TÜVRheinland CERT ISO 9001

M+S HYDRAULIC

AXIAL PISTON VARIABLE MOTORS

In cooperation with HES
HYDRAULIC ELEMENTS & SYSTEMS

MA2V

MEDIUM DUTY MOTOR
AXIAL PISTON DUAL DISPLACEMENT

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CONTENT

Hydraulic Motors Type MA2V

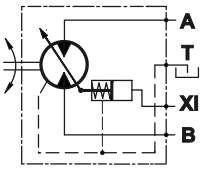
Medium Duty Axial Piston Motors Dual Displacement

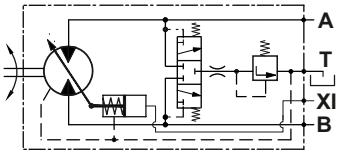
Version history

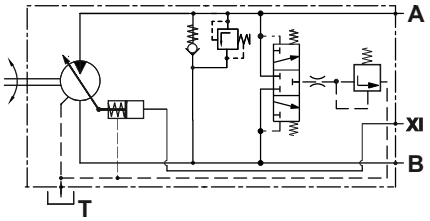
Date	Page	Changed	Ver.
June 2021		Add SAE-B flange	1.4
June 2020		Add manual variable maximal displacement option 50V	1.3a
December 2018		Reduced pressure rating of MA2V50, minor fixes	1.2a
April 2018		Minor fixes	1.2
July 2017		First official edition	1.1

Hydraulic Motors Type MA2V

Medium Duty Axial Piston Motors Dual Displacement







open drain line is always required

APPLICATION

» Agricultural machines
» Road building machines
» Food industry machines
» Swing drives
» Hydraulic transmissions
» Special vehicles

OPTIONS

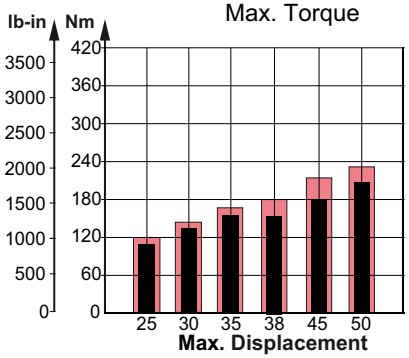
» Port options
» Shaft options
» Integrated valves

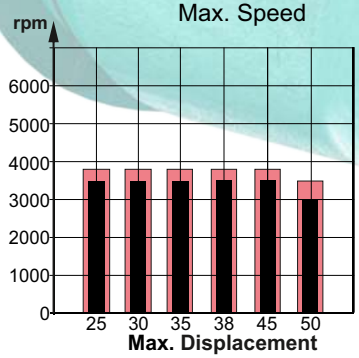
ADVANTAGES

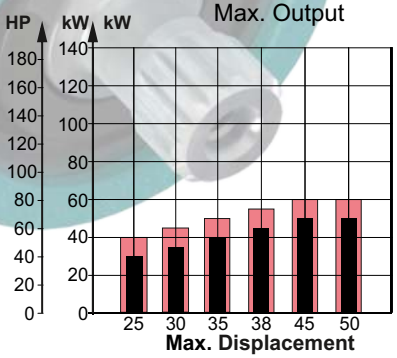
» Smooth operation
» High power density
» Compact size

GENERAL

Displacement,	cm^3/rev [in^3/rev]	**8÷50 [0.48÷3.06]**
Max. Speed,	RPM	**3500**
Max. Torque,	Nm [lb-in]	**200 [1770]**
Max. Output,	kW [HP]	**50 [67]**
Max. Pressure Drop,	bar [PSI]	**280 [4060]**
Max. Oil Flow,	l/min [GPM]	**160 [42]**
Min. Speed,	RPM	**500**
Fluid		**Mineral based- HLP(DIN 51524) or HM(ISO 6743/4)**
Temperature Range,	°C [°F]	**-40÷82 [-40÷180]**
Optimal Viscosity Range,	mm^2/s [SUS]	**12÷68 [66÷311]**
Filtration		**ISO code 18/16/13 (Min. recommended fluid filtration of 10 micron)**

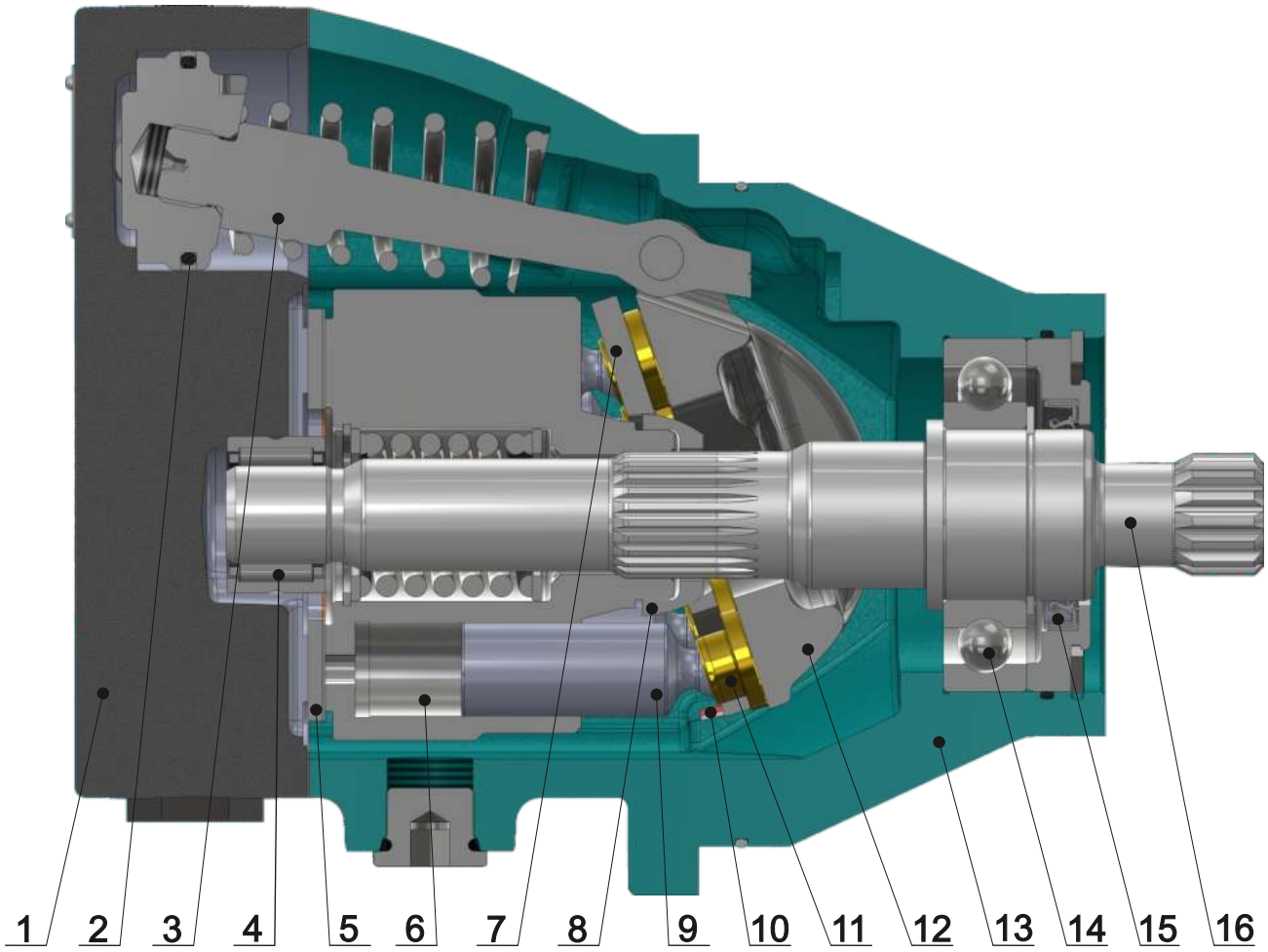






Intermittent values Continuous values

SECTION VIEW



1. Cast iron end cover
2. High pressure displacement control system seal
3. Displacement control system
4. Needle bearing
5. Bimetal distributor
6. Cylinder block
7. Retainer plate
8. Hardened sphere
9. Pistons
10. Cradle plain bearing
11. Piston shoes
12. Hardened cradle
13. Cast iron body
14. Ball bearing
15. Shaft seal
16. Hardened shaft

The medium duty design of the MA2V is dual displacement motor with direct control for open and closed circuits. The motor compact construction is cost effective and have got high power / weight ration.
The design of the motor is maintain friendly. We using swash plate witch insure low level of pulsation and noise level.

SPECIFICATION DATA

Type		MA2V 25	MA2V 30	MA2V 35	MA2V 38	MA2V 45	MA2V 50
Max. Displacement, cm.³ /rev. [in.³/rev.]		25 [1.53]	30 [1.83]	35 [2.14]	38 [2.32]	45 [2.75]	50 [3.06]
Max. Speed at Max. Displ. [RPM]	Cont.	3500	3500	3500	3500	3500	3000
	Int.*	3900	3900	3900	3900	3900	3500
Max. Speed at Min. Displ. [RPM]	Cont.	4000	4000	4000	4000	4000	4000
	Int.*	4500	4500	4500	4500	4500	4500
Max. Torque,*** Nm [lb-in]	Cont.	111 [982]	134 [1186]	156 [1380]	151 [1336]	179 [1584]	200 [1770]
	Int.**	119 [1053]	143 [1265]	167 [1478]	182 [1610]	215 [1903]	230 [2035]
Output, kW [HP]	Cont.	30 [40]	35 [47]	40 [54]	45 [60]	50 [67]	50 [67]
	Int.**	40 [54]	45 [60]	50 [67]	55 [74]	60 [80]	60 [80]
Max. Pressure, bar [PSI]	Cont.	280 [4060]	280 [4060]	280 [4060]	250 [3625]	250 [3625]	250 [3625]
	Int.**	300 [4350]	300 [4350]	300 [4350]	300 [4350]	300 [4350]	290 [4200]
	Peak****	350 [5080]	350 [5080]	350 [5080]	350 [5080]	350 [5080]	320 [4640]
Max. Oil Flow, l/min [GPM]	Cont.	90 [23.8]	105 [27.7]	125 [33]	135 [35.7]	160 [42.3]	150 [39.6]
	Int.*	100 [26.4]	120 [31.7]	140 [37]	150 [39.6]	180 [47.6]	175 [46.2]
Speed Shifting Pressure, Minimum , bar [PSI]		14[200]					
Maximum, bar [PSI]		70[1015]					
Permissible Shaft Load (for standard bearing) Max Axial***** N[lb]		Fa=1000 [225]					
Max Radial***** N[lb]		Fr=350 [80]					
Speed Constant ****** (for max. displacement) RPM/(l/min) [RPM/GPM]		38 [143.8]	31.7 [119.9]	27.1 [102.75]	25 [94.6]	21.1 [79.91]	19 [72]
Torque Constant ****** (for max. displacement) Nm/bar [lb-in/PSI]		0.35 [0.219]	0.43 [0.262]	0.502 [0.306]	0.544 [0.332]	0.645 [0.394]	0.716 [0.437]
Min. Speed, [RPM]		500					
Max. Pressure in Drain Line, bar [PSI]		5 [70] open drain line is always required					
Weight, kg [lb]		15.6 [34.4]					

* Intermittent speed (flow) is for pressure up to 150[2200] bar[PSI].
** Intermittent load: the permissible values may occur for max. 10% of motor lifetime.
*** Theoretical torque
**** Peak load: the permissible values may occur for max. 1% of every minute.
***** The calculated max values are based on the optimal direction of the forces Fr, Fa and optimal position of the shaft.
****** The constant values are used for calculation of torque and speed with motor efficiencies η_{v}=0.95 and η_{mh}=0.9.

1. The recommended output power for continuous operations should not be exceeded.
2. Recommended filtration as per ISO 4406 cleanliness code 18/16/13 or better. This filtration corresponds to SAE AS 4059 8A/7B/7C. Nominal filtration - 10 micron or better.
3. Recommended a premium quality, anti-wear type mineral based hydraulic oil, HLP(DIN51524) or HM(ISO6743/4).
4. Recommended oil viscosity - 12...68 cSt or see page 25.
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.
7. Using low values of the minimal displacement will decrease the starting torque. It is recommendable to run the vehicle starting from maximal displacement.

