TÜVRheinland® CERT ISO 9001

M+S HYDRAULIC

AXIAL PISTON MOTORS AND PUMPS

In cooperation with iHES HYDRAULIC ELEMENTS & SYSTEMS

NEW PRODUCTS

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CONTENT

Axial Piston Motors and Pumps Fixed Displacement

PAGE

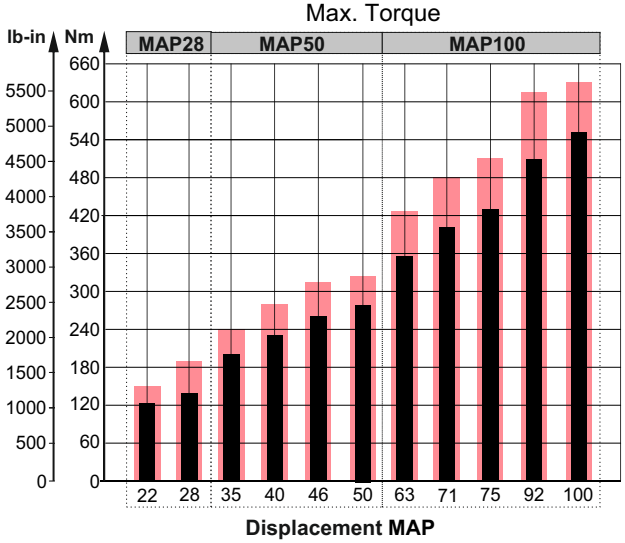
Version history

Date	Page	Changed	Ver.
February 2017	4;8;10;11;12;13;14;15;16;18;19;20;23;25;27;29;30;35;39;43;45;50;55;56;60;61;63;64;65;68;69	Add Twin Side option for MAP28 and MAP100. Add shaft types DR and DO for MAP50 and PAP50. Add Improve Bearing option for MAP28. Add shaft type CM for MAP28. Change of Specification Data of MAP28, MAP50, MAP100 and PAP50. Add speed sensor option for MAP28, MAP50 , MAP100 and PAP50. Add addition valves for MAP28. Add port type 6 for MAP28. Correction of MAP50 ports. Add port type 9 for MAP28, MAP50 and MAP100. Minor fixes.	1.4
July 2016		First official edition	1.3

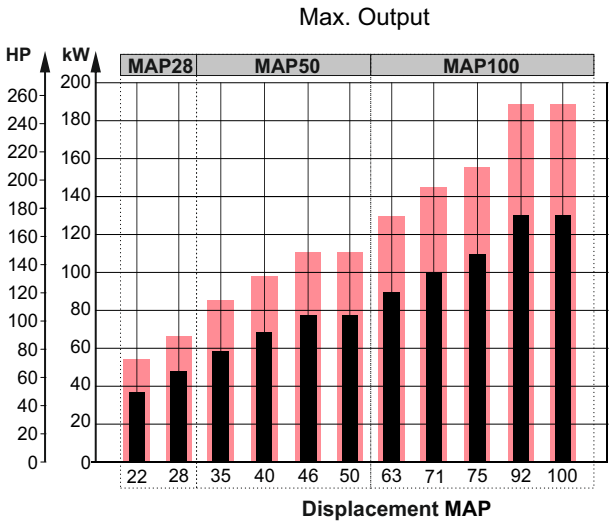
Specification Data Motors Type MAP

Intermittent values Continuous values

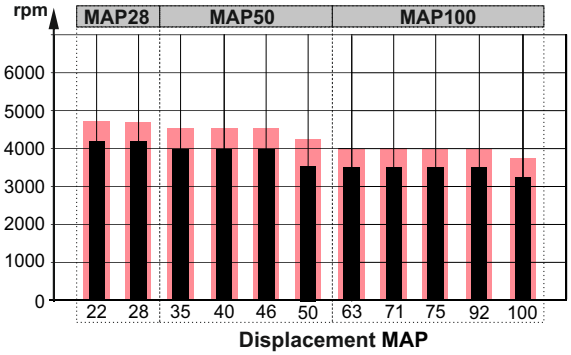
Max. Torque



Max. Output



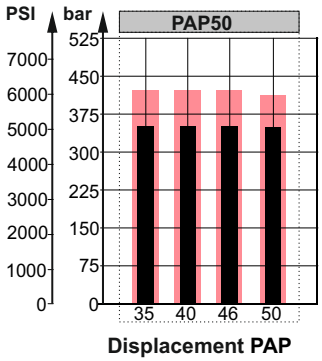
Max. Speed



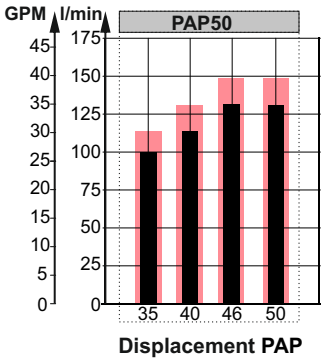
Specification Data Pumps Type PAP

Intermittent values Continuous values

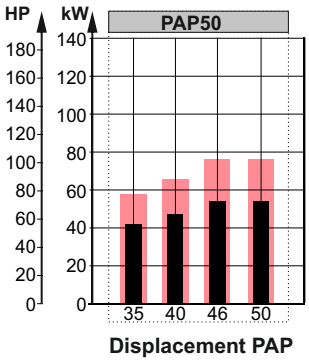
Max. Pressure



Max. Oil Flow



Max. Output



Port, Shaft and Flange Types

Cross Table - Flange Types

MAP28	MAP50	MAP100	PAP50	Type of flanges
x				**A** - 2-Bolt, SAE A, SD. 82,5[3.25"],BC 106,35 [4.19"], BD 13.5 [0.53"]
x	x		x	**B** - 2-Bolt, SAE B, SD. 101.6[4"],BC 146 [5.748"], BD. 14.3 [0.563"]
		x		**4C** - 4-Bolt flange, SAE C, SD. 127 [5"],BC. 161.92 [6.375"], BD. 14.3 [0.563"]
		x		**4M** - 4-Bolt flange, ISO 3019-2, SD. 140 [5.51"],BC. 180 [7.09"], BD. 15 [0.59"]

Legend

BC (Bolt Circle) - Center point of bolt holes
BD (Bolt Diameter) - Diameter of bolt holes
SD (Spigot Diameter) - Center Diameter

Cross Table - Shaft Types

MAP28	MAP50	MAP100	PAP50	Type of shafts
x	x		x	**SD** ø21.72 [0.855"] **Spline** SAE 13T 16/32 DP, M8-6H thread
x	x		x	**GD** ø21.72 [0.855"] **Spline** SAE 13T 16/32 DP, 5/16-18 UNC-2B thread
x	x		x	**LD** ø21.72 [0.855"] **Spline** SAE 13T 16/32 DP, 1/4-20 UNC-2B thread
x	x		x	**SF** ø24.9 [0.98"] **Spline** SAE 15T 16/32, M8-6H thread
x	x		x	**GF** ø24,9 [0.98"] **Spline** SAE 15T 16/32, 3/8-16UNC-2B thread
x	x		x	**LF** ø24.9 [0.98"] **Spline** SAE 15T 16/32 DP,1/4-20UNC-2B thread
	x		x	**SH** ø29.6 [1.165"] **Spline** W30x2x30x14x9g DIN, M10-6H thread
	x		x	**SK** ø31.75 [1.25"] **Spline** SAE 14T 12/24 DP, M10-6H thread
	x		x	**GK** ø31.75 [1.25"] **Spline** SAE 14T 12/24 DP, 7/16-14UNC-2B thread
	x		x	**SP** ø34.5 [1.358"] **Spline** SAE 21T 16/32 DP, M12-6H thread
		x		**SR** ø37.6 [1.48"] **Spline** SAE 23T 16/32 DP, M12-6H thread
		x		**ST** ø39.6 [1.559"] **Spline** W40x2x30x18x9g DIN 5480, M12-6H thread
		x		**GU** ø44.43 [1.749"] **Spline** SAE 13T 8/16 DP, 3/8-16UNC thread
x	x		x	**CK** ø22.2 [ø7/8"] **Straight**, M8-6H thread, parallel key 1/4"x1/4"x1" BS46
x	x		x	**MK** ø22.2 [ø7/8"] **Straight**, M8-6H thread, parallel key 1/4"x1/4"x1 1/2" BS46
x	x		x	**ML** ø25 [ø0.984"] **Straight**, M8-6H thread, parallel key A8x7x25 DIN6885
x	x		x	**CM** ø25.4 [ø1"] **Straight**, M8-6H thread, parallel key 1/4"x1/4"x1" Bs46
	x		x	**DO** ø28.75 [ø1.125"] **Straight**, key 7.95[5/16"] , L31.7[1 1/4"], 3/8-16 UNC thread
	x		x	**CQ** ø30 [ø1.181"] **Straight**, M8-6H thread, parallel key A8x7x32 DIN6885
	x		x	**DR** ø31.75 [ø1.25"] **Straight**, key 7.95[5/16"] , L31.7[1 1/4"], 3/8-16 UNC thread
	x		x	**CS** ø32 [ø1.26"] **Straight**, M8-6H thread, parallel key A10x8x45 DIN6885
		x		**DU** ø38.1[1.5"] **Straight**, key 9.528[0.375"] , L38.1[1.5"], 3/8-16 UNC thread
		x		**CV** ø40 [ø1.575"] **Straight**, M12-6H thread, parallel key A12x8x63 DIN6885
x	x		x	**TD** ø22.22 [7/8"] **Tapered** 1:8 [125:1000], Parallel key 1/4"x1/4"x1",5/8-18 UNF-2A
	x		x	**TH** ø25.4 [1"] **Tapered** 1:8 [125:1000], Parallel key 1/4"x1/4"x1", 3/4-16 UNF-2A
	x		x	**KH** ø25.4 [1"] **Tapered** 1:8 [125:1000], Parallel key 1/4"x1/4"x1", M16x1.5 thread
		x		**TN** ø31.75 [1.25"] **Tapered** 125:1000, key 5/16x5/16 L1 1/8, 1-12 UNF-2A thread

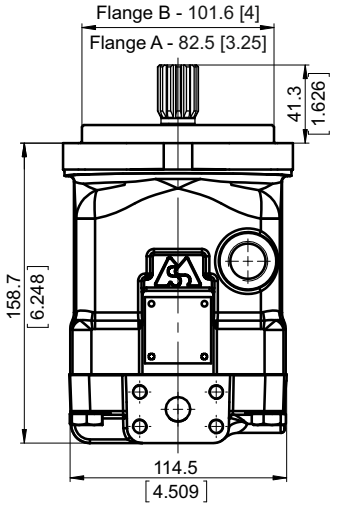
Cross Table - Port Types

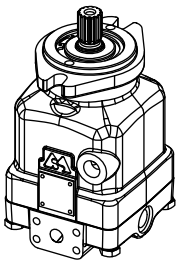
PORTS SIZE - THREAD OPTION				
MAP28	MAP50	MAP100	PAP50	Type of threads
default				2xISO 6162-2 DN13, metric, drain ports M18x1,5-6H
	default			2xISO 6162-2 DN19, metric, drain ports M18x1,5
		default		2xISO 6162-2 DN25, metric, drain ports M27x2-6H, rear drain ports M22x1.5
5				2xSAE 1/2" PSI6000, drain ports 3/4-16 UNF
	5			2xSAE 3/4" PSI6000, SAE, drain ports 7/8-14 UNF
		5		2xSAE 1", PSI6000, drain ports 1 1/16 UNF, rear drain port 7/8-14 UNF
2	6			2xG1/2, drain ports G1/2
6	2			2xG3/4, drain ports G1/2
		2		2xG1, drain ports G3/4, for rear drain port G1/2
3	7			2xM22x2, drain ports M22x2-6H
	3			2xM27x2, drain ports M18x1,5-6H
4	8			2x7/8-14 UNF Ports, drain ports 3/4-16 UNF
	4			2x1_1/16 -12 UN, drain ports 7/8-14 UNF
		4		2x1 5/16-12 UN Ports, drain ports 1 1/16 UNF , rear drain port 7/8-14 UNF
			default	Inlet ISO 6162-1 DN38,Outlet ISO 6162-2 DN19, drain ports M18x1.5
			5	Inlet SAE J518 1-1/2 PSI3000, Outlet SAE J5183/4 PSI6000, drain ports 7/8-14 UNF
9				2xISO 6162-2 DN13, drain ports G1/2
	9			2xISO 6162-2 DN19, drain ports G1/2
		9		2xISO 6162-2 DN25, drain ports G3/4, rear drain port G1/2

MOTOR DIMENSIONS

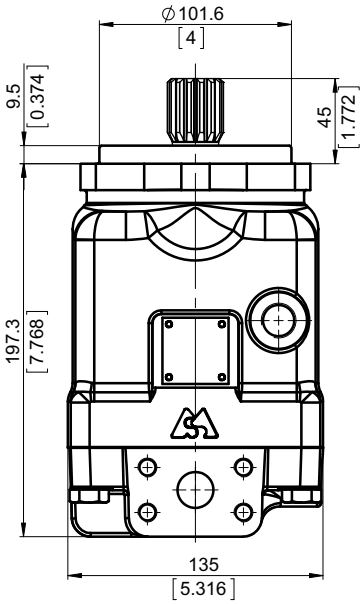
The bellow dimensions are for **comparison only**. The motors can obtain different flanges, shafts and end covers.

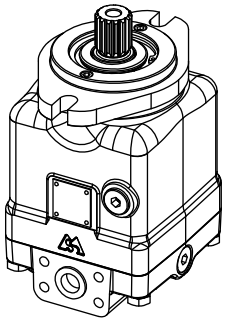
MAP28



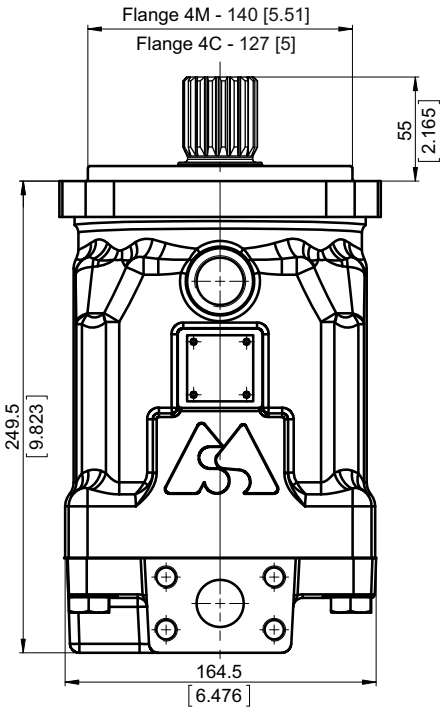


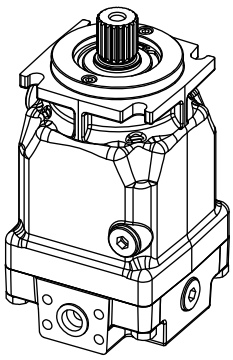
MAP50





MAP100

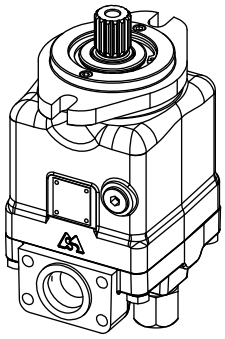


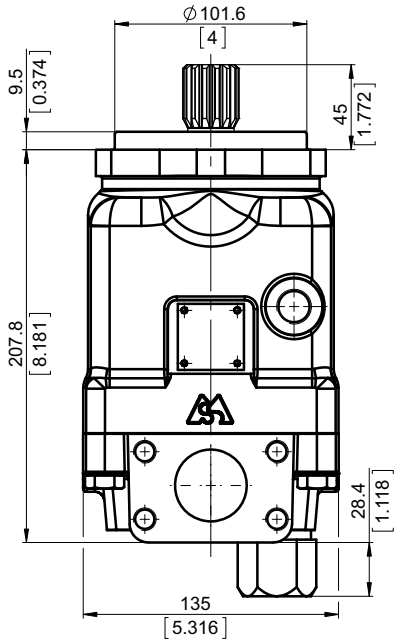


PUMP DIMENSIONS

The bellow dimensions are for **comparison only**. The pumps can obtain different shafts and end covers.

PAP50

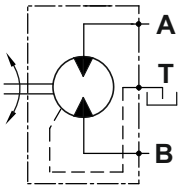


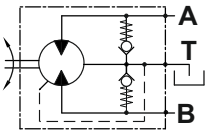


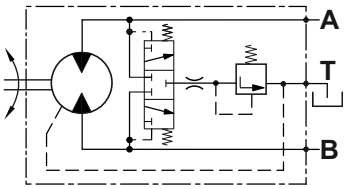
mm [in]

Hydraulic Motors Type MAP28

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

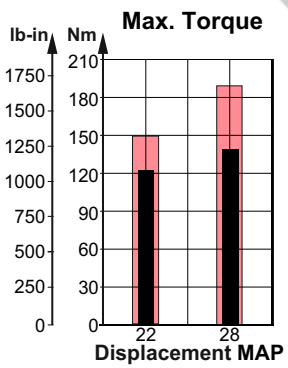
- » Swash plate
- » Flange options
- » Port options
- » Shaft options
- » High pressure ports
- » Integrated valves

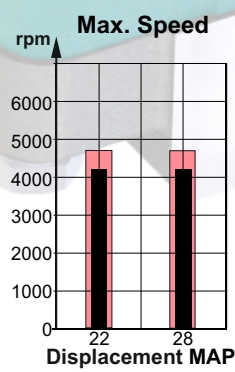
ADVANTAGES

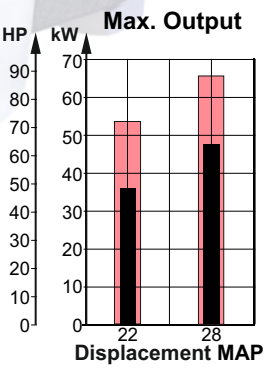
- » High starting torque
- » Smooth operation
- » Long service life
- » High power density

GENERAL

Displacement,	cm^3/rev [in^3/rev]	**22,15÷28.47 [1.35÷1.74]**
Max. Speed,	RPM	**4200**
Max. Torque,	Nm [lb-in]	**159 [1407]**
Max. Output,	kW [HP]	**48 [64]**
Max. Pressure Drop,	bar [PSI]	**350 [5080]**
Max. Oil Flow,	l/min [GPM]	**120 [31.7]**
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)**

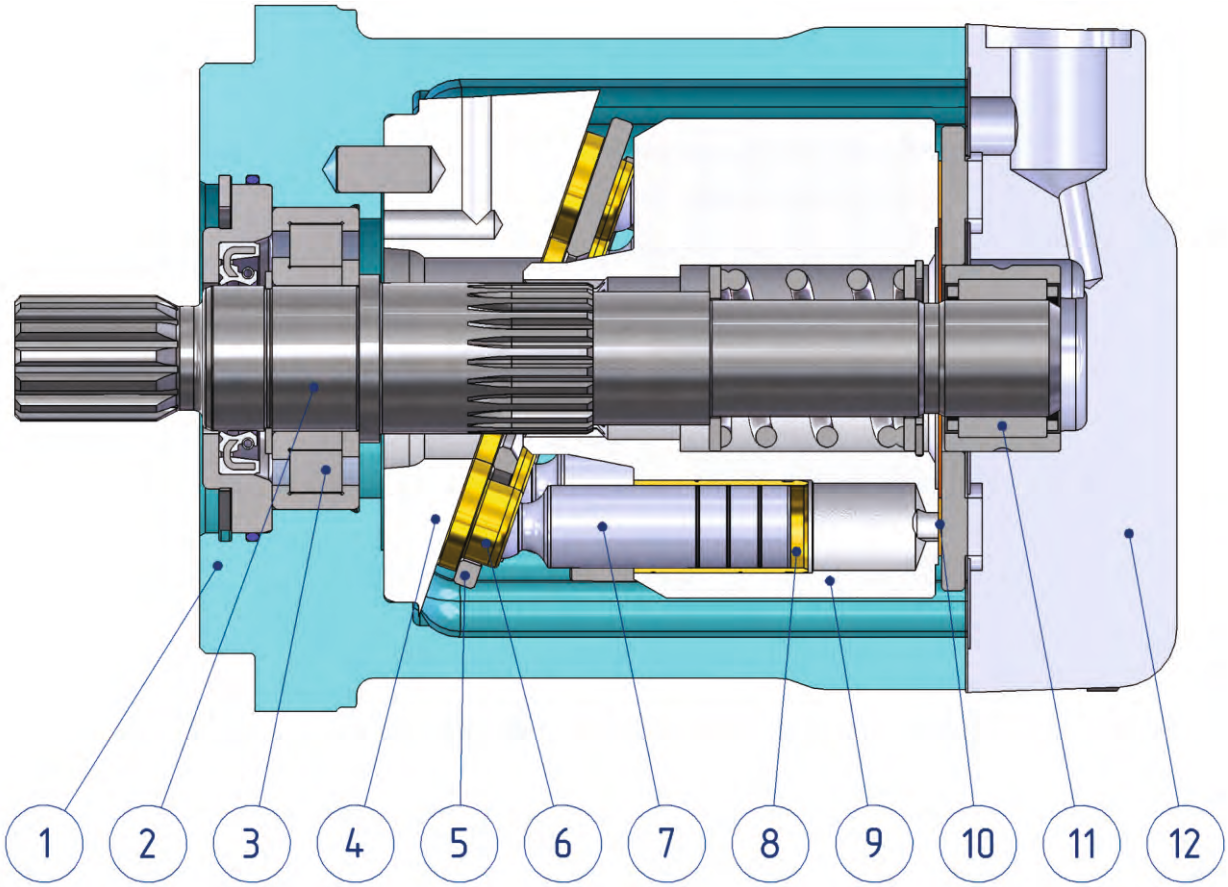






Intermittent values Continuous values

SECTION VIEW



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

The heavy duty design of MAP motor gains big advantage over the typical swash plate motors. The starting torque is close to the starting torque of the bent axis motors and the total efficiency of our design in normal working modes is similar to the bent axis motors. The main advantage of our design over the bent axis motors is that the pulsations and vibrations during the operation are much less. Another advantage is that the swash plate motors are more reliable than the bent axis motors.

SPECIFICATION DATA

Type		MAP 22	MAP 28
Displacement, cm.^{3}/rev. [in.^{3}/rev.]		22.15 [1.35]	28.47 [1.74]
Max. Speed, [RPM]	Cont.	4200	4200
	Int.*	4700	4700
Max. Torque,*** Nm [lb-in]	Cont.	123 [1088]	159 [1407]
	Int.**	148 [1310]	190 [1682]
Output, kW [HP]	Cont.	37 [50]	48 [64]
	Int.**	54 [72]	70 [94]
Max. Pressure, bar [PSI]	Cont.	350 [5080]	350 [5080]
	Int.**	420 [6100]	420 [6100]
	Peak	450 [6527]	450 [6527]
Max. Oil Flow, l/min [GPM]	Cont.	93 [24.6]	120 [31.7]
	Int.*	104 [27.5]	134 [35.4]
Torque Constant ***** Nm/bar [lb-in/PSI]		0.32 [0.194]	0.41 [0.25]
Speed Constant ***** RPM/(l/min) [RPM/GPM]		42.9 [162.4]	33.4 [126.3]
Permissible Shaft Load (for standard bearing) max Axial****	N[lb]	Fa=1300 [292]	
max Radial****	N[lb]	Fr=2200 [495]	
Min. Speed, [RPM]		500	
Max. Pressure in Drain Line, bar [PSI]		5 [70] open drain line is always required	
Weight, kg [lb]		11.3 [24.9]	

Peak pressure is 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 η_v=0.95 and η_{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 68.
5. Recommended maximum system operating temperature - 82°C [180°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.

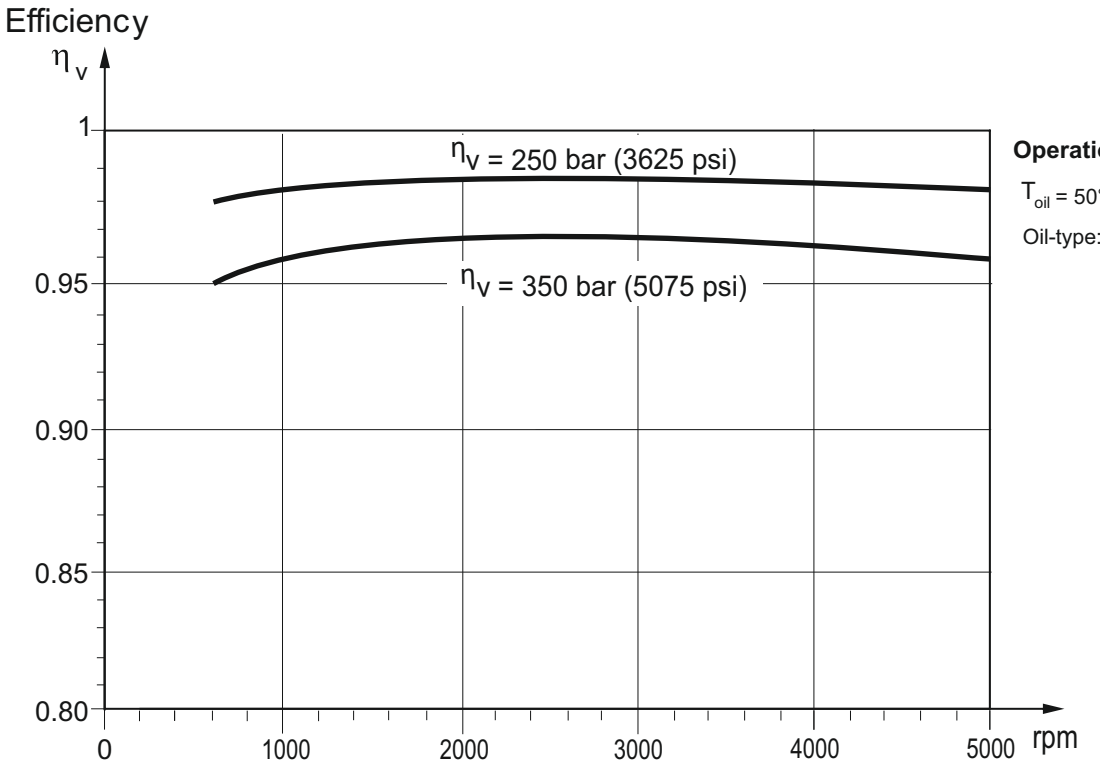
Hint: Motor Torque = Torque Constant * Pressure Drop **Rotation Speed = Speed Constant * Oil Flow**

The constant values are mentioned for rough calculations. Motor torque and rotation speed for a particular project are depending on the real operating conditions. For more detail calculations please see efficiencies on next page and formulas on page 69.

FUNCTION DIAGRAMS

The below efficiencies are applied for all displacements.

VOLUMETRIC EFFICIENCIES

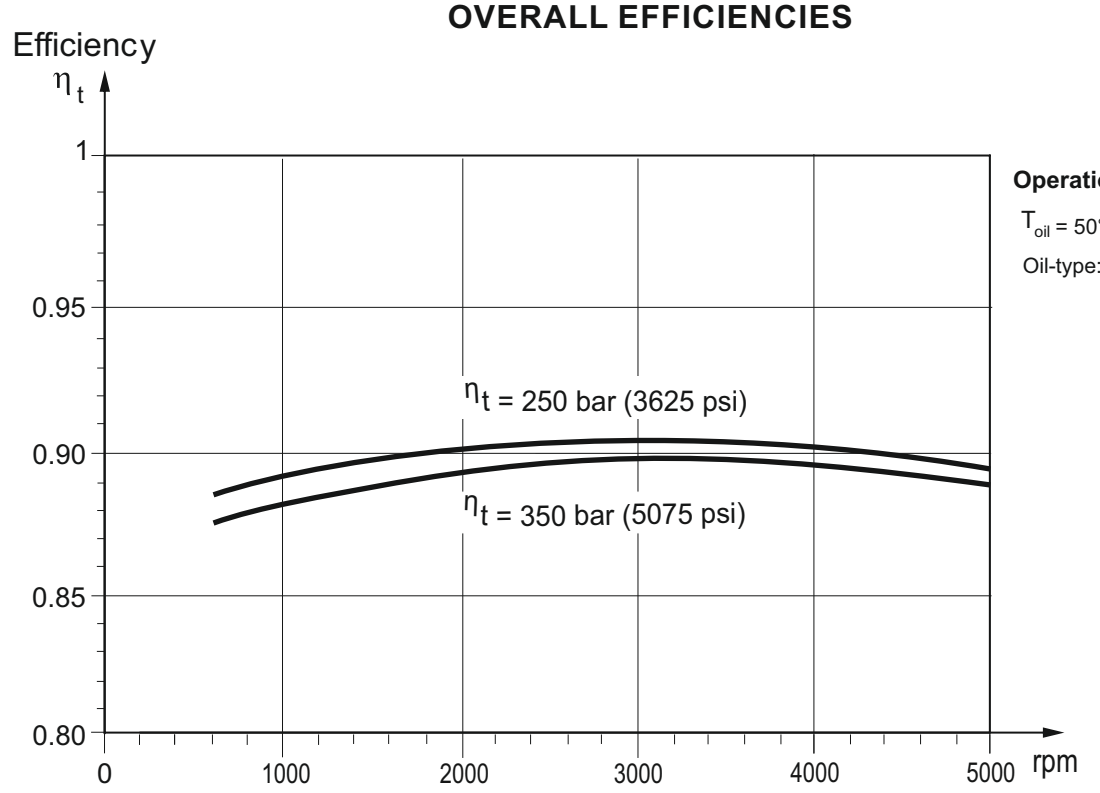


Operation conditions:

T_{oil} = 50°C [122 F]

Oil-type: HPL 46

OVERALL EFFICIENCIES



Operation conditions:

T_{oil} = 50°C [122 F]

Oil-type: HPL 46

The motor size, pressure, torque, speed of rotation and flow rate required for a specific application can be calculated using the formulas on page 69

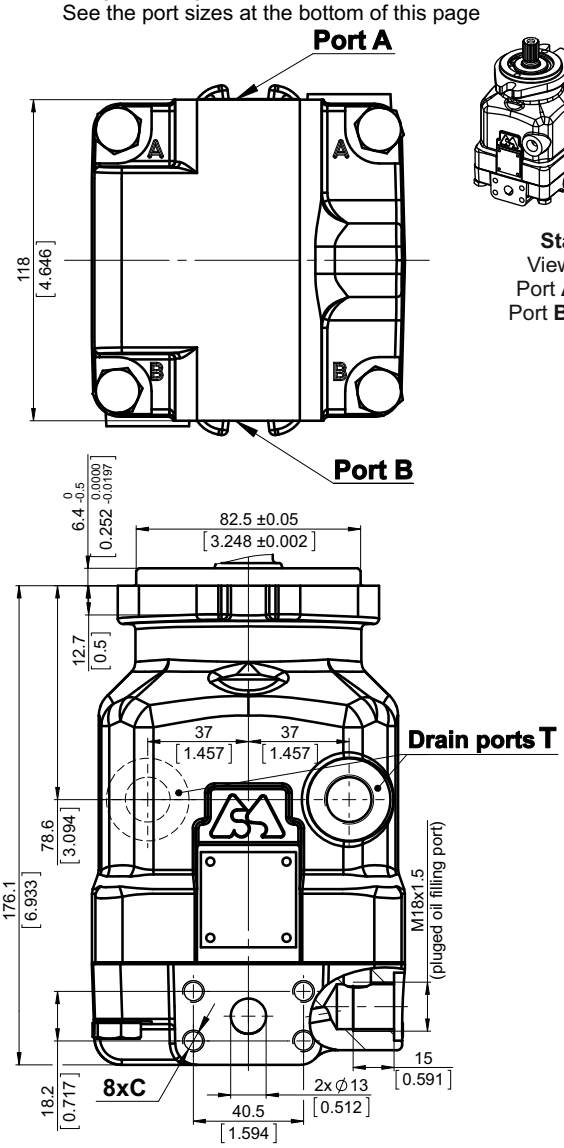
Efficiencies for a particular motor may vary from the shown in the diagram depending on the operating conditions.

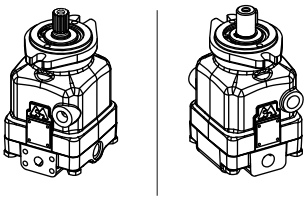
Overall Dimensions and Ports

Side Ports - **Default** Mounting Flange - Type **SAE-A**

Side ports, port size **default** and **5**

See the port sizes at the bottom of this page

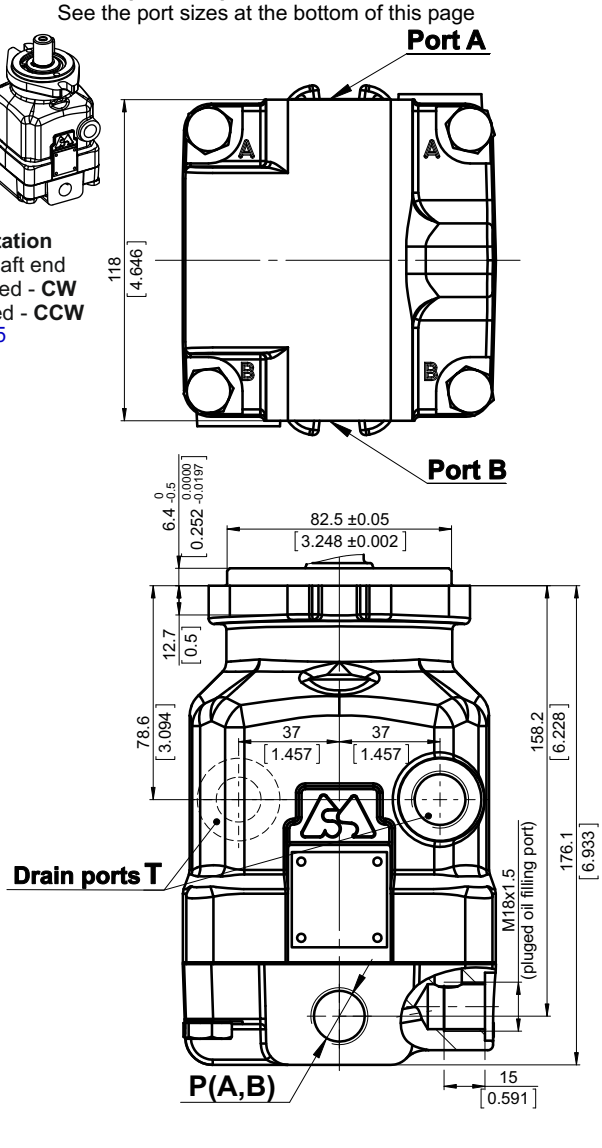




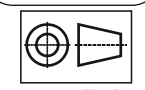
Standard Rotation
Viewed from shaft end
Port **A** Pressurized - **CW**
Port **B** Pressurized - **CCW**
see page 65

Side ports, port size **2, 3, 4** and **6**

See the port sizes at the bottom of this page



Shaft Mounting
see page 13



mm [in]

	Port Size		
	default	5	9
$P_{(A,B)}$	2xISO 6162-2 DN13	2xSAE J518 1/2 PSI6000	2xISO 6162-2 DN13
T	M18x1,5	3/4-16 UNF	G1/2
C	M8-6H	5/16-18 UNC-2B	M8-6H

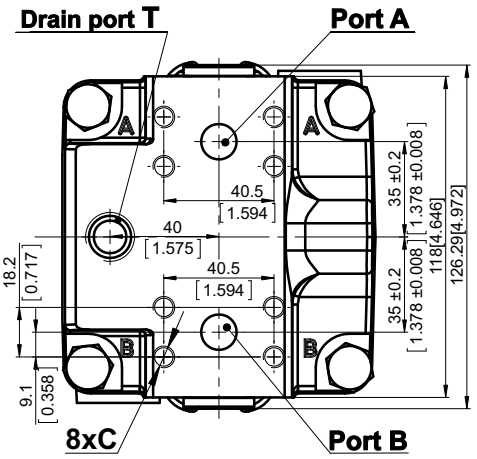
	Port Size			
	2	3	4	6
$P_{(A,B)}$	2xG 1/2	2xM22x1,5	2x 7/8-14UNF	2xG 3/4
T	G 1/2	M18x1,5	3/4 -16UNF	G 1/2

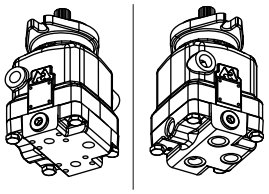
Overall Dimensions and Ports

Rear Ports - Type **E** Mounting Flange - Type **SAE-A**

Rear ports **E**, port size **default** and **5**

See the port sizes at the bottom of this page

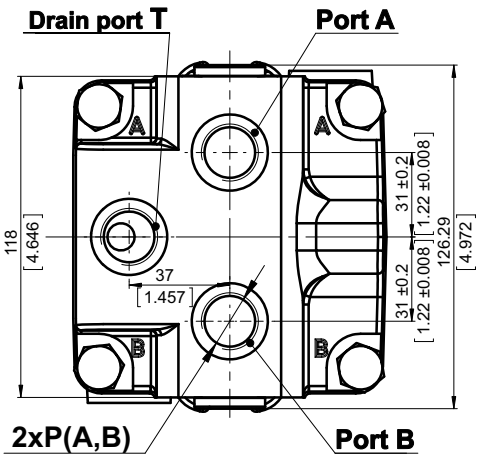


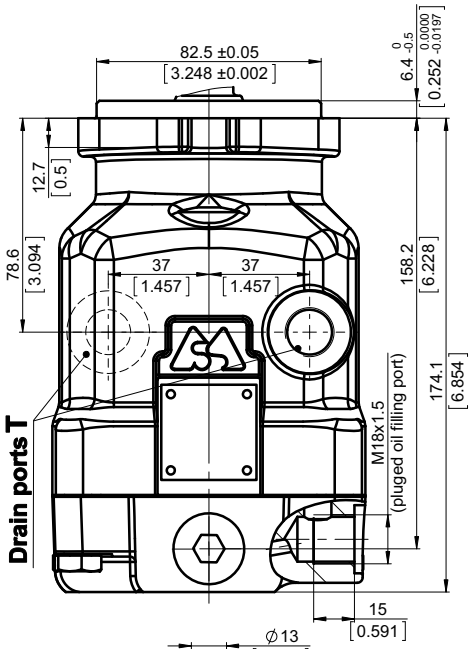


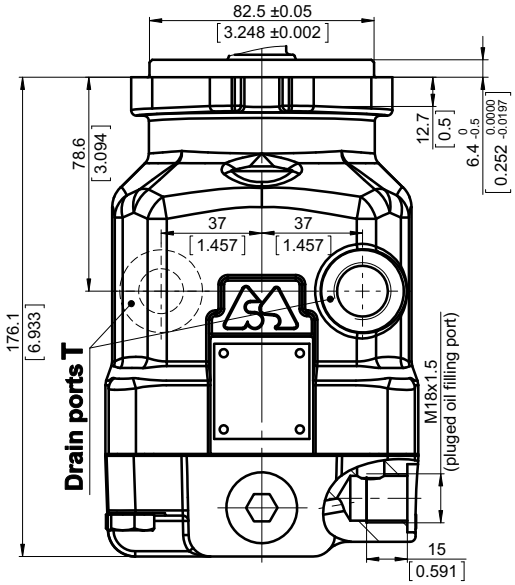
Standard Rotation
Viewed from shaft end
Port **A** Pressurized - **CW**
Port **B** Pressurized - **CCW**
see page 65

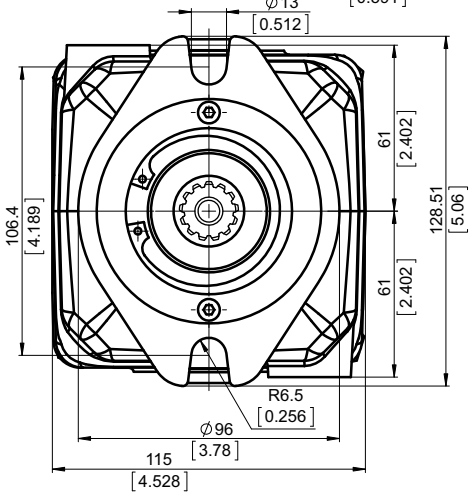
Rear ports **E**, port size **2**,**3**,**4** and **6**

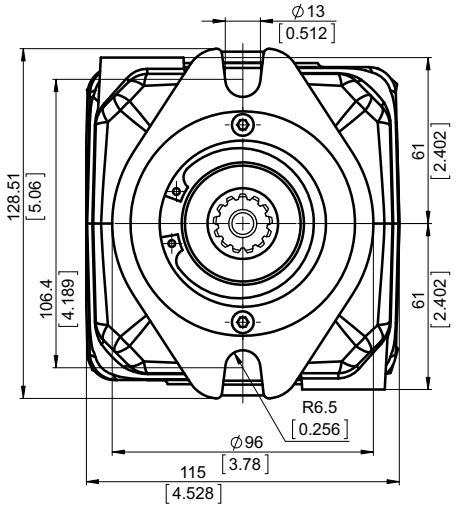
See the port sizes at the bottom of this page



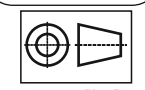








Shaft Mounting
see page 13



mm [in]

	Port Size		
	default	5	9
$P_{(A,B)}$	2xISO 6162-2 DN13	2xSAE J518 1/2 PSI6000	2xISO 6162-2 DN13
T	M18x1,5	3/4-16 UNF	G1/2
C	M8-6H	5/16-18 UNC-2B	M8-6H

