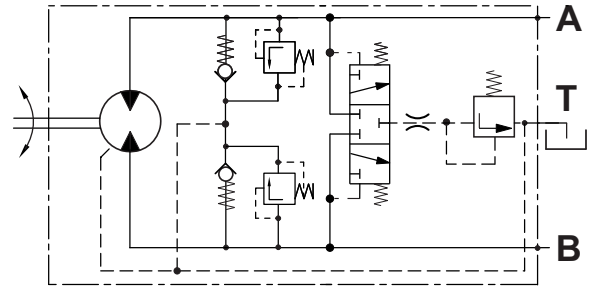
Double Anti-Cavitation, Relief and Purge Valve, relief valve setting is 250 bar, purge valve flow rate 3.5±1 l/min

MAPB50SH2DARP300L5.5

Double Anti-Cavitation, Relief and Purge Valve, relief valve setting 300 bar, purge valve flow rate 5.5±1 l/min

Option **DARF**

Dual Anti-Cavitation, Relief and Flush Valve



- Mainly used in close loop circuit;
- The valve is a combination between a dual anti-cavitation, relief and flush valve;
- Flush valve is used for cooling purpose or cleanliness requirements;
- Anti-Cavitation Check valve is used for applications such as Fan drive control;
- Pressure Relief Valves prevent excessive pressures in the high pressure loop;
- Please, consider the following possible values for pressure set of the relief valve:

Pressure setting **250 300 350** → pressure

- Flow rate of flush valve by **default**

Motors	MAP28	MAP62	MAP100	MAPW62
default	5±2 l/min	6±2 l/min	7±2 l/min	6±2 l/min

and charge pressure 16 bar with 20 bar feed pressure for close loop circuit. The possible values are as follow:

Flow setting **omit L3.5 L5.5** → flow rate

- Other values for charge pressure are possible. Please see Pressure Setting. Example: For charge pressure 10 bar the options are as follow:

Pressure setting **250-10 300-10 350-10**

Relief valve opening pressure Flush valve opening pressure (charge pressure)

EXAMPLE

MAPB50SH2DARF350

Double Anti-Cavitation, Relief and Flush Valve, relief valve setting 350 bar flush valve charge pressure 16 bar, flush valve flow rate 6±2 l/min

MAPB50SH2DARF350-10

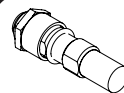
Double Anti-Cavitation, Relief and Flush Valve, relief valve setting 350 bar flush valve charge pressure 10 bar, flush valve flow rate is 6±2 l/min

MAPB50SH2DARF250L3.5

Double Anti-Cavitation, Relief and Flush Valve, relief valve setting 250 bar flush valve charge pressure 16 bar, flush valve flow rate is 3.5±1 l/min

MAPB50SH2DARF300-10L5.5

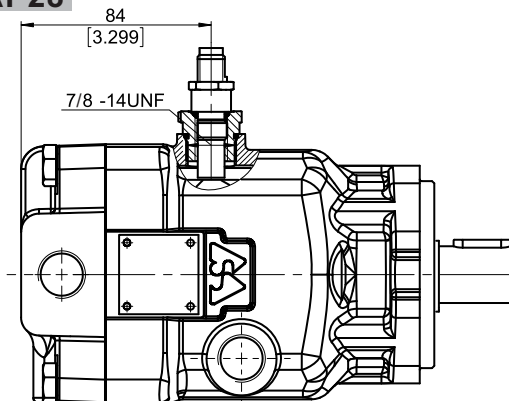
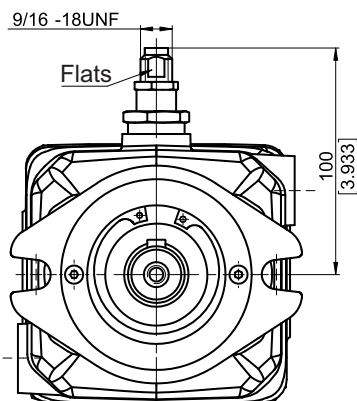
Double Anti-Cavitation, Relief and Flush Valve, relief valve setting 300 bar flush valve charge pressure 10 bar, flush valve flow rate 5.5±1 l/min



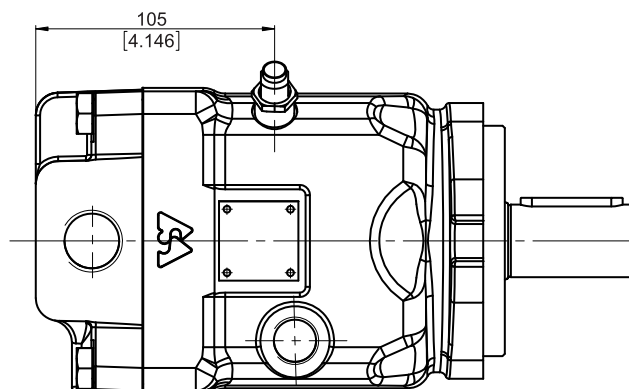
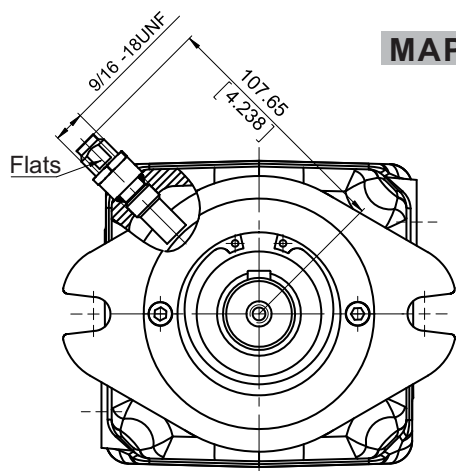
SPEED SENSORS