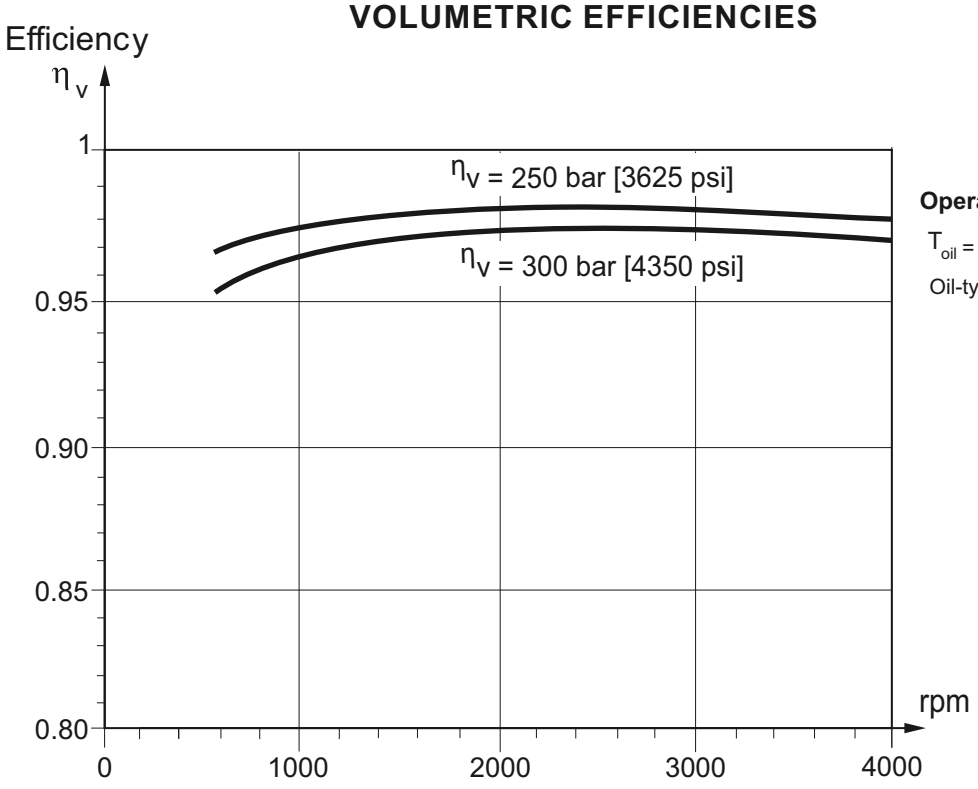
Hint: Motor Torque = Torque Constant * Pressure Drop **Rotation Speed = Speed Constant * Oil Flow**

The constant values are mentioned for rough calculations. Motor torque and rotation speed for a particular project are depending on the real operating conditions. For more detail calculations please see formulas on page 26.

FUNCTION DIAGRAMS

The below efficiencies are applied to all maximum displacements

VOLUMETRIC EFFICIENCIES

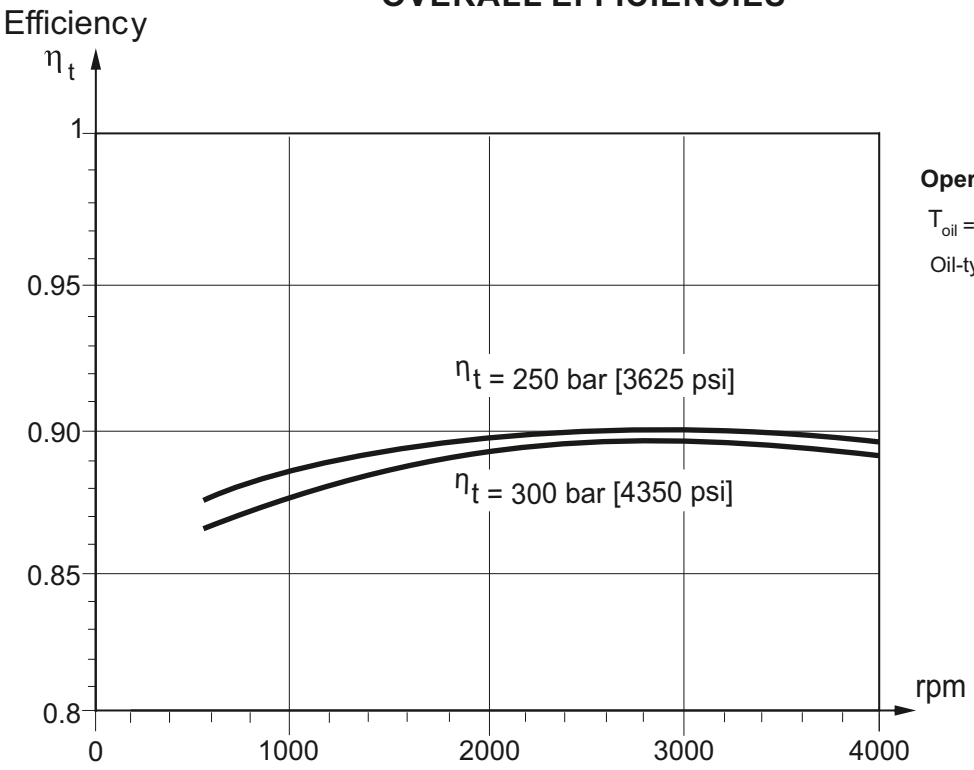


Operation conditions:

T_{oil} = 50°C [122° F]

Oil-type: HPL 46

OVERALL EFFICIENCIES



Operation conditions:

T_{oil} = 50°C [122° F]

Oil-type: HPL 46

The motor size, pressure, torque, speed of rotation and flow rate required for a specific application can be calculated using the formulas on page 26

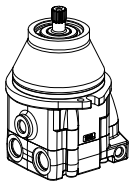
Efficiencies for a particular motor may vary from the shown in the diagram depending on the operating conditions.

OVERALL DIMENSIONS AND PORT

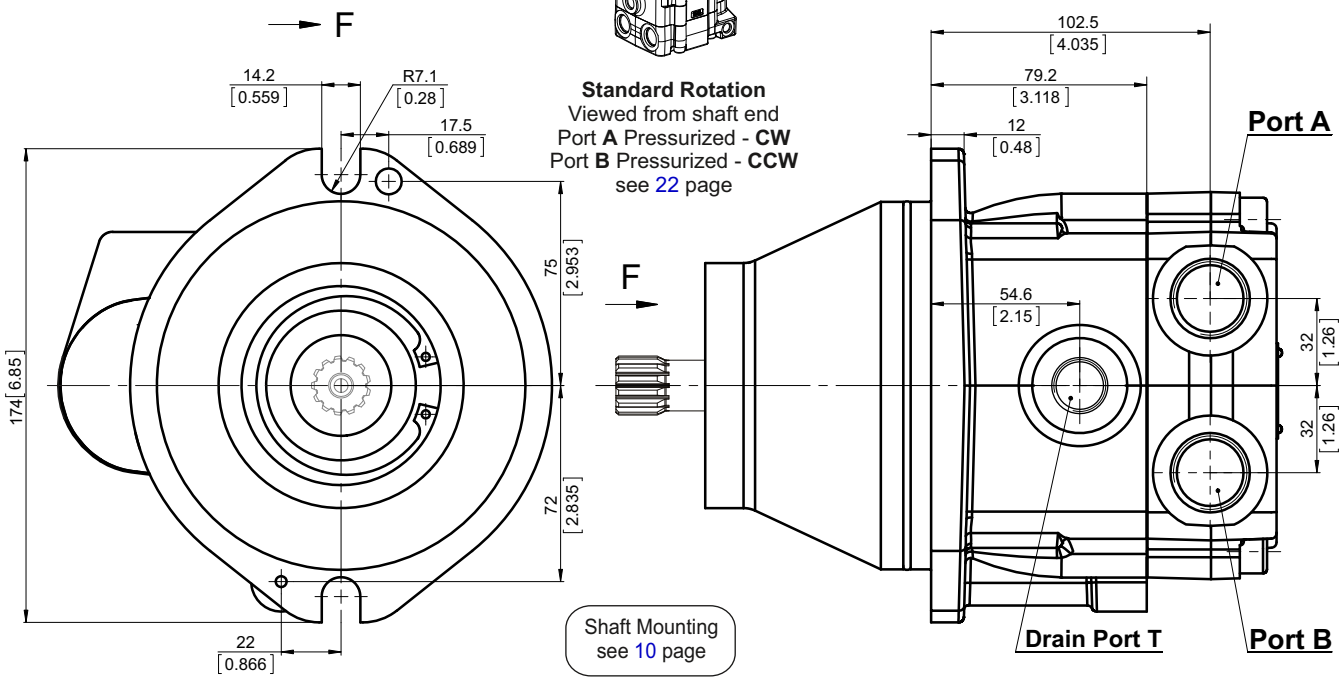
Twin ports with side control port, port size **2**,**3** and **4**

See the port sizes at the bottom of this page

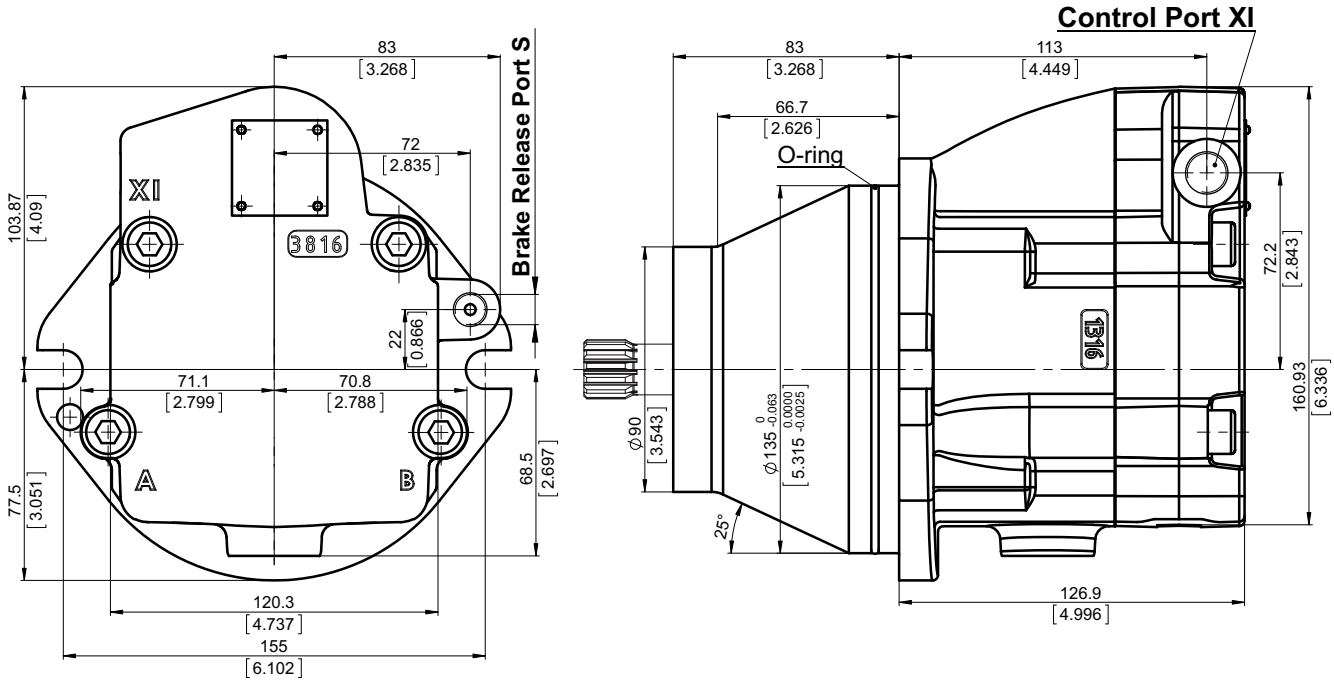
Mounting Flange-Type **Cartage**



Standard Rotation
Viewed from shaft end
Port **A** Pressurized - **CW**
Port **B** Pressurized - **CCW**
see 22 page