	Port Size			
	2	3	4	6
$P_{(A,B)}$	2xG 1/2	2xM22x1,5	2x 7/8-14UNF	2xG 3/4
T	G 1/2	M18x1,5	3/4 -16UNF	G 1/2

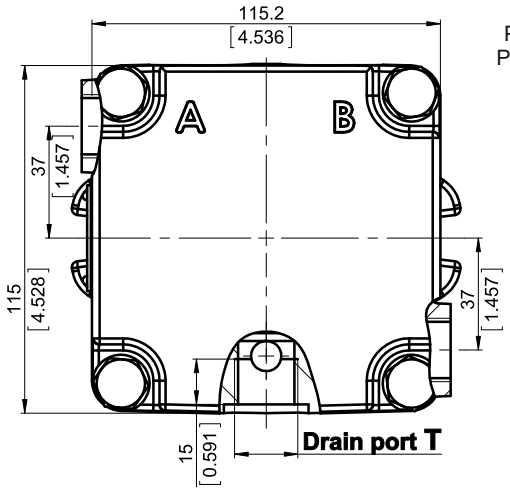
Overall Dimensions and Ports

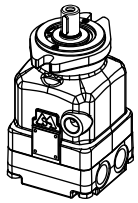
Twin Side Ports - Type **T** Mounting Flange - Type **SAE-A**

Twin side ports **T**, port size **2**,**3**,**4** and **6**

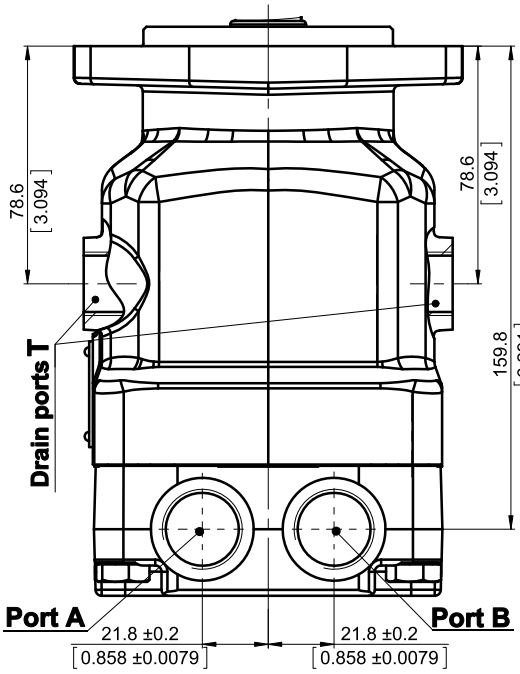
See the port sizes at the bottom of this page

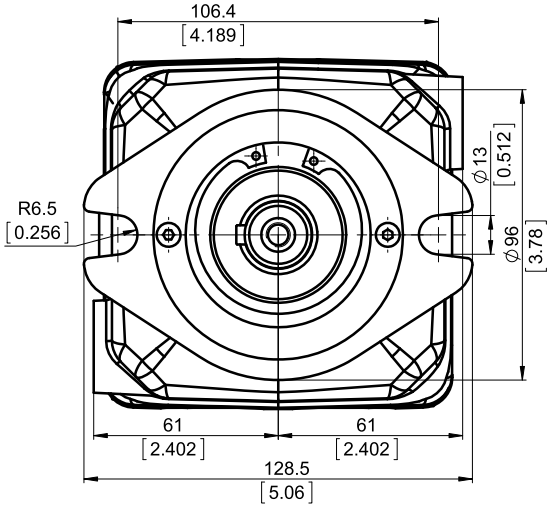
Standard Rotation
Viewed from shaft end
Port **A** Pressurized - **CW**
Port **B** Pressurized - **CCW**
see page 65

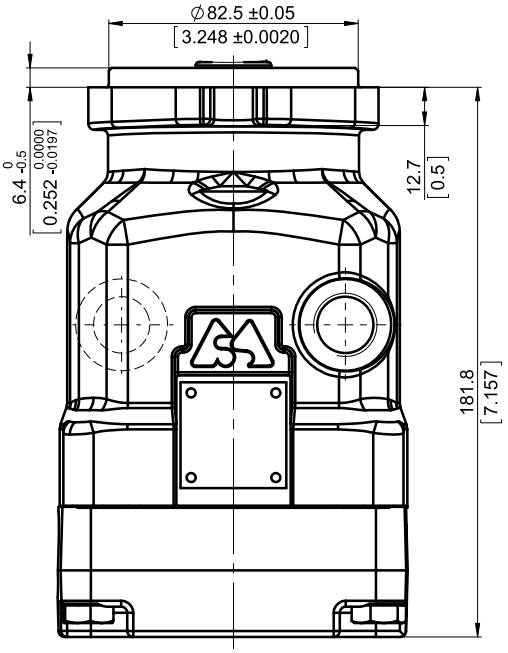




Shaft Mounting
see the next page



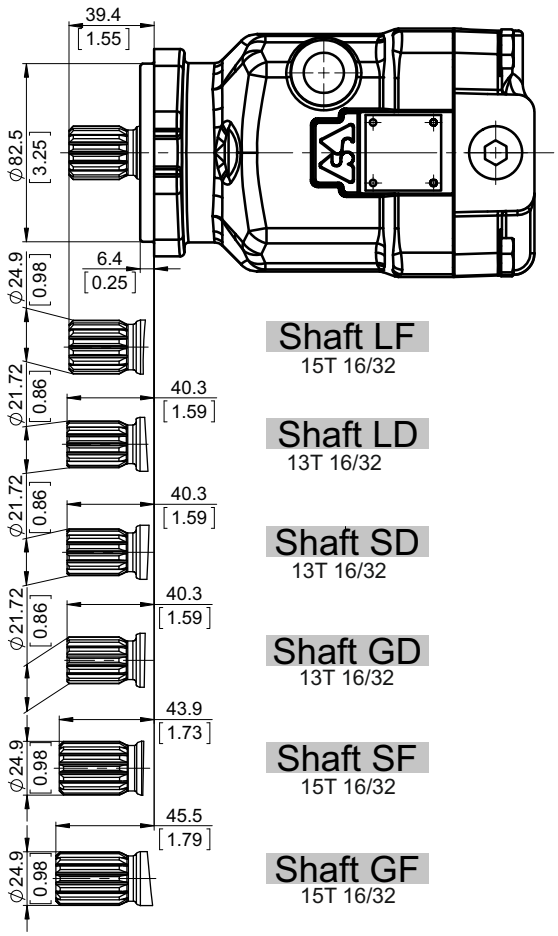




	Port Size			
	2	3	4	6
$P_{(A,B)}$	2xG 1/2	2xM22x1,5	2x 7/8-14UNF	2xG 3/4
T	G 1/2	M18x1,5	3/4 -16UNF	G 1/2

mm [in]

Shafts Mounting
Mounting Flange - Type **SAE-A**



Shaft LF
15T 16/32

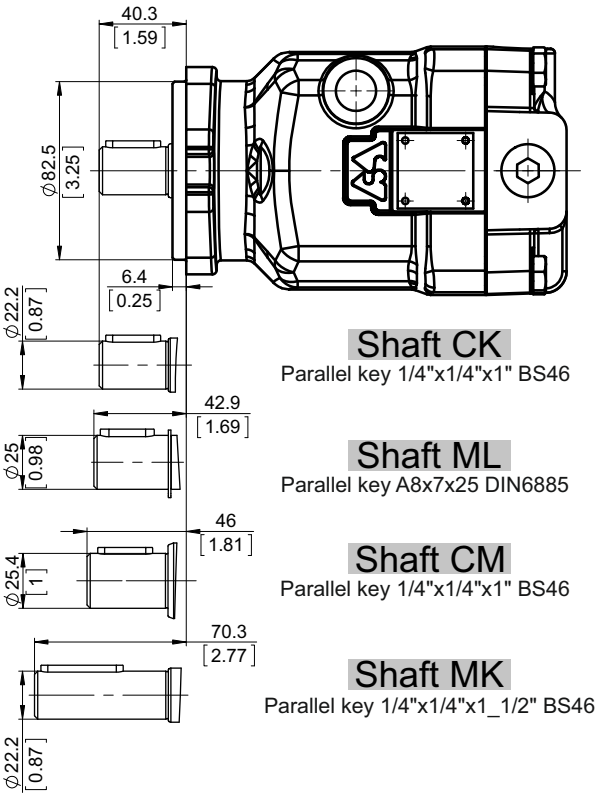
Shaft LD
13T 16/32

Shaft SD
13T 16/32

Shaft GD
13T 16/32

Shaft SF
15T 16/32

Shaft GF
15T 16/32

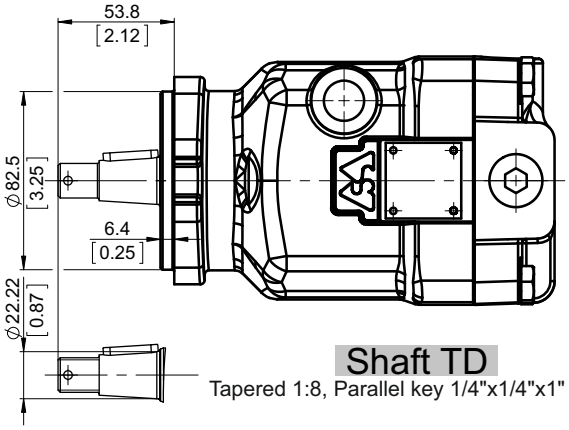


Shaft CK
Parallel key 1/4"x1/4"x1" BS46

Shaft ML
Parallel key A8x7x25 DIN6885

Shaft CM
Parallel key 1/4"x1/4"x1" BS46

Shaft MK
Parallel key 1/4"x1/4"x1_1/2" BS46



Shaft TD
Tapered 1:8, Parallel key 1/4"x1/4"x1"

Shaft Dimensions
See Page 57÷62

PERMISSIBLE SHAFT LOAD

Permissible shaft load		Standrard bearing	Improved bearing
max Axial	N[lb]	Fa=1300 [292]	Fa=1600 [292]
max Radial	N[lb]	Fr=2200 [495]	Fr=3000 [495]

The calculated max values are based on the optimal direction of the forces Fr, Fa and optimal position of the shaft (see page 65).

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

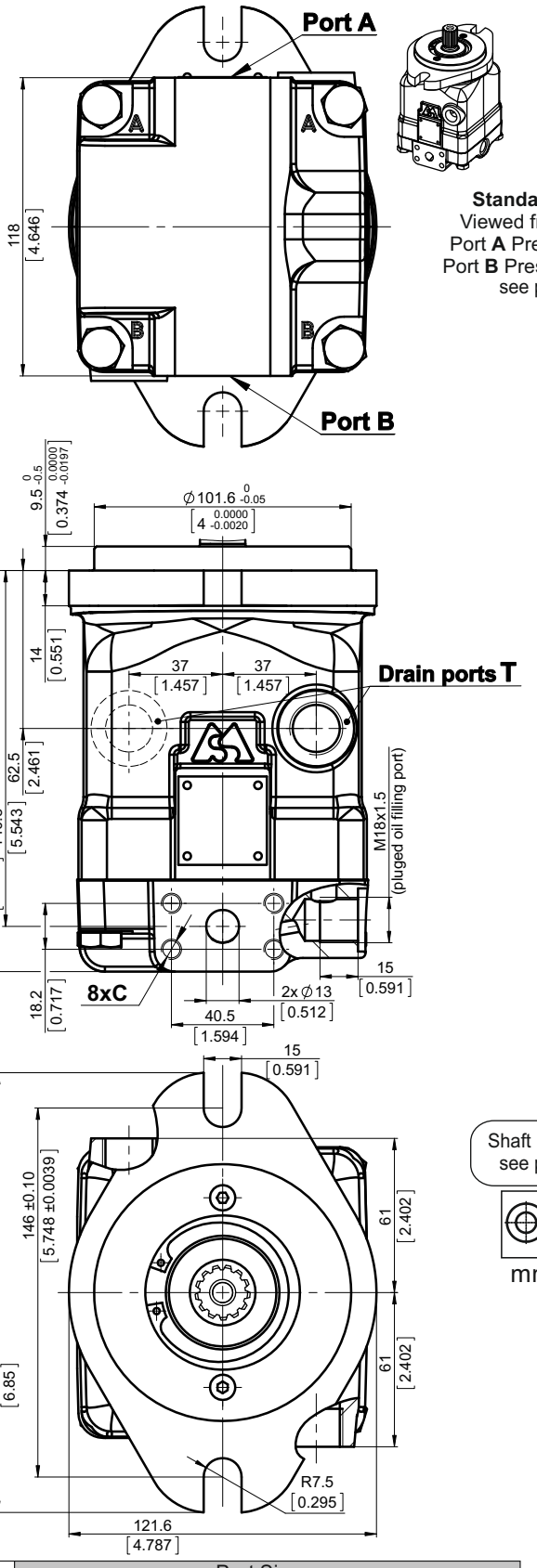
mm [in]

Overall Dimensions and Ports

Side Ports - **Default** Mounting Flange - Type **SAE-B**

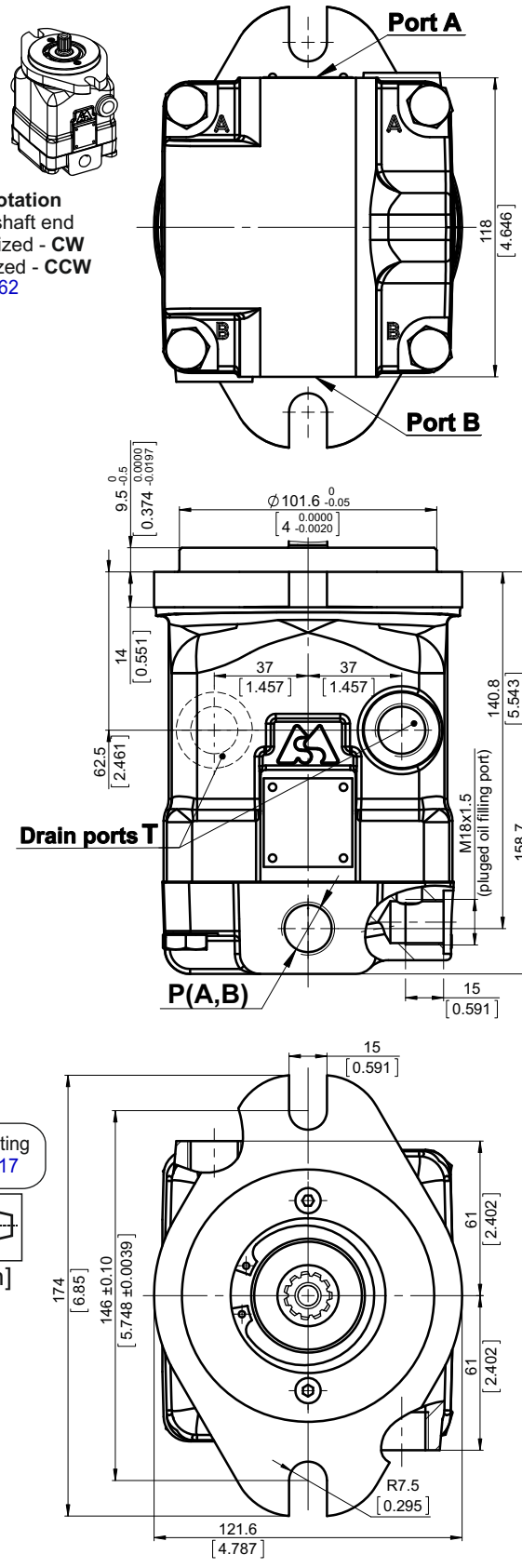
Side ports, port size **default** and **5**

See the port sizes at the bottom of this page



Side ports, port size **2, 3, 4** and **6**

See the port sizes at the bottom of this page



Standard Rotation
Viewed from shaft end
Port **A** Pressurized - **CW**
Port **B** Pressurized - **CCW**
see page 62

Shaft Mounting
see page 17

mm [in]

	Port Size		
	default	5	9
$P_{(A,B)}$	2xISO 6162-2 DN13	2xSAE J518 1/2 PSI6000	2xISO 6162-2 DN13
T	M18x1,5	3/4-16 UNF	G1/2
C	M8-6H	5/16-18 UNC-2B	M8-6H

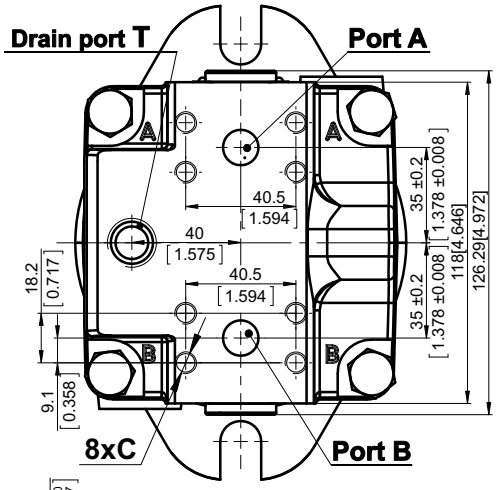
	Port Size			
	2	3	4	6
$P_{(A,B)}$	2xG 1/2	2xM22x1,5	2x 7/8-14UNF	2xG 3/4
T	G 1/2	M18x1,5	3/4 -16UNF	G 1/2

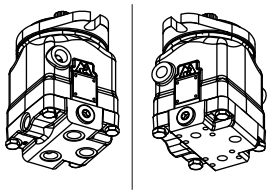
Overall Dimensions and Ports

Rear Ports - Type **E** Mounting Flange - Type **SAE-B**

Rear ports **E**, port size **default** and **5**

See the port sizes at the bottom of this page

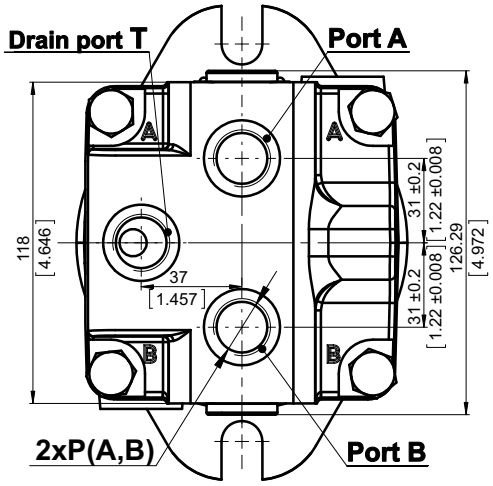


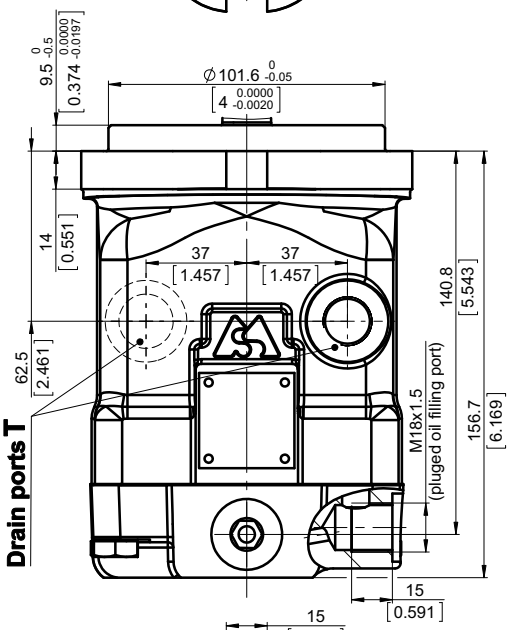


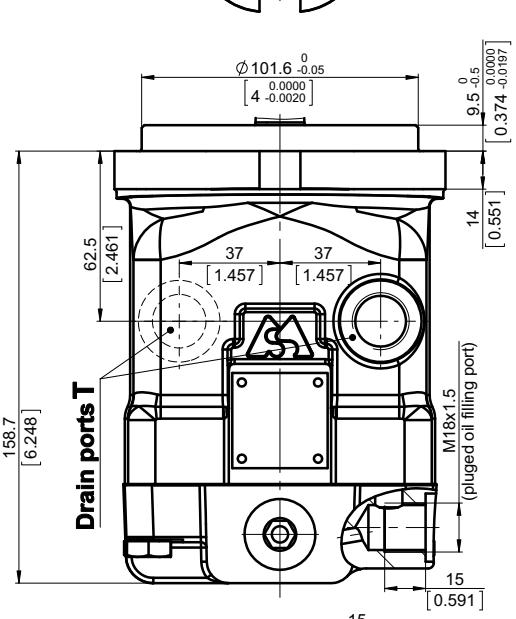
Standard Rotation
Viewed from shaft end
Port **A** Pressurized - **CW**
Port **B** Pressurized - **CCW**
see page 65

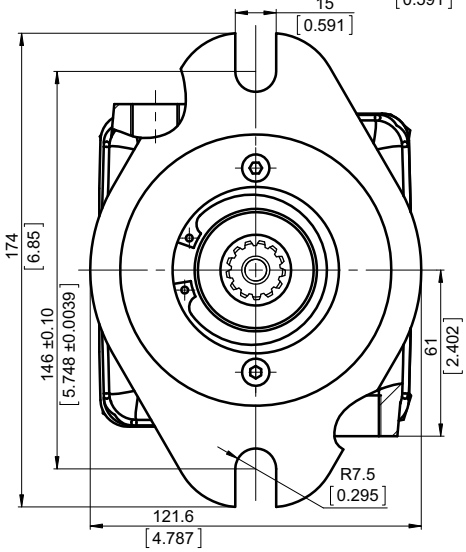
Rear ports **E**, port size **2**,**3**,**4** and **6**

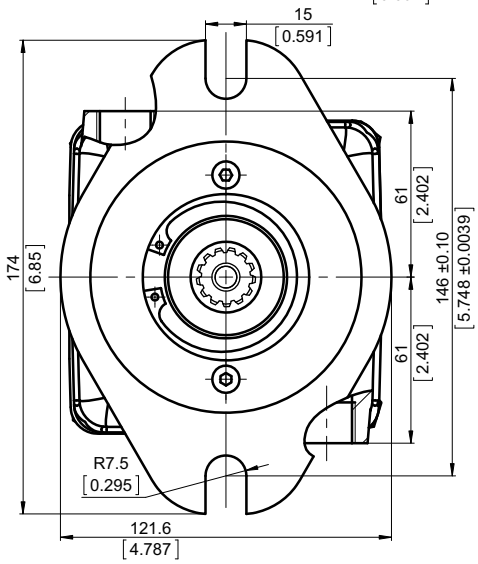
See the port sizes at the bottom of this page



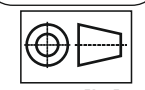








Shaft Mounting
see page 17



mm [in]

	Port Size		
	default	5	9
$P_{(A,B)}$	2xISO 6162-2 DN13	2xSAE J518 1/2 PSI6000	2xISO 6162-2 DN13
T	M18x1,5	3/4-16 UNF	G1/2
C	M8-6H	5/16-18 UNC-2B	M8-6H

	Port Size			
	2	3	4	6
$P_{(A,B)}$	2xG 1/2	2xM22x1,5	2x 7/8-14UNF	2xG 3/4
T	G 1/2	M18x1,5	3/4 -16UNF	G 1/2

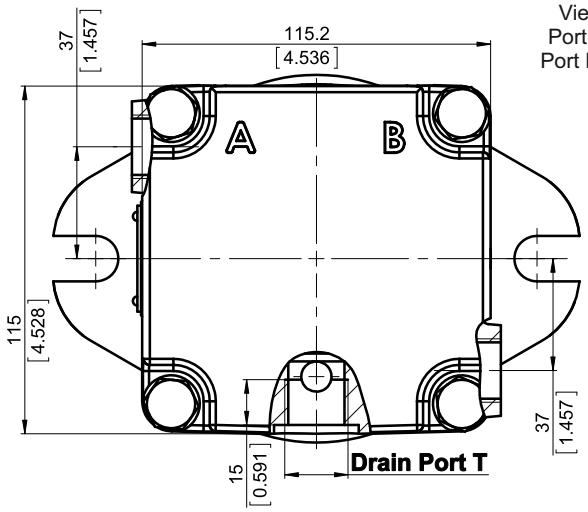
Overall Dimensions and Ports

Twin Side Ports - Type **T** Mounting Flange - Type **SAE-B**

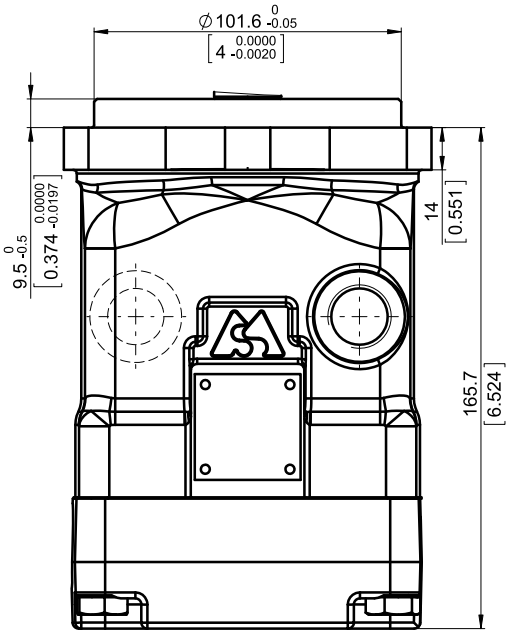
Twin side ports **T**, port size **2**,**3**,**4** and **6**

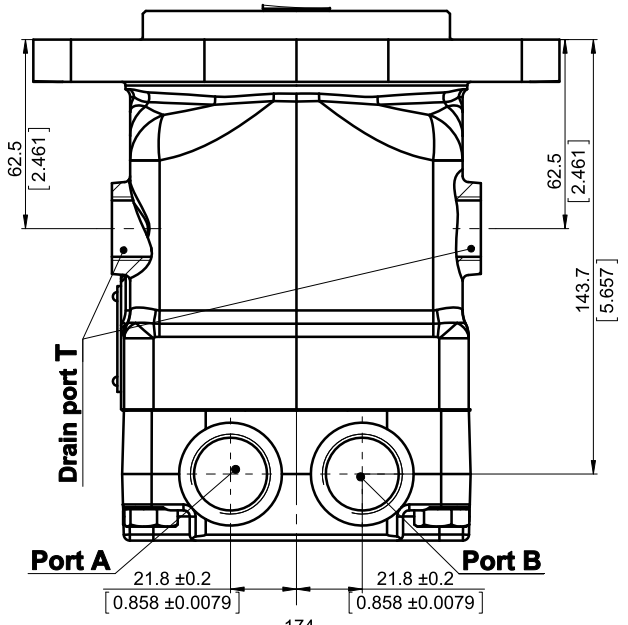
See the port sizes at the bottom of this page

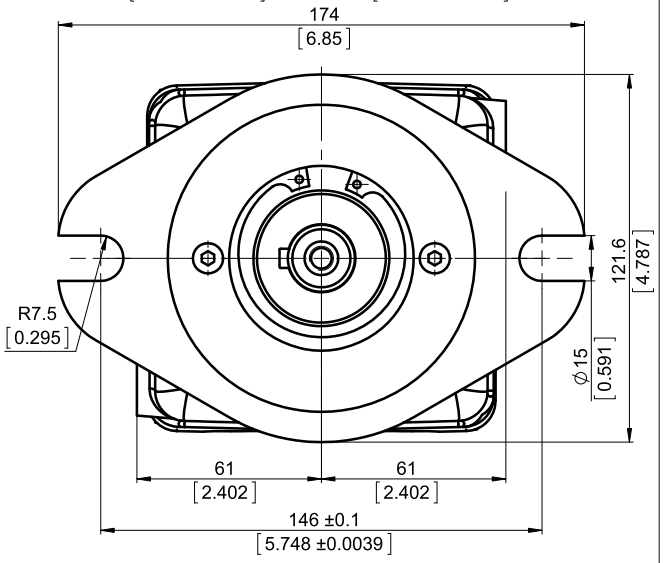
Standard Rotation
Viewed from shaft end
Port **A** Pressurized - **CW**
Port **B** Pressurized - **CCW**
see page 65



Shaft Mounting
see the next page



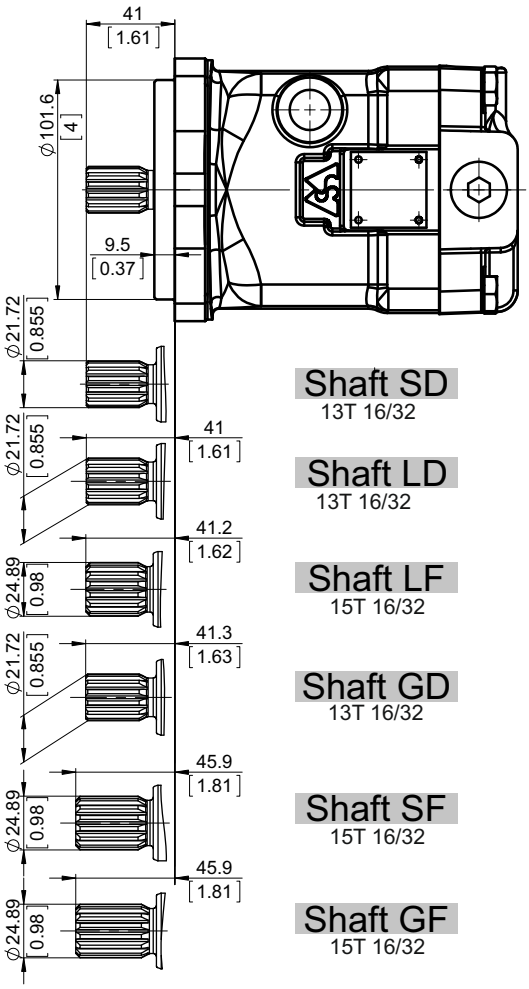




	Port Size			
	2	3	4	6
$P_{(A,B)}$	2xG 1/2	2xM22x1,5	2x 7/8-14UNF	2xG 3/4
T	G 1/2	M18x1,5	3/4 -16UNF	G 1/2

mm [in]

Shafts Mounting
Mounting Flange - Type **SAE-B**



Shaft SD
13T 16/32

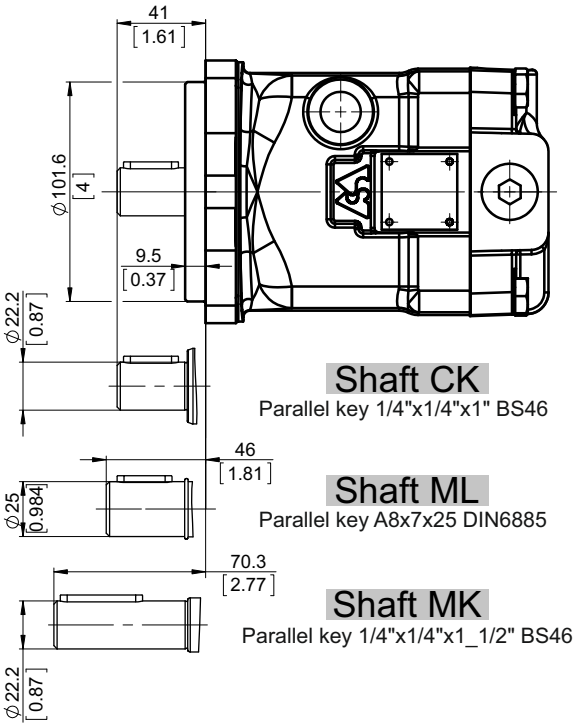
Shaft LD
13T 16/32

Shaft LF
15T 16/32

Shaft GD
13T 16/32

Shaft SF
15T 16/32

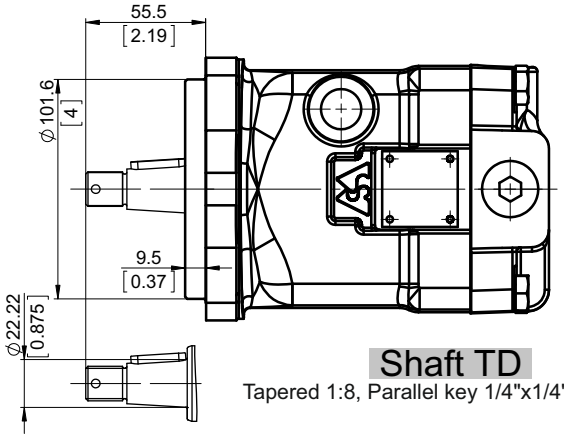
Shaft GF
15T 16/32



Shaft CK
Parallel key 1/4"x1/4"x1" BS46

Shaft ML
Parallel key A8x7x25 DIN6885

Shaft MK
Parallel key 1/4"x1/4"x1_1/2" BS46



Shaft TD
Tapered 1:8, Parallel key 1/4"x1/4"x1"

Shaft Dimensions
See Page 57÷62

PERMISSIBLE SHAFT LOAD

Permissible shaft load		Standrard bearing
max Axial	N[lb]	Fa=1300 [292]
max Radial	N[lb]	Fr=2200 [495]

The calculated max values are based on the optimal direction of the forces Fr, Fa and optimal position of the shaft (see page 65).

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

mm [in]

ORDERING CODE

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	14	14
M A P														[		]

Pos.1 - Mounting Flange

- **A** - 2-Bolt flange, SAE A, spigot dia. 82,5[3.25"], BC 106,35 [4.19"], Bolt Dia. 13.5 [0.53"]
- **B** - 2-Bolt flange, SAE B, spigot dia. 101.6[4"], BC 146 [5.748"], Bolt Dia. 14.3 [0.563"]

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

- **22** - 22.15 cm.^{3}/rev. [1.35 in.^{3}/rev.]
- **28** - 28.47 cm.^{3}/rev. [1.74 in.^{3}/rev.]

Pos.4 - Shaft Extensions**

- **SD** - ø21,72 [0.855"] Spline SAE 13T 16/32 DP, M8-6H thread
- **GD** - ø21,72 [0.855"] Spline SAE 13T 16/32 DP, 5/16-18 UNC-2B thread
- **LD** - ø21,72 [0.855"] Spline SAE 13T 16/32 DP, 1/4-20 UNC-2B thread
- **SF** - ø24.9 [0.98"] Spline SAE 15T 16/32, M8-6H thread
- **GF** - ø24,9 [0.98"] Spline SAE 15T 16/32, 3/8-16UNC-2B thread
- **LF** - ø24.9 [0.98"] Spline SAE 15T 16/32 DP, 1/4-20UNC-2B thread
- **CK** - ø22.2 [ø7/8"] Straight, M8-6H thread Parallel key 1/4"x1/4"x1" BS46
- **MK** - ø22.2 [ø7/8"] Straight, M8-6H thread Parallel key 1/4"x1/4"x1_1/2" BS46
- **ML** - ø25 [ø0.984"] Straight, M8-6H thread Parallel key A8x7x25 DIN6885
- **CM** - ø25.4 [ø1"] Straight, M8-6H thread Parallel key 1/4"x1/4"x1" BS46
- **TD** - ø22.22 [7/8"] Tapered 1:8 [125:1000],

Shaft type CM is available only for Pos.5 option N

Pos.5 - Improved radial load

- omit - standard bearing
- **N** - Improved bearing

Option N is available only for Pos.1 option A

Pos.6 - Port Size

- omit - 2xISO 6162-2 DN13, drain port M18x1,5-6H
- **2** - 2xG1/2, drain ports G1/2
- **3** - 2xM22x2, drain ports M22x2-6H
- **4** - 2x7/8-14 UNF Ports, drain ports 3/4-16 UNF
- **5** - 2xSAE 1/2" PSI6000, drain ports 3/4-16 UNF
- **6** - 2xG3/4, drain ports G1/2
- **9** - 2xISO 6162-2 DN13, drain port G1/2

Option omit;5 and 9 are not available for Pos.2 option T

We remain open to meet your special requirements upon request.

Pos.7 - Seal, Corrosion Resistant Seal Surface

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

Pos.8 - Integrated Valves

See next page for information about valves

- omit - None
- **HR** - Single anti-cavitation valve
- **AR** - Dual anti-cavitation valve
- **PU** - Purge valve
- **FLU** - Flush valve
- **SAR** - Single anti-cavitation and relief valve
- **DAR** - Dual anti-cavitation and relief valve
- **DARP** - Dual anti-cavitation, relief and purge valve
- **DARF** - Dual anti-cavitation, relief and flush valve

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

Pos.9 - Valve Ports for Single Valves

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

Pos.10 - Pressure Setting of Integrated Valves

- omit - None
- **x** - For value - see next page

Pos.11 - Flow Setting of Integrated Valves

- omit - None
- **Lx** - For value - see next page

Pos.12 - Special Features*

- omit - None
- **R2S** - Speed Sensor Two Directional (see page 63)
- **R** - Reverse Rotation (see page 65)

Pos.13 - Paint and Coating

- omit - No paint or coating
- **P** - Painted
- **PC** - Corrosion protected paint
- **PS** - Special painted ***
- **PCS** - Special corrosion protected paint***

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

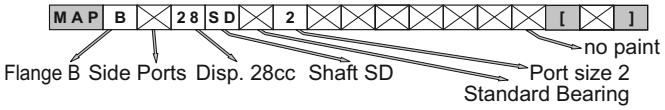
Pos.14 - Design Series

- omit - Factory specified

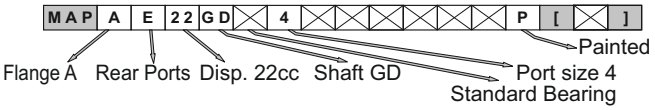
*Available on enquiry
**The permissible output torque for shafts must not be exceeded!
***Non painted feeding surface

EXAMPLE

M A P B 2 8 S D 2



M A P A E 2 2 G D 4 P

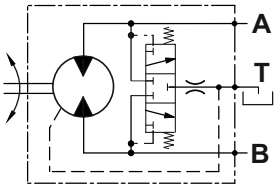


Valve Options

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 (omit) - 3 ÷ 7 l/min**.
- For other options, please see Pos.11 of ordering code, considering the following possible values:

Pos.11	**omit**	**L3.5**	**L5.5**	⇨ flow rate

EXAMPLE

M A P B 2 8 S D 2 **P U** purge valve flow rate 5±2 l/min

M A P B 2 8 S D 2 **P U L 3 . 5** purge valve flow rate 3.5±1 l/min

M A P B 2 8 S D 2 **P U L 5 . 5** purge valve flow rate 5.5±1 l/min

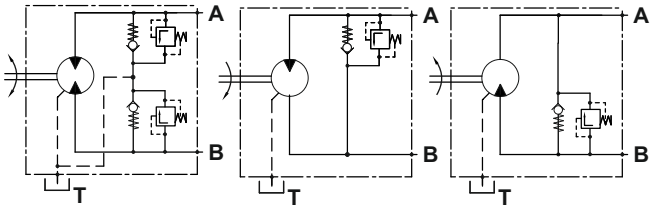
Option **DAR, SARA, SARB**

Combined Anti-Cavitation and Reliev 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.