MOUNTING DIMENSIONS

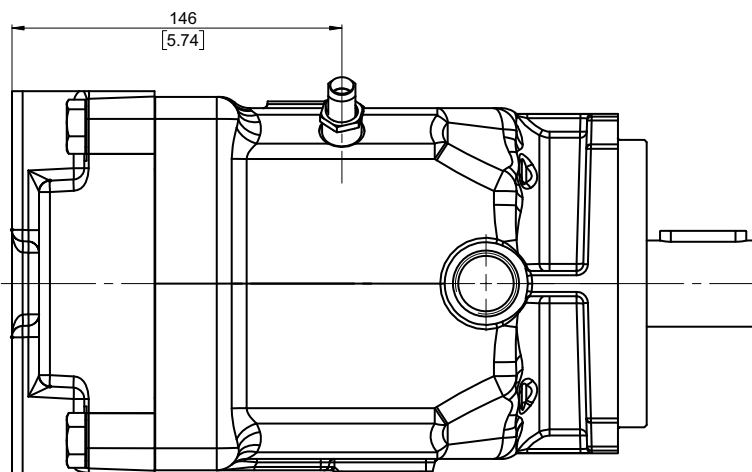
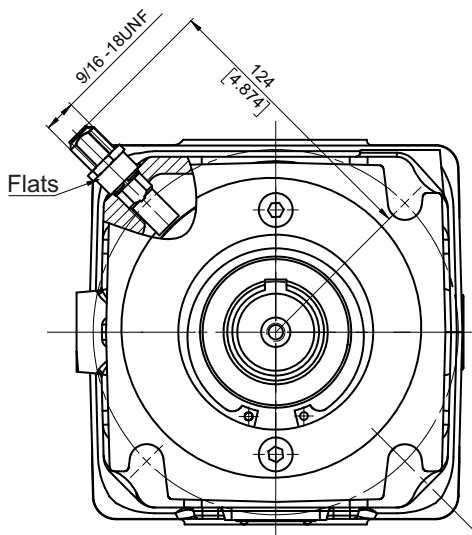
MAP28 and PAP28



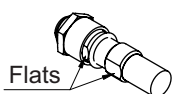
MAP62, MAPW62 and PAP62



MAP100

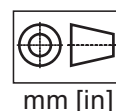


INSTALLATION

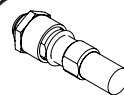


1. Remove the plug.
2. Screw in the (CW) sensor by hand until the bottom end gently touches the speed ring.
3. Unscrew (CCW) sensor 1/4 turn. Continue unscrewing until the flats are perpendicular to motor or pump shaft center line (tolerance 20° to 30° is acceptable). Do not unscrew the sensor more than 3/4 of a turn from the touching.
4. Using the 1/2 inch wrench to hold the sensor, tighten the lock nut to 10⁵ [115] Nm [lb-in]. with an 1 1/16 inch hew wrench.

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



SPEED SENSORS



TECHNICAL DATA OF THE SPEED SENSOR

TECHNICAL DATA

Power supply	4.5 ... 30 VDC
Power consumption	< 15 mA without load
Pin connector	universal /PUSH-PULL/ 4P Delphi Connector DJ3042-2.5-21
Output measurements	Speed, Direction
Output maximum current	100 mA
Resident output voltage	1.5 V with 100 mA of the output 0.5 V without load of the output
Frequency range	0 ... 15 000 Hz
Degree of protection	IP 67
Temperature	-40 ... + 100 °C
Humidity	0 ... 95% RH

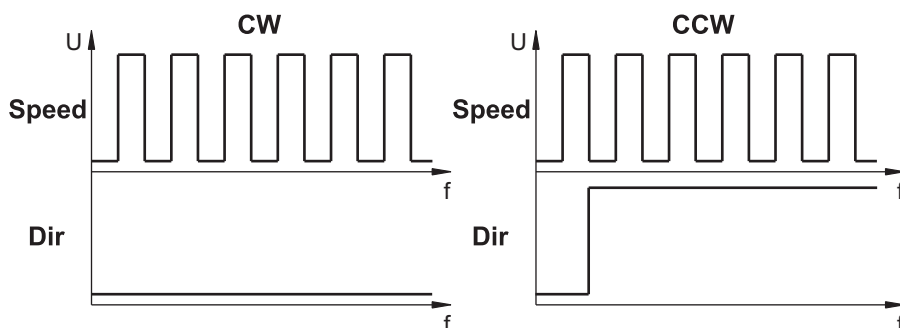
OUTPUT PULSES

per revolution

Motor Type	MAP28	MAP62	MAPW62	MAP100
Output Pulses	42	50	50	65

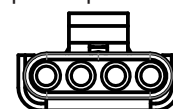
Pump Type	PAP28	PAP62
Output Pulses	42	50