Shaft Mounting
see 10 page



	Port Size		
	2	3	4
$P_{(A,B)}$	2xG 3/4	2xM27x2	2x1 1/16-12 UN
T	G 3/4	7/8-14 UNF	3/4-16 UNF
XI	G 1/8	7/16-20 UNF	9/16-18 UNF
S	7/16-20 UNF	7/16-20 UNF	7/16-20 UNF

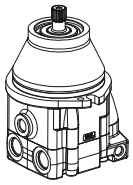
mm [in]

OVERALL DIMENSIONS AND PORT

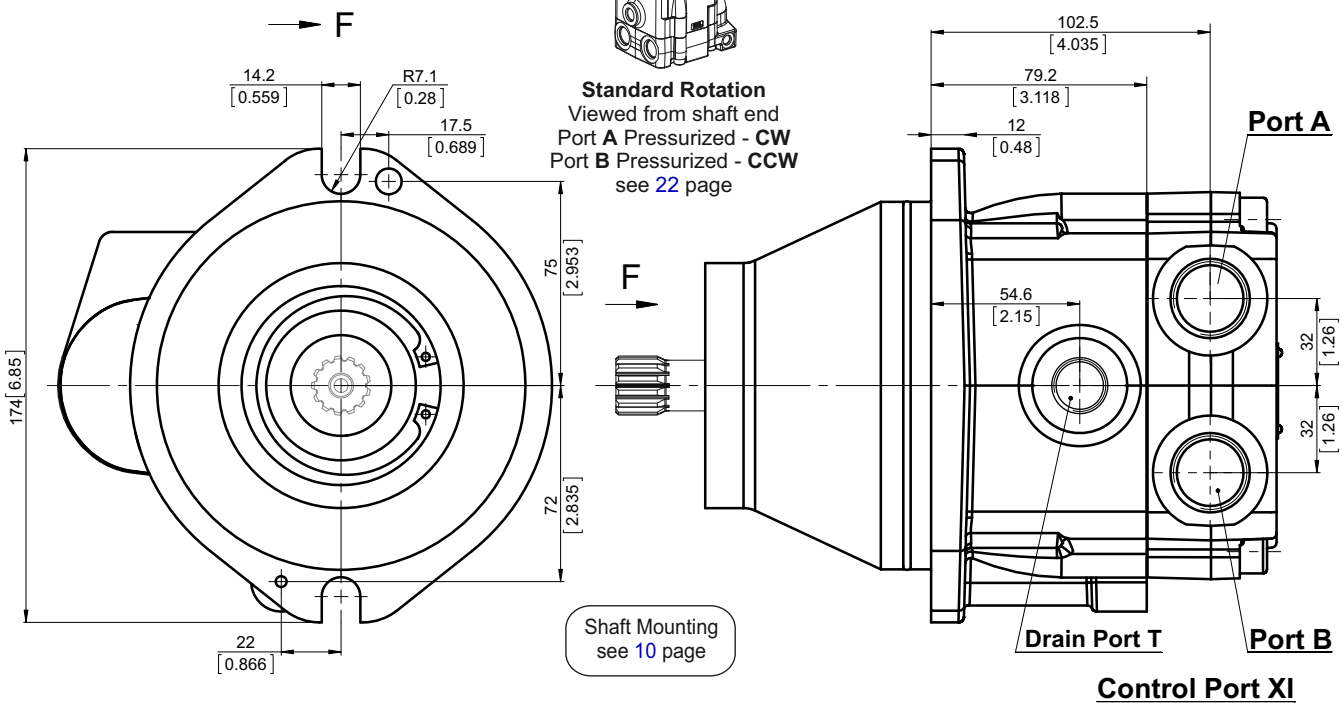
Twin ports with rear control port, port size **2**,**3** and **4**

See the port sizes at the bottom of this page

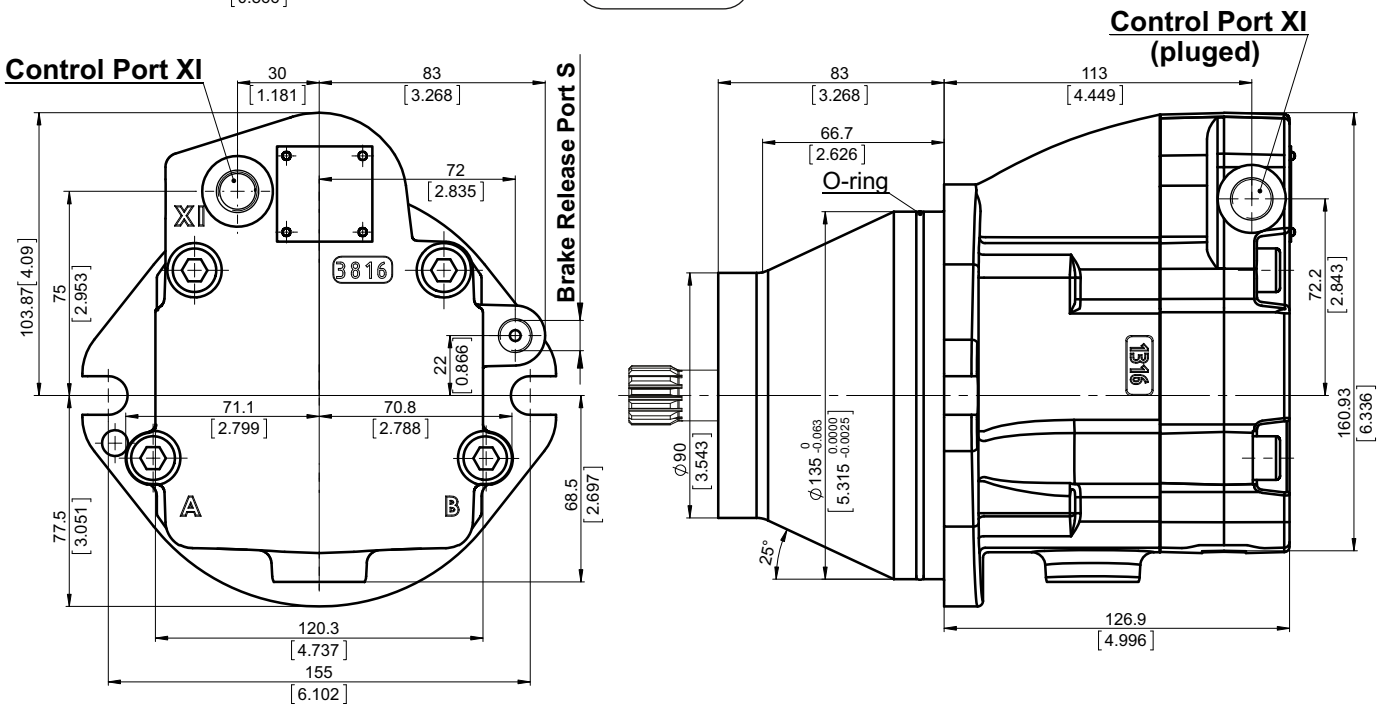
Mounting Flange-Type **Cartage**



Standard Rotation
Viewed from shaft end
Port **A** Pressurized - **CW**
Port **B** Pressurized - **CCW**
see 22 page



Shaft Mounting
see 10 page



	Port Size		
	2	3	4
$P_{(A,B)}$	2xG 3/4	2xM27x2	2x1 1/16-12 UN
T	G 3/4	7/8-14 UNF	3/4-16 UNF
XI	G 1/8	7/16-20 UNF	9/16-18 UNF
S	7/16-20 UNF	7/16-20 UNF	7/16-20 UNF

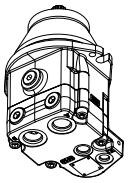
mm [in]

OVERALL DIMENSIONS AND PORT

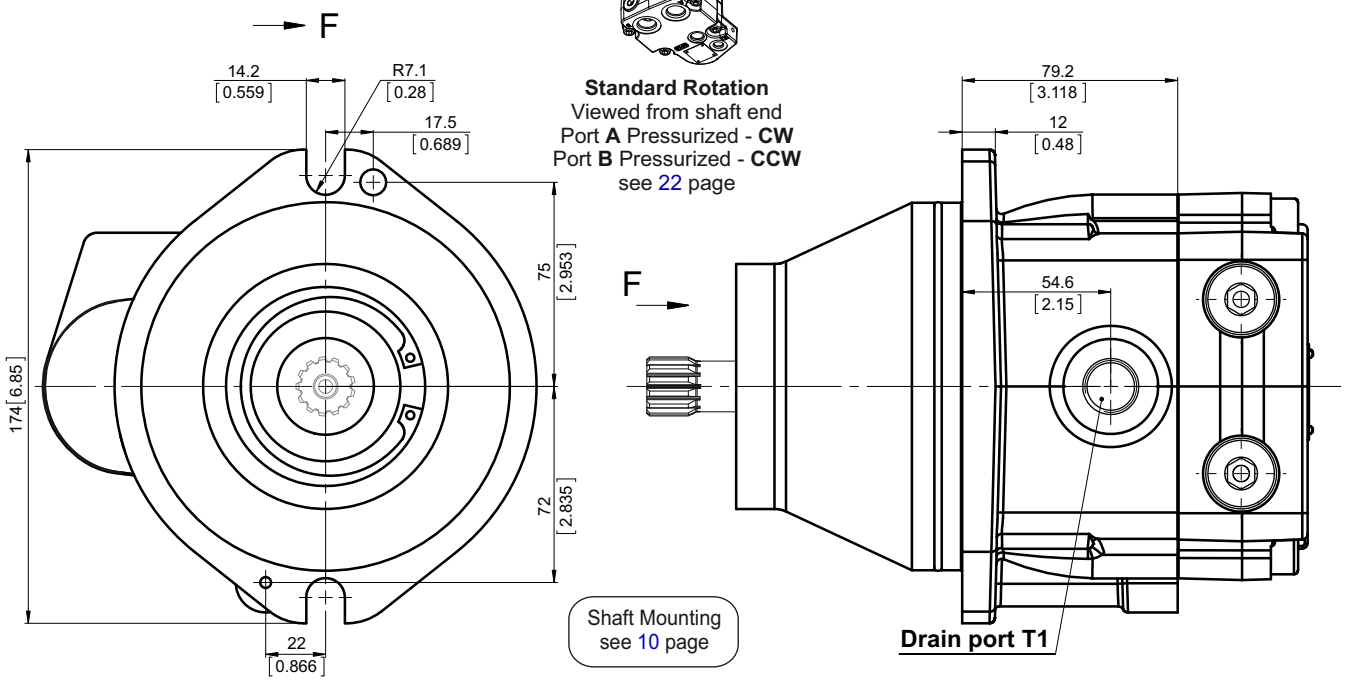
Rear ports with rear control port, port size **2**,**3** and **4**