DAR SARA SARB



Please, consider the following possible values:

Pos.10	**250**	**300***	**350***	⇨ pressure

300 and 350 bar options are available only for Pos.2 option T

EXAMPLE

M A P B 2 8 S D 2 **D A R 2 5 0**

Double Anti-Cavitation and Relief Valve, relief valve setting 250 bar

M A P B 2 8 S D 2 **S A R A 2 5 0**

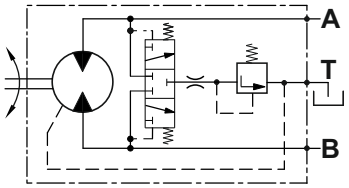
Single Anti-Cavitation and Relief Valve, relief valve setting 250 bar
The valve is placed on port A

M A P B T 2 8 S D 2 **S A R B 3 5 0**

Single Anti-Cavitation and Relief Valve, relief valve setting 350 bar
The valve is placed on port B

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 (omit) - 3 ÷ 7 l/min and charge (opening) pressure 16 bar** with 20 bar feed pressure for close loop circuit;
- For other options, please see Pos.10 and Pos. 11 of ordering code, considering the following possible values:

Pos.10	**omit**	**10**	⇨ pressure
Pos.11	**omit**	**L3.5**	**L5.5** ⇨ flow rate

EXAMPLE

M A P B 2 8 S D 2 **F L U** flow rate 5±2 l/min, charge pressure 16 bar

M A P B 2 8 S D 2 **F L U 1 0 L 5 . 5** flow rate 5.5±1 l/min, charge pressure 10 bar

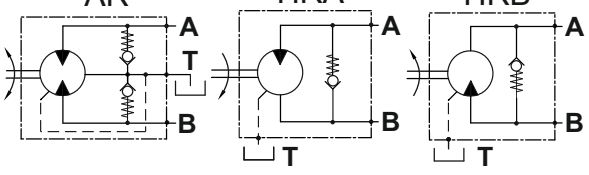
M A P B 2 8 S D 2 **F L U L 3 . 5** flow rate 3.5±1 l/min, charge pressure 16 bar

Option **AR, HRA, HRB**

Anti-Cavitation Valve

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

AR HRA HRB



EXAMPLE

M A P B 2 8 S D 2 **A R**

Double Anti-Cavitation Valve

M A P B 2 8 S D 2 **H R A**

Single Anti-Cavitation Valve, the valve is placed on port A

M A P B 2 8 S D 2 **H R B**

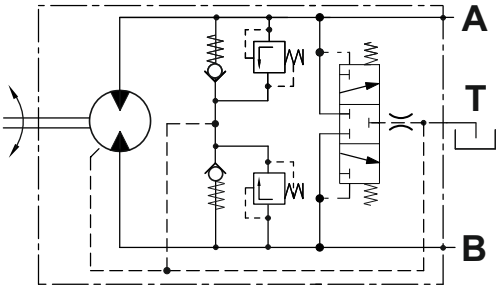
Single Anti-Cavitation Valve, the valve is placed on port B

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-cavitaion, 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:

Pos.10 | **250** | **300*** | **350*** ⟹ pressure

300 and 350 bar options are available only for Pos.2 option T

- Flow rate of purge valve by **default (omit) - 3 ÷ 7 l/min.** The possible values are as follow:

Pos.11 | **omit** | **L3.5** | **L5.5** ⟹ flow rate

EXAMPLE

M A P B T 2 8 S D 2 **D A R P 2 5 0**

Double Anti-Cavitation, Relief and Purge Valve,
relief valve setting 250 bar, purge valve flow rate 5±2 l/min

M A P B T 2 8 S D 2 **D A R P 2 5 0 L 3 . 5**

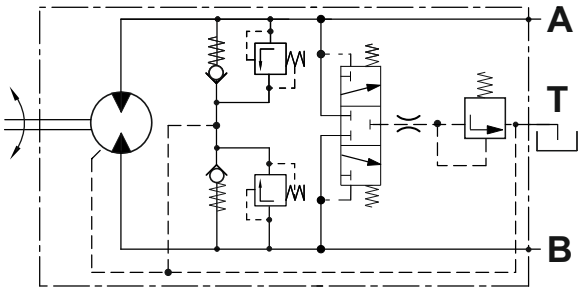
Double Anti-Cavitation, Relief and Purge Valve,
relief valve setting is 250 bar, purge valve flow rate 3.5±1 l/min

M A P B T 2 8 S D 2 **D A R P 3 0 0 L 5 . 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-cavitaion, 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:

Pos.10 | **250** | **300*** | **350*** ⟹ pressure

300 and 350 bar options are available only for Pos.2 option T

- Flow rate of flush valve by **default (omit) - 3 ÷ 7 l/min and charge pressure 16 bar** with 20 bar feed pressure for close loop circuit. The possible values are as follow:

Pos.11 | **omit** | **L3.5** | **L5.5** ⟹ flow rate

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

Pos.9 | 250-**10** | 300-**10** | 350-**10**

Relief valve opening pressure

Flush valve opening pressure (charge pressure)

EXAMPLE

M A P B T 2 8 S D 2 **D A R F 3 0 0**

Double Anti-Cavitation, Relief and Flush Valve, relief valve setting 300 bar
flush valve charge pressure 16 bar, flush valve flow rate 5±2 l/min

M A P B T 2 8 S D 2 **D A R F 3 0 0 - 1 0**

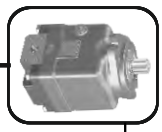
Double Anti-Cavitation, Relief and Flush Valve, relief valve setting 300 bar
flush valve charge pressure 10 bar, flush valve flow rate is 5±2 l/min

M A P B T 2 8 S D 2 **D A R F 2 5 0 L 3 . 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

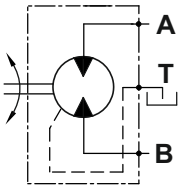
M A P B T 2 8 S D 2 **D A R F 3 0 0 - 1 0 L 5 . 5**

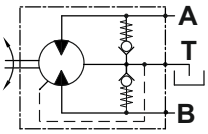
Double Anti-Cavitation, Relief and Flush Valve, relief valve setting 300 bar
flush valve charge pressure 10 bar, flush valve flow rate 5.5±1 l/min

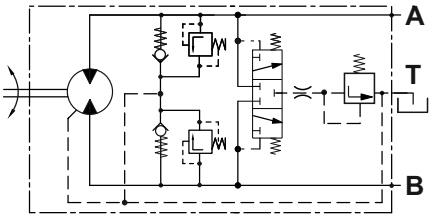


Hydraulic Motors Type MAP50

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

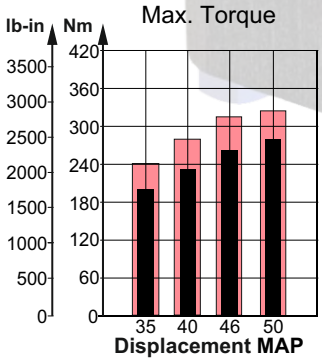
- » Swash plate
- » Port options
- » Shaft options
- » High pressure ports
- » Integrated valves

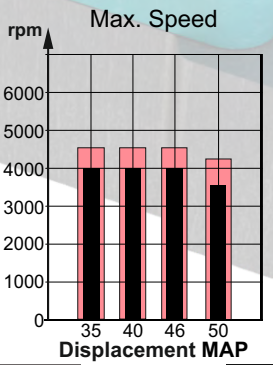
ADVANTAGES

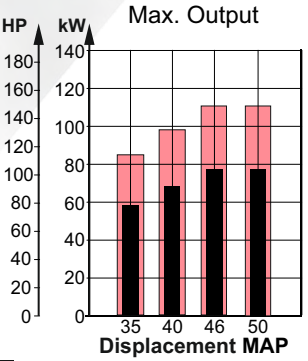
- » High starting torque
- » Smooth operation
- » Long service life
- » High power density

GENERAL

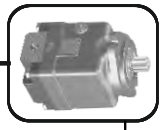
Displacement,	cm^3/rev [in^3/rev]	**36,16÷49.94 [2.21÷3.05]**
Max. Speed,	RPM	**4000**
Max. Torque,	Nm [lb-in]	**278 [2460]**
Max. Output,	kW [HP]	**76 [102]**
Max. Pressure Drop,	bar [PSI]	**350 [5080]**
Max. Oil Flow,	l/min [GPM]	**180 [47.5]**
Min. Speed,	RPM	**500**
Fluid		**Mineral based- HLP(DIN 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)**



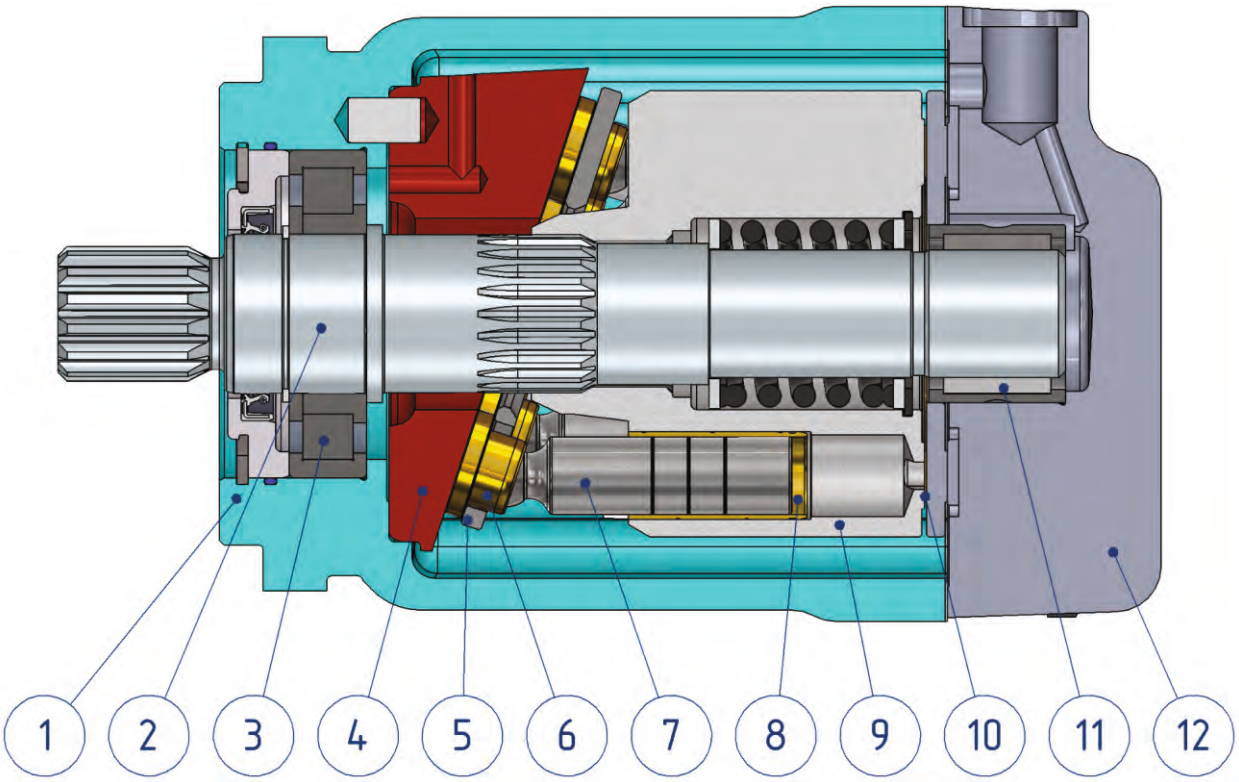




Intermittent values Continuous values



SECTION VIEW



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

The heavy duty design of MAP motor gains big advantage over the typical swash plate motors. The starting torque is close to the starting torque of the bent axis motors and the total efficiency of our design in normal working modes is similar to the bent axis motors. The main advantage of our design over the bent axis motors is that the pulsations and vibrations during the operation are much less. Another advantage is that the swash plate motors are more reliable than the bent axis motors.

SPECIFICATION DATA

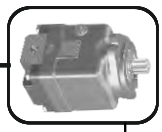
Type		MAP 35	MAP 40	MAP 46	MAP 50
Displacement, cm.^{3}/rev. [in.^{3}/rev.]		36.16 [2.21]	41.59 [2.54]	47.13 [2.88]	49.94 [3.05]
Max. Speed, [RPM]	Cont.	4000	4000	4000	3600
	Int.*	4500	4500	4500	4200
Max. Torque,*** Nm [lb-in]	Cont.	202 [1789]	232 [2053]	263 [2328]	278 [2460]
	Int.**	242 [2142]	278 [2460]	315 [2788]	326 [2885]
Output, kW [HP]	Cont.	58 [78]	67 [90]	76 [102]	76 [102]
	Int.**	84 [113]	97 [130]	110 [148]	110 [148]
Max. Pressure, bar [PSI]	Cont.	350 [5080]	350 [5080]	350 [5080]	350 [5080]
	Int.**	420 [6100]	420 [6100]	420 [6100]	410 [5950]
	Peak	450 [6527]	450 [6527]	450 [6527]	450 [6527]
Max. Oil Flow, l/min [GPM]	Cont.	145 [38.3]	167 [44.1]	189 [50]	180 [47.5]
	Int.*	163 [43.1]	187 [49.4]	212 [56]	210[55.5]
Torque Constant ***** Nm/bar [lb-in/PSI]		0.52 [0.32]	0.6 [0.364]	0.68 [0.41]	0.72 [0.437]
Speed Constant ***** RPM/(l/min) [RPM/GPM]		26.3 [99.4]	22.84 [86.5]	20.2 [76.3]	19.02 [72]
Permissible Shaft Load max Axial**** N[lb]		Fa=2000 [450]			
max Radial**** N[lb]		Fr=3600 [810]			
Min. Speed, [RPM]		500			
Max. Pressure in Drain Line, bar [PSI]		5 [70] open drain line is always required			
Weight, kg [lb]		17.8 [39.2]			

Peak pressure is 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 η_v=0.95 and η_{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 68.
5. Recommended maximum system operating temperature - 82°C [180°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**

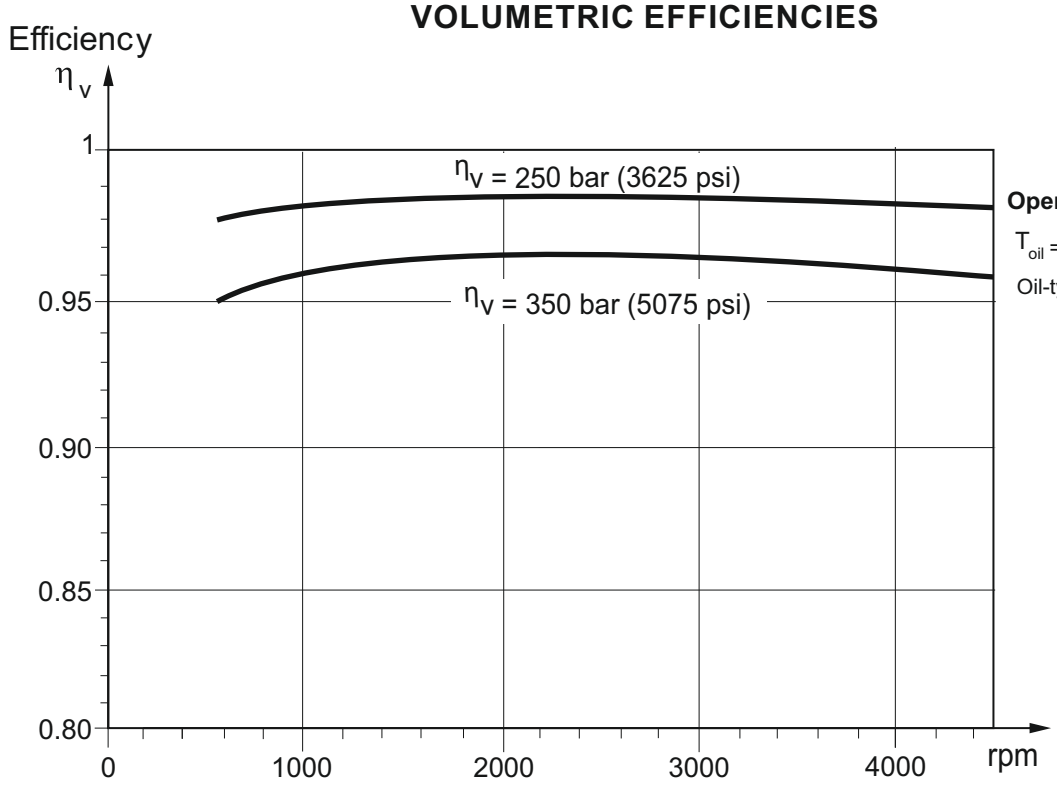
The constant values are mentioned for rough calculations. Motor torque and rotation speed for a particular project are depending on the real operating conditions. For more detail calculations please see efficiencies on next page and formulas on page 69.



FUNCTION DIAGRAMS

The below efficiencies are applied for all displacements.

VOLUMETRIC EFFICIENCIES

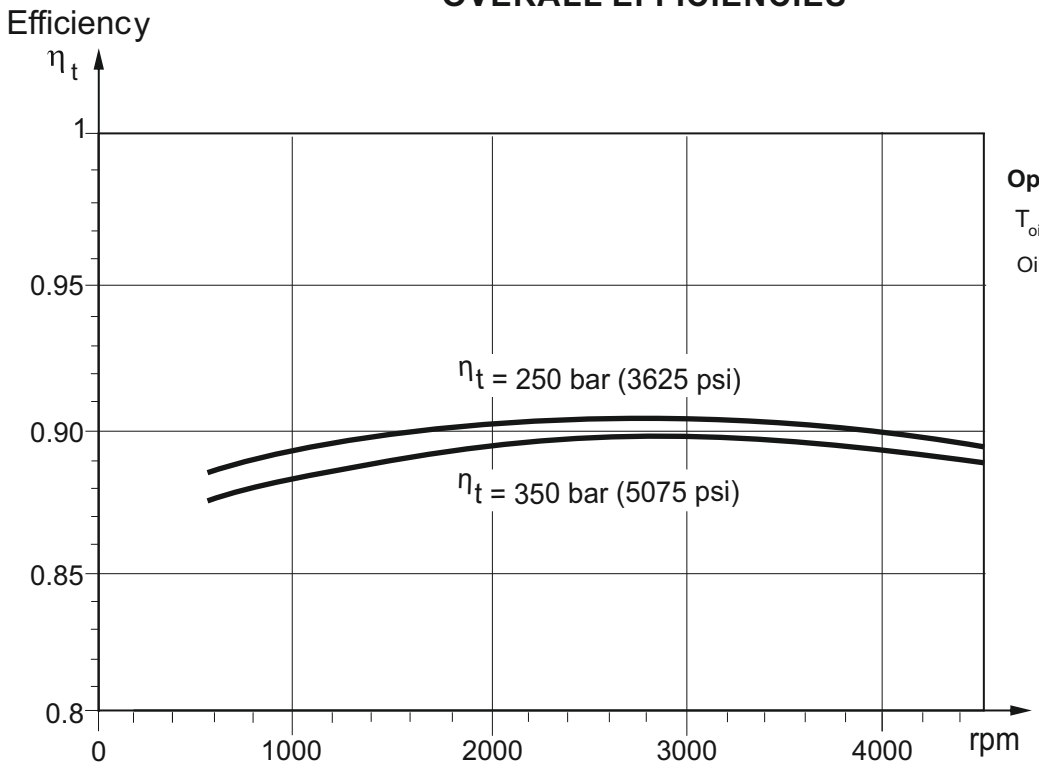


Operation conditions:

T_{oil} = 50°C [122 F]

Oil-type: HPL 46

OVERALL EFFICIENCIES



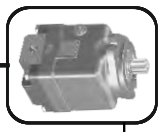
Operation conditions:

T_{oil} = 50°C [122 F]

Oil-type: HPL 46

The motor size, pressure, torque, speed of rotation and flow rate required for a specific application can be calculated using the formulas on page 69

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

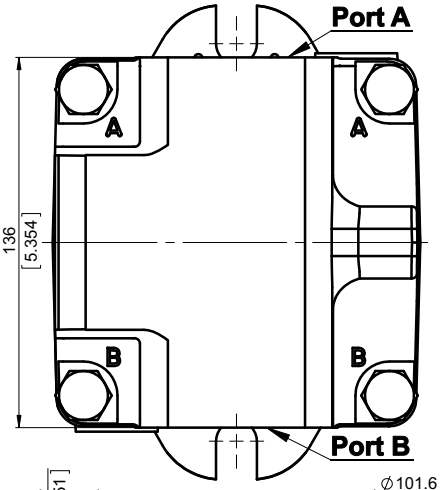


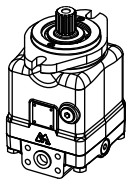
Overall Dimensions and Ports

Side Ports - **Default**

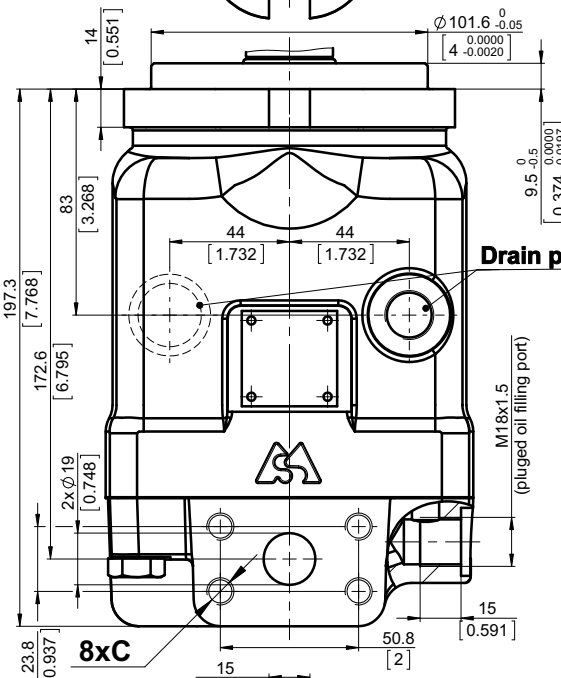
Side ports, port size **default** and **5**

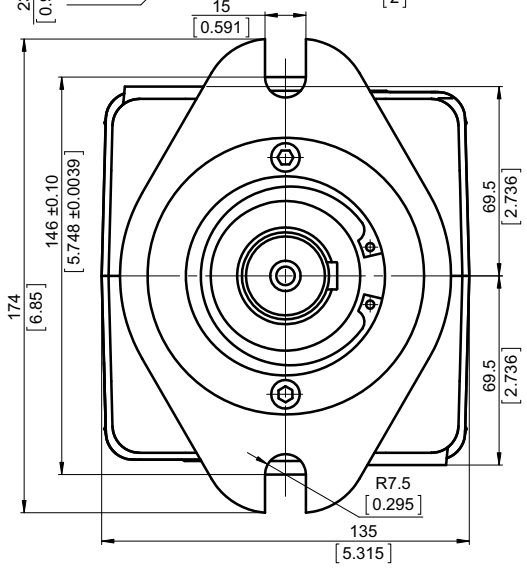
See the port sizes at the bottom of this page





Standard Rotation
Viewed from shaft end
Port **A** Pressurized - **CW**
Port **B** Pressurized - **CCW**
see page 65

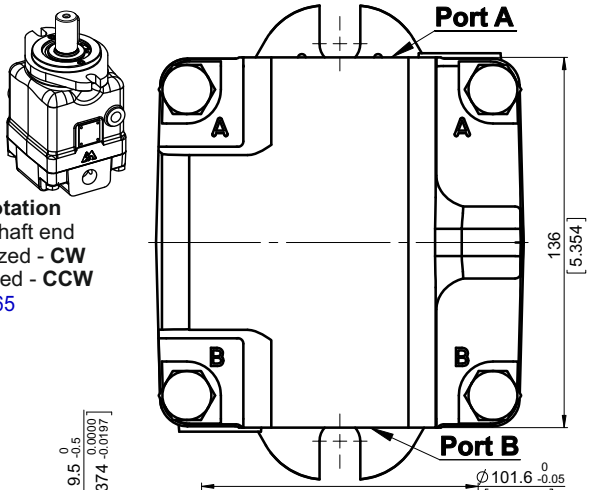


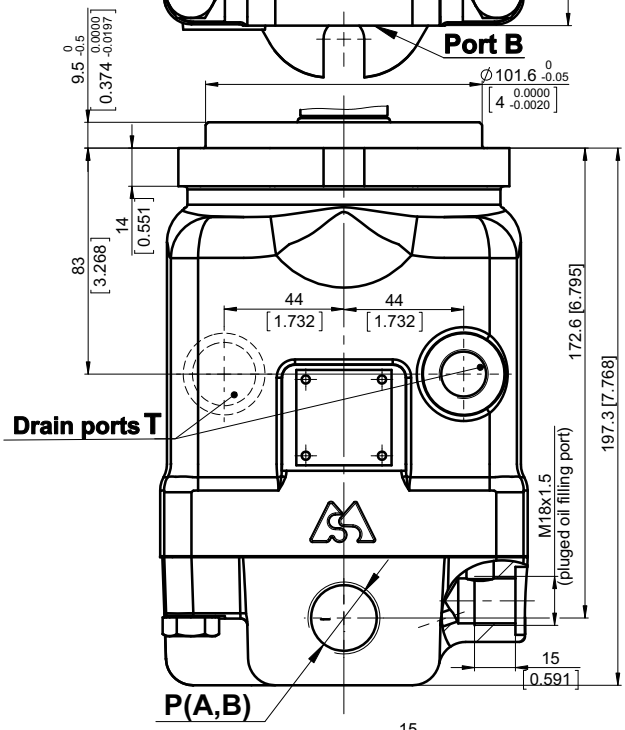


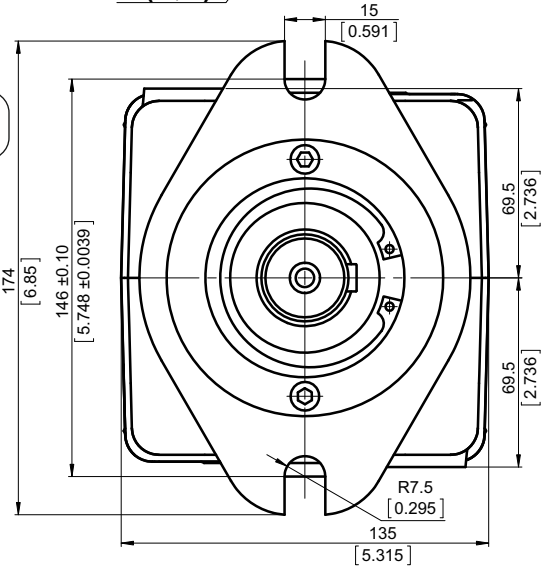
	Port Size		
	default	5	9
$P_{(A,B)}$	2xISO 6162-2 DN19	2xSAE J518 3/4 PSI6000	2xISO 6162-2 DN19
T	M18x1,5	7/8-14 UNF-2B	G1/2
C	M10-6H	3/8-16 UNC-2B	M10-6H

Side ports, port size **2**,**3**,**4**,**6**,**7** and **8**

See the port sizes at the bottom of this page

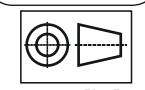




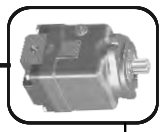


	Port Size		
	2	3	4
$P_{(A,B)}$	2xG 3/4	2xM27x2	2x1 1/16-12UN
T	G 1/2	M18x1,5	7/8-14UNF

Shaft Mounting
see page 27



mm [in]

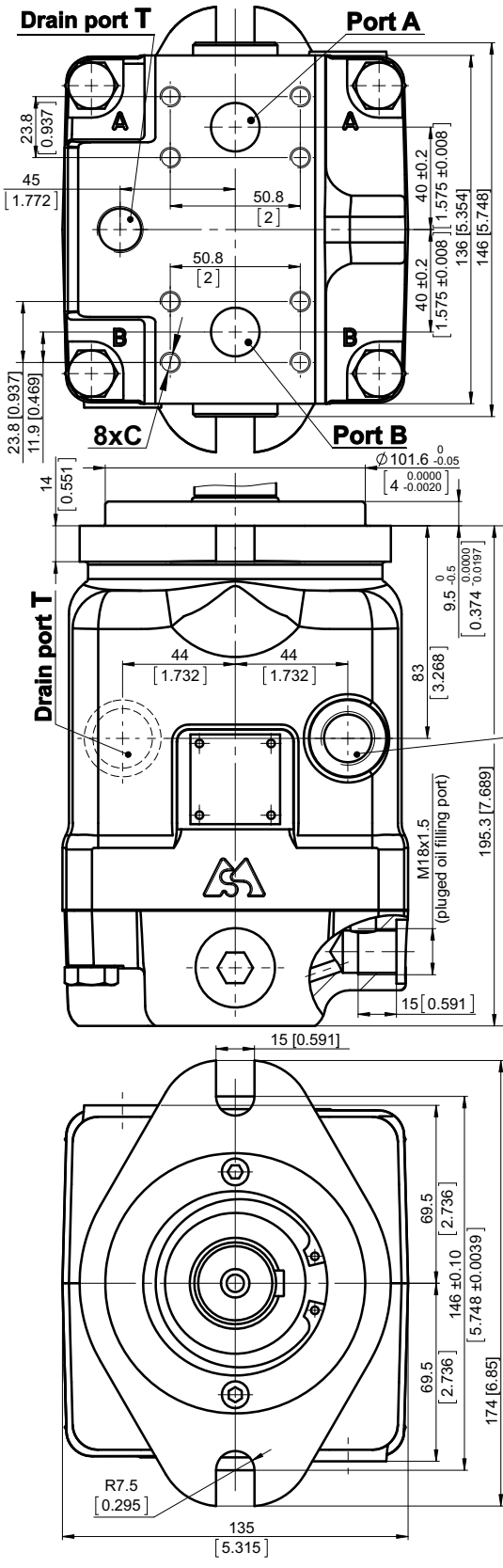


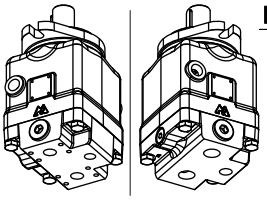
Overall Dimensions and Ports

Rear Ports - Type **E**

Rear ports **E**, port size **default** and **5**

See the port sizes at the bottom of this page

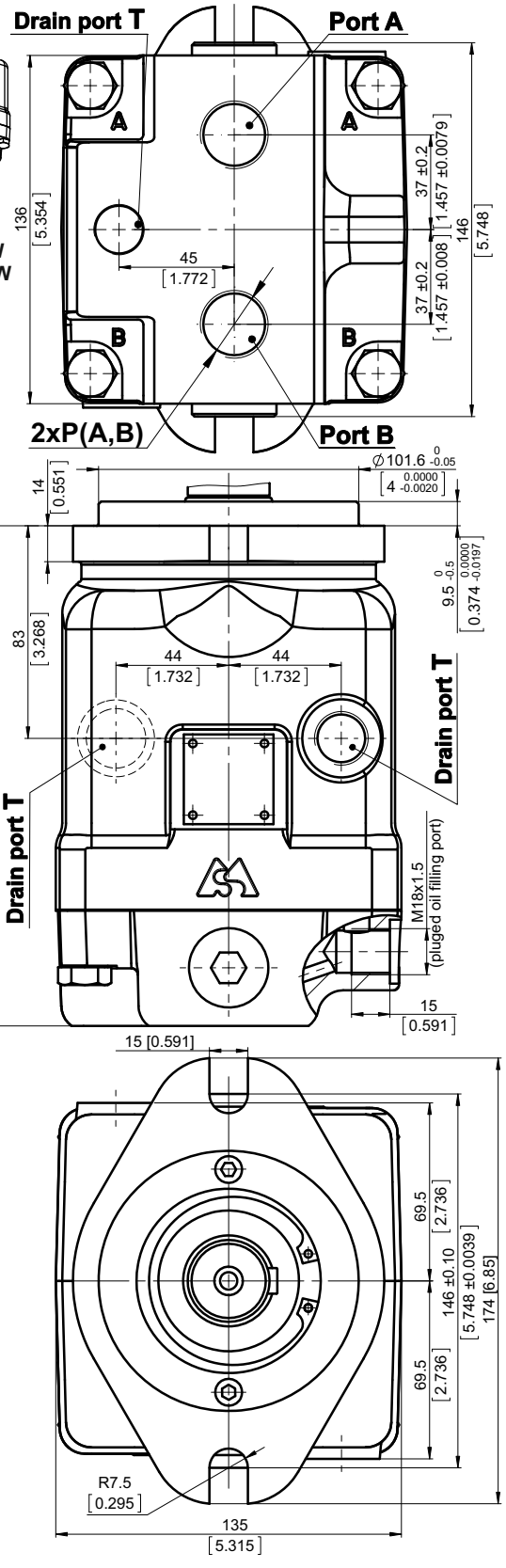




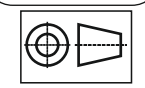
Standard Rotation
Viewed from shaft end
Port **A** Pressurized - **CW**
Port **B** Pressurized - **CCW**
see page 65

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

See the port sizes at the bottom of this page



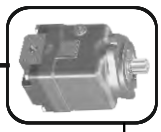
Shaft Mounting
see the next page



mm [in]

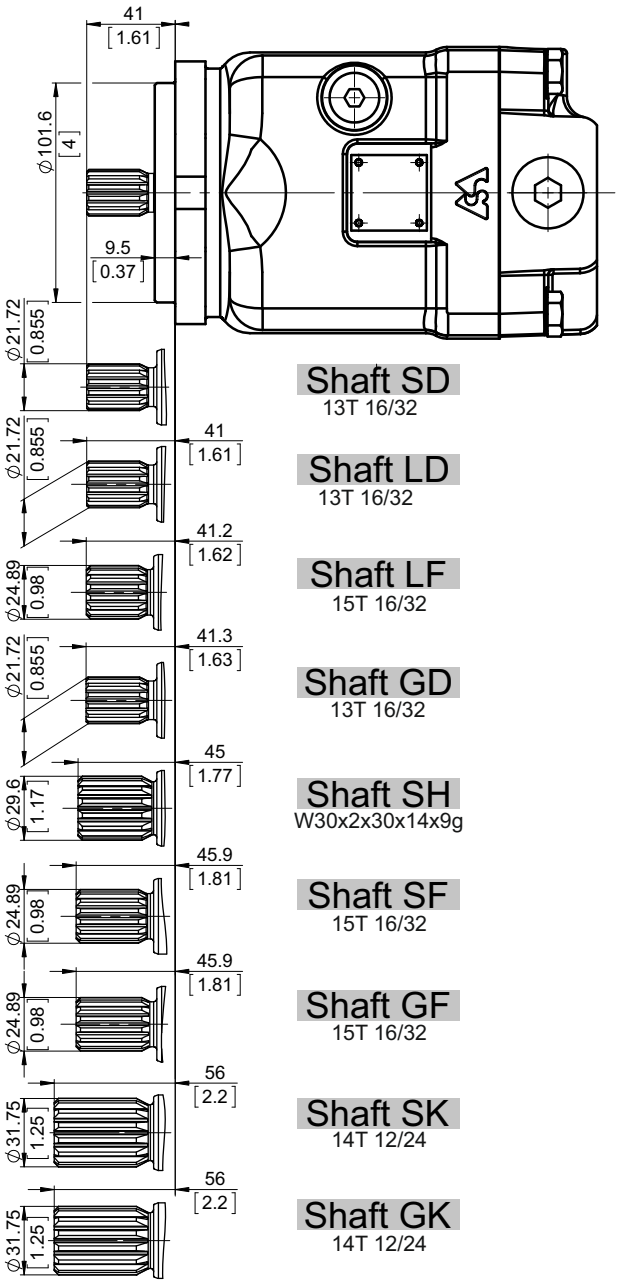
	Port Size		
	default	5	9
$P_{(A,B)}$	2xISO 6162-2 DN19	2xSAE J518 3/4 PSI6000	2xISO 6162-2 DN19
T	M18x1,5	7/8-14 UNF-2B	G1/2
C	M10-6H	3/8-16 UNC-2B	M10-6H

	Port Size					
	2	3	4	6	7	8
$P_{(A,B)}$	2xG 3/4	2xM27x2	2x1 1/16-12UN	2xG 1/2	2xM22x1,5	2x 7/8-14UNF
T	G 1/2	M18x1,5	7/8 -14UNF	G 1/2	M18x1,5	3/4 -16UNF



Shafts Mounting

Ports - Type **Default**, Type **E**



Shaft SD
13T 16/32

Shaft LD
13T 16/32

Shaft LF
15T 16/32

Shaft GD
13T 16/32

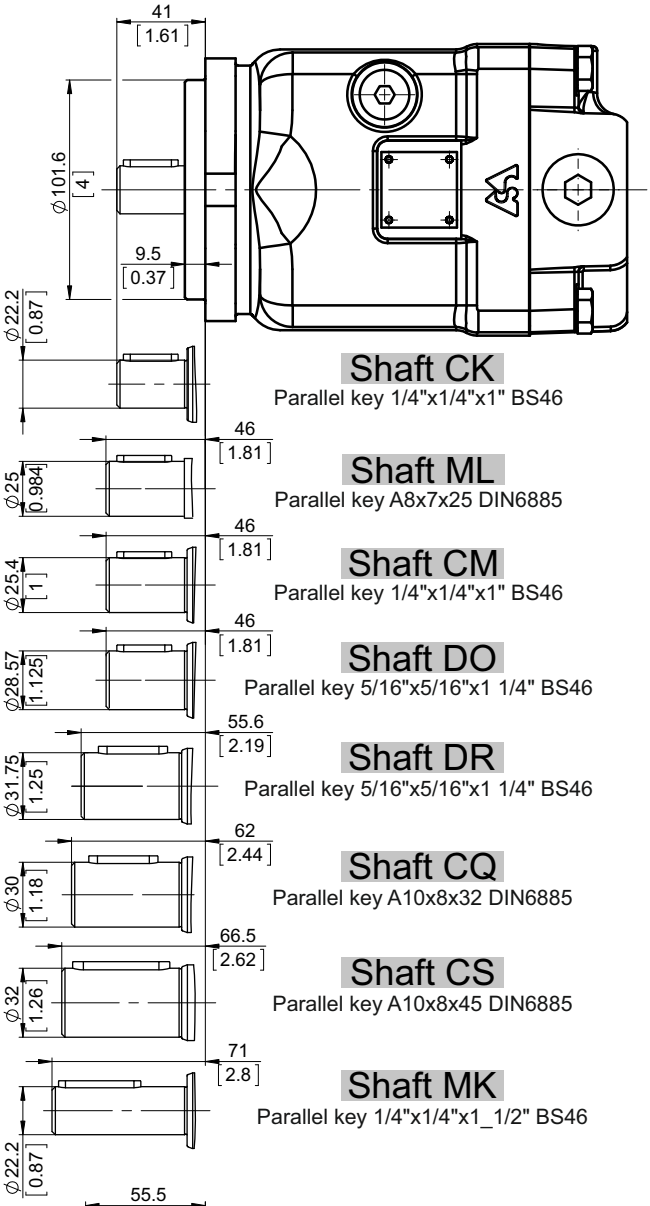
Shaft SH
W30x2x30x14x9g

Shaft SF
15T 16/32

Shaft GF
15T 16/32

Shaft SK
14T 12/24

Shaft GK
14T 12/24



Shaft CK
Parallel key 1/4"x1/4"x1" BS46

Shaft ML
Parallel key A8x7x25 DIN6885

Shaft CM
Parallel key 1/4"x1/4"x1" BS46

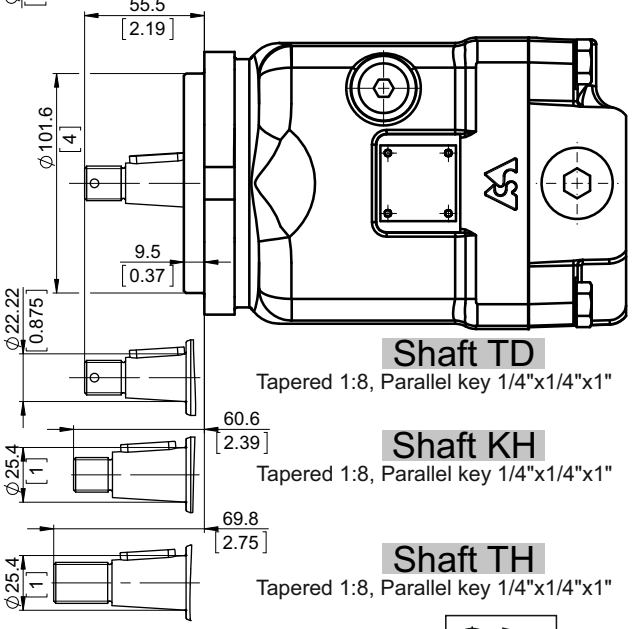
Shaft DO
Parallel key 5/16"x5/16"x1 1/4" BS46

Shaft DR
Parallel key 5/16"x5/16"x1 1/4" BS46

Shaft CQ
Parallel key A10x8x32 DIN6885

Shaft CS
Parallel key A10x8x45 DIN6885

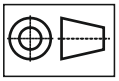
Shaft MK
Parallel key 1/4"x1/4"x1_1/2" BS46



Shaft TD
Tapered 1:8, Parallel key 1/4"x1/4"x1"

Shaft KH
Tapered 1:8, Parallel key 1/4"x1/4"x1"

Shaft TH
Tapered 1:8, Parallel key 1/4"x1/4"x1"



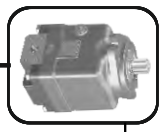
Shaft Dimensions
See Page 57÷62

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 65).