OUTPUT DIAGRAMS



PIN CONNECTOR

4 pin Delphi Connector

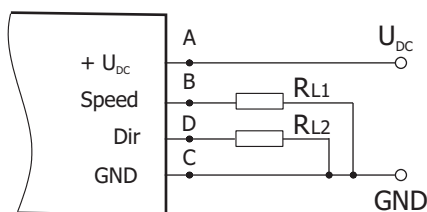


Pin	Connection	Cable Output
A	Power+	Red
B	Speed	White
C	Ground	Black
D	Direction	Green

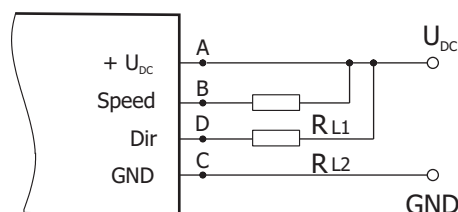
WIRING DIAGRAMS

Sensor could be in use for both type of connections - PNP or NPN

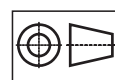
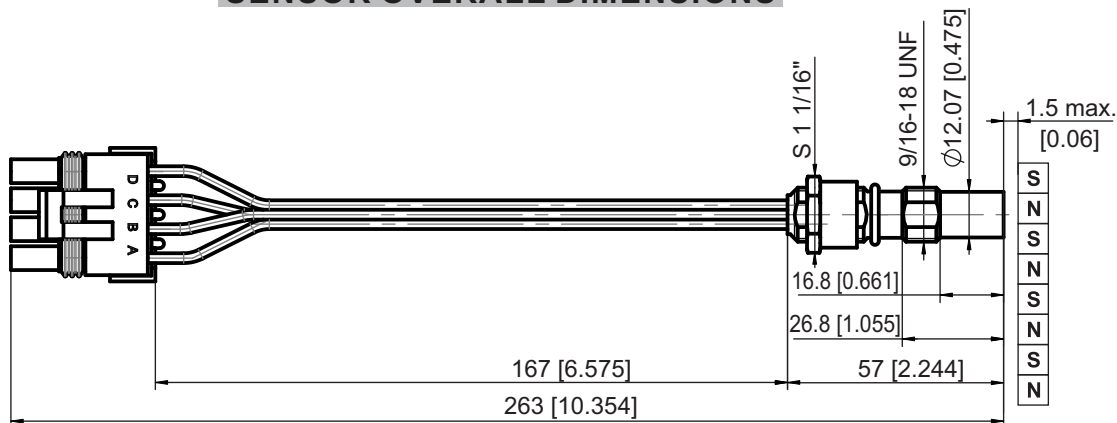
PNP



NPN



SENSOR OVERALL DIMENSIONS



mm [in]