See the port sizes at the bottom of this page

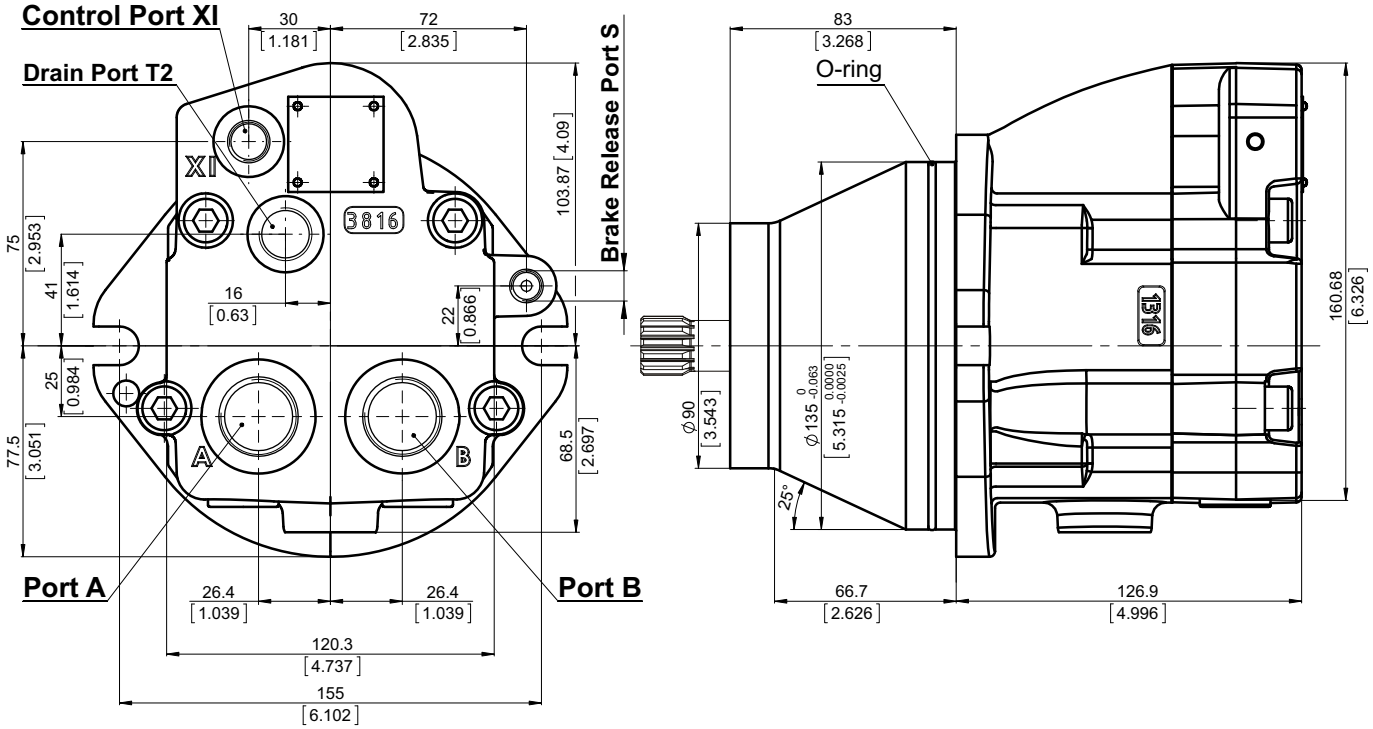
Mounting Flange-Type **Cartage**



Standard Rotation
Viewed from shaft end
Port **A** Pressurized - **CW**
Port **B** Pressurized - **CCW**
see 22 page



Shaft Mounting
see 10 page

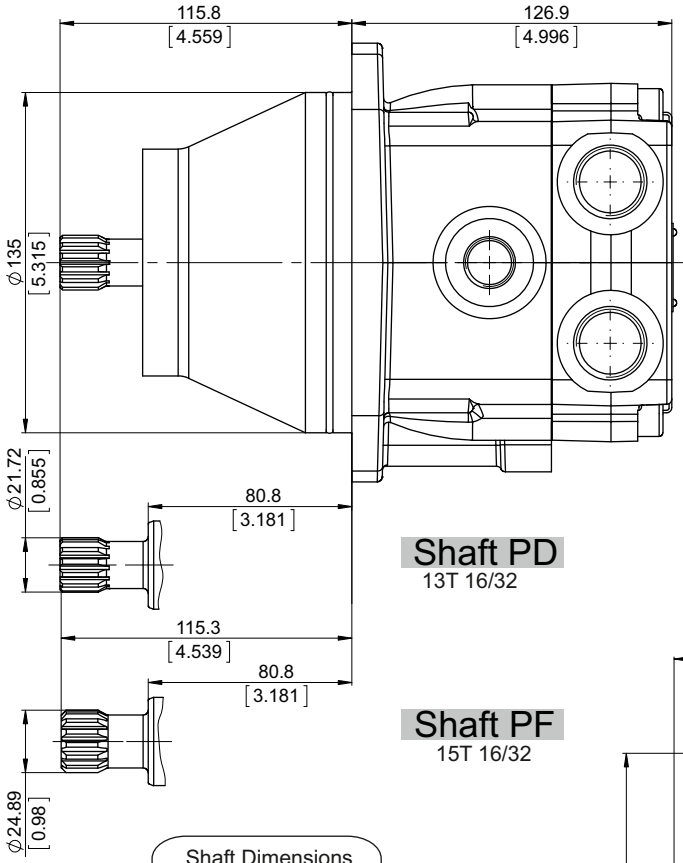


	Port Size		
	2	3	4
$P_{(A,B)}$	2xG 3/4	2xM27x2	2x1 1/16-12 UN
T1	G 3/4	7/8-14 UNF	3/4-16 UNF
T2	G 1/4	7/8-14 UNF	3/4-16 UNF
XI	G 1/8	7/16-20 UNF	9/16-18 UNF
S	7/16-20 UNF	7/16-20 UNF	7/16-20 UNF

mm [in]

SHAFTS MOUNTING

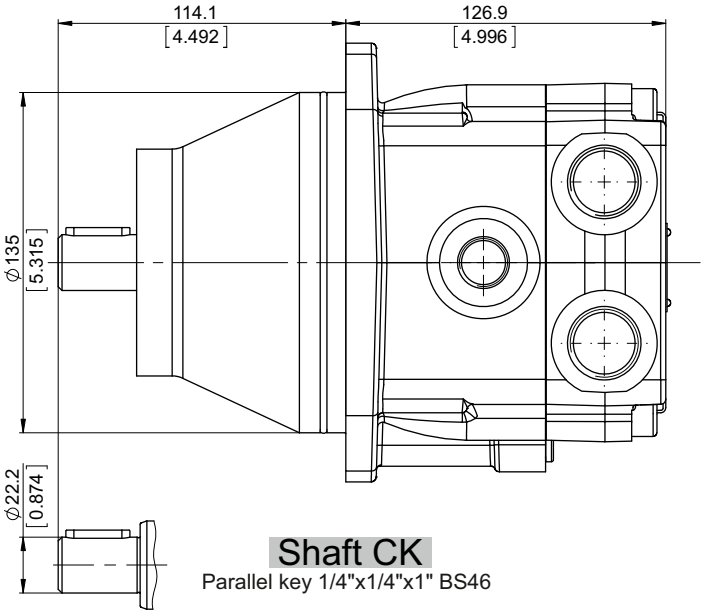
Flange-Type **Cartage**



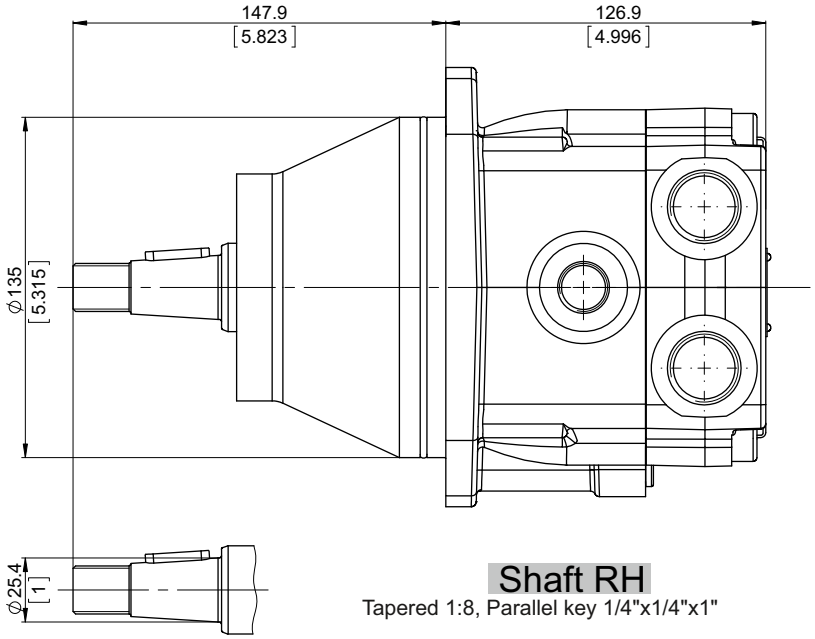
Shaft PD
13T 16/32

Shaft PF
15T 16/32

Shaft Dimensions
See Page 18,19



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



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

PERMISSIBLE SHAFT LOAD

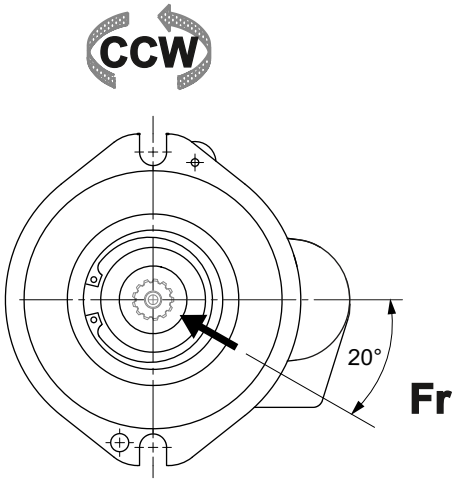
Permissible shaft load		Standrard bearing	Improved bearing
max Axial	N[lb]	Fa=1000 [225]	Fa=2000 [450]
max Radial	N[lb]	Fr=350 [80]	Fr=3000 [495]

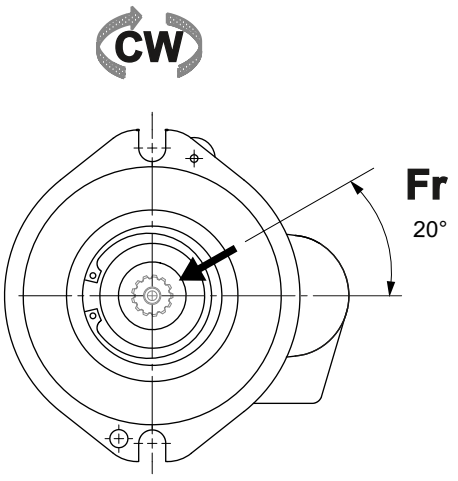
The calculated max values are based on the optimal direction of the forces Fr, Fa and optimal position of the shaft (see scheme bellow).

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

BEST POSITION FOR APPLYING RADIAL LOAD

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





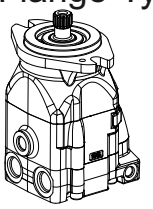
mm [in]

OVERALL DIMENSIONS AND PORT

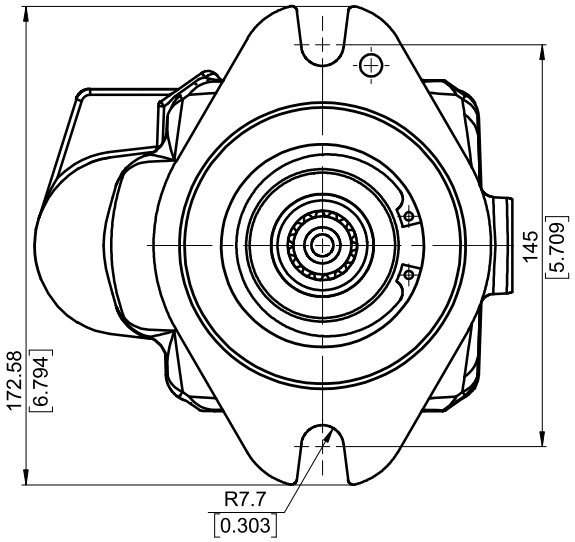
Twin ports with side control port, port size **2**,**3** and **4**

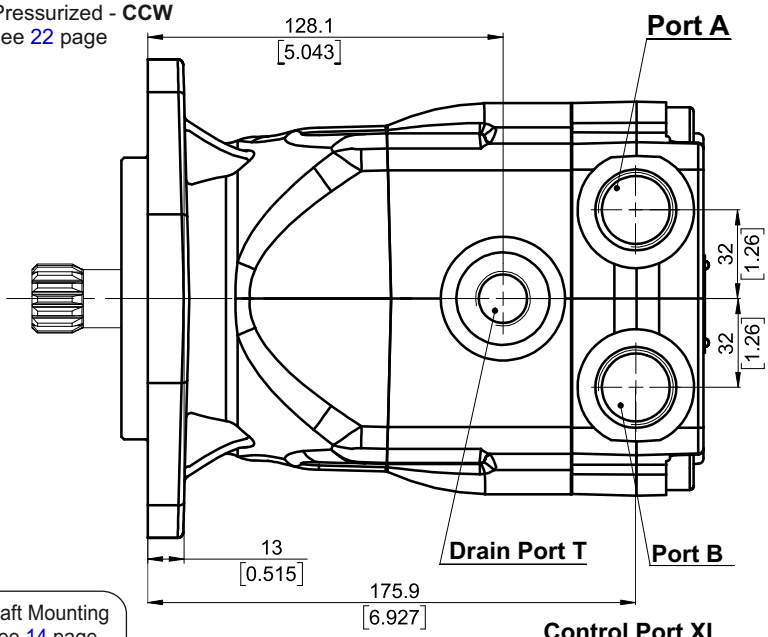
See the port sizes at the bottom of this page