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

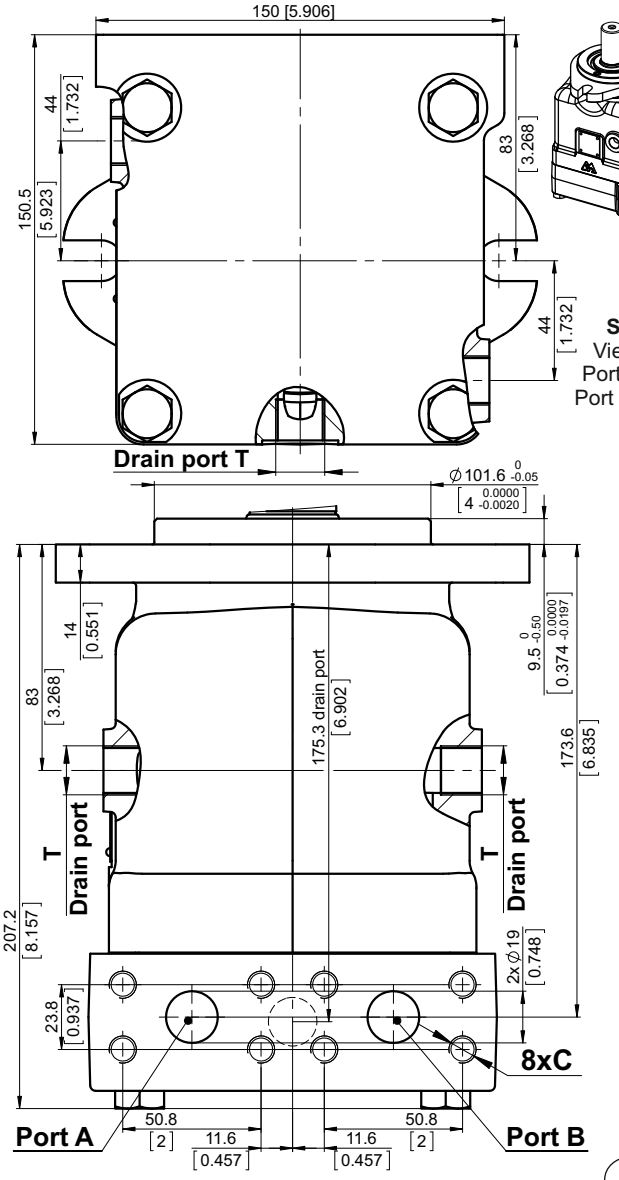


Overall Dimensions and Ports

Twin Side Ports - Type **T**

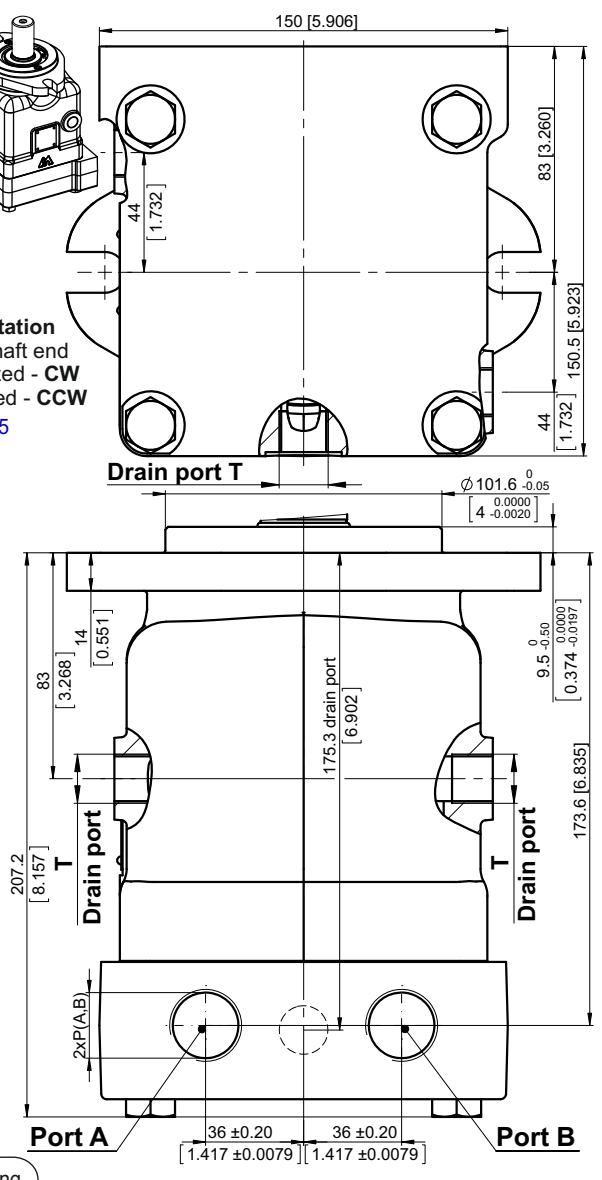
Twin side ports, port size **default** and **5**

See the port sizes at the bottom of this page



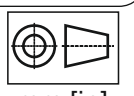
Twin side ports, port size **2**,**3**,**4**,**6**,**7** and **8**

See the port sizes at the bottom of this page

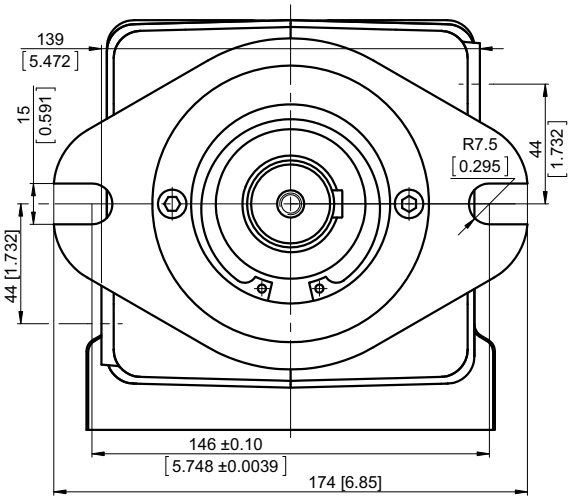


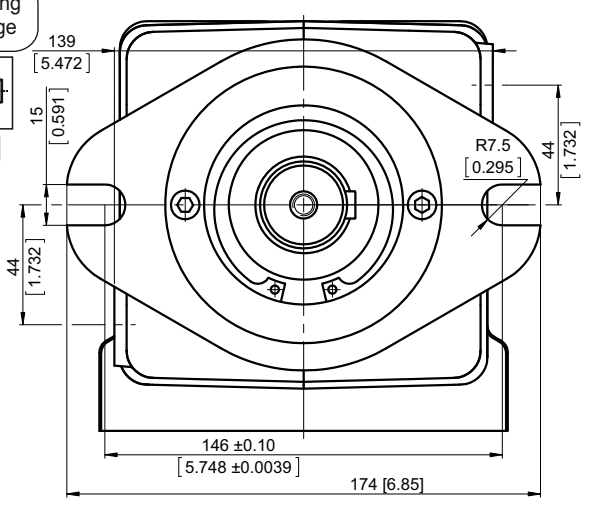
Standard Rotation
Viewed from shaft end
Port **A** Pressurized - **CW**
Port **B** Pressurized - **CCW**
see page 65

Shaft Mounting
see next page



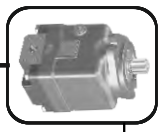
mm [in]



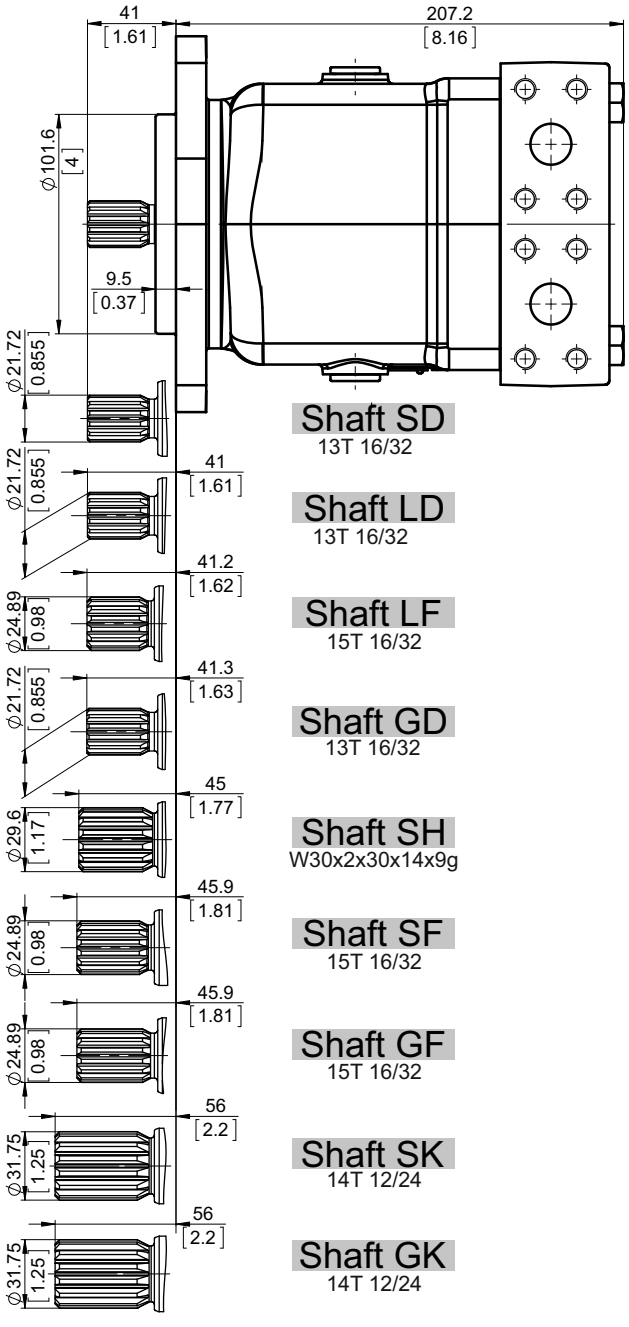


	Port Size		
	default	5	9
$P_{(A,B)}$	2xISO 6162-2 DN19	2xSAE J518 3/4 PSI6000	2xISO 6162-2 DN19
T	M18x1,5	7/8-14 UNF-2B	G1/2
C	M10-6H	3/8-16 UNC-2B	M10-6H

	Port Size					
	2	3	4	6	7	8
$P_{(A,B)}$	2xG 3/4	2xM27x2	2x1 1/16-12UN	2xG 1/2	2xM22x1,5	2x 7/8-14UNF
T	G 1/2	M18x1,5	7/8 -14UNF	G 1/2	M18x1,5	3/4 -16UNF



Shafts Mounting
Twin Side Ports - Type **T**



Shaft SD
13T 16/32

Shaft LD
13T 16/32

Shaft LF
15T 16/32

Shaft GD
13T 16/32

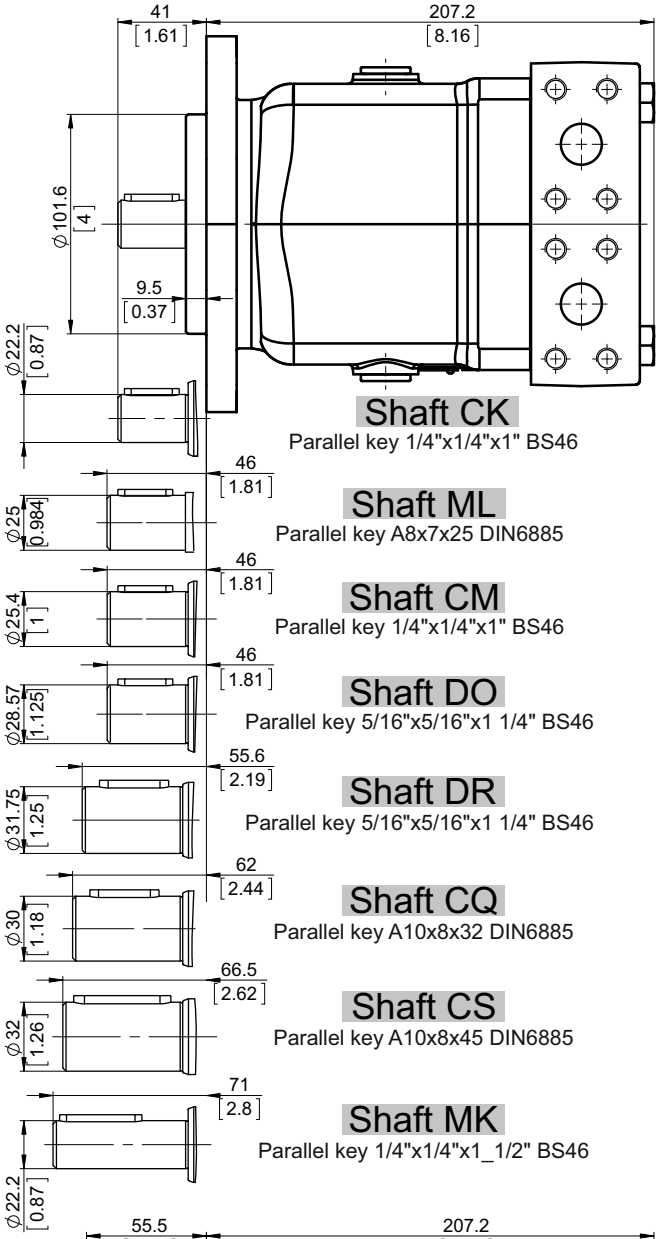
Shaft SH
W30x2x30x14x9g

Shaft SF
15T 16/32

Shaft GF
15T 16/32

Shaft SK
14T 12/24

Shaft GK
14T 12/24



Shaft CK
Parallel key 1/4"x1/4"x1" BS46

Shaft ML
Parallel key A8x7x25 DIN6885

Shaft CM
Parallel key 1/4"x1/4"x1" BS46

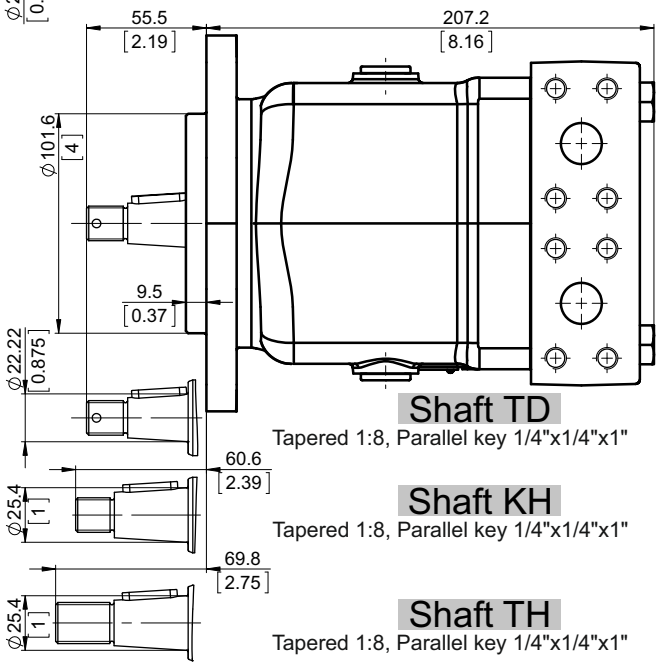
Shaft DO
Parallel key 5/16"x5/16"x1 1/4" BS46

Shaft DR
Parallel key 5/16"x5/16"x1 1/4" BS46

Shaft CQ
Parallel key A10x8x32 DIN6885

Shaft CS
Parallel key A10x8x45 DIN6885

Shaft MK
Parallel key 1/4"x1/4"x1_1/2" BS46



Shaft TD
Tapered 1:8, Parallel key 1/4"x1/4"x1"

Shaft KH
Tapered 1:8, Parallel key 1/4"x1/4"x1"

Shaft TH
Tapered 1:8, Parallel key 1/4"x1/4"x1"

Shaft Dimensions
See Page 57÷62

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 65).

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 mm [4“] - BC 146 mm [5.75”]

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 cm.^{3}/rev. [2.21 in.^{3}/rev.]
40 - 41.59 cm.^{3}/rev. [2.54 in.^{3}/rev.]
46 - 47.13 cm.^{3}/rev. [2.88 in.^{3}/rev.]
50 - 49.94 cm.^{3}/rev. [3.05 in.^{3}/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-2B thread
LD - ø21,72 [0.855"] Spline SAE 13T 16/32 DP, 1/4-20 UNC-2B thread
SF - ø24.9 [0.98"] Spline SAE 15T 16/32, M8-6H
GF - ø24,9 [0.98"] Spline SAE 15T 16/32, 3/8-16UNC-2B
LF - ø24,9 [0.98"] Spline SAE 15T 16/32 DP, 1/4-20UNC-2B thread
SH - ø29.6 [1,165"] Spline W30x2x30x14x9g,M10-6H
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-2B thread
CK - ø22.2 [ø7/8“] Straight, M8-6H thread Parallel key 1/4"x1/4"x1" BS46
MK - ø22.2 [ø7/8“] Straight, M8-6H thread Parallel key 1/4"x1/4"x1_1/2" BS46
ML - ø25 [ø0.984“] Straight, M8-6H thread Parallel key A8x7x25 DIN6885
CM - ø25.4 [ø1“] Straight, M8-6H thread Parallel key 1/4"x1/4"x1" BS46
DO - ø28.75 [ø1.125“] Straight, 3/8-16UNC-2B Parallel key 5/16"x5/16"x1_1/4" BS46
CQ - ø30 [ø1.181“] Straight, M8-6H, key Parallel key A8x7x32 DIN6885
DR - ø31.75 [ø1.25“] Straight, 3/8-16UNC-2B Parallel key 5/16"x5/16"x1_1/4" BS46
CS - ø32 [ø1.26“] Straight, M8-6H 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-2A
TH - ø25.4 [1"] Tapered 1:8 [125:1000], Parallel key 1/4"x1/4"x1", 3/4-16 UNF-2A
KH - ø25.4 [1"] Tapered 1:8 [125:1000], Parallel key 1/4"x1/4"x1", M16x1.5

Pos.5 - Port Size

omit - 2xISO 6162-2 DN19, drain port M18x1,5
2 - 2xG3/4, drain ports G1/2
3 - 2xM27x2, drain ports M18x1,5-6H
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 M18x1,5-6H
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 next page for information about valves
omit - None
HR - Single anti-cavitation valve
AR - Dual anti-cavitation valve
PU - Purge valve
FLU - Flush valve
SAR - Single anti-cavitation and relief valve
DAR - Dual anti-cavitation and relief valve
DARP - Dual anti-cavitation, relief and purge valve
DARF - Dual anti-cavitation, relief and flush valve
Option DAR,DARF,DARP,SAR, AR and HR are not available for Pos.2 option E

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 - For value - see next page

Pos.10 - Flow Setting of Integrated Valves

omit - None
Lx - For value - see next page

Pos.11 - Special Features*

omit - None
R2S - Speed Sensor Two Directional (see page 63)
R - Reverse Rotation (see page 65)

Pos.12 - Paint and Coating

omit - No paint or coating
P - Painted
PC - Corrosion protected paint
PS - Special painted ***
PCS - Special 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

*Available on enquiry
**The permissible output torque for shafts must not be exceeded!
***Non painted feeding surface

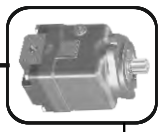
We remain open to meet your special requirements upon request.

EXAMPLE

M A P B E 4 0 G D 4 P

MAP	B	E	40	GD	4						P	[		]

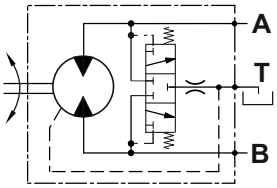
Flange B | Rear Ports | Disp. 40cc | Shaft GD | Port size 4 | Painted



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 (omit) - 4 ÷ 8 l/min**.
- For other options, please see Pos.10 of ordering code, considering the following possible values:

Pos.10	omit	L3.5	L5.5	⇨ flow rate

EXAMPLE

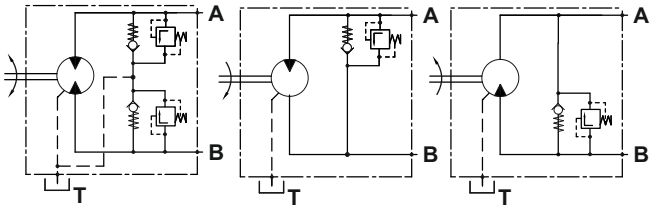
M A P B 4 6 S H 2 **P U** purge valve flow rate 6±2 l/min
M A P B 4 6 S H 2 **P U L 3 . 5** purge valve flow rate 3.5±1 l/min
M A P B 4 6 S H 2 **P U L 5 . 5** purge valve flow rate 5.5±1 l/min

Option **DAR, SARA, SARB**
Combined Anti-Cavitation and Reliev 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.

DAR SARA SARB



Please, consider the following possible values:

Pos.9	250	300	350	⇨ pressure

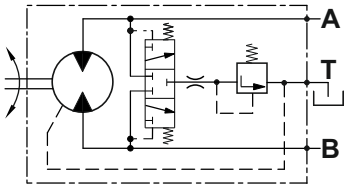
EXAMPLE

M A P B 4 6 S H 2 **D A R 3 5 0**
Double Anti-Cavitation and Relief Valve, relief valve setting 350 bar

M A P B 4 6 S H 2 **S A R A 2 5 0**
Single Anti-Cavitation and Relief Valve, relief valve setting 250 bar
The valve is placed on port A

M A P B 4 6 S H 2 **S A R B 3 0 0**
Single Anti-Cavitation and ReliefValve, relief valve setting 300 bar
The valve is placed on port B

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 (omit) - 4 ÷ 8 l/min and charge (opening) pressure 16 bar** with 20 bar feed pressure for close loop circuit;
- For other options, please see Pos.9 and Pos. 10 of ordering code, considering the following possible values:

Pos.9	omit	10	⇨ pressure
Pos.10	omit	L3.5	L5.5 ⇨ flow rate

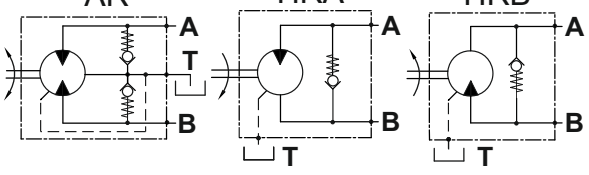
EXAMPLE

M A P B 4 6 S H 2 **F L U** flow rate 6±2 l/min, charge pressure 16 bar
M A P B 4 6 S H 2 **F L U 1 0 L 5 . 5** flow rate 5.5±1 l/min, charge pressure 10 bar
M A P B 4 6 S H 2 **F L U L 3 . 5** flow rate 3.5±1 l/min, charge pressure 16 bar

Option **AR, HRA, HRB**
Anti-Cavitation Valve

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

AR HRA HRB

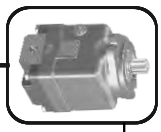


EXAMPLE

M A P B 4 6 S H 2 **A R**
Double Anti-Cavitation Valve

M A P B 4 6 S H 2 **H R A**
Single Anti-Cavitation Valve, the valve is placed on port A

M A P B 4 6 S H 2 **H R B**
Single Anti-Cavitation Valve, the valve is placed on port B

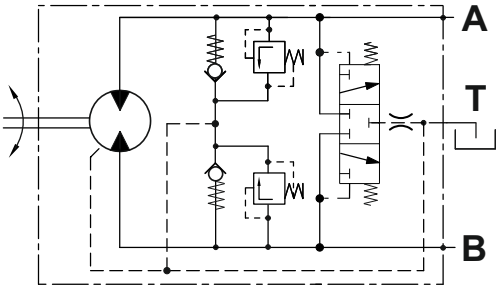


Valve Options

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-cavitaion, 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:

Pos.9 | **250** | **300** | **350** ⇒ pressure

- Flow rate of purge valve by **default (omit) - 4 ÷ 8 l/min.** The possible values are as follow:

Pos.10 | **omit** | **L3.5** | **L5.5** ⇒ flow rate

EXAMPLE

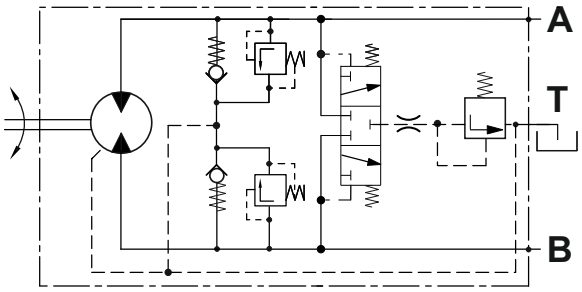
M A P B 4 6 S H 2 **D A R P 3 5 0**
Double Anti-Cavitation, Relief and Purge Valve,
relief valve setting 350 bar, purge valve flow rate 6±2 l/min

M A P B 4 6 S H 2 **D A R P 2 5 0 L 3 . 5**
Double Anti-Cavitation, Relief and Purge Valve,
relief valve setting is 250 bar, purge valve flow rate 3.5±1 l/min

M A P B 4 6 S H 2 **D A R P 3 0 0 L 5 . 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-cavitaion, 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:

Pos.9 | **250** | **300** | **350** ⇒ pressure

- Flow rate of flush valve by **default (omit) - 4 ÷ 8 l/min and charge pressure 16 bar** with 20 bar feed pressure for close loop circuit. The possible values are as follow:

Pos.10 | **omit** | **L3.5** | **L5.5** ⇒ flow rate

- Other values for charge pressure are possible. Please see Pos.9.
Example: For charge pressure 10 bar the options are as follow:

Pos.9 | 250-**10** | 300-**10** | 350-**10**

Relief valve opening pressure

Flush valve opening pressure (charge pressure)

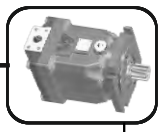
EXAMPLE

M A P B 4 6 S H 2 **D A R F 3 5 0**
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

M A P B 4 6 S H 2 **D A R F 3 5 0 - 1 0**
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

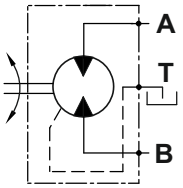
M A P B 5 0 S H 2 **D A R F 2 5 0 L 3 . 5**
Double Anti-Cavitation, Relief and Flush Valve, relief valve setting 250 bar
flush valve charge pressure 16 bar, flush valve flow rate is 3.5±1 l/min

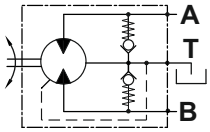
M A P B 4 6 S H 2 **D A R F 3 0 0 - 1 0 L 5 . 5**
Double Anti-Cavitation, Relief and Flush Valve, relief valve setting 300 bar
flush valve charge pressure 10 bar, flush valve flow rate 5.5±1 l/min

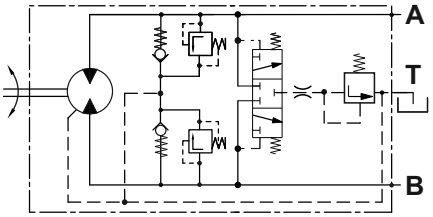


Hydraulic Motors Type MAP100

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

- » Swash plate
- » Flange options
- » Port options
- » Shaft options
- » High pressure ports
- » Integrated valves

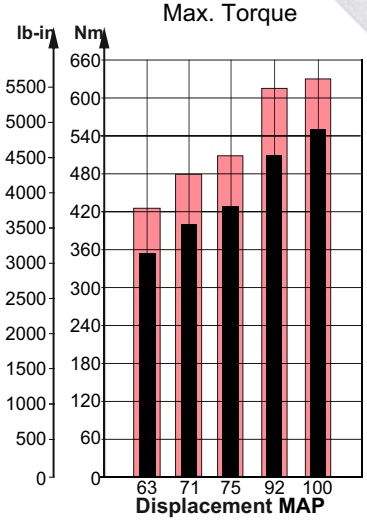
ADVANTAGES

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

GENERAL

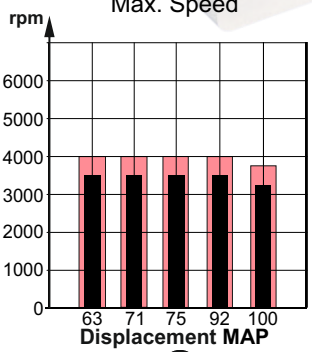
Displacement,	cm^3/rev [in^3/rev]	**63.58÷98.75 [3.88÷6.03]**
Max. Speed,	RPM	**3500**
Max. Torque,	Nm [lb-in]	**550 [4870]**
Max. Output,	kW [HP]	**130 [174]**
Max. Pressure Drop,	bar [PSI]	**350 [5080]**
Max. Oil Flow,	l/min [GPM]	**326 [86.1]**
Min. Speed,	RPM	**500**
Fluid		**Mineral based- HLP(DIN 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)**

Max. Torque

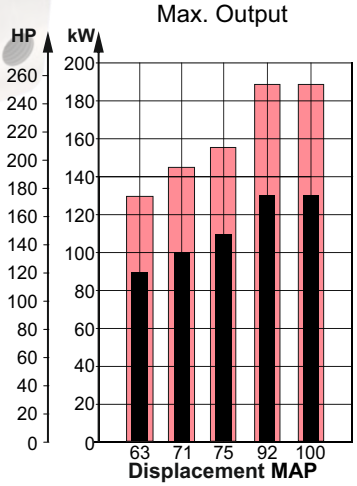


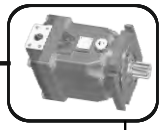
Intermittent values Continuous values

Max. Speed

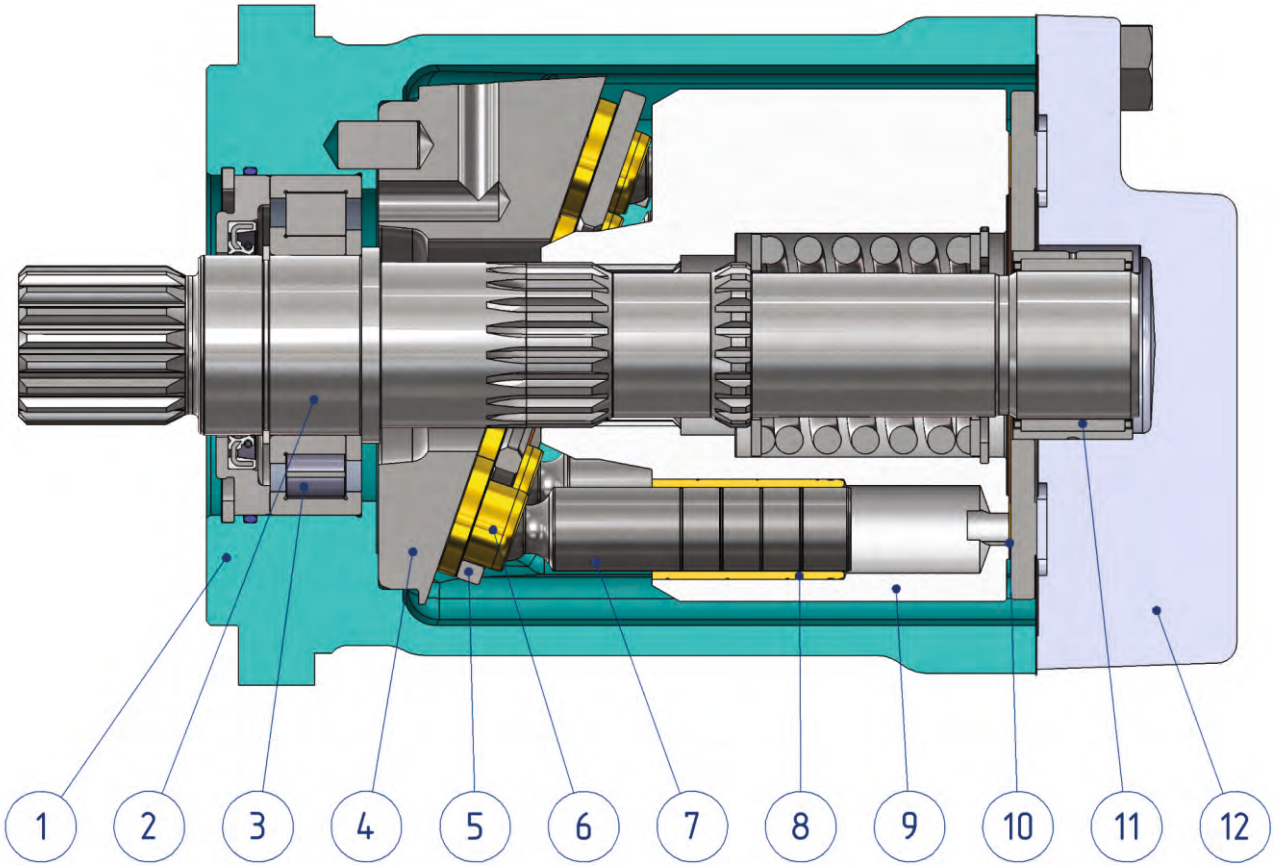


Max. Output



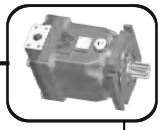


SECTION VIEW



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

The heavy duty design of MAP motor gains big advantage over the typical swash plate motors. The starting torque is close to the starting torque of the bent axis motors and the total efficiency of our design in normal working modes is similar to the bent axis motors. The main advantage of our design over the bent axis motors is that the pulsations and vibrations during the operation are much less. Another advantage is that the swash plate motors are more reliable than the bent axis motors.



SPECIFICATION DATA

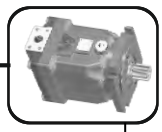
Type		MAP 63	MAP 71	MAP 75	MAP 92	MAP 100
Displacement, cm.^{3}/rev. [in.^{3}/rev.]		63.58 [3.88]	71.5 [4.36]	76.84 [4.69]	93.18 [5.69]	98.75 [6.03]
Max. Speed, [RPM]	Cont.	3500	3500	3500	3500	3240
	Int.*	4000	4000	4000	4000	3750
Max. Torque,*** Nm [lb-in]	Cont.	354 [3133]	398 [3523]	428 [3788]	514 [4549]	550 [4870]
	Int.**	425 [3762]	478 [4230]	514 [4549]	616 [5452]	645 [5710]
Output, kW [HP]	Cont.	89 [120]	100 [134]	108 [145]	130 [174]	130 [174]
	Int.**	129 [173]	145 [195]	156 [209]	188 [252]	188 [252]
Max. Pressure, bar [PSI]	Cont.	350 [5080]	350 [5080]	350 [5080]	350 [5080]	350 [5080]
	Int.**	420 [6100]	420 [6100]	420 [6100]	420 [6100]	410 [5950]
	Peak	450 [6527]	450 [6527]	450 [6527]	450 [6527]	450 [6527]
Max. Oil Flow, l/min [GPM]	Cont.	223 [58.9]	250 [66]	269 [71.1]	326 [86.1]	320 [84.5]
	Int.*	255 [67.4]	286 [75.6]	308 [81.4]	373 [98.5]	370 [97.7]
Torque Constant ***** Nm/bar [lb-in/PSI]		0.91 [0.56]	1.03 [0.63]	1.1 [0.67]	1.32 [0.81]	1.42 [0.87]
Speed Constants ***** RPM/(l/min) [RPM/GPM]		14.94 [56.56]	13.3 [50.3]	12.36 [46.8]	10.2 [38.6]	9.62 [36.42]
Permissible Shaft Load max Axial**** N[lb]		Fa=2500 [562]				
max Radial**** N[lb]		Fr=4500 [1010]				
Min. Speed, [RPM]		500				
Max. Pressure in Drain Line, bar [PSI]		5 [70] open drain line is always required				
Weight, kg [lb]		32.5 [71.7]				

Peak pressure is 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 η_v=0.95 and η_{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 68.
5. Recommended maximum system operating temperature - 82°C [180°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**

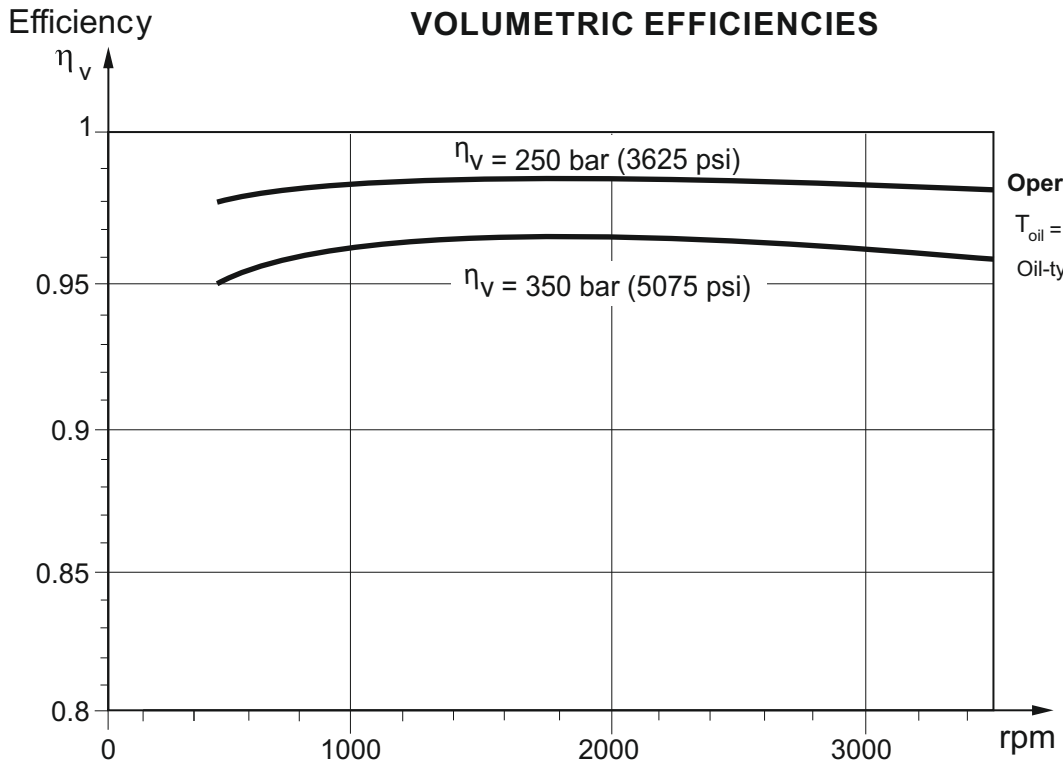
The constant values are mentioned for rough calculations. Motor torque and rotation speed for a particular project are depending on the real operating conditions. For more detail calculations please see efficiencies on next page and formulas on page 69.



FUNCTION DIAGRAMS

The below efficiencies are applied for all displacements.