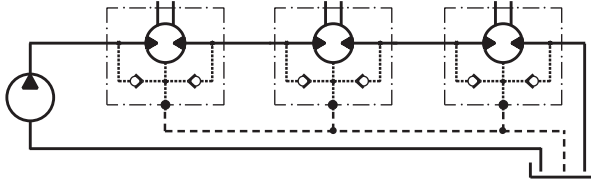


INSTALLATION

TYPE OF CONNECTION

Series connection

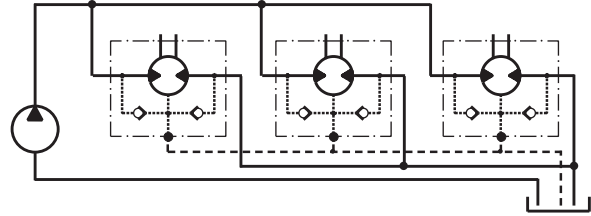
not recommended



open drain line is always required

Parallel connection

recommended

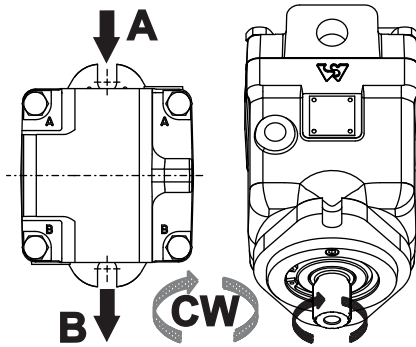


open drain line is always required

DIRECTION OF ROTATION

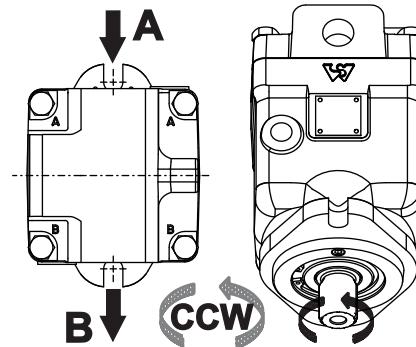
Standard Rotation

Viewed from shaft end
Port A Pressurized - CW
Port B Pressurized - CCW



Reverse Rotation

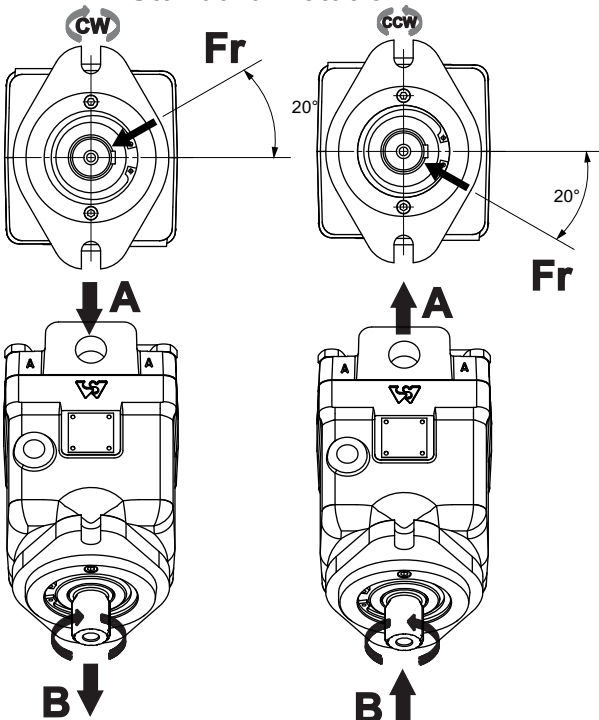
Viewed from shaft end
Port A Pressurized - CCW
Port B Pressurized - CW



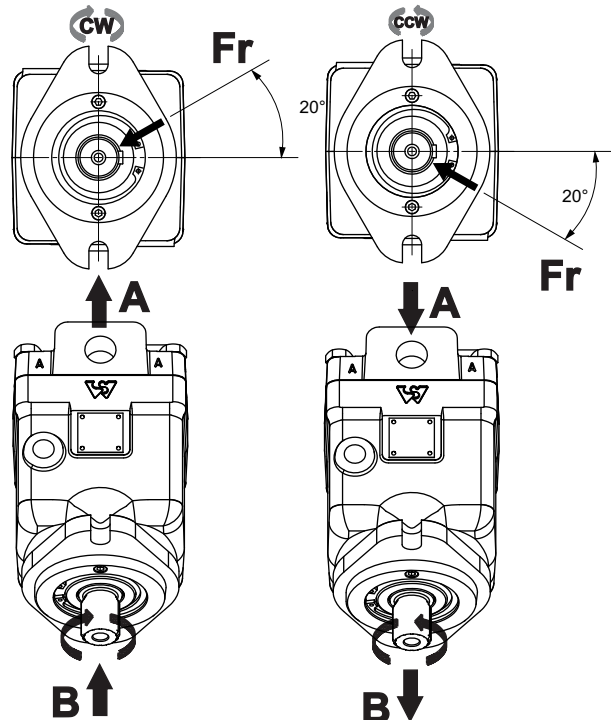
BEST POSITION FOR APPLYING RADIAL LOAD

Optimal position for applying radial load depending on the direction of rotation

Standard Rotation



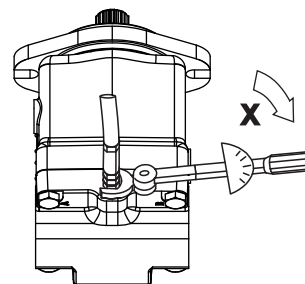
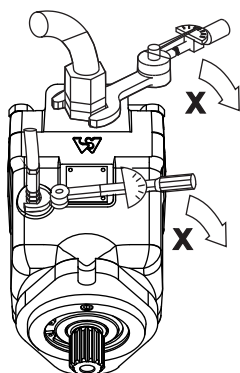
Reverse Rotation

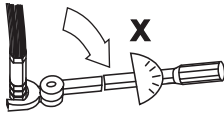
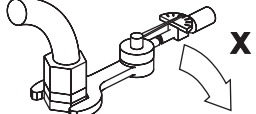




INSTALLATION

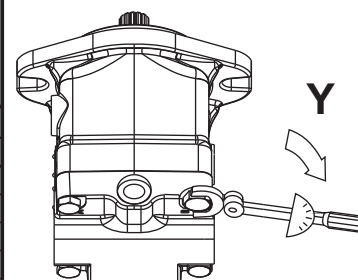
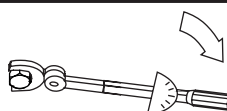
Recommended max. tightening torque X for metal plugs and orifice