Mounting Flange-Type **SAE-B**

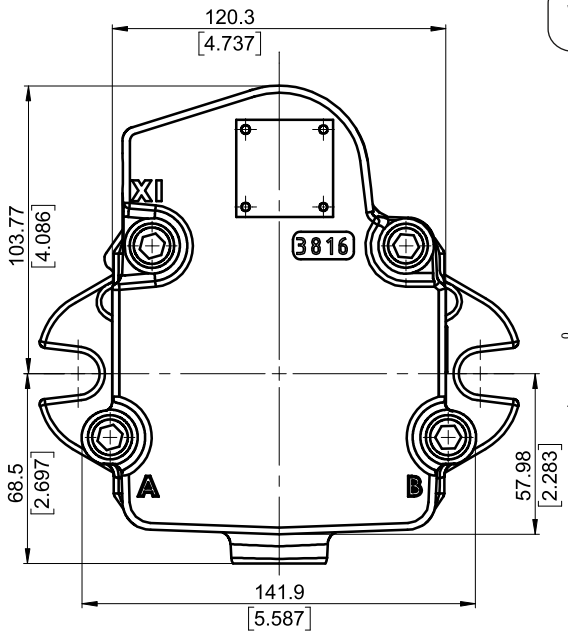


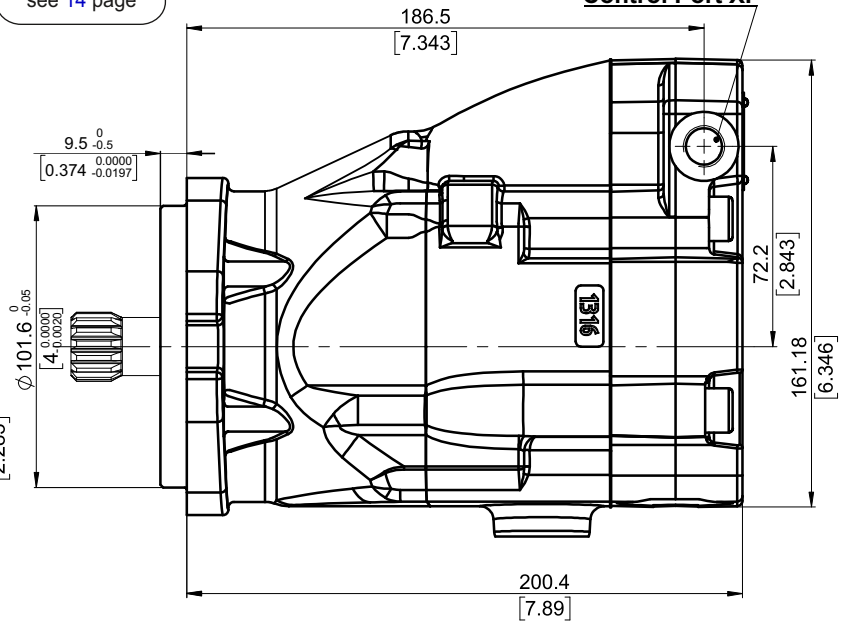
Standard Rotation
Viewed from shaft end
Port **A** Pressurized - **CW**
Port **B** Pressurized - **CCW**
see 22 page





Shaft Mounting
see 14 page





	Port Size		
	2	3	4
$P_{(A,B)}$	2xG 3/4	2xM27x2	2x1 1/16-12 UN
T	G 3/4	7/8-14 UNF	3/4-16 UNF
XI	G 1/8	7/16-20 UNF	9/16-18 UNF

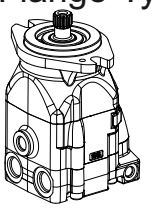
mm [in]

OVERALL DIMENSIONS AND PORT

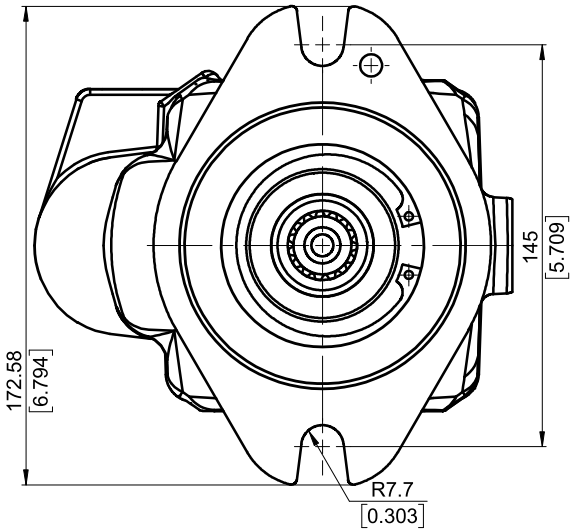
Twin ports with rear control port, port size **2**,**3** and **4**

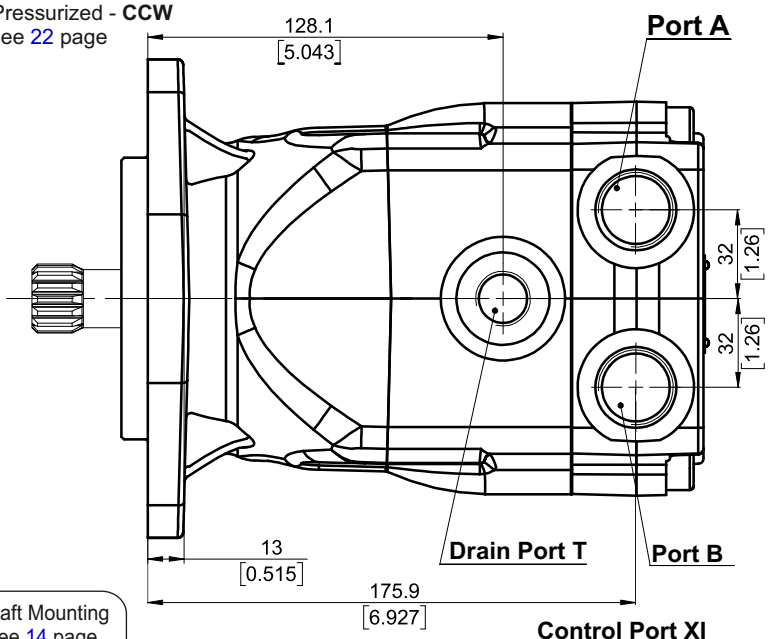
See the port sizes at the bottom of this page

Mounting Flange-Type **SAE-B**

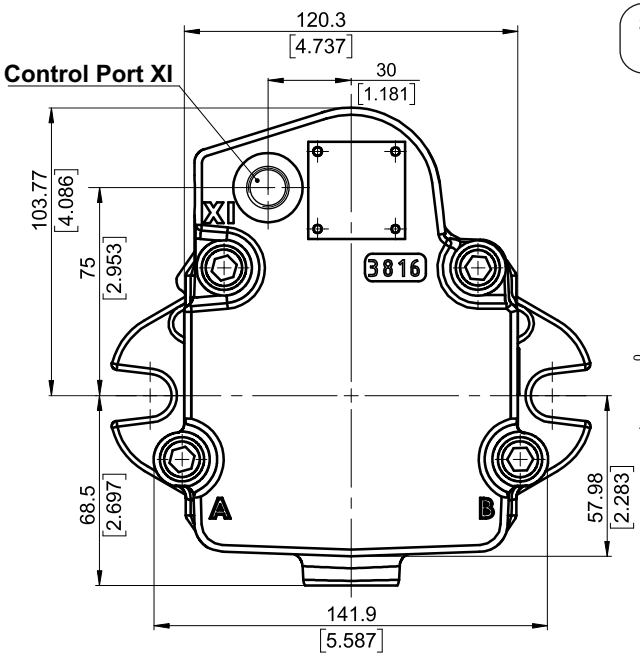


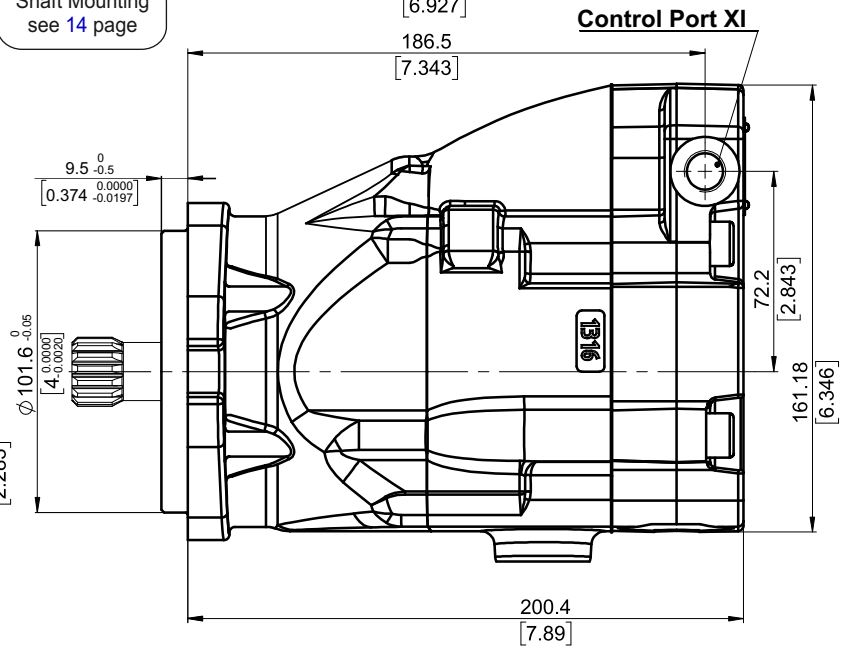
Standard Rotation
Viewed from shaft end
Port **A** Pressurized - **CW**
Port **B** Pressurized - **CCW**
see 22 page





Shaft Mounting
see 14 page





	Port Size		
	2	3	4
$P_{(A,B)}$	2xG 3/4	2xM27x2	2x1 1/16-12 UN
T	G 3/4	7/8-14 UNF	3/4-16 UNF
XI	G 1/8	7/16-20 UNF	9/16-18 UNF

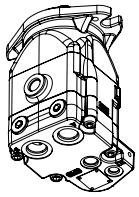
mm [in]

OVERALL DIMENSIONS AND PORT

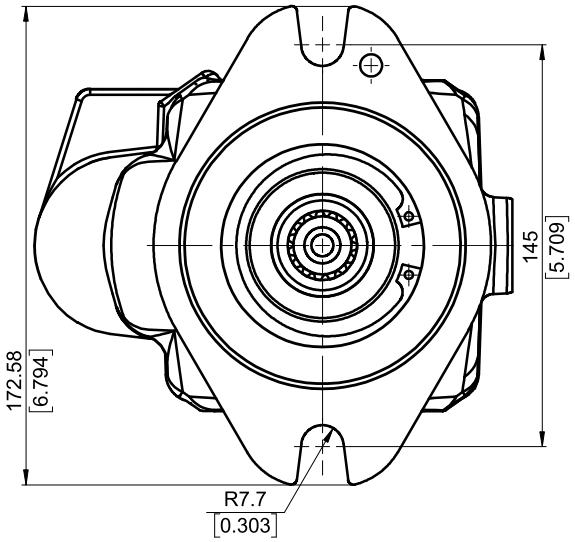
Rear ports with rear control port, port size **2**,**3** and **4**