VOLUMETRIC EFFICIENCIES

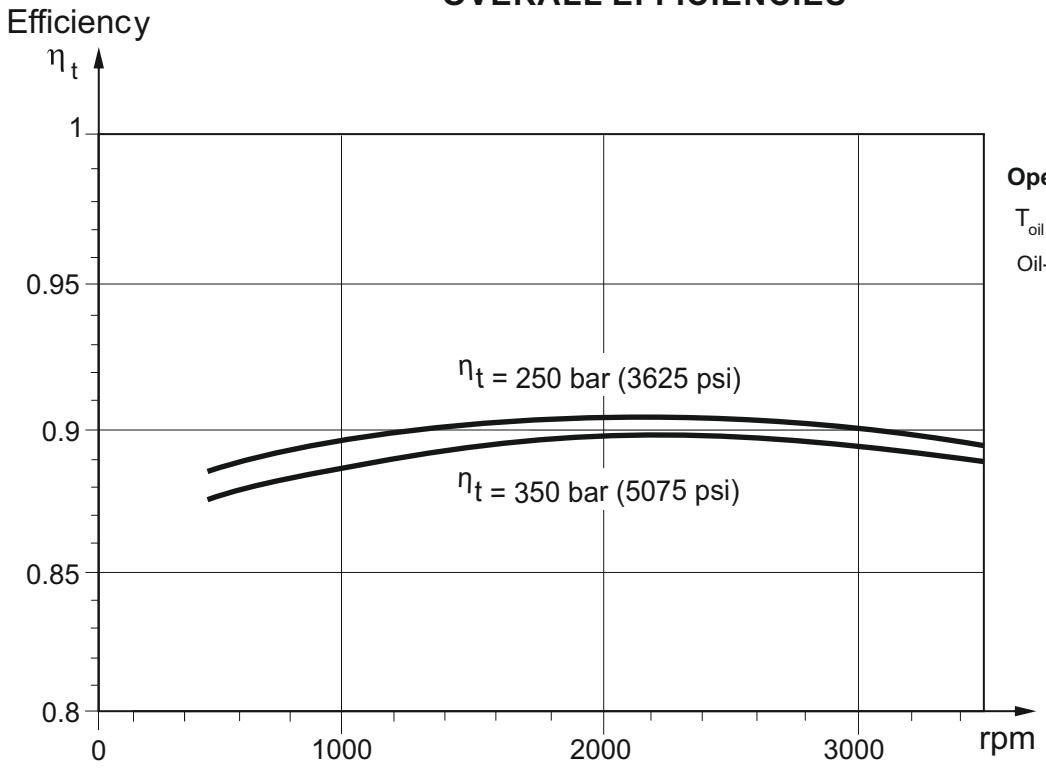


Operation conditions:

T_{oil} = 50°C [122 F]

Oil-type: HPL 46

OVERALL EFFICIENCIES



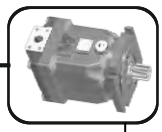
Operation conditions:

T_{oil} = 50°C [122 F]

Oil-type: HPL 46

The motor size, pressure, torque, speed of rotation and flow rate required for a specific application can be calculated using the formulas on page 69

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

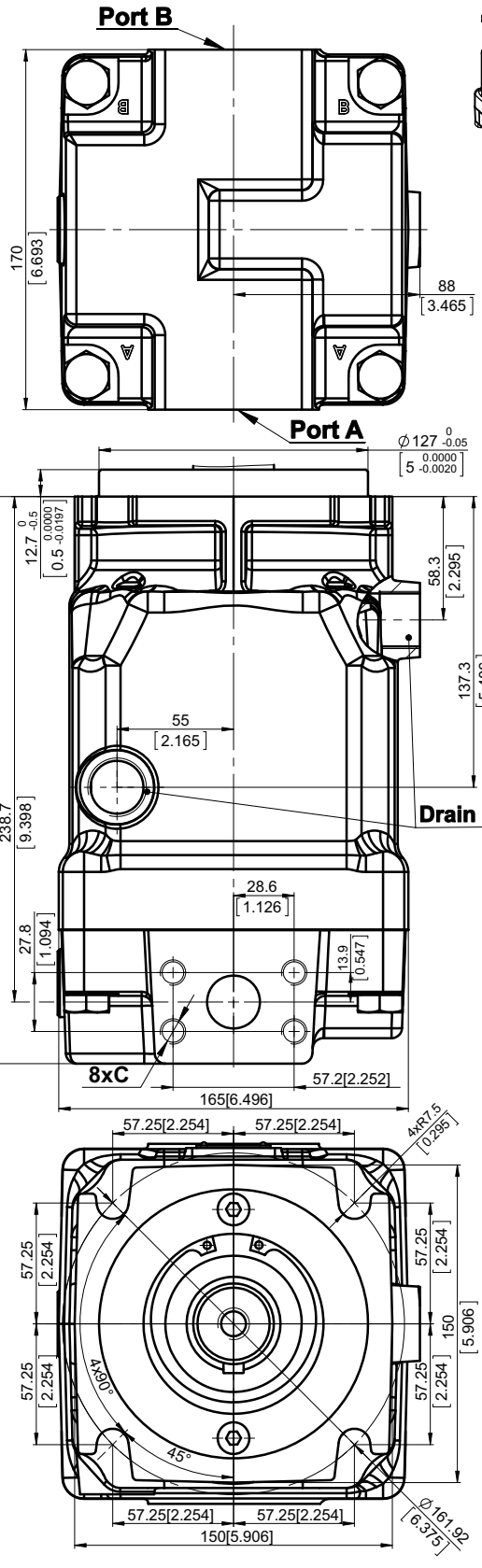


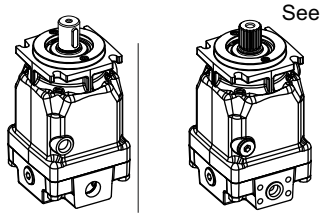
Overall Dimensions and Ports

Side Ports - **Default** Mounting Flange - Type **SAE-4C**

Side ports, port size **default** and **5**

See the port sizes at the bottom of this page

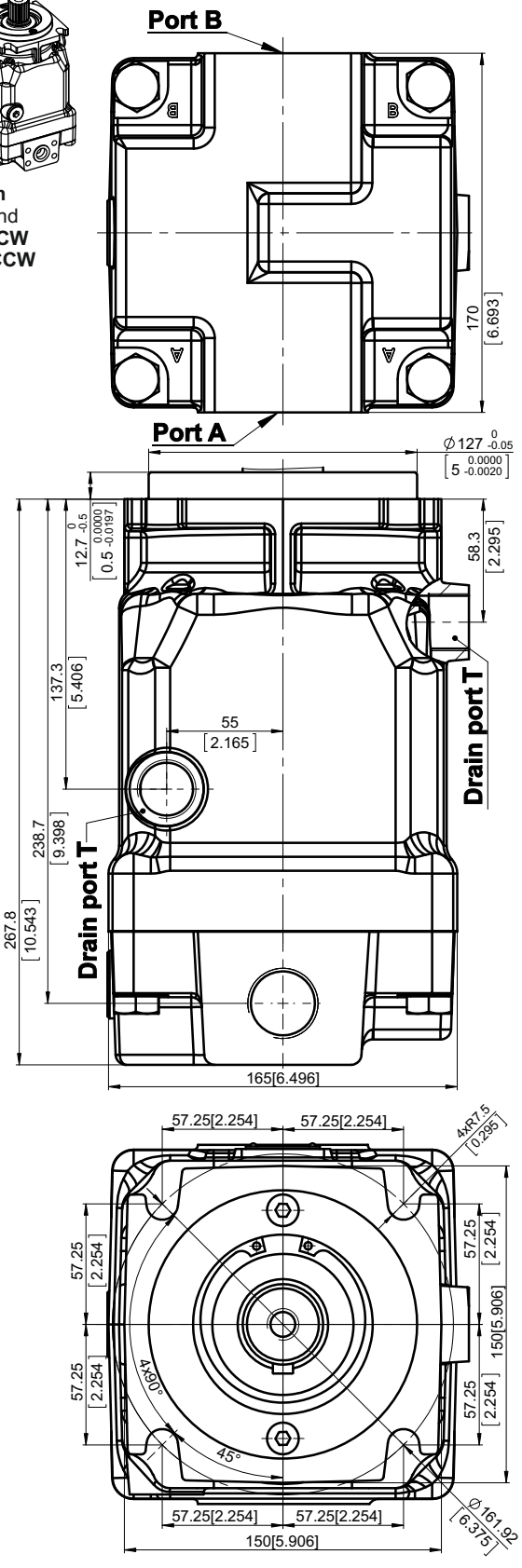




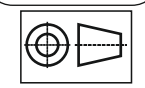
Standard Rotation
Viewed from shaft end
Port **A** Pressurized - **CW**
Port **B** Pressurized - **CCW**
see page 65

Side ports, port size **2** and **4**

See the port sizes at the bottom of this page



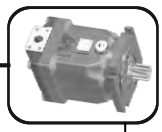
Shaft Mounting
see page 40



mm [in]

	Port Size		
	default	5	9
$P_{(A,B)}$	2xISO 6162-2 DN25	2xSAE J518 1" PSI6000	2xISO 6162-2 DN25
T	M27x2-6H	1 1/16-12 UN	G 3/4
C	M12-6H	7/16-14 UNC-2B	M12-6H

	Port Size	
	2	4
$P_{(A,B)}$	2xG 1	2x1 5/16-12UN
T	G 3/4	1 1/16-12UN

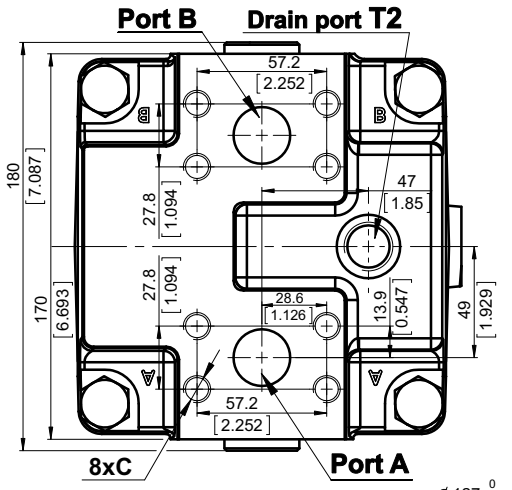


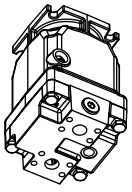
Overall Dimensions and Ports

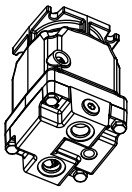
Rear Ports - Type **E** Mounting Flange - Type **SAE-4C**

Side ports, port size **default** and **5**

See the port sizes at the bottom of this page



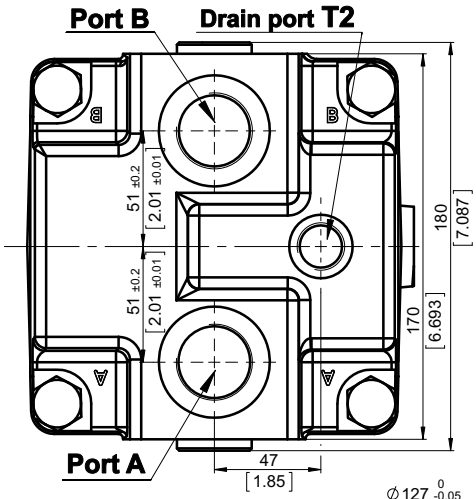


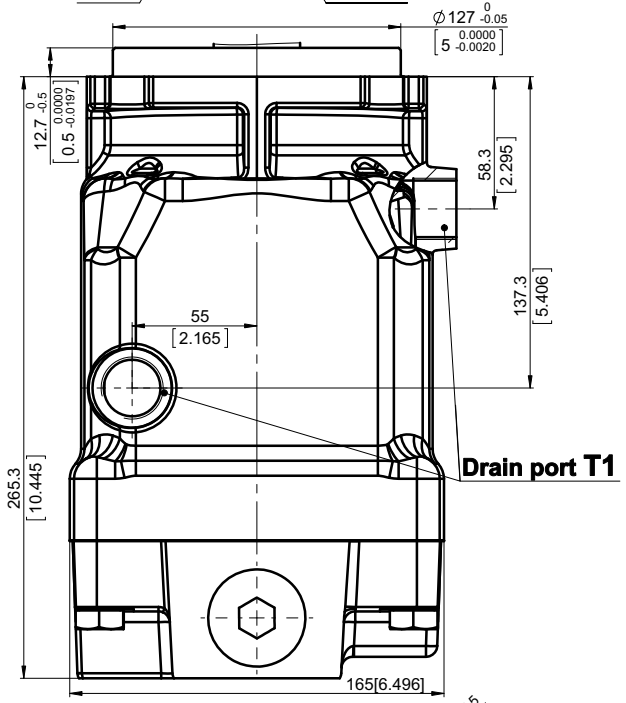


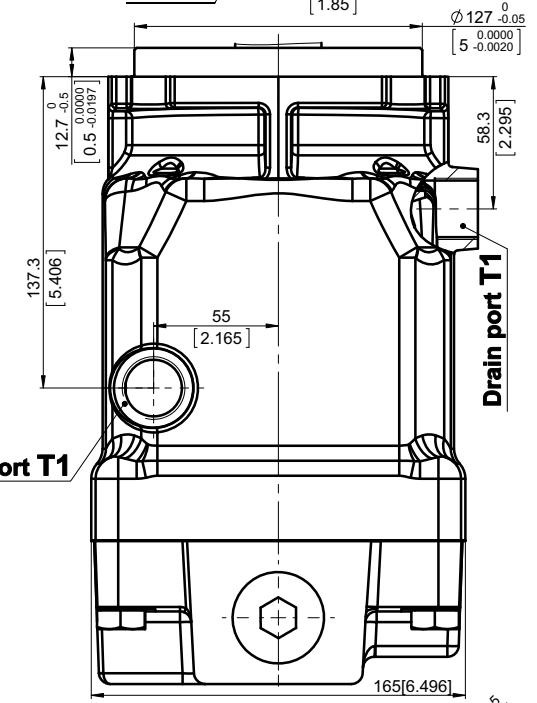
Standard Rotation
Viewed from shaft end
Port **A** Pressurized - **CW**
Port **B** Pressurized - **CCW**
see page 65

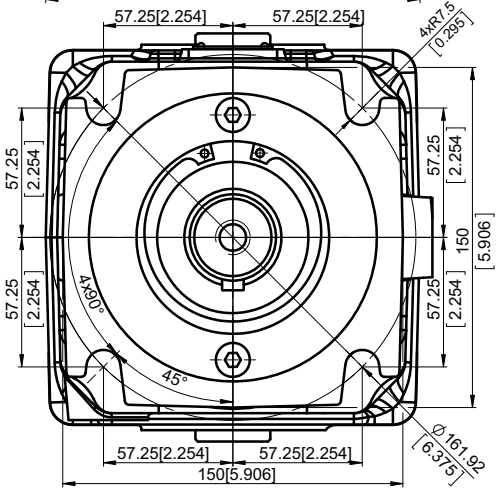
Side ports, port size **2** and **4**

See the port sizes at the bottom of this page

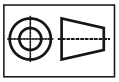




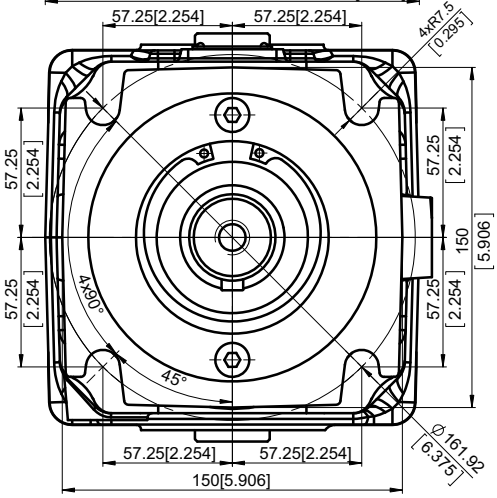




Shaft Mounting
see page 40

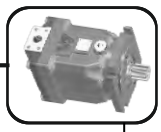


mm [in]



	Port Size		
	default	5	9
$P_{(A,B)}$	2xISO 6162-2 DN25	2xSAE J518 1" PSI6000	2xISO 6162-2 DN25
T1	M27x2-6H	1 1/16-12 UN	G 3/4
T2	M22x1.5-6H	7/8-14 UNF	G 1/2
C	M12-6H	7/16-14 UNC-2B	M12-6H

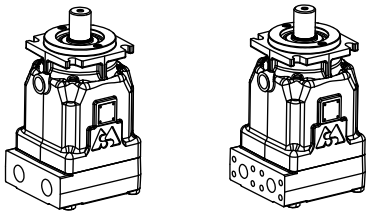
	Port Size	
	2	4
$P_{(A,B)}$	2xG 1	2x1 5/16-12UN
T1	G 3/4	1 1/16-12UN
T2	G 1/2	7/8 - 14 UNF

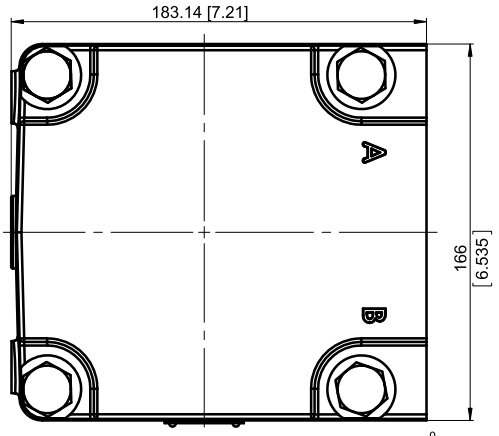


Overall Dimensions and Ports

Twin Side Ports - Type **T** Mounting Flange - Type **SAE-4C**

Standard Rotation
Viewed from shaft end
Port **A** Pressurized - **CW**
Port **B** Pressurized - **CCW**
see page 65

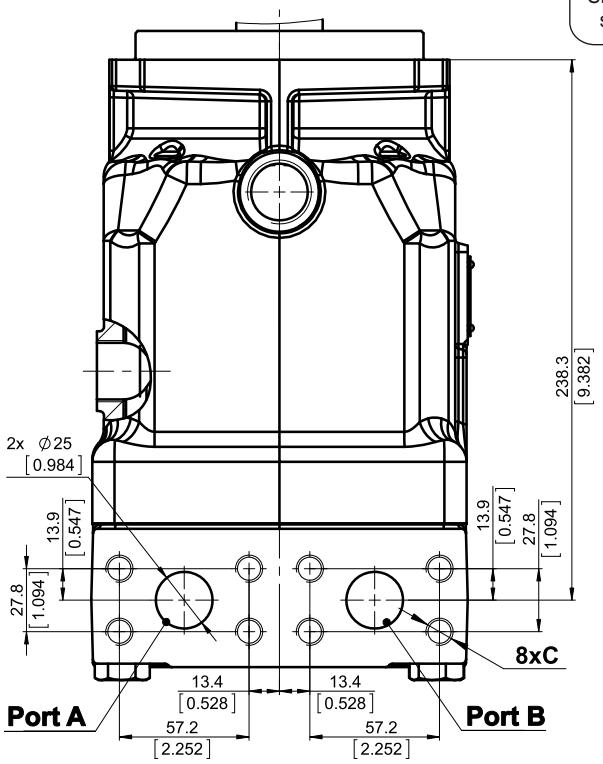


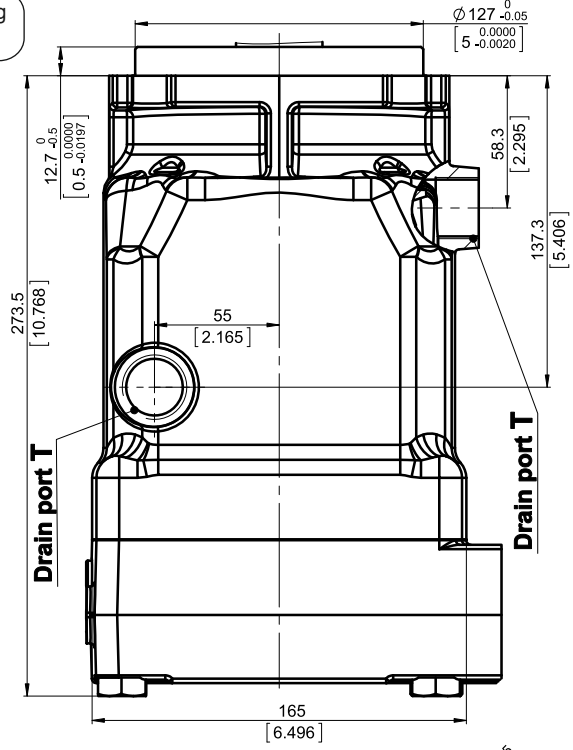


Twin side ports, port size **default** and **5**

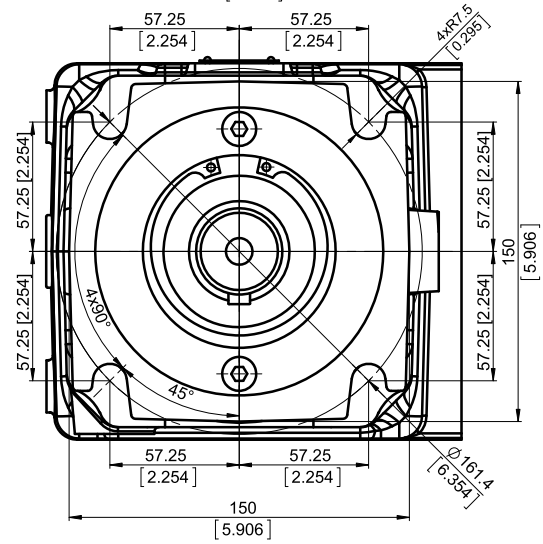
See the port sizes at the bottom of this page

Shaft Mounting
see page 40



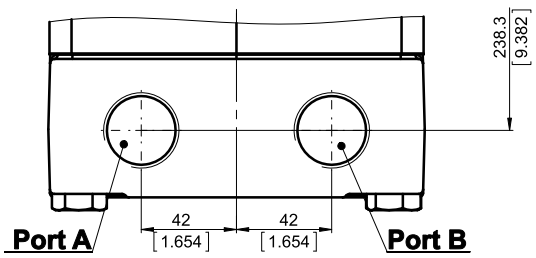


	Port Size		
	default	5	9
$P_{(A,B)}$	2xISO 6162-2 DN25	2xSAE J518 1" PSI6000	2xISO 6162-2 DN25
T	M27x2-6H	1 1/16-12 UN	G 3/4
C	M12-6H	7/16-14 UNC-2B	M12-6H



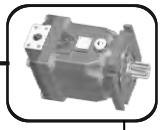
Twin side ports, port size **2** and **4**

See the port sizes at the bottom of this page

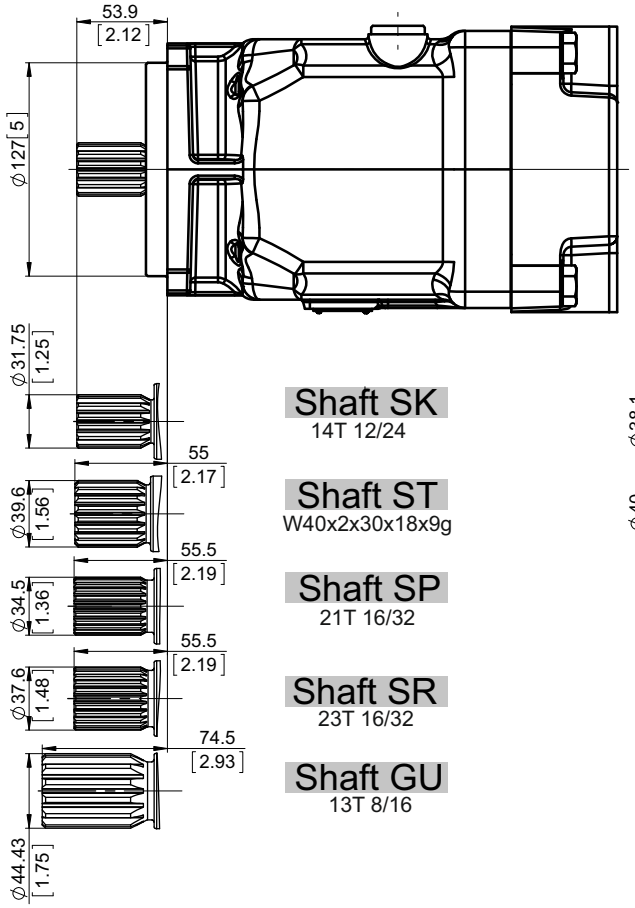


	Port Size	
	2	4
$P_{(A,B)}$	2xG 1	2x1 5/16-12UN
T	G 3/4	1 1/16-12UN

mm [in]



Shafts Mounting
Flange - Type **4C**



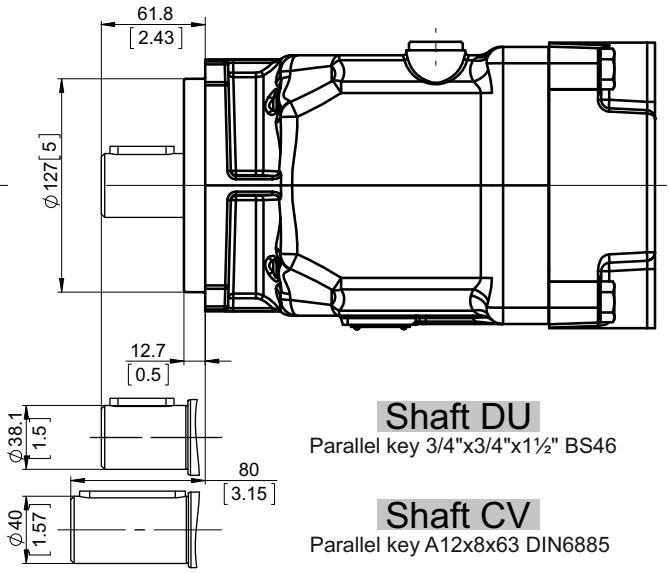
Shaft SK
14T 12/24

Shaft ST
W40x2x30x18x9g

Shaft SP
21T 16/32

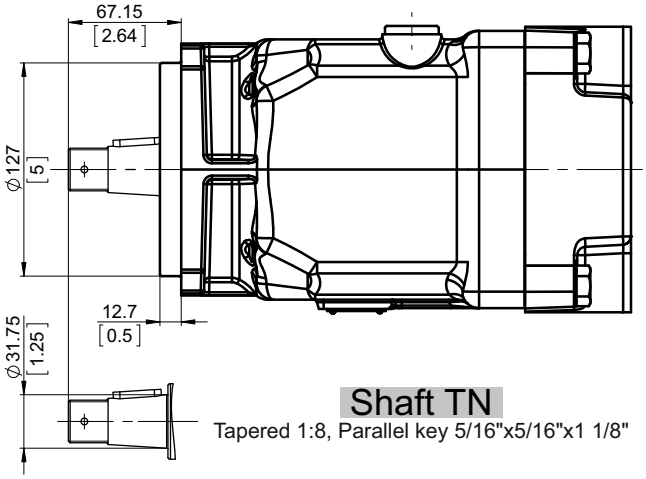
Shaft SR
23T 16/32

Shaft GU
13T 8/16



Shaft DU
Parallel key 3/4"x3/4"x1½" BS46

Shaft CV
Parallel key A12x8x63 DIN6885



Shaft TN
Tapered 1:8, Parallel key 5/16"x5/16"x1 1/8"

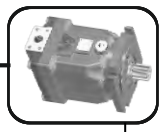
Shaft Dimensions
See Page 57÷62

PERMISSIBLE SHAFT LOAD

Permissible shaft load		
max Axial	**N[lb]**	Fa=2500 [562]
max Radial	**N[lb]**	Fr=4500 [1010]

The calculated max values are based on the optimal direction of the forces Fr, Fa and optimal position of the shaft (see page 65).

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

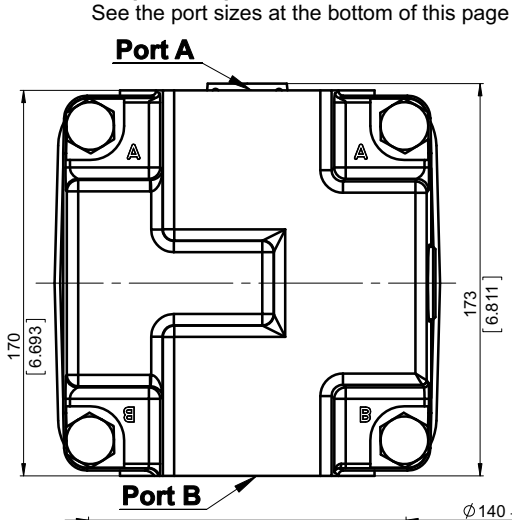


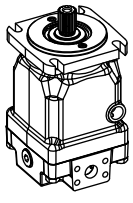
Overall Dimensions and Ports

Side Ports - **Default** Mounting Flange - Type **SAE-4M**

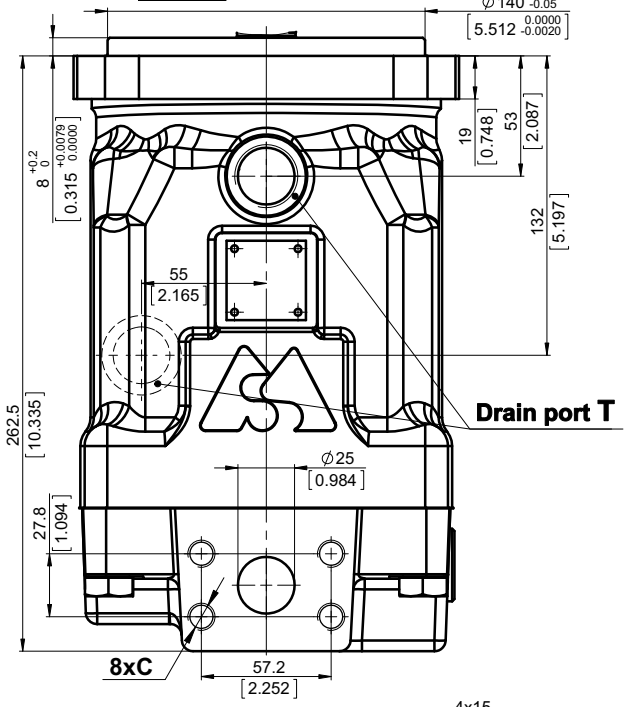
Side ports, port size **default** and **5**

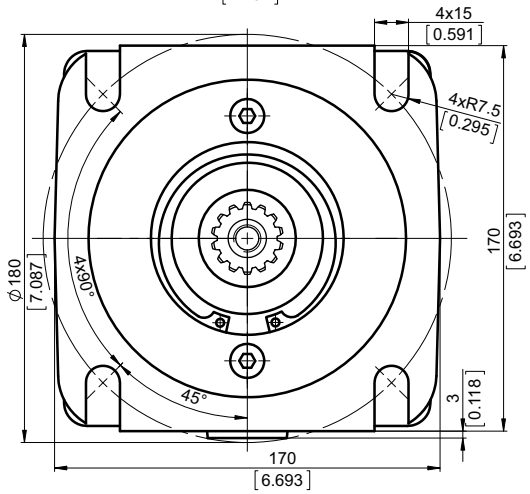
See the port sizes at the bottom of this page





Standard Rotation
Viewed from shaft end
Port **A** Pressurized - **CW**
Port **B** Pressurized - **CCW**
see page 65

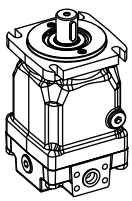


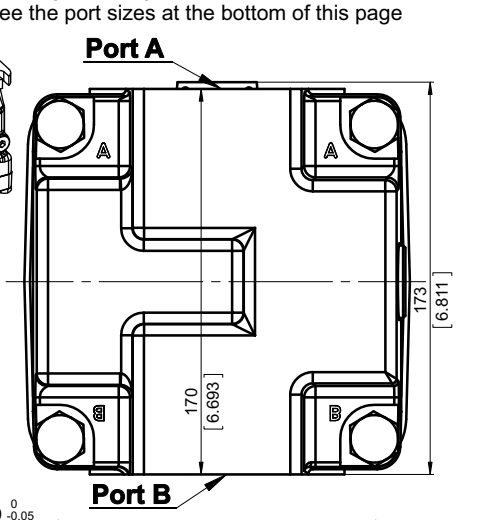


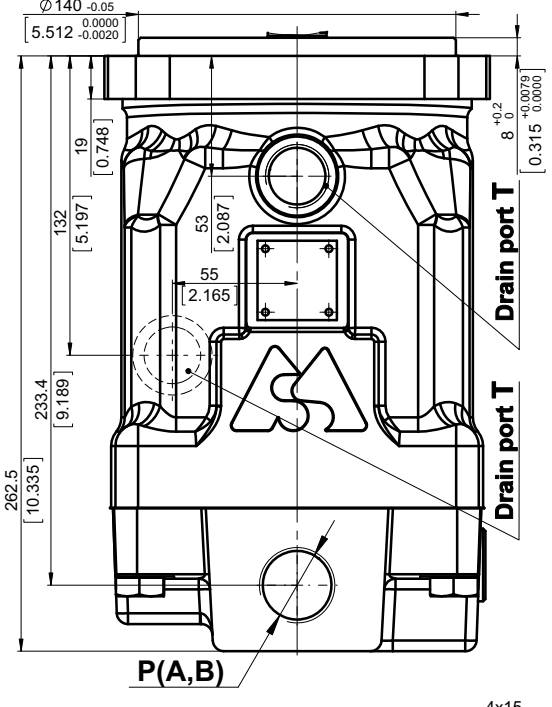
	Port Size		
	default	5	9
$P_{(A,B)}$	2xISO 6162-2 DN25	2xSAE J518 1" PSI6000	2xISO 6162-2 DN25
T	M27x2-6H	$1\frac{1}{16}$-12 UN	G 3/4
C	M12-6H	7/16-14 UNC-2B	M12-6H

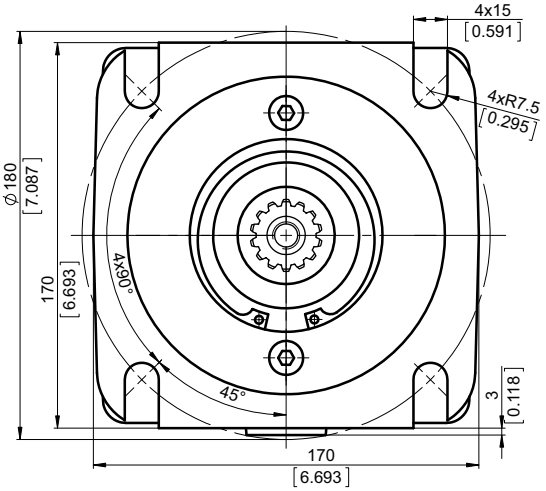
Side ports, port size **2** and **4**

See the port sizes at the bottom of this page



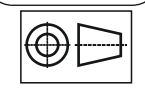




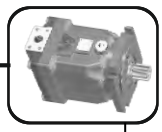


	Port Size	
	2	4
$P_{(A,B)}$	2xG 1	$2x1\frac{5}{16}$-12UN
T	G 3/4	$1\frac{1}{16}$-12UN

Shaft Mounting
see page 44



mm [in]

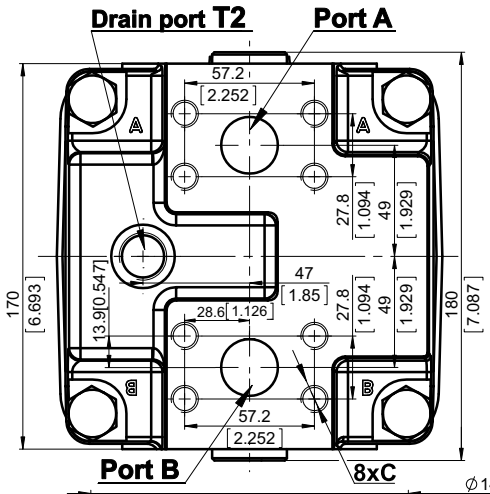


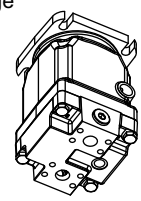
Overall Dimensions and Ports

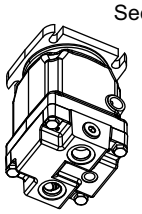
Rear Ports - Type **E** Mounting Flange - Type **SAE-4M**

Side ports, port size **default** and **5**

See the port sizes at the bottom of this page

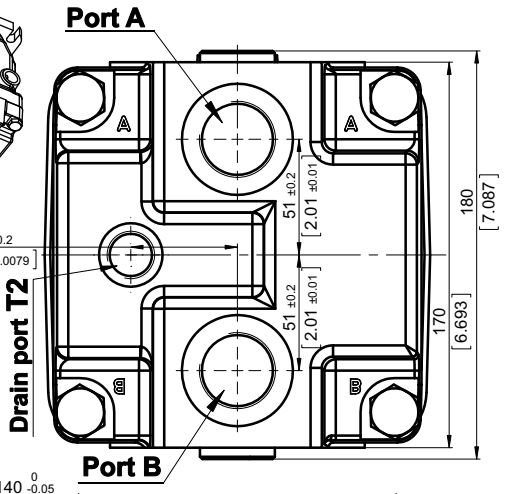




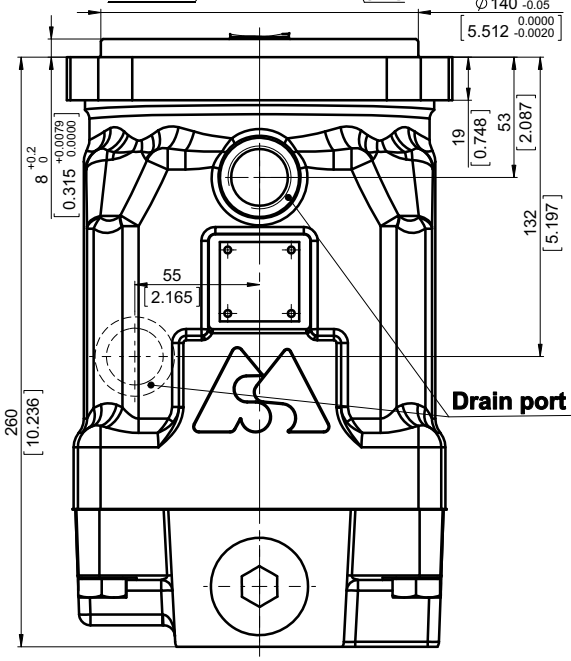


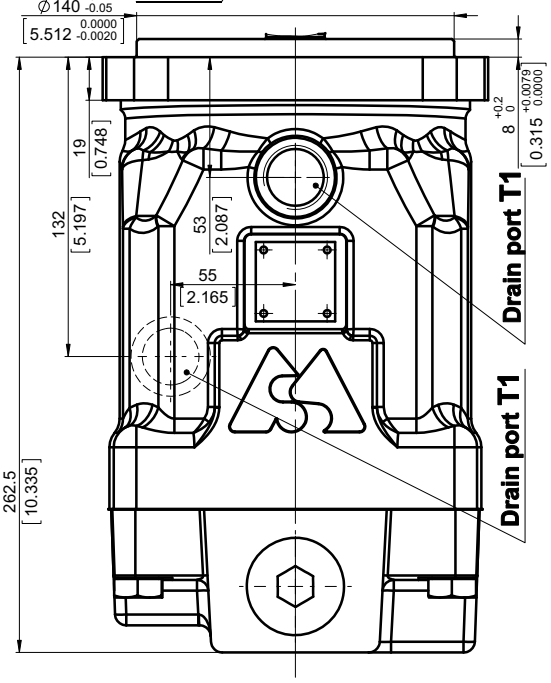
Side ports, port size **2** and **4**

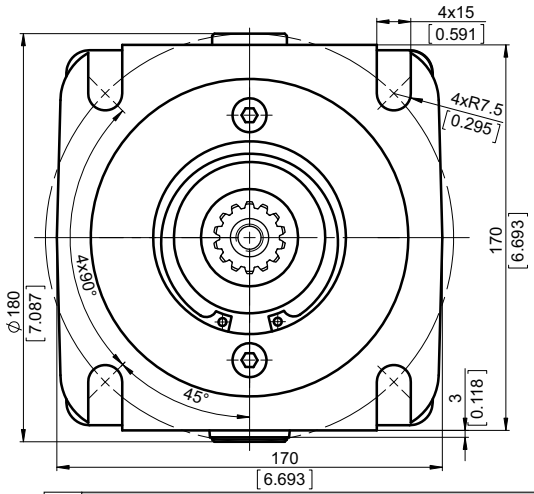
See the port sizes at the bottom of this page



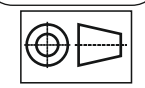
Standard Rotation
Viewed from shaft end
Port **A** Pressurized - **CW**
Port **B** Pressurized - **CCW**
see page 65



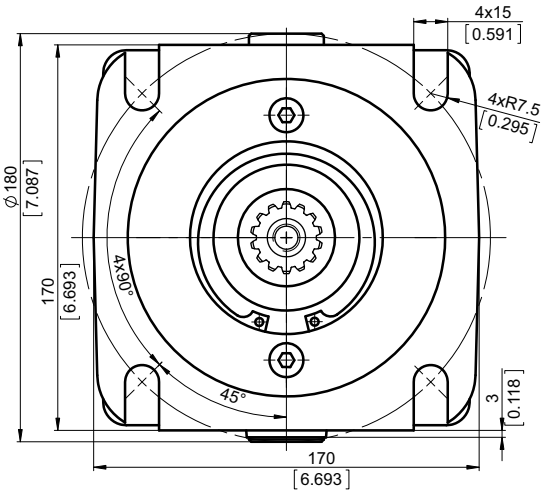




Shaft Mounting
see page 44

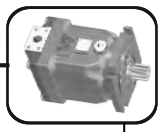


mm [in]



	Port Size		
	default	5	9
$P_{(A,B)}$	2xISO 6162-2 DN25	2xSAE J518 1" PSI6000	2xISO 6162-2 DN25
T1	M27x2-6H	1 1/16-12 UN	G 3/4
T2	M22x1.5-6H	7/8-14 UNF	G 1/2
C	M12-6H	7/16-14 UNC-2B	M12-6H

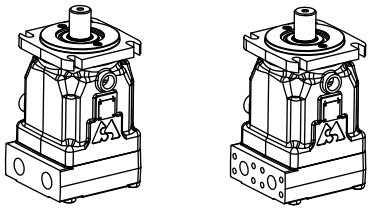
	Port Size	
	2	4
$P_{(A,B)}$	2xG 1	2x1 5/16-12UN
T1	G 3/4	1 1/16-12UN
T2	G 1/2	7/8 - 14 UNF

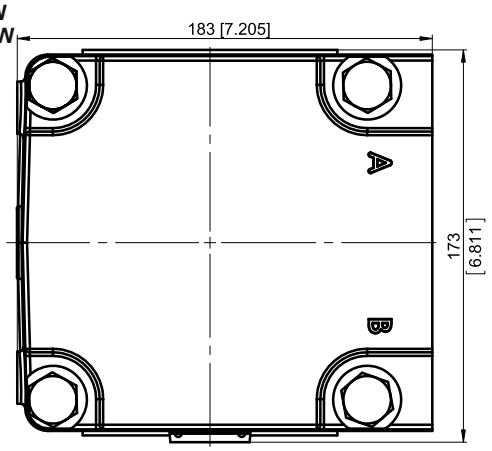


Overall Dimensions and Ports

Twin Side Ports - Type **T** Mounting Flange - Type **SAE-4M**

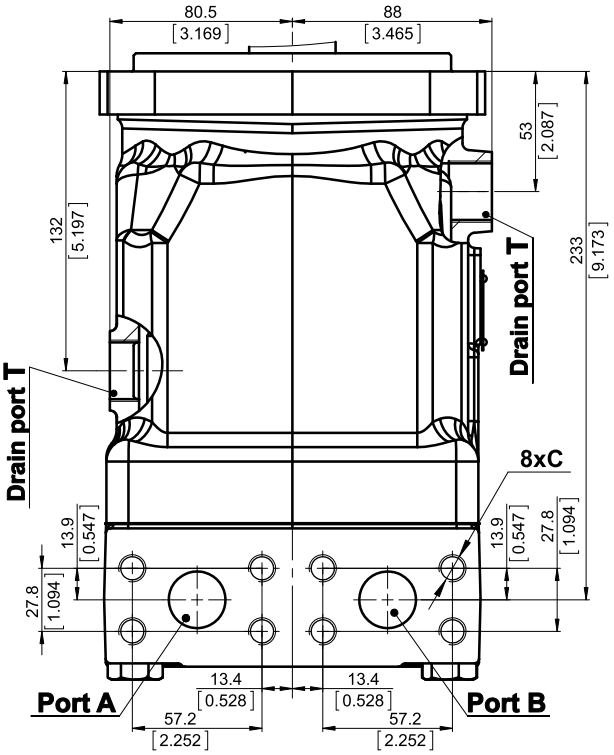
Standard Rotation
Viewed from shaft end
Port **A** Pressurized - **CW**
Port **B** Pressurized - **CCW**
see page 65

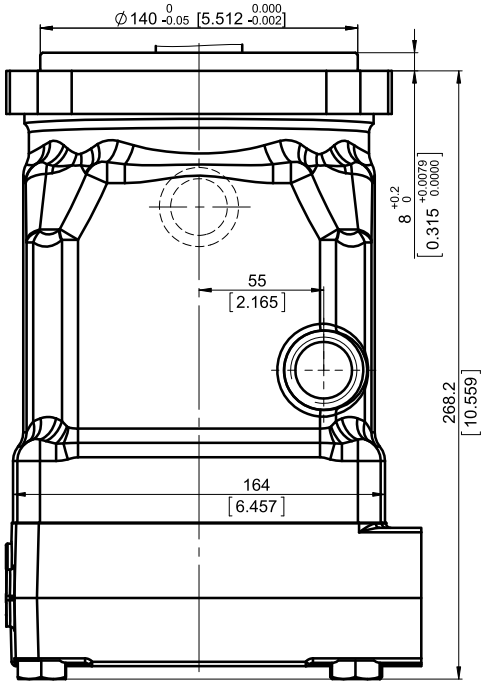




Twin side ports, port size **default** and **5**

See the port sizes at the bottom of this page

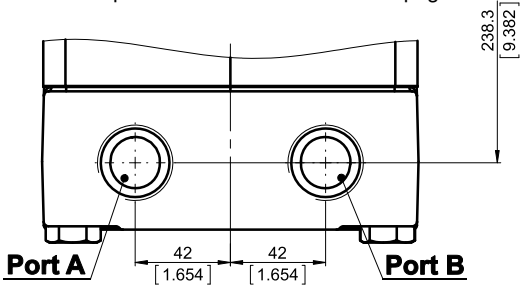




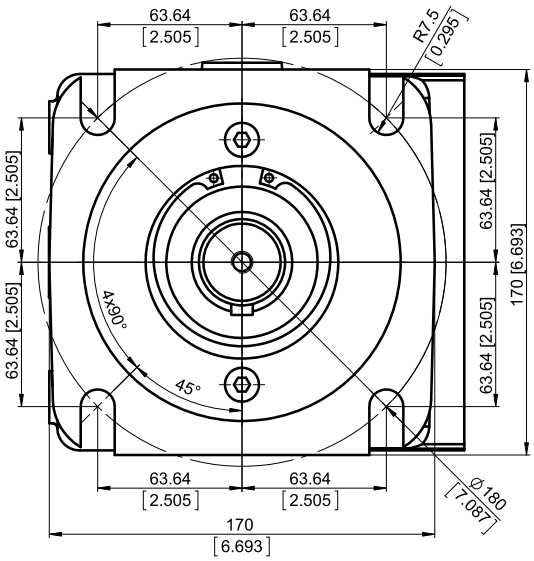
	Port Size		
	default	5	9
$P_{(A,B)}$	2xISO 6162-2 DN25	2xSAE J518 1" PSI6000	2xISO 6162-2 DN25
T	M27x2-6H	1 1/16-12 UN	G 3/4
C	M12-6H	7/16-14 UNC-2B	M12-6H