Screwed connection Anschlussart Raccord Tipo di collegamento Especie de unir Присоединительные резьбы	 Max. Tightening Torque X, daNm [lb-in] Max. Anzugsmoment X, daNm [lb-in] Couple de serrage maxi X, daNm [lb-in] Momento di serraggio max. X, daNm [lb-in] Momento d'apretadura max. X, daNm [lb-in] Момент затяжки X, daNm [lb-in]				
	With copper washer Mit Kupferscheibe Avec rondelle en cuivre Con rondella di rame De arandela de cobre С медной шайбой	With aluminium washer Mit Aluminiumscheibe Avec rondelle en aluminium Con rondella di alluminio De arandela d'aluminio С алюминиевой шайбой	With cutting edge Mit Dichtkante Tranchant Con tagliente di guarnizione De borde compactar С крутым бортиком	With "O" ring Mit "O" Ring Avec joint torique Con "O"-anello De "O"-anillo С резиновым кольцом	
M8	1.6 [150]	1 [88.5]	2 [180]		
M10	3.2 [300]	1 [88.5]	2 [180]		
M12	3.5 [310]	3 [265]	4 [360]		
M14x1.5	4 [360]	3 [265]	4 [360]		3 [265]
M16x1.5	5 [450]	5 [450]	6 [550]		5 [450]
M18x1.5	6 [550]	5 [450]	6 [550]		5 [450]
M20x1.5	8 [710]	8 [700]	10 [885]		8 [700]
M22x1.5	10 [900]	8 [700]	10 [885]		8 [700]
M24x1.5	12 [1070]	10 [885]	10 [885]		10 [885]
M27x2	16 [1420]	13 [1150]	10 [885]		10 [885]
G 1/4	4 [360]	3 [265]	4 [360]		2 [180]
G 3/8	5 [450]	5 [450]	6 [550]		2 [180]
G 1/2	8 [710]	8 [700]	10 [885]		3 [265]
G 3/4	16 [1420]	13 [1150]	16 [1400]		5 [450]
G 1	20 [1800]	20 [1770]	25 [2200]		8 [700]
1/8 - 14(UNF)	2.5 [230]				0.7 [62]
3/8-24(16)UNF(UNC)	3 [270]				1.5 [130]
7/16-20(16)UNF	3.5 [310]				2 [180]
9/16-18 UNF	4 [360]				2 [180]
9/16-20 UNF	5 [450]				3.5 [310]
3/4 -16 UNF	6 [550]				6 [550]
7/8 -14(16)UNF	10 [900]				7 [620]
1 1/16 - 12 UN	16 [1420]				9 [800]
1 5/16 -12 UN	20 [1800]				16 [1400]
1/2 -14 NPTF					3 [265]
1/4 - 18 NPTF					3 [265]

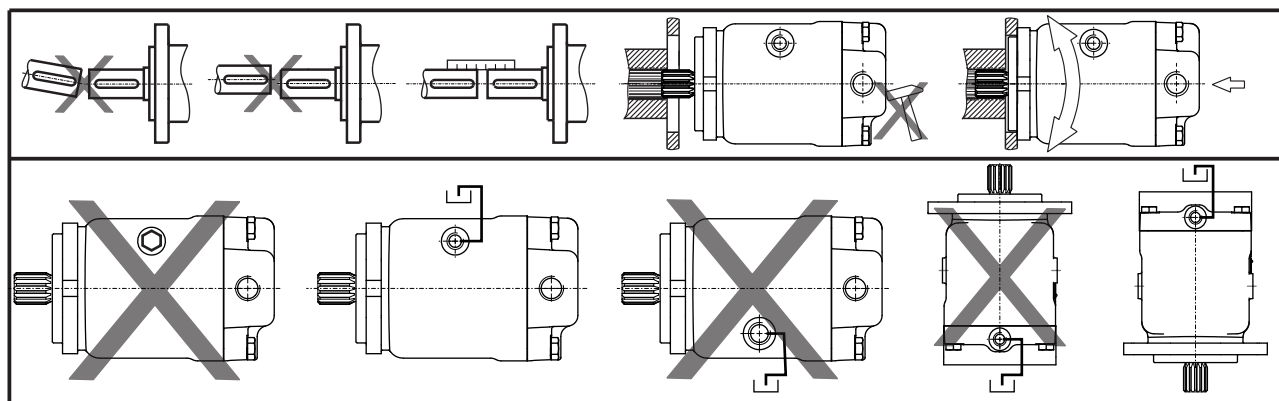
Recommended max. tightening torque Y for screws and bolts