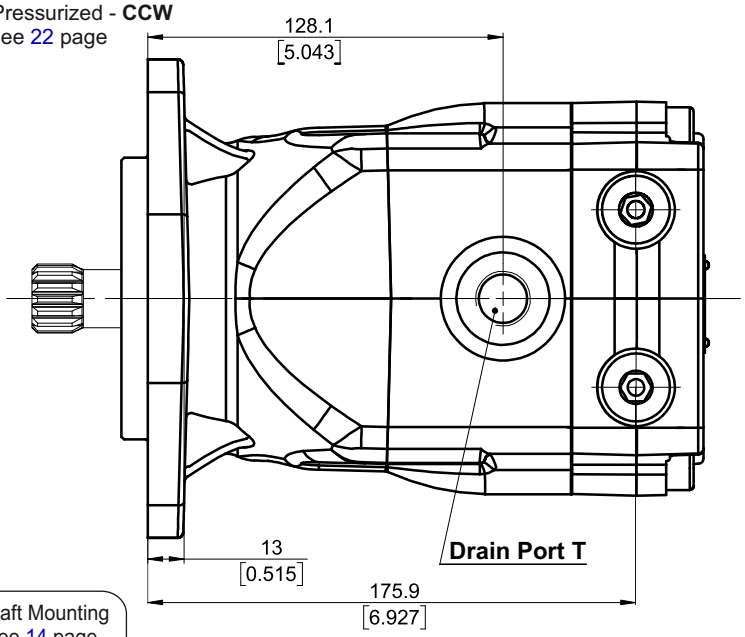
See the port sizes at the bottom of this page

Mounting Flange-Type **SAE-B**

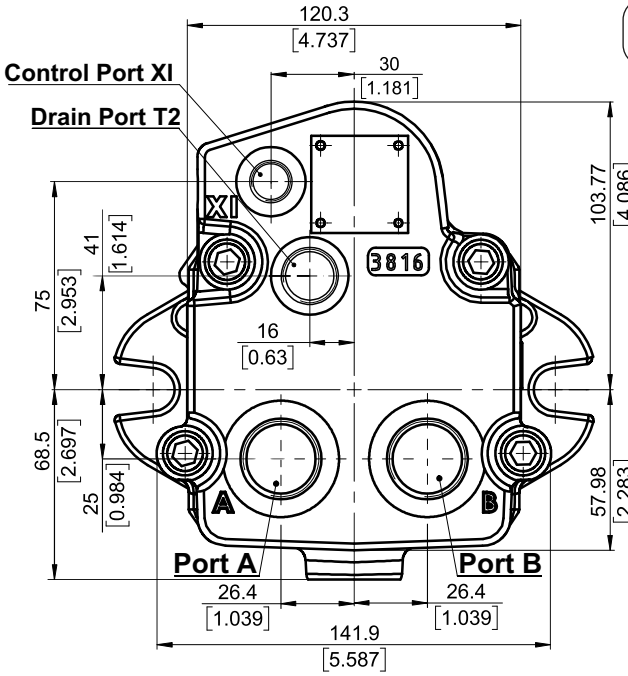


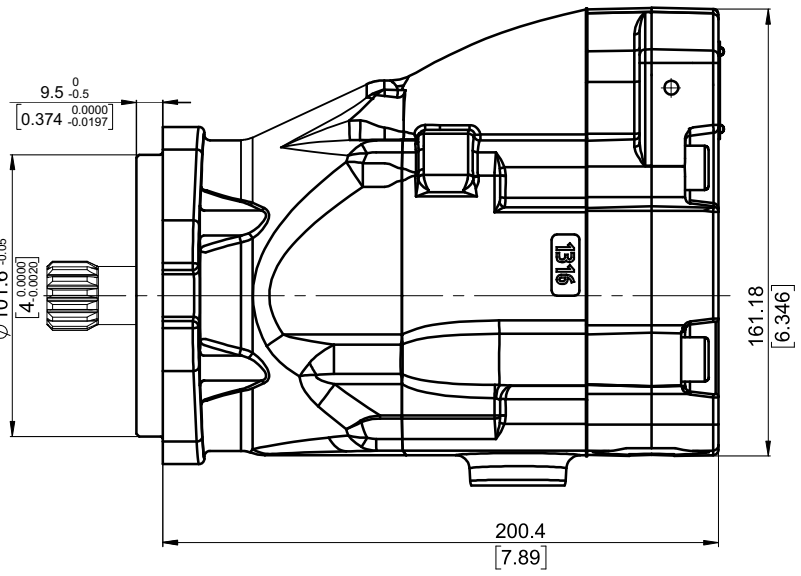
Standard Rotation
Viewed from shaft end
Port **A** Pressurized - **CW**
Port **B** Pressurized - **CCW**
see 22 page





Shaft Mounting
see 14 page



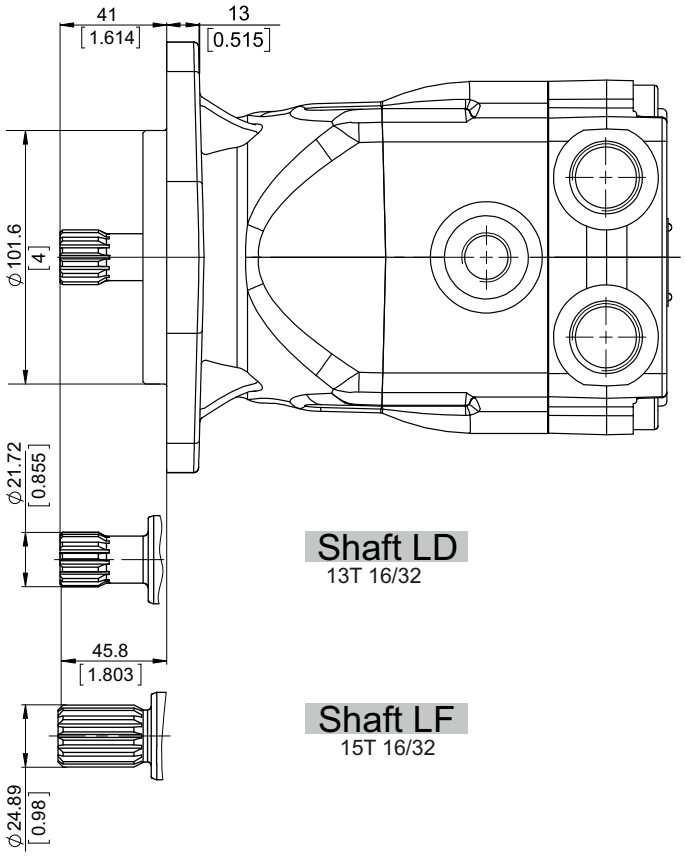


	Port Size		
	2	3	4
$P_{(A,B)}$	2xG 3/4	2xM27x2	2x1 1/16-12 UN
T1	G 3/4	7/8-14 UNF	3/4-16 UNF
T2	G 1/4	7/8-14 UNF	3/4-16 UNF
XI	G 1/8	7/16-20 UNF	9/16-18 UNF

mm [in]

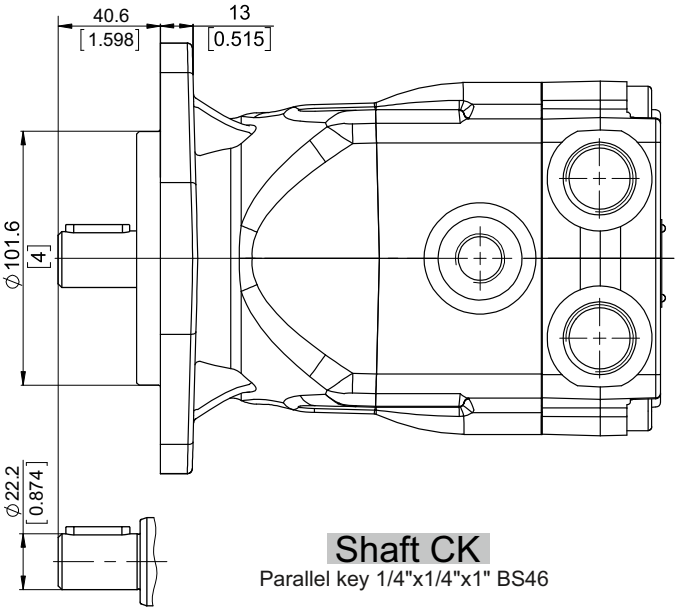
SHAFTS MOUNTING

Flange-Type **B**



Shaft LD
13T 16/32

Shaft LF
15T 16/32



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

Shaft Dimensions
See Page 18,19

PERMISSIBLE SHAFT LOAD

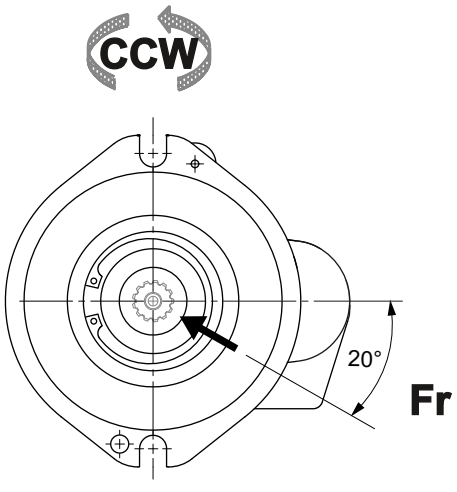
Permissible shaft load		Standrard bearing	Improved bearing
max Axial	N[lb]	Fa=1000 [225]	Fa=2000 [450]
max Radial	N[lb]	Fr=350 [80]	Fr=3000 [495]

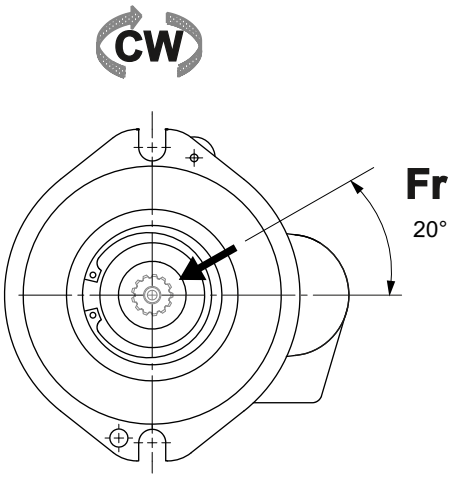
The calculated max values are based on the optimal direction of the forces Fr, Fa and optimal position of the shaft (see scheme bellow).

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

BEST POSITION FOR APPLYING RADIAL LOAD

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





mm [in]

ORDERING CODE

	1	2	3		4	5	6	7	8	9	10	11	12	13	14	15	15	15
M A 2 V				**—**												**[**		**]**

Pos.1 - Mounting Flange

omit - Wheel flange, cartage - 2-Bolt flange spigot diam. 135 mm [5.315"] - BC 155 mm [6.102"]

B - SAE B, 2-Bolt flange, spigot dia.101.6 mm [4"] Bolt circle 146 mm [5.75"]

Pos.2 - Port Type

T - Twin side ports on one side, side control port

H - Twin side ports on one side, rear control port

E - Rear ports, rear control port

Pos.3 - Max Displacement Code* (see table bellow)

Cross Reference Displacement Table

Pos.4 Min. Displacement cm³/rev \ Pos.3 Max. Displacement cm³/rev	25	30	35	38	45	50	50V*
8	x	x	x	x	x	x	x
9	x	x	x	x	x	x	x
10	x	x	x	x	x	x	x
11	x	x	x	x	x	x	x
12	x	x	x	x	x	x	x
13	x	x	x	x	x	x	x
14	x	x	x	x	x	x	x
15	x	x	x	x	x	x	x
16	x	x	x	x	x	x	x
17	x	x	x	x	x	x	x
18	x	x	x	x	x	x	x
19	x	x	x	x	x	x	x
20	x	x	x	x	x	x	x
22		x	x	x	x	x	x
23		x	x	x	x	x	x
25		x	x	x	x	x	x
27			x	x	x	x	x
29			x	x	x	x	x
32				x	x	x	x

On Table are Shown:
- Min./Max. Displacement Combinations

***Option 50V is manual variable displacement, see page 16**

Pos.4 - Min. Displacement Code* (see table above)

Using low values of the minimal displacement will decrease the starting torque. It is recommendable to run the vehicle starting from maximal displacement.