Twin side ports, port size **2** and **4**

See the port sizes at the bottom of this page

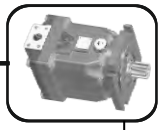


	Port Size	
	2	4
$P_{(A,B)}$	2xG 1	2x1 5/16-12UN
T	G 3/4	1 1/16-12UN

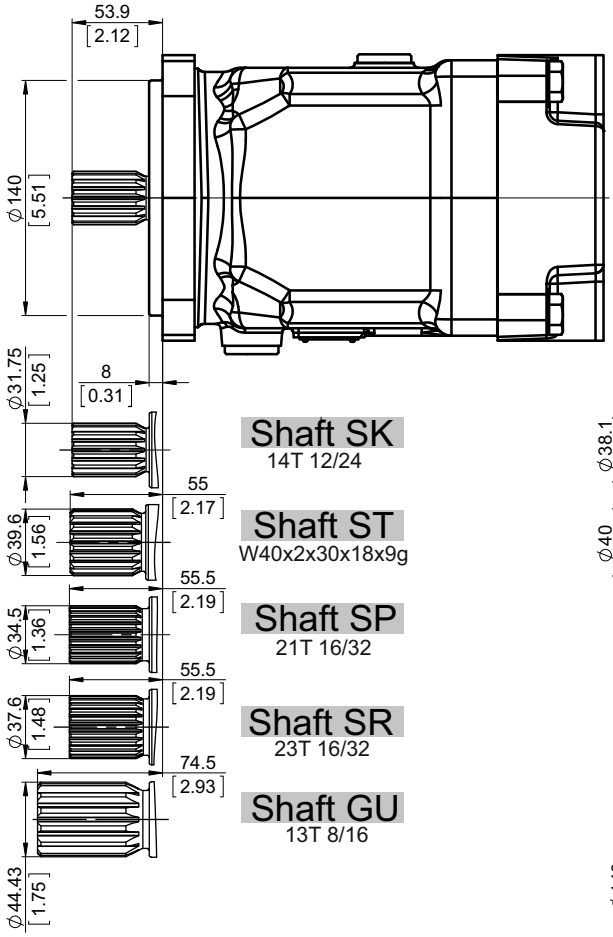


Shaft Mounting
see page 44

mm [in]



Shafts Mounting
Flange - Type **4M**



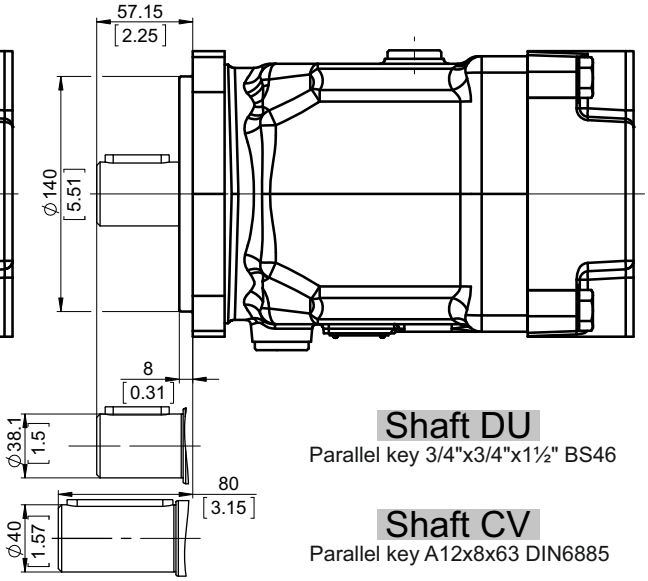
Shaft SK
14T 12/24

Shaft ST
W40x2x30x18x9g

Shaft SP
21T 16/32

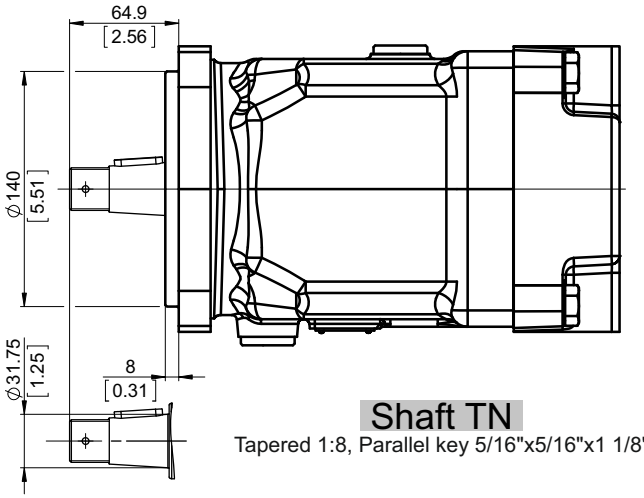
Shaft SR
23T 16/32

Shaft GU
13T 8/16



Shaft DU
Parallel key 3/4"x3/4"x1½" BS46

Shaft CV
Parallel key A12x8x63 DIN6885



Shaft TN
Tapered 1:8, Parallel key 5/16"x5/16"x1 1/8"

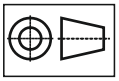
Shaft Dimensions
See Page 57÷62

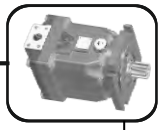
PERMISSIBLE SHAFT LOAD

Permissible shaft load		
max Axial	**N[lb]**	Fa=2500 [562]
max Radial	**N[lb]**	Fr=4500 [1010]

The calculated max values are based on the optimal direction of the forces Fr, Fa and optimal position of the shaft (see page 65).

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

4M - ISO3019-2 4-Bolt flange of spigot diam.140 mm [5.51"] - BC 180 mm [7.09"]

4C - SAE C - 4-Bolt flange spigot diam. 127mm [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

63 - 63.58 cm.^{3}/rev. [3.88 in.^{3}/rev.]

71 - 71.5 cm.^{3}/rev. [4.36 in.^{3}/rev.]

75 - 76.84 cm.^{3}/rev. [4.69 in.^{3}/rev.]

92 - 93.18 cm.^{3}/rev. [5.69 in.^{3}/rev.]

100 - 98.75 cm.^{3}/rev. [6.03 in.^{3}/rev.]

Pos.4 - Shaft Extensions**

SK - ø31,75 [1,25"] Spline SAE 14T 12/24 DP, M10

SP - ø34.5 [1,358"] Spline SAE 21T 16/32 DP, M12

SR - ø37.6 [1,48"] Spline SAE 23T 16/32 DP, M12

ST - ø40 [1,575"] Spline W40x2x30x18x9g DIN 5480, M12-6H thread

GU - ø43.71 [1,721"] Spline SAE 13T 8/16 DP, 3/8-16UNC

DU - ø38.1[1,5"] Straight, key 9.528[0.375"] L38.1[1.5"], 3/8-16 UNC thread

CV - ø40 [ø1.575"] Straight, M12-6H thread Parallel key A12x8x63 DIN6885

TN - ø31.75 [1.25"] Tapered 125:1000, key 7.94[5/16] x7.94[5/16] L28[1 1/8], 1-12 UNF-2A

Pos.5 - Ports

omit - 2xISO 6162-2 DN25, drain ports M27x2-6H, for rear drain port M22x1.5

2 - 2xG1, drain G3/4, for rear drain ports G1/2

4 - 2x1 5/16-12 UN Ports, drain ports 1 1/16 UNF for rear drain port 7/8-14 UNF

5 - 2xSAE 1", PSI6000, drain ports 1 1/16 UNF for rear drain port 7/8-14 UNF

9 - 2xISO 6162-2 DN25, drain ports G3/4, for rear drain port G1/2

Pos.6 - Seal, Corrosion Resistant Seal Surface

omit - NBR seal type material

V - FKM seal type material

Pos.7 - Integrated Valves

See next page for information about valves

omit - None

HR - Single anti-cavitation valve

AR - Dual anti-cavitation valve

PU - Purge valve

FLU - Flush valve

SAR - Single anti-cavitation and relief valve

DAR - Dual anti-cavitation and relief valve

DARP - Dual anti-cavitation, relief and purge valve

DARF - Dual anti-cavitation, relief and flush valve

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 - For value - see next page

Pos.10 - Flow Setting of Integrated Valves

omit - None

Lx - For value - see next page

Pos.11 - Special Features*

omit - None

R2S - Speed Sensor Two Directional (see page 63)

R - Reverse Rotation (see page 65)

Pos.12 - Paint and Coating

omit - No paint or coating

P - Painted

PC - Corrosion protected paint

PS - Special painted ***

PCS - Special 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

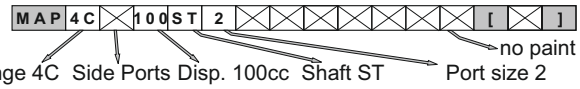
omit - Factory specified

*Available on enquiry
**The permissible output torque for shafts must not be exceeded!
***Non painted feeding surface

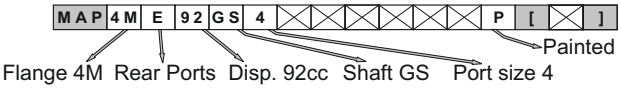
We remain open to meet your special requirements upon request.

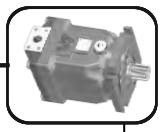
EXAMPLE

M A P 4 C 1 0 0 S T 2



M A P 4 M E 9 2 G S 4 P

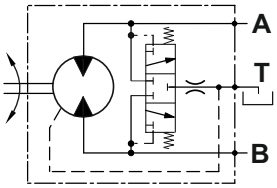




Valve Options

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 (omit) - 5 ÷ 9 l/min**.
- For other options, please see Pos.10 of ordering code, considering the following possible values:

Pos.10	omit	L5.5	L9	⇨ flow rate

EXAMPLE

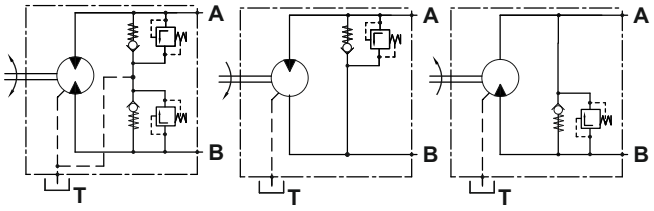
M A P 4 C 1 0 0 S T 2 **P U** purge valve flow rate 7±2 l/min
M A P 4 C 1 0 0 S T 2 **P U L 9** purge valve flow rate 9±1 l/min
M A P 4 C 1 0 0 S T 2 **P U L 5 . 5** purge valve flow rate 5.5±1 l/min

Option **DAR, SARA, SARB**
Combined Anti-Cavitation and Reliev 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.

DAR SARA SARB



Please, consider the following possible values:

Pos.9	250	300	350	⇨ pressure

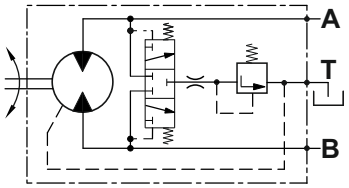
EXAMPLE

M A P 4 C 1 0 0 S T 2 **D A R 3 5 0**
Double Anti-Cavitation and Relief Valve, relief valve setting 350 bar

M A P 4 C 1 0 0 S T 2 **S A R A 2 5 0**
Single Anti-Cavitation and Relief Valve, relief valve setting 250 bar
The valve is placed on port A

M A P 4 C 1 0 0 S T 2 **S A R B 3 0 0**
Single Anti-Cavitation and ReliefValve, relief valve setting 300 bar
The valve is placed on port B

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 (omit) - 5 ÷ 9 l/min and charge (opening) pressure 16 bar** with 20 bar feed pressure for close loop circuit;
- For other options, please see Pos.9 and Pos. 10 of ordering code, considering the following possible values:

Pos.9	omit	10	⇨ pressure
Pos.10	omit	L5.5	L9 ⇨ flow rate

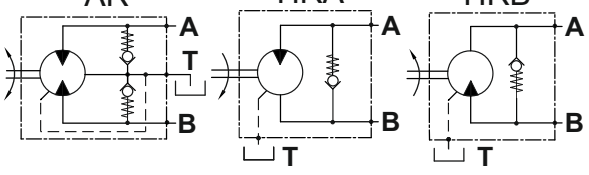
EXAMPLE

M A P 4 C 1 0 0 S T 2 **F L U** flow rate 7±2 l/min, charge pressure 16 bar
M A P 4 C 1 0 0 S T 2 **F L U 1 0 L 5 . 5** flow rate 5.5±1 l/min, charge pressure 10 bar
M A P 4 C 1 0 0 S T 2 **F L U L 9** flow rate 9±1 l/min, charge pressure 16 bar

Option **AR, HRA, HRB**
Anti-Cavitation Valve

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

AR HRA HRB

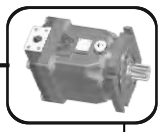


EXAMPLE

M A P 4 C 1 0 0 S T 2 **A R**
Double Anti-Cavitation Valve

M A P 4 C 1 0 0 S T 2 **H R A**
Single Anti-Cavitation Valve, the valve is placed on port A

M A P 4 C 1 0 0 S T 2 **H R B**
Single Anti-Cavitation Valve, the valve is placed on port B

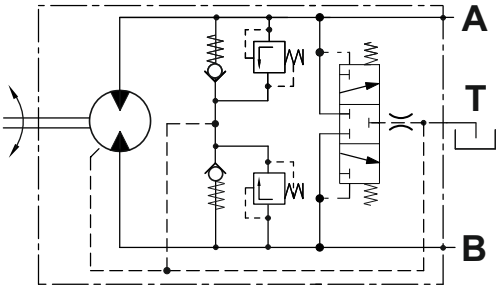


Valve Options

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-cavitaion, 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:

Pos.9 | **250** | **300** | **350** ⇒ pressure

- Flow rate of purge valve by **default (omit) - 5 ÷ 9 l/min.** The possible values are as follow:

Pos.10 | **omit** | **L5.5** | **L9** ⇒ flow rate

EXAMPLE

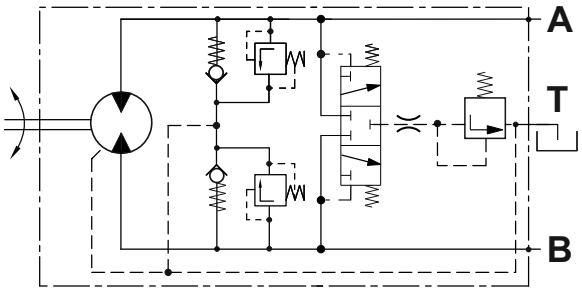
M A P 4 C 1 0 0 S T 2 **D A R P 3 5 0**
Double Anti-Cavitation, Relief and Purge Valve,
relief valve setting 350 bar, purge valve flow rate 7±2 l/min

M A P 4 C 1 0 0 S T 2 **D A R P 2 5 0 L 9**
Double Anti-Cavitation, Relief and Purge Valve,
relief valve setting is 250 bar, purge valve flow rate 9±1 l/min

M A P 4 C 1 0 0 S T 2 **D A R P 3 0 0 L 5 . 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-cavitaion, 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:

Pos.9 | **250** | **300** | **350** ⇒ pressure

- Flow rate of flush valve by **default (omit) - 5 ÷ 9 l/min and charge pressure 16 bar** with 20 bar feed pressure for close loop circuit. The possible values are as follow:

Pos.10 | **omit** | **L5.5** | **L9** ⇒ flow rate

- Other values for charge pressure are possible. Please see Pos.9.
Example: For charge pressure 10 bar the options are as follow:

Pos.9 | 250-**10** | 300-**10** | 350-**10**

Relief valve opening pressure

Flush valve opening pressure (charge pressure)

EXAMPLE

M A P 4 C 1 0 0 S T 2 **D A R F 3 5 0**
Double Anti-Cavitation, Relief and Flush Valve, relief valve setting 350 bar
flush valve charge pressure 16 bar, flush valve flow rate 7±2 l/min

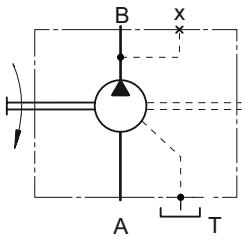
M A P 4 C 1 0 0 S T 2 **D A R F 3 5 0 - 1 0**
Double Anti-Cavitation, Relief and Flush Valve, relief valve setting 350 bar
flush valve charge pressure 10 bar, flush valve flow rate is 7±2 l/min

M A P 4 C 1 0 0 S T 2 **D A R F 2 5 0 L 9**
Double Anti-Cavitation, Relief and Flush Valve, relief valve setting 250 bar
flush valve charge pressure 16 bar, flush valve flow rate is 9±1 l/min

M A P 4 C 1 0 0 S T 2 **D A R F 3 0 0 - 1 0 L 5 . 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

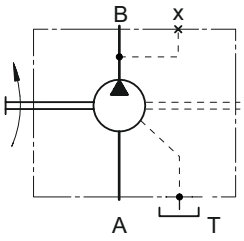
Hydraulic Pumps Type PAP50

Heavy Duty Axial Piston Pumps Fixed Displacement for open loop circuit



Symbols

B	Outlet port
A	Inlet port
T	Drain port



open drain line is always required

APPLICATION

- » Open loop circuit
- » Agricultural machines
- » Road building machines
- » Mining machinery
- » Food industry machines
- » Special vehicles

OPTIONS

- » Swash plate
- » Port options
- » Shaft options
- » High pressure ports

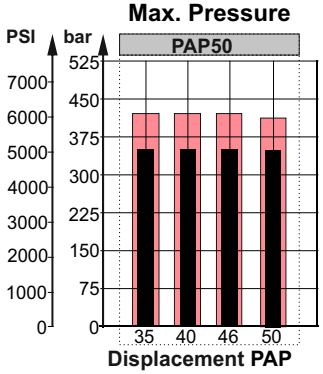
ADVANTAGES

- » Low noise
- » Low pulsation
- » Long service life
- » High power density

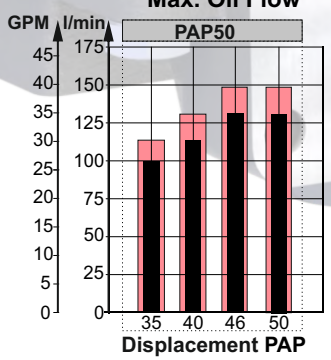
GENERAL

Displacement,	cm^3/rev [in^3/rev]	**36,16÷49.94 [2.21÷3.05]**
Max. Driving Speed,	RPM	**2800**
Max. Driving Torque,	Nm [lb-in]	**278 [2460]**
Max. Output,	kW [HP]	**54 [72.5]**
Max. Pressure,	bar [PSI]	**350 [5080]**
Max. Oil Flow,	l/min [GPM]	**132 [35]**
Min. Driving 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)**

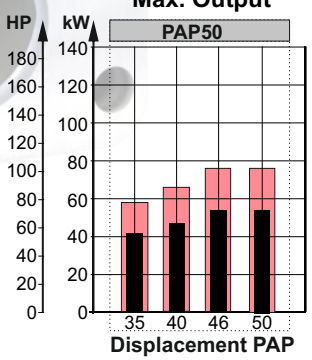
Max. Pressure



Max. Oil Flow



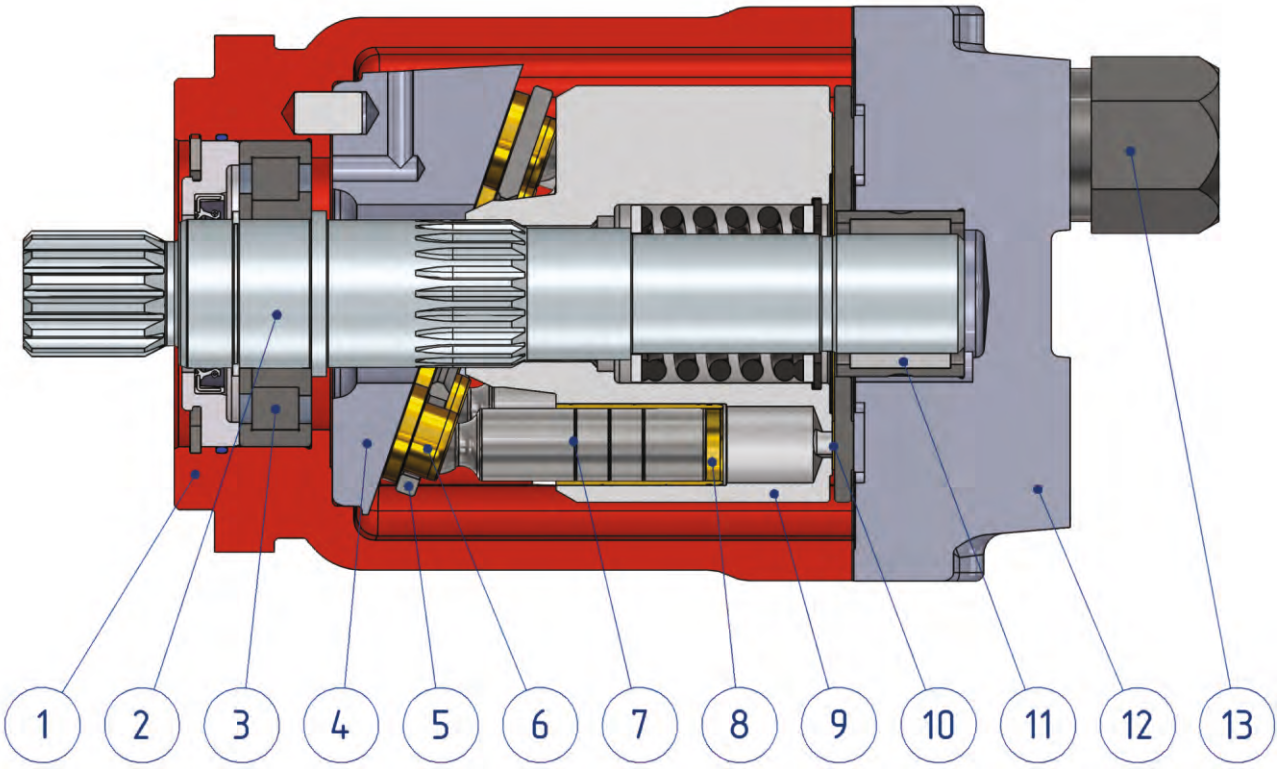
Max. Output



Intermittent values

Continuous values

SECTION VIEW



1. Cast iron body
2. Hardened shaft
3. Robust radial - axial roller bearing
4. Solid swash plate
5. Retainer plate
6. Improved piston shoes
7. Improved pistons
8. Brass bushings
9. Hardened steel cylinder block
10. Bimetal distributor
11. Needle bearing
12. Solid end cover
13. Part of hydraulic system helps reduces pump noise and vibration

The heavy duty design of PAP pumps gains big advantage over the typical swash plate pumps.
One of then is a special hydraulic system, which reduces noise and vibration created from pump.
Another big advantage of our design, which in general is typical for swash plate pumps, is that the pulsations during the operation are much less. In general the swash plate pumps are more reliable than the bent axis pumps and gear pumps.

SPECIFICATION DATA

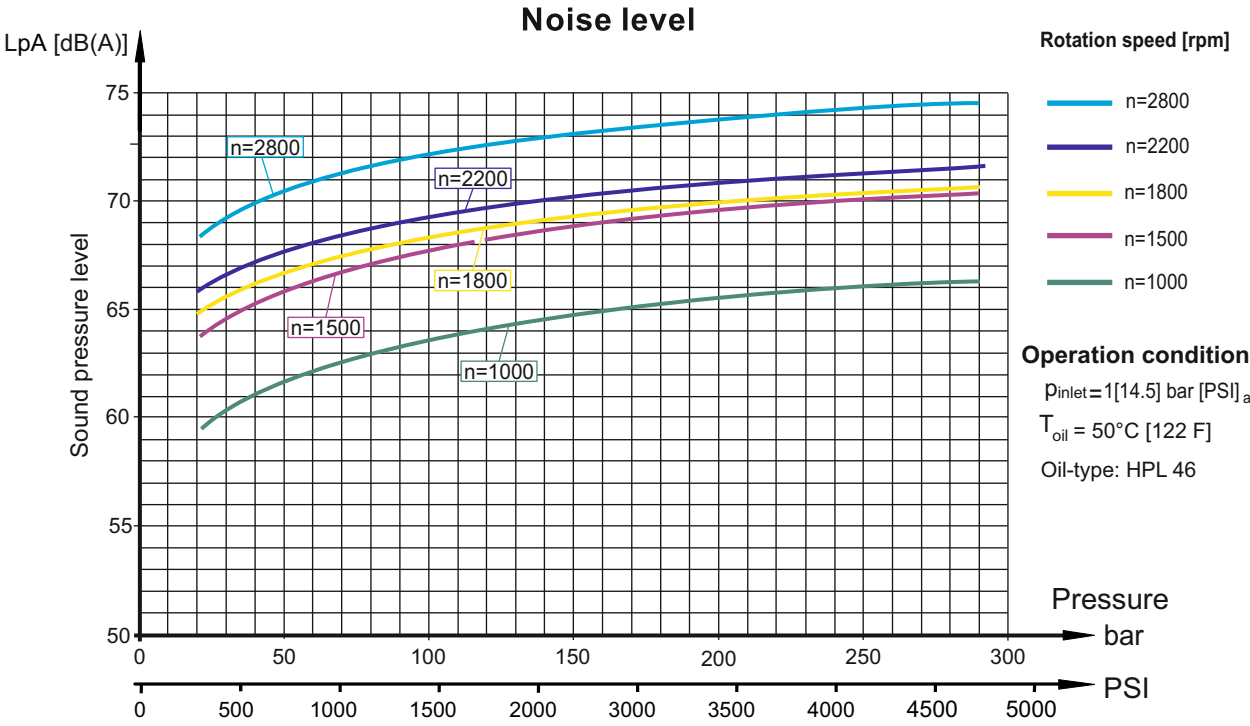
Type		PAP 35	PAP 40	PAP 46	PAP 50
Displacement, cm.^{3}/rev. [in.^{3}/rev.]		36.16 [2.21]	41.59 [2.54]	47.13 [2.88]	49.94 [3.05]
Max. Driving Speed, [RPM]	Cont.	2800	2800	2800	2500
	Int.*	3150	3150	3150	2800
Max. Driving Torque,*** Nm [lb-in]	Cont.	202 [1789]	232 [2053]	263 [2328]	278 [2460]
	Int.**	242 [2142]	278 [2460]	315 [2788]	326 [2885]
Output, kW [HP]	Cont.	41 [55]	47 [63]	54 [72.5]	54 [72.5]
	Int.**	58 [78]	67 [90]	77 [198]	77 [198]
Max. Pressure, bar [PSI]	Cont.	350 [5080]	350 [5080]	350 [5080]	350 [5080]
	Int.**	420 [6100]	420 [6100]	420 [6100]	410 [5950]
	Peak	450 [6527]	450 [6527]	450 [6527]	450 [6527]
Max. Oil Flow, l/min [GPM]	Cont.	100 [26.4]	116 [30]	132 [34.9]	132 [34.9]
	Int.*	114 [30]	131 [35]	148 [39]	148 [39]
Permissible Shaft Load max Axial**** N[lb]		Fa=2000 [450]			
max Radial**** N[lb]		Fr=3600 [810]			
Min. Speed, [RPM]		500			
Max. Pressure in Drain Line, bar [PSI]		5 [70] open drain line is always required			
Weight, kg [lb]		20,5 [45]			

Peak pressure is 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 pump lifetime;
*** Theoretical torque;
**** The calculated max values are based on the optimal direction of the forces Fr, Fa and optimal position of the shaft.

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 68.
5. Recommended maximum system operating temperature - 82°C [180°F].
6. To ensure optimum life of the pump, fill it up with fluid prior to load it and run with moderate load and speed for about 10-15 minutes.

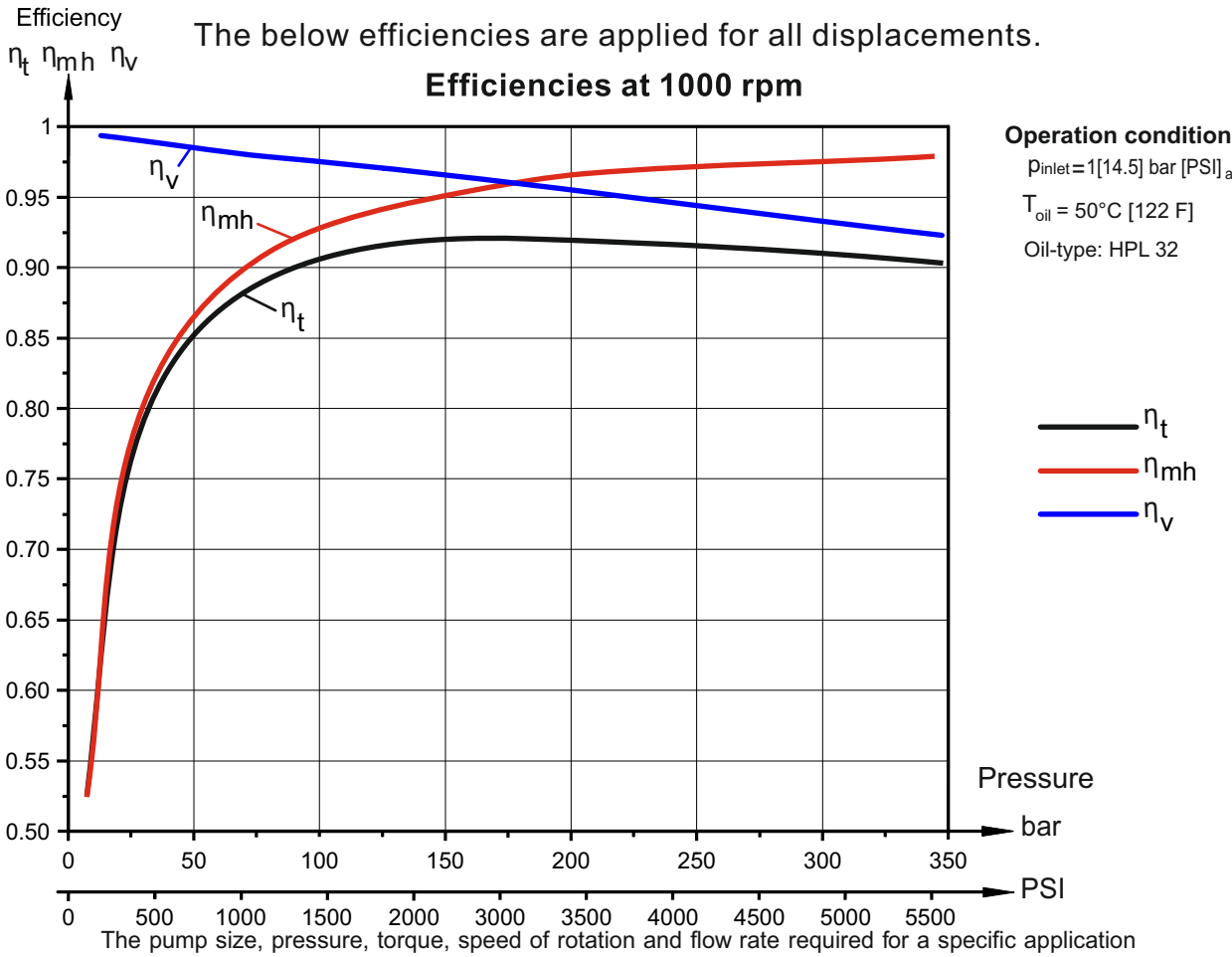
FUNCTION DIAGRAMS

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



The sound pressure level for a particular pump may vary ±2 dB(A) compared to what is shown in the diagram.

The below efficiencies are applied for all displacements.

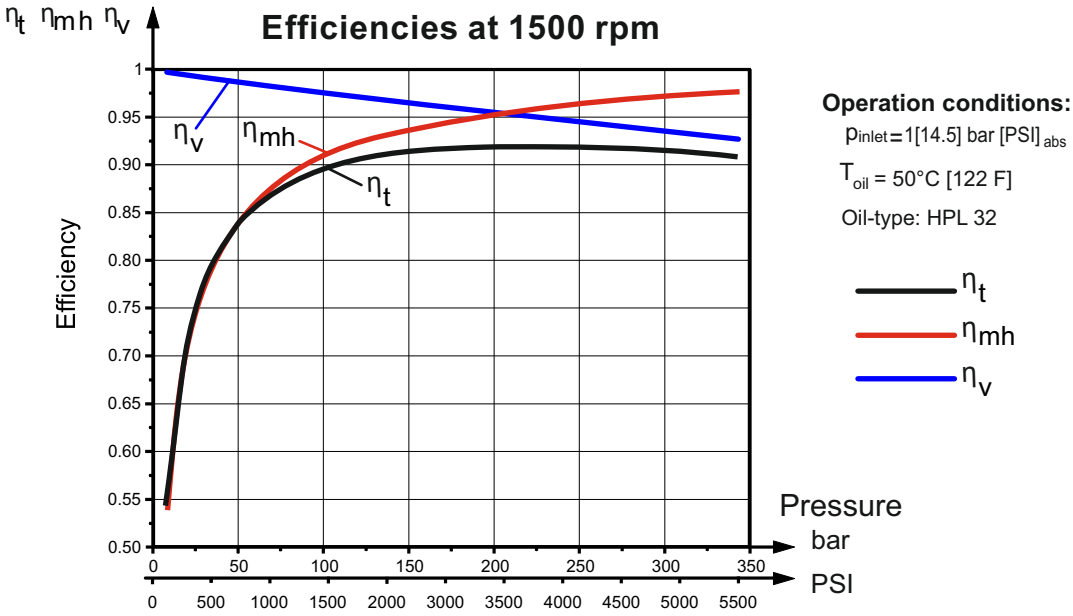


The pump size, pressure, torque, speed of rotation and flow rate required for a specific application can be calculated using the formulas on page 69

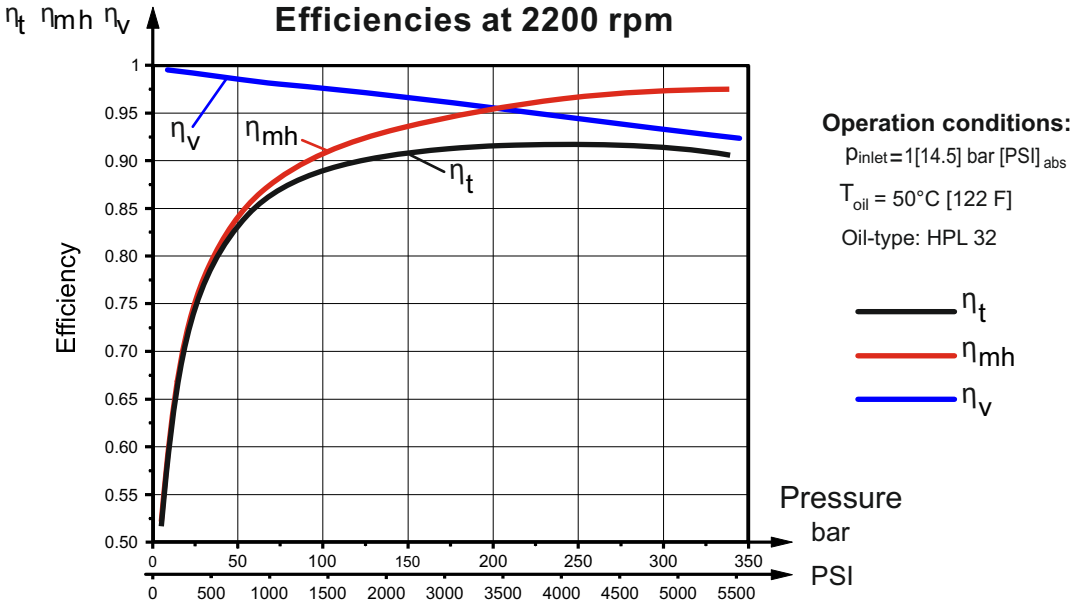
Efficiencies for a particular pump may vary from the shown in the diagram depending on the operating conditions.

FUNCTION DIAGRAMS

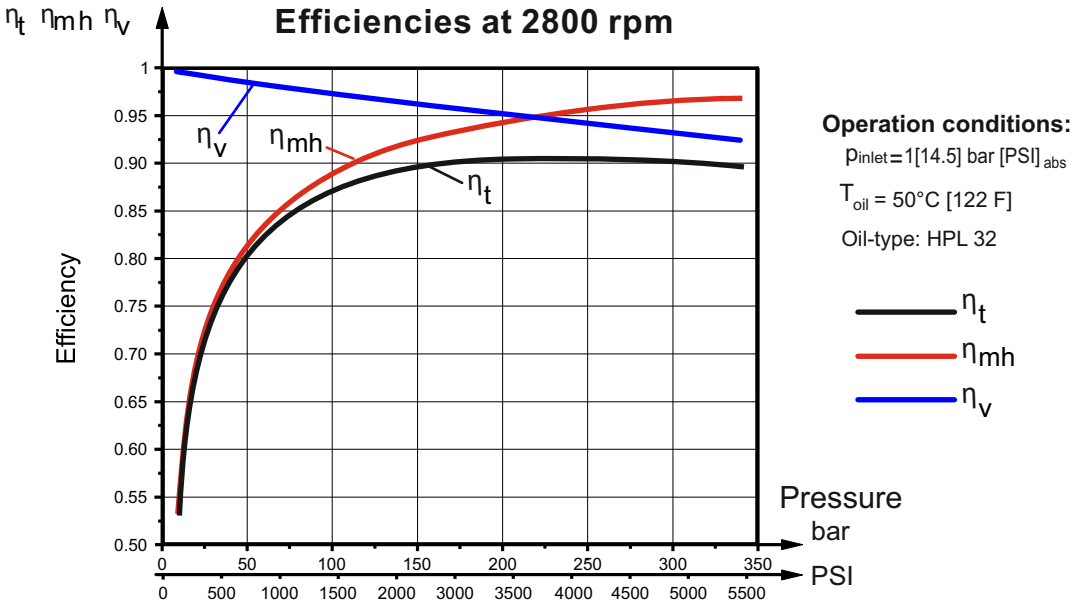
Efficiencies at 1500 rpm



Efficiencies at 2200 rpm



Efficiencies at 2800 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 69

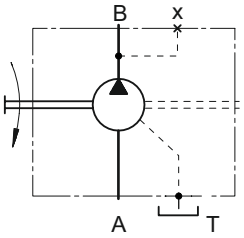
Efficiencies for a particular pump may vary from the shown in the diagram depending on the operating conditions.

