



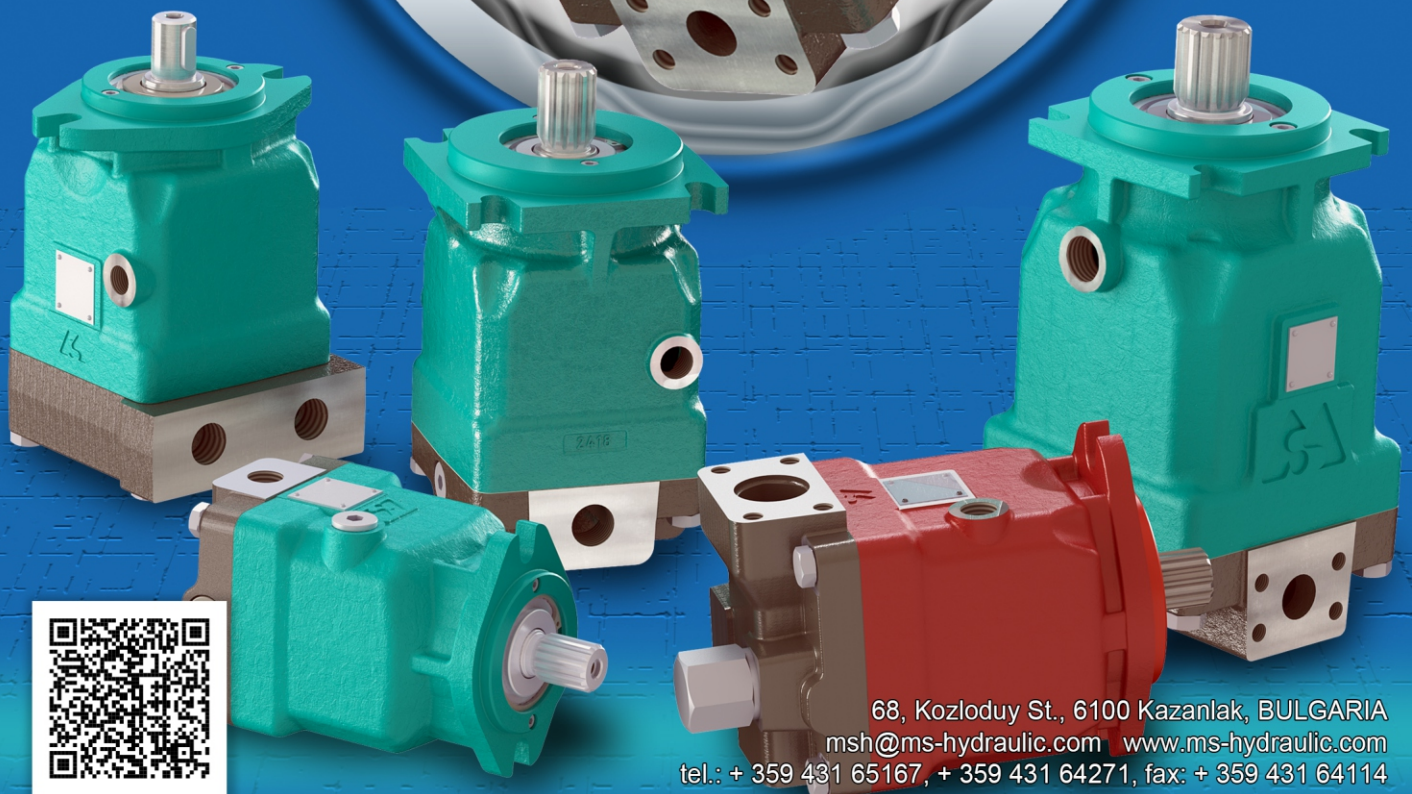
# MS HYDRAULIC

## AXIAL PISTON MOTORS AND PUMPS

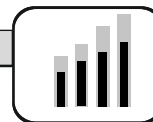
In cooperation with  **HES**  
HYDRAULIC ELEMENTS & SYSTEMS



**NEW**  
PRODUCTS



68, Kozloduy St., 6100 Kazanlak, BULGARIA  
msh@ms-hydraulic.com www.ms-hydraulic.com  
tel.: + 359 431 65167, + 359 431 64271, fax: + 359 431 64114



**CONTENT**

**Axial Piston Motors and Pumps Fixed Displacement**

**Technical Specification Guide.....3**

**Hydraulic motor MAP28 .....7**

**Hydraulic motor MAP50 .....19**

**Hydraulic motor MAP62 .....27**

**Hydraulic motor MAP100 .....39**

**Hydraulic motor MAPW62 .....51**

**Hydraulic pump PAP62 .....59**

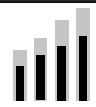
**Shaft dimensions .....68**

**Valves, Special Features, Application, Installation information, Diagrams and Formulas.....73**

**Version history**

| Date          | Page                                                                                       | Changed                                                                                                                                                                                                                                                                                                                                                                                                                           | Ver. |
|---------------|--------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| October 2018  |                                                                                            | Added series: MAP62 and MAPW62. Added displacements: 52, 58 and 62 PAP. Castings update.                                                                                                                                                                                                                                                                                                                                          | 2    |
| April 2018    |                                                                                            | Minor fixes                                                                                                                                                                                                                                                                                                                                                                                                                       | 1.4g |
| 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 | Additional options: Twin Side option for MAP28 and MAP100; Shaft types DR and DO for MAP50 and PAP50; Improved Bearing option for MAP28; Shaft type CM for MAP28; speed sensor option for MAP28, MAP50 , MAP100 and PAP50; addition valves for MAP28; port type 6 for MAP28; port type 9 for MAP28, MAP50 and MAP100. Correction of MAP50 ports. Change of the Specification Data of MAP28, MAP50, MAP100 and PAP50. Minor fixes. | 1.4  |
| July 2016     |                                                                                            | First official edition                                                                                                                                                                                                                                                                                                                                                                                                            | 1.3  |

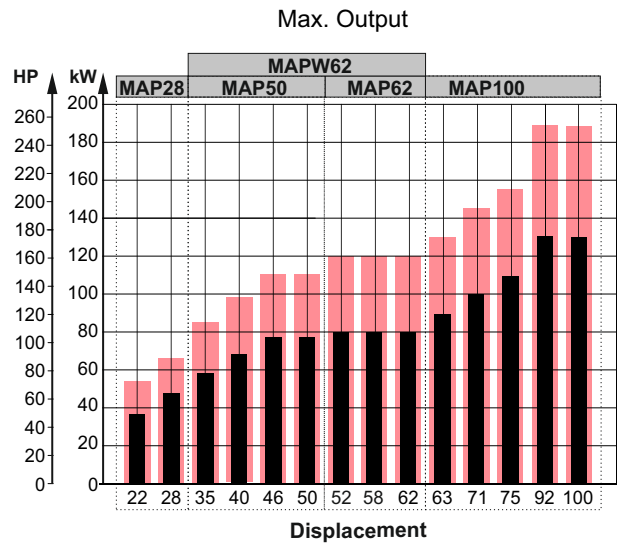
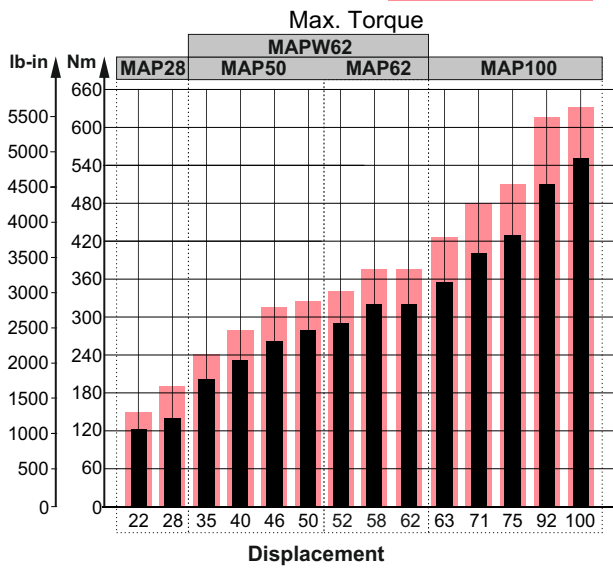
"M+S HYDRAULIC" takes no responsibility for possible errors in catalogues, brochures and other printed material. "M+S HYDRAULIC" reserves the right to alter its products without notice. This also applies to products already on order provided that such alterations can be made without subsequential changes being necessary in specifications already agreed.



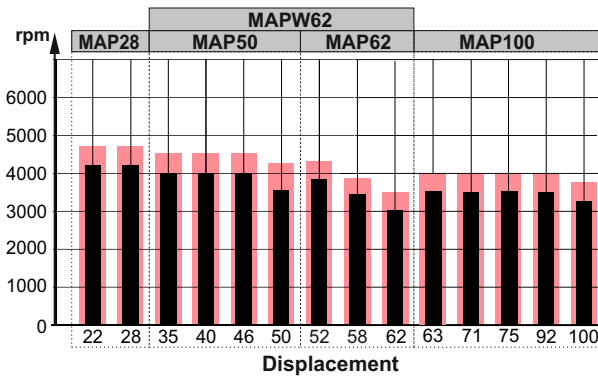
**SPECIFICATION DATA MOTORS TYPE MAP**

Intermittent values

Continuous values



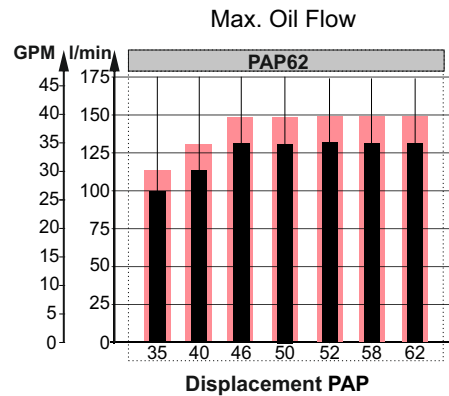
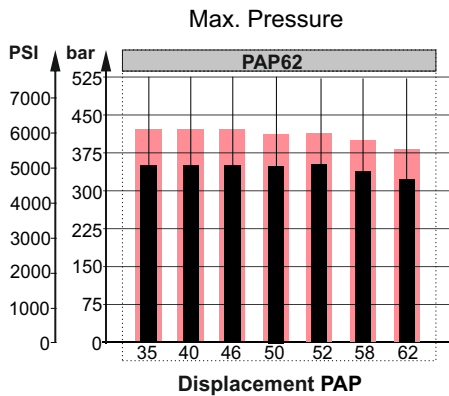
Max. Speed



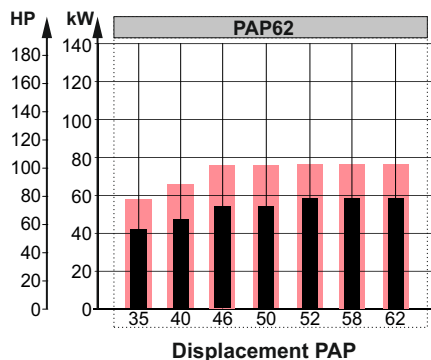
**Specification Data Pumps Type PAP**

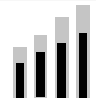
Intermittent values

Continuous values



Max. Output

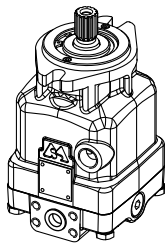
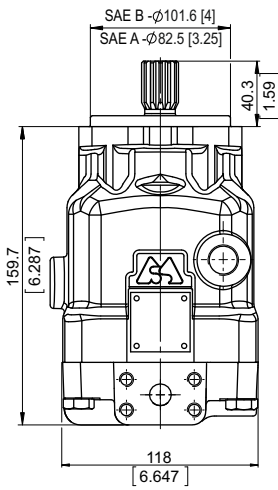




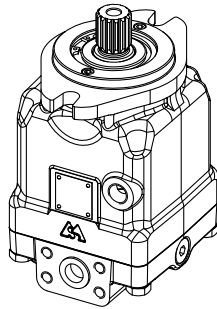
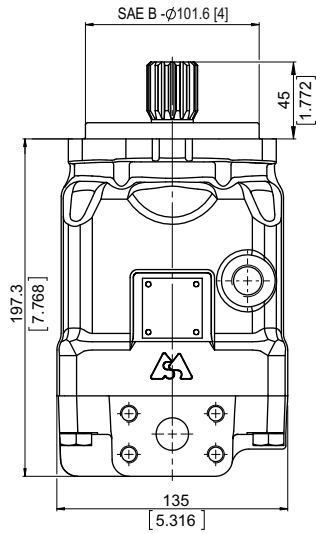
### MOTOR DIMENSIONS

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

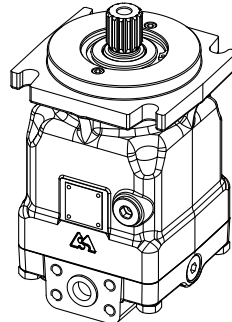
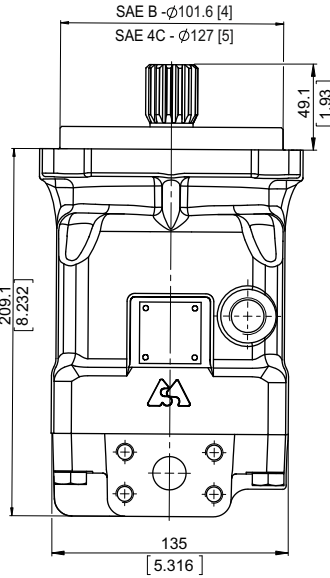
**MAP28**



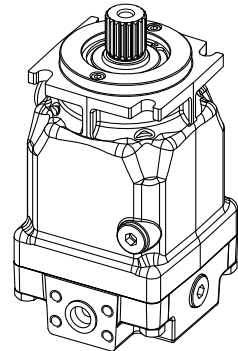
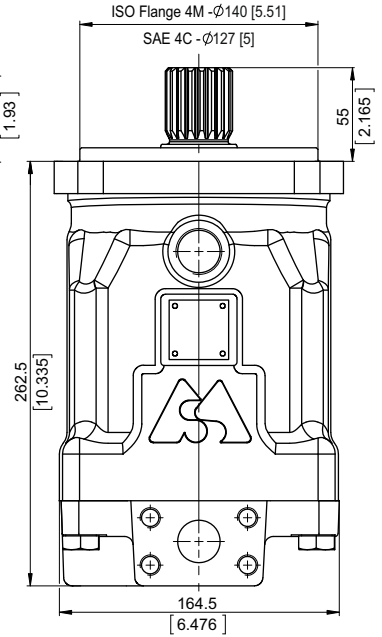
**MAP50**



**MAP62**



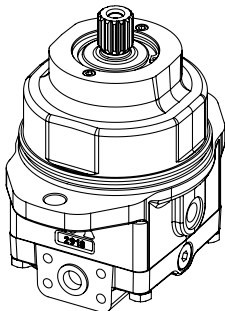
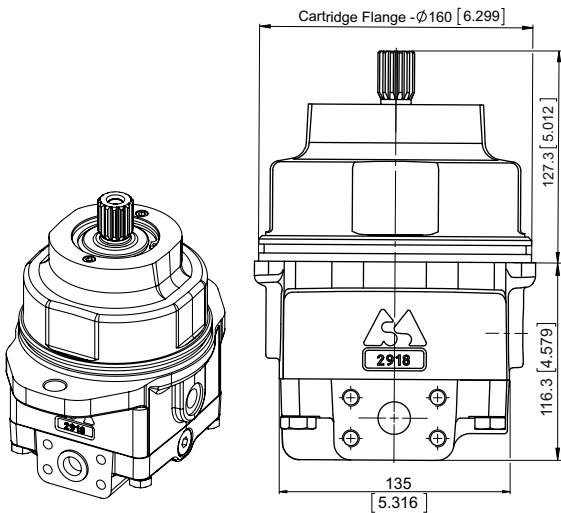
**MAP100**



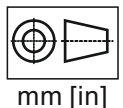
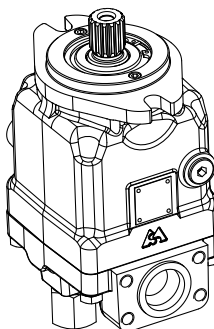
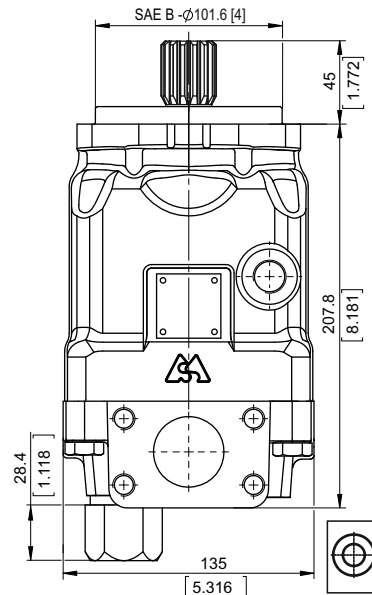
### PUMP DIMENSIONS

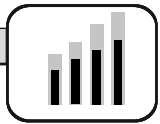
The below dimensions are for **comparison only**. The pumps can obtain different shafts and end covers.

**MAPW62**



**PAP62**





**PORT, SHAFT AND FLANGE TYPES**

**Cross Table - Flange Types**

| MAP28 | MAP50 | MAP62 | MAP100 | MAPW62 | PAP62 | Type of flanges                                                                      |
|-------|-------|-------|--------|--------|-------|--------------------------------------------------------------------------------------|
| x     |       |       |        |        |       | <b>A</b> - 2-Bolt, SAE A; SD-82.5[3.25"];BC-106.35 [4.19"]; BD-13.5 [0.53"]          |
| x     | x     | x     |        |        | x     | <b>B</b> - 2-Bolt, SAE B; SD-101.6[4"];BC-146 [5.748"]; BD-14.3 [0.563"]             |
|       |       | x     | x      |        |       | <b>4C</b> - 4-Bolt flange; SAE C; SD-127 [5"];BC-161.92 [6.375"]; BD-14.3 [0.563"]   |
|       |       |       | x      |        |       | <b>4M</b> - 4-Bolt flange; ISO 3019-2; SD-140 [5.51"];BC-180 [7.09"]; BD-15 [0.59"]  |
|       |       |       |        | x      |       | <b>Cartage</b> - 2-Bolt flange; Wheel flange cartage; SD-135[5.315"]; BC 155[6.102"] |

**Legend**

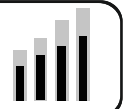
BC (Bolt Circle) - Center point of bolt holes  
BD (Bolt Diameter) - Diameter of bolt holes  
SD (Spigot Diameter) - Center Diameter

**Cross Table - Shaft Types**

| MAP28 | MAP50 | MAP62 | MAP100 | MAPW62 | PAP62 | Type of shafts                                                                                 |
|-------|-------|-------|--------|--------|-------|------------------------------------------------------------------------------------------------|
| x     | x     |       |        |        | x     | <b>SD</b> ø21.72 [0.855"] <b>Spline</b> SAE 13T 16/32 DP, M8 thread                            |
| x     | x     |       |        |        | x     | <b>GD</b> ø21.72 [0.855"] <b>Spline</b> SAE 13T 16/32 DP, 5/16-18 UNC thread                   |
| x     | x     | x     |        |        | x     | <b>SF</b> ø24.9 [0.98"] <b>Spline</b> SAE 15T 16/32, M8 thread                                 |
| x     | x     | x     |        |        | x     | <b>GF</b> ø24.9 [0.98"] <b>Spline</b> SAE 15T 16/32, 3/8-16 UNC thread                         |
|       | x     | x     |        | x      | x     | <b>SH</b> ø29.6 [1.165"] <b>Spline</b> W30x2x30x14x9g DIN, M10 thread                          |
|       | x     | x     |        |        | x     | <b>SK</b> ø31.75 [1.25"] <b>Spline</b> SAE 14T 12/24 DP, M10 thread                            |
|       | x     | x     |        |        | x     | <b>GK</b> ø31.75 [1.25"] <b>Spline</b> SAE 14T 12/24 DP, 7/16-14UNC thread                     |
|       | x     | x     |        |        | x     | <b>SP</b> ø34.5 [1.358"] <b>Spline</b> SAE 21T 16/32 DP, M12 thread                            |
|       |       |       | x      |        |       | <b>SR</b> ø37.6 [1.48"] <b>Spline</b> SAE 23T 16/32 DP, M12 thread                             |
|       |       |       | x      |        |       | <b>ST</b> ø39.6 [1.559"] <b>Spline</b> W40x2x30x18x9g DIN 5480, M12 thread                     |
|       |       |       | x      |        |       | <b>GU</b> ø44.43 [1.749"] <b>Spline</b> SAE 13T 8/16 DP, 3/8-16 UNC thread                     |
| x     | x     |       |        |        | x     | <b>CK</b> ø22.2 [7/8"] <b>Straight</b> , M8 thread, Parallel key 1/4"x1/4"x1" BS46             |
| x     | x     |       |        |        | x     | <b>MK</b> ø22.2 [7/8"] <b>Straight</b> , M8 thread, Parallel key 1/4"x1/4"x1 1/2" BS46         |
| x     | x     | x     |        |        | x     | <b>ML</b> ø25 [0.984"] <b>Straight</b> , M8 thread, Parallel key A8x7x25 DIN6885               |
| x     | x     | x     |        |        | x     | <b>CM</b> ø25.4 [1"] <b>Straight</b> , M8 thread, Parallel key 1/4"x1/4"x1" BS46               |
|       | x     | x     |        |        | x     | <b>DO</b> ø28.75 [1.125"] <b>Straight</b> , key 7.95[5/16"] , L31.7[1 1/4"], 3/8-16 UNC thread |
|       | x     | x     |        |        | x     | <b>CQ</b> ø30 [1.181"] <b>Straight</b> , M8 thread, Parallel key A8x7x32 DIN6885               |
|       | x     | x     |        |        | x     | <b>DR</b> ø31.75 [1.25"] <b>Straight</b> , key 7.95[5/16"] , L31.7[1 1/4"], 3/8-16 UNC thread  |
|       | x     | x     |        |        | x     | <b>CS</b> ø32 [1.26"] <b>Straight</b> , M8 thread, Parallel key A10x8x45 DIN6885               |
|       |       |       | x      |        |       | <b>DU</b> ø38.1[1.5"] <b>Straight</b> , key 9.528[0.375"] , L38.1[1.5"], 3/8-16 UNC thread     |
|       |       |       | x      |        |       | <b>CV</b> ø40 [1.575"] <b>Straight</b> , M12 thread, Parallel key A12x8x63 DIN6885             |
| x     | x     |       |        |        | x     | <b>TD</b> ø22.22 [7/8"] <b>Tapered</b> 1:8 [125:1000], Parallel key 1/4"x1/4"x1", 5/8-18 UNF   |
|       | x     | x     |        |        | x     | <b>TH</b> ø25.4 [1"] <b>Tapered</b> 1:8 [125:1000], Parallel key 1/4"x 1/4"x1", 3/4-16 UNF     |
|       | x     | x     |        |        | x     | <b>KH</b> ø25.4 [1"] <b>Tapered</b> 1:8 [125:1000], Parallel key 1/4"x1/4"x1", M16x1.5 thread  |
|       |       |       | x      |        |       | <b>TN</b> ø31.75 [1.25"] <b>Tapered</b> 125:1000, key 5/16x5/16 L 1 1/8, 1-12 UNF thread       |

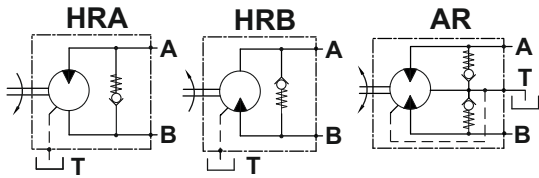
**Cross Table - Port Types**

| PORTS SIZE - THREAD OPTION |         |         |         |         |         | Type of threads                                                                  |
|----------------------------|---------|---------|---------|---------|---------|----------------------------------------------------------------------------------|
| MAP28                      | MAP50   | MAP62   | MAP100  | MAPW62  | PAP62   |                                                                                  |
| default                    |         |         |         |         |         | 2xISO 6162-2 DN13, metric, drain ports M18x1.5                                   |
|                            | default | default |         | default |         | 2xISO 6162-2 DN19, metric, drain ports M18x1.5                                   |
|                            |         |         | default |         |         | 2xISO 6162-2 DN25, metric, drain ports M27x2, rear drain ports M22x1.5           |
| 5                          |         |         |         |         |         | 2xSAE 1/2" PSI6000, drain ports 3/4-16 UNF                                       |
|                            | 5       | 5       |         | 5       |         | 2xSAE 3/4" PSI6000, SAE, drain ports 7/8-14 UNF                                  |
|                            |         |         | 5       |         |         | 2xSAE 1", PSI6000, drain ports 1 1/8 UNF, rear drain port 7/8-14 UNF             |
| 2                          | 6       |         |         |         |         | 2xG1/2, drain ports G1/2                                                         |
| 6                          | 2       | 2       |         | 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                                                       |
|                            | 3       | 3       |         | 3       |         | 2xM27x2, drain ports M18x1.5                                                     |
| 4                          | 8       |         |         |         |         | 2x7/8-14 UNF Ports, drain ports 3/4-16 UNF                                       |
|                            | 4       | 4       |         | 4       |         | 2x1 1/8 -12 UN, drain ports 7/8-14 UNF                                           |
|                            |         |         | 4       |         |         | 2x1 5/8 -12 UN Ports, drain ports 1 1/8 -12 UN , 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       | 9       |         | 9       |         | 2xISO 6162-2 DN19, drain ports G1/2                                              |
|                            |         |         | 9       |         |         | 2xISO 6162-2 DN25, drain ports G3/4, rear drain port G1/2                        |

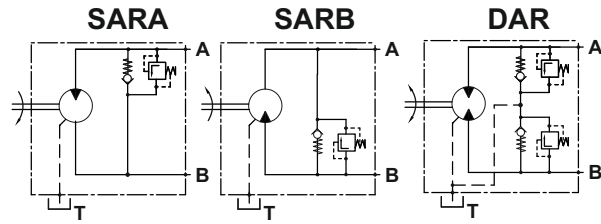


**VALVE OPTIONS**

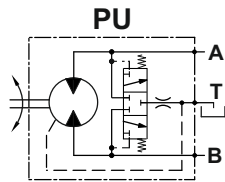
**Anti-Cavitation Valve**



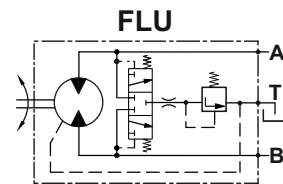
**Combined Anti-Cavitation and Relief Valve**



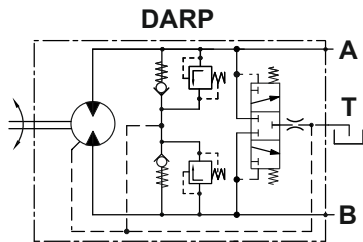
**Purge Valve**



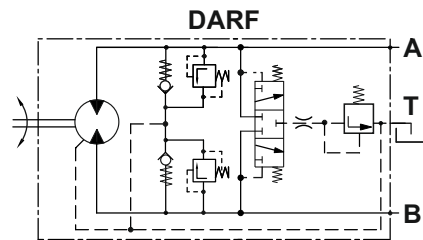
**Flush Valve**



**Dual Anti-Cavitation, Relief and Purge Valve**



**Dual Anti-Cavitation, Relief and Flush Valve**



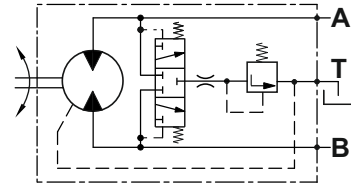
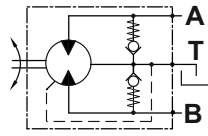
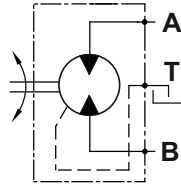
**Cross Table - Valve Types**

| Type of valves | MAP28 |   |   | MAP50 |   |   | MAP62 |   |   | MAP100 |   |   | MAPW62 |   |   |
|----------------|-------|---|---|-------|---|---|-------|---|---|--------|---|---|--------|---|---|
|                | omit  | T | E | omit  | T | E | omit  | T | E | omit   | T | E | omit   | T | E |
| HRA            | x     | x | x | x     | x | x | x     | x | x | x      | x | x | x      | x | x |
| HRB            | x     | x | x | x     | x | x | x     | x | x | x      | x | x | x      | x | x |
| AR             | x     | x |   | x     | x | x | x     | x | x | x      | x | x | x      | x | x |
| SARA           | x     | x |   | x     | x | x | x     | x | x | x      | x | x | x      | x | x |
| SARB           | x     | x |   | x     | x | x | x     | x | x | x      | x | x | x      | x | x |
| DAR            | x     | x |   | x     | x | x | x     | x | x | x      | x | x | x      | x | x |
| PU             | x     | x | x | x     | x | x | x     | x | x | x      | x | x | x      | x | x |
| FLU            | x     | x | x | x     | x | x | x     | x | x | x      | x | x | x      | x | x |
| DARP           |       | x |   | x     | x |   | x     | x |   | x      | x | x | x      | x |   |
| DARF           |       | x |   | x     | x |   | x     | x |   | x      | x | x | x      | x |   |



# 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

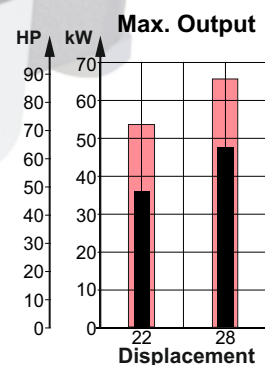
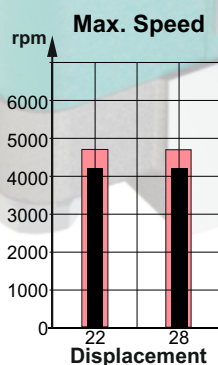
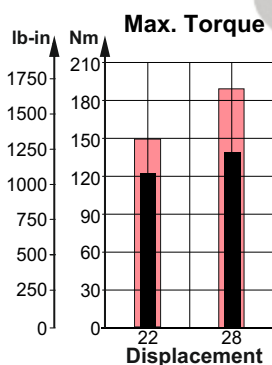
- » Swash plate
- » Flange options
- » Port options
- » Shaft options
- » High pressure ports
- » Integrated valves

### ADVANTAGES

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

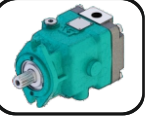
### GENERAL

|                          |                                                                    |                         |
|--------------------------|--------------------------------------------------------------------|-------------------------|
| Displacement,            | cm <sup>3</sup> /rev [in <sup>3</sup> /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 <sup>2</sup> /s [SUS]                                           | 12÷68 [66÷311]          |
| Filtration               | ISO code 18/16/13 (Min. recommended fluid filtration of 10 micron) |                         |

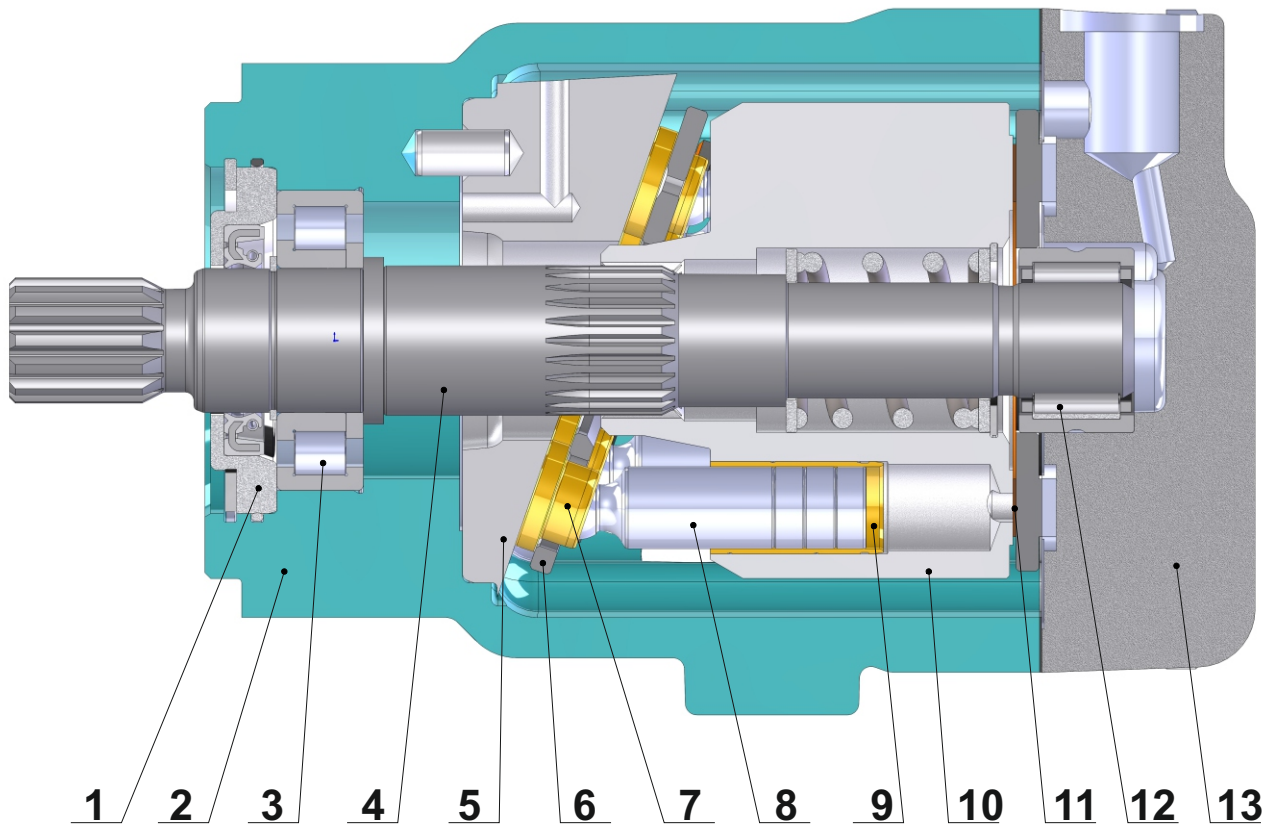


Intermittent values

Continuous values



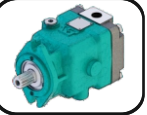
## SECTION VIEW



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

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




**SPECIFICATION DATA**

| Type                                                                    |                                               | MAP<br>22                                       | MAP<br>28       |
|-------------------------------------------------------------------------|-----------------------------------------------|-------------------------------------------------|-----------------|
| Displacement,<br>cm. <sup>3</sup> /rev. [in. <sup>3</sup> /rev.]        |                                               | 22.15<br>[1.35]                                 | 28.47<br>[1.74] |
| Max. Speed,<br>[RPM]                                                    | Cont.                                         | 4200                                            | 4200            |
|                                                                         | Int.*                                         | 4700                                            | 4700            |
| Max. Torque,**<br>Nm [lb-in]                                            | Cont.                                         | 123 [1088]                                      | 159 [1407]      |
|                                                                         | Int.**                                        | 148 [1310]                                      | 190 [1682]      |
| Output,<br>kW [HP]                                                      | Cont.                                         | 37 [50]                                         | 48 [64]         |
|                                                                         | Int.**                                        | 54 [72]                                         | 70 [94]         |
| Max. Pressure,<br>bar [PSI]                                             | Cont.                                         | 350 [5080]                                      | 350 [5080]      |
|                                                                         | Int.**                                        | 420 [6100]                                      | 420 [6100]      |
|                                                                         | Peak                                          | 450 [6527]                                      | 450 [6527]      |
| Max. Oil Flow,<br>l/min[GPM]                                            | Cont.                                         | 93 [24.6]                                       | 120 [31.7]      |
|                                                                         | Int.*                                         | 104 [27.5]                                      | 134 [35.4]      |
| Torque Constant *****<br>Nm/bar [lb-in/PSI]                             |                                               | 0.32<br>[0.194]                                 | 0.41<br>[0.25]  |
|                                                                         | Speed Constant *****<br>RPM/(l/min) [RPM/GPM] | 42.9<br>[162.4]                                 | 33.4<br>[126.3] |
| Permissible Shaft Load<br>(for standard bearing)<br>max Axial**** N[lb] |                                               | Fa=1300 [292]                                   |                 |
|                                                                         | max Radial**** N[lb]                          | Fr=2200 [495]                                   |                 |
| Min. Speed, [RPM]                                                       |                                               | 500                                             |                 |
| Max. Pressure in<br>Drain Line, bar [PSI]                               |                                               | 5 [70]<br>open drain line is<br>always required |                 |
| Weight, kg [lb]                                                         |                                               | 10.79 [23.79] for SAE-A flange                  |                 |
|                                                                         |                                               | 11.50 [25.35] for SAE-B flange                  |                 |

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

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

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

\*\*\* Theoretical torque;

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

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

1. The recommended output power for continuous operations should not be exceeded.
2. Recommended filtration as per ISO 4406 cleanliness code 18/16/13 or better. This filtration corresponds to SAE AS 4059 8A/7B/7C. Nominal filtration - 10 micron or better.
3. Recommended a premium quality, anti-wear type mineral based hydraulic oil, HLP(DIN51524) or HM(ISO6743/4).
4. Recommended oil viscosity - 12...68 cSt or see page 81.
5. Recommended maximum system operating temperature - 82°[180°] C[F].
6. To ensure optimum life of the motor, fill it up with fluid prior to load it and run with moderate load and speed for about 10-15 minutes.

Hint: Motor Torque = Torque Constant \* Pressure Drop

Rotation Speed = Speed Constant \* Oil Flow

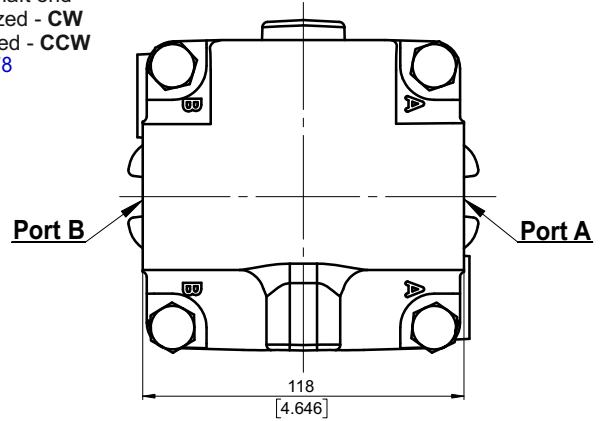
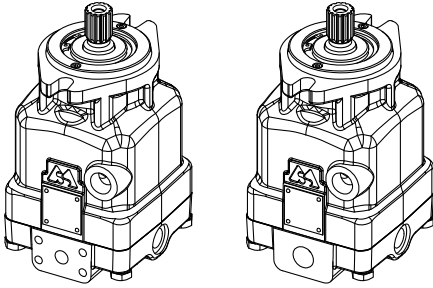
The constant values are approximate. Motor torque and rotation speed for a particular project are depending on the real operating conditions. For more detailed calculations please see efficiencies on next page and formulas on page 82.



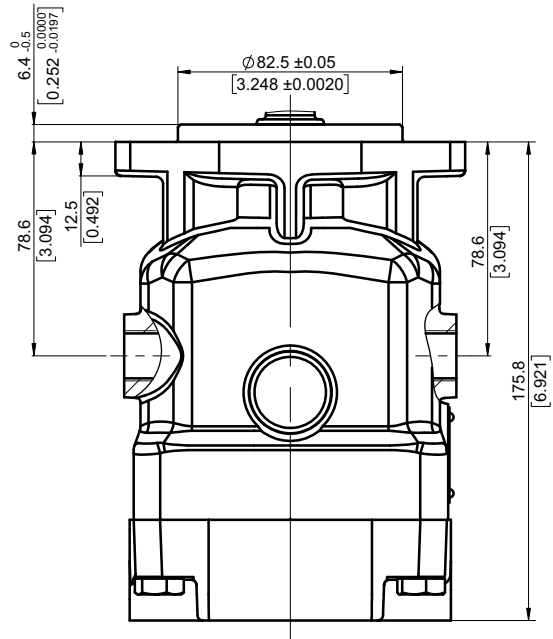
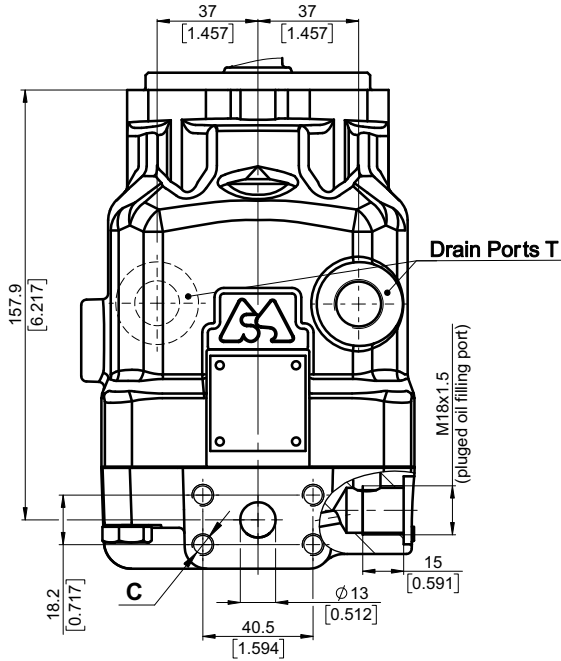
**OVERALL DIMENSIONS AND PORTS**

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

**Standard Rotation**  
Viewed from shaft end  
Port A Pressurized - CW  
Port B Pressurized - CCW  
see page 78

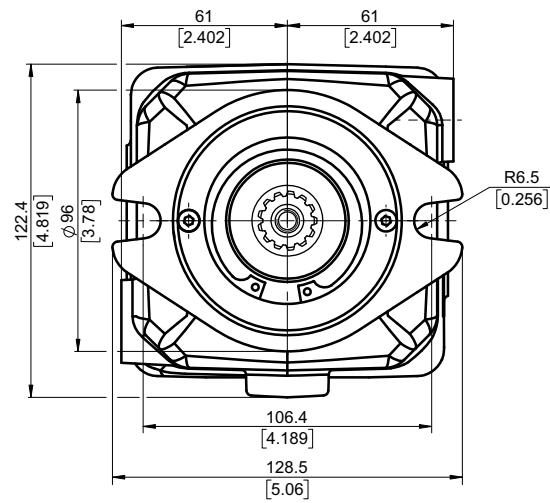
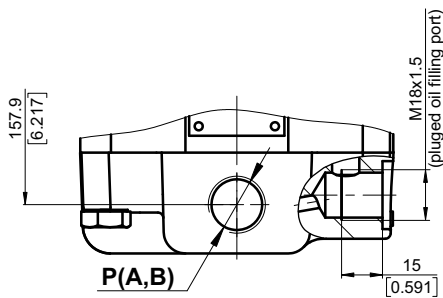


**Side ports, port size default, 5 and 9**



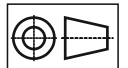
|                    | Port Size         |                         |                   |
|--------------------|-------------------|-------------------------|-------------------|
|                    | default           | 5                       | 9                 |
| P <sub>(A,B)</sub> | 2xISO 6162-2 DN13 | 2xSAE J518 1/2" PSI6000 | 2xISO 6162-2 DN13 |
| T                  | M18x1.5           | 3/4-16 UNF              | G1/2              |
| C                  | 8xM8              | 8x5/16-18 UNC           | 8xM8              |

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

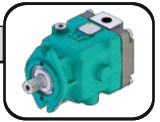


|                    | Port Size |           |             |         |
|--------------------|-----------|-----------|-------------|---------|
|                    | 2         | 3         | 4           | 6       |
| P <sub>(A,B)</sub> | 2xG 1/2   | 2xM22x1.5 | 2x7/8-14UNF | 2xG 3/4 |
| T                  | G 1/2     | M18x1.5   | 3/4-16UNF   | G 1/2   |

Shaft Mounting  
see page 13



mm [in]

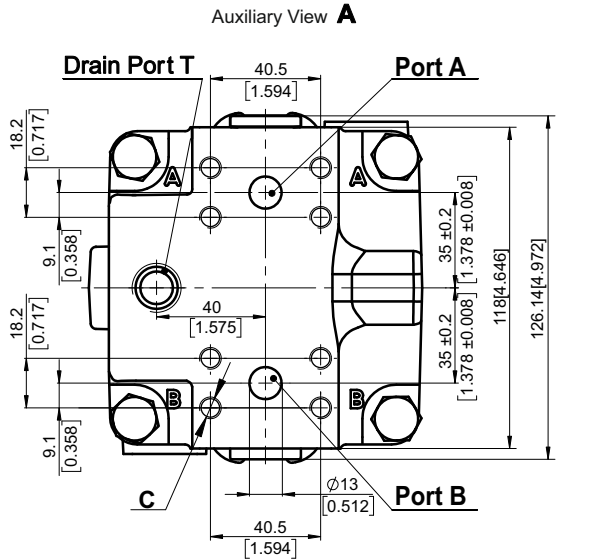


**OVERALL DIMENSIONS AND PORTS**

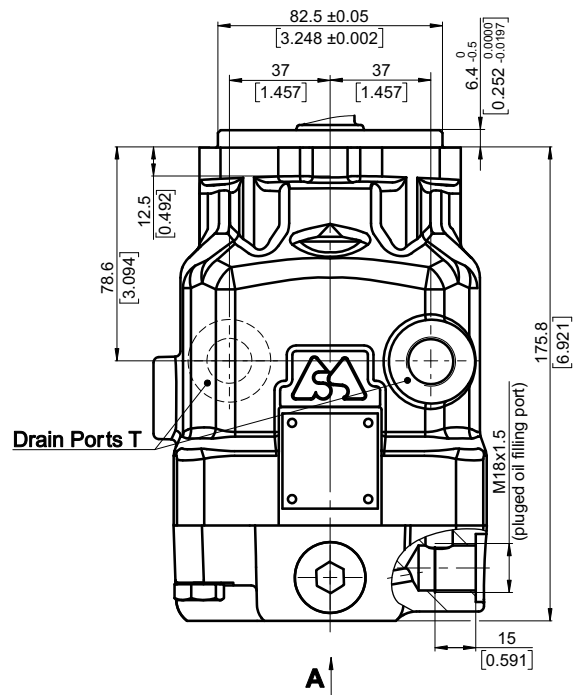
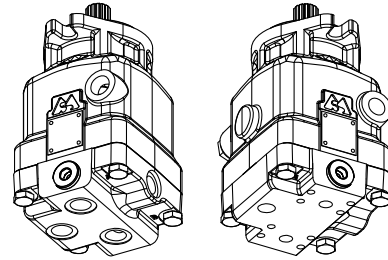
**Rear Ports - Type E Mounting Flange - Type SAE-A**

**Standard Rotation**  
Viewed from shaft end  
Port A Pressurized - CW  
Port B Pressurized - CCW  
see page 78

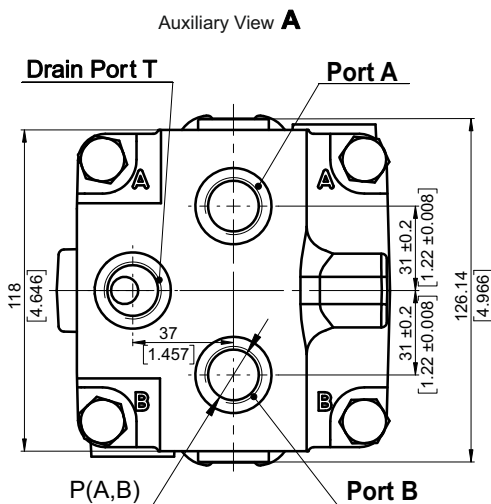
**Rear ports E, port size default, 5 and 9**



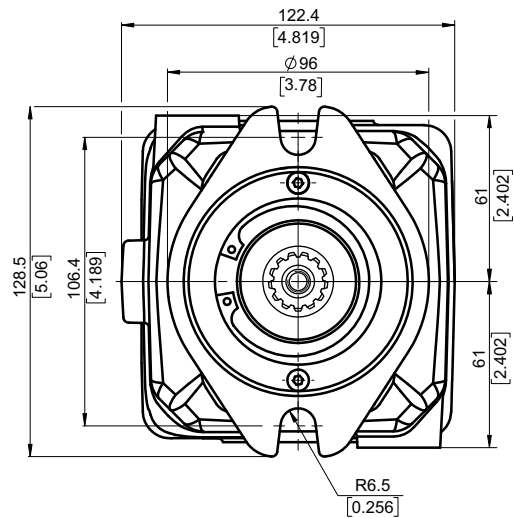
|                    | Port Size         |                         |                   |
|--------------------|-------------------|-------------------------|-------------------|
|                    | default           | 5                       | 9                 |
| P <sub>(A,B)</sub> | 2xISO 6162-2 DN13 | 2xSAE J518 1/2" PSI6000 | 2xISO 6162-2 DN13 |
| T                  | M18x1.5           | 3/4-16 UNF              | G1/2              |
| C                  | 8xM8              | 8x5/16-18 UNC           | 8xM8              |



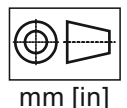
**Rear ports E, port size 2, 3, 4 and 6**



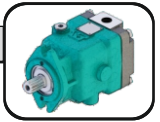
|                    | Port Size |           |              |         |
|--------------------|-----------|-----------|--------------|---------|
|                    | 2         | 3         | 4            | 6       |
| P <sub>(A,B)</sub> | 2xG 1/2   | 2xM22x1.5 | 2x7/8-14 UNF | 2xG 3/4 |
| T                  | G 1/2     | M18x1.5   | 3/4-16 UNF   | G 1/2   |



Shaft Mounting  
see page 13



mm [in]