Pos.5 - Shaft Extensions**

PD - ø21.72 [0.855"] Spline SAE 13T 16/32 DP, 1/4-20 UNC thread

LD - ø21.72 [0.855"] Spline SAE 13T 16/32 DP, 5/16-18 UNC thread

PF - ø24.9 [0.98"] Spline SAE 15T 16/32 DP, 1/4-20UNC thread

LF - ø24.9 [0.98"] Spline SAE 15T 16/32, 3/8-16UNC

CK - ø22.2 [ø7/8"] Straight, M8 thread Parallel key 1/4"x1/4"x1" BS46

RH - ø25.4 [1"] Tapered 1:8 [125:1000], Parallel key 1/4"x1/4"x1", 3/4-16 UNF

Shaft type LD and LF is available only for Pos.1 option SAE B
Shaft type PD;PF and RH is available only for Pos.1 option wheel flange, cartage

Pos.6 - Improved radial load

omit - standard bearing

N - Improved bearing

Pos.7 - Port Size

2 - 2xG3/4

3 - 2xM27x2

4 - 2x1 1/16 -12 UN

Pos.8 - Seal, Corrosion Resistant Seal Surface

omit - NBR seal type material

V - FKM seal type material

Pos.9 - Integrated Valves

See next page for information about valves

omit - None

PU - Purge valve

FLU - Flush valve

SAR - Single anti-cavitation and relief valve

SARF - Single anti-cavitation, relief and flush valve

Pos.10 - Valve's Port for Single Valves

omit - None

A - Port A

B - Port B

Pos.11 - Pressure Setting of Integrated Valves

omit - None

x - For value - see next page

Pos.12 - Flow Setting of Integrated Valves

omit - None

Lx - For value - see next page

Pos.13 - Special Features**

omit - None

R2S - Speed Sensor Two Directional

Pos.14 - Paint and Coating*

omit - No paint or coating

P - Painted

PC - Corrosion protected paint

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

Pos.15 - Design Series

omit - Factory specified

* For more information about variable option **50V** please ask
**The permissible output torque for shafts must not be exceeded!
***Non painted feeding surface
****Available on enquiry

EXAMPLE

M A 2 V T 4 5 - 1 7 P F 4 P

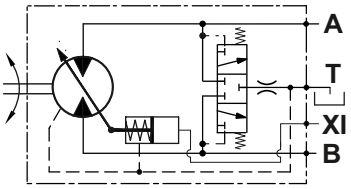
MA2V	T	45	—	17	PF	4	P	[	]
	Twin Port	Max. Disp.	Min. Disp.	Shaft PF	Standard Bearing	Port type 4	Painted		

VALVE OPTIONS

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

Option **PU**

PURGE VALVE



- Mainly used in open loop circuit;
- Used for cooling purpose or oil cleanliness requirements;
- Flow rate by **default (omit) - 3.5 ÷ 4.9 l/min**
- For other options, please see Pos.12 of ordering code, considering the following possible values:

Pos.12	omit	L2	L6	L7.5	⇨ flow rate

EXAMPLE

M A 2 V T 4 5 - 1 7 P F 4 **P U**
purge valve flow rate 4.2±0.7 l/min

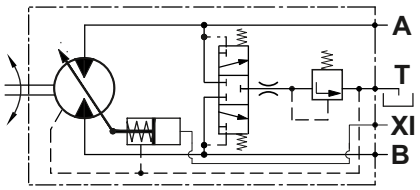
M A 2 V T 4 5 - 1 7 P F 4 **P U L 2**
purge valve flow rate 2÷2.5 l/min

M A 2 V T 4 5 - 1 7 P F 4 **P U L 7 . 5**
purge valve flow rate 7.5±1 l/min

M A 2 V T 4 5 - 1 7 P F 4 **P U L 6**
purge valve flow rate 6±0.8 l/min

Option **FLU**

FLUSH VALVE



- Mainly used in close loop circuit;
- The valve is a combination between a purge valve and check valve;
- Flow rate by **default (omit) - 3.5 ÷ 4.9 l/min and cracking (opening) pressure 10.3 bar** with 15 bar feed pressure for close loop circuit.
- For other options, please see Pos.11 and Pos. 12 of ordering code, considering the following possible values:

Pos.11	omit	7	⇨ pressure
Pos.12	omit	L2	L6	L7.5	⇨ flow rate

EXAMPLE

M A 2 V T 4 5 - 1 7 P F 4 **F L U**	flow rate 4.2±0.7 l/min, crack pressure 10.3 bar
M A 2 V T 4 5 - 1 7 P F 4 **F L U 7 L 7 . 5**	flow rate 7.5±1 l/min, crack pressure 7 bar
M A 2 V T 4 5 - 1 7 P F 4 **F L U L 2**	flow rate 2÷2.5 l/min, crack pressure 10.3 bar

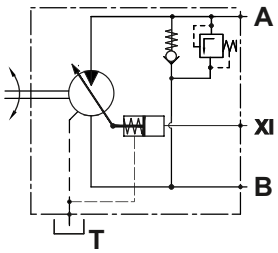
Option **SARA, SARB**

Combined Anti-Cavitation and Reliev Valve

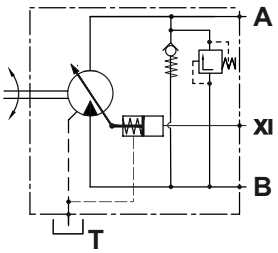
- Anti-cavitation check valve is used for applications such as Fan drive control;

- Pressure relief valves prevent excessive pressures in the high pressure loop.

SARA



SARB



Please, consider the following possible values:

Pos.11	280	300	345	⇨ pressure

EXAMPLE

M A 2 V T 4 5 - 1 7 P F 4 **S A R A 2 8 0**
Single Anti-Cavitation and Relief Valve, relief valve setting 280 bar
The valve is placed on port A

M A 2 V T 4 5 - 1 7 P F 4 **S A R B 3 0 0**
Single Anti-Cavitation and Relief Valve, relief valve setting 300 bar
The valve is placed on port B

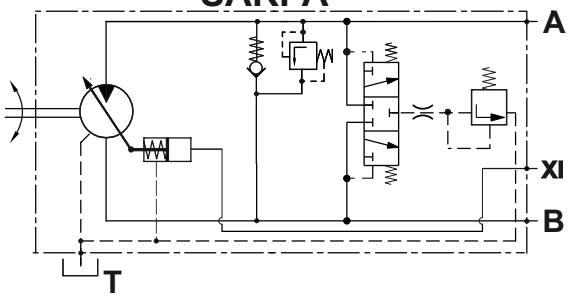
VALVE OPTIONS

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

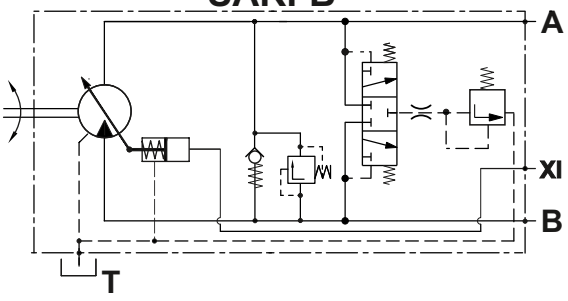
Option **SARFA, SARFB**

Single Anti-Cavitation, Relief and Flush Valve

SARFA



SARFB



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

Pos.11 | **280** | **300** | **345** ⇨ pressure

- Flow rate of flush valve by **default (omit) - 3.5 ÷ 4.9 l/min and cracking pressure 10.3 bar** with 15 bar feed pressure for close loop circuit. The possible values are as follow:

Pos.12 | **omit** | **L2** | **L6** | **L7.5** ⇨ flow rate

- Other values for **cracking** pressure are possible. Please see Pos.11.

Example: For cracking pressure 7 bar the options are as follow:

Pos.11 | 280-**7** | 300-**7** | 345-**7**

Relief valve opening pressure

Flush valve cracking pressure (charge pressure)

EXAMPLE

M A 2 V T 4 5 - 1 7 P F 4 **S A R F A 3 4 5**

Single Anti-Cavitation, Relief and Flush Valve, relief valve setting 345 bar
flush valve cracking pressure 10.3 bar, flush valve flow rate 4.2±0.7 l/min
The valve is placed on port A

M A 2 V T 4 5 - 1 7 P F 4 **S A R F B 3 4 5 - 7**

Single Anti-Cavitation, Relief and Flush Valve, relief valve setting 345 bar
flush valve cracking pressure 7 bar, flush valve flow rate is 4.2±0.7 l/min
The valve is placed on port B

M A 2 V T 4 5 - 1 7 P F 4 **S A R F A 2 8 0 L 2**

Single Anti-Cavitation, Relief and Flush Valve, relief valve setting 280 bar
flush valve cracking pressure 10.3 bar, flush valve flow rate is 2÷2.5 l/min
The valve is placed on port A

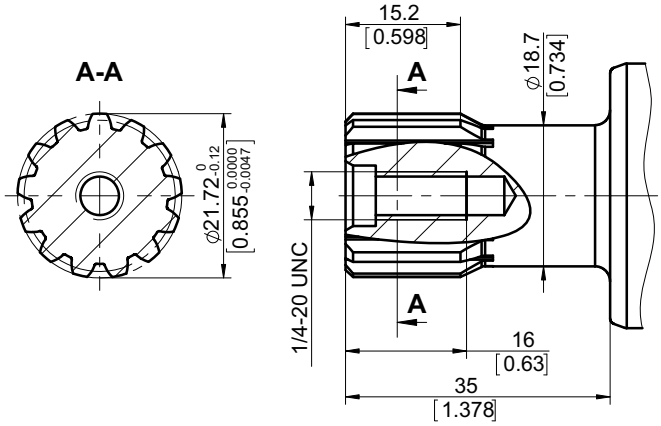
M A 2 V T 4 5 - 1 7 P F 4 **S A R F B 3 0 0 - 7 L 7 . 5**

Single Anti-Cavitation, Relief and Flush Valve, relief valve setting 300 bar
flush valve cracking pressure 7 bar, flush valve flow rate 7.5±1 l/min
The valve is placed on port B

SHAFT TYPES AND DIMENSIONS

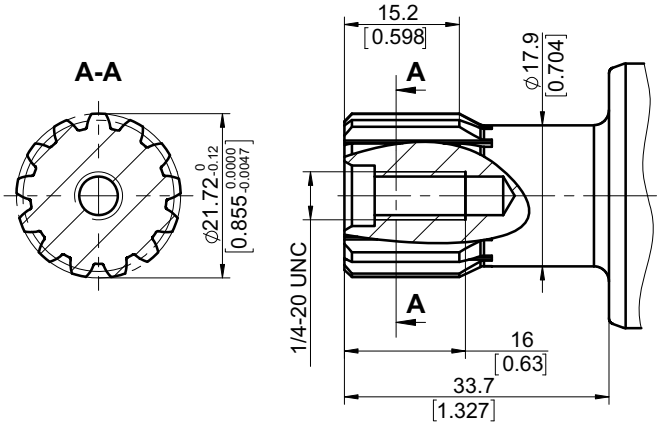
PD

ø21.72 [0.855] , 1/4-20 UNC thread
13T 16/32 DP splined ANSI B92.1-1996
Max. torque 200 Nm [1770 lb-in]



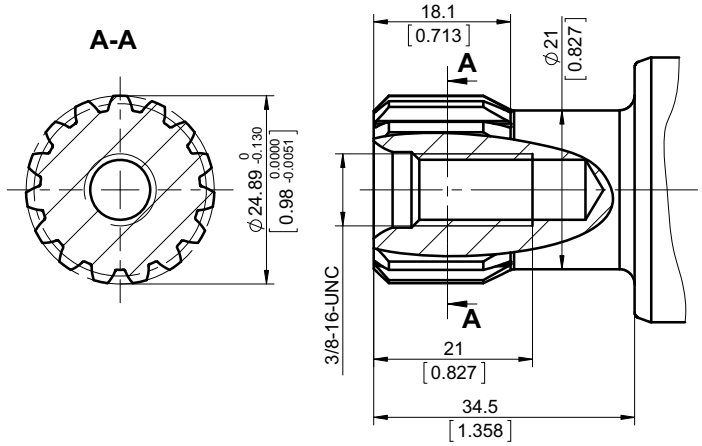
LD

ø21.72 [0.855] , 1/4-20 UNC thread
13T 16/32 DP splined ANSI B92.1-1996
Max. torque 200 Nm [1770 lb-in]