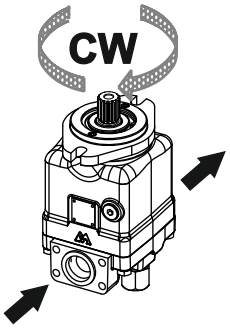
Overall Dimensions and Ports

Direction of Rotation **CW**(Right)

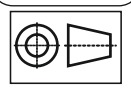
Port sizes **default** and **5**

See the port sizes at the bottom of this page

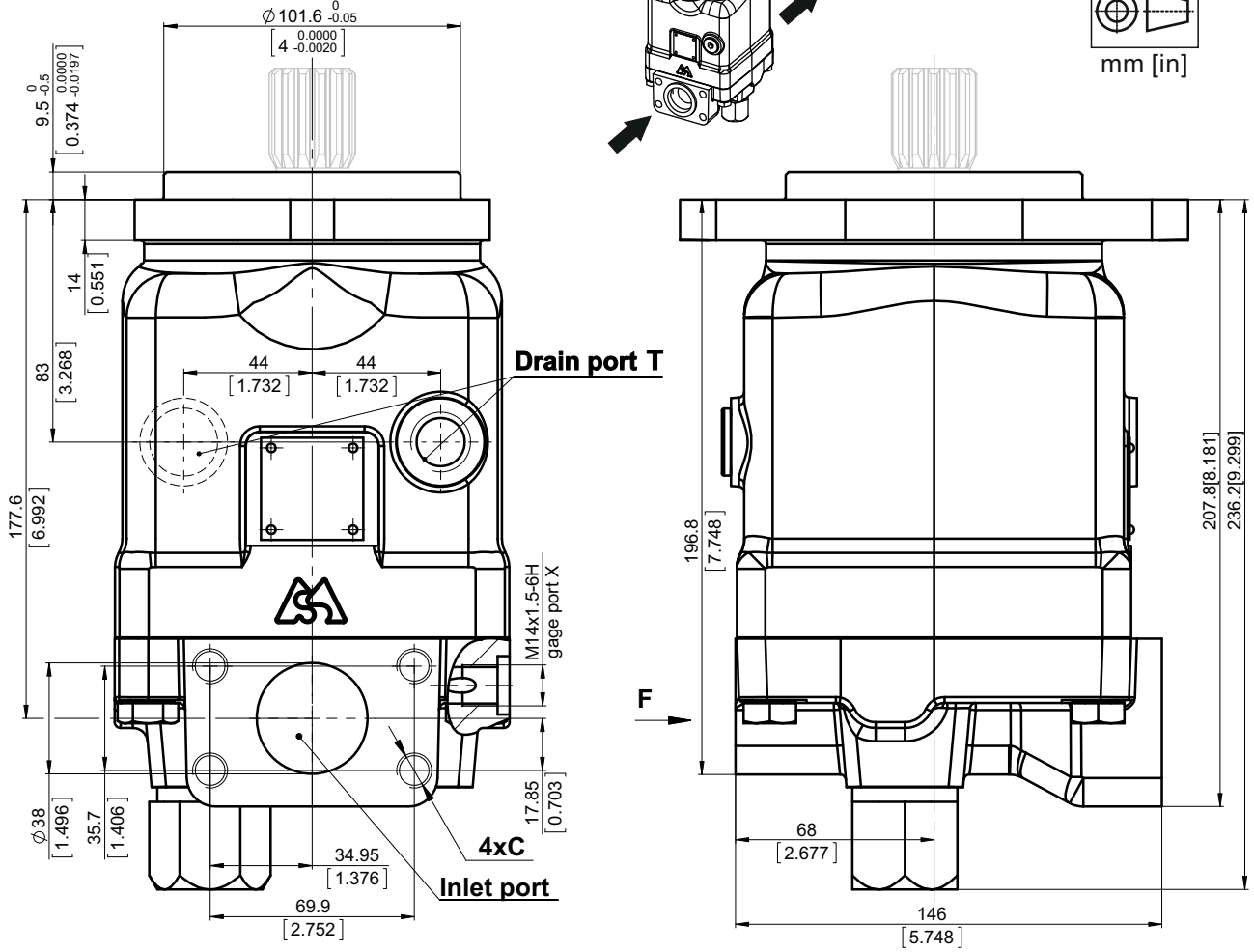


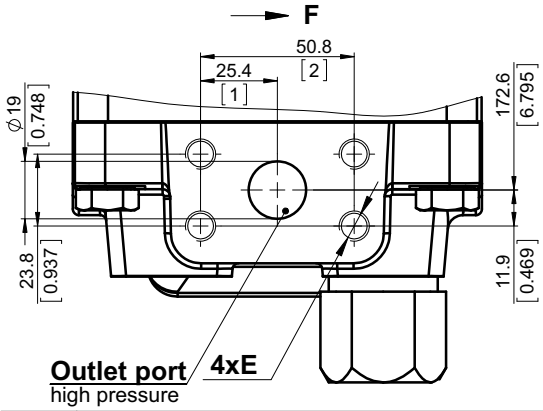


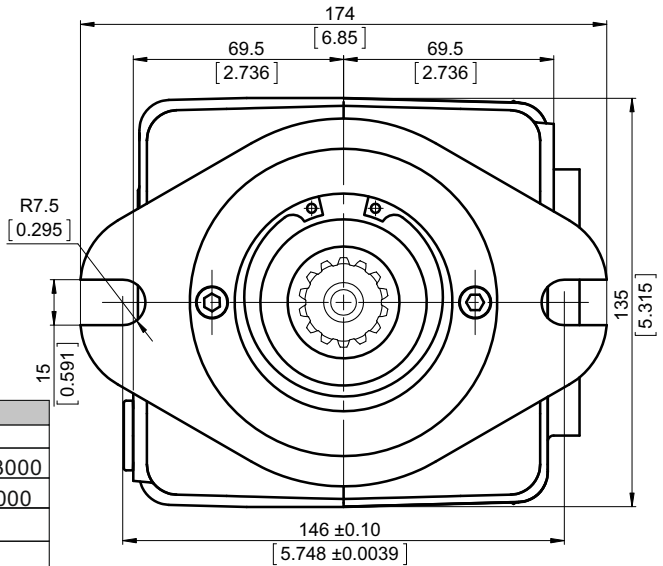
Shaft Mounting
see page 50



mm [in]







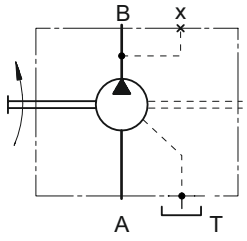
	Port Size	
	default	**5**
Inlet	ISO 6162-1 DN38	SAE J518 1-1/2 PSI3000
Outlet	ISO 6162-2 DN19	SAE J518 3/4 PSI6000
T	M18x1,5	7/8-14 UNF-2B
C	4xM12-6H	1/2-13 UNC-2B
E	4xM10-6H	3/8-16 UNC-2B

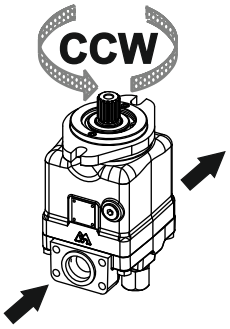
Overall Dimensions and Ports

Direction of Rotation **CCW**(Left)

Port sizes **default** and **5**

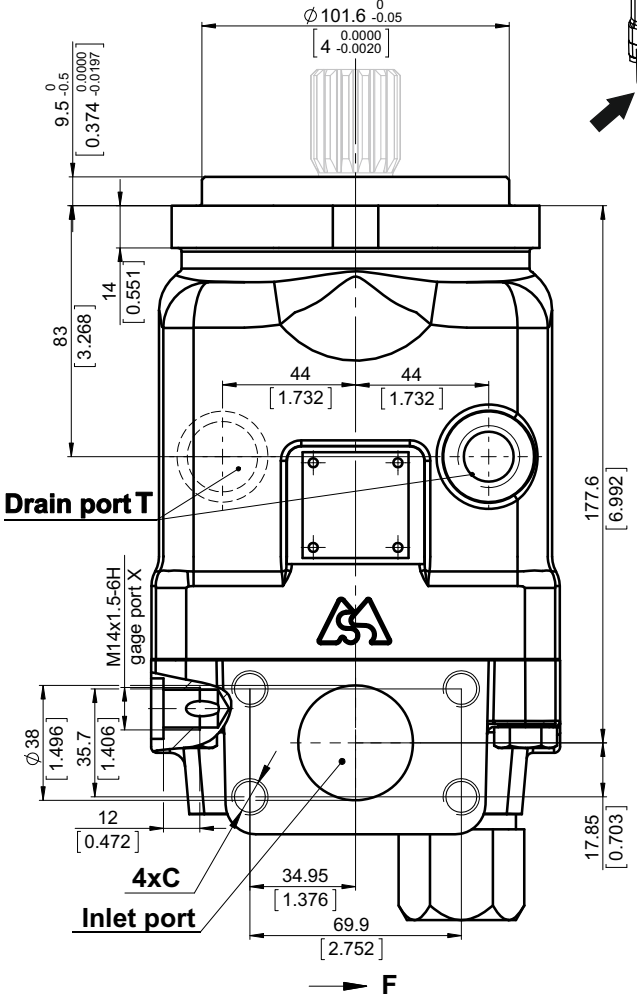
See the port sizes at the bottom of this page

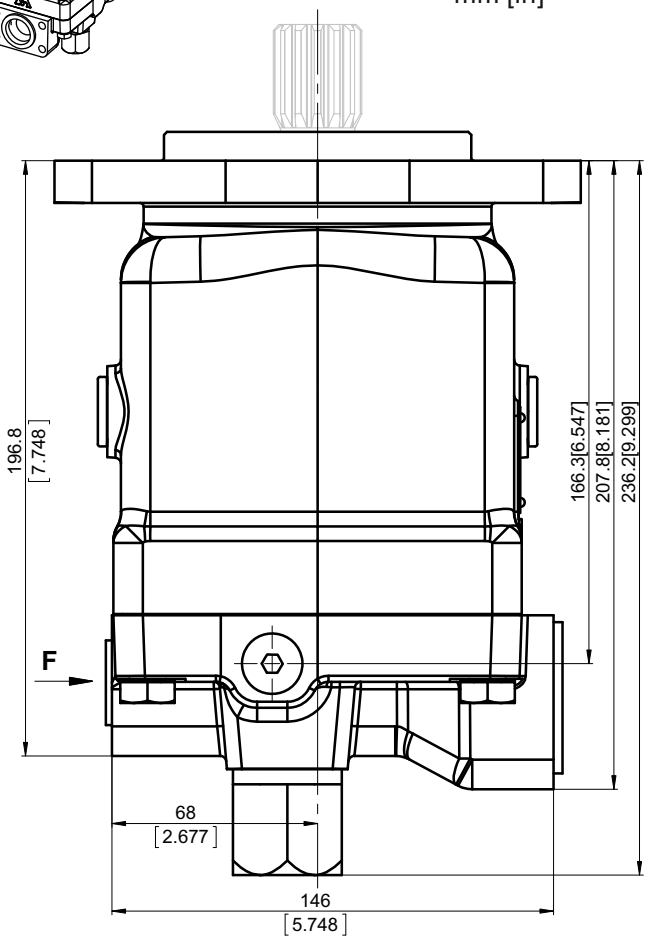


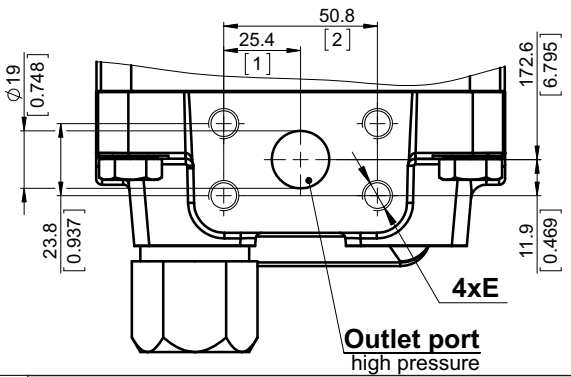


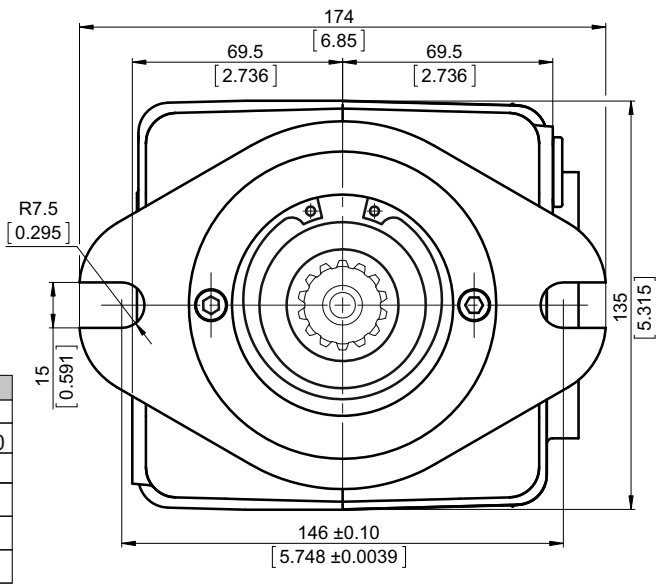
Shaft Mounting
see next page

mm [in]



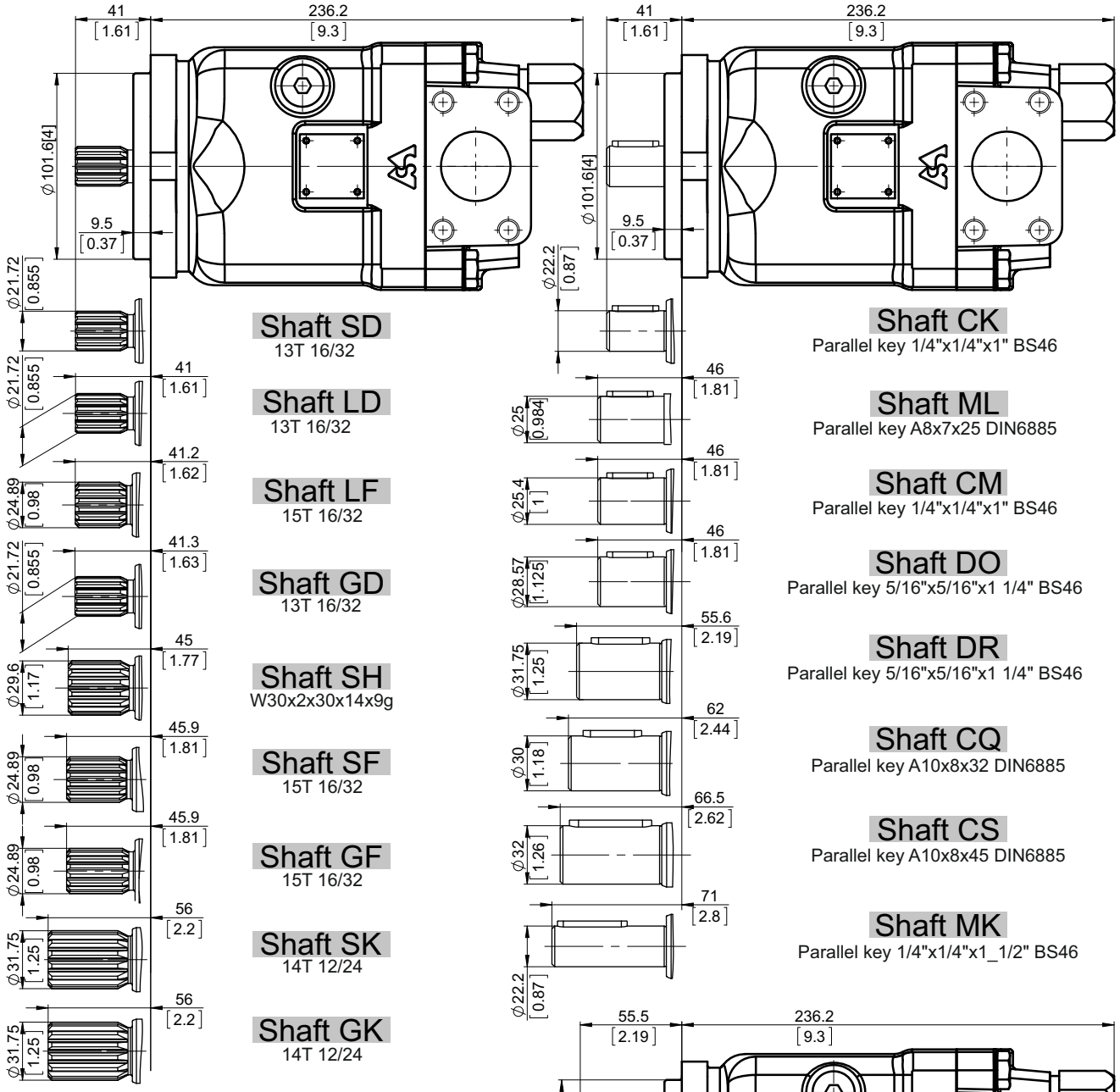






	Port Size	
	default	**5**
Inlet	ISO 6162-1 DN38	SAE J518 1-1/2 PSI3000
Outlet	ISO 6162-2 DN19	SAE J518 3/4 PSI6000
T	M18x1,5	7/8-14 UNF-2B
C	4xM12-6H	1/2-13 UNC-2B
E	4xM10-6H	3/8-16 UNC-2B

Shafts Mounting



Shaft SD
13T 16/32

Shaft LD
13T 16/32

Shaft LF
15T 16/32

Shaft GD
13T 16/32

Shaft SH
W30x2x30x14x9g

Shaft SF
15T 16/32

Shaft GF
15T 16/32

Shaft SK
14T 12/24

Shaft GK
14T 12/24

Shaft CK
Parallel key 1/4"x1/4"x1" BS46

Shaft ML
Parallel key A8x7x25 DIN6885

Shaft CM
Parallel key 1/4"x1/4"x1" BS46

Shaft DO
Parallel key 5/16"x5/16"x1 1/4" BS46

Shaft DR
Parallel key 5/16"x5/16"x1 1/4" BS46

Shaft CQ
Parallel key A10x8x32 DIN6885

Shaft CS
Parallel key A10x8x45 DIN6885

Shaft MK
Parallel key 1/4"x1/4"x1_1/2" BS46

Shaft TD
Tapered 1:8, Parallel key 1/4"x1/4"x1"

Shaft KH
Tapered 1:8, Parallel key 1/4"x1/4"x1"

Shaft TH
Tapered 1:8, Parallel key 1/4"x1/4"x1"

mm [in]

Shaft Dimensions
See Page 57÷62

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 65).

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

ORDERING CODE

		1	2	3	4	5	6	7	8	9	9	9
P A P										[		]

Pos.1 - Mounting Flange

B - SAE B - 2-Bolt flange spigot diam. 101,6 mm [4"] - BC 146 mm [5.75"]

Pos.2 - Displacement Code

35 - 36.16 cm.^{3}/rev. [2.21 in.^{3}/rev.]
40 - 41.59 cm.^{3}/rev. [2.54 in.^{3}/rev.]
46 - 47.13 cm.^{3}/rev. [2.88 in.^{3}/rev.]
50 - 49.94 cm.^{3}/rev. [3.05 in.^{3}/rev.]

Pos.3 - Direction of Rotation

R - CW, Right direction
L - CCW, Left direction

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-2B thread
LD - ø21,72 [0.855"] Spline SAE 13T 16/32 DP, 1/4-20 UNC-2B thread
SF - ø24.9 [0.98"] Spline SAE 15T 16/32, M8-6H
GF - ø24,9 [0.98"] Spline SAE 15T 16/32, 3/8-16UNC-2B
LF - ø24,9 [0.98"] Spline SAE 15T 16/32 DP, 1/4-20UNC-2B thread
SH - ø29.6 [1,165"] Spline W30x2x30x14x9g DIN, M10-6H thread
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-2B thread
CK - ø22.2 [ø7/8"] Straight, M8-6H thread Parallel key 1/4"x1/4"x1" BS46
MK - ø22.2 [ø7/8"] Straight, M8-6H thread Parallel key 1/4"x1/4"x1_1/2" BS46
ML - ø25 [ø0.984"] Straight, M8-6H thread Parallel key A8x7x25 DIN6885
CM - ø25.4 [ø1"] Straight, M8-6H thread Parallel key 1/4"x1/4"x1" BS46
DO - ø28.75 [ø1.125"] Straight, 3/8-16UNC-2B Parallel key 5/16"x5/16"x1_1/4" BS46
CQ - ø30 [ø1.181"] Straight, M8-6H, key Parallel key A8x7x32 DIN6885
DR - ø31.75 [ø1.25"] Straight, 3/8-16UNC-2B Parallel key 5/16"x5/16"x1_1/4" BS46
CS - ø32 [ø1.26"] Straight, M8-6H 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-2A
TH - ø25.4 [1"] Tapered 1:8 [125:1000], Parallel key 1/4"x1/4"x1", 3/4-16 UNF-2A
KH - ø25.4 [1"] Tapered 1:8 [125:1000], Parallel key 1/4"x1/4"x1", M16x1.5

Pos.5 - Port Size

omit - Inlet ISO 6162-1 DN38,Outlet ISO 6162-2 DN19 ,metric thread, drain ports M18x1.5
5 - Inlet SAE J518 1-1/2 PSI3000, Outlet SAEJ518 3/4 PSI6000, sae thread, drain 7/8-14 UNF-2B

Pos.6 - Seal, Corrosion Resistant Seal Surface

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

Pos.7 - Special Features* see page 63

omit - None
R2S - Speed Sensor Two Directional

Pos.8 - Paint and Coating

omit - No paint or coating
PS - Painted ***
PCS - Painted 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.9 - Design Series

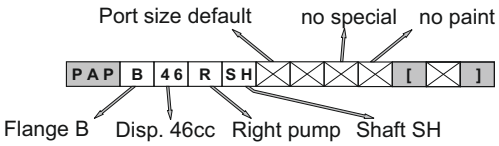
omit - Factory specified

*Available on enquiry
**The permissible output torque for shafts must not be exceeded!
***Non painted feeding surface

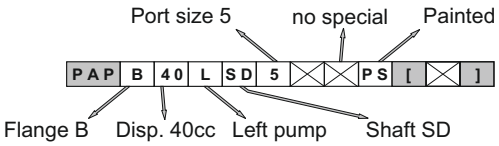
We remain open to meet your special requirements upon request.

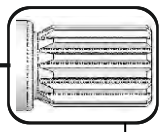
EXAMPLE

P A P B 4 6 R S H



P A P B 4 0 L S D P S

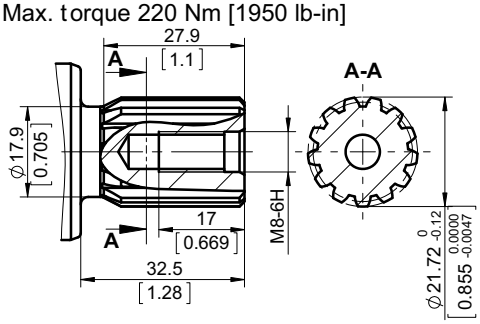




Shaft Types and Dimensions

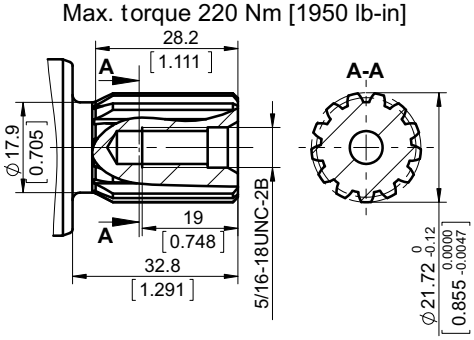
SD

ø21.72 [ø0.855“], M8-6H thread
13T 16/32 DP splined ANSI B92.1-1970
Max. torque 220 Nm [1950 lb-in]



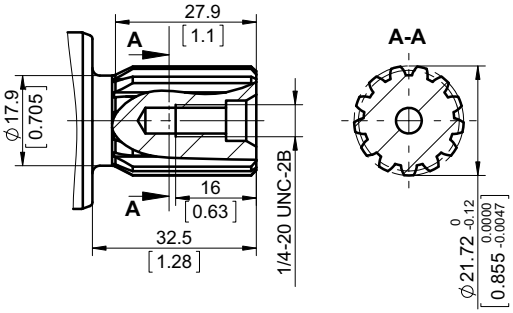
GD

ø21.72 [ø0.855“], 5/16-18 UNC-2B thread
13T 16/32 DP splined ANSI B92.1-1970
Max. torque 220 Nm [1950 lb-in]



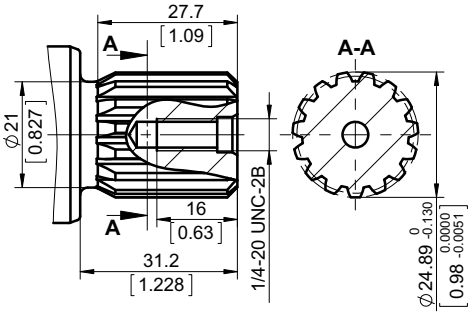
LD

ø21.72 [ø0.855“], 1/4-20 UNC-2B thread
13T 16/32 DP splined ANSI B92.1-1970
Max. torque 220 Nm [1950 lb-in]



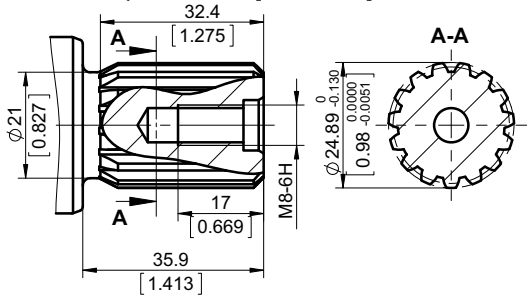
LF

ø24.89 [ø0.98“], 1/4-20 UNC-2B thread
15T 16/32 DP splined ANSI B92.1-1970
Max. torque 360 Nm [3180 lb-in]



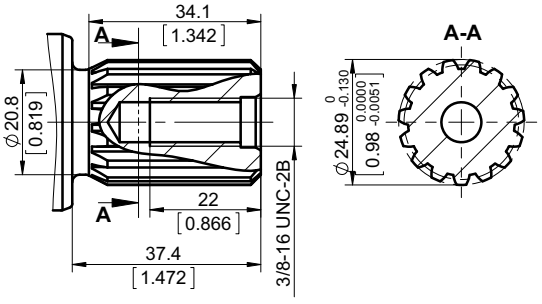
SF

ø24.89 [ø0.98“], M8-6H thread
15T 16/32 DP splined ANSI B92.1-1970
Max. torque 360 Nm [3180 lb-in]

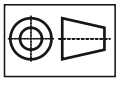


GF

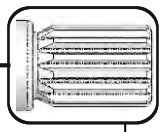
ø24.89 [ø0.98“], 3/8-16 UNC-2B thread
15T 16/32 DP splined ANSI B92.1-1970
Max. torque 360 Nm [3180 lb-in]



The required max. torque must not be exceeded



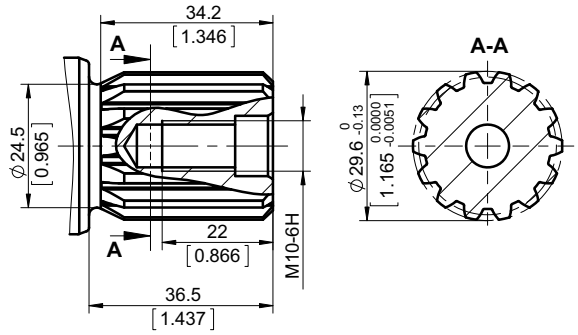
mm [in]



Shaft Types and Dimensions

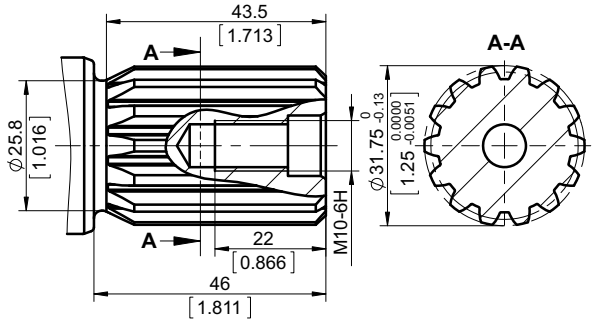
SH

ø29,6 [ø1.165“], M10-6H thread
W30x2x30x14x9g splined DIN 5480
Max. torque 600 Nm [5310 lb-in]



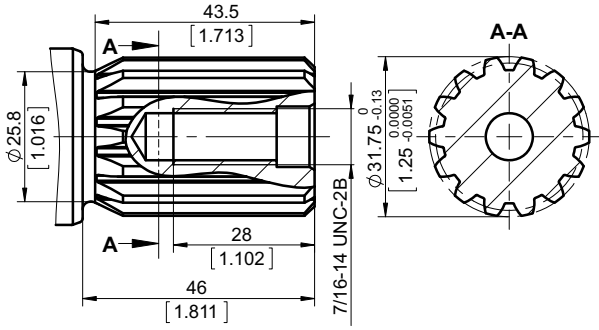
SK

ø31,75 [ø1.25“], M10-6H thread
14T 12/24 DP splined ANSI B92.1-1970
Max. torque 600 Nm [5310 lb-in]



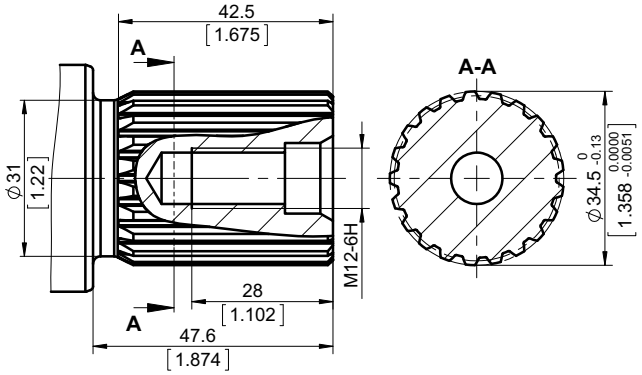
GK

ø31,75 [ø1.25“], 7/16-14 UNC-2B thread
14T 12/24 DP splined ANSI B92.1-1970
Max. torque 600 Nm [5310 lb-in]



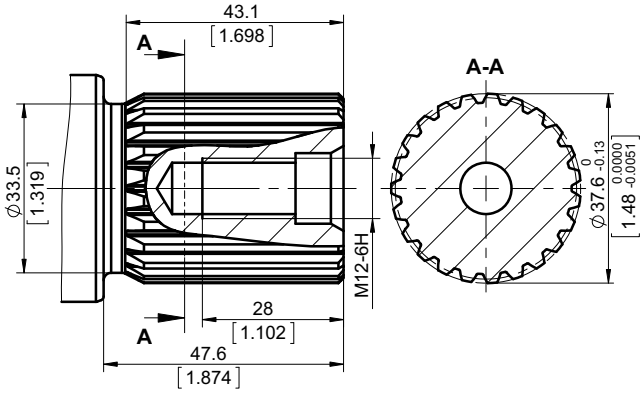
SP

ø34,5 [ø1.358“], M12-6H thread
21T 16/32 DP splined ANSI B92.1-1970
Max. torque 1085 Nm [9600 lb-in]

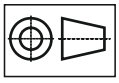


SR

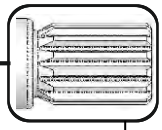
ø37,6 [ø1½“], M12-6H thread
23T 16/32 DP splined ANSI B92.1-1970
Max. torque 1300 Nm [11500 lb-in]



The required max. torque must not be exceeded



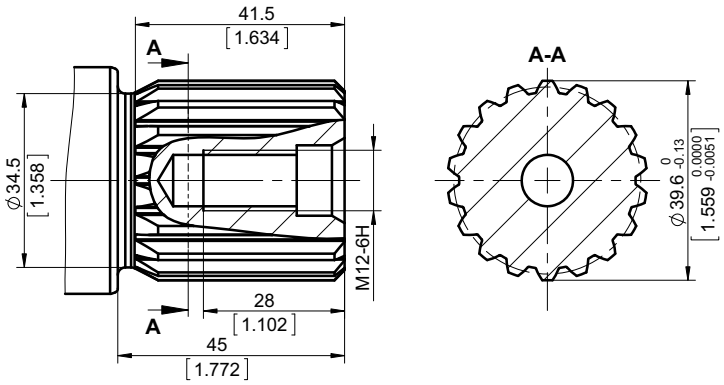
mm [in]



Shaft Types and Dimensions

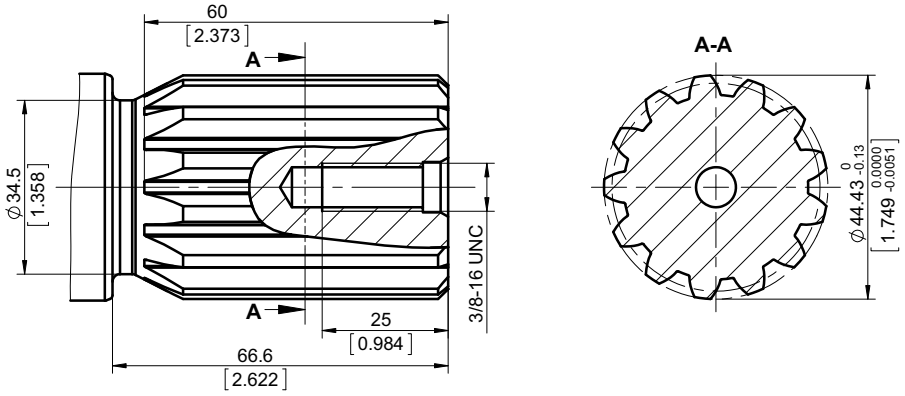
ST

ø39,6 [ø1.559"], M12-6H thread
W40x2x30x18x9g splined DIN 5480
Max. torque 1400 Nm [12400 lb-in]

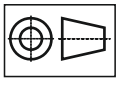


GU

ø44,43 [ø1¾"], 3/8-16 UNC-2B thread
13T 8/16 DP splined ANSI B92.1-1970
Max. torque 2000 Nm [17700 lb-in]



The required max. torque must not be exceeded

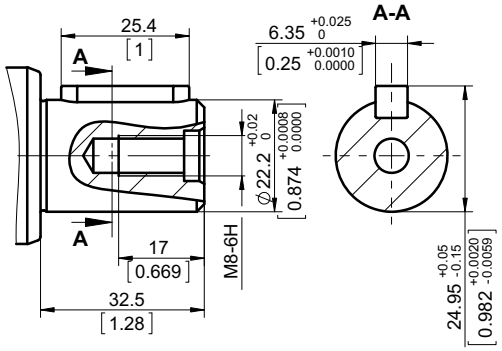


mm [in]

Shaft Types and Dimensions

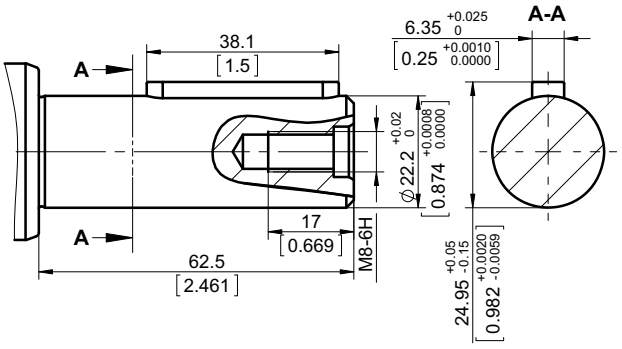
CK

ø22.2 [ø7/8“] straight, M8-6H thread
Parallel key **1/4"x1/4"x1**" BS46
Max. torque 180 Nm [1600 lb-in]



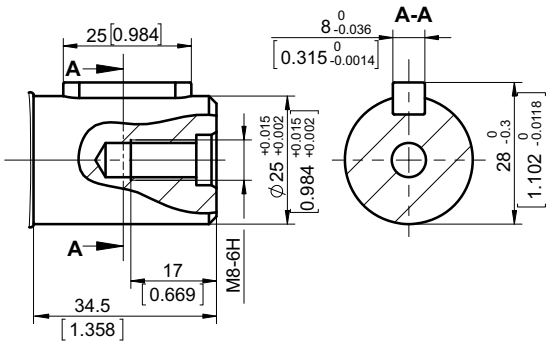
MK

ø22.2 [ø7/8“] straight, M8-6H thread
Parallel key **1/4"x1/4"x1_1/2**" BS46
Max. torque 180 Nm [1600 lb-in]



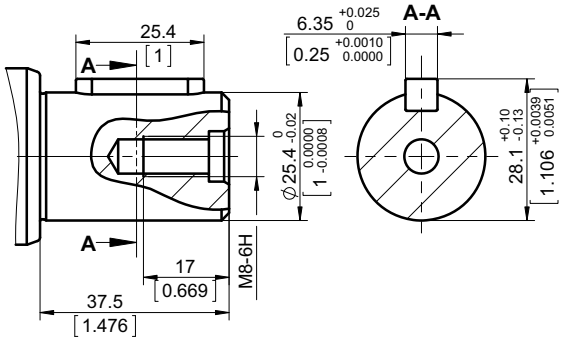
ML

ø25 [ø0.984“] straight, M8-6H thread
Parallel key **A8x7x25** DIN6885
Max. torque 250 Nm [2210 lb-in]



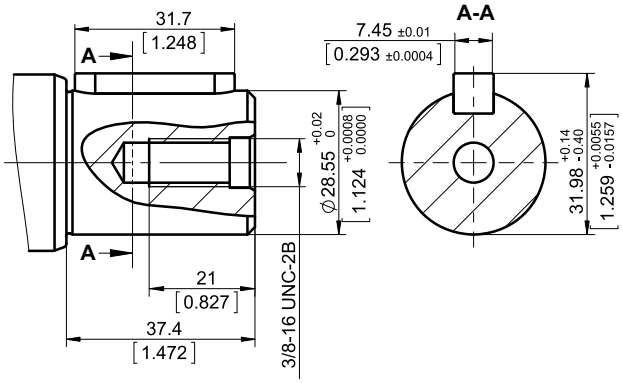
CM

ø25.4 [ø1“] straight, M8-6H thread
Parallel key **1/4"x1/4"x1**" BS46
Max. torque 250 Nm [2210 lb-in]



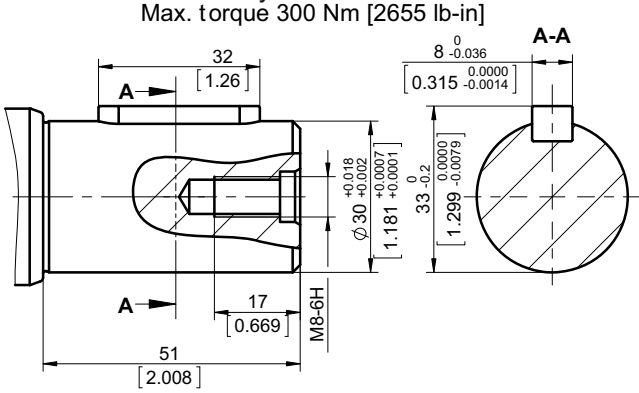
DO

ø28.55 [ø1.125“] straight, 3/8-16 UNC-2B thread
Parallel key **5/16"x5/16"x1 1/4**"
Max. torque 280 Nm [2480 lb-in]

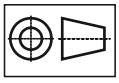


CQ

ø30 [ø1.181“] straight, M8-6H thread
Parallel key **A8x7x32** DIN6885
Max. torque 300 Nm [2655 lb-in]



The required max. torque must not be exceeded

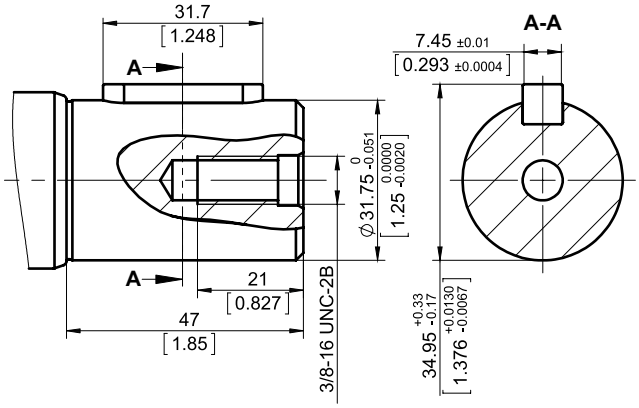


mm [in]

Shaft Types and Dimensions

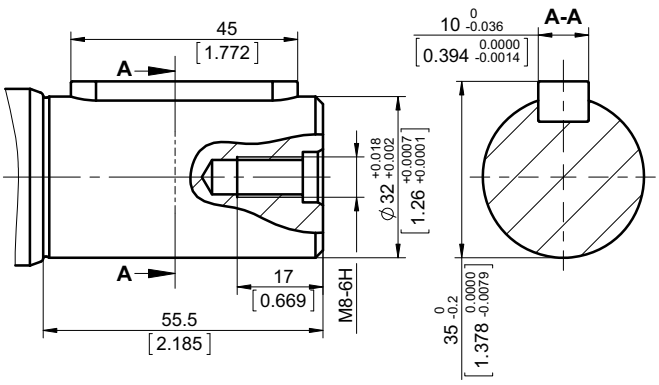
DR

ø31.75 [ø1.25“] straight, 3/8-16 UNC-2B thread
Parallel key **5/16"x5/16"x1 1/4"**
Max. torque 770 Nm [6815 lb-in]



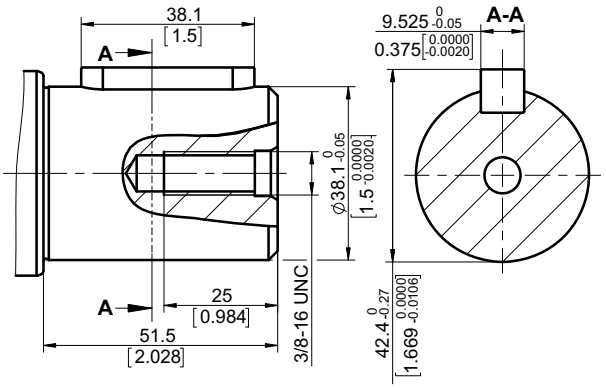
CS

ø32 [ø1.26“] straight, M8-6H thread
Parallel key **A10x8x45** DIN6885
Max. torque 565 Nm [5000 lb-in]



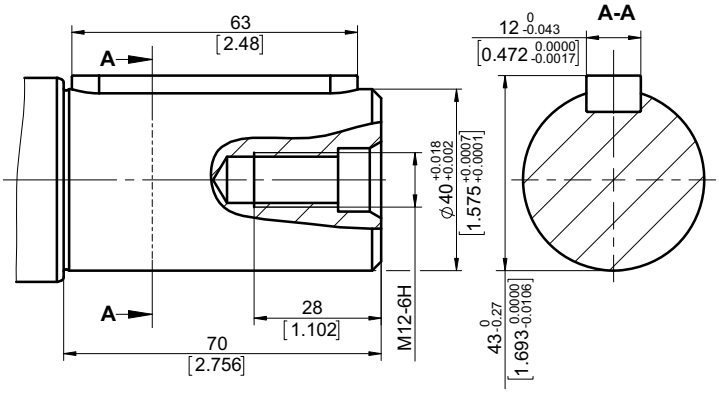
DU

ø38.1 [ø1½“] straight, 3/8-16 UNC-2B thread
Parallel key **3/4"x3/4"x1½"** BS46
Max. torque 1000 Nm [8850 lb-in]