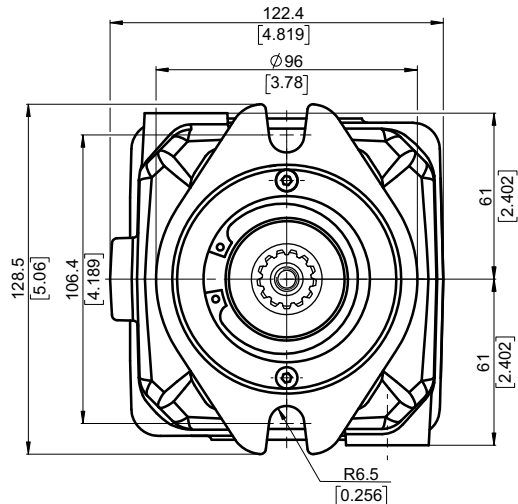
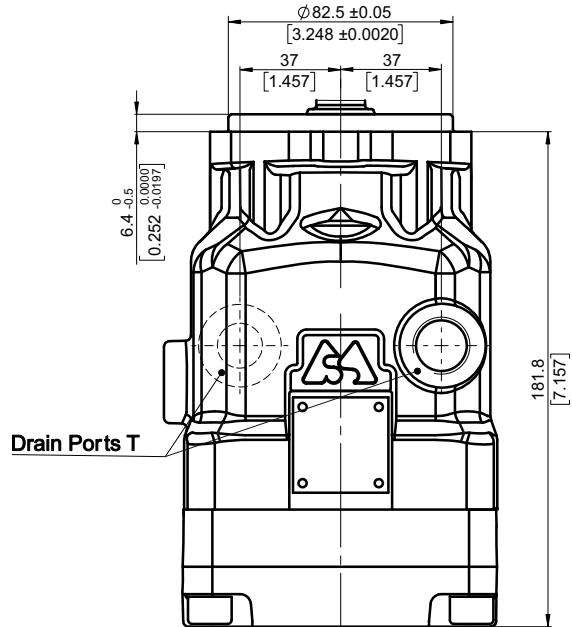
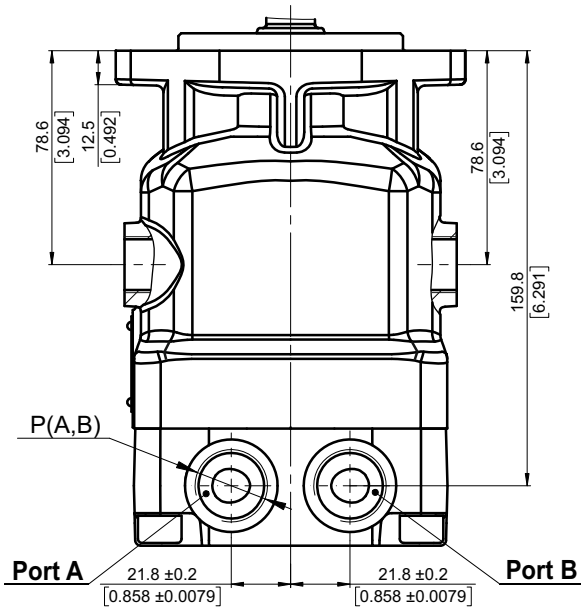
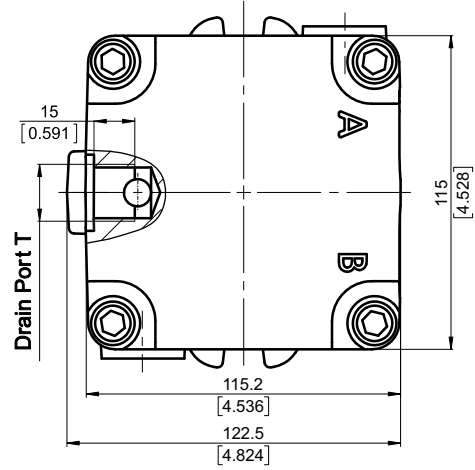
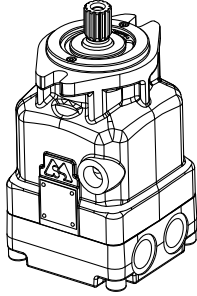
**OVERALL DIMENSIONS AND PORTS**

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

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

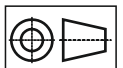
See the port sizes at the bottom of this page

**Standard Rotation**  
Viewed from shaft end  
Port A Pressurized - CW  
Port B Pressurized - CCW  
see page 78

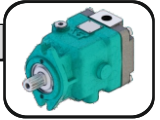


|                    |  | Port Size |           |             |         |
|--------------------|--|-----------|-----------|-------------|---------|
|                    |  | 2         | 3         | 4           | 6       |
| P <sub>(A,B)</sub> |  | 2xG 1/2   | 2xM22x1.5 | 2x7/8-14UNF | 2xG 3/4 |
| T                  |  | G 1/2     | M18x1.5   | 3/4-16UNF   | G 1/2   |

Shaft Mounting  
see the next page

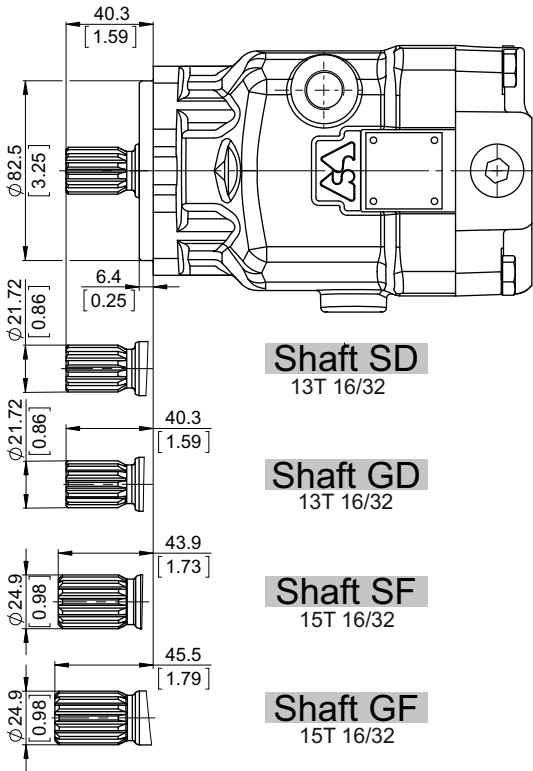


mm [in]



**SHAFTS MOUNTING**

**Mounting Flange - Type SAE-A**

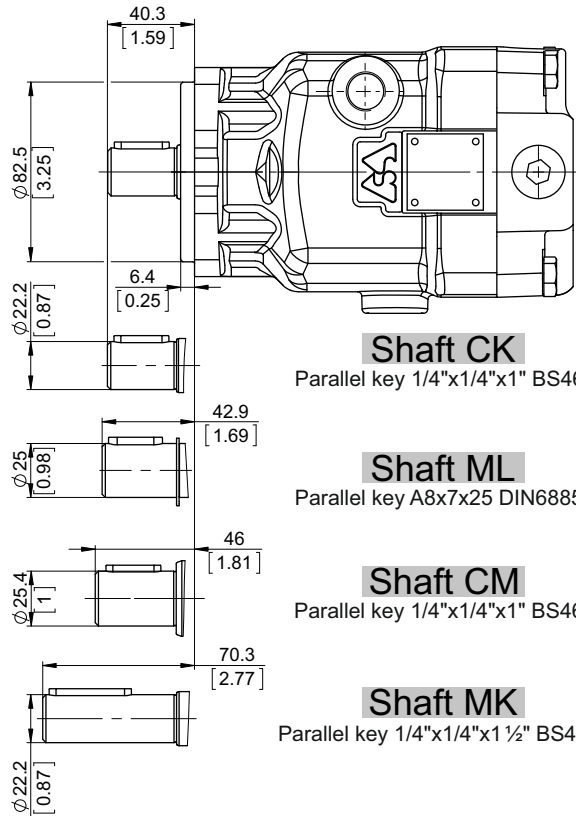


**Shaft SD**  
13T 16/32

**Shaft GD**  
13T 16/32

**Shaft SF**  
15T 16/32

**Shaft GF**  
15T 16/32

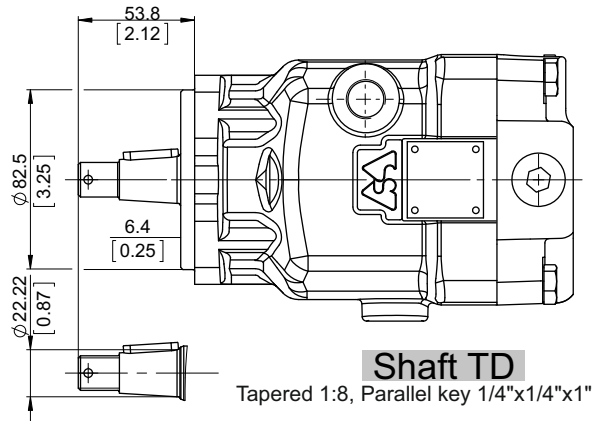


**Shaft CK**  
Parallel key 1/4"x1/4"x1" BS46

**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"

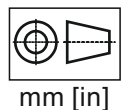
Shaft Dimensions  
See Page 68+72

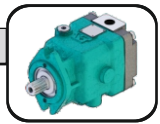
**PERMISSIBLE SHAFT LOAD**

| Permissible shaft load |       | Standard bearing | Improved bearing |
|------------------------|-------|------------------|------------------|
| max Axial              | N[lb] | Fa=1300 [292]    | Fa=1600 [360]    |
| max Radial             | N[lb] | Fr=2200 [495]    | Fr=3000 [674]    |

The calculated max values are based on the optimal direction of the forces Fr, Fa and optimal position of the shaft (see page 78).

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

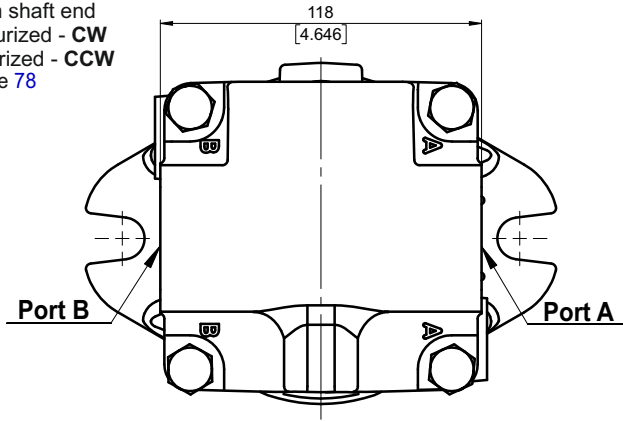
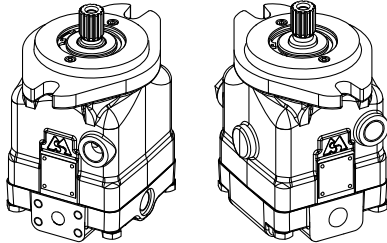




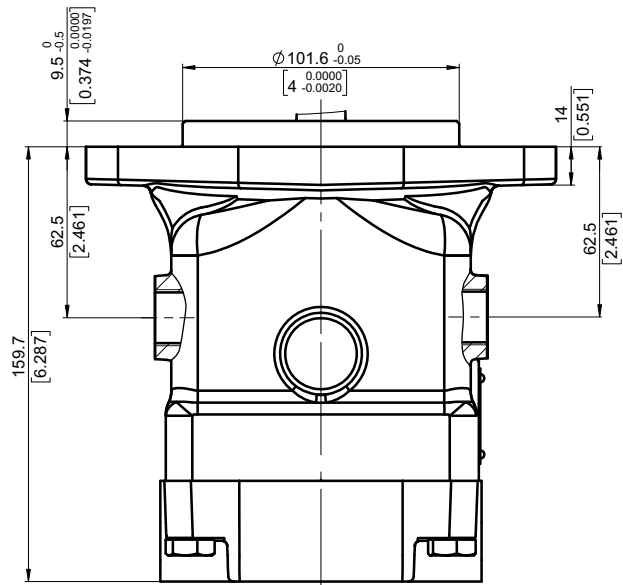
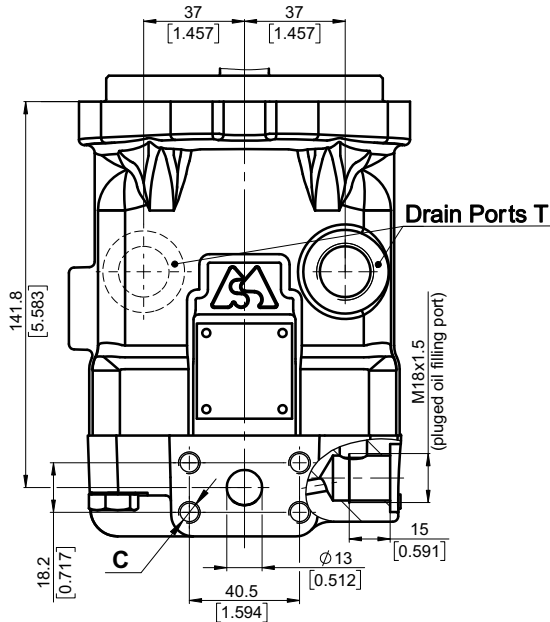
**OVERALL DIMENSIONS AND PORTS**

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

**Standard Rotation**  
Viewed from shaft end  
Port A Pressurized - CW  
Port B Pressurized - CCW  
see page 78

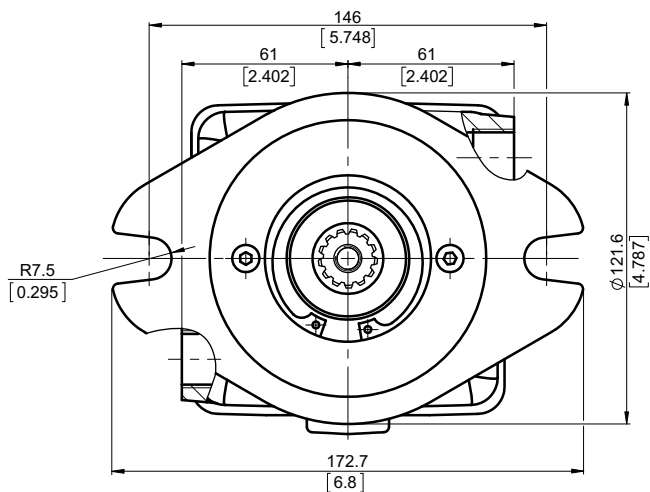
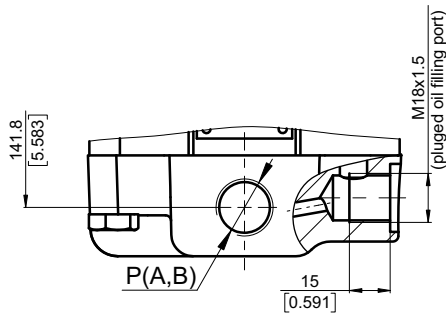


**Side ports, port size default ,5 and 9**



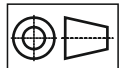
|                          | Port Size         |                         |                   |
|--------------------------|-------------------|-------------------------|-------------------|
|                          | default           | 5                       | 9                 |
| <b>P<sub>(A,B)</sub></b> | 2xISO 6162-2 DN13 | 2xSAE J518 1/2" PSI6000 | 2xISO 6162-2 DN13 |
| <b>T</b>                 | M18x1.5           | 3/4-16 UNF              | G1/2              |
| <b>C</b>                 | 8xM8              | 8x5/16-18 UNC           | 8xM8              |

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

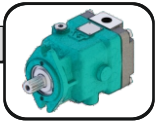


|                          | Port Size |           |              |         |
|--------------------------|-----------|-----------|--------------|---------|
|                          | 2         | 3         | 4            | 6       |
| <b>P<sub>(A,B)</sub></b> | 2xG 1/2   | 2xM22x1.5 | 2x7/8-14 UNF | 2xG 3/4 |
| <b>T</b>                 | G 1/2     | M18x1.5   | 3/4-16 UNF   | G 1/2   |

Shaft Mounting  
see page 17



mm [in]

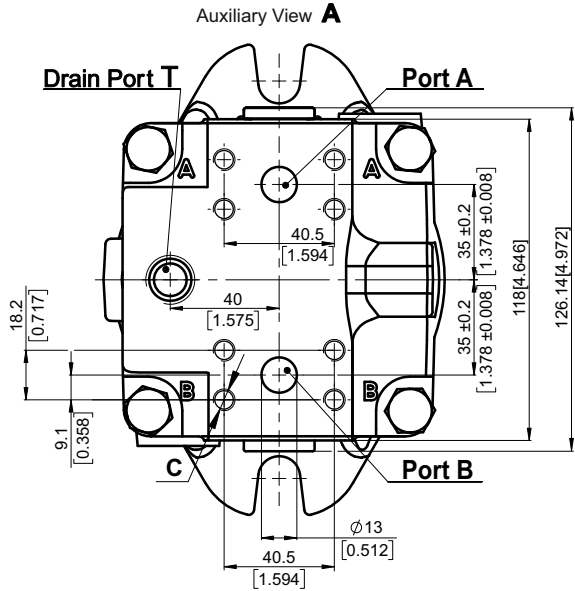


**OVERALL DIMENSIONS AND PORTS**

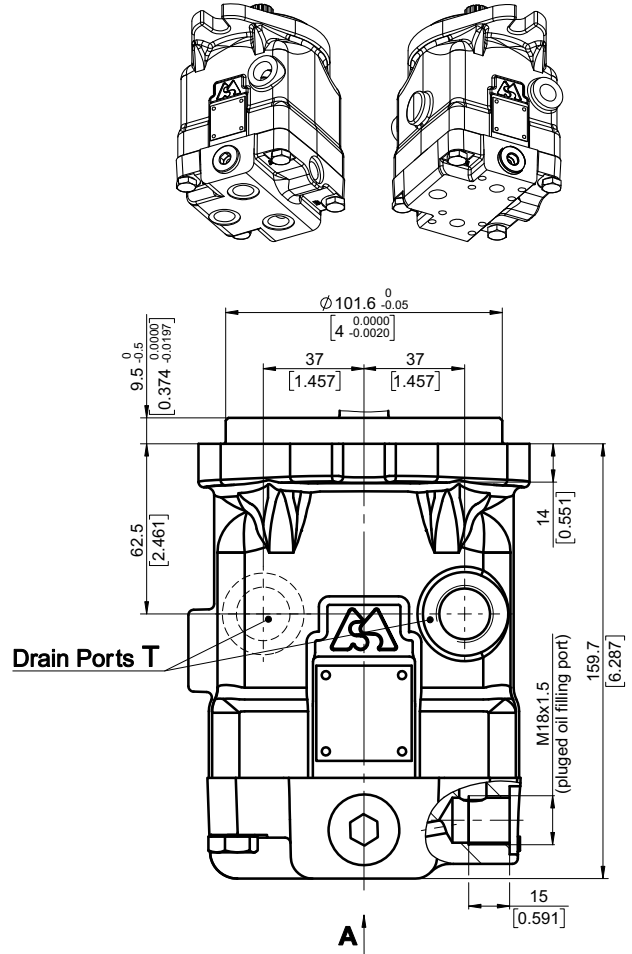
**Rear Ports - Type E Mounting Flange - Type SAE-B**

**Standard Rotation**  
Viewed from shaft end  
Port A Pressurized - CW  
Port B Pressurized - CCW  
see page 78

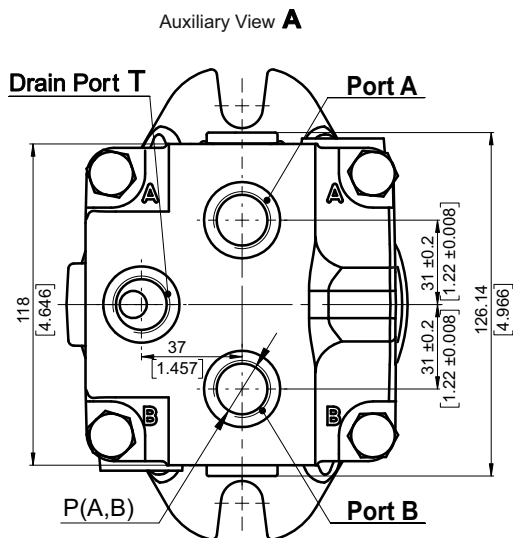
**Rear ports E, port size default, 5 and 9**



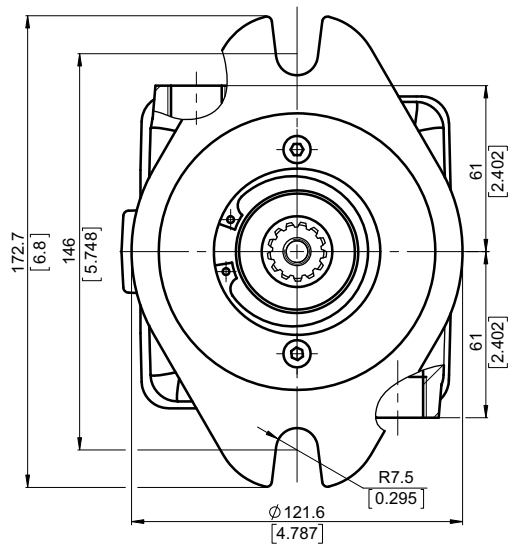
|                    | Port Size         |                         |                   |
|--------------------|-------------------|-------------------------|-------------------|
|                    | default           | 5                       | 9                 |
| P <sub>(A,B)</sub> | 2xISO 6162-2 DN13 | 2xSAE J518 1/2" PSI6000 | 2xISO 6162-2 DN13 |
| T                  | M18x1.5           | 3/4-16 UNF              | G1/2              |
| C                  | 8xM8              | 8x5/16-18 UNC           | 8xM8              |



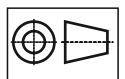
**Rear ports E, port size 2, 3, 4 and 6**



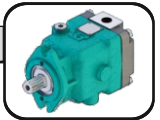
|                    | Port Size |           |             |         |
|--------------------|-----------|-----------|-------------|---------|
|                    | 2         | 3         | 4           | 6       |
| P <sub>(A,B)</sub> | 2xG 1/2   | 2xM22x1.5 | 2x7/8-14UNF | 2xG 3/4 |
| T                  | G 1/2     | M18x1.5   | 3/4-16UNF   | G 1/2   |



Shaft Mounting  
see page 17



mm [in]



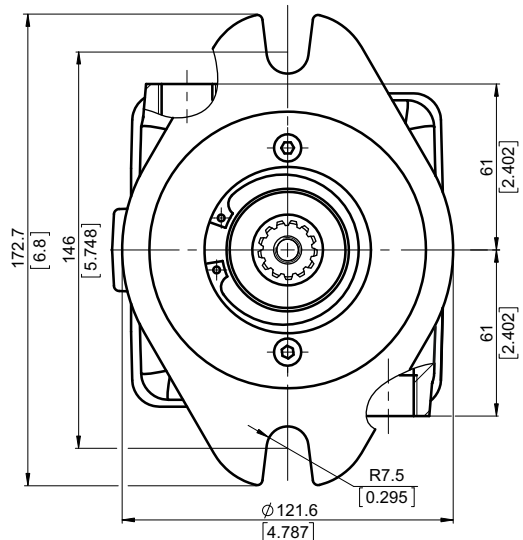
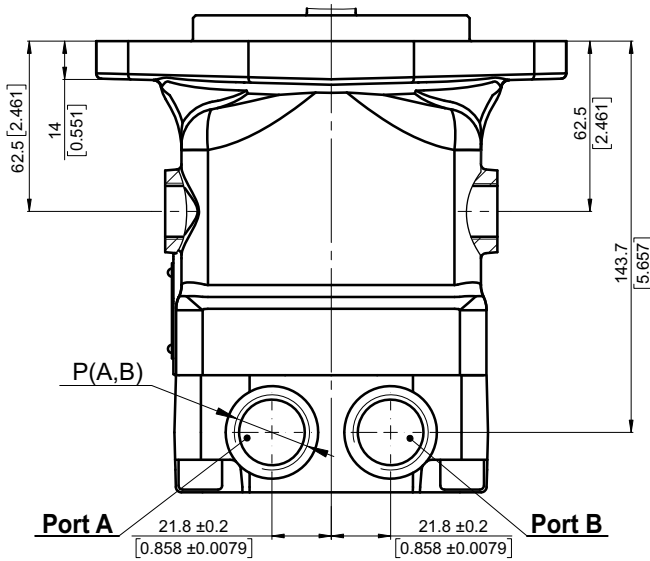
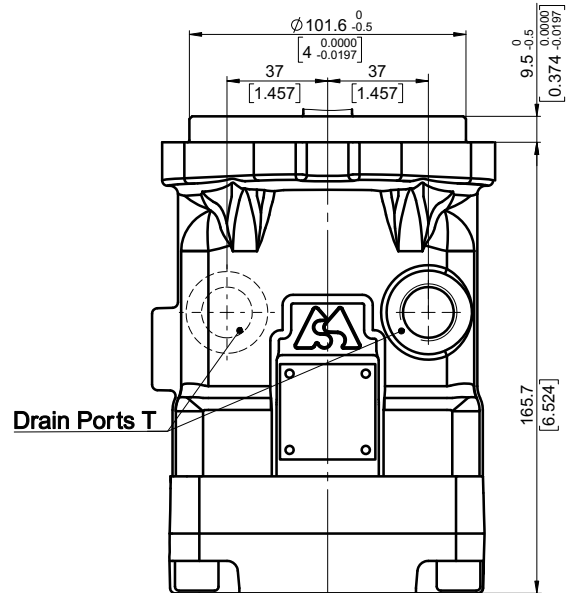
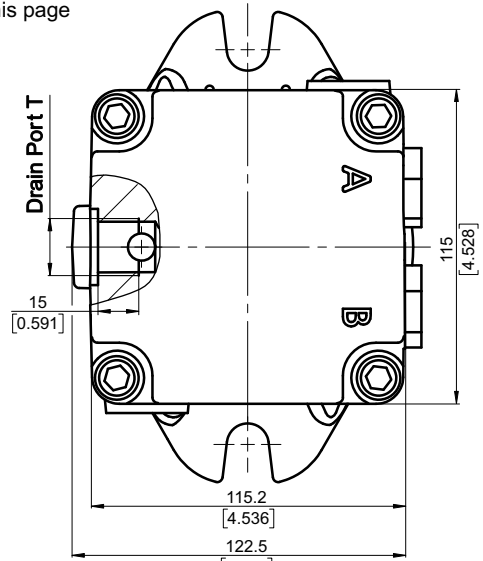
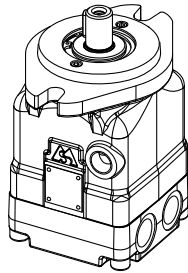
**OVERALL DIMENSIONS AND PORTS**

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

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

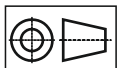
See the port sizes at the bottom of this page

**Standard Rotation**  
Viewed from shaft end  
Port A Pressurized - CW  
Port B Pressurized - CCW  
see page 78



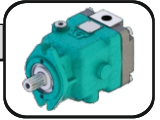
|                    | Port Size |           |             |         |
|--------------------|-----------|-----------|-------------|---------|
|                    | 2         | 3         | 4           | 6       |
| P <sub>(A,B)</sub> | 2xG 1/2   | 2xM22x1.5 | 2x7/8-14UNF | 2xG 3/4 |
| T                  | G 1/2     | M18x1.5   | 3/4-16UNF   | G 1/2   |

Shaft Mounting  
see the next page



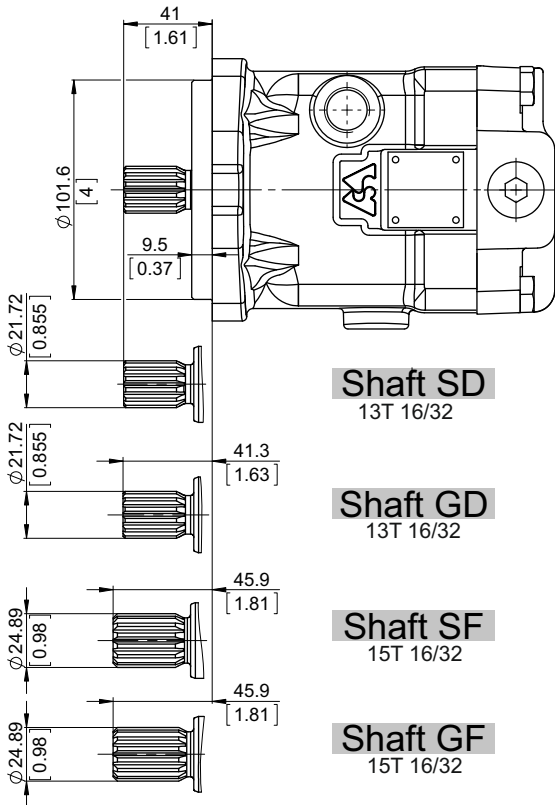
mm [in]





**SHAFTS MOUNTING**

Mounting Flange - Type **SAE-B**

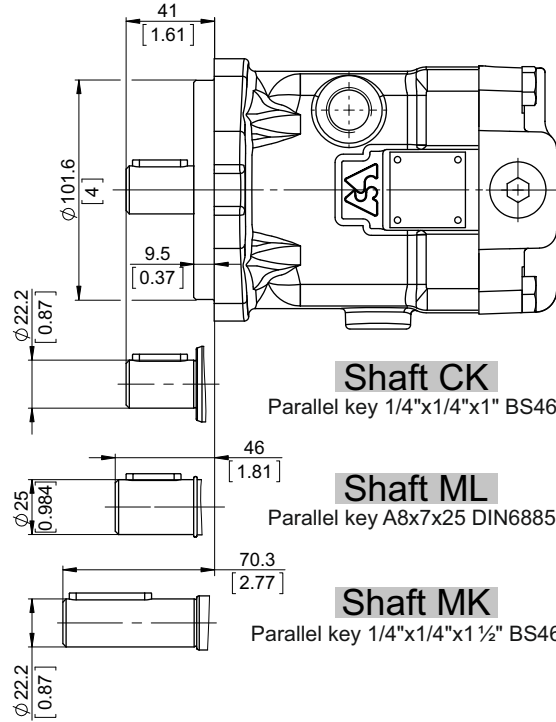


**Shaft SD**  
13T 16/32

**Shaft GD**  
13T 16/32

**Shaft SF**  
15T 16/32

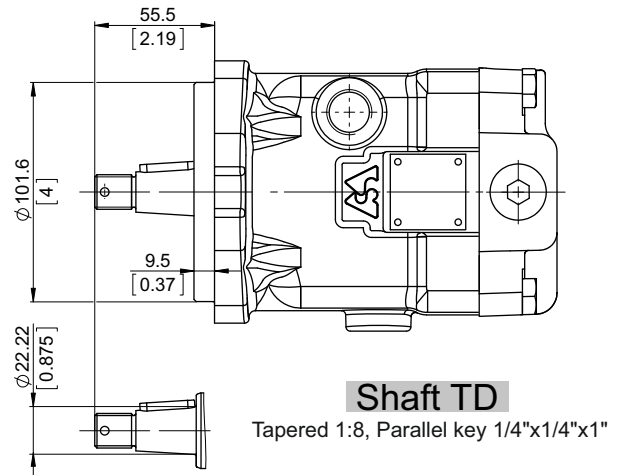
**Shaft GF**  
15T 16/32



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

**Shaft ML**  
Parallel key A8x7x25 DIN6885

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



**Shaft TD**

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

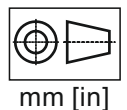
Shaft Dimensions  
See Page 68+72

**PERMISSIBLE SHAFT LOAD**

| Permissible shaft load |       | Standard 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 78).

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





**ORDERING CODE**

|              |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |
|--------------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|
|              | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 14 | 14 |
| <b>M A P</b> |   |   |   |   |   |   |   |   |   |    |    |    |    | [  |    | ]  |

**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.<sup>3</sup>/rev. [1.35 in.<sup>3</sup>/rev.]
- 28** - 28.47 cm.<sup>3</sup>/rev. [1.74 in.<sup>3</sup>/rev.]

**Pos.4 - Shaft Extensions\*\***

- SD** - ø21.72 [0.855"] Spline SAE 13T 16/32 DP, M8 thread
- GD** - ø21.72 [0.855"] Spline SAE 13T 16/32 DP, 5/16-18 UNC thread
- SF** - ø24.9 [0.98"] Spline SAE 15T 16/32, M8 thread
- GF** - ø24.9 [0.98"] Spline SAE 15T 16/32, 3/8-16UNC thread
- CK** - ø22.2 [7/8"] Straight, M8 thread Parallel key 1/4"x1/4"x1" BS46
- MK** - ø22.2 [7/8"] Straight, M8 thread Parallel key 1/4"x1/4"x1 1/2" BS46
- ML** - ø25 [0.984"] Straight, M8 thread Parallel key A8x7x25 DIN6885
- CM** - ø25.4 [1"] Straight, M8 thread Parallel key 1/4"x1/4"x1" BS46
- TD** - ø22.22 [7/8"] Tapered 1:8 [125:1000], Parallel key 1/4"x1/4"x1", 5/8-18 UNF-2A

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
- 2** - 2xG1/2, drain ports G1/2
- 3** - 2xM22x2, drain ports M18x1.5
- 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 page 74+75 for information about valves

- omit - None
- HR** - Single anti-cavitation valve
- AR** - Dual anti-cavitation valve
- PU** - Purge valve - default - 5±2 l/min.
- FLU** - Flush valve - default - 5±2 l/min at 20 bar.
- SAR** - Single anti-cavitation and relief valve
- DAR** - Dual anti-cavitation and relief valve
- DARP** - Dual anti-cavitation, relief and purge valve, default flow - 5±2 l/min.
- DARF** - Dual anti-cavitation, relief and flush valve, default flow - 5±2 l/min at 20 bar.

Option DAR, SAR, AR and HR are not available for Pos.2 option E  
Option FLU are not available for Pos.2 option E combine with Pos.6 option 1 and 5  
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** - 

|     |      |      |
|-----|------|------|
| 250 | 300* | 350* |
|-----|------|------|

\* 300 and 350 bar options are available only for Pos.2 option T. for more information see page 74+75

**Pos.11 - Flow Setting of Integrated Valves**

- omit - None
- Lx** - For value - see page 74+75

**Pos.12 - Special Features\***

- omit - None
- R2S** - Speed Sensor Two Directional (see page 76)
- R** - Reverse Rotation (see page 78)

**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**

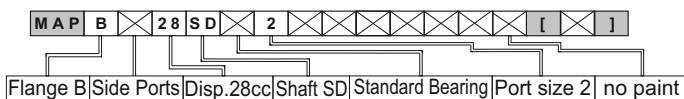
- omit - Factory specified

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

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

**EXAMPLE**

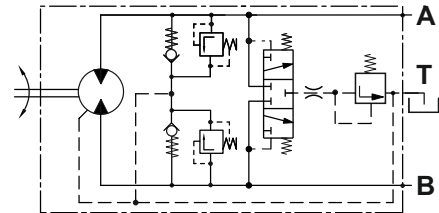
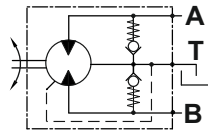
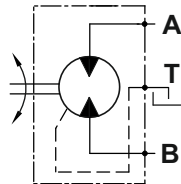
**M A P A E 2 2 G D 4 P**





# Hydraulic Motors Type MAP50

## Heavy Duty Axial Piston Motors Fixed Displacement



open drain line is always required

### APPLICATION

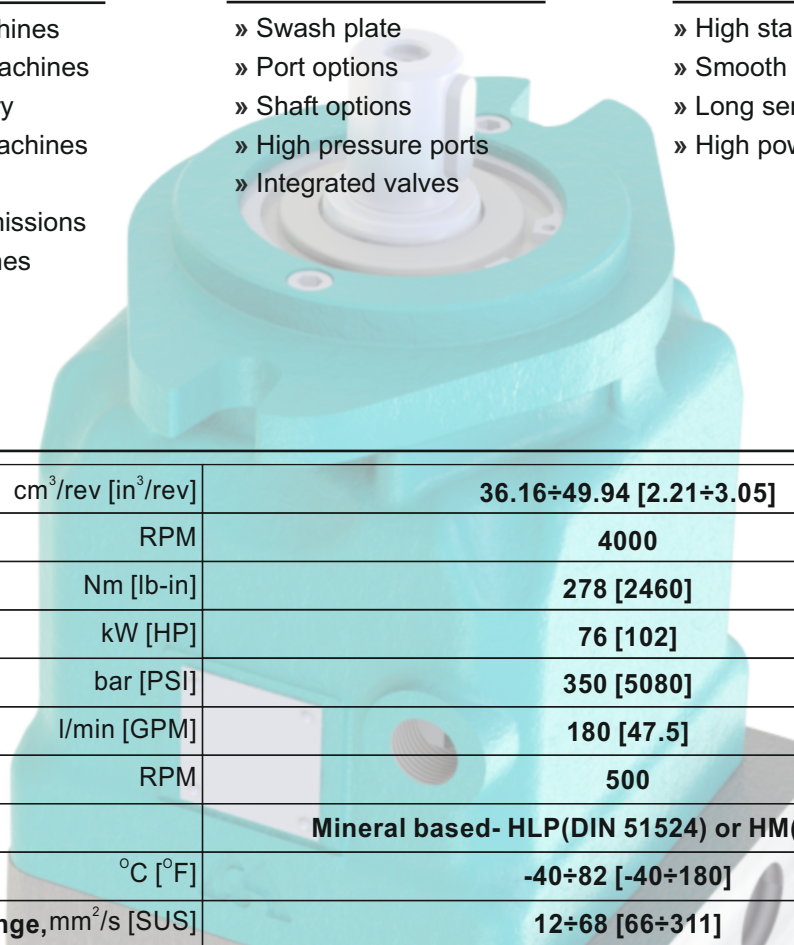
- » Agricultural machines
- » Road building machines
- » Mining machinery
- » Food industry machines
- » Swing drives
- » Hydraulic transmissions
- » Vibration machines
- » Fan drives
- » Special vehicles

### OPTIONS

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

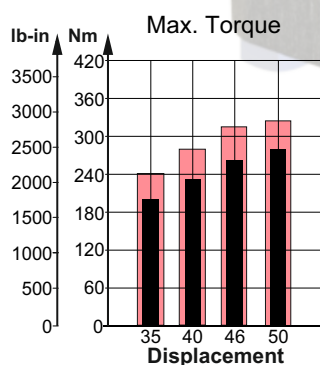
### ADVANTAGES

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

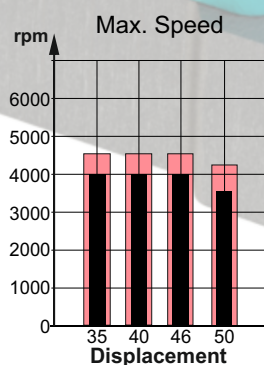


### GENERAL

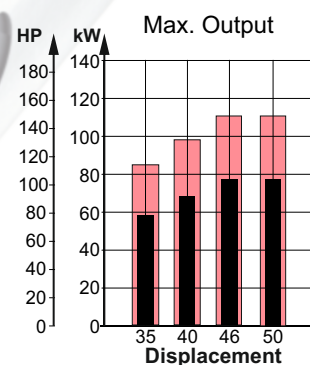
|                          |                                                                    |                         |
|--------------------------|--------------------------------------------------------------------|-------------------------|
| Displacement,            | cm <sup>3</sup> /rev [in <sup>3</sup> /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 <sup>2</sup> /s [SUS]                                           | 12÷68 [66÷311]          |
| Filtration               | ISO code 18/16/13 (Min. recommended fluid filtration of 10 micron) |                         |



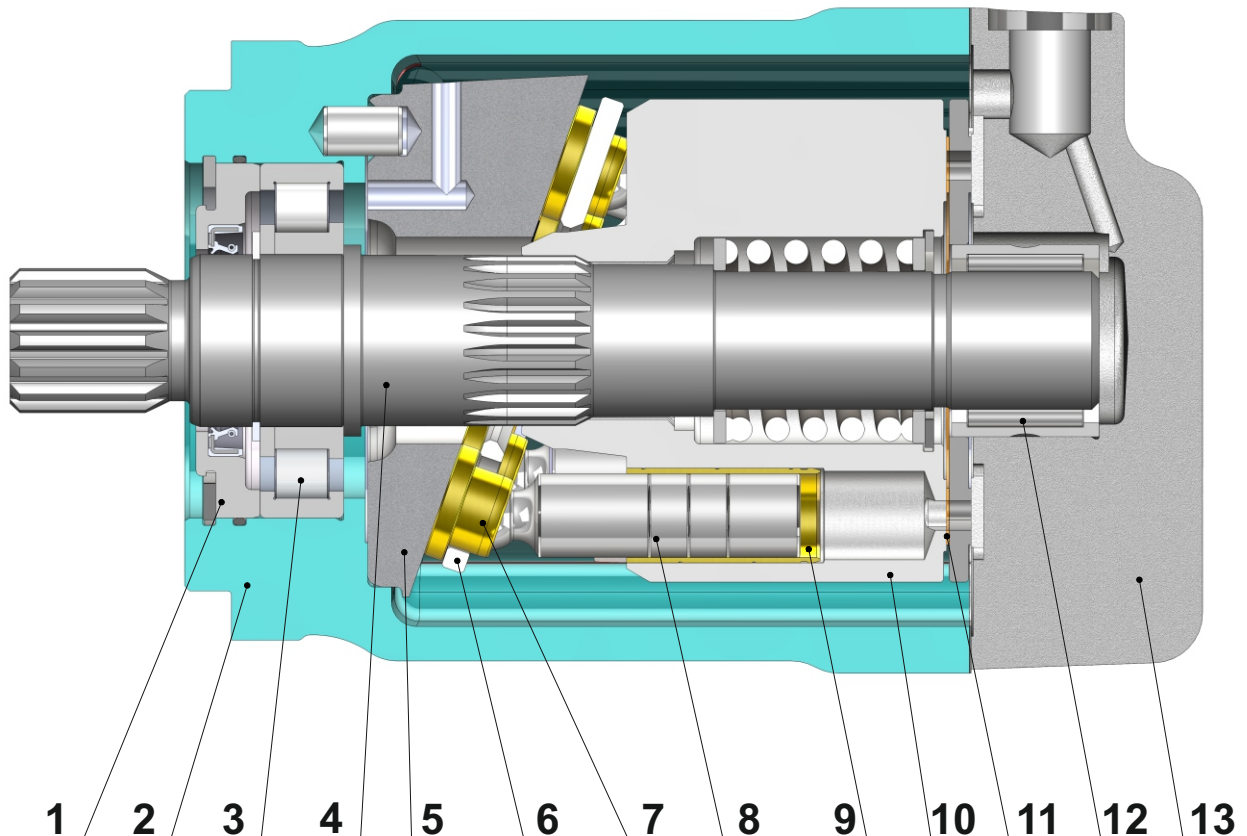
Intermittent values



Continuous values



## SECTION VIEW



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

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



**SPECIFICATION DATA**

| Type                                                                       |        | MAP<br>35                                    | MAP<br>40       | MAP<br>46       | MAP<br>50       |
|----------------------------------------------------------------------------|--------|----------------------------------------------|-----------------|-----------------|-----------------|
| <b>Displacement,</b><br><b>cm.<sup>3</sup>/rev. [in.<sup>3</sup>/rev.]</b> |        | 36.16<br>[2.21]                              | 41.59<br>[2.54] | 47.13<br>[2.88] | 49.94<br>[3.05] |
| <b>Max. Speed,</b><br><b>[RPM]</b>                                         | Cont.  | 4000                                         | 4000            | 4000            | 3600            |
|                                                                            | Int.*  | 4500                                         | 4500            | 4500            | 4200            |
| <b>Max. Torque,**</b><br><b>Nm [lb-in]</b>                                 | Cont.  | 202 [1789]                                   | 232 [2053]      | 263 [2328]      | 278 [2460]      |
|                                                                            | Int.** | 242 [2142]                                   | 278 [2460]      | 315 [2788]      | 326 [2885]      |
| <b>Output,</b><br><b>kW [HP]</b>                                           | Cont.  | 58 [78]                                      | 67 [90]         | 76 [102]        | 76 [102]        |
|                                                                            | Int.** | 84 [113]                                     | 97 [130]        | 110 [148]       | 110 [148]       |
| <b>Max. Pressure,</b><br><b>bar [PSI]</b>                                  | 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]      |
| <b>Max. Oil Flow,</b><br><b>l/min [GPM]</b>                                | Cont.  | 145 [38.3]                                   | 167 [44.1]      | 189 [50]        | 180 [47.5]      |
|                                                                            | Int.*  | 163 [43.1]                                   | 187 [49.4]      | 212 [56]        | 210 [55.5]      |
| <b>Torque Constant</b> *****                                               |        | 0.52                                         | 0.6             | 0.68            | 0.72            |
| <b>Nm/bar [lb-in/PSI]</b>                                                  |        | [0.32]                                       | [0.364]         | [0.41]          | [0.437]         |
| <b>Speed Constant</b> *****                                                |        | 26.3                                         | 22.84           | 20.2            | 19.02           |
| <b>RPM/(l/min) [RPM/GPM]</b>                                               |        | [99.4]                                       | [86.5]          | [76.3]          | [72]            |
| <b>Permissible Shaft Load</b>                                              |        |                                              |                 |                 |                 |
| <b>max Axial**** N[lb]</b>                                                 |        | Fa=2000 [450]                                |                 |                 |                 |
| <b>max Radial**** N[lb]</b>                                                |        | Fr=3600 [810]                                |                 |                 |                 |
| <b>Min. Speed, [RPM]</b>                                                   |        | 500                                          |                 |                 |                 |
| <b>Max. Pressure in</b><br><b>Drain Line, bar [PSI]</b>                    |        | 5 [70]<br>open drain line is always required |                 |                 |                 |
| <b>Weight, kg [lb]</b>                                                     |        | 17.65 [38.9]                                 |                 |                 |                 |

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

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

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

\*\*\* Theoretical torque;

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

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

1. The recommended output power for continuous operations should not be exceeded.
2. Recommended filtration as per ISO 4406 cleanliness code 18/16/13 or better. This filtration corresponds to SAE AS 4059 8A/7B/7C. Nominal filtration - 10 micron or better.
3. Recommended a premium quality, anti-wear type mineral based hydraulic oil, HLP(DIN51524) or HM(ISO6743/4).
4. Recommended oil viscosity - 12...68 cSt or see page 81.
5. Recommended maximum system operating temperature - 82°[180°] C[F].
6. To ensure optimum life of the motor, fill it up with fluid prior to load it and run with moderate load and speed for about 10-15 minutes.

**Hint: Motor Torque = Torque Constant \* Pressure Drop**

**Rotation Speed = Speed Constant \* Oil Flow**

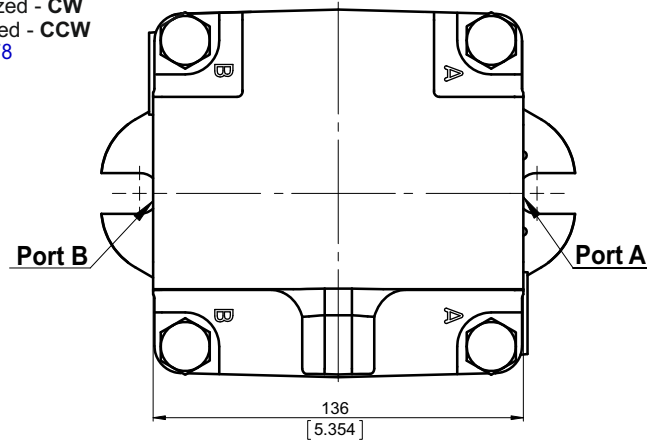
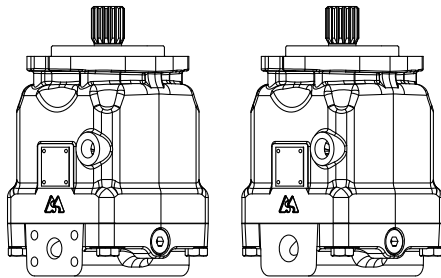
The constant values are approximate. Motor torque and rotation speed for a particular project are depending on the real operating conditions. For more detailed calculations please see efficiencies on next page and formulas on page 82.