Motor Type	End Cover - Body		Axial Piston Group - Body		Axial Piston Group	
	Bolt	daNm [lb-in]	Screw	daNm [lb-in]	Screw	daNm [lb-in]
MAPA28	M10 - 12.9	7[620]	M4 - 12.9	0.4[40]	M5 - 12.9	0.6[60]
MAPB28	M10 - 12.9	7[620]	M5 - 12.9	0.6[60]	M5 - 12.9	0.6[60]
MAP62	M12 - 12.9	10[890]	M6 - 12.9	1.3[120]	M6 - 12.9	1.3[120]
MAPW62	M12 - 12.9	10[890]	M6 - 12.9	1.3[120]	M6 - 12.9	1.3[120]
MAP100	M14 - 12.9	13[1160]	M8 - 12.9	3.5[310]	M6 - 12.9	1.3[120]
PAPA28	M10 - 12.9	7[620]	M4 - 12.9	0.4[40]	M5 - 12.9	0.6[60]
PAP62	M12 - 12.9	10[890]	M6 - 12.9	1.3[120]	M6 - 12.9	1.3[120]



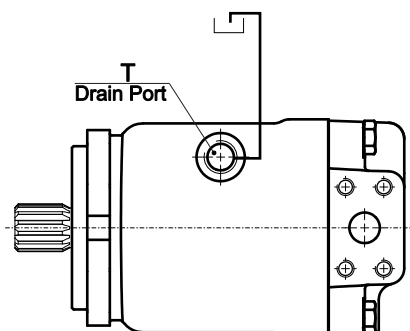
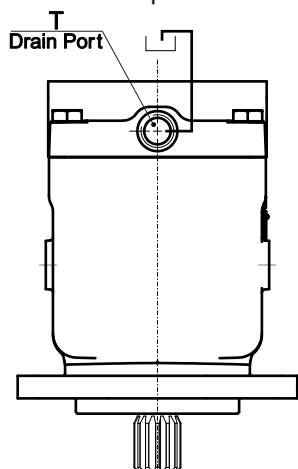


At start-up and during operation the motor(pump) housing has to be filled up with hydraulic fluid. Start-up has to be carried out at low or moderate speed and without load (for example 1000 rpm and pressure 50[725] bar [PSI]) till the motor(pump) and the hydraulic scheme are filled up with oil. Generally the start-up needs 10-15 minutes to finish. The leakage oil in the housing has to be discharged to the tank through the highest positioned drain port T. The max. pressure in the drain line is 5 [70] bar [PSI].



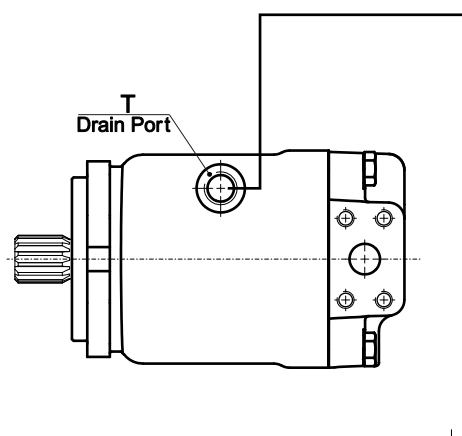
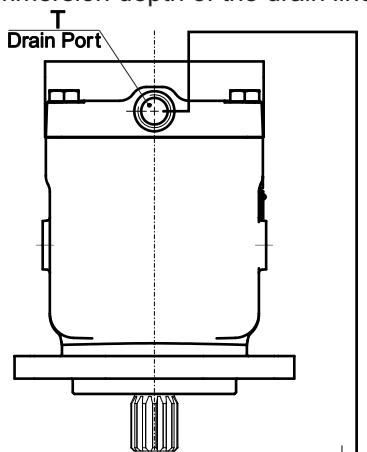
Installation below the tank level (recommended)

- Fill up the axial piston motor(pump) before the start-up through the highest positioned drain port T.
- Operate the motor(pump) at low speed till the motor system is completely filled up.
- The minimum immersion depth of the drain line in the tank is 200 mm [8 in] relative to the minimum oil level in the tank.



Installation on top of the tank level

- Fill up the axial piston motor(pump) before the start-up through the highest positioned drain port T.
- Operate the motor(pump) at low speed till the motor system is completely filled up.
- The minimum immersion depth of the drain line in the tank is 200 mm [8 in] relative to the minimum oil level in the tank.