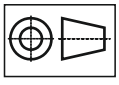


CV

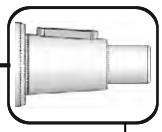
ø40 [ø1.575“] straight, M12-6H thread
Parallel key **A12x8x63** DIN6885
Max. torque 1100 Nm [9735 lb-in]



The required max. torque must not be exceeded



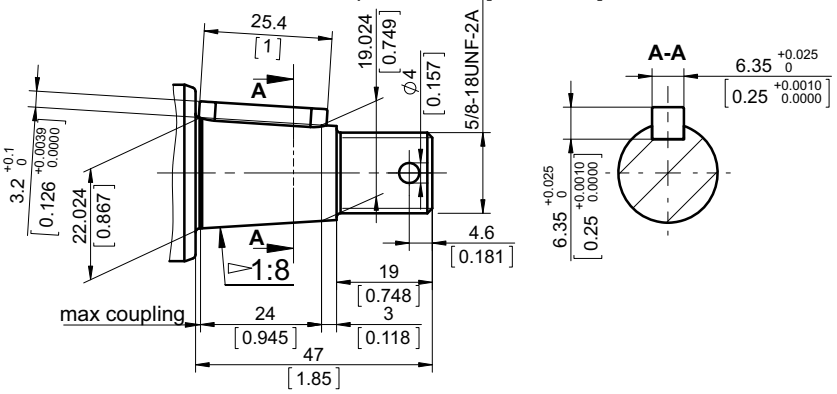
mm [in]



Shaft Types and Dimensions

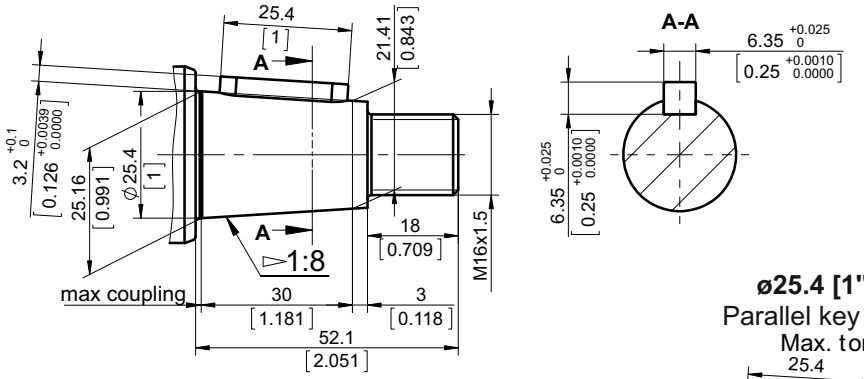
TD

ø22.22 [7/8"] Tapered **1:8 [125:1000],**
Parallel key **1/4"x1/4"x1**", 5/8-18 UNF-2A
Max. torque 220 Nm [1950 lb-in]



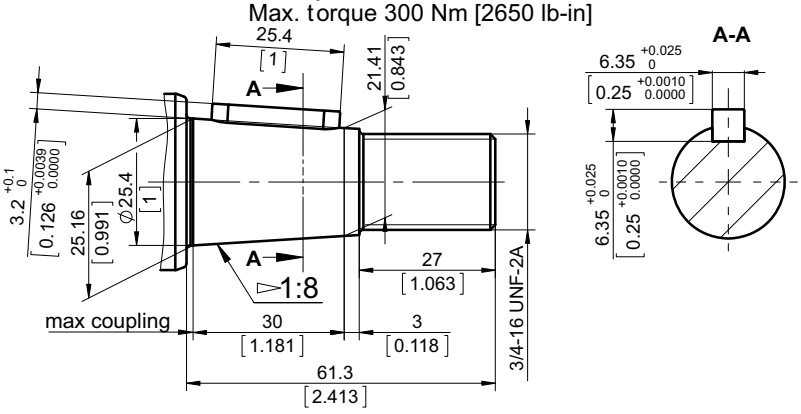
KH

ø25.4 [1"] Tapered **1:8 [125:1000],**
Parallel key **1/4"x1/4"x1**", M16x1.5
Max. torque 300 Nm [2650 lb-in]



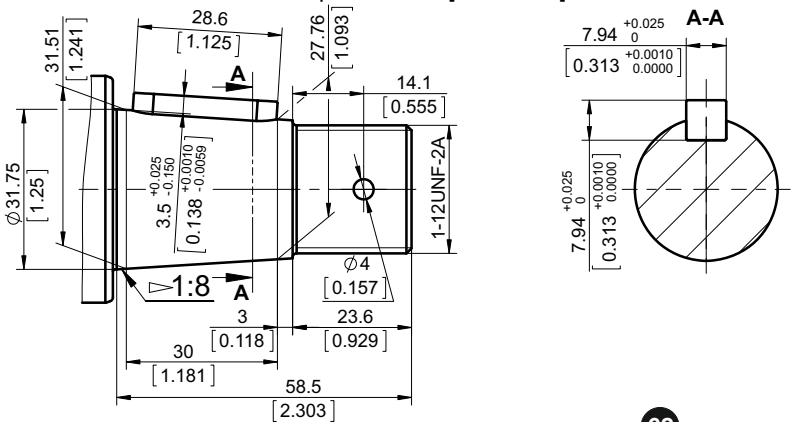
TH

ø25.4 [1"] Tapered **1:8 [125:1000],**
Parallel key **1/4"x1/4"x1**", 3/4-16 UNF-2A
Max. torque 300 Nm [2650 lb-in]

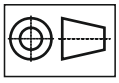


TN

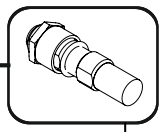
ø31.75 [1¼"] Tapered **1:8 [125:1000],**
Parallel key **5/16"x5/16"x1 1/8**", 1-12UNF-2A
Max. torque 500 Nm [4425 lb-in]



The required max. torque must not be exceeded



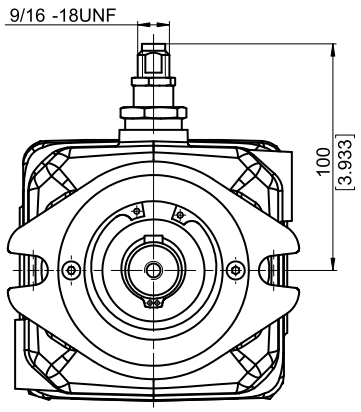
mm [in]

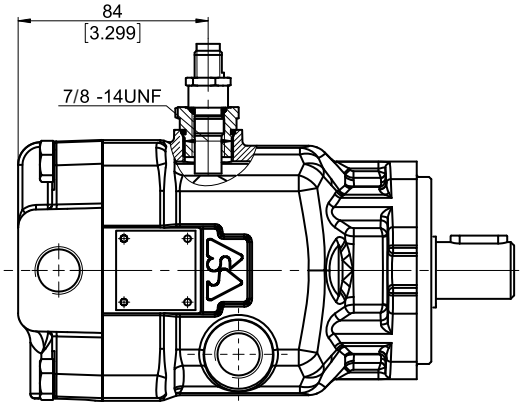


Speed Sensors

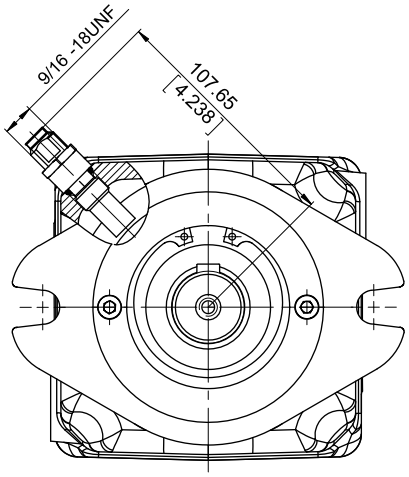
MOUNTING DIMENSIONS

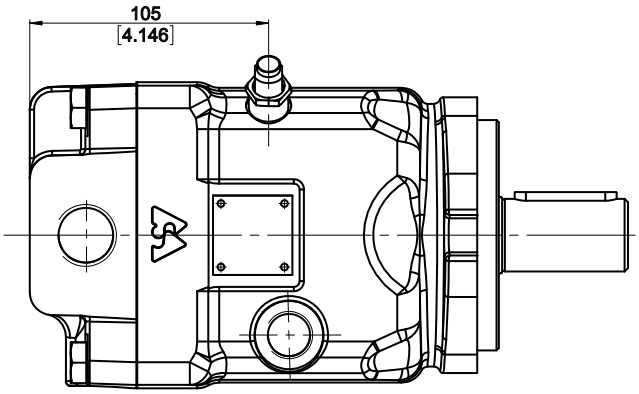
MAP28



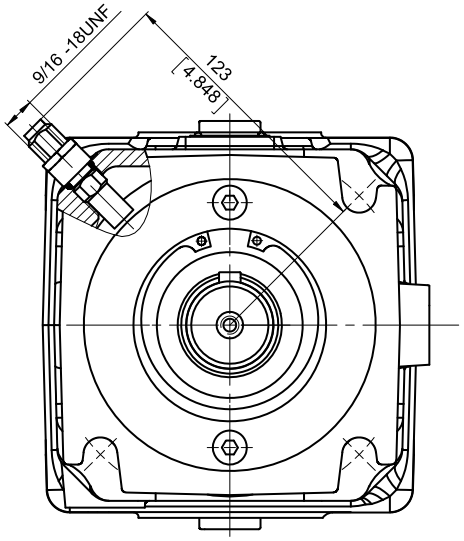


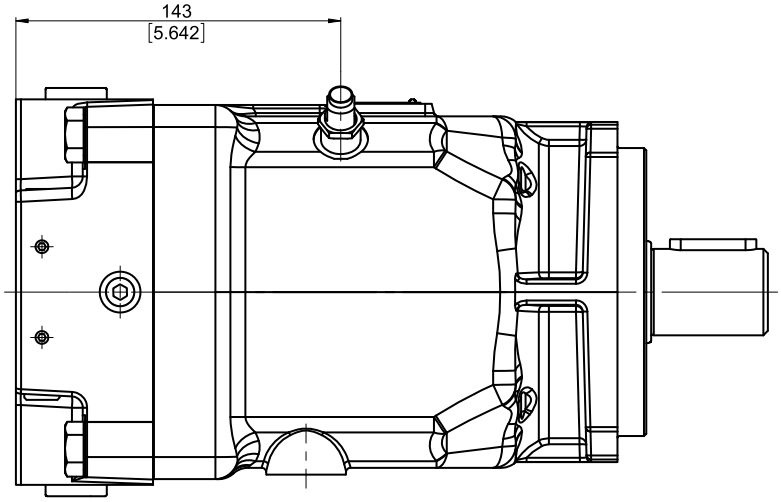
MAP50 and PAP50





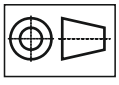
MAP100



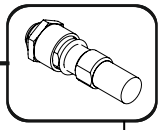


INSTALLATION

1. Turn in (CW) by hand until bottom end gently touches the speed ring.
2. Back out (CCW) 1/4 turn. Continue backing out until the flats are 22° either side of pump or motor shaft center line (20° to 30° is acceptable). Do not back out the sensor more than 3/4 of a turn from touching.
3. Using the 1/2 inch wrench to hold the sensor, torque the lock nut to 13[115] Nm [lb-in] with an 11/16 inch hew wrench.



mm [in]



Speed Sensors

TECHNICAL DATA OF THE SPEED SENSOR

TECHNICAL DATA

Power supply	4.5 ... 30 VDC
Power consummation	< 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
Frequence range	0 ... 15 000 Hz
Degree of protection	IP 67
Temperature	-40 ... + 100 °C
Humidity	0 ... 95% RH

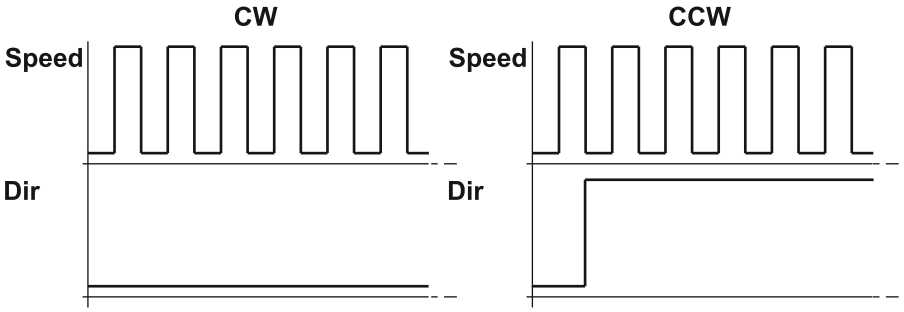
OUTPUT PULSES

per revolution

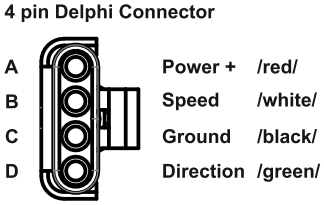
Motor Type	MAP28	MAP50	MAP100
Output Pulses	42	50	65

Pump Type	PAP50
Output Pulses	50

OUTPUT DIAGRAMS



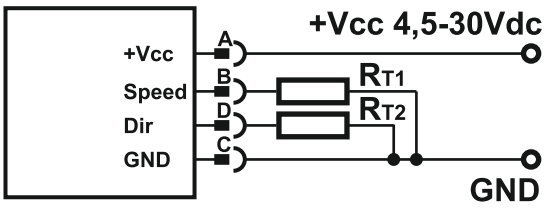
PIN CONNECTOR



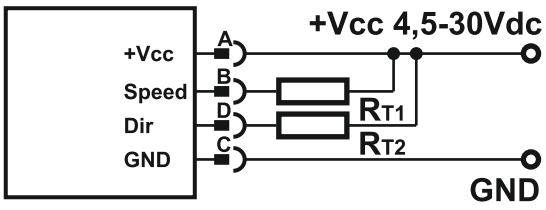
WIRING DIAGRAMS

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

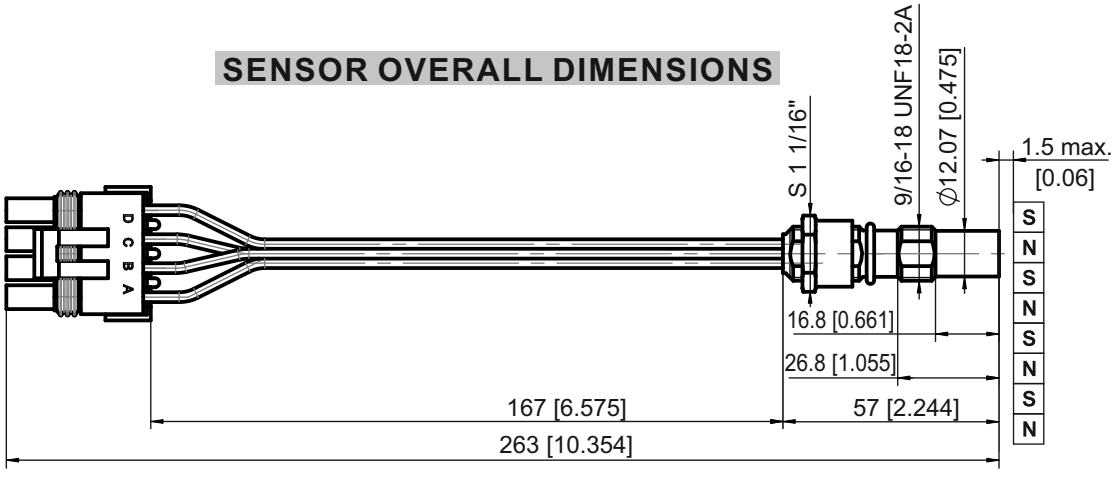
PNP



NPN



SENSOR OVERALL DIMENSIONS

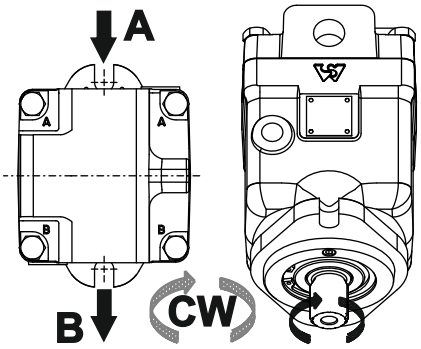


mm [in]

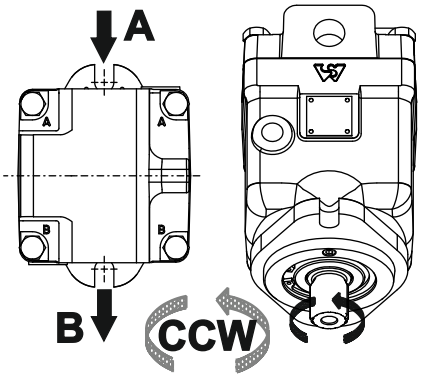
INSTALLATION

DIRECTION OF ROTATION

Standard Rotation
Viewed from shaft end
Port **A** Pressurized - **CW**
Port **B** Pressurized - **CCW**



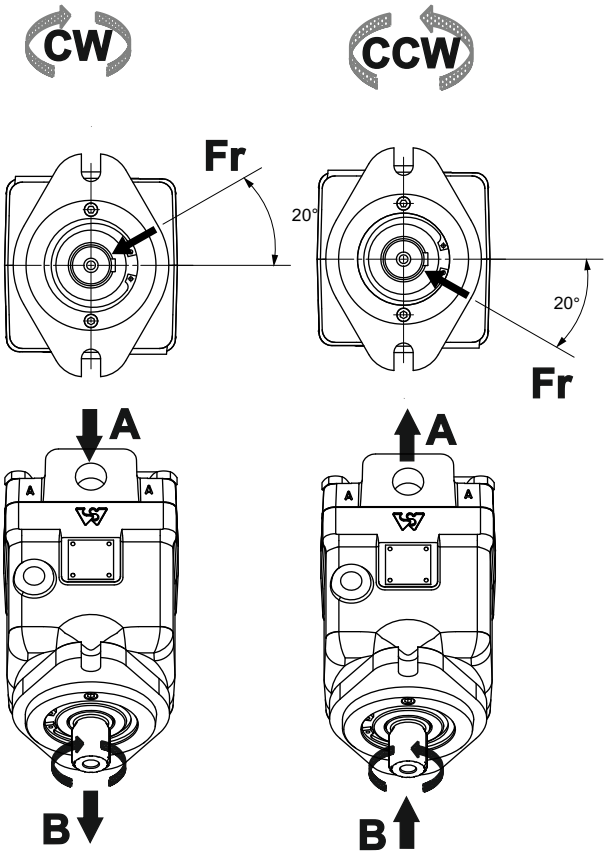
Reverse Rotation
Viewed from shaft end
Port **A** Pressurized - **CCW**
Port **B** Pressurized - **CW**



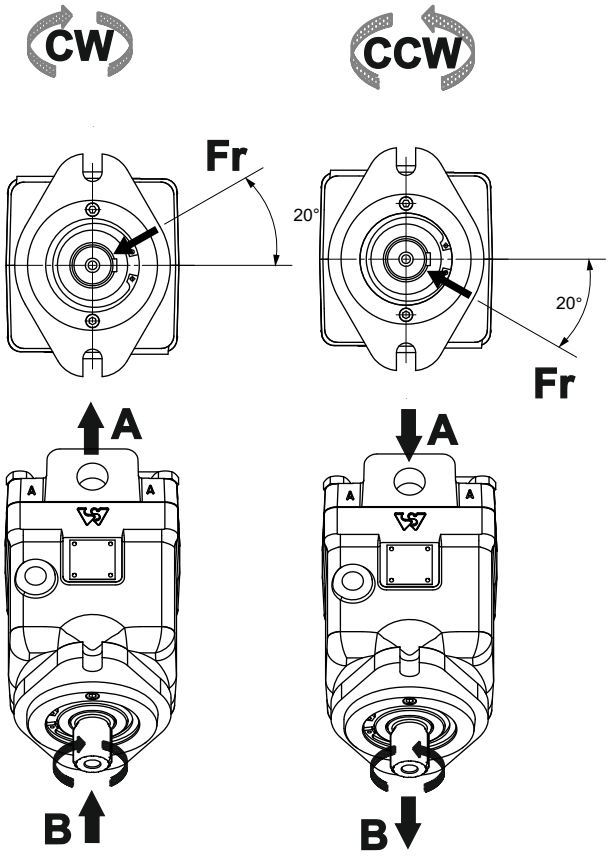
BEST POSITION FOR APPLYING RADIAL LOAD

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

Standard Rotation

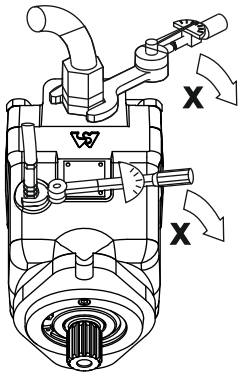


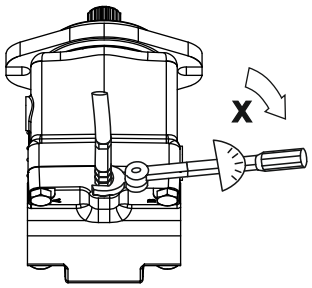
Reverse Rotation

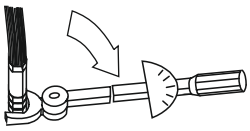
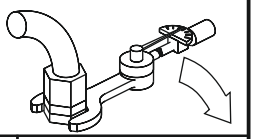


INSTALLATION

Recommended max. tightening torque X for metal plugs and orifice

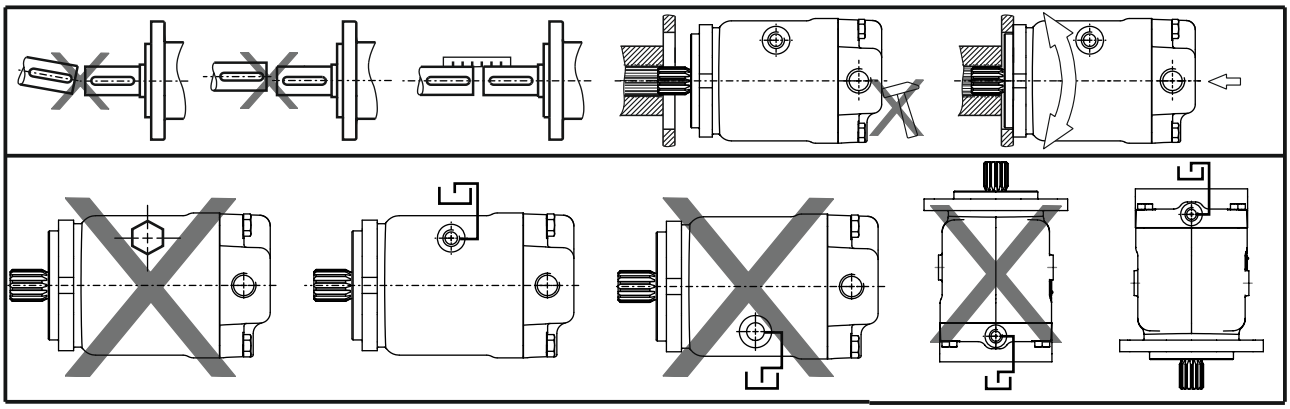




Screwed connection Anschlussart Raccord Tipo di collegamento Especie de unir Присоединительные резбы	 Max. Tightening Torque X, daNm [lb-in] Max. Anzugsmoment X, daNm [lb-in] Couple de serrage maxi X, daNm [lb-in] Momento di serraggio max. X, daNm [lb-in] Momento d'apretadura max. X, daNm [lb-in] Момент 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
G 1/4	2 [180]	3 [265]	4 [360]	2 [180]
G 3/8	2 [180]	5 [450]	6 [550]	2 [180]
G 1/2	3 [265]	8 [700]	10 [885]	3 [265]
G 3/4	5 [450]	13 [1150]	16 [1400]	5 [450]
G 1	8 [700]	20 [1770]	25 [2200]	8 [700]
1/8-14 UNF				7 [620]
3/8-24(16) UNF(UNC)				1,5 [130]
7/16-20(16) UNF				2 [180]
9/16-18 UNF				2 [180]
9/16-20 UNF				3.5 [310]
3/4-16 UNF				6 [550]
7/8-14(16) UNF				7 [620]
1 1/16-12 UN				9 [800]
1 5/16-12 UN				16 [1400]
1/2-14 NPTF				3 [265]
1/4-18 NPTF				3 [265]
M 8	2 [180]	1 [88.5]	2 [180]	
M 10	2 [180]	1 [88.5]	2 [180]	
M 12	2 [180]	3 [265]	4 [360]	
M 14x1,5	2 [180]	3 [265]	4 [360]	3 [265]
M 16x1,5	2 [180]	5 [450]	6 [550]	5 [450]
M 18x1,5	2 [180]	5 [450]	6 [550]	5 [450]
M 20x1,5	3 [265]	8 [700]	10 [885]	8 [700]
M 22x1,5	3 [265]	8 [700]	10 [885]	8 [700]
M 24x1,5	2 [180]	3 [265]	4 [360]	10 [885]
M 27x2	5 [450]	13 [1150]	10 [885]	10 [885]

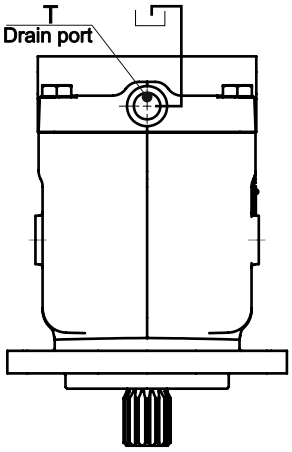
INSTALLATION

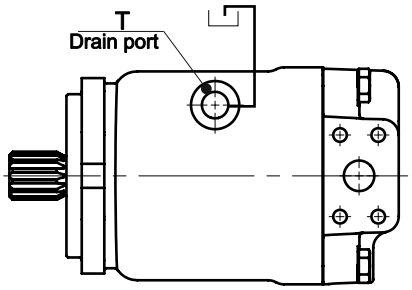
At start-up and during operation the motor(pump) housing has to be filled up with hydraulic fluid. Start-up has to be carried out at low or moderate speed and without load (for example 1000 rpm and pressure 50 bar [725 PSI]) till the motor(pump) and the hydraulic scheme are filled up with oil. Generally 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 bar.



Installation below the tank level (recommended)

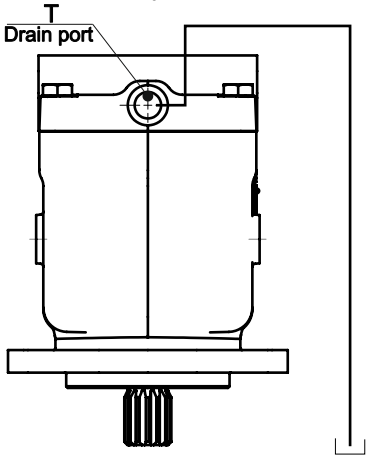
- Fill up the axial piston motor(pump) before the start-up through the highest positioned drain port T;
- Operate the motor(pump) at low speed till the motor system is completely filled up;
- The minimum immersion depth of the drain line in the tank is 200 mm relative to the minimum oil level in the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

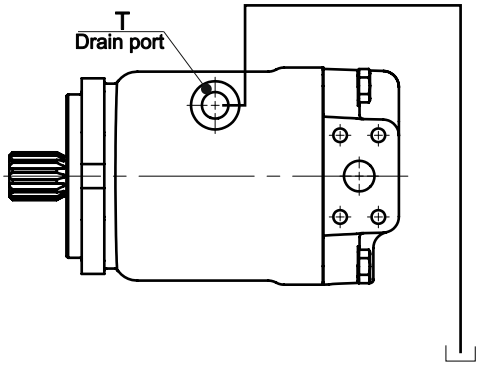




Installation on top of the tank level

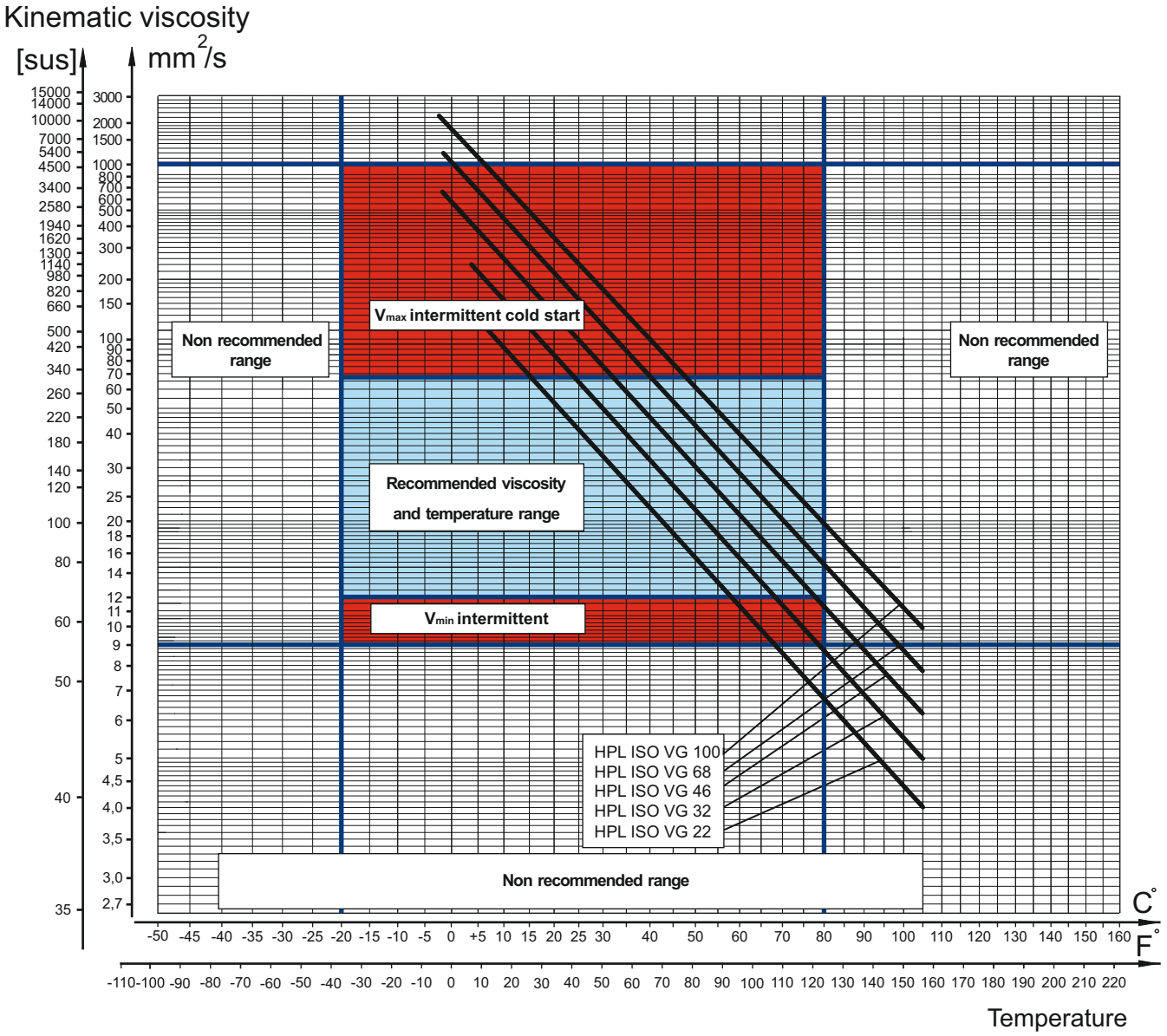
- Fill up the axial piston motor(pump) before the start-up through the highest positioned drain port T;
- Operate the motor(pump) at low speed till the motor system is completely filled up;
- The minimum immersion depth of the drain line in the tank is 200 mm relative to the minimum oil level in the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



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

Efficiency	$\eta_t = \eta_{mh} \cdot \eta_v \quad \eta_{mh} = \frac{\eta_t}{\eta_v} \quad \eta_v = \frac{\eta_t}{\eta_{mh}}$	
Input flow (for Motor)	$Q = \frac{Vg \cdot n}{1000 \cdot \eta_v}$	[l/min]
Output torque (for Motor)	$M = \frac{Vg \cdot \Delta p \cdot \eta_{mh}}{62.8}$ or $M = \Delta p \cdot T_{con.}$	[Nm]
Output power (for Motor)	$P = \frac{M \cdot n}{9550} = \frac{Q \cdot \Delta p \cdot \eta_t}{60}$	[kW]
Speed (for Motor)	$n = \frac{Q \cdot 1000 \cdot \eta_v}{Vg}$ or $n = Q \cdot N_{con.}$	[min^{-1}]
Output flow (for pump)	$Q = \frac{Vg \cdot n \cdot \eta_v}{1000}$	[l/min]
Driving torque (for pump)	$M = \frac{Vg \cdot \Delta p}{62.8 \cdot \eta_{mh}}$	[Nm]
Input power (for pump)	$P = \frac{M \cdot n}{9550} = \frac{Q \cdot \Delta p}{60 \cdot \eta_t}$	[kW]

Vg =	Displacement per rev.	[cm^3]
Δp =	$p_{HP} - p_{LP}$	[bar]
p_{HP} =	High pressure	[bar]
p_{LP} =	Low pressure	[bar]
n =	Rotation speed	[RPM]
Q =	Oil flow	[l/min]
$T_{con.}$ =	Toque constant	[Nm/bar]
$N_{con.}$ =	Speed constant	[RPM/(l/min)]
η_v =	Volumetric efficiency	
η_{mh} =	Mechanical-hydraulic efficiency	
η_t =	Overall efficiency	

Inch System

Efficiency	$\eta_t = \eta_{mh} \cdot \eta_v \quad \eta_{mh} = \frac{\eta_t}{\eta_v} \quad \eta_v = \frac{\eta_t}{\eta_{mh}}$	
Input flow (for Motor)	$Q = \frac{Vg \cdot n}{231 \cdot \eta_v}$	[GPM]
Output torque (for Motor)	$M = \frac{Vg \cdot \Delta p \cdot \eta_{mh}}{2.\pi}$ or $M = \Delta p \cdot T_{con.}$	[lb-in]
Output power (for Motor)	$P = \frac{Vg \cdot n \cdot \Delta p \cdot \eta_t}{396000}$	[hp]
Speed (for Motor)	$n = \frac{Q \cdot 231 \cdot \eta_v}{Vg}$ or $n = Q \cdot N_{con.}$	[min^{-1}]
Output flow (for pump)	$Q = \frac{Vg \cdot n \cdot \eta_v}{231}$	[GPM]
Driving torque (for pump)	$M = \frac{Vg \cdot \Delta p}{2.\pi \cdot \eta_{mh}}$	[lb-in]
Input power (for pump)	$P = \frac{Vg \cdot n \cdot \Delta p}{396000 \cdot \eta_t}$	[hp]

Vg =	Displacement per rev.	[in^3]
Δp =	$p_{HP} - p_{LP}$	[PSI]
p_{HP} =	High pressure	[PSI]
p_{LP} =	Low pressure	[PSI]
n =	Rotation speed	[RPM]
Q =	Oil flow	[GPM]
$T_{con.}$ =	Toque constant	[lb-in/PSI]
$N_{con.}$ =	Speed constant	[RPM/GPM]
η_v =	Volumetric efficiency	
η_{mh} =	Mechanical-hydraulic efficiency	
η_t =	Overall efficiency	

Application Formulas

Motor speed: n [RPM]

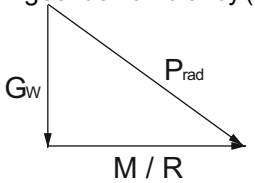
$$n = \frac{2{,}65 \cdot v_{km} \cdot i}{R_m} \qquad n = \frac{168 \cdot v_{mi} \cdot i}{R_{in}}$$

v_{km} - vehicle speed [km/h]
v_{mi} - vehicle speed [mil/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.

Radial motor loading: P_{rad}, N [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 ring.

G_W - Weight held by the shaft
P_{rad} - Total radial load of the motor shaft
M/R- Motion force

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



Total tractive effort: TE, N [lbs]
Total tractive effort **TE** is the total effort necessary for vehicle motion i.e. the sum of the calculated forces increased by 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)

Motor Torque moment: M, Nm [lb-in]
Necessary torque for the hydraulic motor:

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

I – motor numbers
η_M - mechanical gearbox efficiency (if it is available)

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

Notes

WARRANTY

M+S Hydraulic warrants, that its products, supplied directly to original equipment manufacturer, authorized distributor or other customer, will be free of defects in material or workmanship at the time of shipment from M+S Hydraulic and will conform to the products technical documentation (drawings and specifications) under sale agreement with Buyer.

This warranty will apply only to defects appearing within applicable Warranty period, mentioned below. If Buyer notifies M+S Hydraulic within the Warranty period about any such defects, M+S, at its sole option will replace or repair the defective products or their parts found by M+S Hydraulic to be defective in material or workmanship.

THE FOREGOING LIMITED WARRANTY IS AVAILABLE ONLY IF “M+S HYDRAULIC” IS PROMPTLY NOTIFIED IN WRITTEN OF THE ALLEGED DEFECT AND DOES NOT COVER FAILURE TO FUNCTION CAUSED BY DAMAGE TO THE PRODUCT, IMPROPER INSTALLATION, UNREASONABLE USE OR ABUSE OF THE PRODUCT, FAILURE TO PROVIDE OR USE OF IMPROPER MAINTENANCE OR USUAL, DEGRADATION OF THE PRODUCT DUE TO PHYSICAL ENVIRONMENTS OF AN USUAL NATURE. THE FOREGOING REMEDIES ARE THE SOLE AND EXCLUSIVE REMEDIES AVAILABLE TO CUSTOMER. To facilitate the inspection, M+S Hydraulic may require return of the product/part, which Buyer claims to be defective.

M+S Hydraulic shall not be liable for labor costs or any other expenses incurred during the disassembling or reinstalling of the product/part.

In case the claimed products are returned to M+S Hydraulic in bad condition: dirty, disassembled, with damaged or missing parts during transportation, the warranty will be considered as not applicable and the products will not be liable to repair.

Warranty periods

New products: The Warranty period is limited to 24 consecutive months (2 years) from the date of production of the product.

Repaired products: If the product is repaired in M+S Hydraulic during its warranty period, the warranty period of the repaired item shall continue for the balance of original Warranty period or for a period equal to 50% of the original new product Warranty period, whichever is later.

Spare parts: The Warranty period for Spare parts is 12 consecutive months (1 year) from the dispatch date of such parts from M+S Hydraulic.

LIMITATION OF LIABILITY M+S Hydraulic's liability for claim of any kind, for loss or damage arising out of, connected with or resulting from an order, or from the performance or branch thereof, or from the design, manufacture, sale delivery, operation or use of any of its products shall be limited to, at M+S 's sole option, replacement, repair of any defective product or the issuance of a credit to Customer against any future purchases. Cash refunds will not be made under any circumstances and Customer will not be entitled to recover any damages of any kind against M+S Hydraulic, including but not limited to incidental or consequential damages, whether direct or indirect, known or unknown, foreseen or unforeseen.

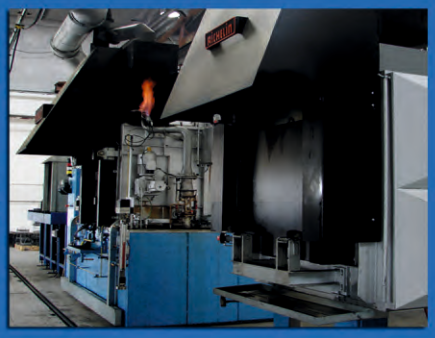
HES HYDRAULIC ELEMENTS AND SYSTEMS OVERVIEW



Hydraulic Elements and Systems PLC is a public stock company located in the town of Yambol, South-East Bulgaria. The factory has a long history and traditions in the design and manufacture of hydraulic cylinders. The product range includes Piston cylinders, Telescopic cylinders, Plunger cylinders and Rack cylinders.

M+S HYDRAULIC OVERVIEW





M+S Hydraulic is a leading manufacturer of Hydraulic Motors, Hydrostatic Steering Units and accessories, Hydraulic brakes Motor-brakes and Valve Blocks in Europe and all over the world.

The main advantage of our company is that we offer hydraulic solutions to the specific needs of the customers meeting their technical requirements thanks to the various product's options. M+S Hydraulic commodities are guaranteed with after-sales services, technical support and warranty period of 24 months.

M+S Hydraulic has an enlarging world-wide distributors' network. The company has Agency contracts and Consignment agreements with more than 35 companies in the world. We have the know-how to develop solutions for productivity and efficiency on every continent.

DEVOTED TO THE QUALITY


Certificate

Standard: ISO 9001:2008

Certificate Holder: M + S HYDRAULIC AD
8G – 6100 Kazanlak
68, Kozloduy Str.
Bulgaria

Scope: Design, production and distribution of low - speed high - torque planetary hydraulic motors, hydrostatic steering units and accessories.


BUREAU VERITAS Certification

M+S HYDRAULIC PLC
68, Kozlodui str., 6100 Kazanlak, Bulgaria

ISO 14001:2004

Design, production and distribution of low speed high torque planetary hydraulic motors, hydrostatic steering units and accessories.


BUREAU VERITAS Certification

M+S HYDRAULIC PLC
68, Kozlodui str., 6100 Kazanlak, Bulgaria

OHSAS 18001:2007

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РОССИЙСКАЯ ФЕДЕРАЦИЯ
СЕРТИФИКАТ СООТВЕТСТВИЯ