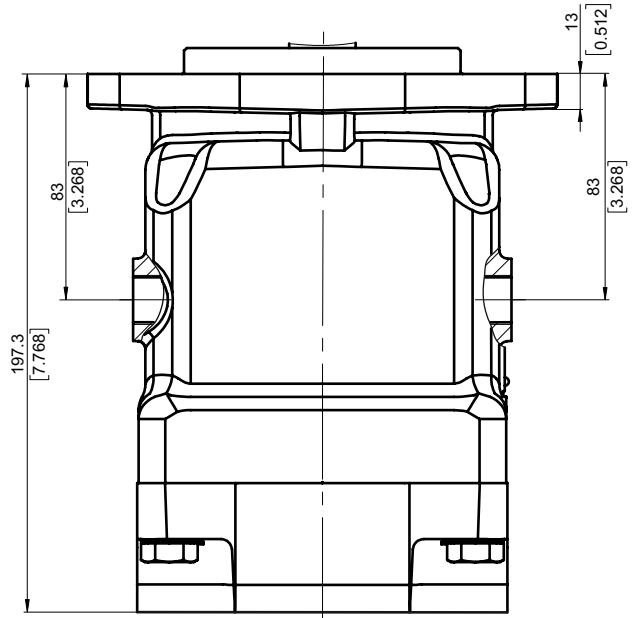
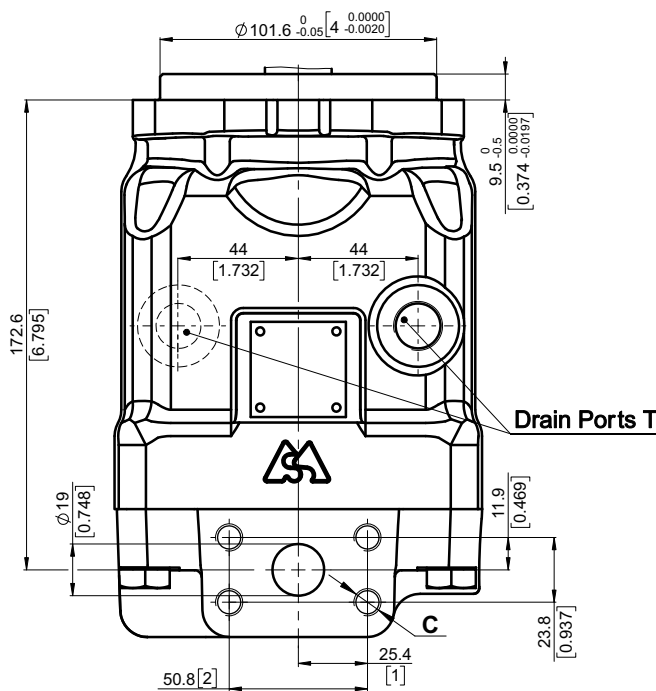
**OVERALL DIMENSIONS AND PORTS**

**Side Ports - Default**

**Standard Rotation**  
Viewed from shaft end  
Port A Pressurized - CW  
Port B Pressurized - CCW  
see page 78

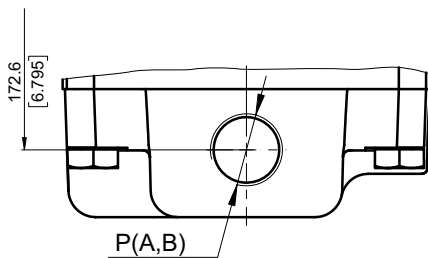


**Side ports, port size default, 5 and 9**

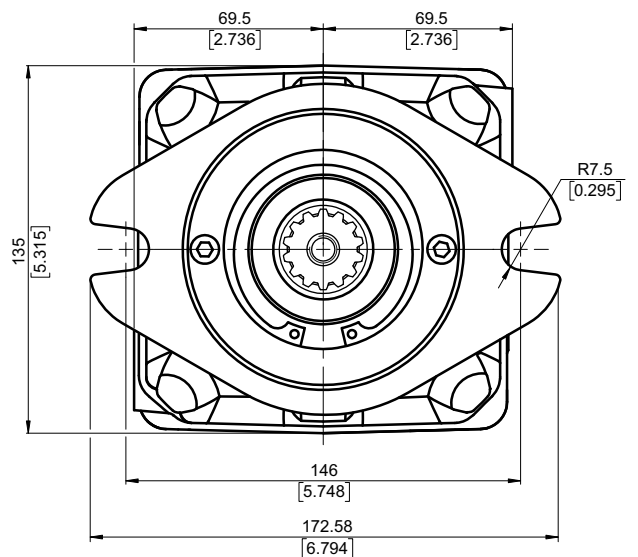


|                    | Port Size         |                         |                   |
|--------------------|-------------------|-------------------------|-------------------|
|                    | default           | 5                       | 9                 |
| P <sub>(A,B)</sub> | 2xISO 6162-2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

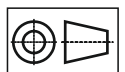
**Side ports, port size 2,3 and 4**



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



Shaft Mounting  
see page 25



mm [in]

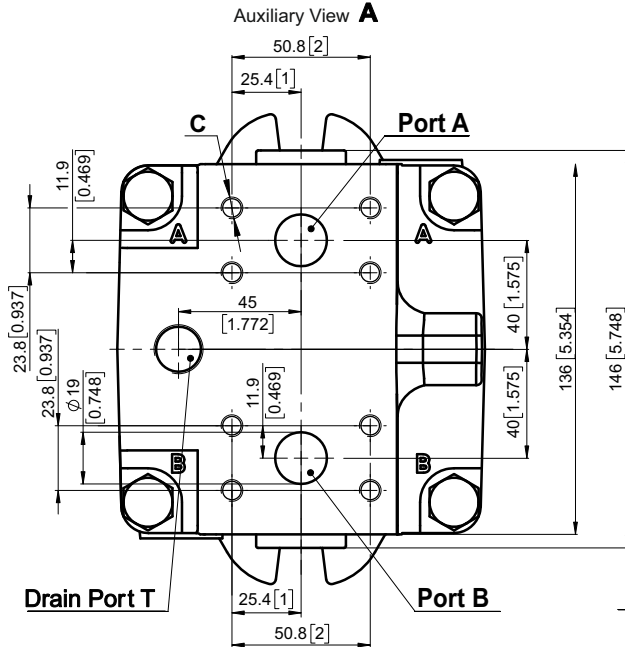


**OVERALL DIMENSIONS AND PORTS**

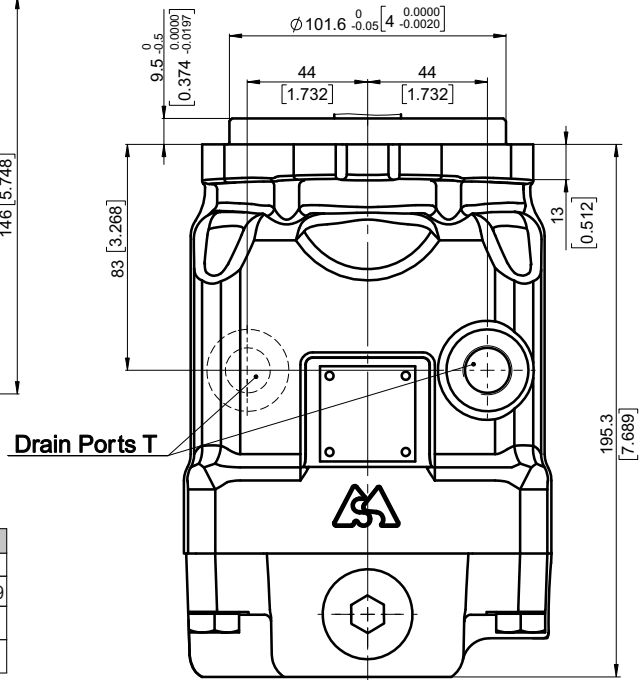
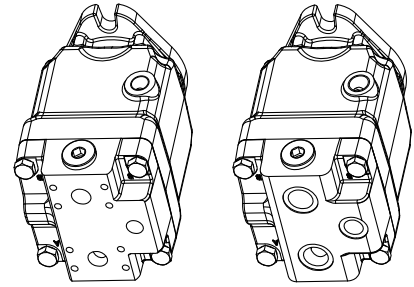
**Rear Ports - Type E**

**Standard Rotation**  
Viewed from shaft end  
Port A Pressurized - CW  
Port B Pressurized - CCW  
see page 78

**Rear ports E, port size default, 5 and 9**

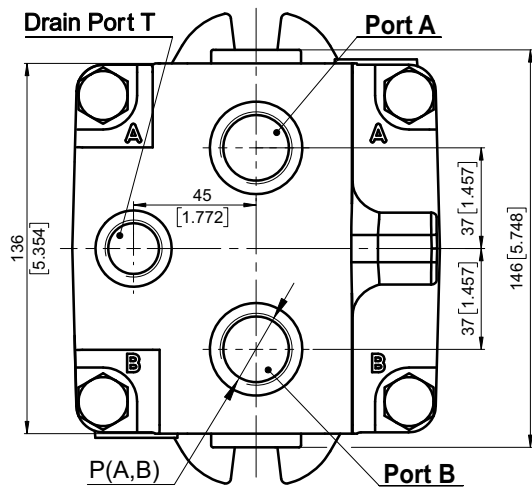


|                    | Port Size         |                         |                   |
|--------------------|-------------------|-------------------------|-------------------|
|                    | default           | 5                       | 9                 |
| P <sub>(A,B)</sub> | 2xISO 6162-2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

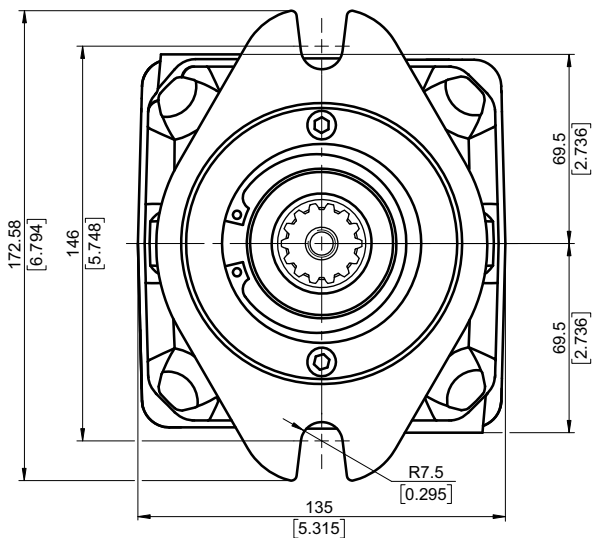


**Rear ports E, port size 2,3,4,6,7 and 8**

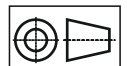
Auxiliary View A



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



Shaft Mounting  
see page 25



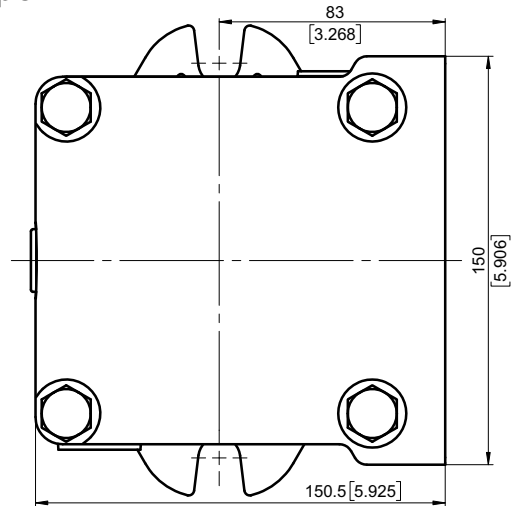
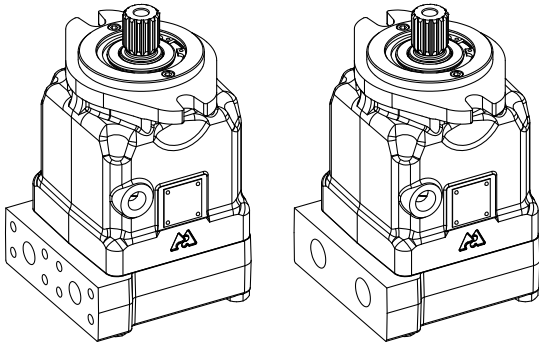
mm [in]



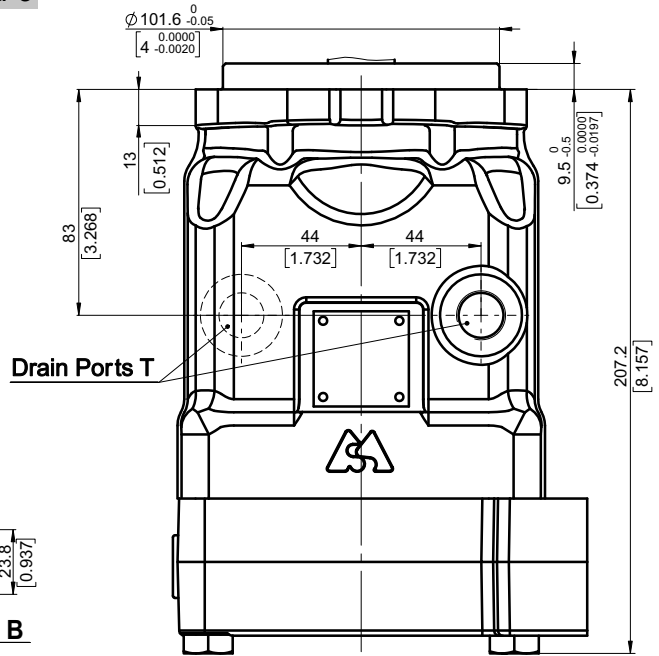
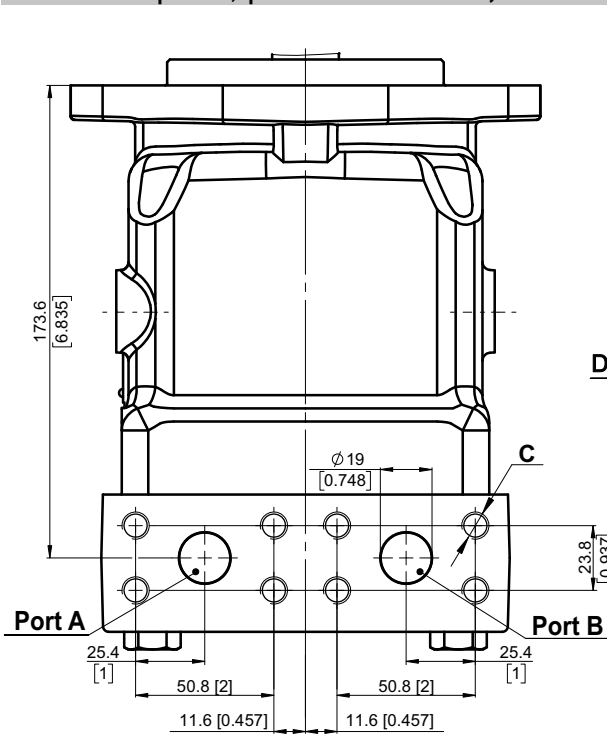
**OVERALL DIMENSIONS AND PORTS**

**Twin Side Ports - Type T**

**Standard Rotation**  
Viewed from shaft end  
Port A Pressurized - CW  
Port B Pressurized - CCW  
see page 78

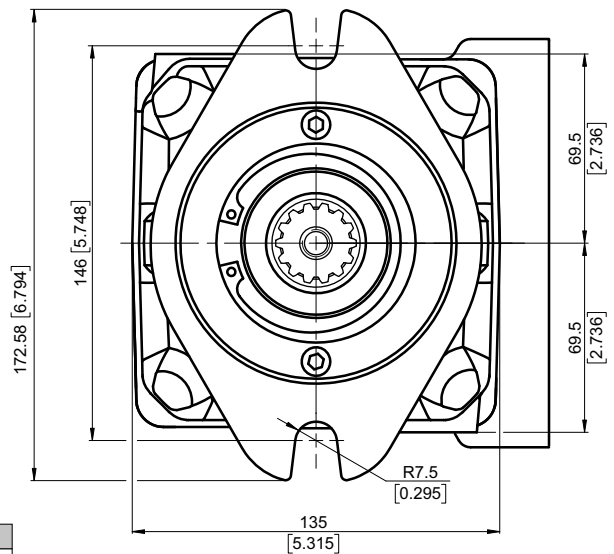
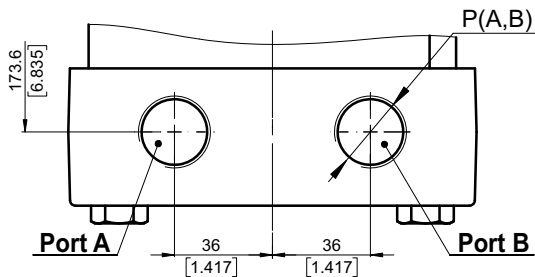


**Twin side ports, port size default, 5 and 9**



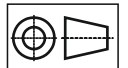
|                  | Port Size         |                         |                   |
|------------------|-------------------|-------------------------|-------------------|
|                  | default           | 5                       | 9                 |
| P <sub>A,B</sub> | 2xISO 6162-2 DN19 |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

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



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

Shaft Mounting  
see next page



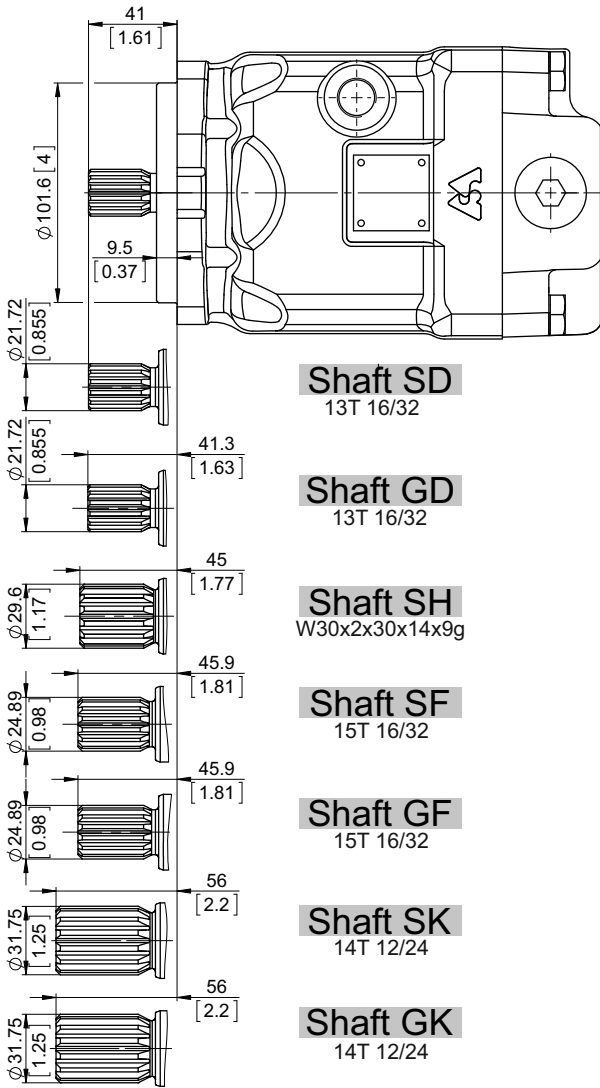
mm [in]





**SHAFTS MOUNTING**

Ports - Type Default, Type E, Type T



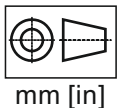
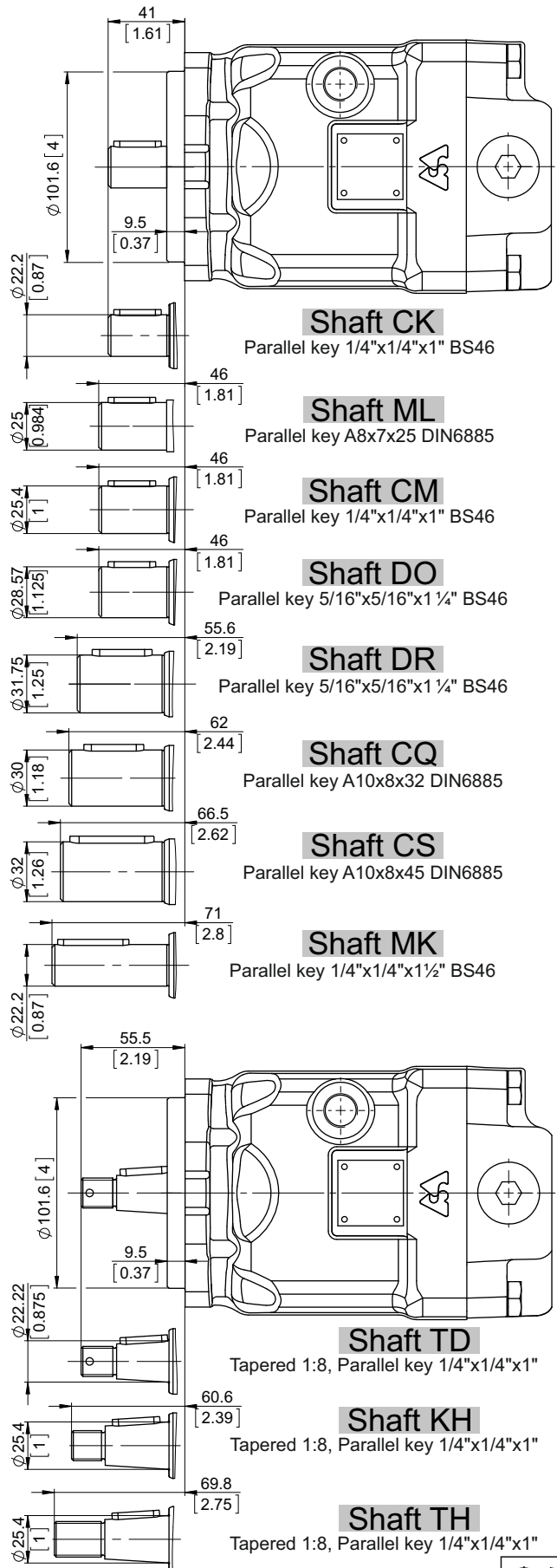
Shaft Dimensions  
See Page 68+72

**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 78).

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 |
| <b>M A P</b> |   |   |   |   |   |   |   |   |   |    |    | [  |    | ]  |

**Pos.1 - Mounting Flange**  
**B** - SAE B - 2-Bolt flange  
 spigot diam. 101.6 [4"] - BC 146 [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.<sup>3</sup>/rev. [2.21 in.<sup>3</sup>/rev.]  
**40** - 41.59 cm.<sup>3</sup>/rev. [2.54 in.<sup>3</sup>/rev.]  
**46** - 47.13 cm.<sup>3</sup>/rev. [2.88 in.<sup>3</sup>/rev.]  
**50** - 49.94 cm.<sup>3</sup>/rev. [3.05 in.<sup>3</sup>/rev.]

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

**Pos.5 - Port Size**  
 omit - 2xISO 6162-2 DN19, drain port M18x1.5  
**2** - 2xG3/4, drain ports G1/2  
**3** - 2xM27x2, drain ports M18x1.5  
**4** - 2x1 1/16 -12 UN, drain ports 7/8-14 UNF  
**5** - 2xSAE 3/4" PSI6000, drain port 7/8-14 UNF  
**6** - 2xG1/2, drain ports G1/2  
**7** - 2xM22x1.5, drain ports M18x1.5  
**8** - 2x7/8-14 UNF Ports, drain ports 3/4-16 UNF  
**9** - 2xISO 6162-2 DN19, drain port G1/2  
 Option 6;7 and 8 are not available for Pos.2 option omit

**Pos.6 - Seal, Corrosion Resistant Seal Surface**  
 omit - NBR seal type material  
**V** - FKM seal type material

**Pos.7 - Integrated Valves**  
 See page 74+75 for information about valves  
 omit - None

**HR** - Single anti-cavitation valve  
**AR** - Dual anti-cavitation valve  
**PU** - Purge valve - default - 6±2 l/min.  
**FLU** - Flush valve - default - 6±2 l/min at 20 bar.  
**SAR** - Single anti-cavitation and relief valve  
**DAR** - Dual anti-cavitation and relief valve  
**DARP** - Dual anti-cavitation, relief and purge valve, default flow - 6±2 l/min.  
**DARF** - Dual anti-cavitation, relief and flush valve, default flow - 6±2 l/min at 20 bar.

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

**Pos.8 - Valve's Port for Single Valves**  
 omit - None  
**A** - Port A  
**B** - Port B

**Pos.9 - Pressure Setting of Integrated Valves**  
 omit - None  
**x** - 

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

  
 for more information see page 74+75

**Pos.10 - Flow Setting of Integrated Valves**  
 omit - None  
**Lx** - For value - see page 74+75

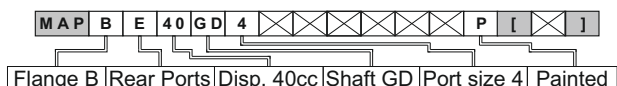
**Pos.11 - Special Features\***  
 omit - None  
**R2S** - Speed Sensor Two Directional (see page 76)  
**R** - Reverse Rotation (see page 78)

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

**EXAMPLE**

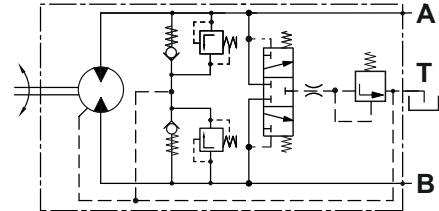
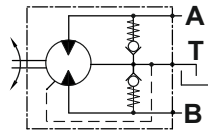
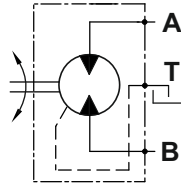
**M A P B E 40 G D 4 P**





# Hydraulic Motors Type MAP62

## Heavy Duty Axial Piston Motors Fixed Displacement



open drain line is always required

### APPLICATION

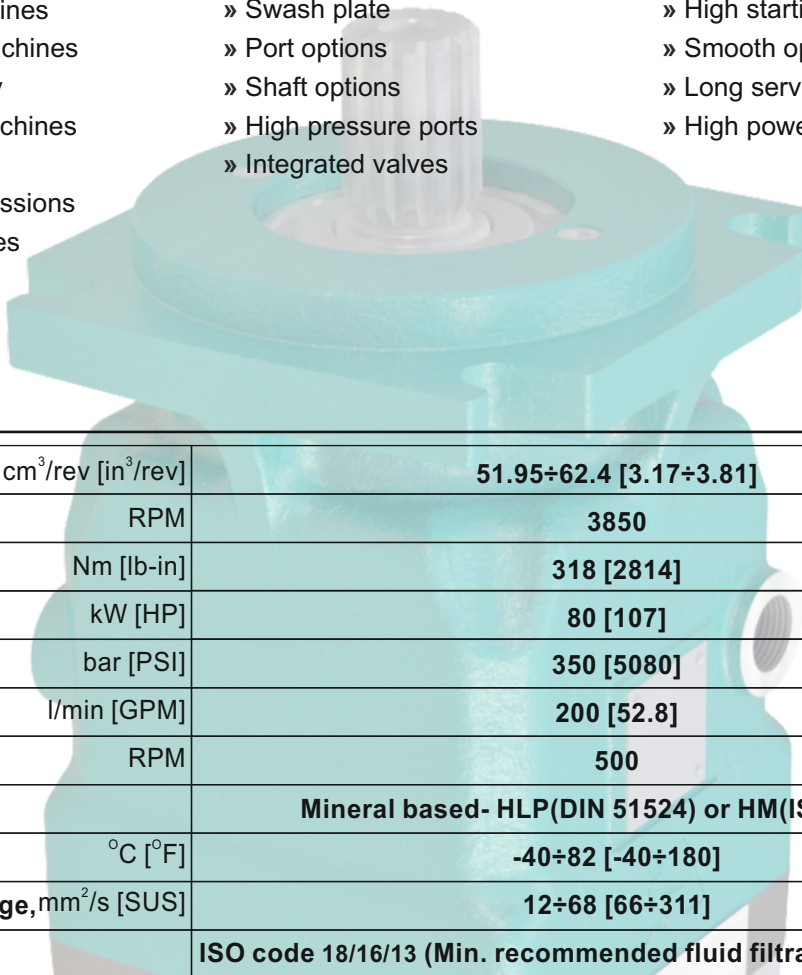
- » Agricultural machines
- » Road building machines
- » Mining machinery
- » Food industry machines
- » Swing drives
- » Hydraulic transmissions
- » Vibration machines
- » Fan drives
- » Special vehicles

### OPTIONS

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

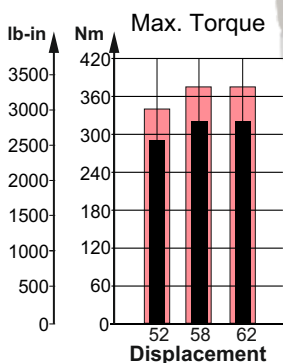
### ADVANTAGES

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

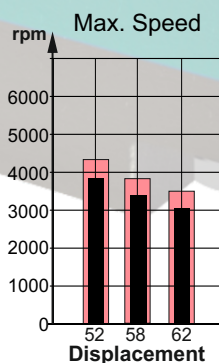


### GENERAL

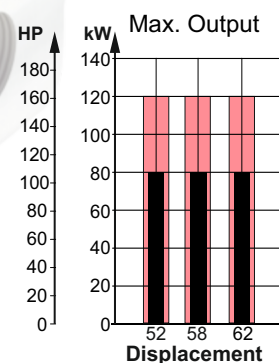
|                          |                                                                    |                        |
|--------------------------|--------------------------------------------------------------------|------------------------|
| Displacement,            | cm <sup>3</sup> /rev [in <sup>3</sup> /rev]                        | 51.95÷62.4 [3.17÷3.81] |
| Max. Speed,              | RPM                                                                | 3850                   |
| Max. Torque,             | Nm [lb-in]                                                         | 318 [2814]             |
| Max. Output,             | kW [HP]                                                            | 80 [107]               |
| Max. Pressure Drop,      | bar [PSI]                                                          | 350 [5080]             |
| Max. Oil Flow,           | l/min [GPM]                                                        | 200 [52.8]             |
| Min. Speed,              | RPM                                                                | 500                    |
| Fluid                    | Mineral based- HLP(DIN 51524) or HM(ISO 6743/4)                    |                        |
| Temperature Range,       | °C [°F]                                                            | -40÷82 [-40÷180]       |
| Optimal Viscosity Range, | mm <sup>2</sup> /s [SUS]                                           | 12÷68 [66÷311]         |
| Filtration               | ISO code 18/16/13 (Min. recommended fluid filtration of 10 micron) |                        |



Intermittent values

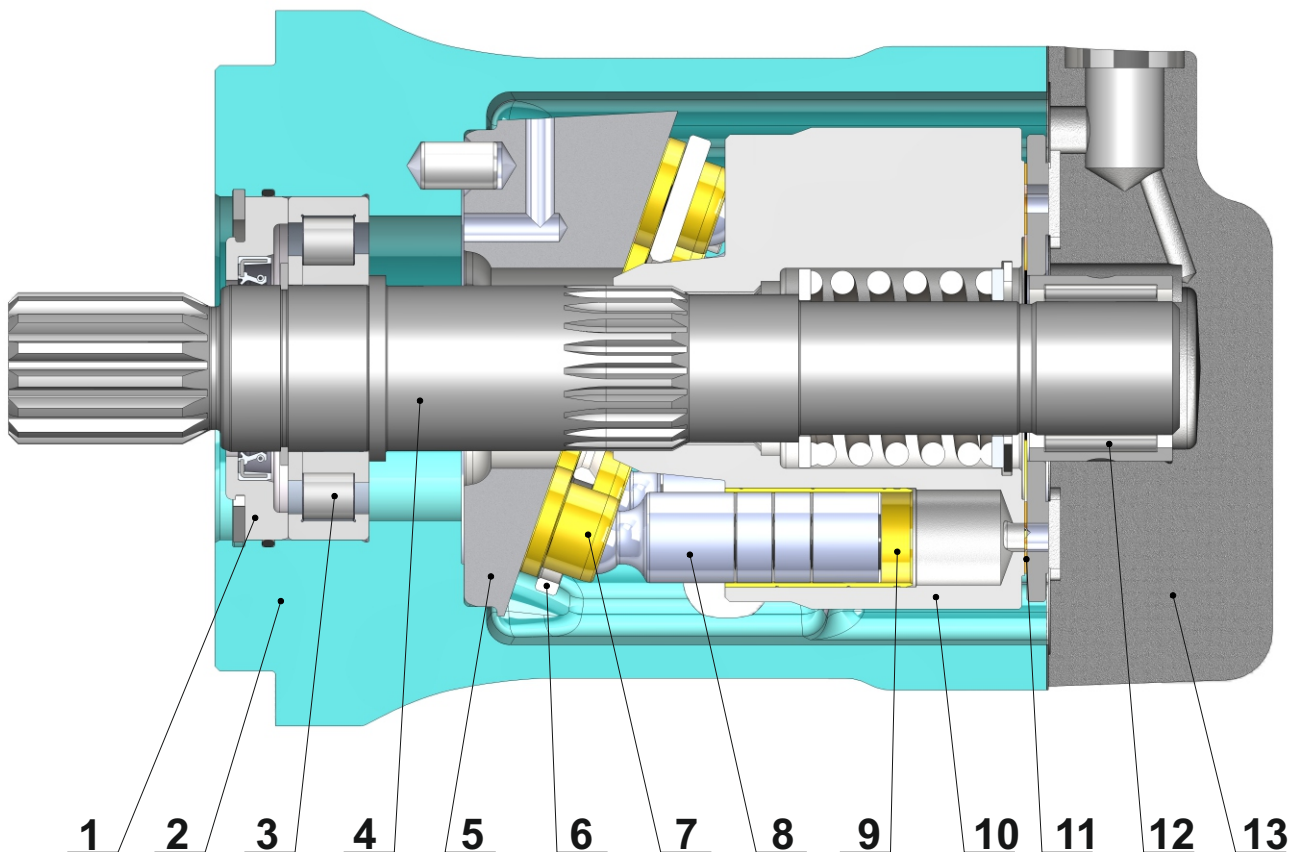


Continuous values





## SECTION VIEW



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

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



**SPECIFICATION DATA**

| Type                                                             |        | MAP 52                                                          | MAP 58          | MAP 62          |
|------------------------------------------------------------------|--------|-----------------------------------------------------------------|-----------------|-----------------|
| <b>Displacement, cm.<sup>3</sup>/rev. [in.<sup>3</sup>/rev.]</b> |        | 51.95<br>[3.17]                                                 | 58.8<br>[3.59]  | 62.4<br>[3.81]  |
| <b>Max. Speed, [RPM]</b>                                         | Cont.  | 3850                                                            | 3398            | 3050            |
|                                                                  | Int.*  | 4330                                                            | 3823            | 3500            |
| <b>Max. Torque,*** Nm [lb-in]</b>                                | Cont.  | 290 [2566]                                                      | 320 [2832]      | 318 [2814]      |
|                                                                  | Int.** | 347 [3071]                                                      | 375 [3320]      | 377 [3337]      |
| <b>Output, kW [HP]</b>                                           | Cont.  | 80 [107]                                                        | 80 [107]        | 80 [107]        |
|                                                                  | Int.** | 120 [161]                                                       | 120 [161]       | 120 [161]       |
| <b>Max. Pressure, bar [PSI]</b>                                  | Cont.  | 350 [5080]                                                      | 340 [4930]      | 320 [4640]      |
|                                                                  | Int.** | 420 [6100]                                                      | 400 [5800]      | 380 [5510]      |
|                                                                  | Peak   | 450 [6527]                                                      | 440 [6381]      | 410 [5950]      |
| <b>Max. Oil Flow, l/min [GPM]</b>                                | Cont.  | 200 [52.8]                                                      | 200 [52.8]      | 190 [50]        |
|                                                                  | Int.*  | 225 [59.4]                                                      | 225 [59.4]      | 215 [56.8]      |
| <b>Torque Constant ***** Nm/bar [lb-in/PSI]</b>                  |        | 0.75<br>[0.454]                                                 | 0.85<br>[0.515] | 0.9<br>[0.546]  |
| <b>Speed Constant ***** RPM/(l/min) [RPM/GPM]</b>                |        | 18.28<br>[70.2]                                                 | 16.13<br>[61.1] | 15.23<br>[57.6] |
| <b>Permissible Shaft Load</b>                                    |        |                                                                 |                 |                 |
| <b>max Axial**** N[lb]</b>                                       |        | Fa=2000 [450]                                                   |                 |                 |
| <b>max Radial**** N[lb]</b>                                      |        | Fr=3200 [720]                                                   |                 |                 |
| <b>Min. Speed, [RPM]</b>                                         |        | 500                                                             |                 |                 |
| <b>Max. Pressure in Drain Line, bar [PSI]</b>                    |        | 5 [70]<br>open drain line is always required                    |                 |                 |
| <b>Weight, kg [lb]</b>                                           |        | 17.65 [38.9] for SAE-B flange;<br>19.8 [43.7] for SAE-4C flange |                 |                 |

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

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

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

\*\*\* Theoretical torque;

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

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

1. The recommended output power for continuous operations should not be exceeded.
2. Recommended filtration as per ISO 4406 cleanliness code 18/16/13 or better. This filtration corresponds to SAE AS 4059 8A/7B/7C. Nominal filtration - 10 micron or better.
3. Recommended a premium quality, anti-wear type mineral based hydraulic oil, HLP(DIN51524) or HM(ISO6743/4).
4. Recommended oil viscosity - 12...68 cSt or see page 81.
5. Recommended maximum system operating temperature - 82°[180°] C[F].
6. To ensure optimum life of the motor, fill it up with fluid prior to load it and run with moderate load and speed for about 10-15 minutes.

**Hint: Motor Torque = Torque Constant \* Pressure Drop**

**Rotation Speed = Speed Constant \* Oil Flow**

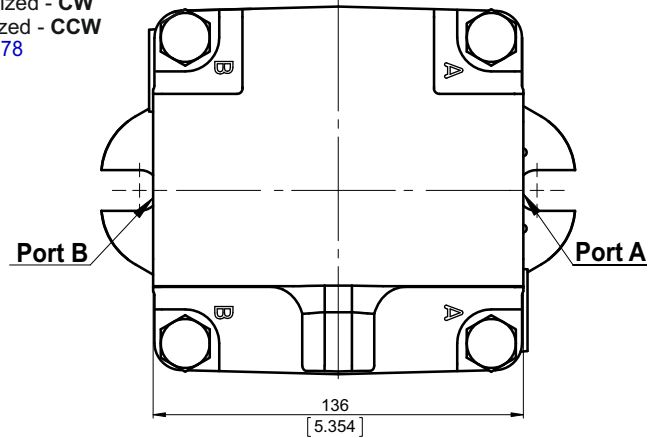
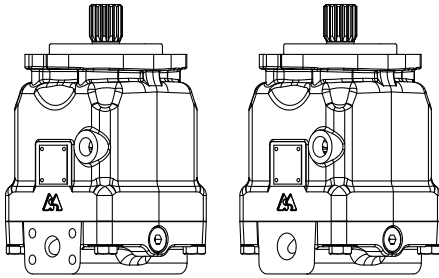
The constant values are approximate. Motor torque and rotation speed for a particular project are depending on the real operating conditions. For more detailed calculations please see efficiencies on next page and formulas on page 82.



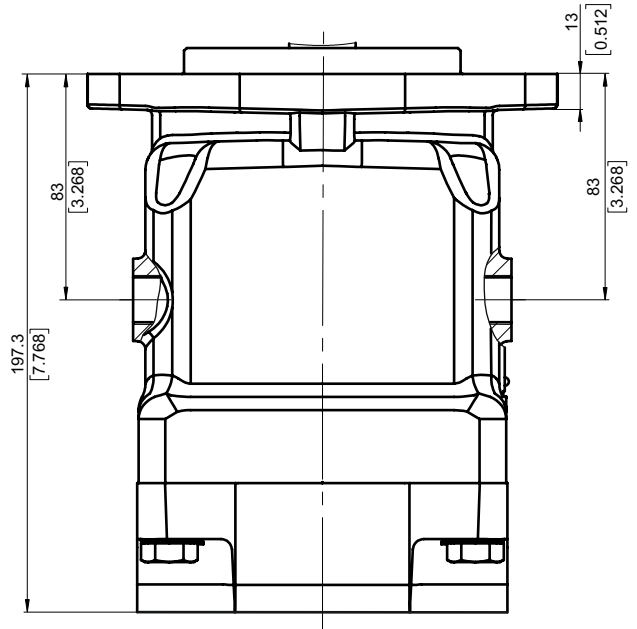
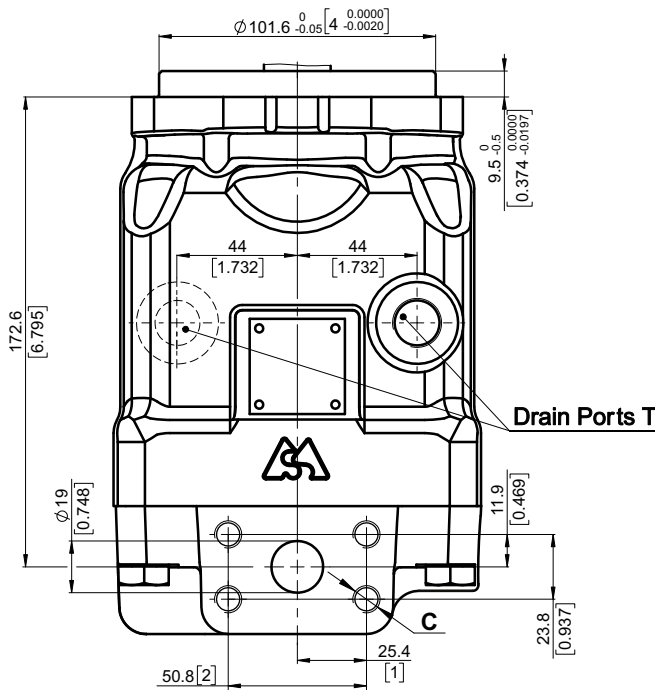
**OVERALL DIMENSIONS AND PORTS**

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

**Standard Rotation**  
Viewed from shaft end  
Port A Pressurized - CW  
Port B Pressurized - CCW  
see page 78

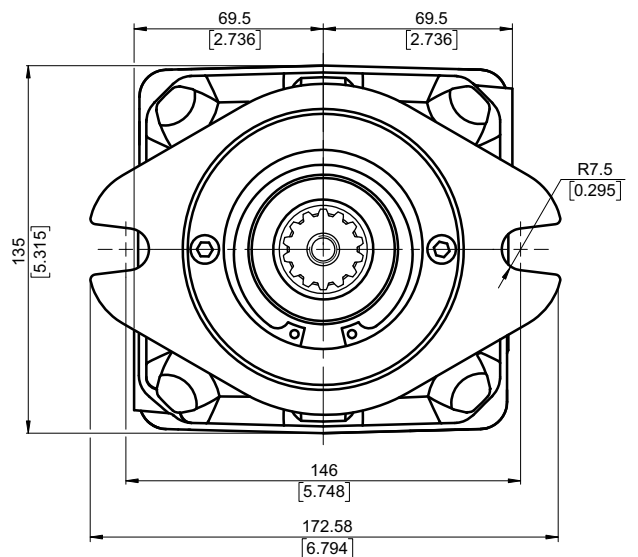
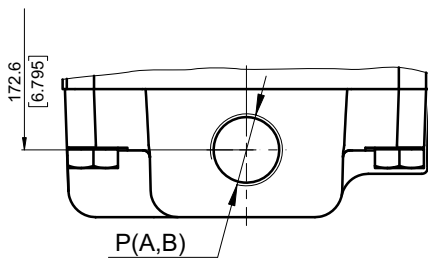


**Side ports, port size default, 5 and 9**



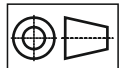
|                    | Port Size         |                         |                   |
|--------------------|-------------------|-------------------------|-------------------|
|                    | default           | 5                       | 9                 |
| P <sub>(A,B)</sub> | 2xISO 6162-2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

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



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

Shaft Mounting  
see page 34



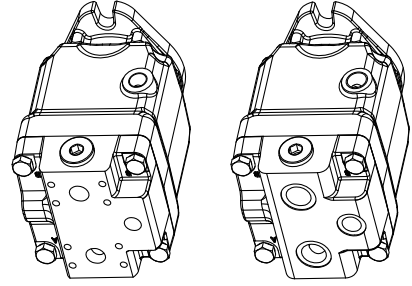
mm [in]



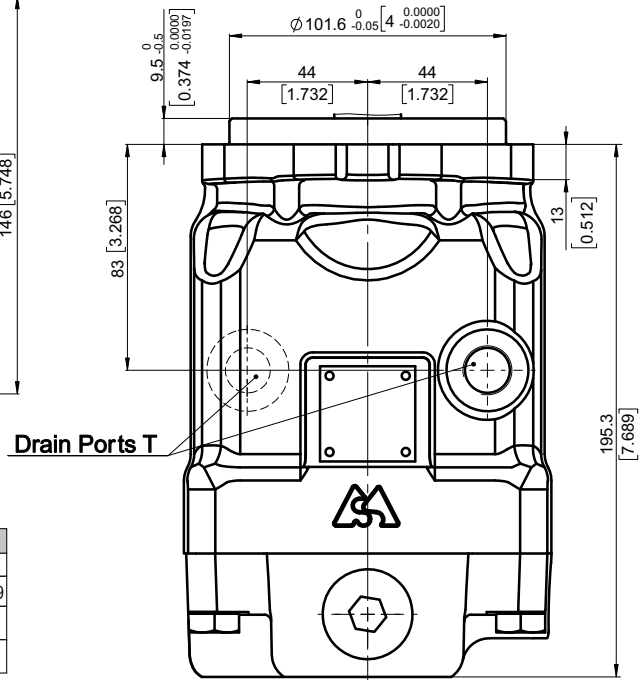
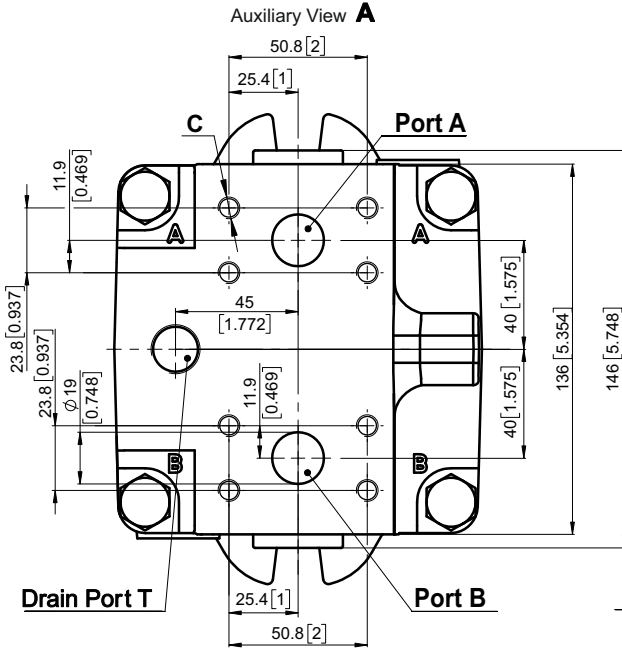
**OVERALL DIMENSIONS AND PORTS**

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

**Standard Rotation**  
Viewed from shaft end  
Port A Pressurized - CW  
Port B Pressurized - CCW  
see page 78

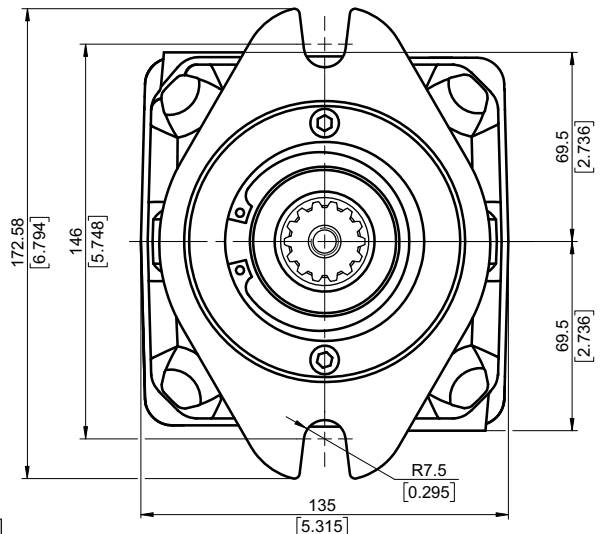
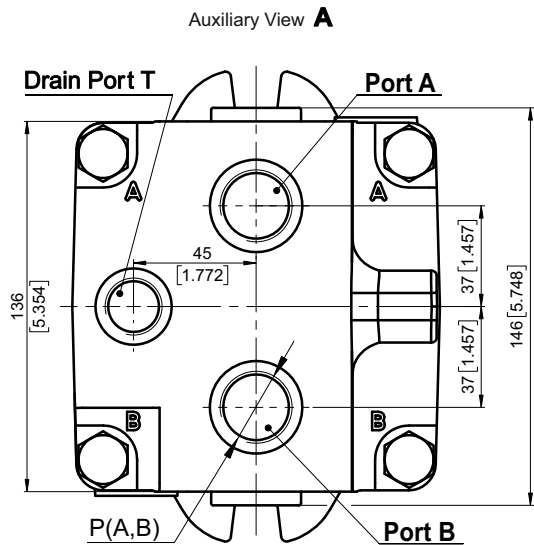


**Rear ports E, port size default, 5 and 9**



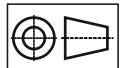
|                    | Port Size         |                         |                   |
|--------------------|-------------------|-------------------------|-------------------|
|                    | default           | 5                       | 9                 |
| P <sub>(A,B)</sub> | 2xISO 6162-2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

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



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

Shaft Mounting  
see page 34



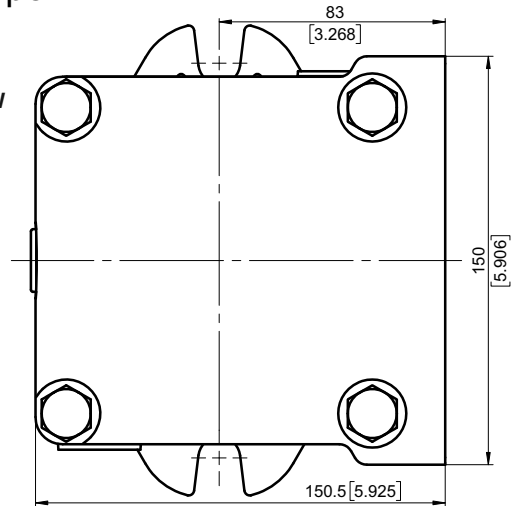
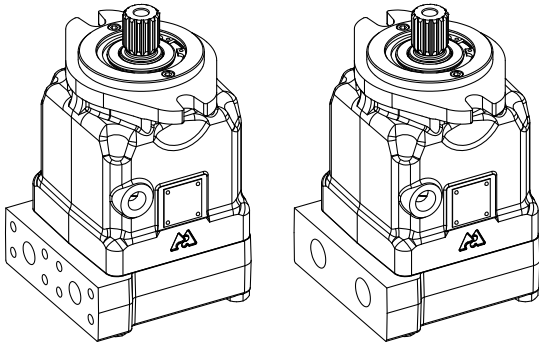
mm [in]



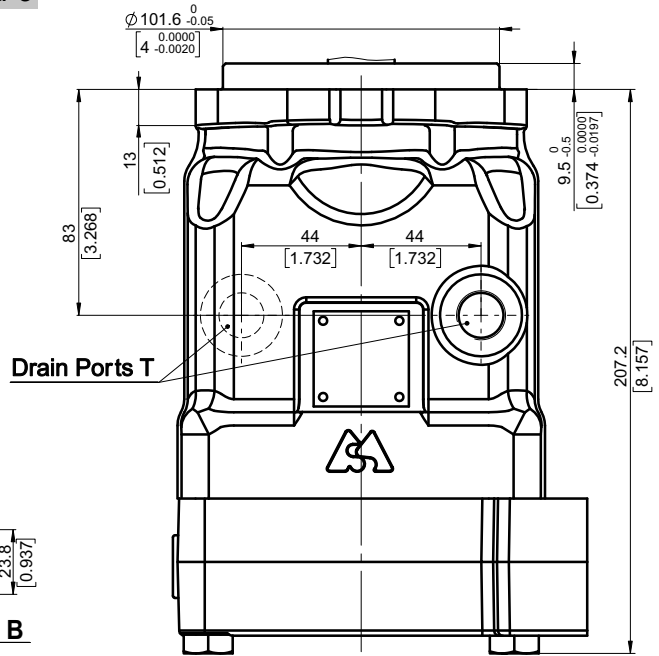
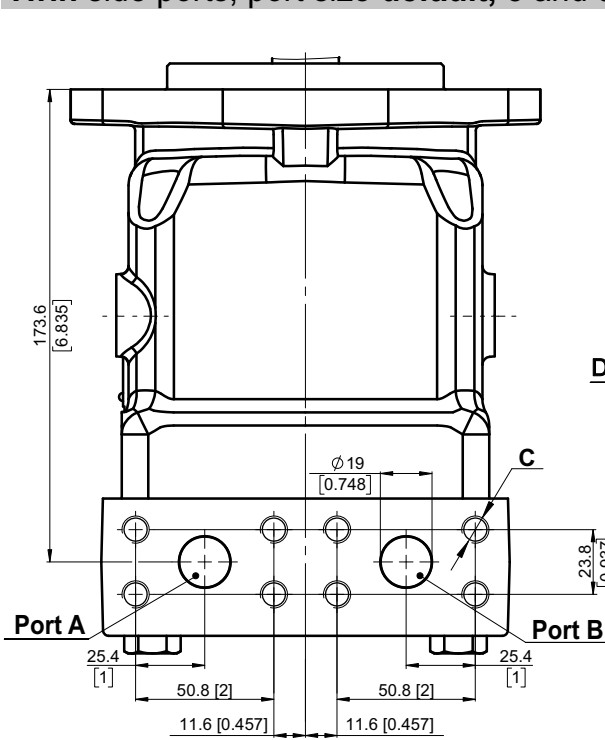
**OVERALL DIMENSIONS AND PORTS**