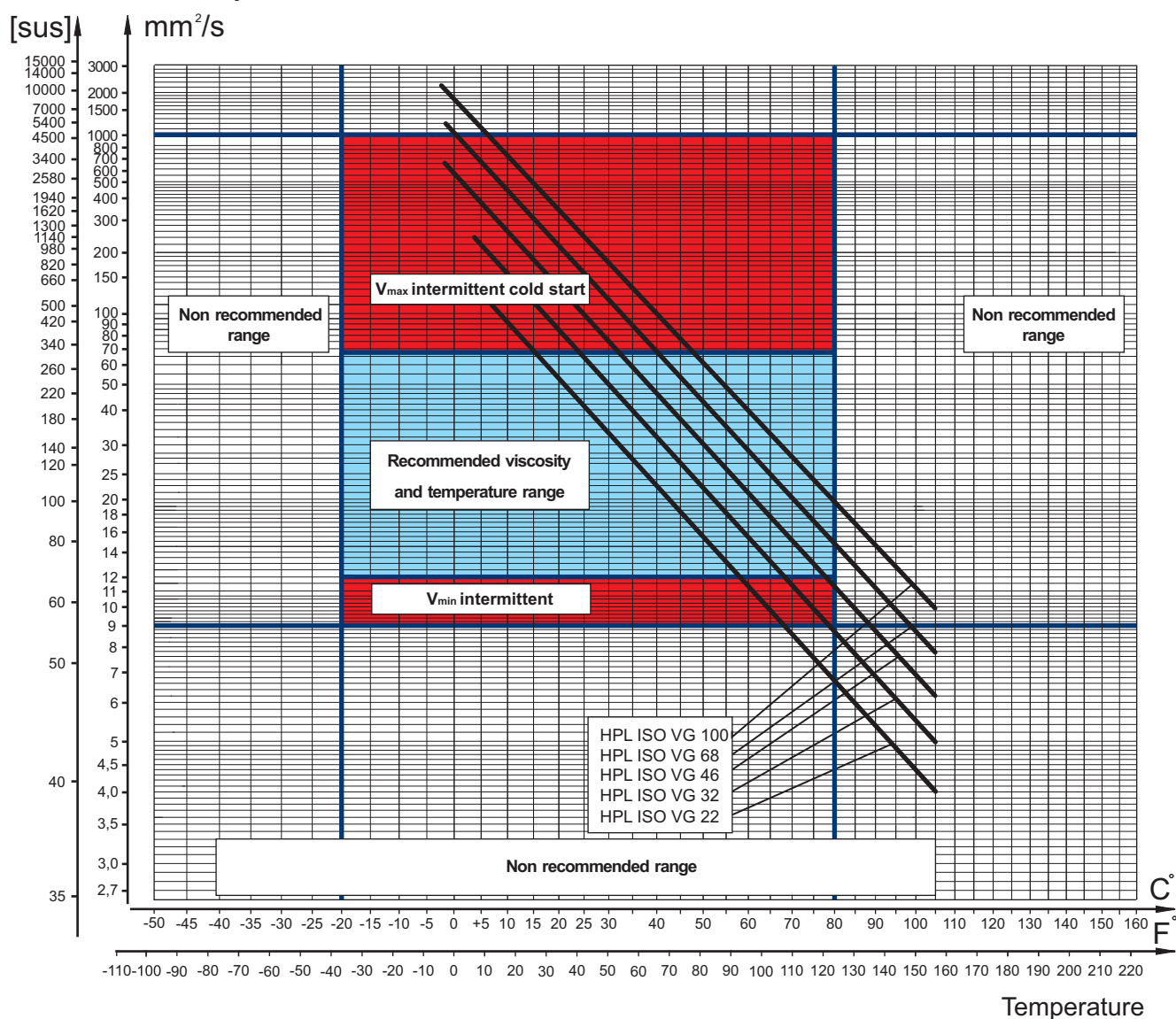




FLUID VISCOSITY LIMITS

In order to obtain optimum efficiency and service life, we recommend to select the operating viscosity (at operating temperature) within the range shown on diagram below.

Kinematic viscosity



The above - shown viscosity characteristics are for reference only. Please, check the actual viscosity with the manufacturer of the fluid.

BASIC FORMULAS

The motor(pump) size, pressure and flow required for a specific application can be calculated using the formulas below.

Metric System

$$\text{Efficiency} \quad \eta_t = \eta_{mh} \cdot \eta_v \quad \eta_{mh} = \frac{\eta_t}{\eta_v} \quad \eta_v = \frac{\eta_t}{\eta_{mh}}$$

$$\text{Input flow (for Motor)} \quad Q = \frac{Vg \cdot n}{1000 \cdot \eta_v} \quad [l/min]$$

$$\text{Output torque (for Motor)} \quad M = \frac{Vg \cdot \Delta p \cdot \eta_{mh}}{62,8} \quad \text{or} \quad M = \Delta p \cdot T_{con.} \quad [Nm]$$

$$\text{Output power (for Motor)} \quad P = \frac{M \cdot n}{9550} = \frac{Q \cdot \Delta p \cdot \eta_t}{600} \quad [kW]$$

$$\text{Speed (for Motor)} \quad n = \frac{Q \cdot 1000 \cdot \eta_v}{Vg} \quad \text{or} \quad n = Q \cdot N_{con.} \quad [min^{-1}]$$

$$\text{Output flow (for pump)} \quad Q = \frac{Vg \cdot n \cdot \eta_v}{1000} \quad [l/min]$$

$$\text{Driving torque (for pump)} \quad M = \frac{Vg \cdot \Delta p}{62,8 \cdot \eta_{mh}} \quad [Nm]$$

$$\text{Input power (for pump)} \quad P = \frac{M \cdot n}{9550} = \frac{Q \cdot \Delta p}{600 \cdot \eta_t} \quad [kW]$$