**Twin Side Ports - Type T**

**Standard Rotation**  
Viewed from shaft end  
Port A Pressurized - CW  
Port B Pressurized - CCW  
see page 78

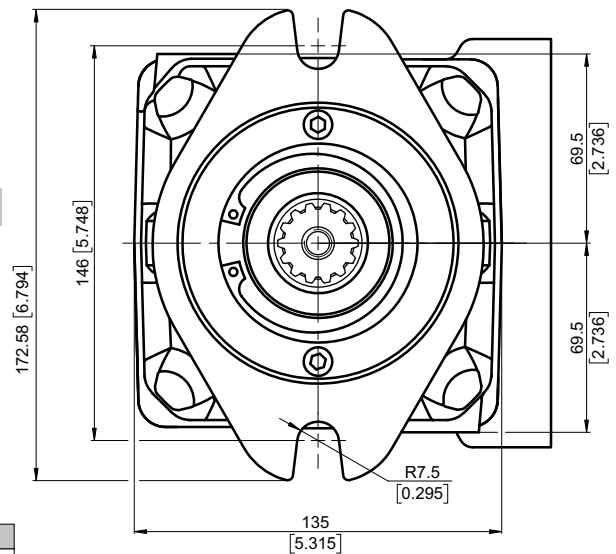
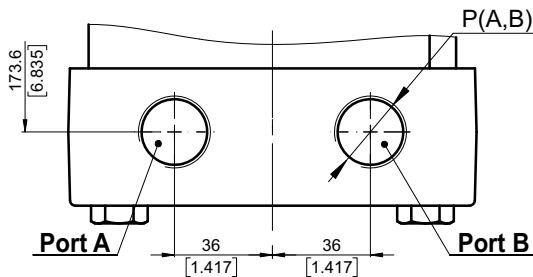


**Twin side ports, port size default, 5 and 9**



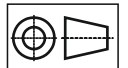
|                        | Port Size         |                         |                   |
|------------------------|-------------------|-------------------------|-------------------|
|                        | default           | 5                       | 9                 |
| <b>P<sub>A,B</sub></b>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

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



|                        | Port Size |         |               |         |           |             |
|------------------------|-----------|---------|---------------|---------|-----------|-------------|
|                        | 2         | 3       | 4             | 6       | 7         | 8           |
| <b>P<sub>A,B</sub></b> | 2xG 3/4   | 2xM27x2 | 2x1 1/16-12UN | 2xG 1/2 | 2xM22x1.5 | 2x7/8-14UNF |
| <b>T</b>               | G 1/2     | M18x1.5 | 7/8-14UNF     | G 1/2   | M18x1.5   | 3/4-16UNF   |

Shaft Mounting  
see next page



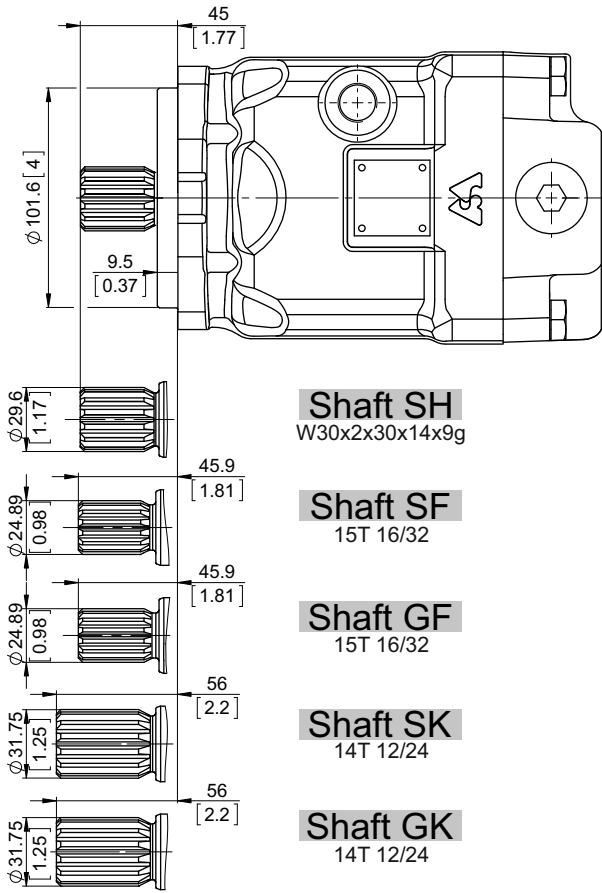
mm [in]





**SHAFTS MOUNTING**

**Mounting Flange - Type SAE-B**



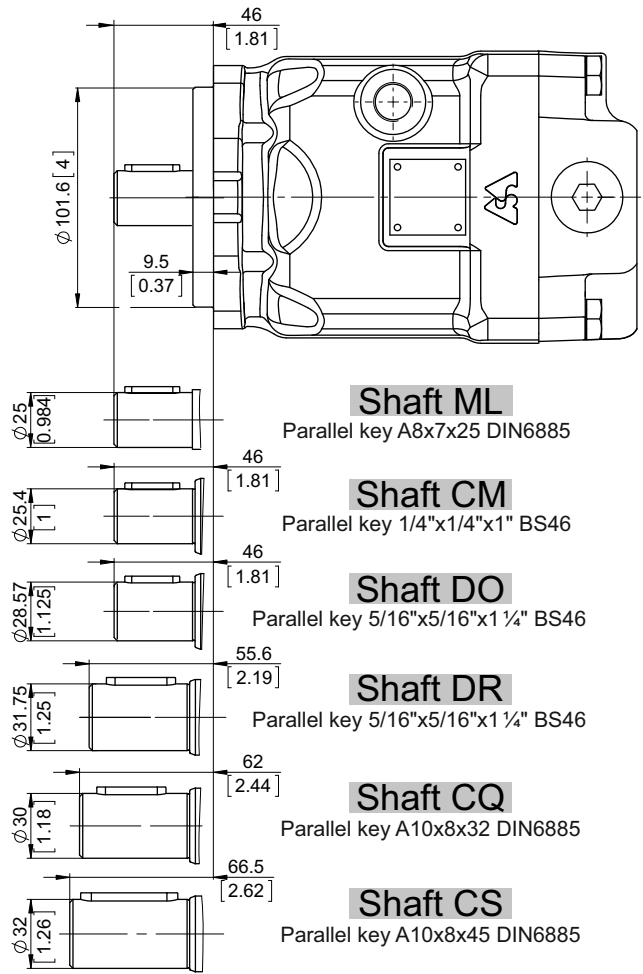
**Shaft SH**  
W30x2x30x14x9g

**Shaft SF**  
15T 16/32

**Shaft GF**  
15T 16/32

**Shaft SK**  
14T 12/24

**Shaft GK**  
14T 12/24



**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

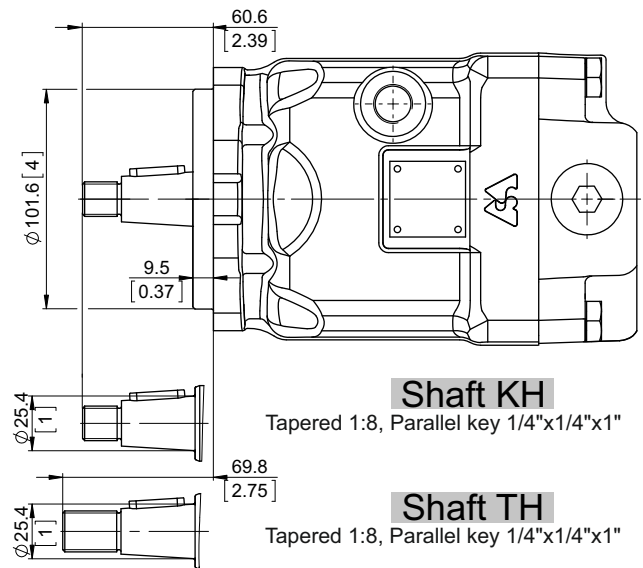
Shaft Dimensions  
See Page 68+72

**PERMISSIBLE SHAFT LOAD**

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

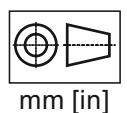
The calculated max values are based on the optimal direction of the forces Fr, Fa and optimal position of the shaft (see page 78).

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



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

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

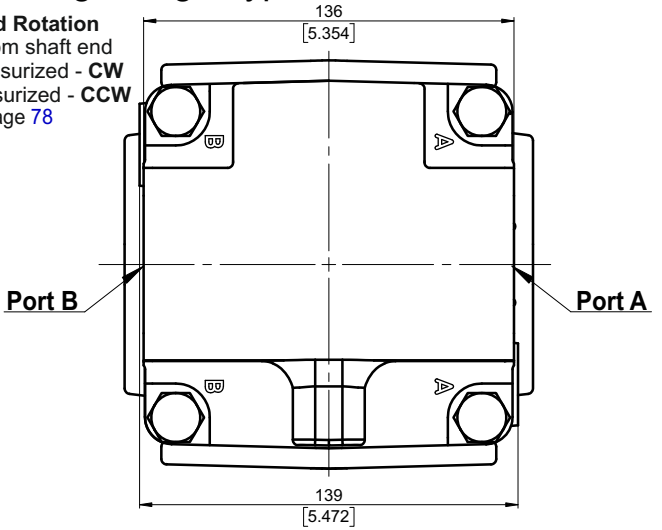
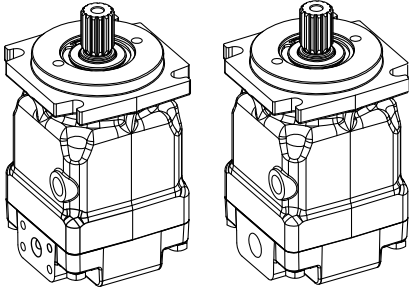




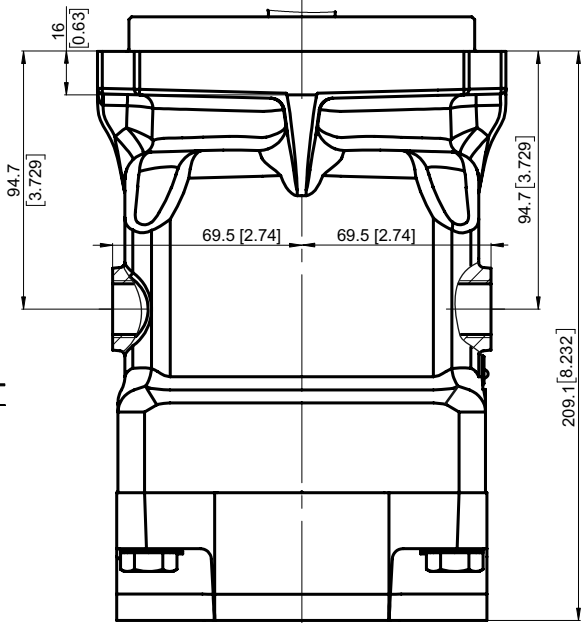
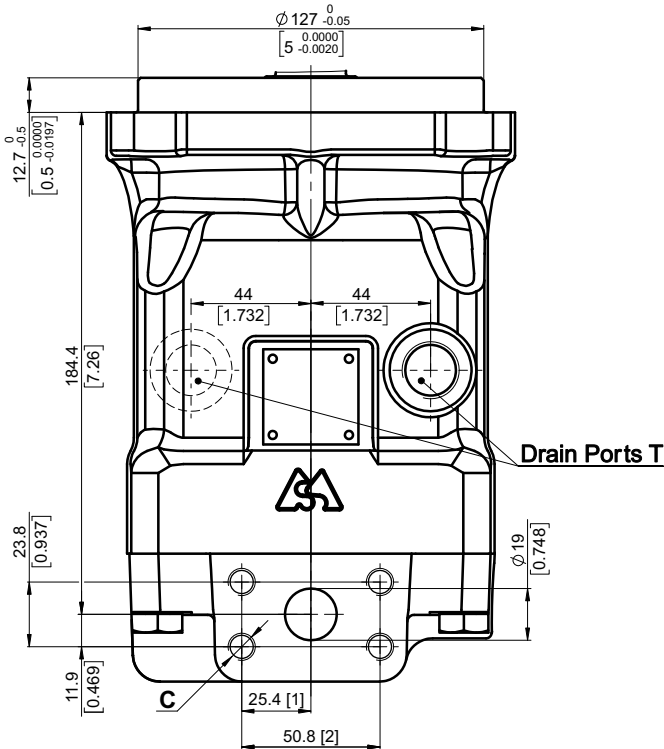
**OVERALL DIMENSIONS AND PORTS**

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

**Standard Rotation**  
Viewed from shaft end  
Port A Pressurized - CW  
Port B Pressurized - CCW  
see page 78

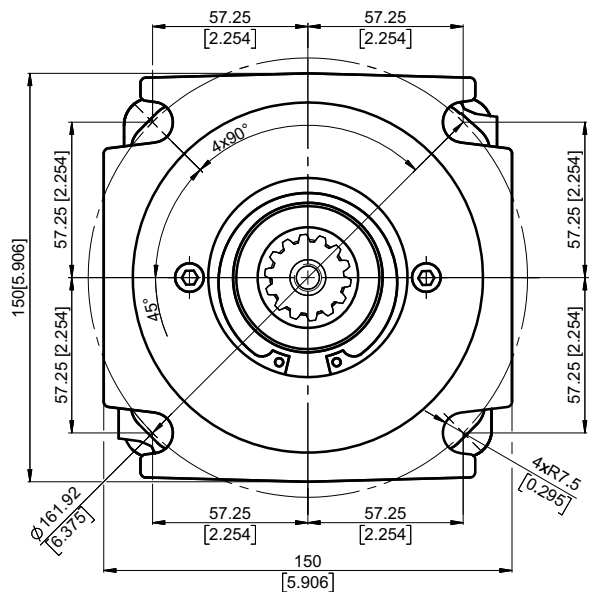
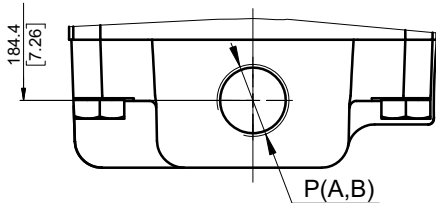


**Side ports, port size default, 5 and 9**



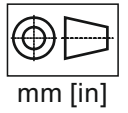
|                    | Port Size         |                          |                   |
|--------------------|-------------------|--------------------------|-------------------|
|                    | default           | 5                        | 9                 |
| P <sub>(A,B)</sub> | 2xISO 6162-2 DN19 | 2xSAE J518 3/4" PSI16000 | 2xISO 6162-2 DN19 |
| T                  | M18x1.5           | 7/8-14 UNF               | G1/2              |
| C                  | 8xM10             | 8x3/8-16 UNC             | 8xM10             |

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



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

Shaft Mounting  
see page 37



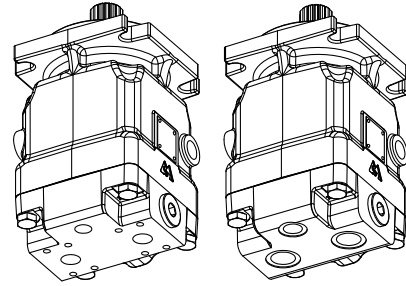
mm [in]



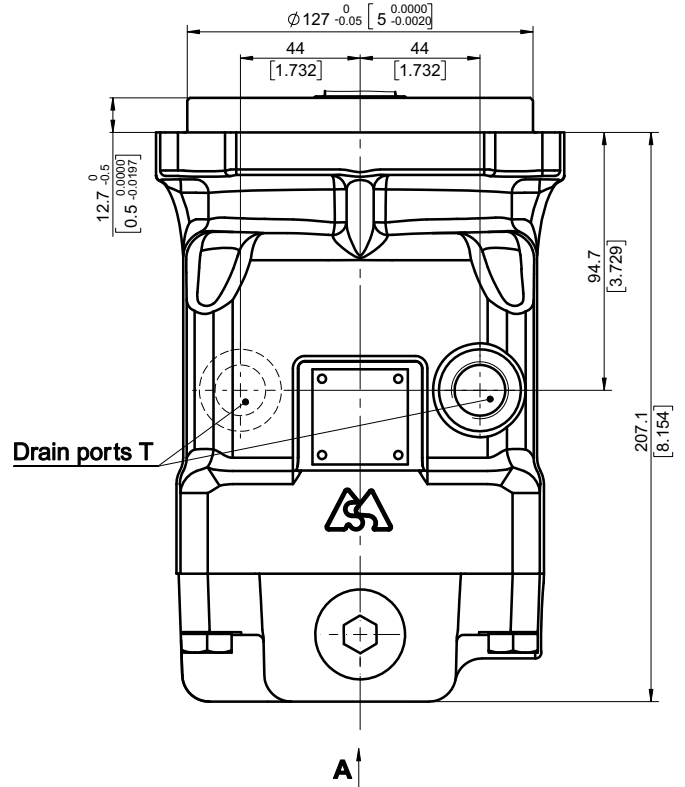
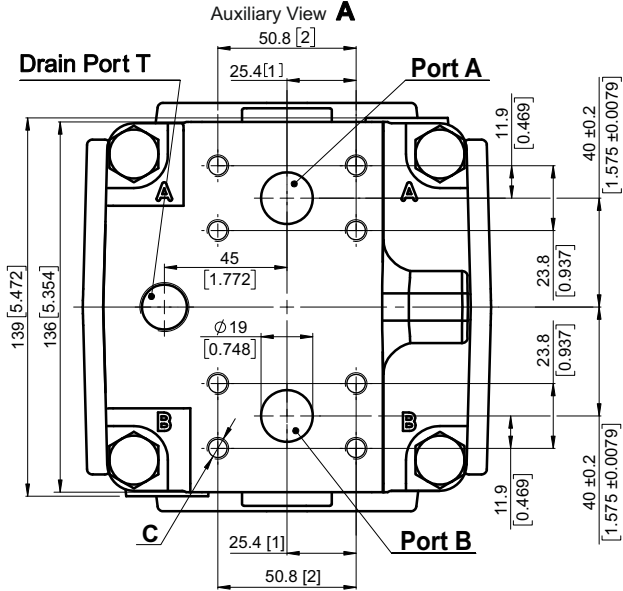
**OVERALL DIMENSIONS AND PORTS**

**Rear Ports - Default Mounting Flange Type - 4C**

**Standard Rotation**  
Viewed from shaft end  
Port A Pressurized - CW  
Port B Pressurized - CCW  
see page 78

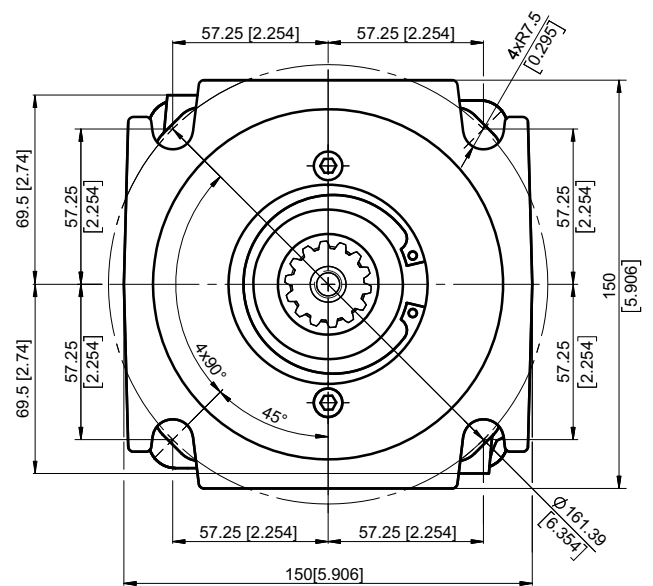
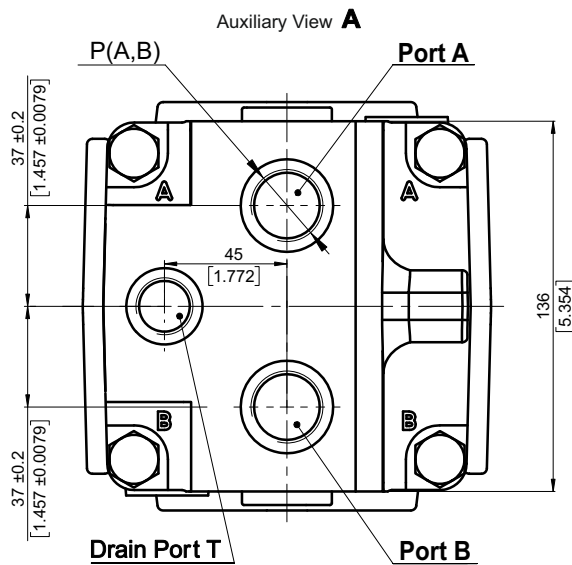


**Rear ports, port size default, 5 and 9**



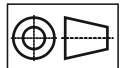
|                    |                   | Port Size       |         |                   |
|--------------------|-------------------|-----------------|---------|-------------------|
|                    |                   | default         | 5       | 9                 |
| P <sub>(A,B)</sub> | 2xISO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

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



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

Shaft Mounting  
see page 37



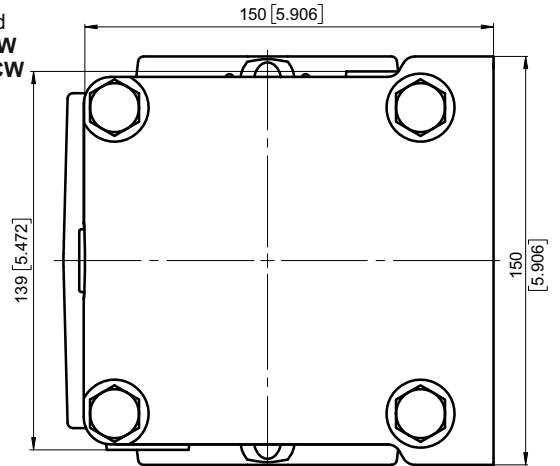
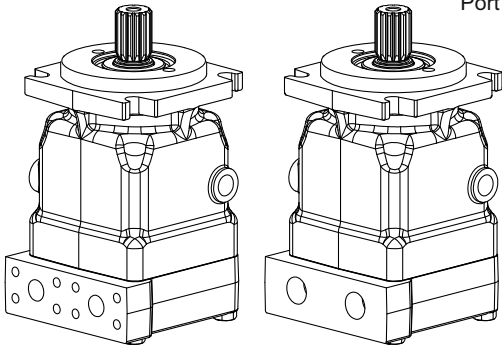
mm [in]



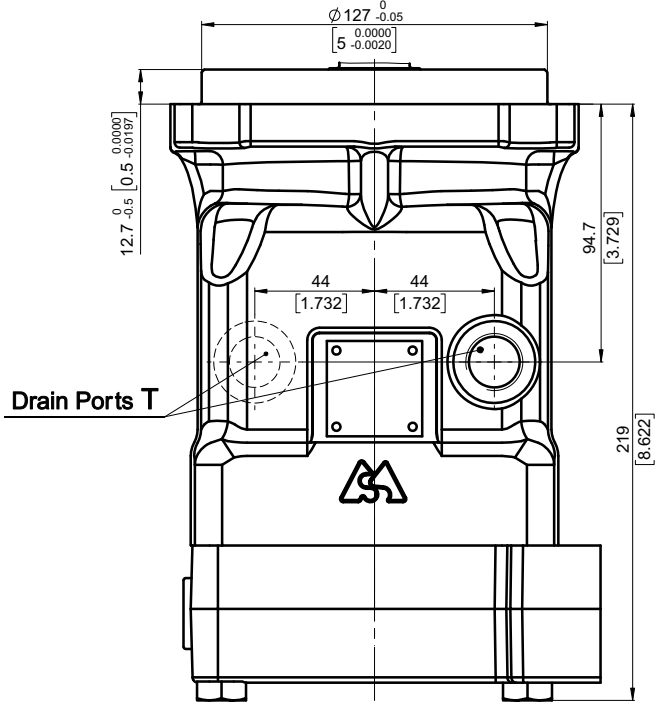
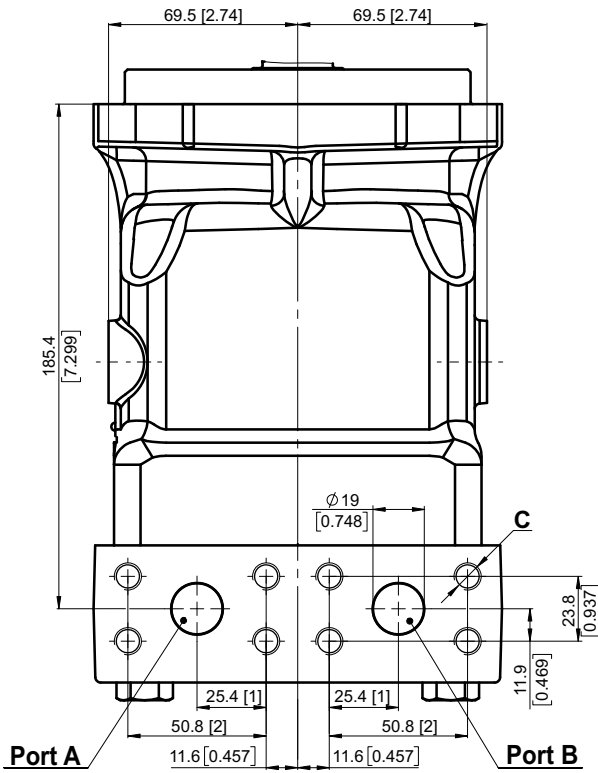
**OVERALL DIMENSIONS AND PORTS**

**Twin Ports - Default Mounting Flange Type - 4C**

**Standard Rotation**  
Viewed from shaft end  
Port A Pressurized - CW  
Port B Pressurized - CCW  
see page 78

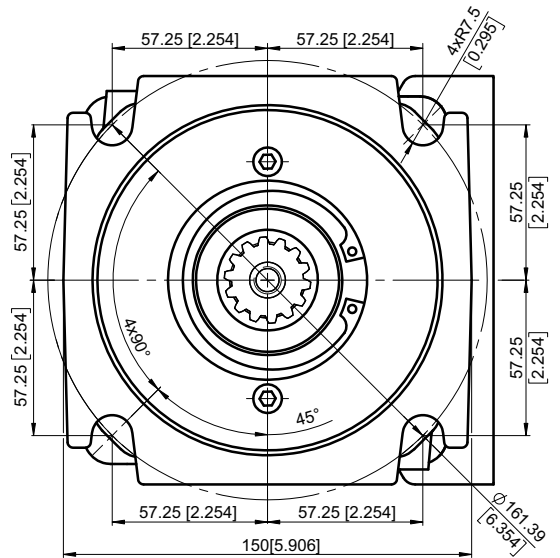
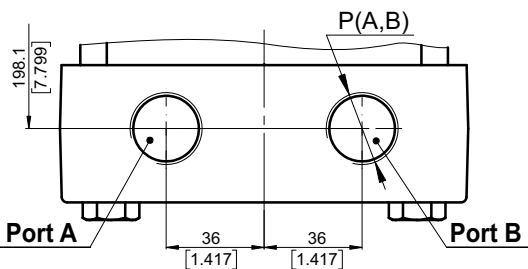


**Twin ports, port size default, 5 and 9**



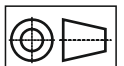
|                          | Port Size         |                         |                   |
|--------------------------|-------------------|-------------------------|-------------------|
|                          | default           | 5                       | 9                 |
| <b>P<sub>(A,B)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

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



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

Shaft Mounting  
see page 37

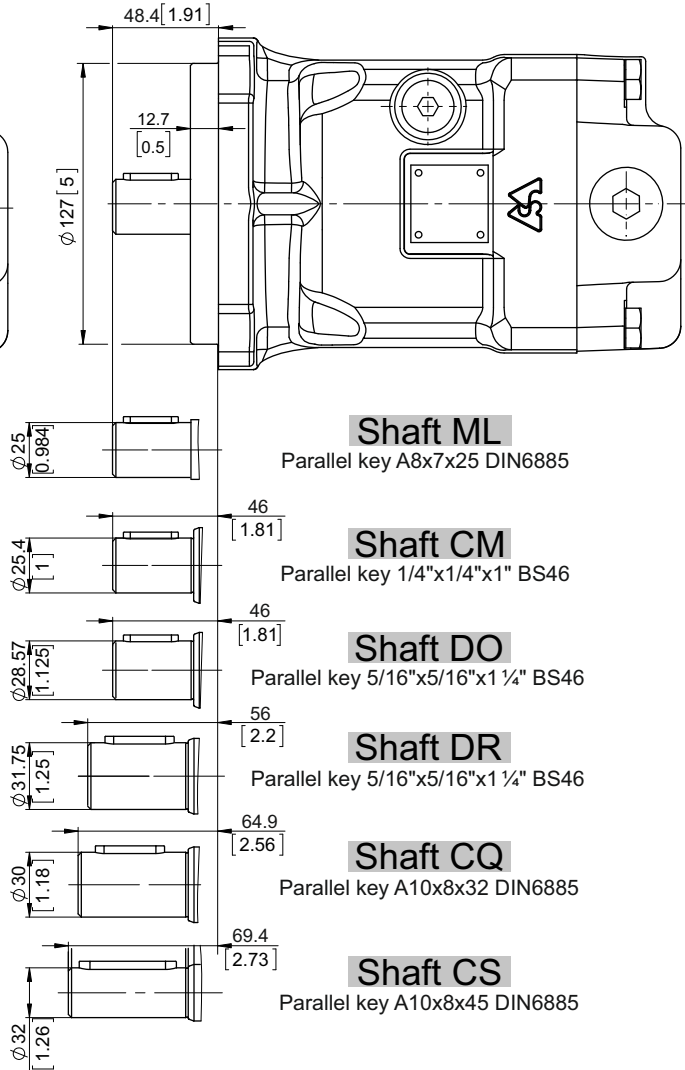
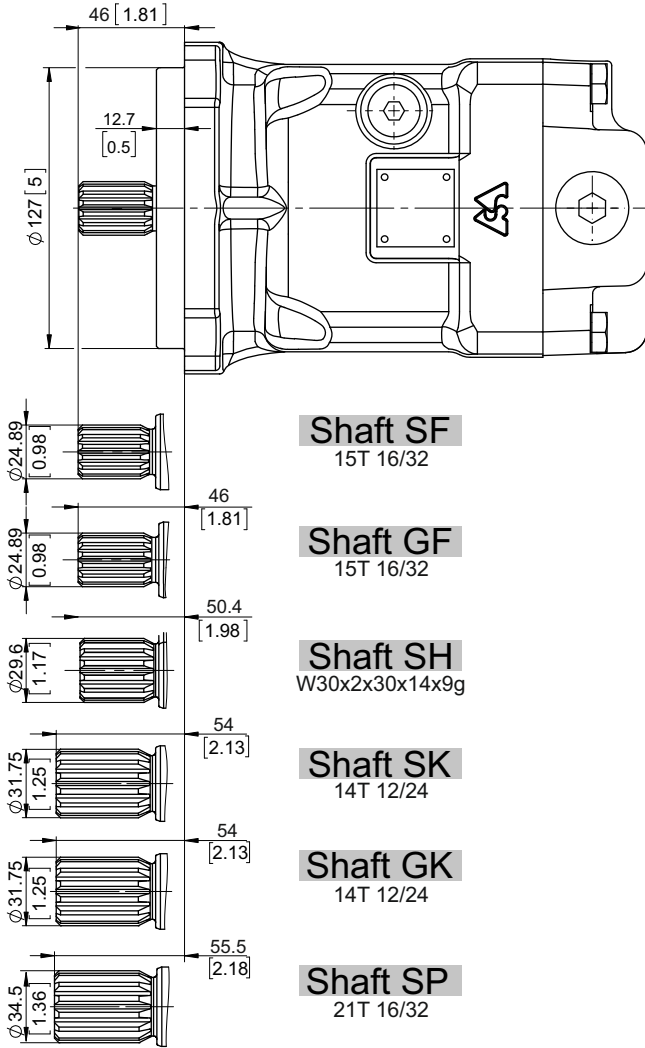


mm [in]



**SHAFTS MOUNTING**

**Mounting Flange - Type - 4C**



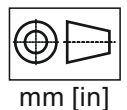
Shaft Dimensions  
See Page 68+72

**PERMISSIBLE SHAFT LOAD**

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

The calculated max values are based on the optimal direction of the forces Fr, Fa and optimal position of the shaft (see page 78).

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 |
| <b>M A P</b> |   |   |   |   |   |   |   |   |   |    |    | [  |    | ]  |

**Pos.1 - Mounting Flange**

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

**Pos.2 - Port Type**

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

**Pos.3 - Displacement Code**

- 52** - 51.95 cm.<sup>3</sup>/rev. [3.17 in.<sup>3</sup>/rev.]
- 58** - 58.8 cm.<sup>3</sup>/rev. [3.59 in.<sup>3</sup>/rev.]
- 62** - 62.4 cm.<sup>3</sup>/rev. [3.81 in.<sup>3</sup>/rev.]

**Pos.4 - Shaft Extensions\*\***

- SF** - ø24.9 [0.98"] Spline SAE 15T 16/32, M8
- GF** - ø24.9 [0.98"] Spline SAE 15T 16/32, 3/8-16UNC
- SH** - ø29.6 [1.165"] Spline W30x2x30x14x9g,M10
- SK** - ø31.75 [1.25"] Spline SAE 14T 12/24 DP, M10
- GK** - ø31.75 [1.25"] Spline SAE 14T 12/24 DP, 7/16-14UNC thread
- SP** - ø34.5 [1.358"] Spline SAE 21T 16/32 DP, M12
- ML** - ø25 [0.984"] Straight, M8 thread  
Parallel key A8x7x25 DIN6885
- CM** - ø25.4 [1"] Straight, M8 thread  
Parallel key 1/4"x1/4"x1" BS46
- DO** - ø28.75 [1.125"] Straight, 3/8-16UNC  
Parallel key 5/16"x5/16"x1 1/4" BS46
- CQ** - ø30 [1.181"] Straight, M8 thread  
Parallel key A8x7x32 DIN6885
- DR** - ø31.75 [1.25"] Straight, 3/8-16UNC  
Parallel key 5/16"x5/16"x1 1/4" BS46
- CS** - ø32 [1.26"] Straight, M8 thread

**Pos.5 - Ports**

- omit - 2xISO 6162-2 DN19, drain port M18x1.5
- 2** - 2xG3/4, drain ports G1/2
- 3** - 2xM27x2, drain ports M18x1.5
- 4** - 2x1 1/16 -12 UN, drain ports 7/8-14 UNF
- 5** - 2xSAE 3/4" PSI6000, drain port 7/8-14 UNF
- 6** - 2xG1/2, drain ports G1/2
- 7** - 2xM22x1.5, drain ports M18x1.5
- 8** - 2x7/8-14 UNF Ports, drain ports 3/4-16 UNF
- 9** - 2xISO 6162-2 DN19, drain port G1/2  
Option 6;7 and 8 are not available for Pos.2 option omit

**Pos.6 - Seal, Corrosion Resistant Seal Surface**

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

**Pos.7 - Integrated Valves**

- See page 74+75 for information about valves
- omit - None
- HR** - Single anti-cavitation valve
- AR** - Dual anti-cavitation valve
- PU** - Purge valve -default - 6±2 l/min.
- FLU** - Flush valve - default - 6±2 l/min at 20 bar.
- SAR** - Single anti-cavitation and relief valve
- DAR** - Dual anti-cavitation and relief valve
- DARP** - Dual anti-cavitation, relief and purge valve, default flow - 6±2 l/min.
- DARF** - Dual anti-cavitation, relief and flush valve, default flow - 6±2 l/min at 20 bar.

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

**Pos.8 - Valve's Port for Single Valves**

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

**Pos.9 - Pressure Setting of Integrated Valves**

- omit - None
- x** - 

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

  
for more information see page 74+75

**Pos.10 - Flow Setting of Integrated Valves**

- omit - None
- Lx** - For value - see page 74+75

**Pos.11 - Special Features\***

- omit - None
- R2S** - Speed Sensor Two Directional (see page 76)
- R** - Reverse Rotation (see page 78)

**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.

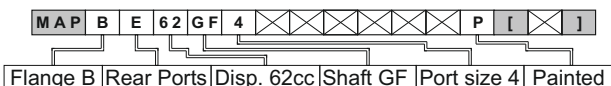
**Pos.13 - Design Series**

- omit - Factory specified

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

**EXAMPLE**

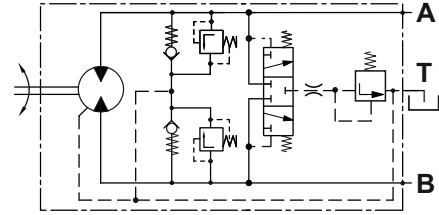
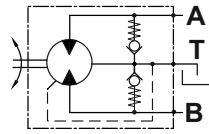
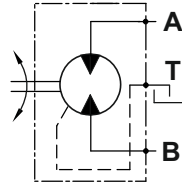
**M A P B E 62 G F 4 P [ X ]**





# 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

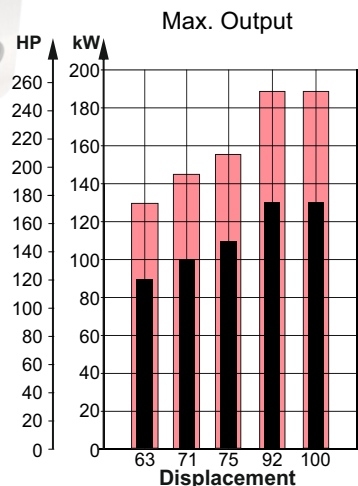
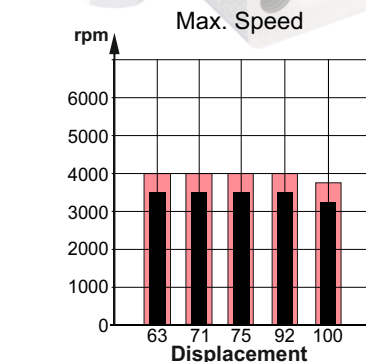
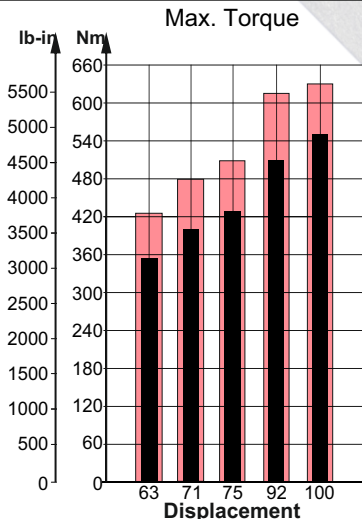
- » Swash plate
- » Flange options
- » Port options
- » Shaft options
- » High pressure ports
- » Integrated valves

### ADVANTAGES

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

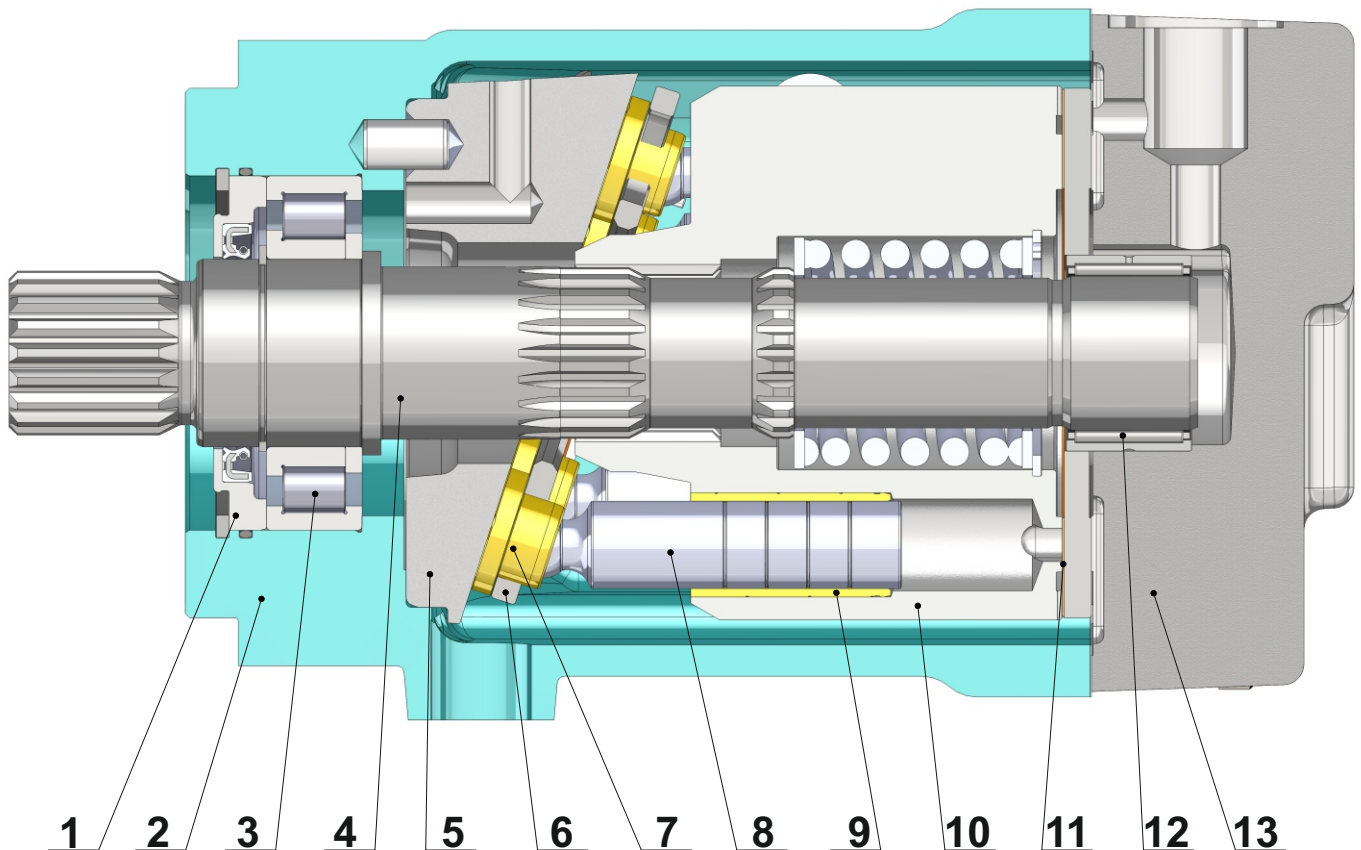
### GENERAL

|                          |                                                                    |                         |
|--------------------------|--------------------------------------------------------------------|-------------------------|
| Displacement,            | cm <sup>3</sup> /rev [in <sup>3</sup> /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 <sup>2</sup> /s [SUS]                                           | 12÷68 [66÷311]          |
| Filtration               | ISO code 18/16/13 (Min. recommended fluid filtration of 10 micron) |                         |





**SECTION VIEW**



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

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





**SPECIFICATION DATA**

| Type                                                                       | MAP 63                                                            | MAP 71         | MAP 75          | MAP 92          | MAP 100         |            |
|----------------------------------------------------------------------------|-------------------------------------------------------------------|----------------|-----------------|-----------------|-----------------|------------|
| <b>Displacement,</b><br><b>cm.<sup>3</sup>/rev. [in.<sup>3</sup>/rev.]</b> | 63.58<br>[3.88]                                                   | 71.5<br>[4.36] | 76.84<br>[4.69] | 93.18<br>[5.69] | 98.75<br>[6.03] |            |
| <b>Max. Speed,</b><br><b>[RPM]</b>                                         | Cont.                                                             | 3500           | 3500            | 3500            | 3240            |            |
|                                                                            | Int.*                                                             | 4000           | 4000            | 4000            | 3750            |            |
| <b>Max. Torque,***</b><br><b>Nm [lb-in]</b>                                | Cont.                                                             | 354 [3133]     | 398 [3523]      | 428 [3788]      | 514 [4549]      | 550 [4870] |
|                                                                            | Int.**                                                            | 425 [3762]     | 478 [4230]      | 514 [4549]      | 616 [5452]      | 645 [5710] |
| <b>Output,</b><br><b>kW [HP]</b>                                           | Cont.                                                             | 89 [120]       | 100 [134]       | 108 [145]       | 130 [174]       | 130 [174]  |
|                                                                            | Int.**                                                            | 129 [173]      | 145 [195]       | 156 [209]       | 188 [252]       | 188 [252]  |
| <b>Max. Pressure,</b><br><b>bar [PSI]</b>                                  | 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] |
| <b>Max. Oil Flow,</b><br><b>l/min [GPM]</b>                                | 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] |
| <b>Torque Constant</b> *****                                               | 0.91                                                              | 1.03           | 1.1             | 1.32            | 1.42            |            |
| <b>Nm/bar [lb-in/PSI]</b>                                                  | [0.56]                                                            | [0.63]         | [0.67]          | [0.81]          | [0.87]          |            |
| <b>Speed Constants</b> *****                                               | 14.94                                                             | 13.3           | 12.36           | 10.2            | 9.62            |            |
| <b>RPM/(l/min) [RPM/GPM]</b>                                               | [56.56]                                                           | [50.3]         | [46.8]          | [38.6]          | [36.42]         |            |
| <b>Permissible Shaft Load</b>                                              |                                                                   |                |                 |                 |                 |            |
| <b>max Axial**** N[lb]</b>                                                 | Fa=2500 [562]                                                     |                |                 |                 |                 |            |
| <b>max Radial**** N[lb]</b>                                                | Fr=4500 [1010]                                                    |                |                 |                 |                 |            |
| <b>Min. Speed, [RPM]</b>                                                   | 500                                                               |                |                 |                 |                 |            |
| <b>Max. Pressure in Drain Line, bar [PSI]</b>                              | 5 [70]<br>open drain line is always required                      |                |                 |                 |                 |            |
| <b>Weight, kg [lb]</b>                                                     | 34.3 [75.62] for SAE-4C flange;<br>35.3 [77.82] for SAE-4M flange |                |                 |                 |                 |            |

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

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

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

\*\*\* Theoretical torque;

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

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

1. The recommended output power for continuous operations should not be exceeded.
2. Recommended filtration as per ISO 4406 cleanliness code 18/16/13 or better. This filtration corresponds to SAE AS 4059 8A/7B/7C. Nominal filtration - 10 micron or better.
3. Recommended a premium quality, anti-wear type mineral based hydraulic oil, HLP(DIN51524) or HM(ISO6743/4).
4. Recommended oil viscosity - 12...68 cSt or see page 81.
5. Recommended maximum system operating temperature - 82°[180°] C[F].
6. To ensure optimum life of the motor, fill it up with fluid prior to load it and run with moderate load and speed for about 10-15 minutes.

**Hint: Motor Torque = Torque Constant \* Pressure Drop**

**Rotation Speed = Speed Constant \* Oil Flow**

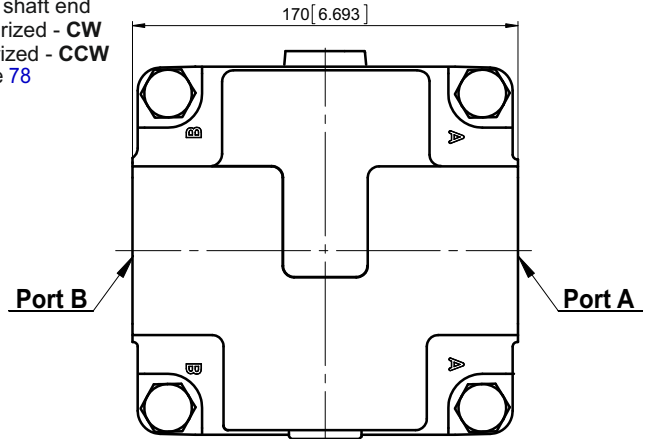
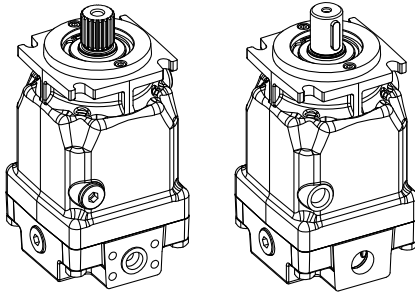
The constant values are approximate. Motor torque and rotation speed for a particular project are depending on the real operating conditions. For more detailed calculations please see efficiencies on next page and formulas on page 82.



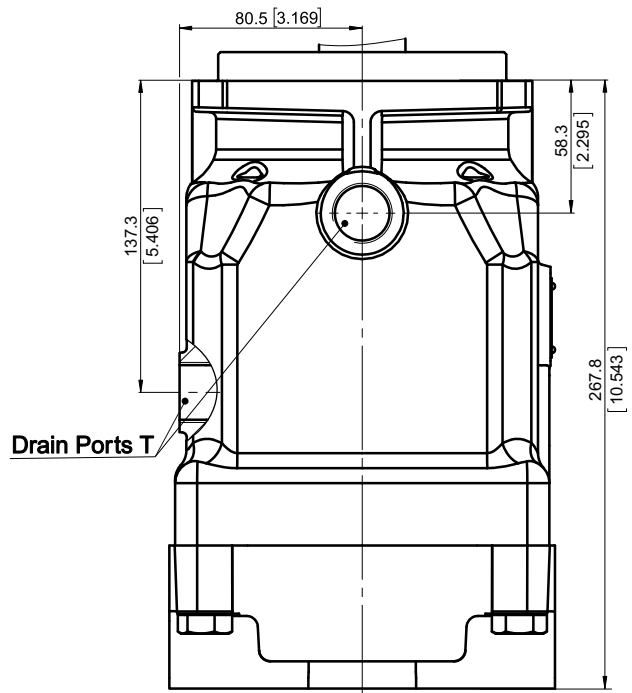
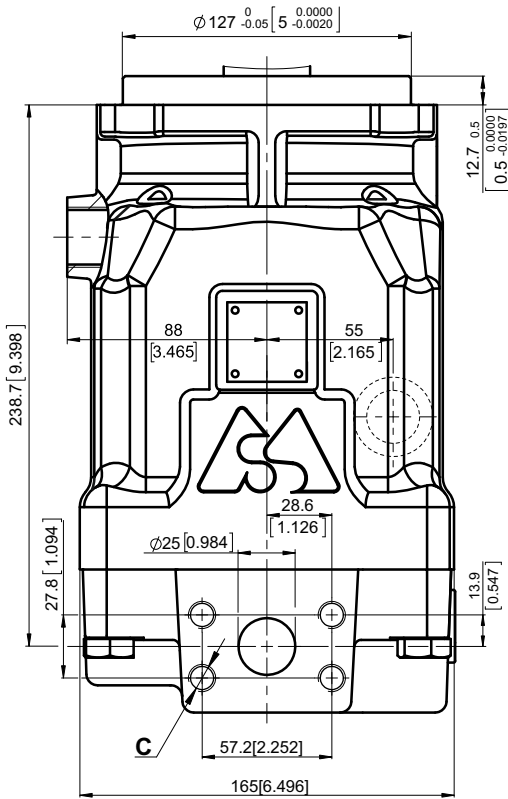
**OVERALL DIMENSIONS AND PORTS**

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

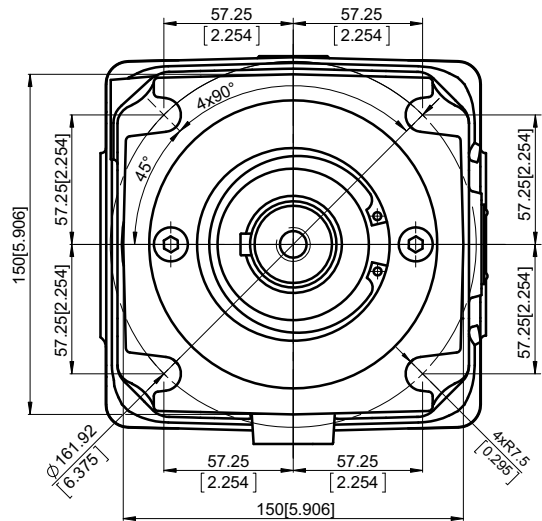
**Standard Rotation**  
Viewed from shaft end  
Port A Pressurized - CW  
Port B Pressurized - CCW  
see page 78



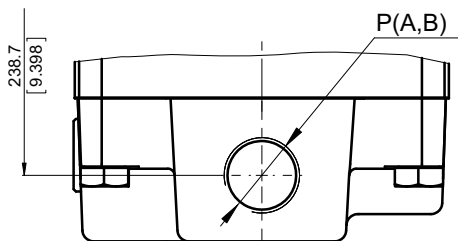
**Side ports, port size default, 5 and 9**



|                    | Port Size         |                       |                   |
|--------------------|-------------------|-----------------------|-------------------|
|                    | default           | 5                     | 9                 |
| P <sub>(A,B)</sub> | 2xISO 6162-2 DN25 | 2xSAE J518 1" PSI6000 | 2xISO 6162-2 DN25 |
| T                  | M27x2             | 1 1/16-12 UN          | G 3/4             |
| C                  | 8xM12             | 8x7/16-14 UNC         | 8xM12             |

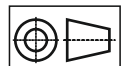


**Side ports, port size 2 and 4**



|                    | Port Size |                |
|--------------------|-----------|----------------|
|                    | 2         | 4              |
| P <sub>(A,B)</sub> | 2xG 1     | 2x1 1/16-12 UN |
| T                  | G 3/4     | 1 1/16-12 UN   |

Shaft Mounting  
see page 45



mm [in]

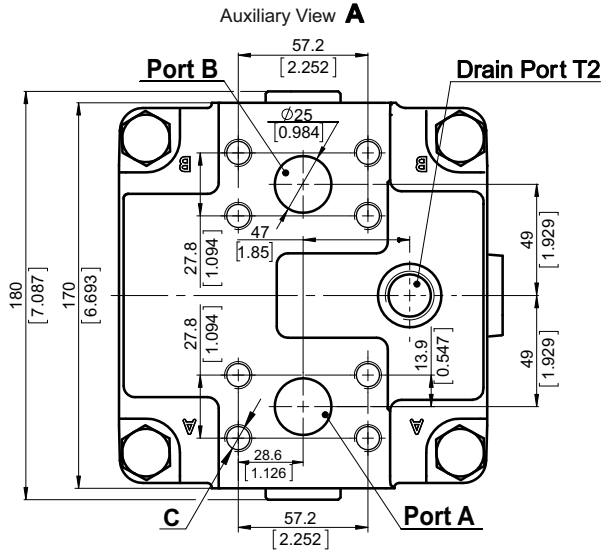


**OVERALL DIMENSIONS AND PORTS**

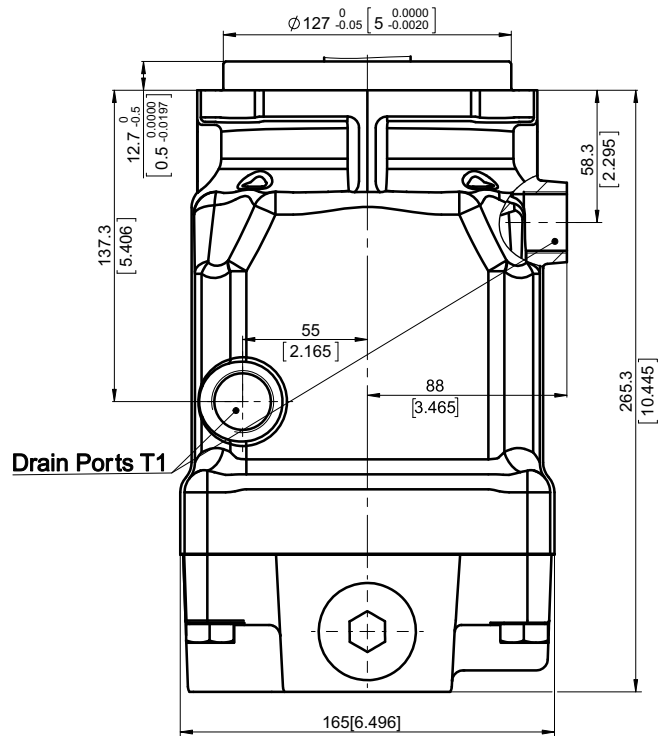
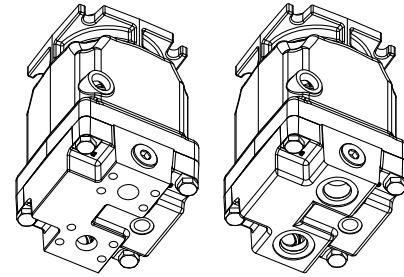
**Rear Ports - Type E Mounting Flange - Type SAE-4C**

**Standard Rotation**  
Viewed from shaft end  
Port A Pressurized - CW  
Port B Pressurized - CCW  
see page 78

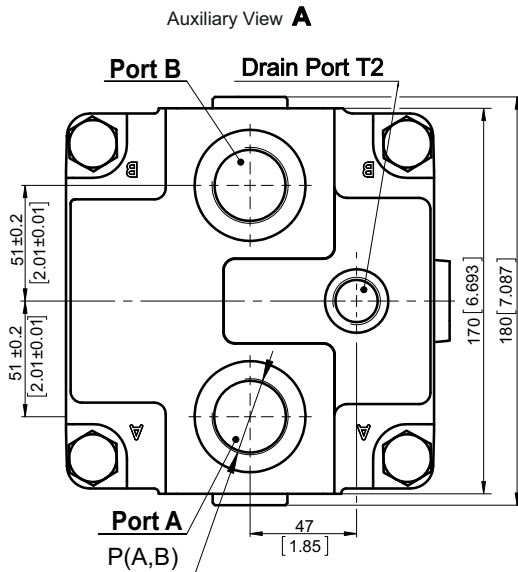
**Rear ports, port size default, 5 and 9**



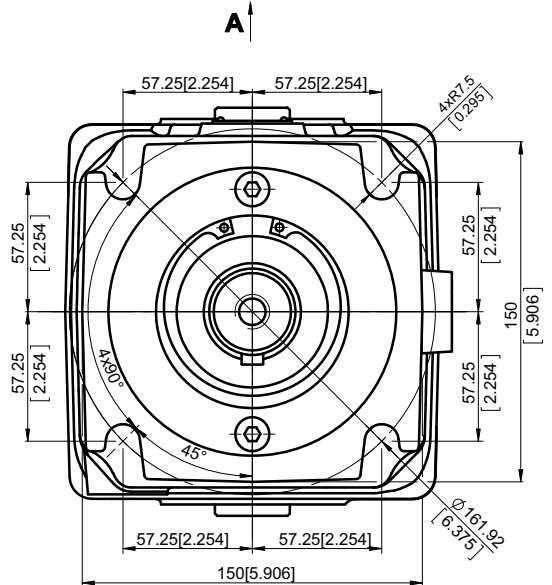
|                    | Port Size         |                       |                   |
|--------------------|-------------------|-----------------------|-------------------|
|                    | default           | 5                     | 9                 |
| P <sub>(A,B)</sub> | 2xISO 6162-2 DN25 | 2xSAE J518 1" PSI6000 | 2xISO 6162-2 DN25 |
| T1                 | M27x2             | 1 1/16-12 UN          | G 3/4             |
| T2                 | M22x1.5           | 7/8-14 UNF            | G 1/2             |
| C                  | 8xM12             | 8x7/16-14 UNC         | 8xM12             |



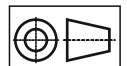
**Rear ports, port size 2 and 4**



|                    | Port Size |               |
|--------------------|-----------|---------------|
|                    | 2         | 4             |
| P <sub>(A,B)</sub> | 2xG 1     | 2x1 5/16-12UN |
| T1                 | G 3/4     | 1 1/16-12UN   |
| T2                 | G 1/2     | 7/8 - 14 UNF  |



Shaft Mounting  
see page 45



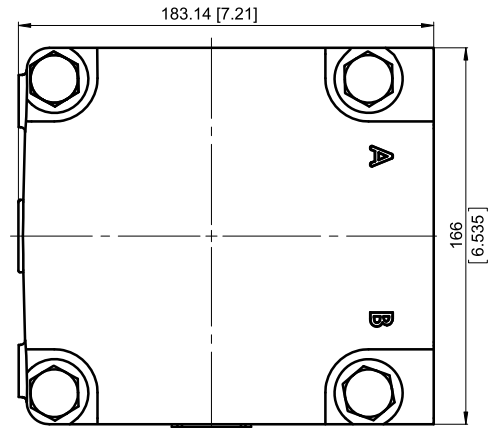
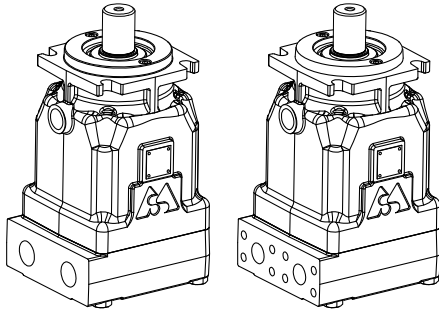
mm [in]



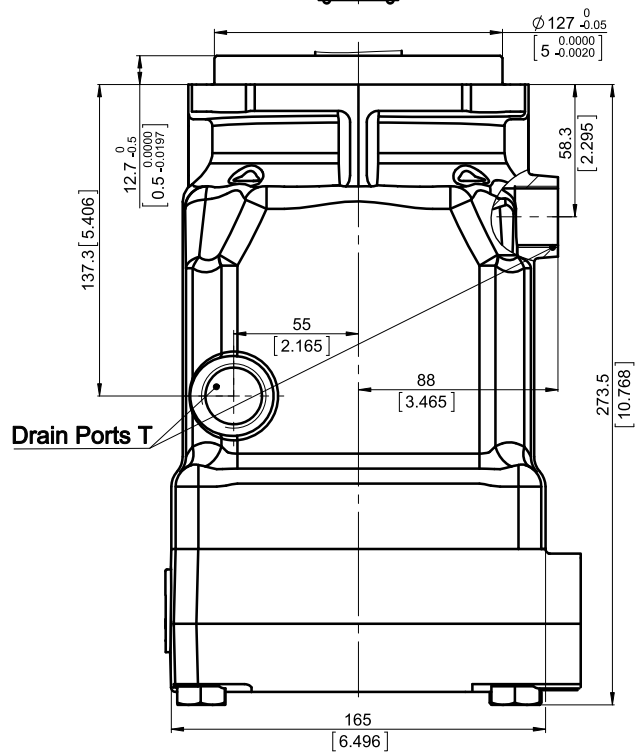
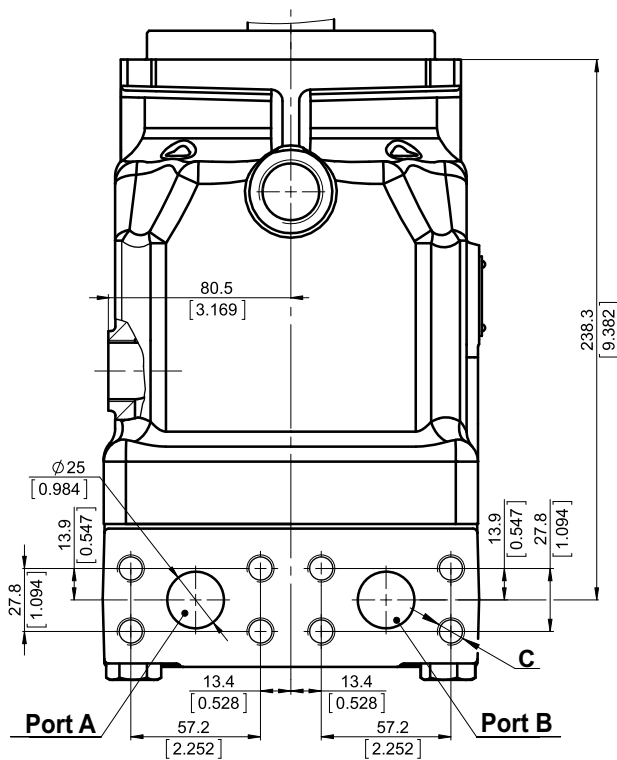
**OVERALL DIMENSIONS AND PORTS**

**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 78

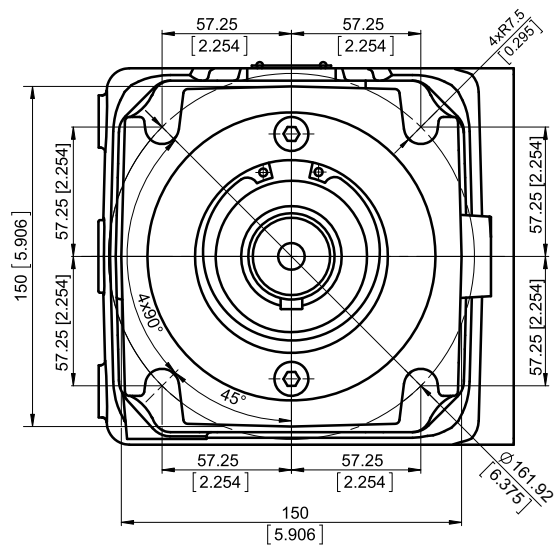
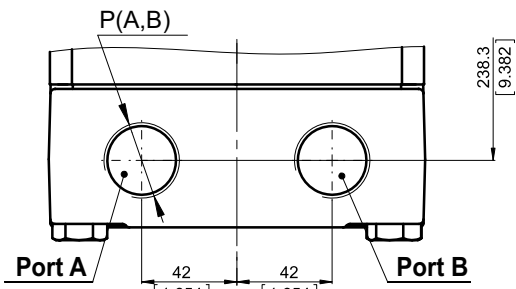


**Twin side ports, port size default, 5 and 9**



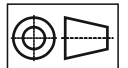
|                    | Port Size         |                                       |                   |
|--------------------|-------------------|---------------------------------------|-------------------|
|                    | default           | 5                                     | 9                 |
| P <sub>(A,B)</sub> | 2xISO 6162-2 DN25 | 2xSAE J518 1" PSI6000                 | 2xISO 6162-2 DN25 |
| T                  | M27x2             | 1 <sup>1</sup> / <sub>16</sub> -12 UN | G 3/4             |
| C                  | 8xM12             | 8x7/16-14 UNC                         | 8xM12             |

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



|                    | Port Size |                                        |
|--------------------|-----------|----------------------------------------|
|                    | 2         | 4                                      |
| P <sub>(A,B)</sub> | 2xG 1     | 2x1 <sup>5</sup> / <sub>16</sub> -12UN |
| T                  | G 3/4     | 1 <sup>1</sup> / <sub>16</sub> -12UN   |

Shaft Mounting  
see page 45

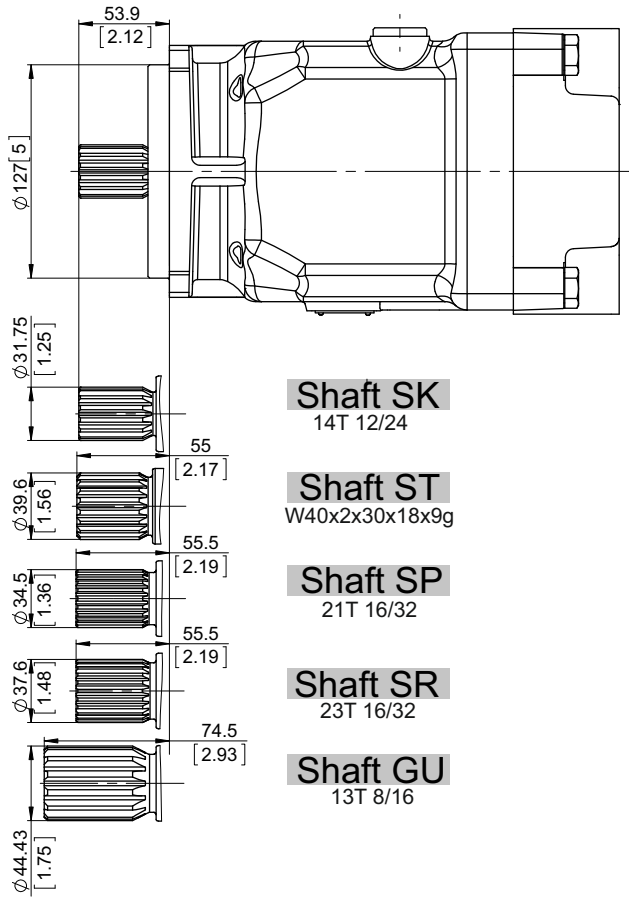


mm [in]



**SHAFTS MOUNTING**

**Flange - Type 4C**



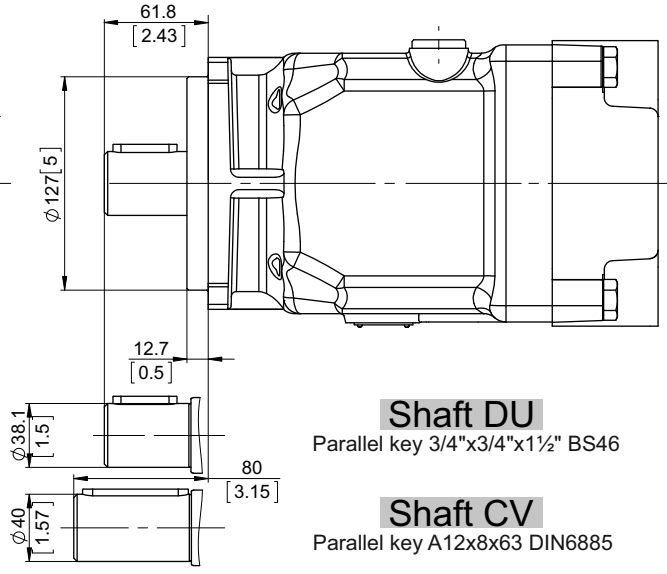
**Shaft SK**  
14T 12/24

**Shaft ST**  
W40x2x30x18x9g

**Shaft SP**  
21T 16/32

**Shaft SR**  
23T 16/32

**Shaft GU**  
13T 8/16

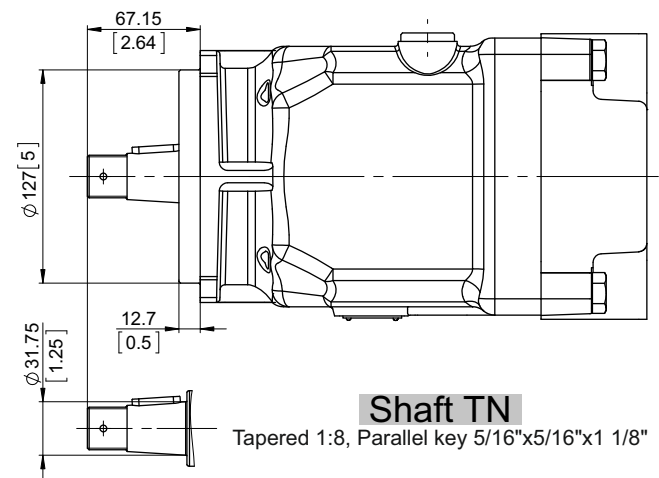


**Shaft DU**

Parallel key 3/4"x3/4"x1 1/2" BS46

**Shaft CV**

Parallel key A12x8x63 DIN6885



**Shaft TN**

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

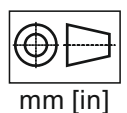
Shaft Dimensions  
See Page 68+72

**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 78).

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

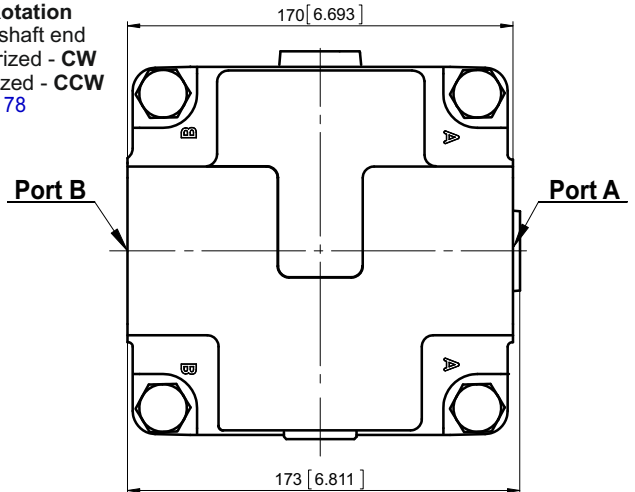
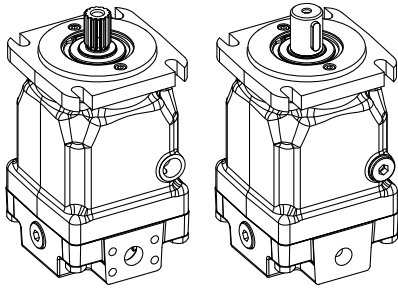




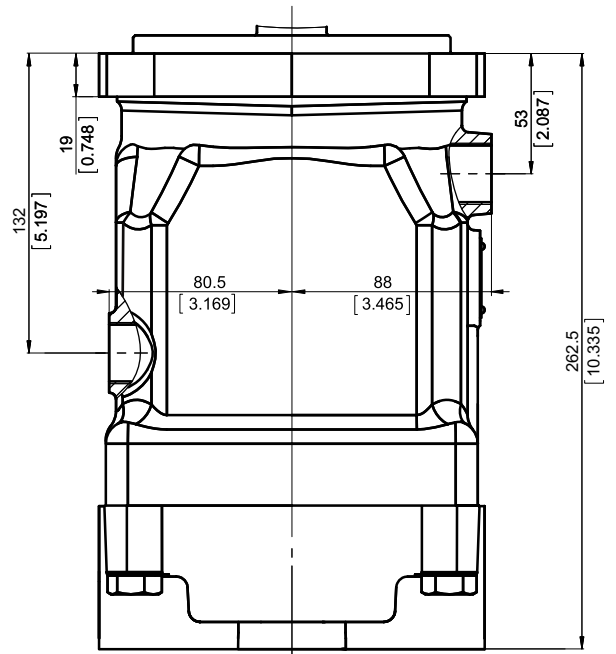
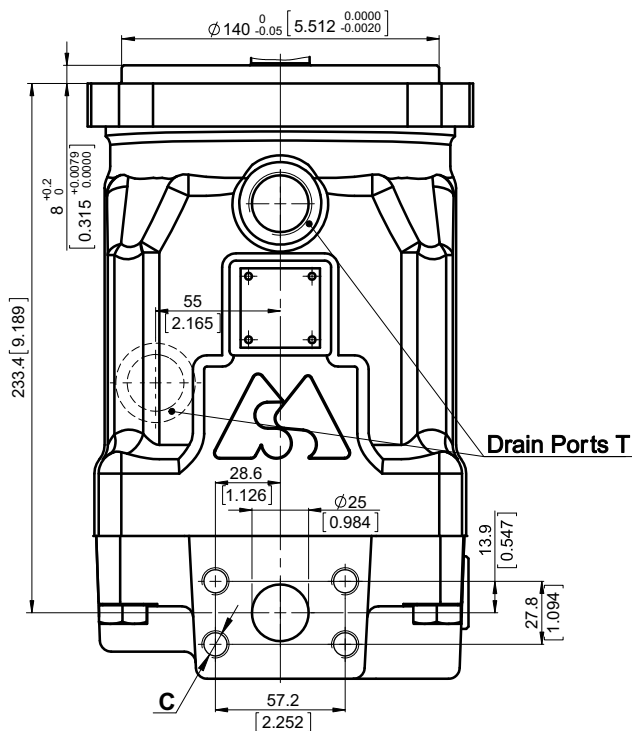
**OVERALL DIMENSIONS AND PORTS**

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

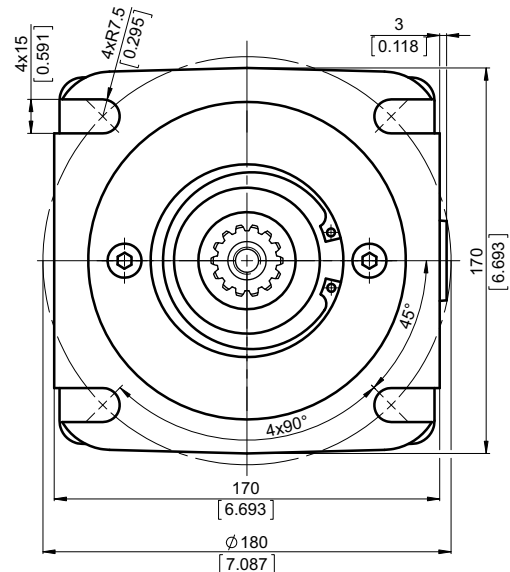
**Standard Rotation**  
Viewed from shaft end  
Port A Pressurized - CW  
Port B Pressurized - CCW  
see page 78



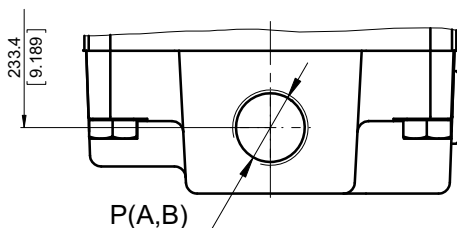
**Side ports, port size default, 5 and 9**



|                    | Port Size         |                       |                   |
|--------------------|-------------------|-----------------------|-------------------|
|                    | default           | 5                     | 9                 |
| P <sub>(A,B)</sub> | 2xISO 6162-2 DN25 | 2xSAE J518 1" PSI6000 | 2xISO 6162-2 DN25 |
| T                  | M27x2             | 1 1/16-12 UN          | G 3/4             |
| C                  | 8xM12             | 8x7/16-14 UNC         | 8xM12             |

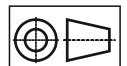


**Side ports, port size 2 and 4**



|                    | Port Size |               |
|--------------------|-----------|---------------|
|                    | 2         | 4             |
| P <sub>(A,B)</sub> | 2xG 1     | 2x1 5/16-12UN |
| T                  | G 3/4     | 1 1/16-12UN   |

Shaft Mounting  
see page 49



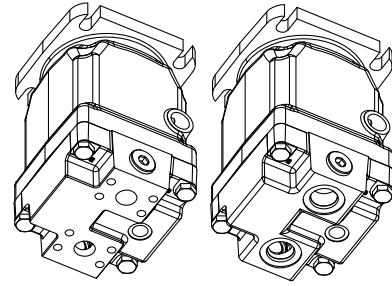
mm [in]



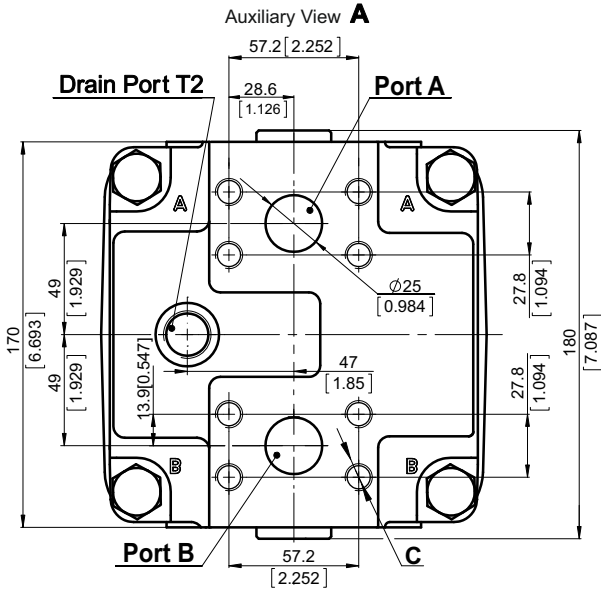
**OVERALL DIMENSIONS AND PORTS**

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

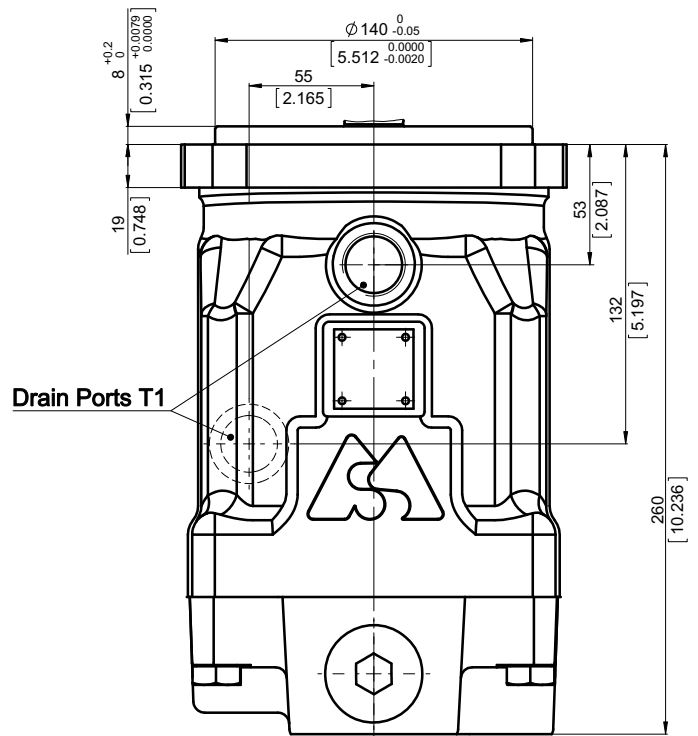
**Standard Rotation**  
Viewed from shaft end  
Port A Pressurized - CW  
Port B Pressurized - CCW  
see page 78



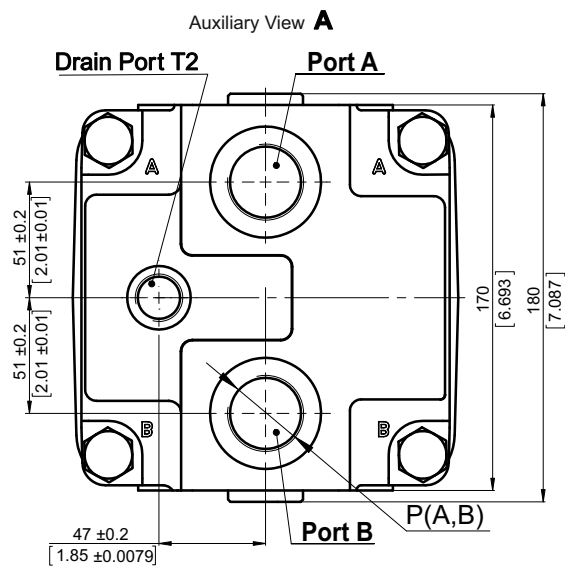
**Rear ports, port size default, 5 and 9**



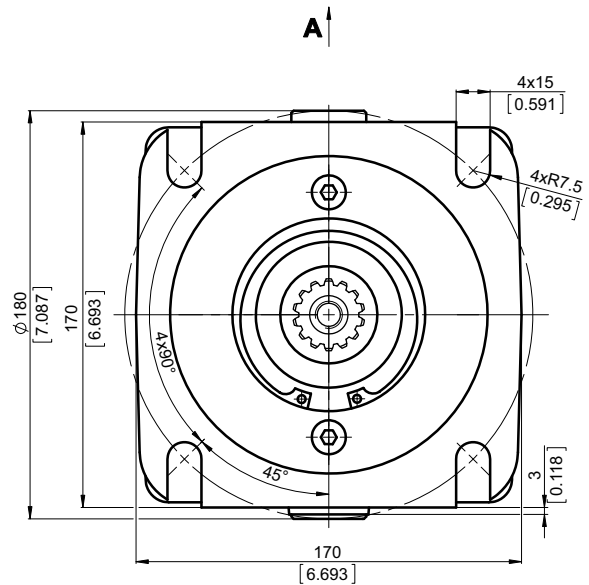
|                    | Port Size         |                       |                   |
|--------------------|-------------------|-----------------------|-------------------|
|                    | default           | 5                     | 9                 |
| P <sub>(A,B)</sub> | 2xISO 6162-2 DN25 | 2xSAE J518 1" PSI6000 | 2xISO 6162-2 DN25 |
| T1                 | M27x2             | 1 1/16 -12 UN         | G 3/4             |
| T2                 | M22x1.5           | 7/8-14 UNF            | G 1/2             |
| C                  | 8xM12             | 8x7/16-14 UNC         | 8xM12             |



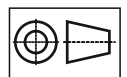
**Rear ports, port size 2 and 4**



|                    | Port Size |               |
|--------------------|-----------|---------------|
|                    | 2         | 4             |
| P <sub>(A,B)</sub> | 2xG 1     | 2x1 5/16-12UN |
| T1                 | G 3/4     | 1 1/16-12UN   |
| T2                 | G 1/2     | 7/8 - 14 UNF  |



Shaft Mounting  
see page 49



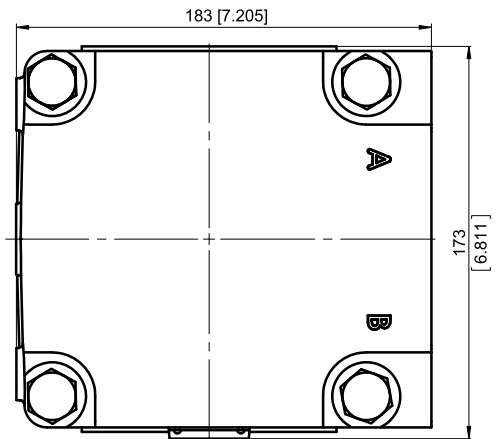
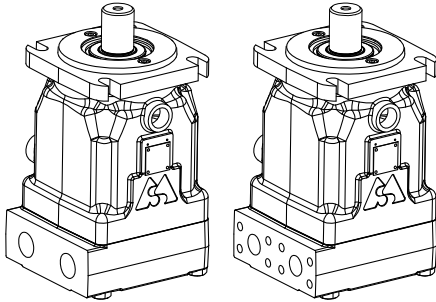
mm [in]



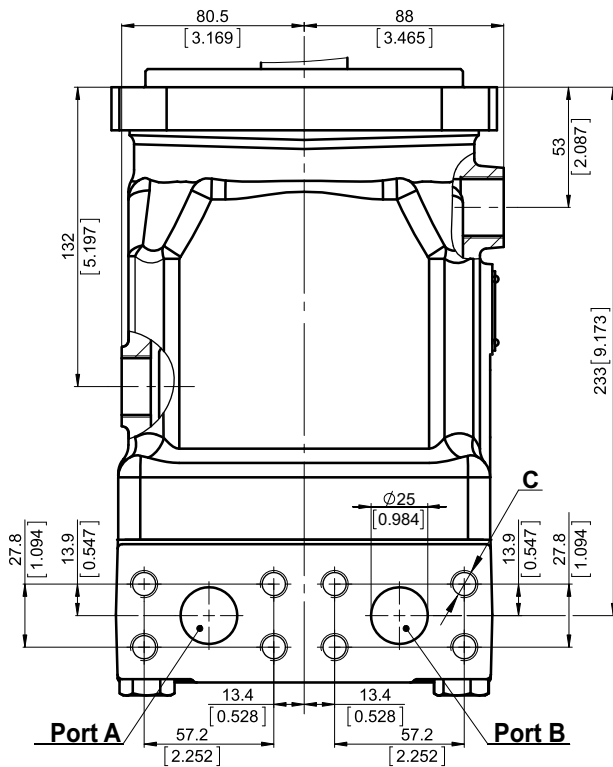
**OVERALL DIMENSIONS AND PORTS**

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

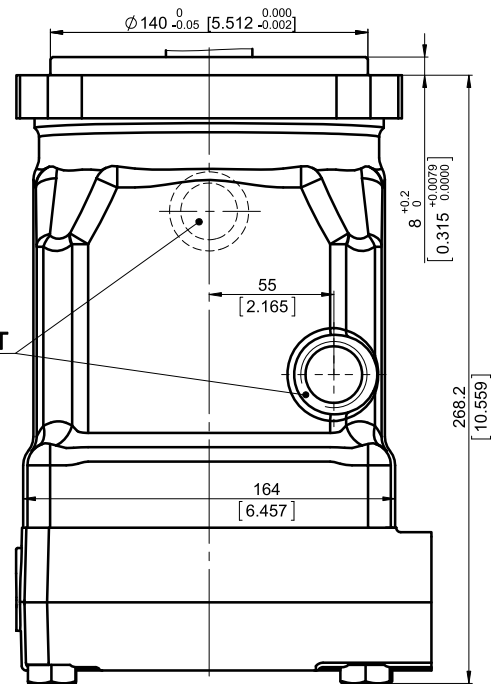
**Standard Rotation**  
Viewed from shaft end  
Port A Pressurized - CW  
Port B Pressurized - CCW  
see page 78



**Twin side ports, port size default, 5 and 9**

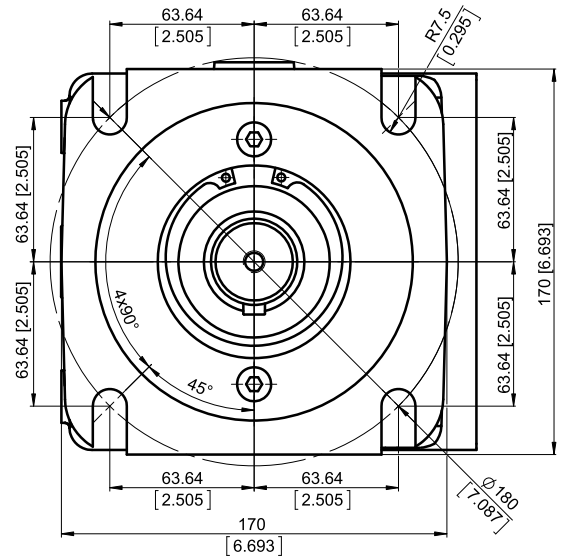
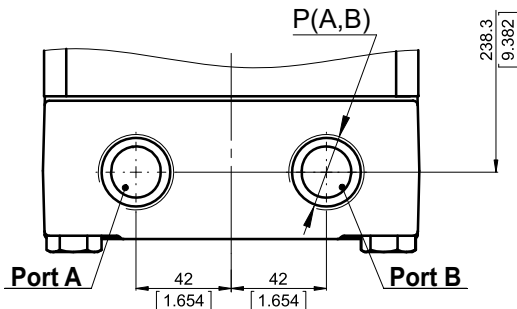


Drain Ports T



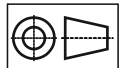
|                    | Port Size         |                       |                   |
|--------------------|-------------------|-----------------------|-------------------|
|                    | default           | 5                     | 9                 |
| P <sub>(A,B)</sub> | 2xISO 6162-2 DN25 | 2xSAE J518 1" PSI6000 | 2xISO 6162-2 DN25 |
| T                  | M27x2             | 1 1/16 -12 UN         | G 3/4             |
| C                  | 8xM12             | 8x7/16-14 UNC         | 8xM12             |

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



|                    | Port Size |               |
|--------------------|-----------|---------------|
|                    | 2         | 4             |
| P <sub>(A,B)</sub> | 2xG 1     | 2x1 1/16-12UN |
| T                  | G 3/4     | 1 1/16-12UN   |

Shaft Mounting  
see page 49



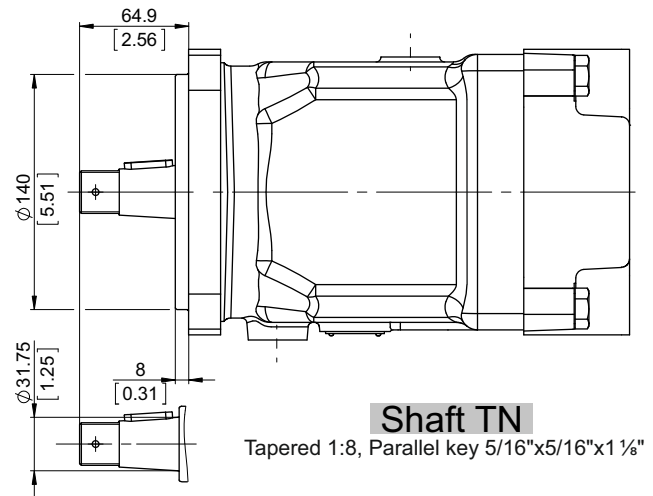
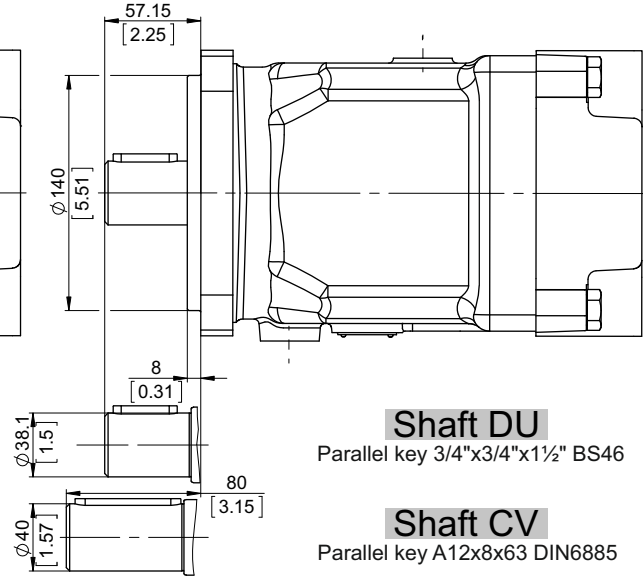
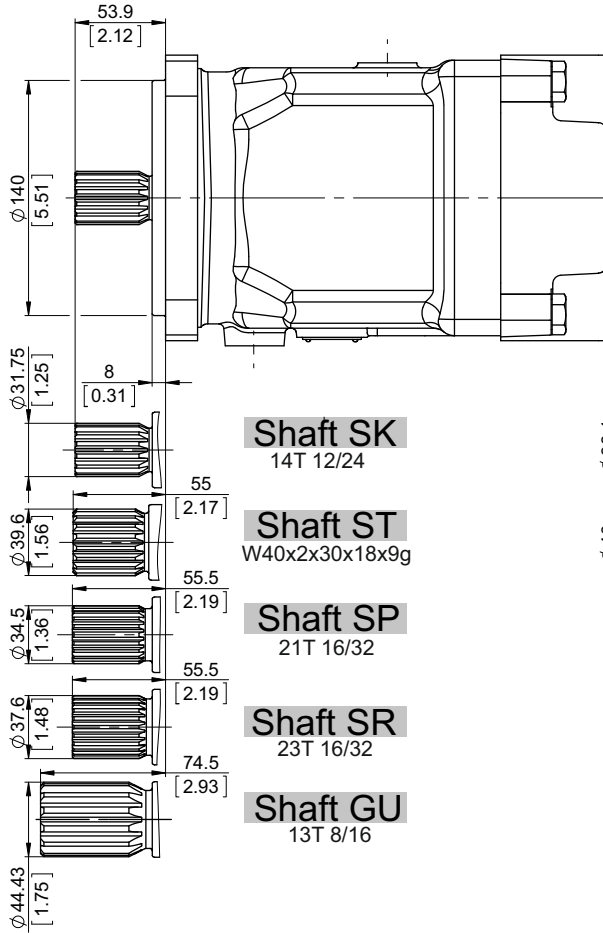
mm [in]





**SHAFTS MOUNTING**

**Flange - Type 4M**



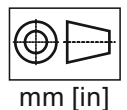
Shaft Dimensions  
See Page 68+72

**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 78).

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 |
| <b>M A P</b> |   |   |   |   |   |   |   |   |   |    |    |    | [  |    | ]  |

**Pos.1 - Mounting Flange**

- 4M** - ISO3019-2 4-Bolt flange of spigot diam.140 [5.51"] - BC 180 [7.09"]
- 4C** - SAE C - 4-Bolt flange spigot diam. 127 [5"] - BC 161.92 [6.375"]

**Pos.2 - Port Type**

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

**Pos.3 - Displacement Code**

- 63** - 63.58 cm.<sup>3</sup>/rev. [3.88 in.<sup>3</sup>/rev.]
- 71** - 71.5 cm.<sup>3</sup>/rev. [4.36 in.<sup>3</sup>/rev.]
- 75** - 76.84 cm.<sup>3</sup>/rev. [4.69 in.<sup>3</sup>/rev.]
- 92** - 93.18 cm.<sup>3</sup>/rev. [5.69 in.<sup>3</sup>/rev.]
- 100** - 98.75 cm.<sup>3</sup>/rev. [6.03 in.<sup>3</sup>/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 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 [1.575"] Straight, M12 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

**Pos.5 - Ports**

- omit - 2xISO 6162-2 DN25, drain ports M27x2, 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 page 74+75 for information about valves
- omit - None
- HR** - Single anti-cavitation valve
- AR** - Dual anti-cavitation valve
- PU** - Purge valve - default - 7±2 l/min.
- FLU** - Flush valve - default - 7±2 l/min at 20 bar.
- SAR** - Single anti-cavitation and relief valve
- DAR** - Dual anti-cavitation and relief valve
- DARP** - Dual anti-cavitation, relief and purge valve, default flow - 7±2 l/min.
- DARF** - Dual anti-cavitation, relief and flush valve, default flow - 7±2 l/min at 20 bar.

**Pos.8 - Valve's Port for Single Valves**

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

**Pos.9 - Pressure Setting of Integrated Valves**

- omit - None
- x** - 

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

 for more information see page 74+75

**Pos.10 - Flow Setting of Integrated Valves**

- omit - None
- Lx** - For value - see page 74+75

**Pos.11 - Special Features\***

- omit - None
- R2S** - Speed Sensor Two Directional (see page 76)
- R** - Reverse Rotation (see page 78)

**Pos.12 - Paint and Coating**

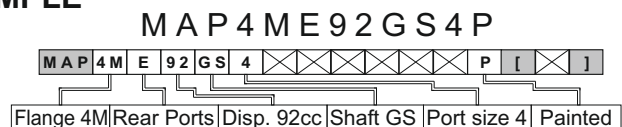
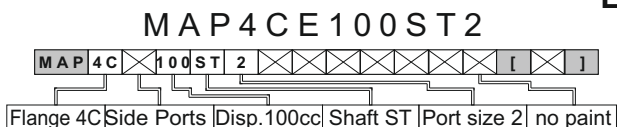
- omit - No paint or coating
- P** - Painted
- PC** - Corrosion protected paint
- PS** - Special painted \*\*\*
- PCS** - Special corrosion protected paint\*\*\*\*
- If a painting option is required, the standard color is black-Alkyd-Styrenated Enamel, Black RAL 9005. Other color by customer's request.