$$Vg = \text{Displacement per rev.} \quad [cm^3]$$

$$\Delta p = p_{HP} - p_{LP} \quad [bar]$$

$$p_{HP} = \text{High pressure} \quad [bar]$$

$$p_{LP} = \text{Low pressure} \quad [bar]$$

$$n = \text{Rotation speed} \quad [RPM]$$

$$Q = \text{Oil flow} \quad [l/min]$$

$$T_{con.} = \text{Toque constant} \quad [Nm/bar]$$

$$N_{con.} = \text{Speed constant} \quad [RPM/(l/min)]$$

$$\eta_v = \text{Volumetric efficiency}$$

$$\eta_{mh} = \text{Mechanical-hydraulic efficiency}$$

$$\eta_t = \text{Overall efficiency}$$

Inch System

$$\text{Efficiency} \quad \eta_t = \eta_{mh} \cdot \eta_v \quad \eta_{mh} = \frac{\eta_t}{\eta_v} \quad \eta_v = \frac{\eta_t}{\eta_{mh}}$$

$$\text{Input flow (for Motor)} \quad Q = \frac{Vg \cdot n}{231 \cdot \eta_v} \quad [GPM]$$

$$\text{Output torque (for Motor)} \quad M = \frac{Vg \cdot \Delta p \cdot \eta_{mh}}{2 \cdot \pi} \quad \text{or} \quad M = \Delta p \cdot T_{con.} \quad [lb-in]$$

$$\text{Output power (for Motor)} \quad P = \frac{Vg \cdot n \cdot \Delta p \cdot \eta_t}{396000} \quad [hp]$$

$$\text{Speed (for Motor)} \quad n = \frac{Q \cdot 231 \cdot \eta_v}{Vg} \quad \text{or} \quad n = Q \cdot N_{con.} \quad [min^{-1}]$$

$$\text{Output flow (for pump)} \quad Q = \frac{Vg \cdot n \cdot \eta_v}{231} \quad [GPM]$$

$$\text{Driving torque (for pump)} \quad M = \frac{Vg \cdot \Delta p}{2 \cdot \pi \cdot \eta_{mh}} \quad [lb-in]$$

$$\text{Input power (for pump)} \quad P = \frac{Vg \cdot n \cdot \Delta p}{396000 \cdot \eta_t} \quad [hp]$$

$$Vg = \text{Displacement per rev.} \quad [in^3]$$

$$\Delta p = p_{HP} - p_{LP} \quad [PSI]$$

$$p_{HP} = \text{High pressure} \quad [PSI]$$

$$p_{LP} = \text{Low pressure} \quad [PSI]$$

$$n = \text{Rotation speed} \quad [RPM]$$

$$Q = \text{Oil flow} \quad [GPM]$$

$$T_{con.} = \text{Toque constant} \quad [lb-in/PSI]$$

$$N_{con.} = \text{Speed constant} \quad [RPM/GPM]$$

$$\eta_v = \text{Volumetric efficiency}$$

$$\eta_{mh} = \text{Mechanical-hydraulic efficiency}$$

$$\eta_t = \text{Overall efficiency}$$

Depending on the results of the load calculations, the most appropriate type of motor from the catalogue is selected.

Table 1

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

APPLICATION FORMULAS

1. Motor speed: n, RPM

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

v_{km} - vehicle speed [km/h]

v_{mi} - vehicle speed [mi/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, daN [lbs]

The resistance force resulted in wheels contact with different surfaces:

$$RR = G \cdot \rho$$

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

ρ - rolling resistance coefficient (Table 1).

3. Grade resistance: GR, daN [lbs]

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

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°

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

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:

$$FA = \frac{v_{km} \cdot G}{3,6 \cdot t \cdot 10} \text{ [daN]} \quad FA = \frac{v_{mi} \cdot G}{2,2 \cdot t} \text{ [lbs]}$$

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.

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

RR - force required to overcome the rolling resistance;

GR - force required to slope upwards;

FA - force required to accelerate (acceleration force);

DP - additional tractive effort (trailer).

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

Necessary torque moment for every hydraulic motor:

$$M = \frac{TE \cdot R_m [R_{in}]}{N \cdot i \cdot \eta_M}$$

N - motor numbers;

η_M - mechanical gear efficiency (if it is available).

8. Cohesion between tire and road covering: M_w, daNm [in-lb]

$$M_w = \frac{G_w \cdot f \cdot R_m [R_{in}]}{i \cdot \eta_M}$$

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].

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

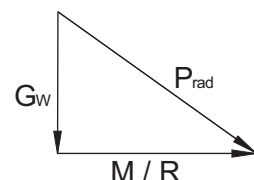
When the motor is used for motion with a ring or gear mounted directly on the motor shaft, the total radial load of the motor shaft **P_{rad}** is the sum of the motion force and the weight force acting on the ring.

G_w - Weight held by wheel;

P_{rad} - Total radial loading of motor shaft;

M/R - Motion force.

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



Depending on the results of the load calculations, the most appropriate type of motor from the catalogue is selected.