**Pos.13 - Design Series**

- omit - Factory specified

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

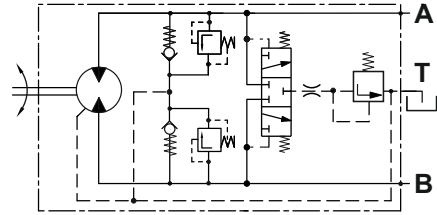
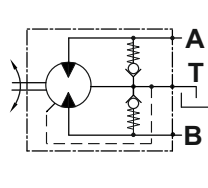
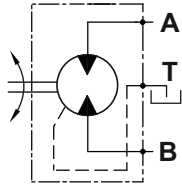
**EXAMPLE**





# Hydraulic Motors Type MAPW62

## 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

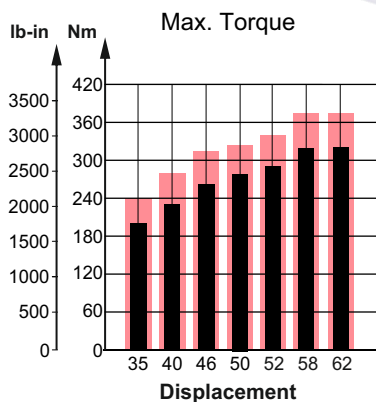
- » Swash plate
- » Port options
- » Shaft options
- » High pressure ports
- » Integrated valves

### ADVANTAGES

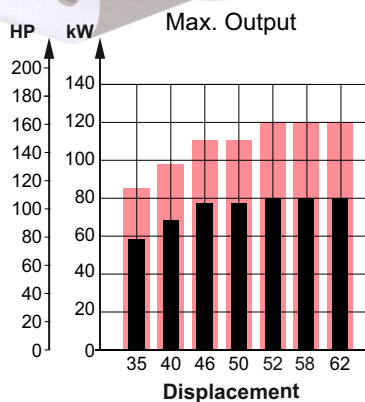
- » High starting torque
- » Smooth operation
- » Long service life
- » High power density

### GENERAL

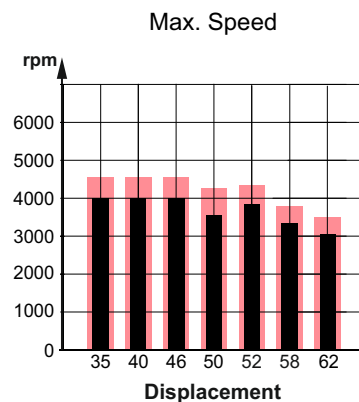
|                          |                                                                    |                        |
|--------------------------|--------------------------------------------------------------------|------------------------|
| Displacement,            | cm <sup>3</sup> /rev [in <sup>3</sup> /rev]                        | 36.16÷62.4 [2.21÷3.81] |
| Max. Speed,              | RPM                                                                | 4000                   |
| Max. Torque,             | Nm [lb-in]                                                         | 318 [2814]             |
| Max. Output,             | kW [HP]                                                            | 80 [107]               |
| Max. Pressure Drop,      | bar [PSI]                                                          | 350 [5080]             |
| Max. Oil Flow,           | l/min [GPM]                                                        | 200 [52.8]             |
| Min. Speed,              | RPM                                                                | 500                    |
| Fluid                    | Mineral based- HLP(DIN 51524) or HM(ISO 6743/4)                    |                        |
| Temperature Range,       | °C [°F]                                                            | -40÷82 [-40÷180]       |
| Optimal Viscosity Range, | mm <sup>2</sup> /s [SUS]                                           | 12÷68 [66÷311]         |
| Filtration               | ISO code 18/16/13 (Min. recommended fluid filtration of 10 micron) |                        |



Intermittent values

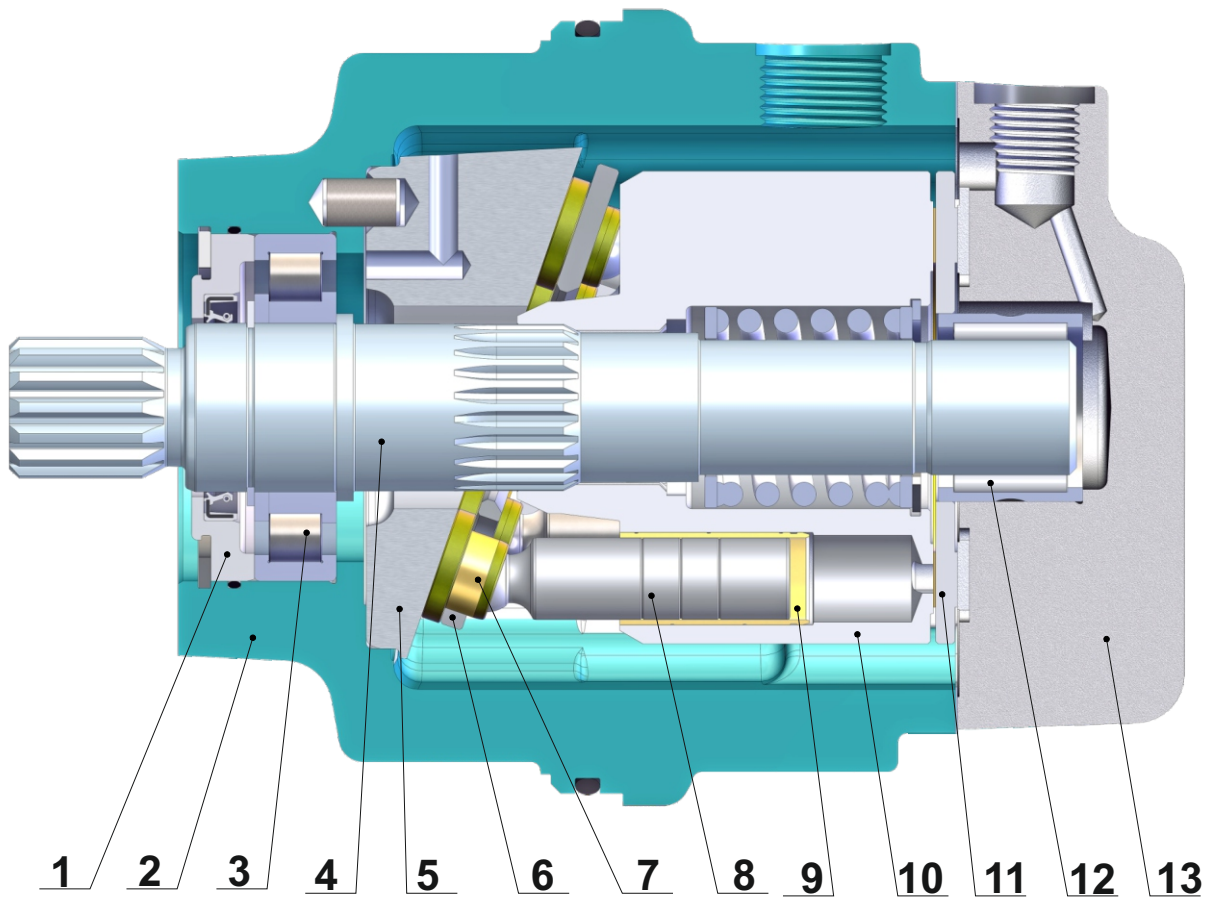


Continuous values





**SECTION VIEW**



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

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



**SPECIFICATION DATA**

| Type                                                             |                      | MAPW<br>35                                   | MAPW<br>40 | MAPW<br>46 | MAPW<br>50 | MAPW<br>52 | MAPW<br>58 | MAPW<br>62 |  |
|------------------------------------------------------------------|----------------------|----------------------------------------------|------------|------------|------------|------------|------------|------------|--|
| Displacement,<br>cm. <sup>3</sup> /rev. [in. <sup>3</sup> /rev.] |                      | 36.16                                        | 41.59      | 47.13      | 49.94      | 51.95      | 58.8       | 62.4       |  |
|                                                                  |                      | [2.21]                                       | [2.54]     | [2.88]     | [3.05]     | [3.17]     | [3.59]     | [3.81]     |  |
| Max. Speed,<br>[RPM]                                             | Cont.                | 4000                                         | 4000       | 4000       | 3600       | 3850       | 3398       | 3050       |  |
|                                                                  | Int.*                | 4500                                         | 4500       | 4500       | 4200       | 4330       | 3823       | 3500       |  |
| Max. Torque,***<br>Nm [lb-in]                                    | Cont.                | 202 [1789]                                   | 232 [2053] | 263 [2328] | 278 [2460] | 290 [2566] | 320 [2832] | 318 [2814] |  |
|                                                                  | Int.**               | 242 [2142]                                   | 278 [2460] | 315 [2788] | 326 [2885] | 347 [3071] | 375 [3320] | 377 [3337] |  |
| Output,<br>kW [HP]                                               | Cont.                | 58 [78]                                      | 67 [90]    | 76 [102]   | 76 [102]   | 80 [107]   | 80 [107]   | 80 [107]   |  |
|                                                                  | Int.**               | 84 [113]                                     | 97 [130]   | 110 [148]  | 110 [148]  | 120 [161]  | 120 [161]  | 120 [161]  |  |
| Max. Pressure,<br>bar [PSI]                                      | Cont.                | 350 [5080]                                   | 350 [5080] | 350 [5080] | 350 [5080] | 350 [5080] | 340 [4930] | 320 [4640] |  |
|                                                                  | Int.**               | 420 [6100]                                   | 420 [6100] | 420 [6100] | 410 [5950] | 420 [6100] | 400 [5800] | 380 [5510] |  |
|                                                                  | Peak                 | 450 [6527]                                   | 450 [6527] | 450 [6527] | 450 [6527] | 450 [6527] | 440 [6381] | 410 [5950] |  |
| Max. Oil Flow,<br>l/min [GPM]                                    | Cont.                | 145 [38.3]                                   | 167 [44.1] | 189 [50]   | 180 [47.5] | 200 [52.8] | 200 [52.8] | 190 [50]   |  |
|                                                                  | Int.*                | 163 [43.1]                                   | 187 [49.4] | 212 [56]   | 210 [55.5] | 225 [59.4] | 225 [59.4] | 215 [56.8] |  |
| Torque Constant<br>Nm/bar [lb-in/PSI]                            | *****                | 0.52                                         | 0.6        | 0.68       | 0.72       | 0.75       | 0.85       | 0.9        |  |
|                                                                  |                      | [0.32]                                       | [0.364]    | [0.41]     | [0.437]    | [0.454]    | [0.515]    | [0.546]    |  |
| Speed Constant<br>RPM/(l/min) [RPM/GPM]                          | *****                | 26.3                                         | 22.84      | 20.2       | 19.02      | 18.28      | 16.13      | 15.23      |  |
|                                                                  |                      | [99.4]                                       | [86.5]     | [76.3]     | [72]       | [70.2]     | [61.1]     | [57.6]     |  |
| Permissible Shaft Load<br>max Axial**** N[lb]                    |                      | Fa=2000 [450]                                |            |            |            |            |            |            |  |
|                                                                  | max Radial**** N[lb] | Fr=3600 [810]                                |            |            |            |            |            |            |  |
| Min. Speed, [RPM]                                                |                      | 500                                          |            |            |            |            |            |            |  |
| Max. Pressure in<br>Drain Line, bar [PSI]                        |                      | 5 [70]<br>open drain line is always required |            |            |            |            |            |            |  |
| Weight, kg [lb]                                                  |                      | 19.65 [43.3]                                 |            |            |            |            |            |            |  |

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

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

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

\*\*\* Theoretical torque;

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

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

1. The recommended output power for continuous operations should not be exceeded.
2. Recommended filtration as per ISO 4406 cleanliness code 18/16/13 or better. This filtration corresponds to SAE AS 4059 8A/7B/7C. Nominal filtration - 10 micron or better.
3. Recommended a premium quality, anti-wear type mineral based hydraulic oil, HLP(DIN51524) or HM(ISO6743/4).
4. Recommended oil viscosity - 12...68 cSt or see page 81.
5. Recommended maximum system operating temperature - 82°[180°] C[F].
6. To ensure optimum life of the motor, fill it up with fluid prior to load it and run with moderate load and speed for about 10-15 minutes.

Hint: Motor Torque = Torque Constant \* Pressure Drop

Rotation Speed = Speed Constant \* Oil Flow

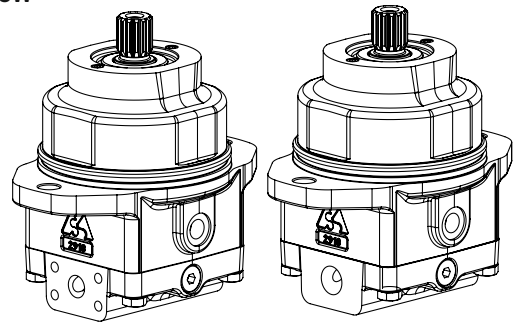
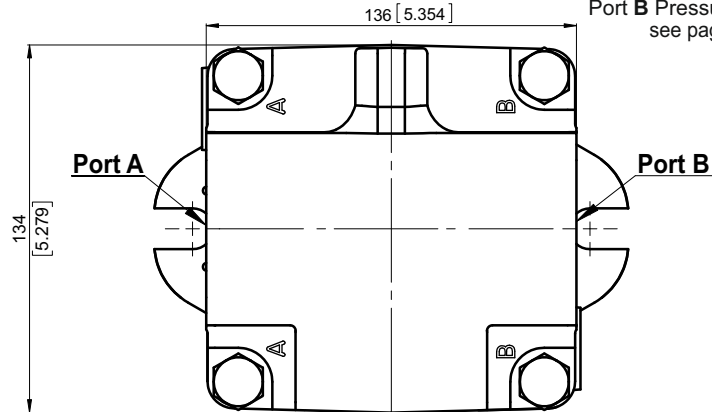
The constant values are approximate. Motor torque and rotation speed for a particular project are depending on the real operating conditions. For more detailed calculations please see efficiencies on next page and formulas on page 82.



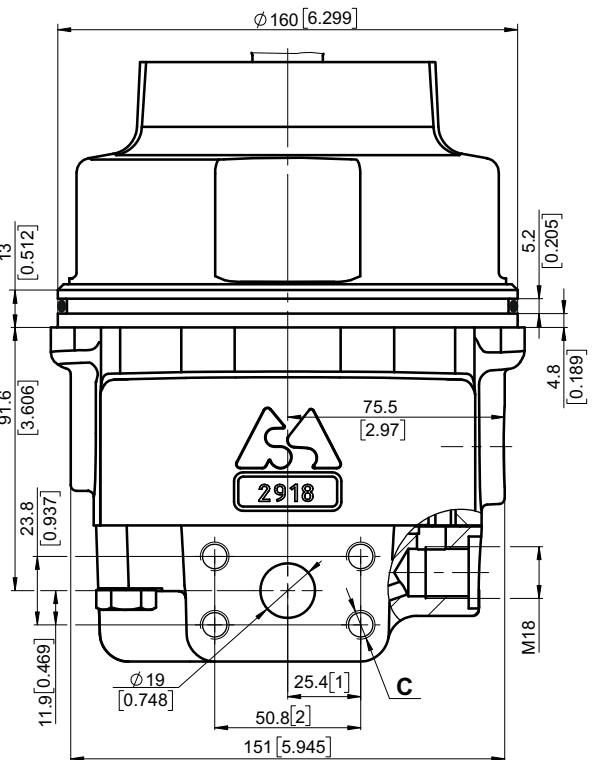
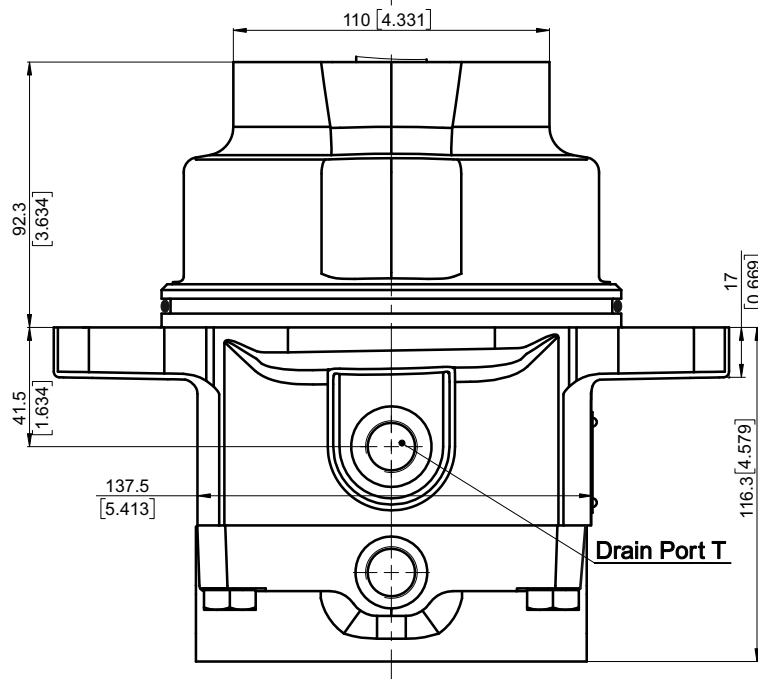
**OVERALL DIMENSIONS AND PORTS**

**Side Ports - Default Mounting Flange-Type Cartage**

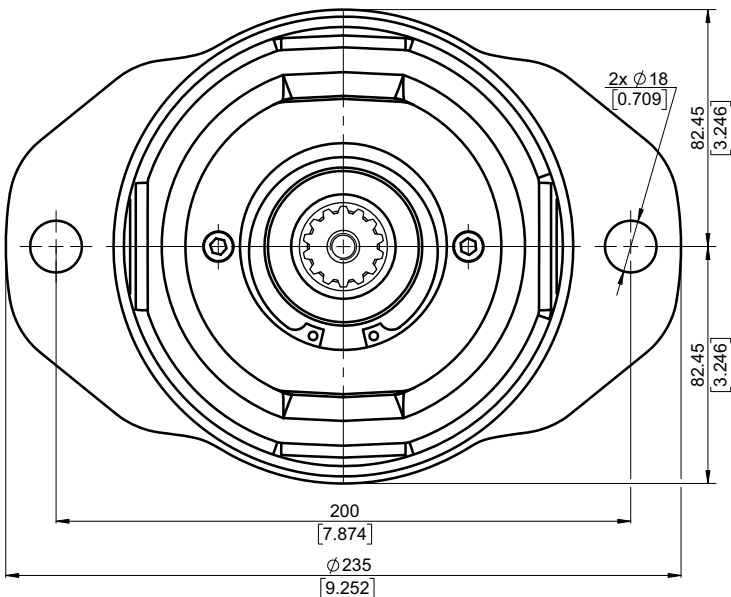
Standard Rotation  
Viewed from shaft end  
Port A Pressurized - CW  
Port B Pressurized - CCW  
see page 78



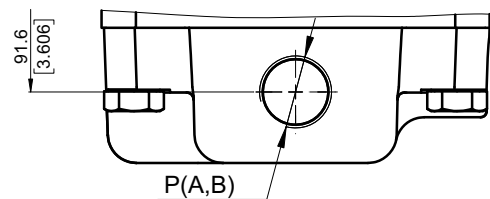
**Side ports, port size default ,5 and 9**



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

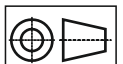


**Side ports, port size 2 ,3 and 4**

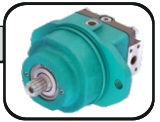


|                    |         | Port Size |               |   |
|--------------------|---------|-----------|---------------|---|
|                    |         | 2         | 3             | 4 |
| P <sub>(A,B)</sub> | 2xG 3/4 | 2xM27x2   | 2x1 1/16-12UN |   |
| T                  | G 1/2   | M18x1.5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

Shaft Mounting  
see page 57

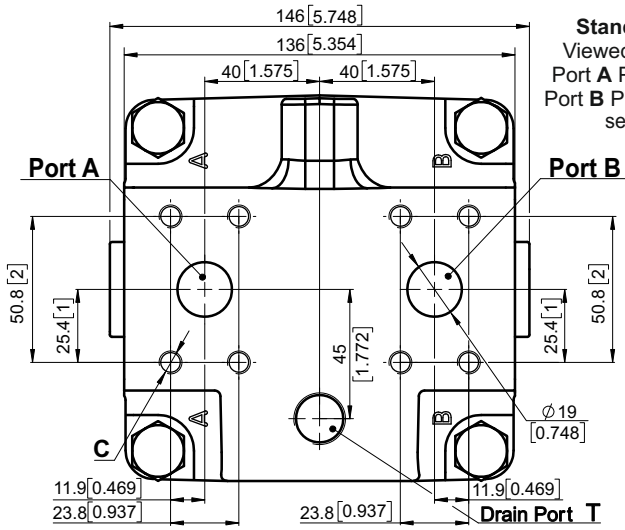


mm [in]

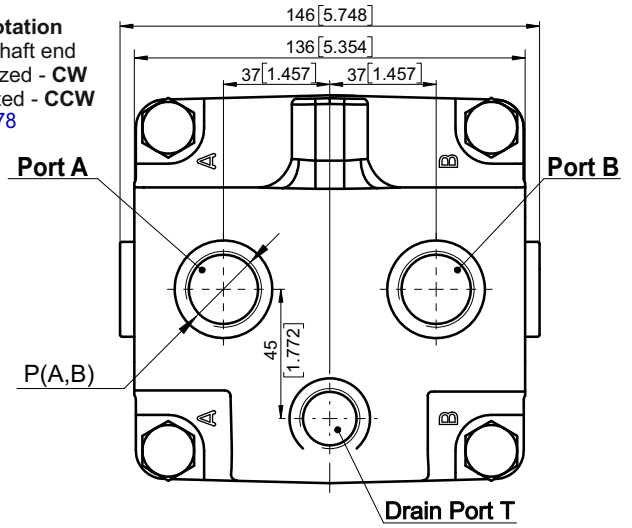


**OVERALL DIMENSIONS AND PORTS**

View without body, port size **default, 5 and 9** Rear Ports - Type E View without body, port size **2, 3 and 4**

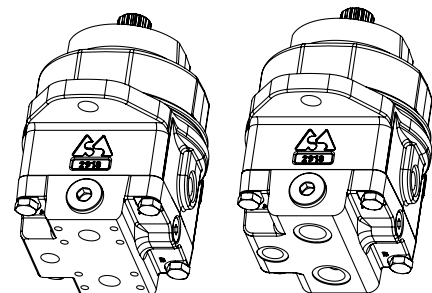
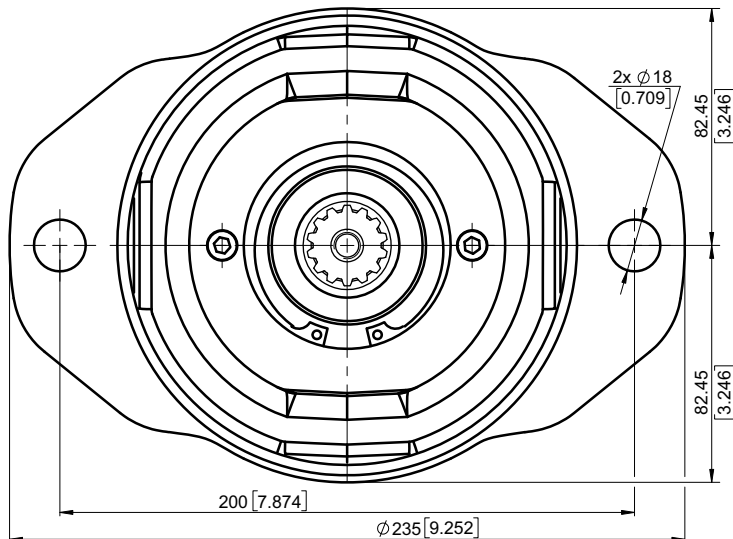
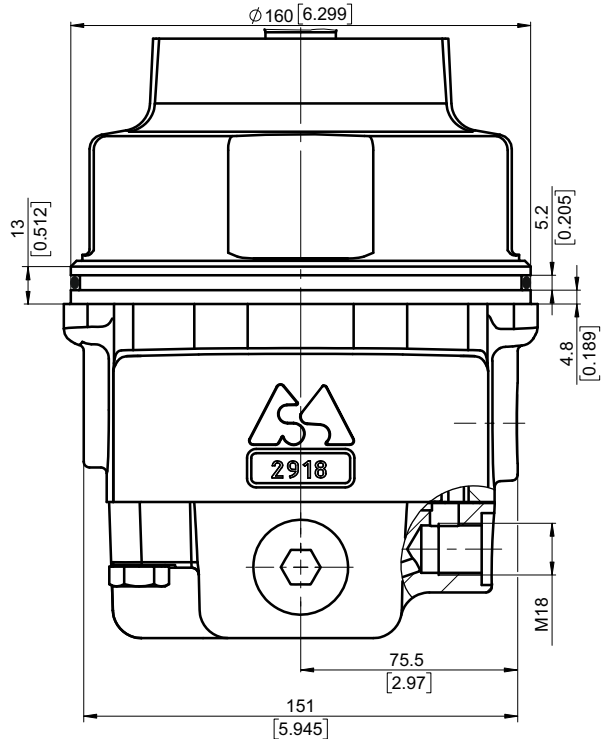
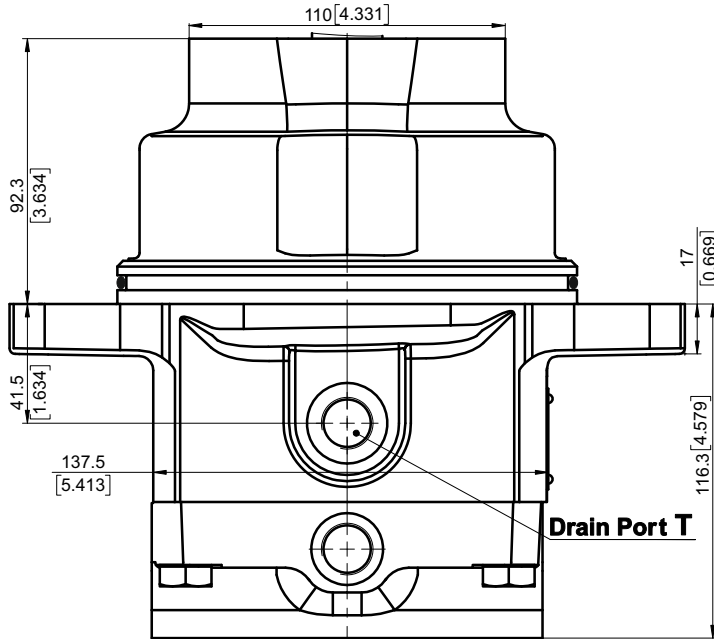


**Standard Rotation**  
Viewed from shaft end  
Port A Pressurized - CW  
Port B Pressurized - CCW  
see page 78

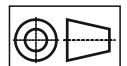


|                    | Port Size         |                        |                   |
|--------------------|-------------------|------------------------|-------------------|
|                    | default           | 5                      | 9                 |
| P <sub>(A,B)</sub> | 2xISO 6162-2 DN19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

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



Shaft Mounting  
see page 57



mm [in]

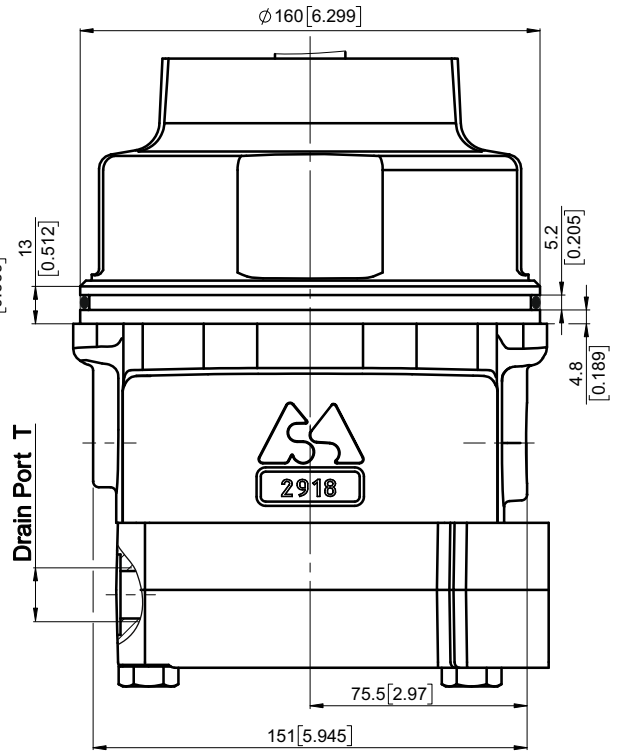
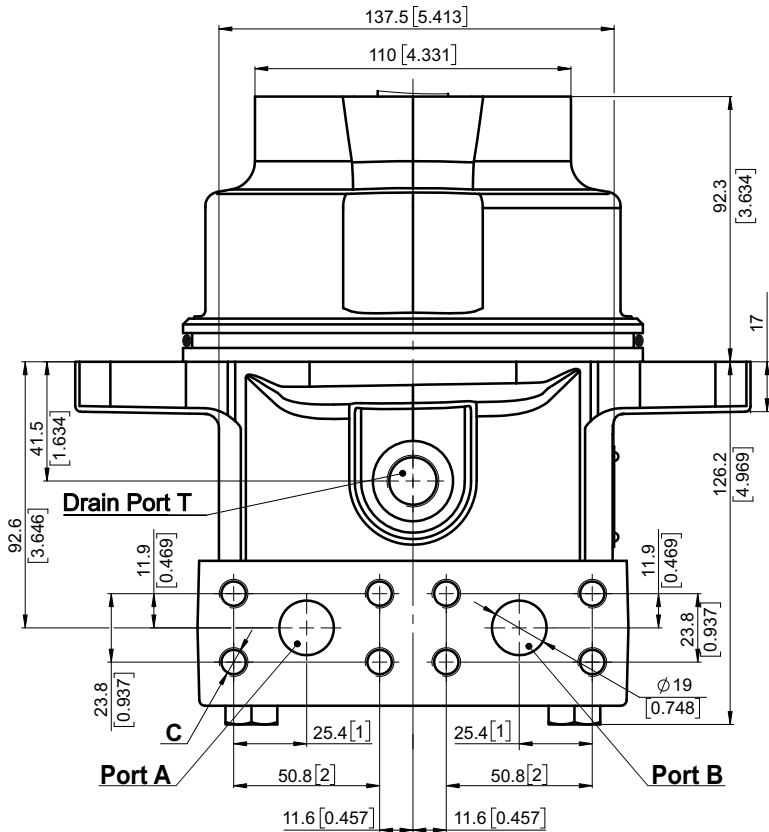


**OVERALL DIMENSIONS AND PORTS**

**Twin Side Ports - Type T**

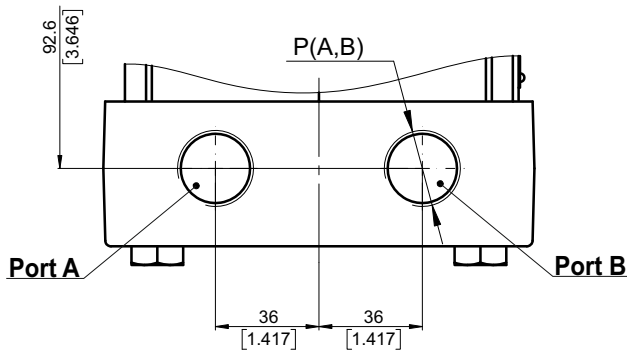
**Standard Rotation**  
Viewed from shaft end  
Port A Pressurized - CW  
Port B Pressurized - CCW  
see page 78

Twin side ports, port size default ,5 and 9

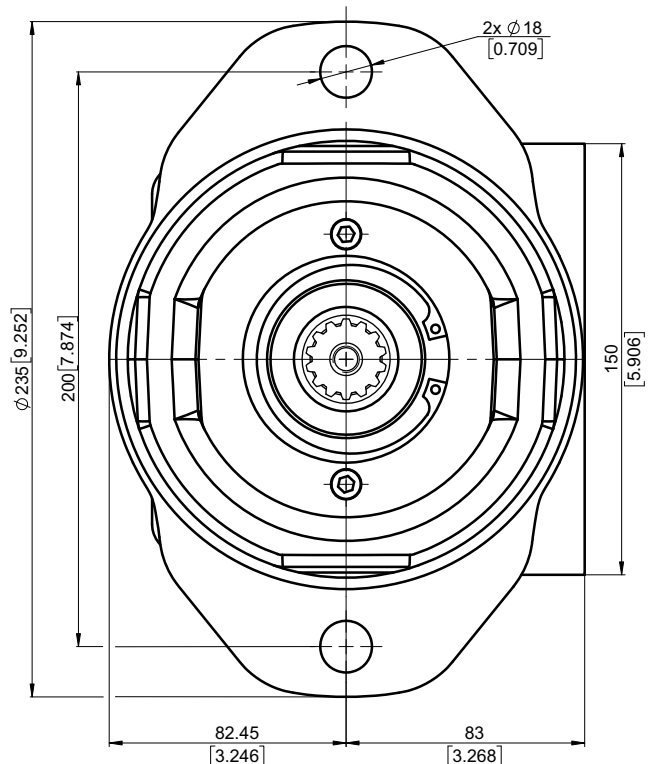


|                    | Port Size         |                        |                   |
|--------------------|-------------------|------------------------|-------------------|
|                    | default           | 5                      | 9                 |
| P <sub>(A,B)</sub> | 2xISO 6162-2 DN19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

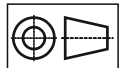
Twin side ports, port size 2 ,3 and 4



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



Shaft Mounting  
see page 57



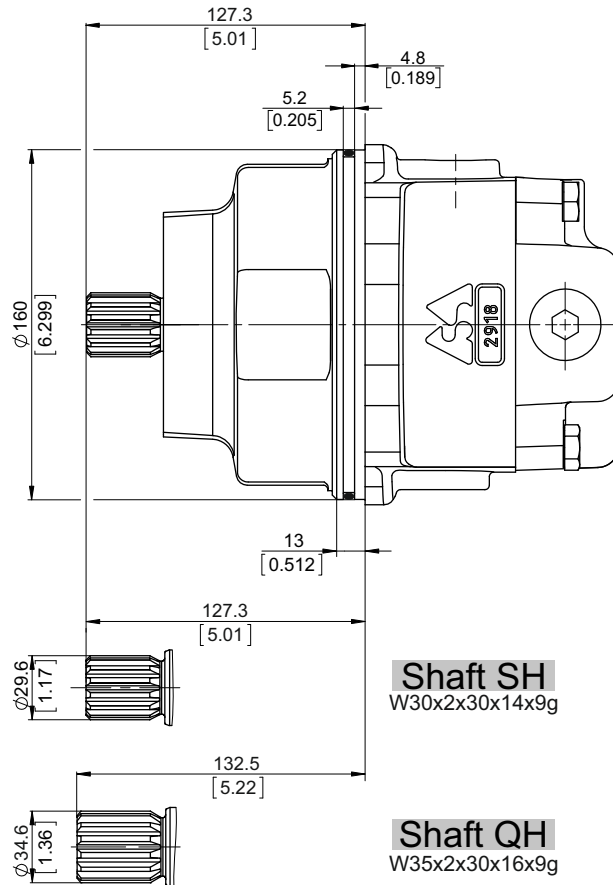
mm [in]





## SHAFTS MOUNTING

### Flange - Type Cartage



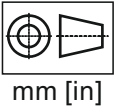
Shaft Dimensions  
See Page 68+72

### PERMISSIBLE SHAFT LOAD

| Permissible shaft load |              |                |
|------------------------|--------------|----------------|
| <b>max Axial</b>       | <b>N[lb]</b> | Fa=2500 [562]  |
| <b>max Radial</b>      | <b>N[lb]</b> | 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 78).

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





**ORDERING CODE**

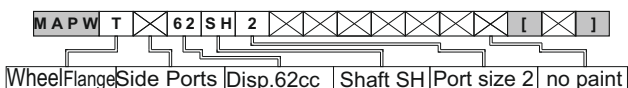
|                |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |
|----------------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|
|                | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 13 | 13 |
| <b>M A P W</b> |   |   |   |   |   |   |   |   |   |    |    | [  |    | ]  |    |

- |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |     |     |     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|
| <p><b>Pos.1 - Mounting Flange</b></p> <p><b>T</b> - Wheel flange, cartage-2bolt flange spigot diam. 160 [6.3"] -BC 200 [7.87"]</p> <p><b>Pos.2 - Port Type</b></p> <p>omit - Side ports on opposite sides</p> <p><b>T</b> - Twin (Two) side ports on one side</p> <p><b>E</b> - Rear ports</p> <p><b>Pos.3 - Displacement Code</b></p> <p><b>35</b> - 36.16 cm.<sup>3</sup>/rev. [2.21 in.<sup>3</sup>/rev.]</p> <p><b>40</b> - 41.59 cm.<sup>3</sup>/rev. [2.54 in.<sup>3</sup>/rev.]</p> <p><b>46</b> - 47.13 cm.<sup>3</sup>/rev. [2.88 in.<sup>3</sup>/rev.]</p> <p><b>50</b> - 49.94 cm.<sup>3</sup>/rev. [3.05 in.<sup>3</sup>/rev.]</p> <p><b>52</b> - 51.95 cm.<sup>3</sup>/rev. [3.17 in.<sup>3</sup>/rev.]</p> <p><b>58</b> - 58.8 cm.<sup>3</sup>/rev. [3.59 in.<sup>3</sup>/rev.]</p> <p><b>62</b> - 62.4 cm.<sup>3</sup>/rev. [3.81 in.<sup>3</sup>/rev.]</p> <p><b>Pos.4 - Shaft Extensions**</b></p> <p><b>SH</b> - ø29.6 [1.165"] Spline W30x2x30x14x9g, M10</p> <p><b>QH</b> - ø34.6 [1.36"] Spline W35x2x30x16x9g, M12</p> <p><b>Pos.5 - Port Size</b></p> <p>omit - 2xISO 6162-2 DN19, drain port M18x1.5</p> <p><b>2</b> - 2xG3/4, drain ports G1/2</p> <p><b>3</b> - 2xM27x2, drain ports M18x1.5</p> <p><b>4</b> - 2x1 1/16 -12 UN, drain ports 7/8-14 UNF</p> <p><b>5</b> - 2xSAE 3/4" PSI6000, drain port 7/8-14 UNF</p> <p><b>9</b> - 2xISO 6162-2 DN19, drain port G1/2</p> <p><b>Pos.6 - Seal, Corrosion Resistant Seal Surface</b></p> <p>omit - NBR seal type material</p> <p><b>V</b> - FKM seal type material</p> <p><b>Pos.7 - Integrated Valves</b></p> <p>See page 74+75 for information about valves</p> <p>omit - None</p> <p><b>HR</b> - Single anti-cavitation valve</p> <p><b>AR</b> - Dual anti-cavitation valve</p> <p><b>PU</b> - Purge valve - default - 6±2 l/min.</p> <p><b>FLU</b> - Flush valve - default - 6±2 l/min at 20 bar.</p> <p><b>SAR</b> - Single anti-cavitation and relief valve</p> <p><b>DAR</b> - Dual anti-cavitation and relief valve</p> <p><b>DARP</b> - Dual anti-cavitation, relief and purge valve, default flow - 6±2 l/min</p> <p><b>DARF</b> - Dual anti-cavitation, relief and flush valve, default flow - 6±2 l/min at 20 bar.</p> | <p><b>Pos.8 - Valve's Port for Single Valves</b></p> <p>omit - None</p> <p><b>A</b> - Port A</p> <p><b>B</b> - Port B</p> <p><b>Pos.9 - Pressure Setting of Integrated Valves</b></p> <p>omit - None</p> <p><b>x</b> - <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td>250</td><td>300</td><td>350</td></tr></table></p> <p>for more information see page 74+75</p> <p><b>Pos.10 - Flow Setting of Integrated Valves</b></p> <p>omit - None</p> <p><b>Lx</b> - For value - see page 74+75</p> <p><b>Pos.11 - Special Features*</b></p> <p>omit - None</p> <p><b>R2S</b> - Speed Sensor Two Directional (see page 76)</p> <p><b>R</b> - Reverse Rotation (see page 78)</p> <p><b>Pos.12 - Paint and Coating</b></p> <p>omit - No paint or coating</p> <p><b>P</b> - Painted</p> <p><b>PC</b> - Corrosion protected paint</p> <p><b>PS</b> - Special painted ***</p> <p><b>PCS</b> - Special corrosion protected paint***</p> <p>If a painting option is required, the standard color is black-Alkyd-Styrenated Enamel, Black RAL 9005. Other color by customer's request.</p> <p><b>Pos.13 - Design Series</b></p> <p>omit - Factory specified</p> | 250 | 300 | 350 |
| 250                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 300                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 350 |     |     |

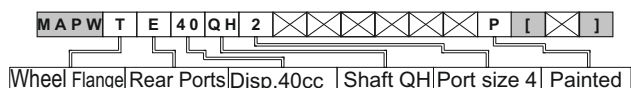
\*\*The permissible output torque for shafts must not be exceeded!  
\*\*\*Non painted feeding surface

**EXAMPLE**

**M A P W T 6 2 S H 2**



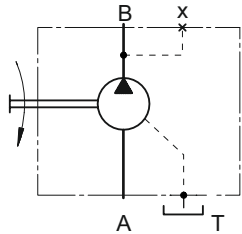
**M A P W T 4 0 Q H 4 P**





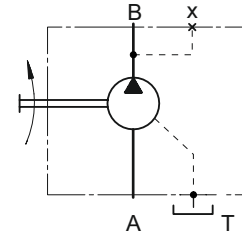
# Hydraulic Pumps Type PAP62

## 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

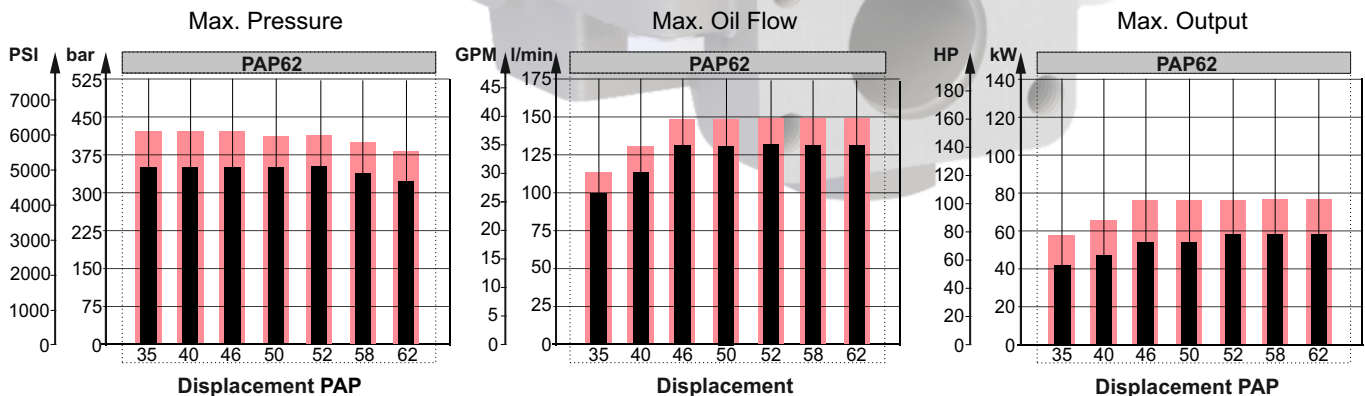
- » Swash plate
- » Port options
- » Shaft options
- » High pressure ports

### ADVANTAGES

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

### GENERAL

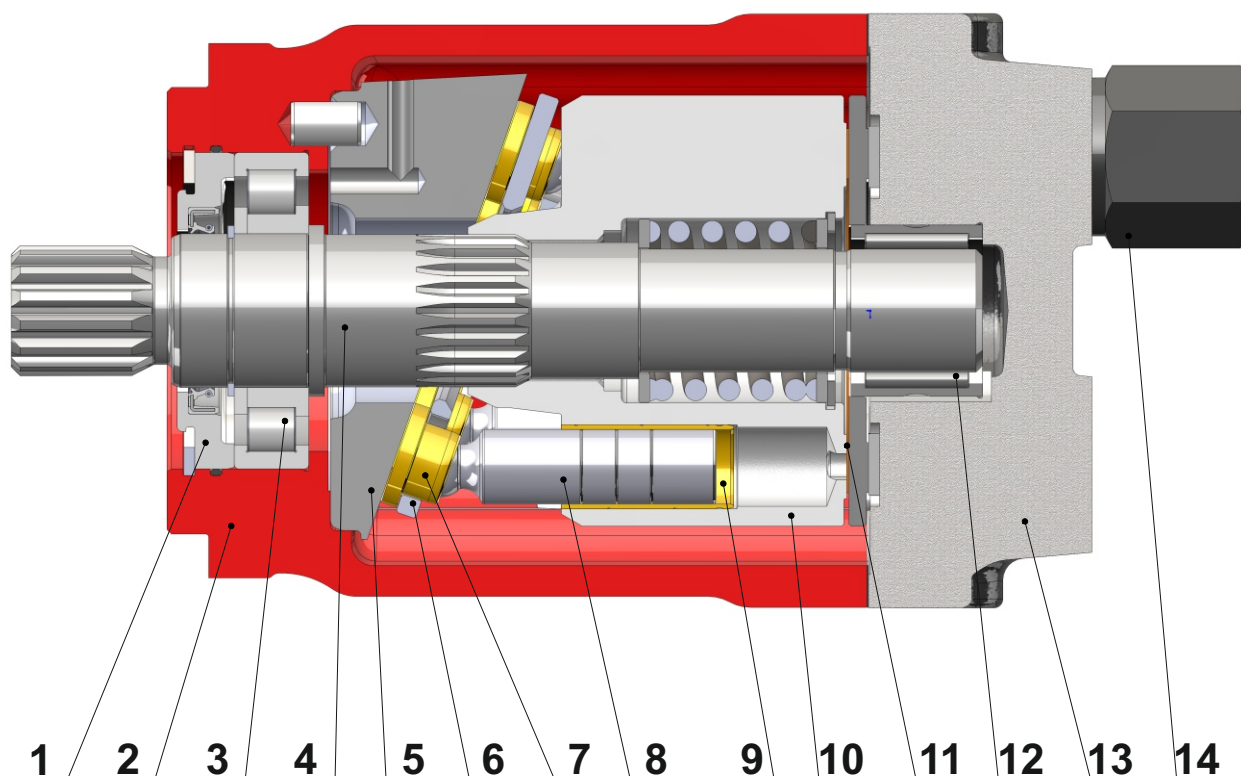
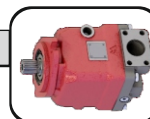
|                          |                                                                    |                        |
|--------------------------|--------------------------------------------------------------------|------------------------|
| Displacement,            | cm <sup>3</sup> /rev [in <sup>3</sup> /rev]                        | 36.16÷62.4 [2.21÷3.81] |
| Max. Driving Speed,      | RPM                                                                | 2800                   |
| Max. Driving Torque,     | Nm [lb-in]                                                         | 318 [2814]             |
| Max. Output,             | kW [HP]                                                            | 56 [77.8]              |
| 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 <sup>2</sup> /s [SUS]                                           | 12÷68 [66÷311]         |
| Filtration               | ISO code 18/16/13 (Min. recommended fluid filtration of 10 micron) |                        |



Intermittent values

Continuous values

## SECTION VIEW



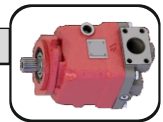
1. Front cover
2. Cast iron body
3. Robust radial - axial roller bearing
4. Hardened shaft
5. Solid swash plate
6. Retainer plate
7. Improved piston shoes
8. Improved pistons
9. Brass bushings
10. Hardened steel cylinder block
11. Bimetal distributor
12. Needle bearing
13. Solid end cover
14. Part of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

The main advantages of the heavy duty PAP pumps design over the typical pumps are:

- Special hydraulic system reducing the levels of noise and vibration created by the pump.
- Lower pulsations during operation.

In comparison with the bent axis and the gear pumps, the swash plate type is in general considered to have higher reliability.

## SPECIFICATION DATA



| Type                                                             |                                    | PAP<br>35       | PAP<br>40       | PAP<br>46       | PAP<br>50       | PAP<br>52       | PAP<br>58      | PAP<br>62                                    |  |
|------------------------------------------------------------------|------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------------|----------------------------------------------|--|
| Displacement,<br>cm. <sup>3</sup> /rev. [in. <sup>3</sup> /rev.] |                                    | 36.16<br>[2.21] | 41.59<br>[2.54] | 47.13<br>[2.88] | 49.94<br>[3.05] | 51.95<br>[3.17] | 58.8<br>[3.59] | 62.4<br>[3.81]                               |  |
|                                                                  | Max. Driving Speed, Cont.<br>[RPM] | 2800            | 2800            | 2800            | 2500            | 2400            | 2130           | 2000                                         |  |
|                                                                  | Int.*                              | 3150            | 3150            | 3150            | 2800            | 2700            | 2390           | 2250                                         |  |
| Max. Driving Torque,***<br>Nm [lb-in]                            | Cont.                              | 202 [1789]      | 232 [2053]      | 263 [2328]      | 278 [2460]      | 290 [2566]      | 320 [2832]     | 318 [2814]                                   |  |
|                                                                  | Int.**                             | 242 [2142]      | 278 [2460]      | 315 [2788]      | 326 [2885]      | 347 [3071]      | 375 [3320]     | 377 [3337]                                   |  |
| Output,<br>kW [HP]                                               | Cont.                              | 41 [55]         | 47 [63]         | 54 [72.5]       | 54 [72.5]       | 58 [77.8]       | 58 [77.8]      | 58 [77.8]                                    |  |
|                                                                  | Int.**                             | 58 [78]         | 67 [90]         | 77 [198]        | 77 [198]        | 77 [198]        | 77 [198]       | 77 [198]                                     |  |
| Max. Pressure,<br>bar [PSI]                                      | Cont.                              | 350 [5080]      | 350 [5080]      | 350 [5080]      | 350 [5080]      | 350 [5080]      | 340 [4930]     | 320 [4640]                                   |  |
|                                                                  | Int.**                             | 420 [6100]      | 420 [6100]      | 420 [6100]      | 410 [5950]      | 420 [6100]      | 400 [5800]     | 380 [5510]                                   |  |
|                                                                  | Peak                               | 450 [6527]      | 450 [6527]      | 450 [6527]      | 450 [6527]      | 450 [6527]      | 440 [6381]     | 410 [5950]                                   |  |
| Max. Oil Flow,<br>l/min [GPM]                                    | Cont.                              | 100 [26.4]      | 116 [30]        | 132 [34.9]      | 132 [34.9]      | 132 [34.9]      | 132 [34.9]     | 132 [34.9]                                   |  |
|                                                                  | Int.*                              | 114 [30]        | 131 [35]        | 148 [39]        | 148 [39]        | 148 [39]        | 148 [39]       | 148 [39]                                     |  |
| Permissible Shaft Load<br>max Axial**** N[lb]                    |                                    |                 |                 |                 |                 |                 |                | Fa=2000 [450]                                |  |
|                                                                  | max Radial**** N[lb]               |                 |                 |                 |                 |                 |                | Fr=3600 [810]                                |  |
| Min. Speed, [RPM]                                                |                                    |                 |                 |                 |                 |                 |                | 500                                          |  |
| Max. Pressure in<br>Drain Line, bar [PSI]                        |                                    |                 |                 |                 |                 |                 |                | 5 [70]<br>open drain line is always required |  |
| Weight, kg [lb]                                                  |                                    |                 |                 |                 |                 |                 |                | 18.14 [40]                                   |  |

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

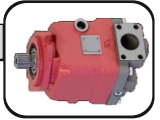
\* Intermittent speed (flow): for pressure up to 150[2200] bar[PSI];

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

\*\*\* Theoretical torque;

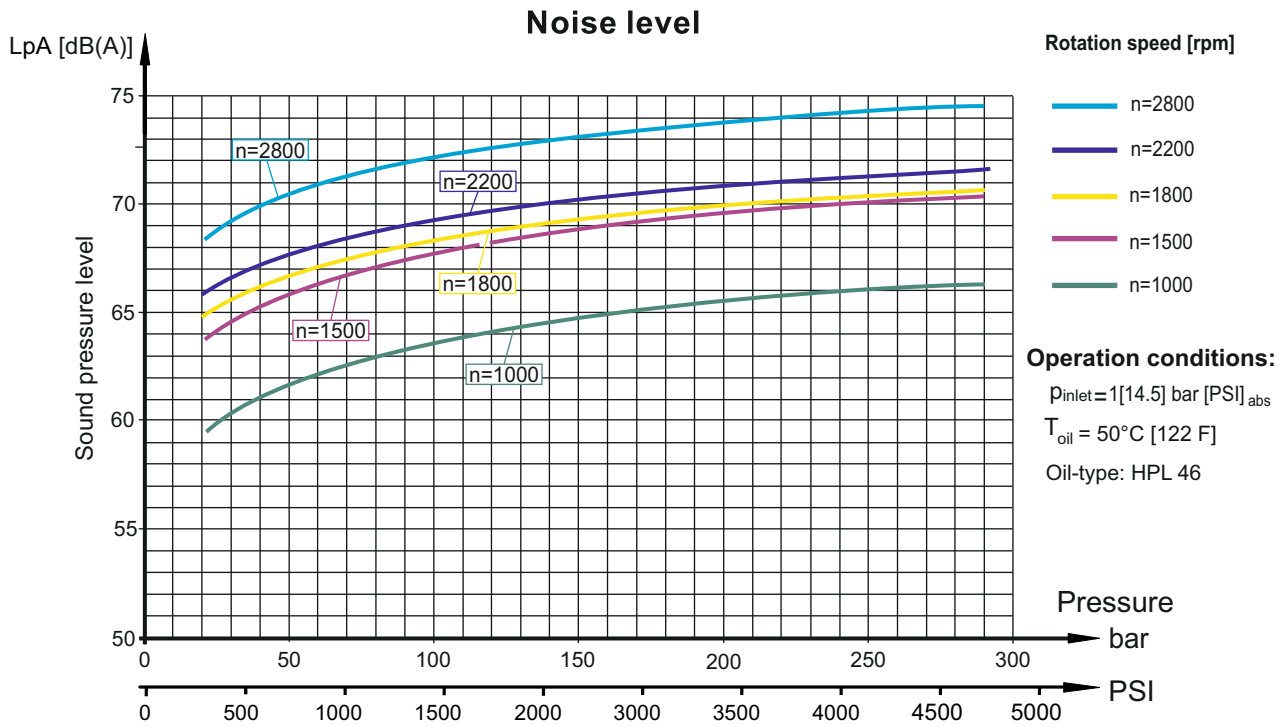
\*\*\*\* The calculated max values are based on the optimal direction of the forces Fr, Fa and optimal position of the shaft.

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 81.
5. Recommended maximum system operating temperature - 82°[180°] C[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.



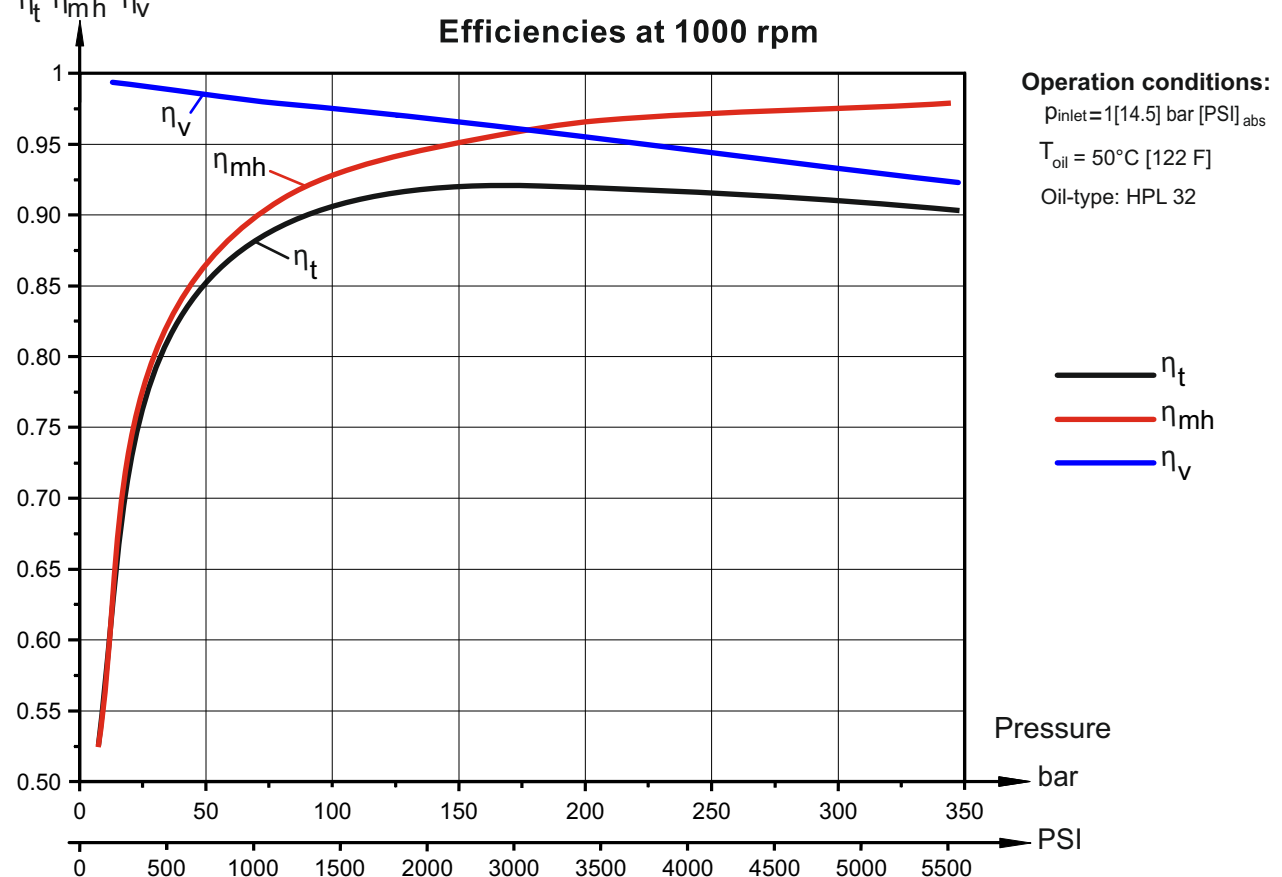
FUNCTION DIAGRAMS

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  $\pm 2 \text{ dB(A)}$  compared to what is shown in the diagram.

The below efficiencies are applied for all displacements.

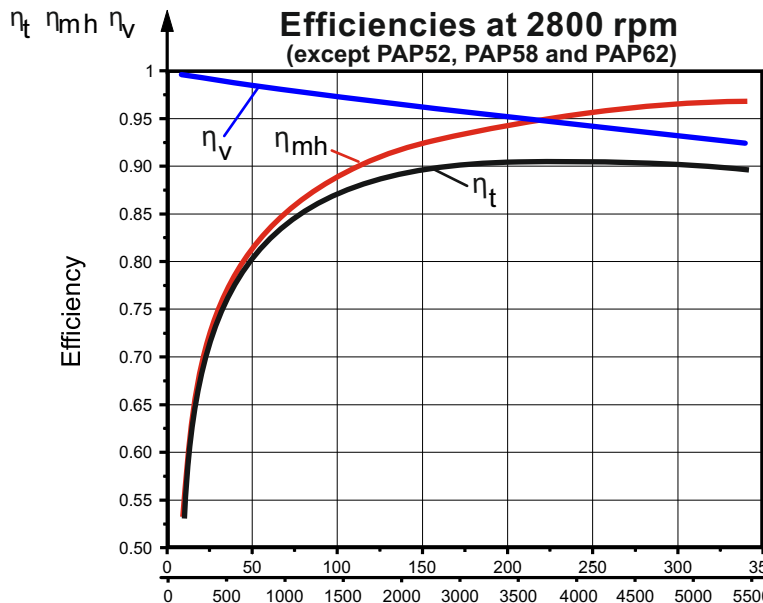
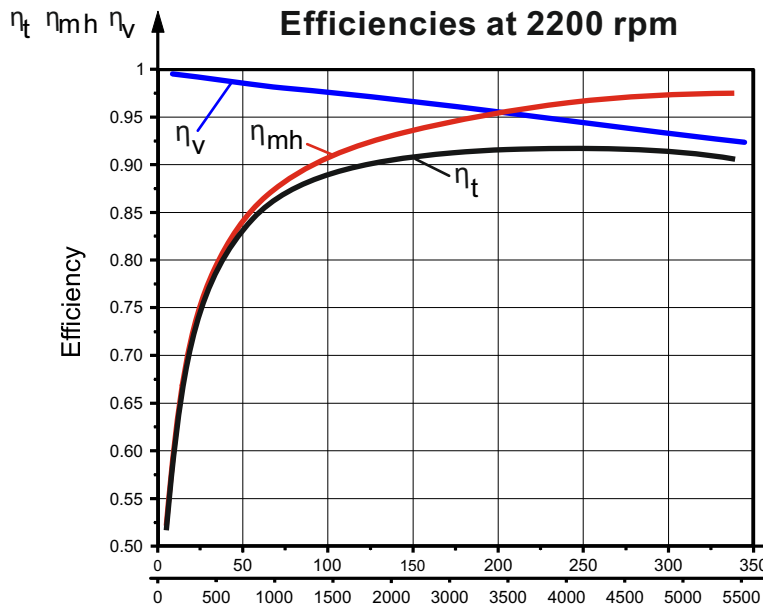
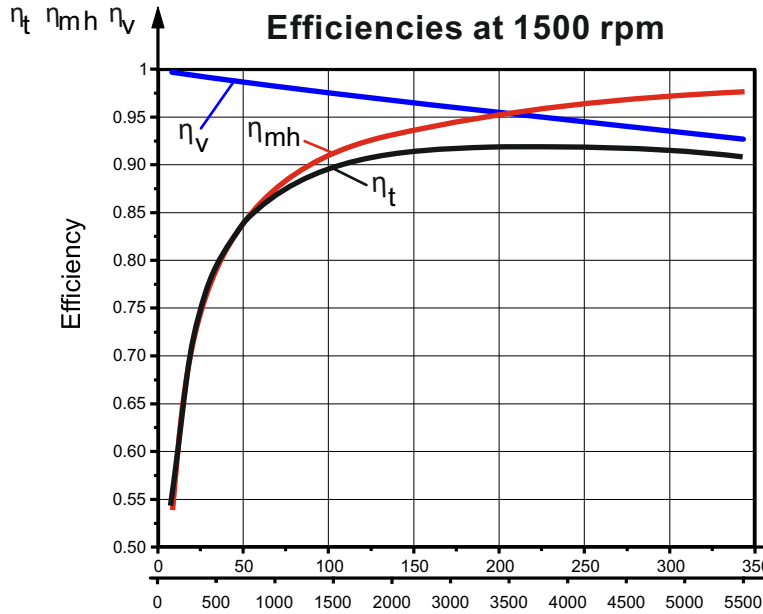


The pump size, pressure, torque, speed of rotation and flow rate required for a specific application can be calculated using the formulas on page 82

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



**FUNCTION DIAGRAMS**



The pump size, pressure, torque, speed of rotation and flow rate required for a specific application can be calculated using the formulas on page 82

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

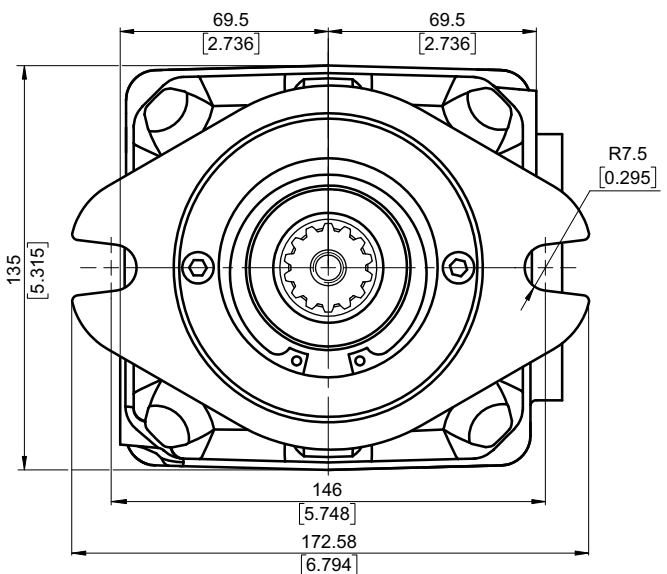
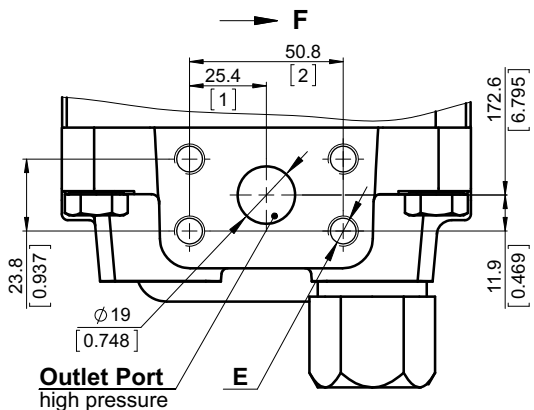
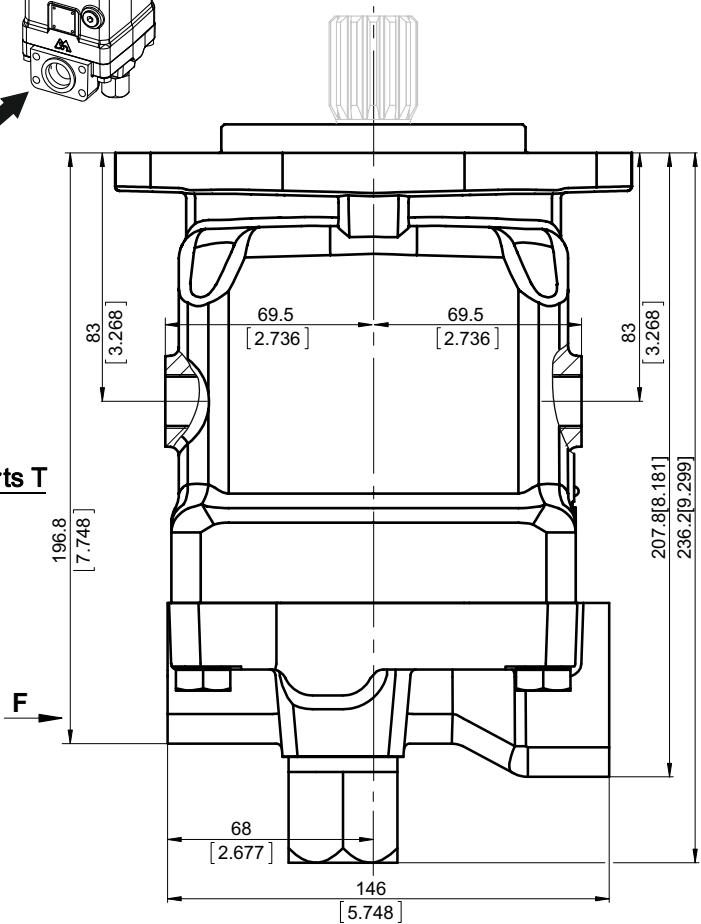
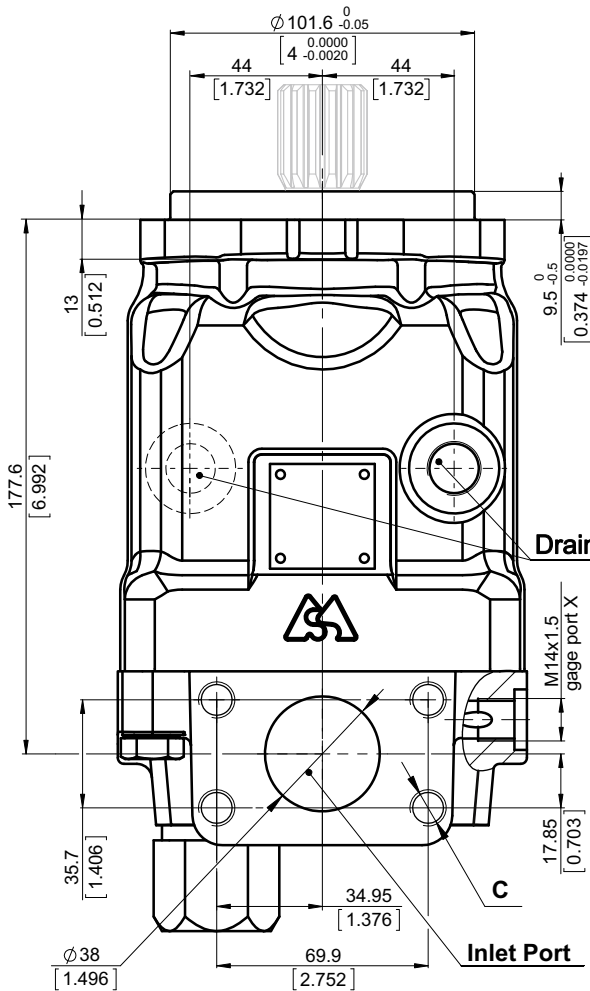
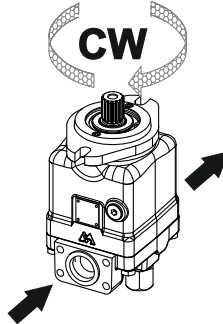
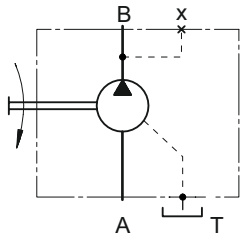


## OVERALL DIMENSIONS AND PORTS

Direction of Rotation **CW**(Right)

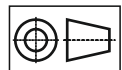
**Port sizes default and 5**

See the port sizes at the bottom of this page



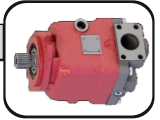
|        | Port Size       |                        |
|--------|-----------------|------------------------|
|        | default         | 5                      |
| Inlet  | ISO 6162-1 DN38 | SAE J518 1 1/2 PSI3000 |
| Outlet | ISO 6162-2 DN19 | SAE J518 3/4 PSI6000   |
| T      | M18x1,5         | 7/8-14 UNF             |
| C      | 4xM12           | 4x1/2-13 UNC           |
| F      | 4xM10           | 4x3/8-16 UNC           |

Shaft Mounting  
see page 66



mm [in]



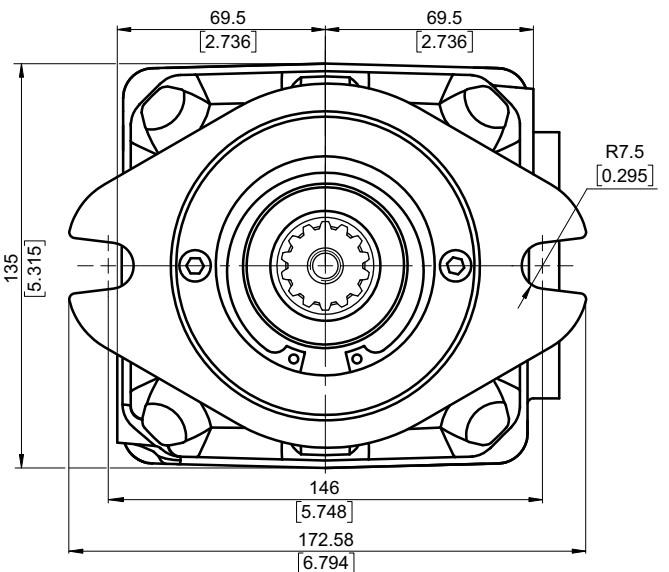
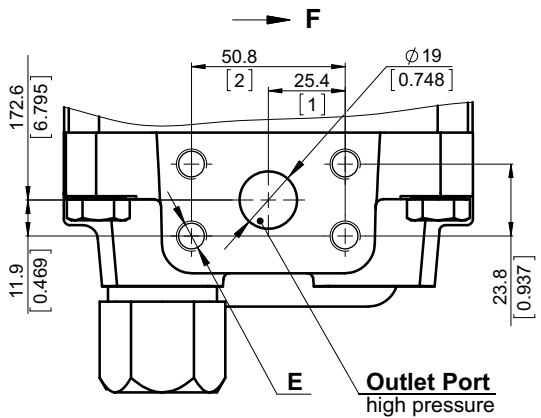
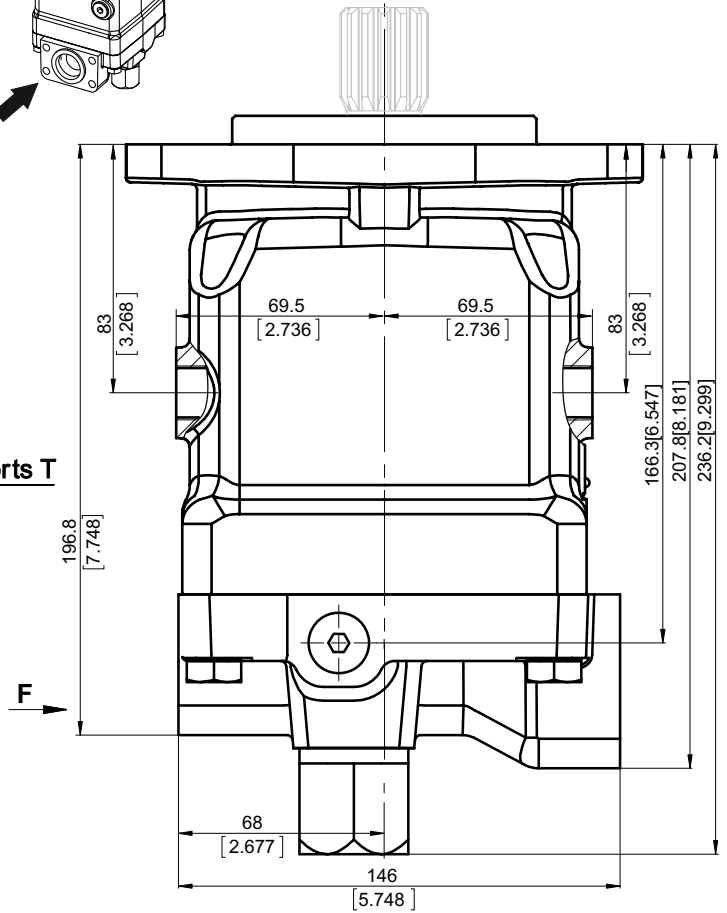
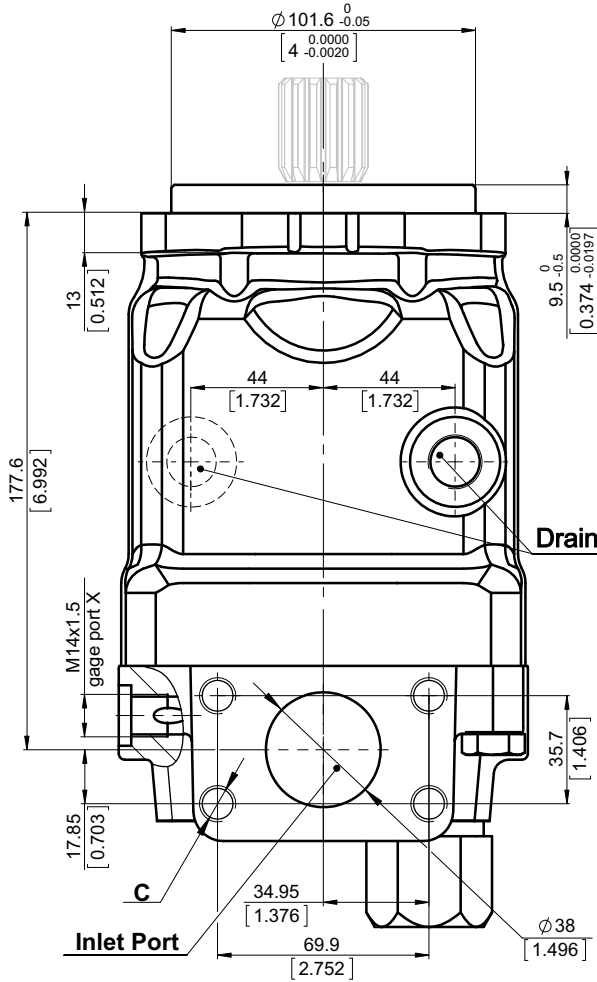
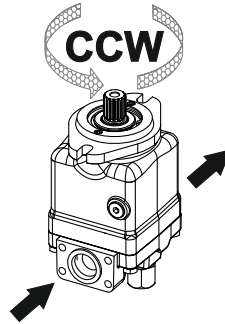
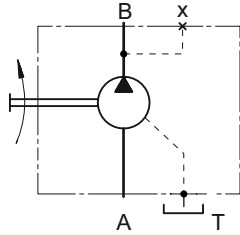


**OVERALL DIMENSIONS AND PORTS**

Direction of Rotation **CCW**(Left)

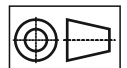
Port sizes **default** and **5**

See the port sizes at the bottom of this page



|               | Port Size       |                        |
|---------------|-----------------|------------------------|
|               | default         | 5                      |
| <b>Inlet</b>  | ISO 6162-1 DN38 | SAE J518 1 1/2 PSI3000 |
| <b>Outlet</b> | ISO 6162-2 DN19 | SAE J518 3/4 PSI6000   |
| <b>T</b>      | M18x1.5         | 7/8-14 UNF             |
| <b>C</b>      | 4xM12           | 4x1/2-13 UNC           |
| <b>F</b>      | 4xM10           | 4x3/8-16 UNC           |

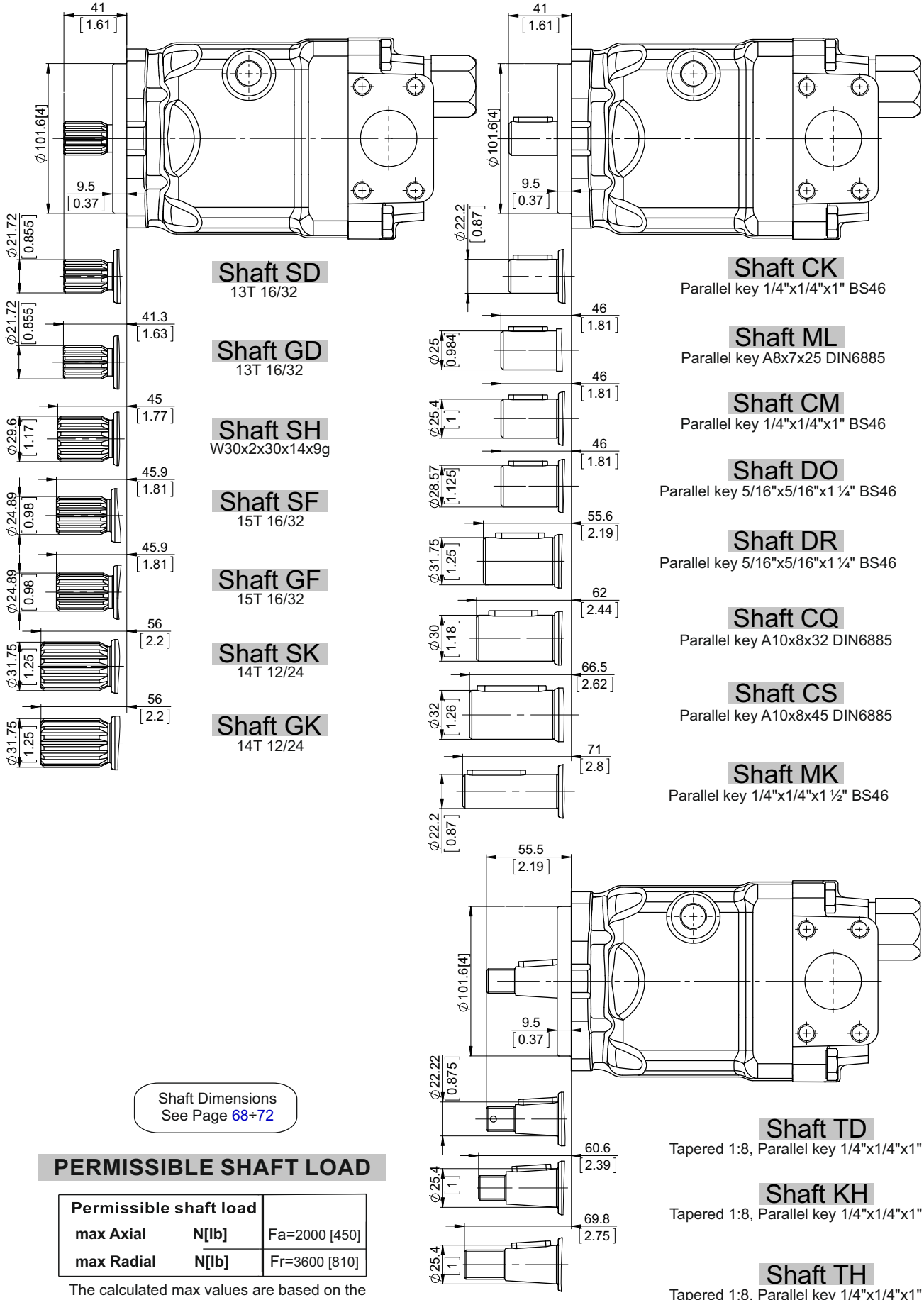
Shaft Mounting  
see next page



mm [in]



**SHAFTS MOUNTING**



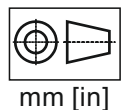
Shaft Dimensions  
See Page 68+72

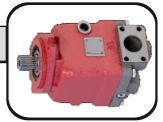
**PERMISSIBLE SHAFT LOAD**

| 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 78).

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





ORDERING CODE

|     |   |   |   |   |   |   |   |   |   |   |   |
|-----|---|---|---|---|---|---|---|---|---|---|---|
|     | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 9 | 9 |
| PAP |   |   |   |   |   |   |   |   | [ |   | ] |

Pos.1 - Mounting Flange

**B** - SAE B - 2-Bolt flange  
spigot diam. 101.6 [4"] - BC 146 [5.75"]

Pos.2 - Displacement Code

- 35** - 36.16 cm.<sup>3</sup>/rev. [2.21 in.<sup>3</sup>/rev.]
- 40** - 41.59 cm.<sup>3</sup>/rev. [2.54 in.<sup>3</sup>/rev.]
- 46** - 47.13 cm.<sup>3</sup>/rev. [2.88 in.<sup>3</sup>/rev.]
- 50** - 49.94 cm.<sup>3</sup>/rev. [3.05 in.<sup>3</sup>/rev.]
- 52** - 51.95 cm.<sup>3</sup>/rev. [3.17 in.<sup>3</sup>/rev.]
- 58** - 58.8 cm.<sup>3</sup>/rev. [3.59 in.<sup>3</sup>/rev.]
- 62** - 62.4 cm.<sup>3</sup>/rev. [3.81 in.<sup>3</sup>/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 thread
- SF** - ø24.9 [0.98"] Spline SAE 15T 16/32, M8
- GF** - ø24.9 [0.98"] Spline SAE 15T 16/32, 3/8-16UNC
- SH** - ø29.6 [1,165"] Spline W30x2x30x14x9g DIN, M10 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 thread
- CK** - ø22.2 [7/8"] Straight, M8 thread  
Parallel key 1/4"x1/4"x1" BS46
- MK** - ø22.2 [7/8"] Straight, M8 thread  
Parallel key 1/4"x1/4"x1½" BS46
- ML** - ø25 [0.984"] Straight, M8 thread  
Parallel key A8x7x25 DIN6885
- CM** - ø25.4 [1"] Straight, M8 thread  
Parallel key 1/4"x1/4"x1" BS46
- DO** - ø28.75 [1.125"] Straight, 3/8-16UNC  
Parallel key 5/16"x5/16"x1¼" BS46
- CQ** - ø30 [1.181"] Straight, M8 thread  
Parallel key A8x7x32 DIN6885
- DR** - ø31.75 [1.25"] Straight, 3/8-16UNC  
Parallel key 5/16"x5/16"x1¼" BS46
- CS** - ø32 [1.26"] Straight, M8 thread  
Parallel key A10x8x45 DIN6885
- TD** - ø22.22 [7/8"] Tapered 1:8 [125:1000],  
Parallel key 1/4"x1/4"x1", 5/8-18 UNF
- TH** - ø25.4 [1"] Tapered 1:8 [125:1000],  
Parallel key 1/4"x1/4"x1", 3/4-16 UNF
- KH** - ø25.4 [1"] Tapered 1:8 [125:1000],  
Parallel key 1/4"x1/4"x1", M16x1.5

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 1½" PSI3000, Outlet SAEJ518 3/4" PSI6000, sae thread, drain 7/8-14 UNF

Pos.6 - Seal, Corrosion Resistant Seal Surface

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

Pos.7 - Special Features\* see page 77

- 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.

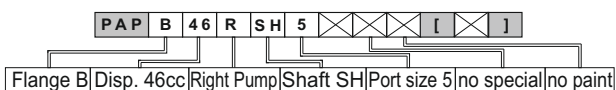
Pos.9 - Design Series

- omit - Factory specified

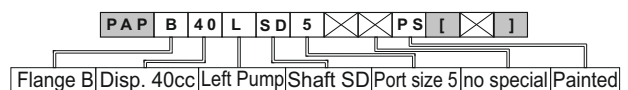
\*\*The permissible output torque for shafts must not be exceeded!  
\*\*\*Non painted feeding surface

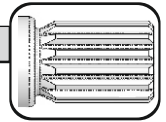
EXAMPLE

PAPB46RSH5



PAPB40LSD5PS

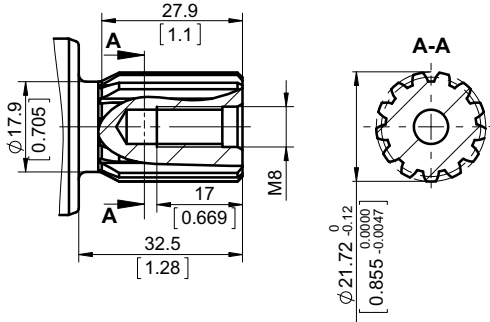




SHAFT TYPES AND DIMENSIONS

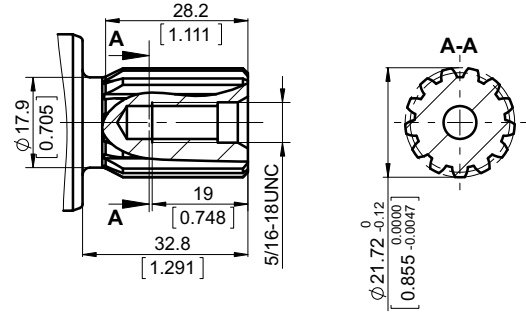
SD

**ø21.72 [0.855], M8 thread**  
**13T 16/32 DP splined ANSI B92.1-1970**  
 Max. torque 220 Nm [1950 lb-in]



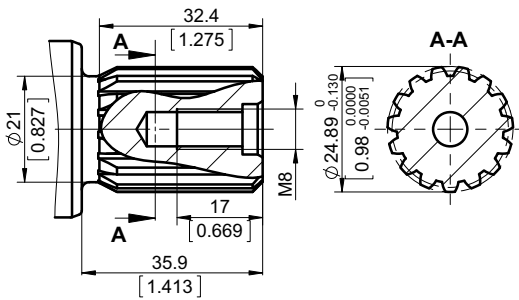
GD

**ø21.72 [0.855], 5/16-18 UNC thread**  
**13T 16/32 DP splined ANSI B92.1-1970**  
 Max. torque 220 Nm [1950 lb-in]



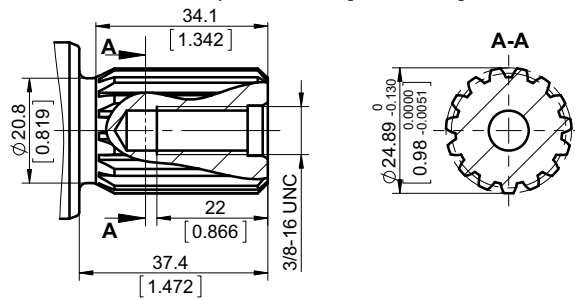
SF

**ø24.89 [0.98], M8 thread**  
**15T 16/32 DP splined ANSI B92.1-1970**  
 Max. torque 360 Nm [3180 lb-in]



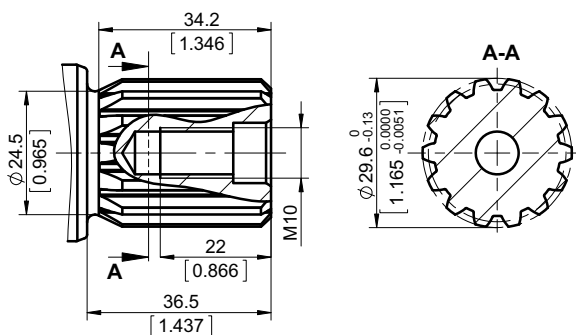
GF

**ø24.89 [0.98], 3/8-16 UNC thread**  
**15T 16/32 DP splined ANSI B92.1-1970**  
 Max. torque 360 Nm [3180 lb-in]



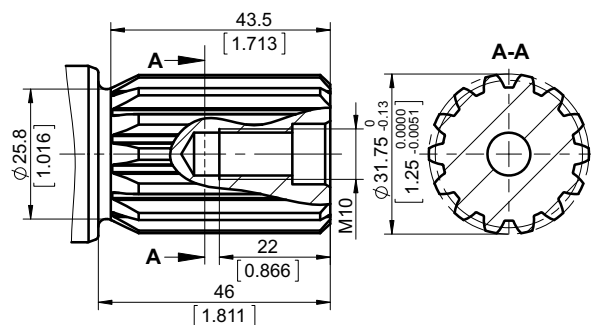
SH

**ø29.6 [1.165], M10 thread**  
**W30x2x30x14x9g splined DIN 5480**  
 Max. torque 600 Nm [5310 lb-in]

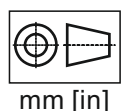


SK

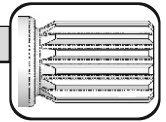
**ø31.75 [1.25], M10 thread**  
**14T 12/24 DP splined ANSI B92.1-1970**  
 Max. torque 600 Nm [5310 lb-in]



The required max. torque must not be exceeded

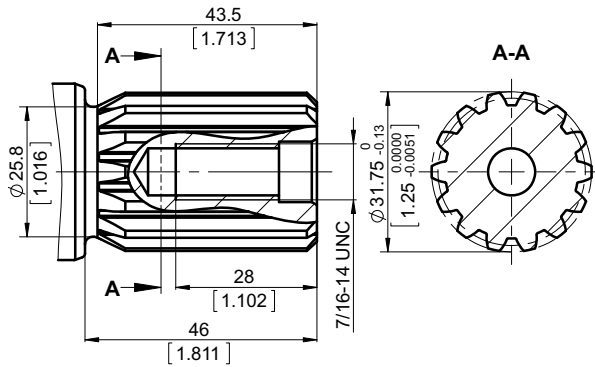


## SHAFT TYPES AND DIMENSIONS



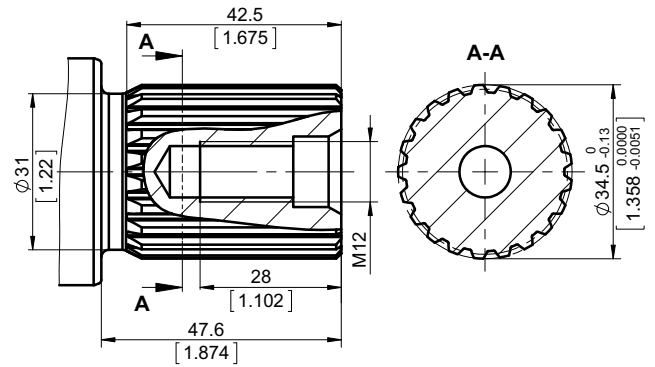
## GK

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



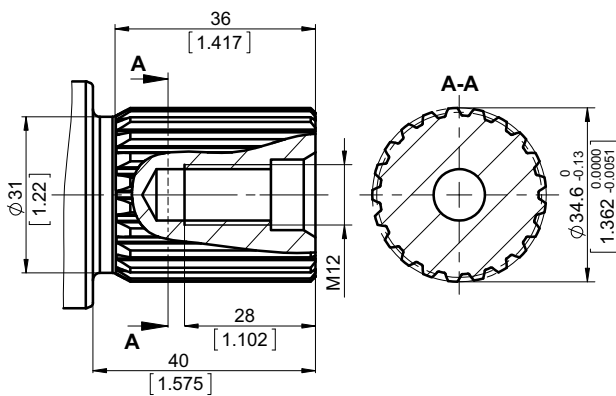
## SP

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



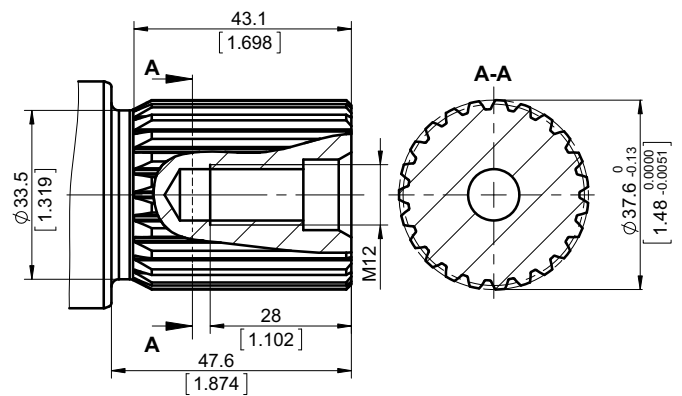
## QH

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



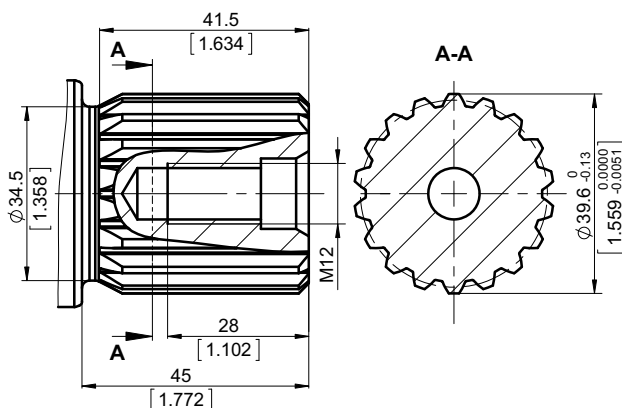
## SR

$\phi 37.6$  [1.5], M12 thread  
23T 16/32 DP splined ANSI B92.1-1970  
Max. torque 1300 Nm [11500 lb-in]



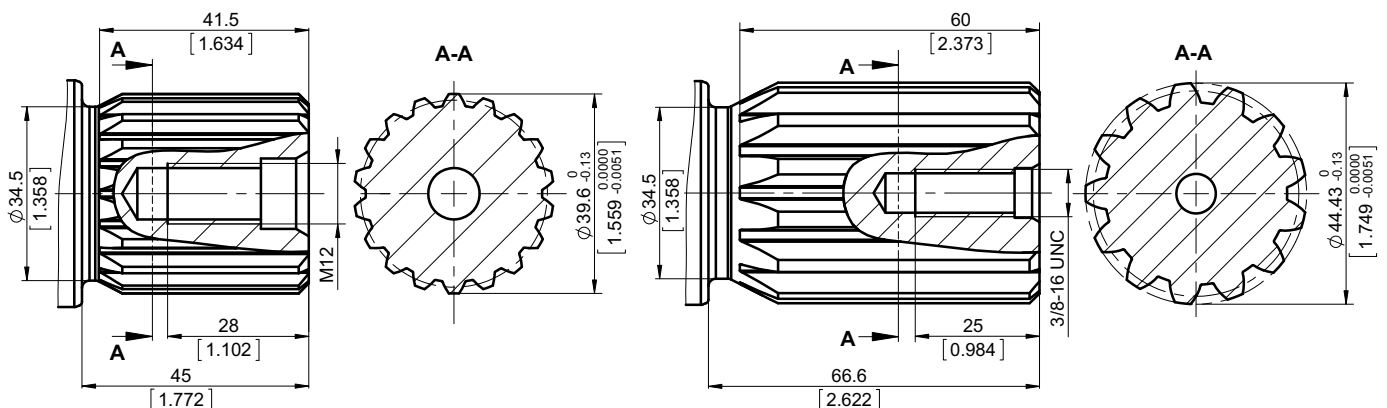
## ST

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

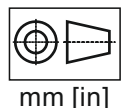


## GU

$\phi 44.43$  [1.749], 3/8-16 UNC 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

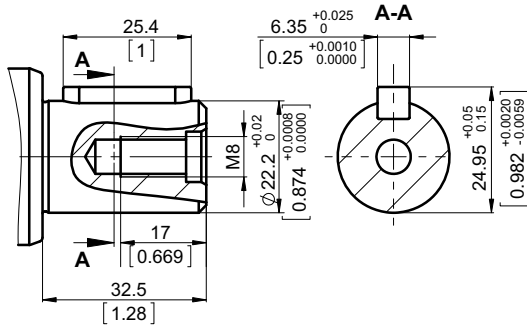


mm [in]

**SHAFT TYPES AND DIMENSIONS**

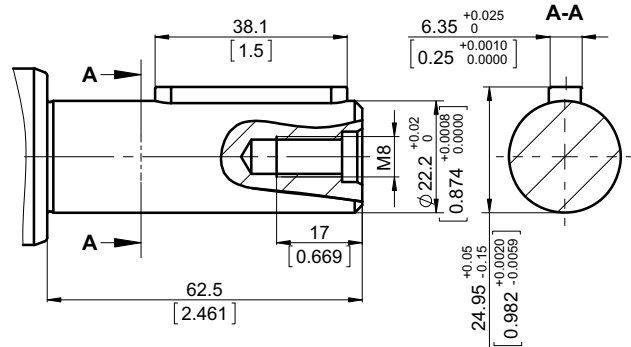
**CK**

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



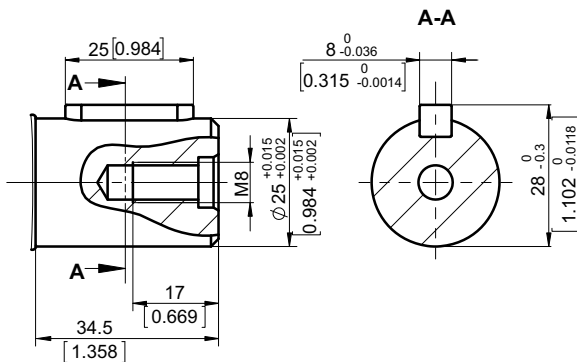
**MK**

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



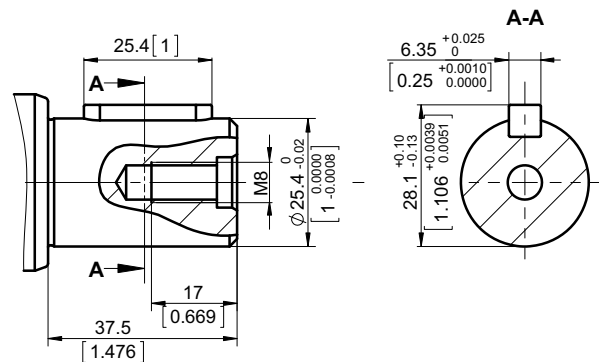
**ML**

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



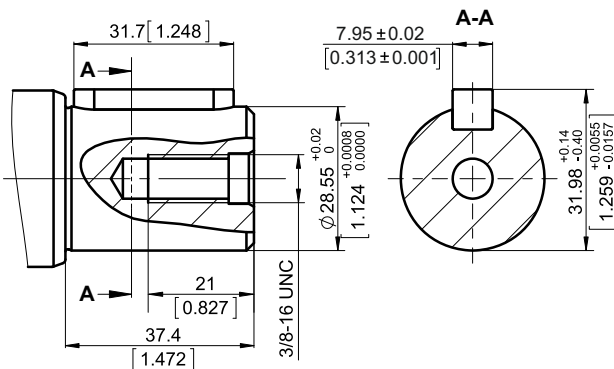
**CM**

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



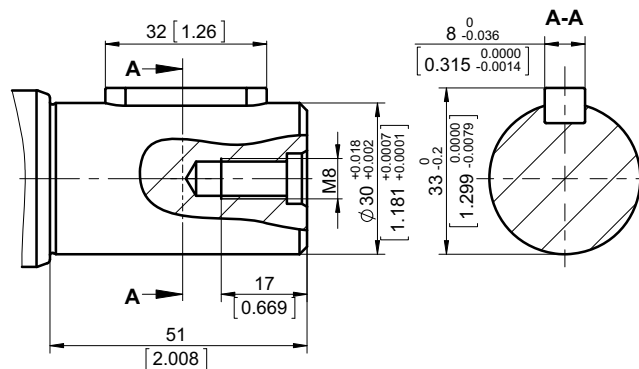
**DO**

**ø28.55 [1.125]** straight, 3/8-16 UNC thread  
 Parallel key **5/16"x5/16"x1 1/4"**  
 Max. torque 280 Nm [2480 lb-in]

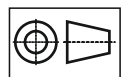


**CQ**

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



The required max. torque must not be exceeded

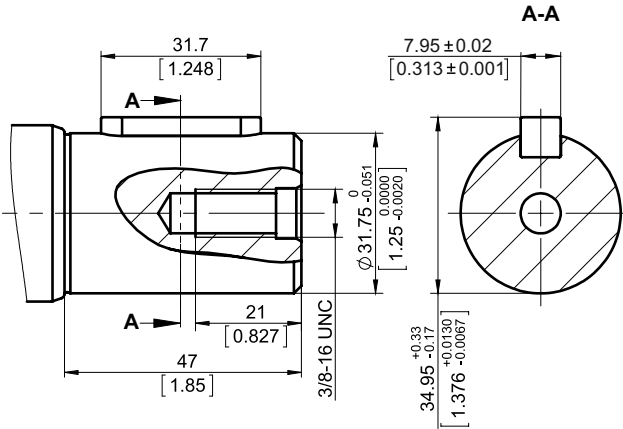


mm [in]

**SHAFT TYPES AND DIMENSIONS**

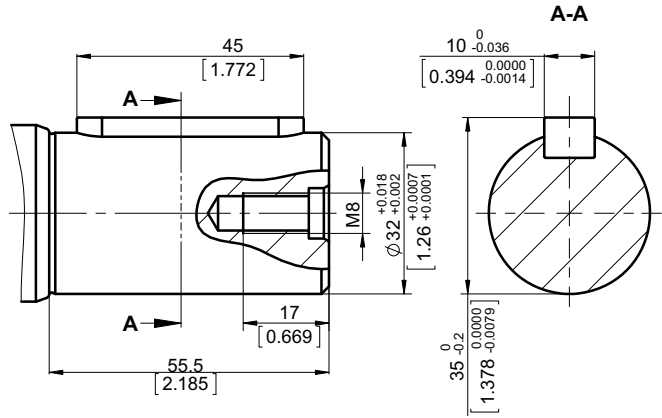
**DR**

**ø31.75 [1.25]** straight, 3/8-16 UNC thread  
 Parallel key **5/16"x5/16"x1/4"**  
 Max. torque 770 Nm [6815 lb-in]



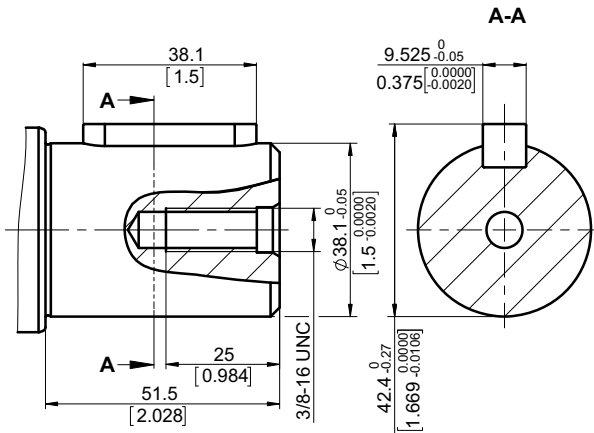
**CS**

**ø32 [1.26]** straight, M8 thread  
 Parallel key **A10x8x45** DIN6885  
 Max. torque 565 Nm [5000 lb-in]



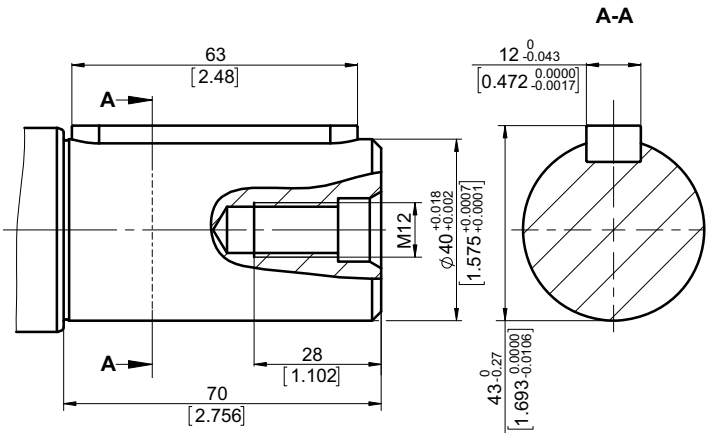
**DU**

**ø38.1 [1½]** straight, 3/8-16 UNC thread  
 Parallel key **3/4"x3/4"x1½"** BS46  
 Max. torque 1000 Nm [8850 lb-in]

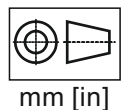


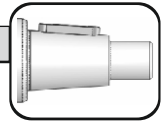
**CV**

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



The required max. torque must not be exceeded

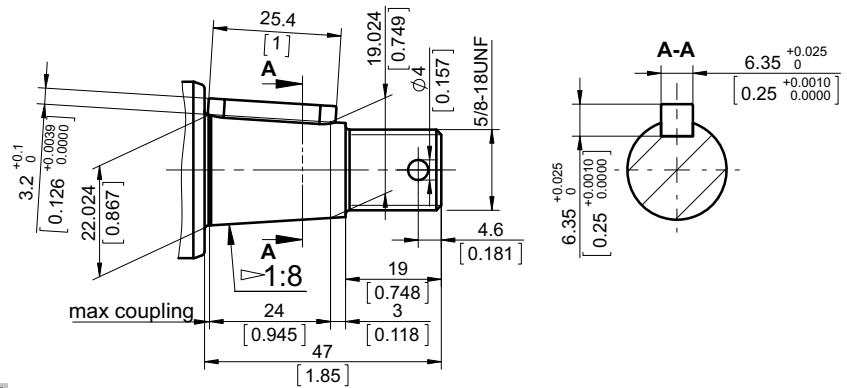




SHAFT TYPES AND DIMENSIONS

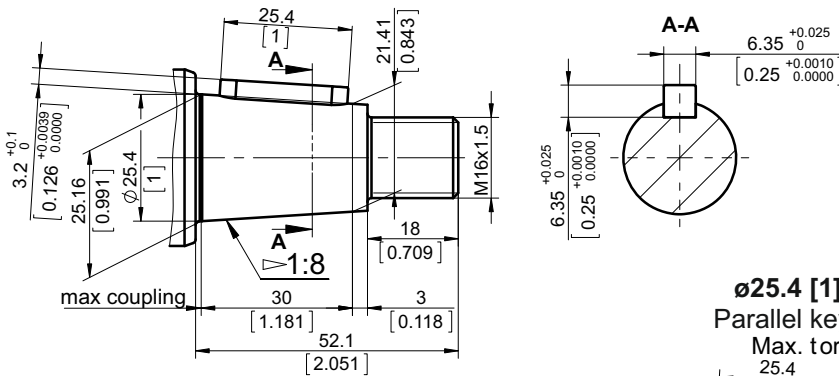
TD

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



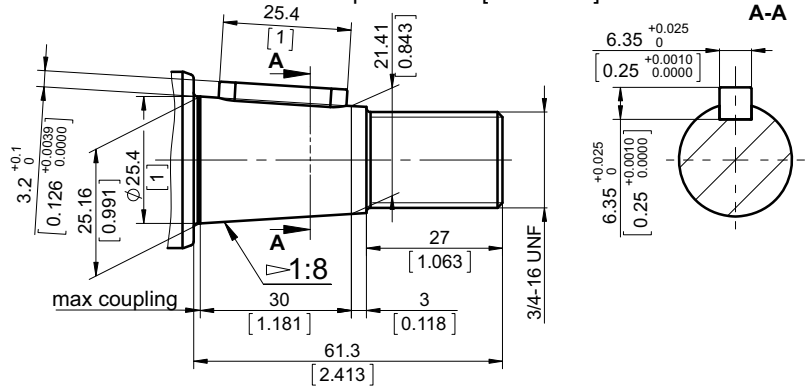
KH

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



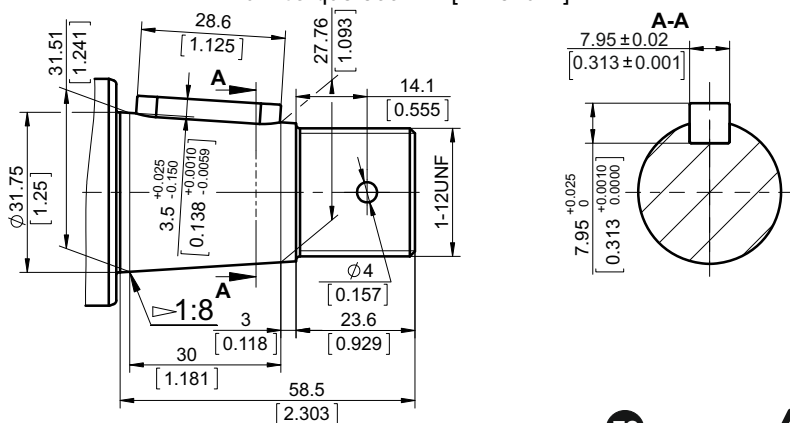
TH

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

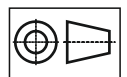


TN

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

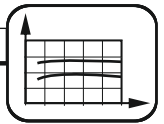


The required max. torque must not be exceeded



mm [in]

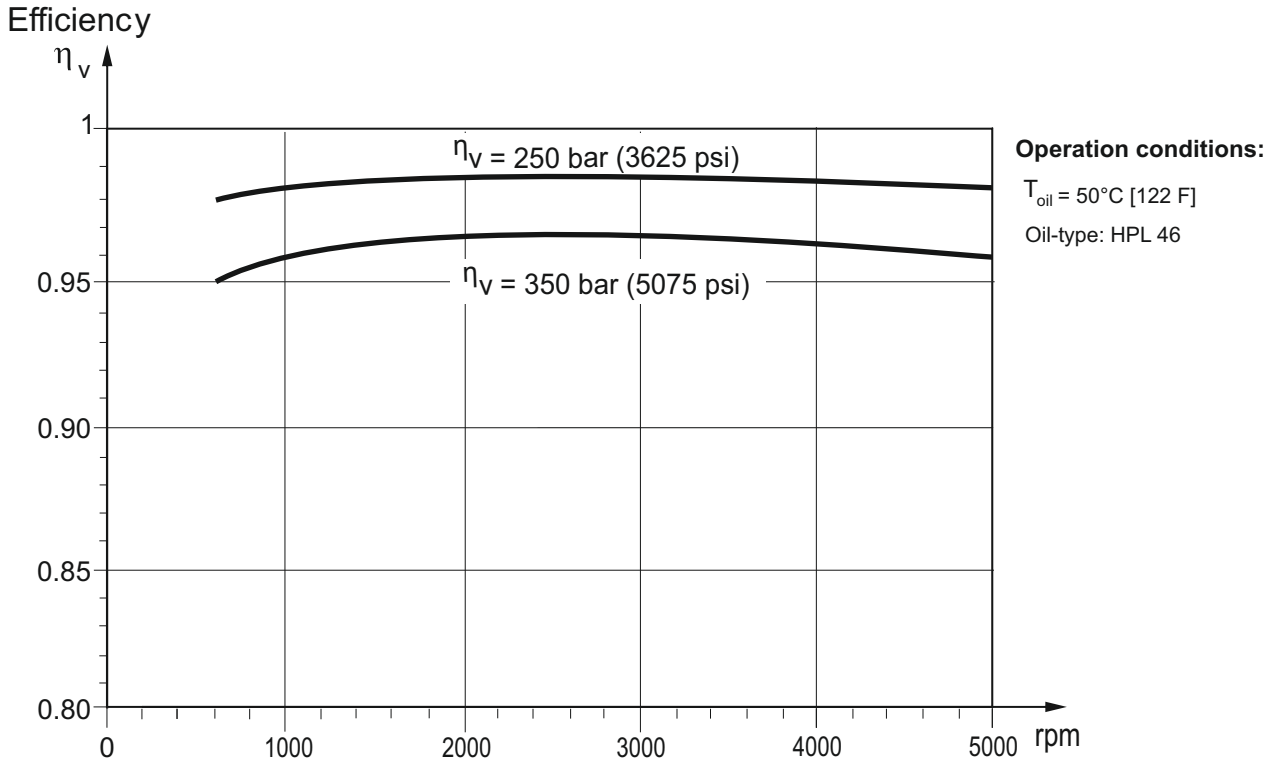




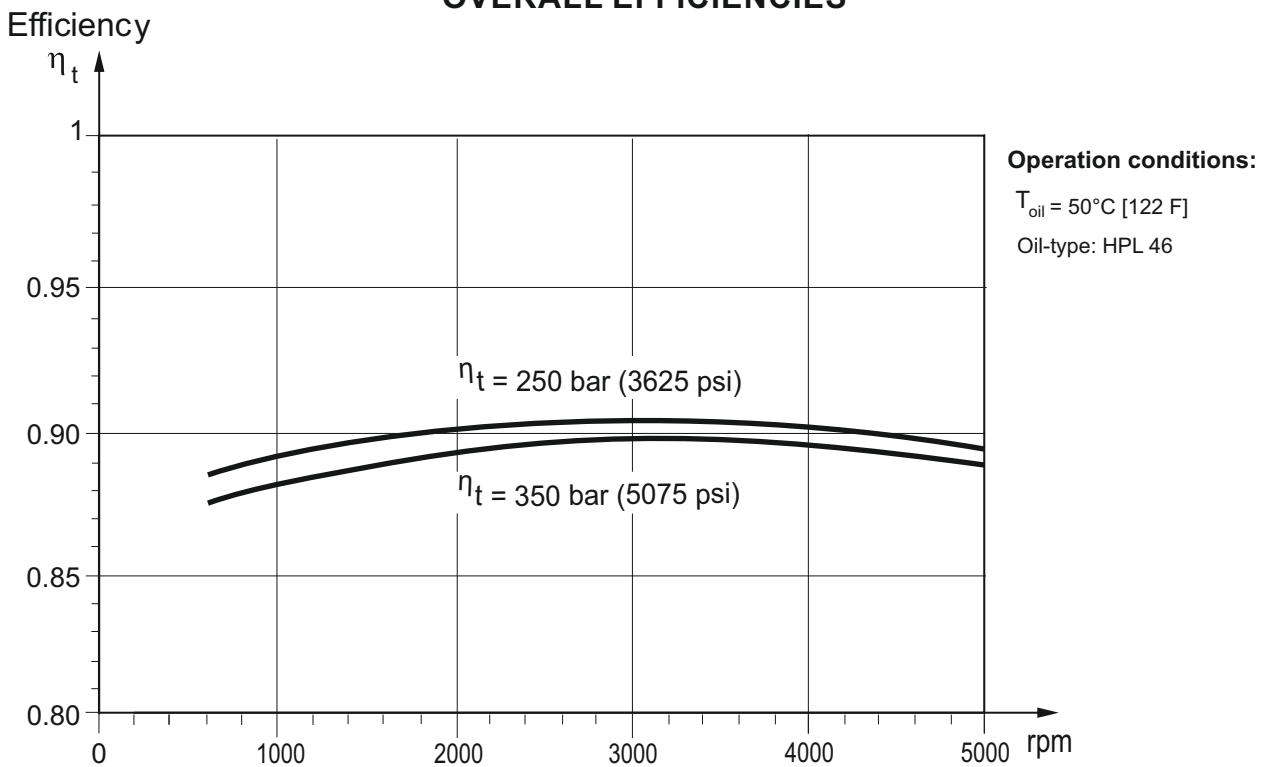
**MOTOR FUNCTION DIAGRAMS**

The below efficiencies are applied for all motor displacements.

**VOLUMETRIC EFFICIENCIES**



**OVERALL EFFICIENCIES**



The motor size, pressure, torque, speed of rotation and flow rate required for a specific application can be calculated using the formulas on page 82

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



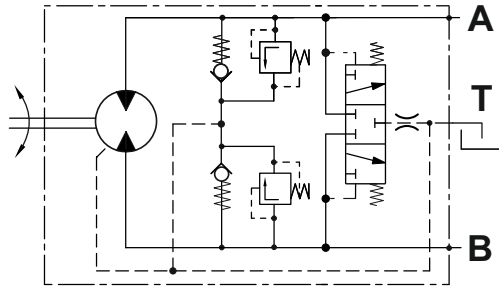


**VALVE OPTIONS**

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

**Option DARP**

Dual Anti-Cavitation, Relief and Purge Valve



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

Pressure setting    → pressure

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

| Motors  | MAP28     | MAP50     | MAP62     | MAP100    | MAPW62    |
|---------|-----------|-----------|-----------|-----------|-----------|
| default | 5±2 l/min | 6±2 l/min | 6±2 l/min | 7±2 l/min | 6±2 l/min |

The possible values are as follow:

Flow setting    → flow rate

**EXAMPLE**

MAPB50SH2DARP350

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

MAPB50SH2DARP250L3.5

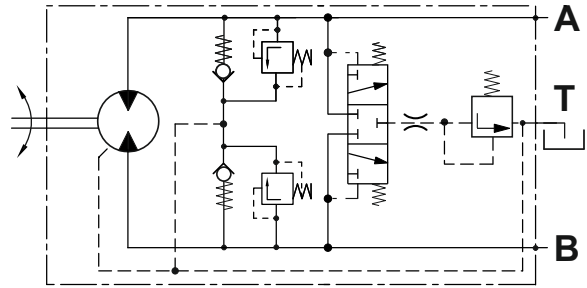
Double Anti-Cavitation, Relief and Purge Valve, relief valve setting is 250 bar, purge valve flow rate 3.5±1 l/min

MAPB50SH2DARP300L5.5

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

**Option DARF**

Dual Anti-Cavitation, Relief and Flush Valve



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

Pressure setting    → pressure

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

| Motors  | MAP28     | MAP50     | MAP62     | MAP100    | MAPW62    |
|---------|-----------|-----------|-----------|-----------|-----------|
| default | 5±2 l/min | 6±2 l/min | 6±2 l/min | 7±2 l/min | 6±2 l/min |

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

Flow setting    → flow rate

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

Pressure setting

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

**EXAMPLE**

MAPB50SH2DARF350

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

MAPB50SH2DARF350-10

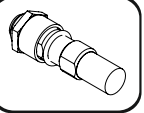
Double Anti-Cavitation, Relief and Flush Valve, relief valve setting 350 bar flush valve charge pressure 10 bar, flush valve flow rate is 6±2 l/min

MAPB50SH2DARF250L3.5

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

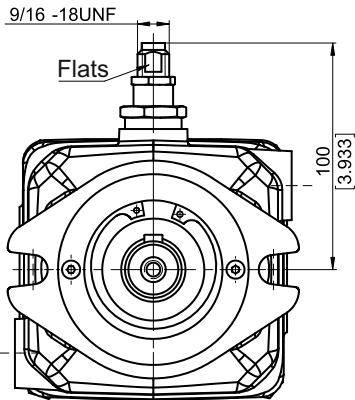
MAPB50SH2DARF300-10L5.5

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

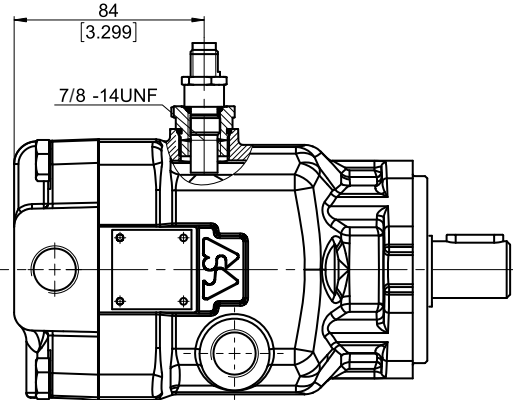


**SPEED SENSORS**

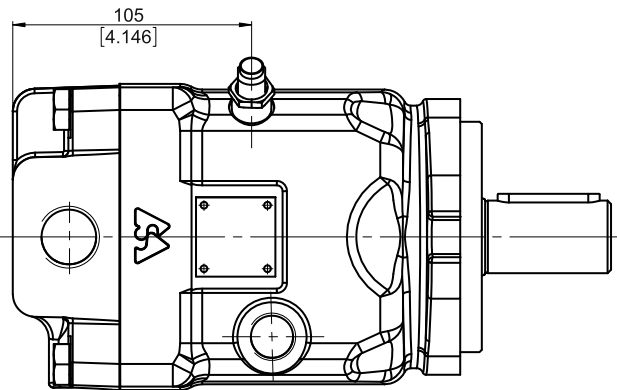
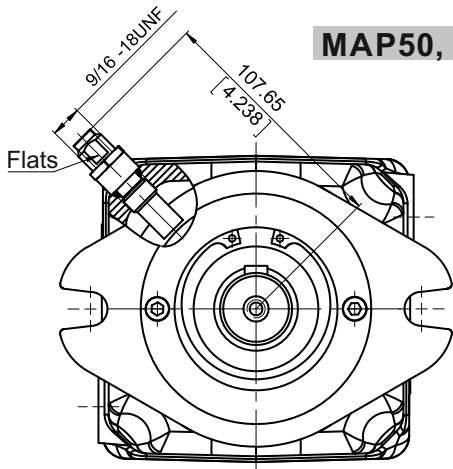
**MOUNTING DIMENSIONS**



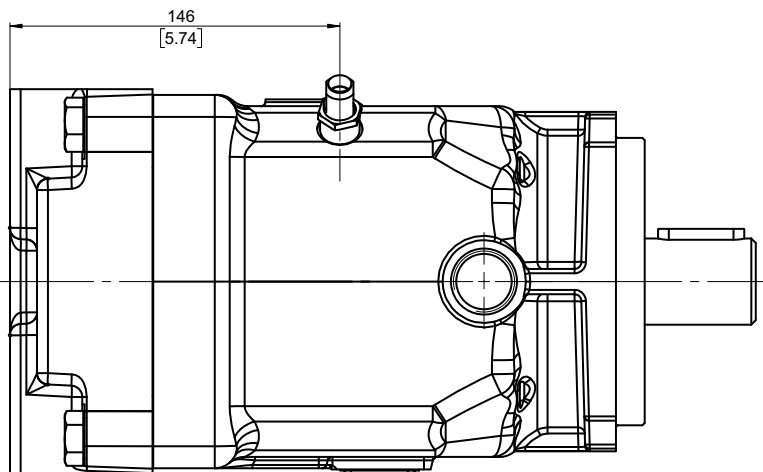
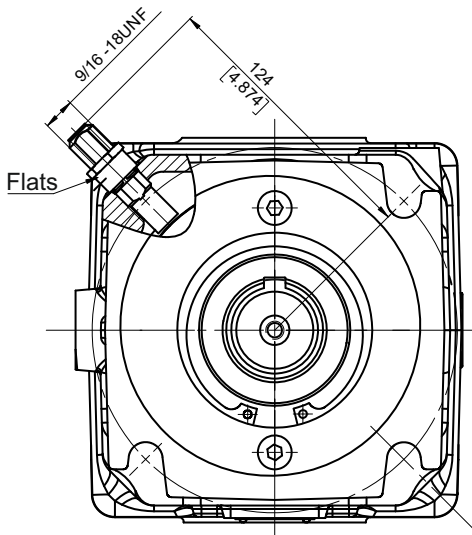
**MAP28**



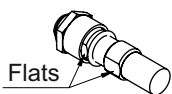
**MAP50, MAP62, MAPW62 and PAP62**



**MAP100**

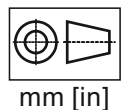


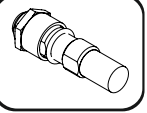
**INSTALLATION**



1. Remove the plug.
2. Screw in the (CW) sensor by hand until the bottom end gently touches the speed ring.
3. Unscrew (CCW) sensor 1/4 turn. Continue unscrewing until the flats are perpendicular to motor or pump shaft center line (tolerance 20° to 30° is acceptable). Do not unscrew the sensor more than 3/4 of a turn from the touching.
4. Using the 1/2 inch wrench to hold the sensor, tighten the lock nut to 10<sup>±5</sup>[115] Nm [lb-in]. with an 1 1/16 inch hew wrench.

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





**SPEED SENSORS**

**TECHNICAL DATA OF THE SPEED SENSOR**

**TECHNICAL DATA**

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

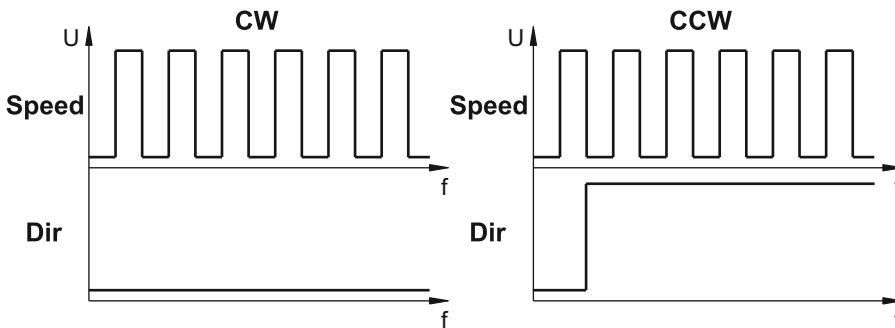
**OUTPUT PULSES**

per revolution

| Motor Type    | MAP28 | MAP50 | MAP100 |
|---------------|-------|-------|--------|
| Output Pulses | 42    | 50    | 65     |

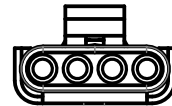
| Pump Type     | PAP50 |
|---------------|-------|
| Output Pulses | 50    |

**OUTPUT DIAGRAMS**



**PIN CONNECTOR**

4 pin Delphi Connector

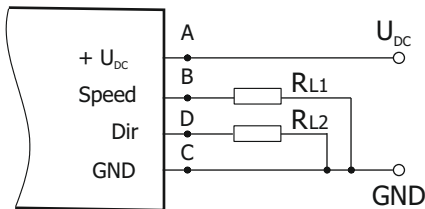


| Pin | Connection | Cable Output |
|-----|------------|--------------|
| A   | Power+     | Red          |
| B   | Speed      | White        |
| C   | Ground     | Black        |
| D   | Direction  | Green        |

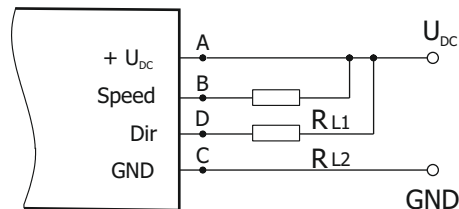
**WIRING DIAGRAMS**

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

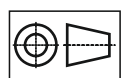
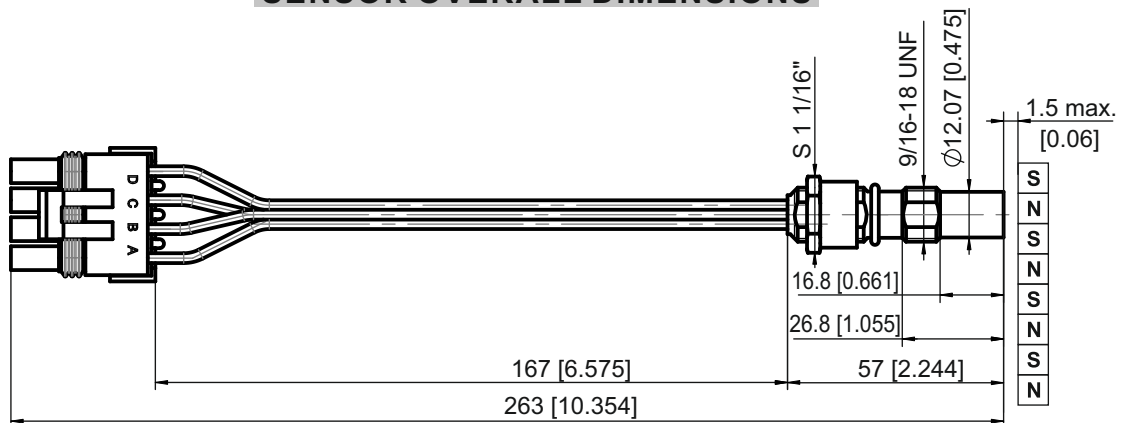
**PNP**



**NPN**



**SENSOR OVERALL DIMENSIONS**



mm [in]

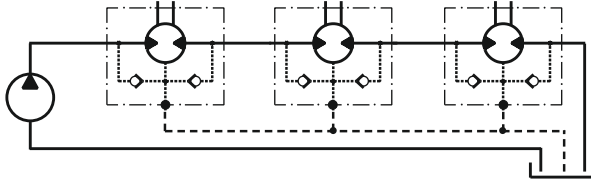


**INSTALLATION**

**TYPE OF CONNECTION**

**Series connection**

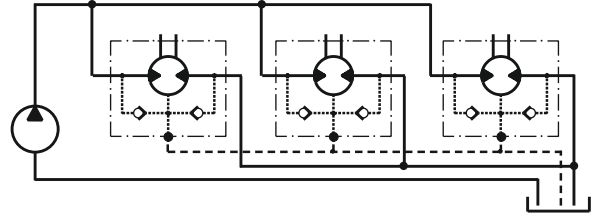
not recommended



open drain line is always required

**Parallel connection**

recommended

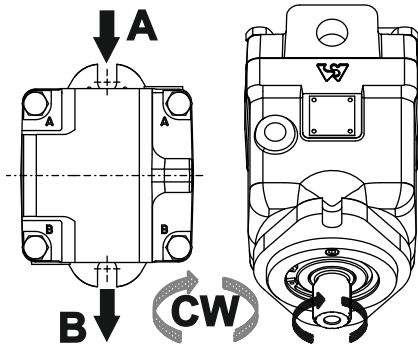


open drain line is always required

**DIRECTION OF ROTATION**

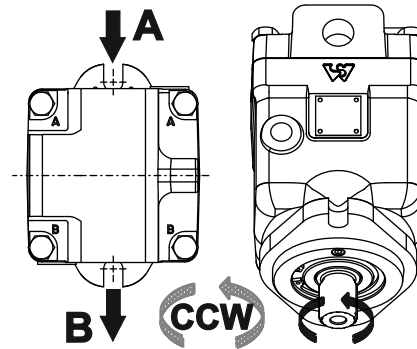
**Standard Rotation**

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



**Reverse Rotation**

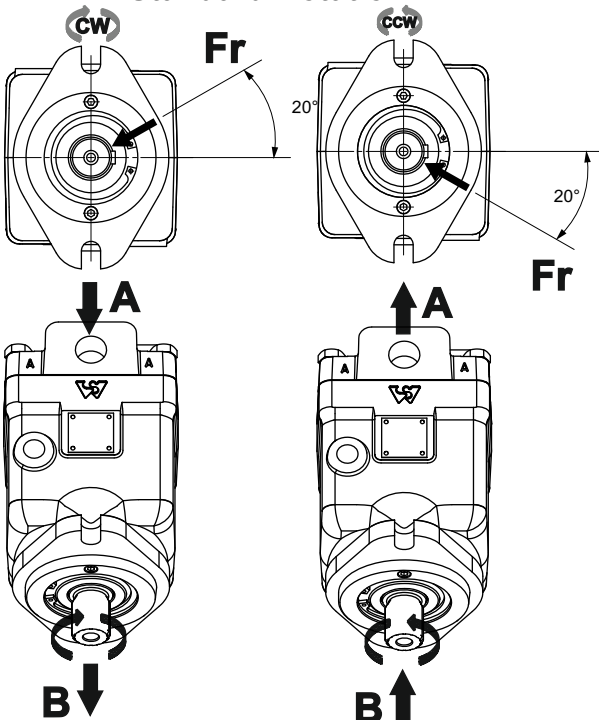
Viewed from shaft end  
Port A Pressurized - CCW  
Port B Pressurized - CW



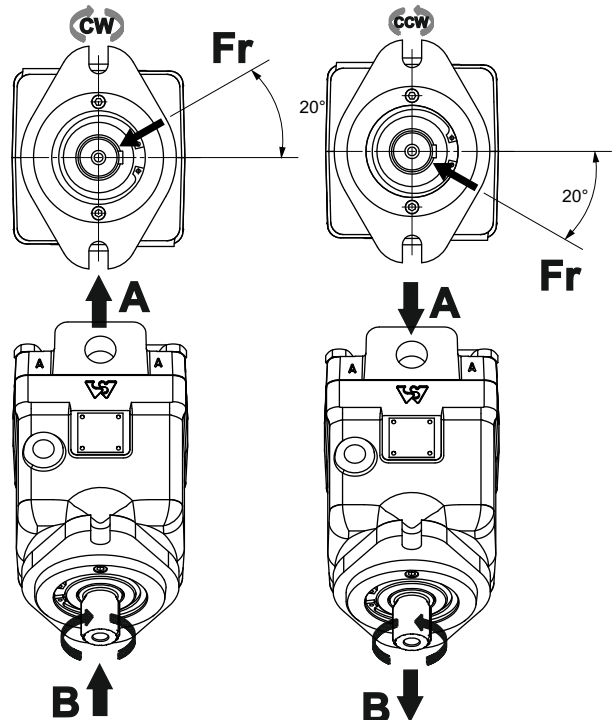
**BEST POSITION FOR APPLYING RADIAL LOAD**

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

**Standard Rotation**



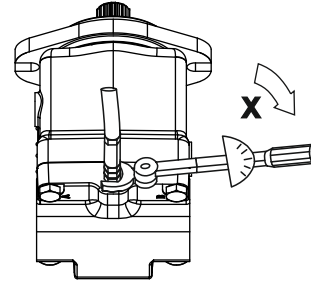
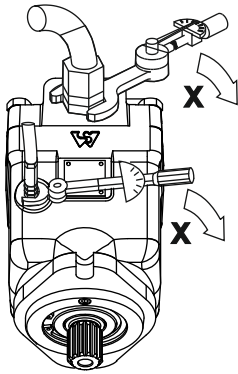
**Reverse Rotation**





INSTALLATION

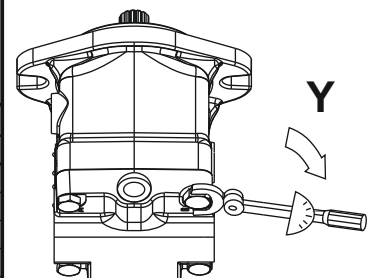
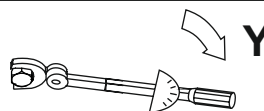
Recommended max. tightening torque X for metal plugs and orifice



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

Recommended max. tightening torque Y for screws and bolts

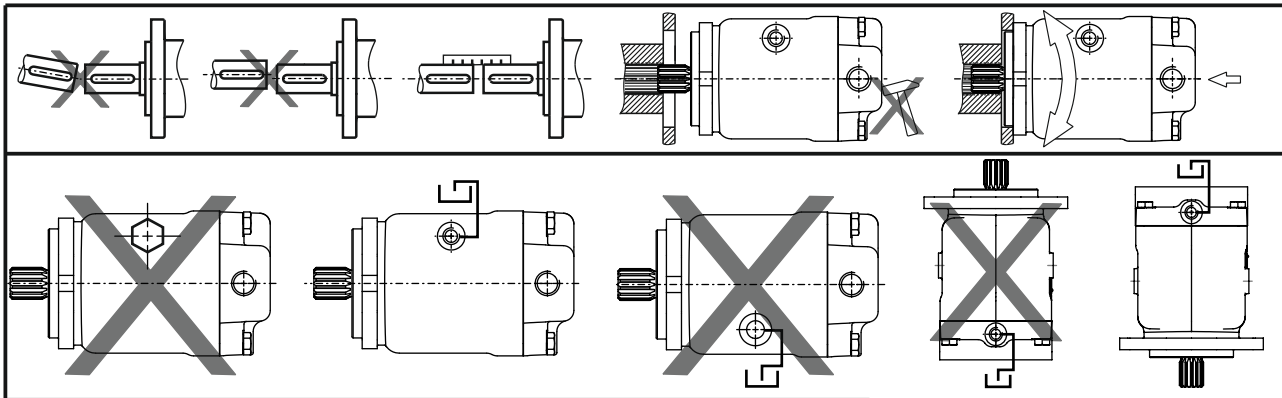
| Motor Type | End Cover - Body |              | Axial Piston Group - Body |              | Axial Piston Group |              |
|------------|------------------|--------------|---------------------------|--------------|--------------------|--------------|
|            | Bolt             | daNm [lb-in] | Screw                     | daNm [lb-in] | Screw              | daNm [lb-in] |
| MAPA28     | M10 - 12.9       | 7[620]       | M4 - 12.9                 | 0.4[40]      | M5 - 12.9          | 0.6[60]      |
| MAPB28     | M10 - 12.9       | 7[620]       | M5 - 12.9                 | 0.6[60]      | M5 - 12.9          | 0.6[60]      |
| MAP50      | M12 - 12.9       | 10[890]      | M6 - 12.9                 | 1.3[120]     | M6 - 12.9          | 1.3[120]     |
| MAP62      | M12 - 12.9       | 10[890]      | M6 - 12.9                 | 1.3[120]     | M6 - 12.9          | 1.3[120]     |
| MAP100     | M14 - 12.9       | 13[1160]     | M8 - 12.9                 | 3.5[310]     | M6 - 12.9          | 1.3[120]     |
| MAPW62     | M12 - 12.9       | 10[890]      | M6 - 12.9                 | 1.3[120]     | M6 - 12.9          | 1.3[120]     |
| PAP62      | M12 - 12.9       | 10[890]      | M6 - 12.9                 | 1.3[120]     | M6 - 12.9          | 1.3[120]     |





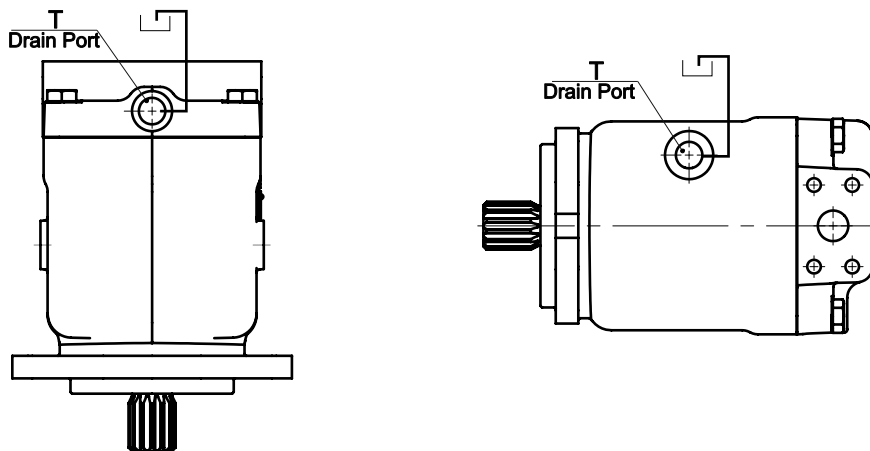
**INSTALLATION**

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.



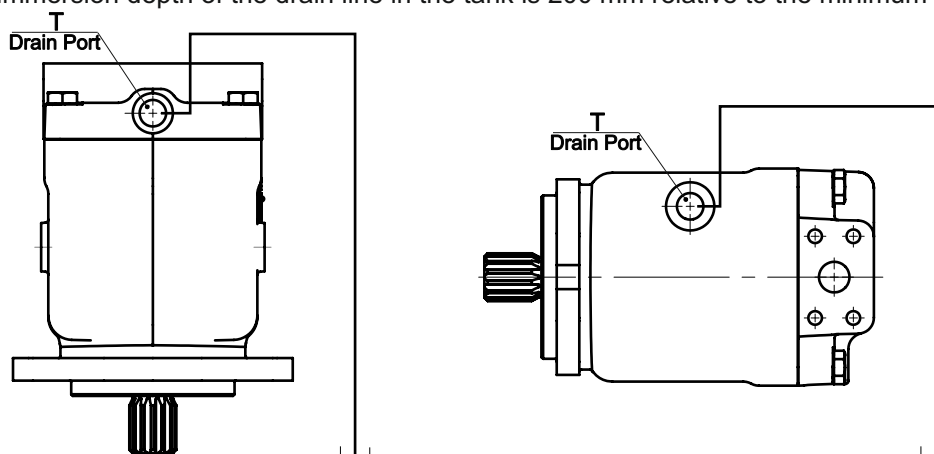
**Installation below the tank level (recommended)**

- 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.



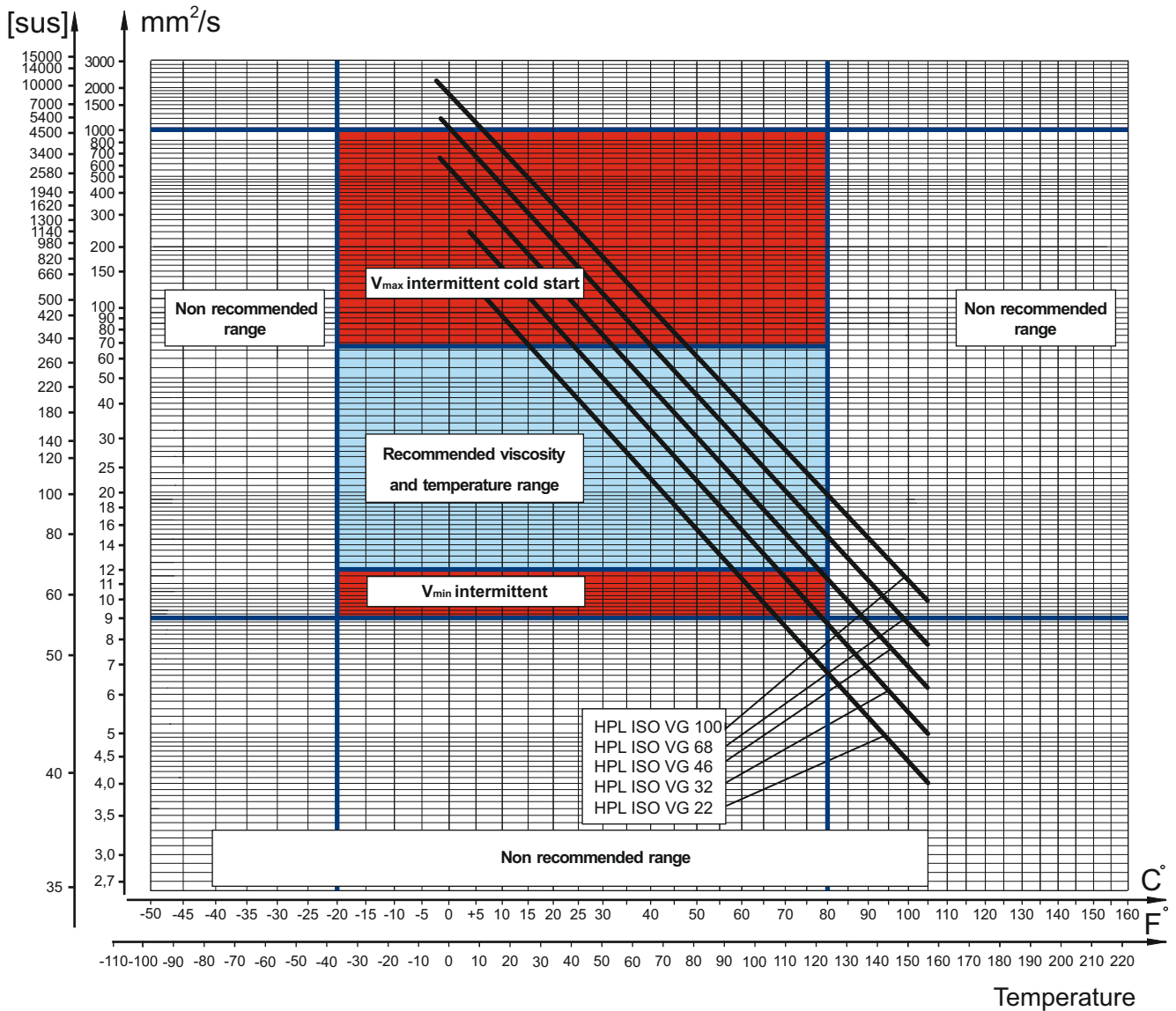




**FLUID VISCOSITY LIMITS**

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.

**Kinematic viscosity**



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

**BASIC FORMULAS**

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

| Metric System                                  |                                                                                                           | Inch System                                    |                                                                                                           |
|------------------------------------------------|-----------------------------------------------------------------------------------------------------------|------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| <b>Efficiency</b>                              | $\eta_t = \eta_{mh} \cdot \eta_v$ $\eta_{mh} = \frac{\eta_t}{\eta_v}$ $\eta_v = \frac{\eta_t}{\eta_{mh}}$ | <b>Efficiency</b>                              | $\eta_t = \eta_{mh} \cdot \eta_v$ $\eta_{mh} = \frac{\eta_t}{\eta_v}$ $\eta_v = \frac{\eta_t}{\eta_{mh}}$ |
| <b>Input flow (for Motor)</b>                  | $Q = \frac{Vg \cdot n}{1000 \cdot \eta_v}$ [l/min]                                                        | <b>Input flow (for Motor)</b>                  | $Q = \frac{Vg \cdot n}{231 \cdot \eta_v}$ [GPM]                                                           |
| <b>Output torque (for Motor)</b>               | $M = \frac{Vg \cdot \Delta p \cdot \eta_{mh}}{62,8}$ or $M = \Delta p \cdot T_{con.}$ [Nm]                | <b>Output torque (for Motor)</b>               | $M = \frac{Vg \cdot \Delta p \cdot \eta_{mh}}{2 \cdot \pi}$ or $M = \Delta p \cdot T_{con.}$ [lb-in]      |
| <b>Output power (for Motor)</b>                | $P = \frac{M \cdot n}{9550} = \frac{Q \cdot \Delta p \cdot \eta_t}{60}$ [kW]                              | <b>Output power (for Motor)</b>                | $P = \frac{Vg \cdot n \cdot \Delta p \cdot \eta_t}{396000}$ [hp]                                          |
| <b>Speed (for Motor)</b>                       | $n = \frac{Q \cdot 1000 \cdot \eta_v}{Vg}$ or $n = Q \cdot N_{con.}$ [min <sup>-1</sup> ]                 | <b>Speed (for Motor)</b>                       | $n = \frac{Q \cdot 231 \cdot \eta_v}{Vg}$ or $n = Q \cdot N_{con.}$ [min <sup>-1</sup> ]                  |
| <b>Output flow (for pump)</b>                  | $Q = \frac{Vg \cdot n \cdot \eta_v}{1000}$ [l/min]                                                        | <b>Output flow (for pump)</b>                  | $Q = \frac{Vg \cdot n \cdot \eta_v}{231}$ [GPM]                                                           |
| <b>Driving torque (for pump)</b>               | $M = \frac{Vg \cdot \Delta p}{62,8 \cdot \eta_{mh}}$ [Nm]                                                 | <b>Driving torque (for pump)</b>               | $M = \frac{Vg \cdot \Delta p}{2 \cdot \pi \cdot \eta_{mh}}$ [lb-in]                                       |
| <b>Input power (for pump)</b>                  | $P = \frac{M \cdot n}{9550} = \frac{Q \cdot \Delta p}{60 \cdot \eta_t}$ [kW]                              | <b>Input power (for pump)</b>                  | $P = \frac{Vg \cdot n \cdot \Delta p}{396000 \cdot \eta_t}$ [hp]                                          |
| $Vg =$ Displacement per rev.                   | [cm <sup>3</sup> ]                                                                                        | $Vg =$ Displacement per rev.                   | [in <sup>3</sup> ]                                                                                        |
| $\Delta p =$ p <sub>HP</sub> - p <sub>LP</sub> | [bar]                                                                                                     | $\Delta p =$ p <sub>HP</sub> - p <sub>LP</sub> | [PSI]                                                                                                     |
| p <sub>HP</sub> = High pressure                | [bar]                                                                                                     | p <sub>HP</sub> = High pressure                | [PSI]                                                                                                     |
| p <sub>LP</sub> = Low pressure                 | [bar]                                                                                                     | p <sub>LP</sub> = Low pressure                 | [PSI]                                                                                                     |
| n = Rotation speed                             | [RPM]                                                                                                     | n = Rotation speed                             | [RPM]                                                                                                     |
| Q = Oil flow                                   | [l/min]                                                                                                   | Q = Oil flow                                   | [GPM]                                                                                                     |
| T <sub>con.</sub> = Toque constant             | [Nm/bar]                                                                                                  | T <sub>con.</sub> = Toque constant             | [lb-in/PSI]                                                                                               |
| N <sub>con.</sub> = Speed constant             | [RPM/(l/min)]                                                                                             | N <sub>con.</sub> = Speed constant             | [RPM/GPM]                                                                                                 |
| $\eta_v =$ Volumetric efficiency               |                                                                                                           | $\eta_v =$ Volumetric efficiency               |                                                                                                           |
| $\eta_{mh} =$ Mechanical-hydraulic efficiency  |                                                                                                           | $\eta_{mh} =$ Mechanical-hydraulic efficiency  |                                                                                                           |
| $\eta_t =$ Overall efficiency                  |                                                                                                           | $\eta_t =$ Overall efficiency                  |                                                                                                           |

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

Table 1

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

APPLICATION FORMULAS

1. Motor speed: n, RPM

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

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

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

$R_m$  - wheel rolling radius [m]

$R_n$  - wheel rolling radius [in]

$i$  - gear ratio between motor and wheels.

If no gearbox, use  $i=1$ .

2. Rolling resistance: RR, daN [lbs]

The resistance force resulted in wheels contact with different surfaces:

$$RR = G \cdot \rho$$

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

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

3. Grade resistance: GR, daN [lbs]

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

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

Table 2

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

Table 3

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

4. Acceleration force: FA, daN [lbs]

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

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

$FA$  - acceleration force, daN [lbs]

$t$  - time, [s]

5. Tractive effort: DP, daN [lbs]

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

-acc. to constructor's assessment;

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

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

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

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

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

$GR$  - force required to slope upwards;

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

$DP$  - additional tractive effort (trailer).

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

Necessary torque moment for every hydraulic motor:

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

$N$  - motor numbers;

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

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

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

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

$f$  - frictional factor;

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

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

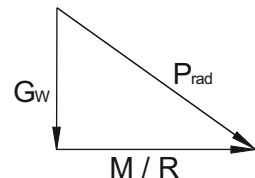
When the motor is used for motion with a ring or gear mounted directly on the motor shaft, the total radial load of the motor shaft  $P_{rad}$  is the sum of the motion force and the weight force acting on the ring .

$G_w$  - Weight held by wheel;

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

$M/R$  - Motion force.

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



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



# 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 M+S company is that we offer hydraulic solutions to the specific needs of the customers meeting their technical requirements thanks to the specific 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