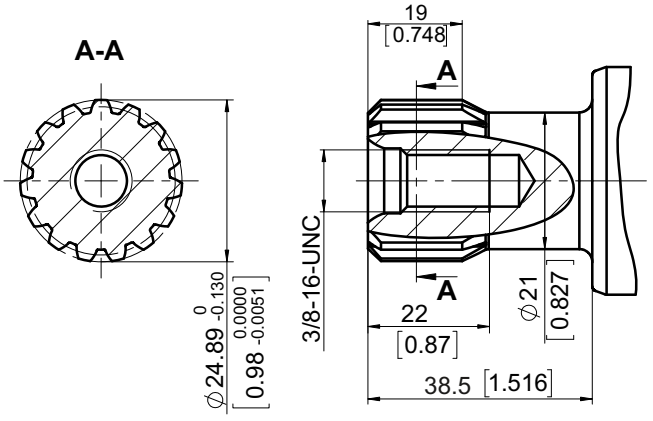
PF

ø24.89 [0.98] , 3/8-16 UNC thread
15T 16/32 DP splined ANSI B92.1-1970
Max. torque 330 Nm [2920 lb-in]

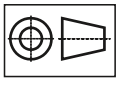


LF

ø24.89 [0.98], 3/8-16 UNC thread
15T 16/32 DP splined ANSI B92.1-1970
Max. torque 330 Nm [2920 lb-in]



The required max. torque must not be exceeded

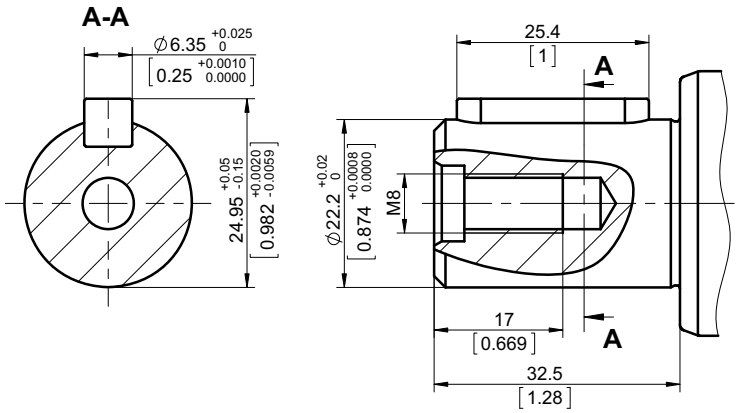


mm [in]

SHAFT TYPES AND DIMENSIONS

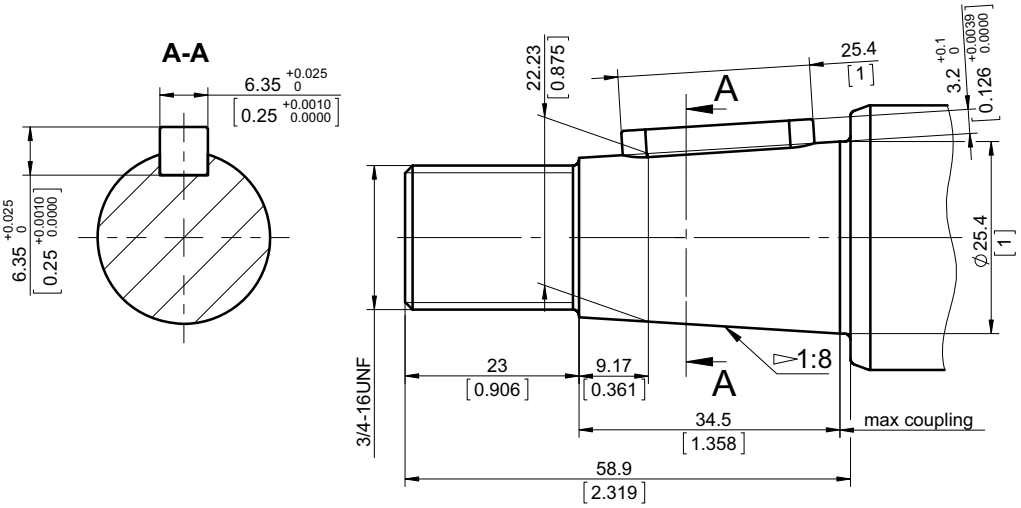
CK

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

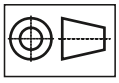


RH

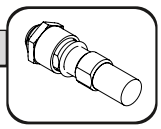
ø25.4 [1] Tapered **1:8 [123:1000]**,
Parallel key **1/4"x1/4"x1"**, 3/4-16 UNF
Max. torque 300 Nm [2650 lb-in]



The required max. torque must not be exceeded

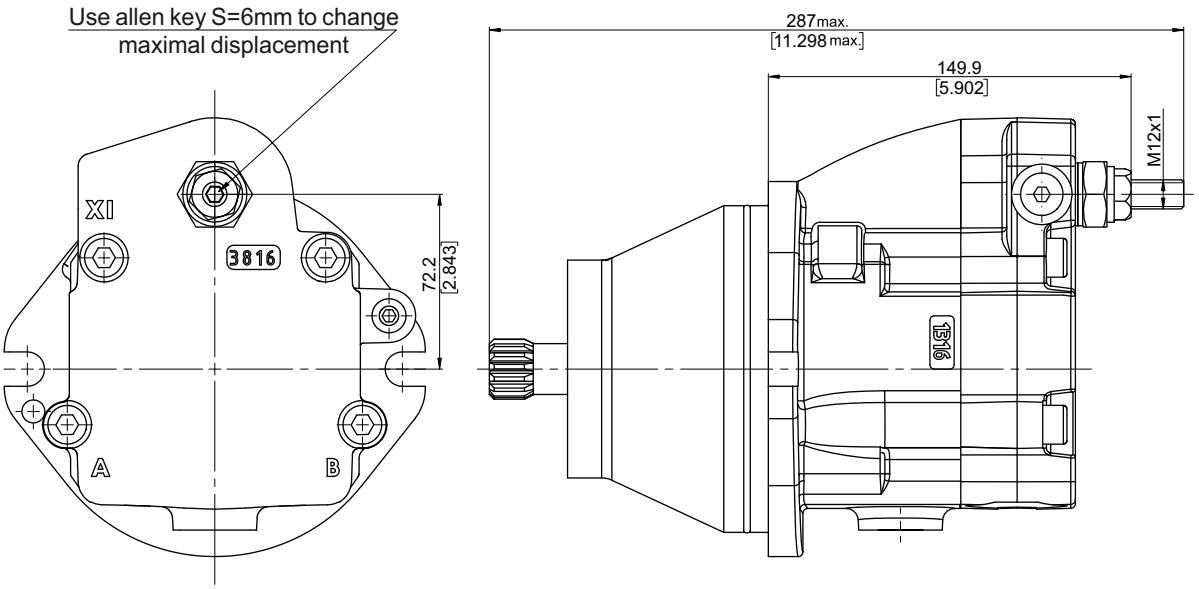


mm [in]



OPTION 50V

Manual Variable Displacement

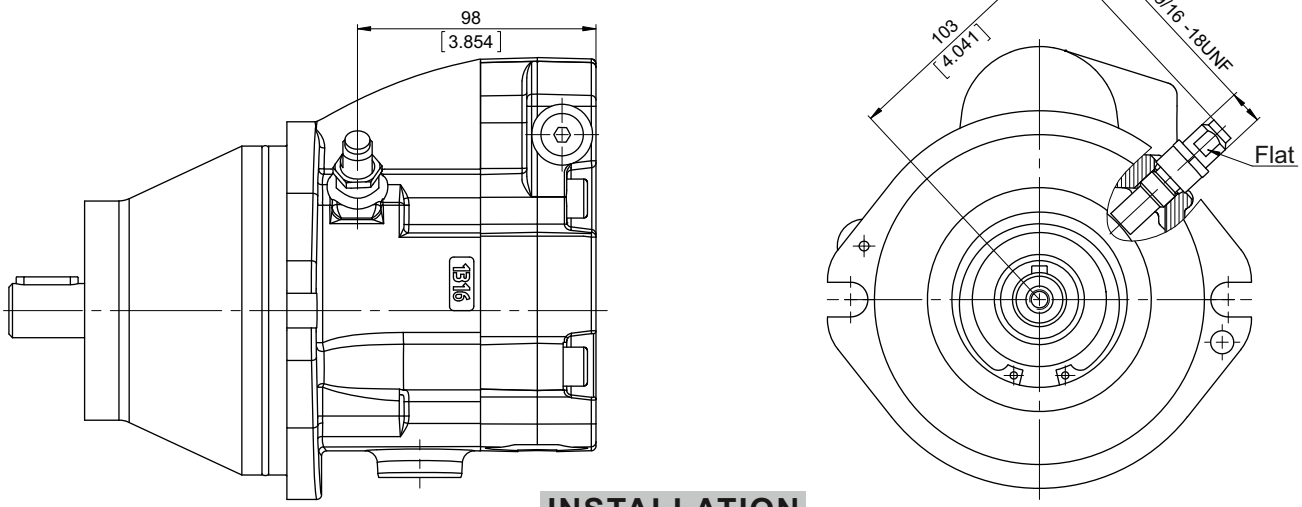


SPEED SENSORS

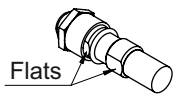
MOUNTING DIMENSIONS AND INSTALLATION

MA2V with R2S - Dual Channel Hall Sensor

Output Pulses per revolution	45

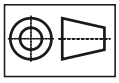


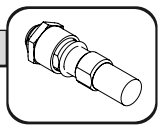
INSTALLATION



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 unscrew 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" wrench to hold the sensor, tighten the lock nut to 10^{+5} Nm [115 lb-in]. with an 11/16" 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 insructions.


mm [in]



SPEED SENSORS R2S

TECHNICAL DATA OF THE DUAL CHANNEL HALL SPEED SENSOR

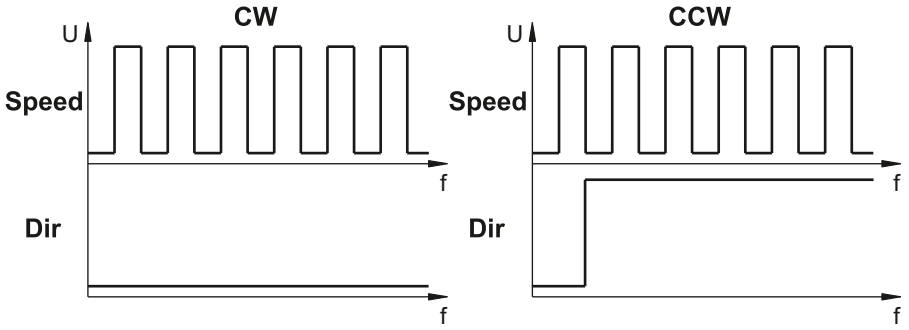
Power supply	4.5 ... 30 VDC
Power consummation	< 15 mA without load
Pin connector	universal /PUSH-PULL/ 4P Delphi Connector DJ3042-2.5-21
Output measurements	Speed, Direction
Output maximum current	100 mA
Resident output voltage	1.5 V with 100 mA of the output 0.5 V without load of the output
Frequence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

OUTPUT PULSES

per revolution

Motor Type	MA2V
Output Pulses	45

OUTPUT DIAGRAMS



PIN CONNECTOR

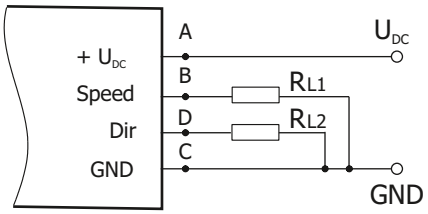
4 pin Delphi Connector

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

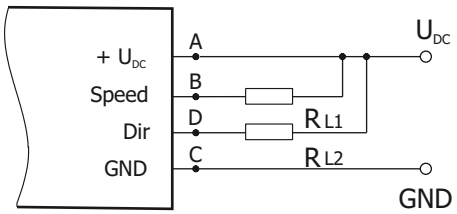
WIRING DIAGRAMS

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

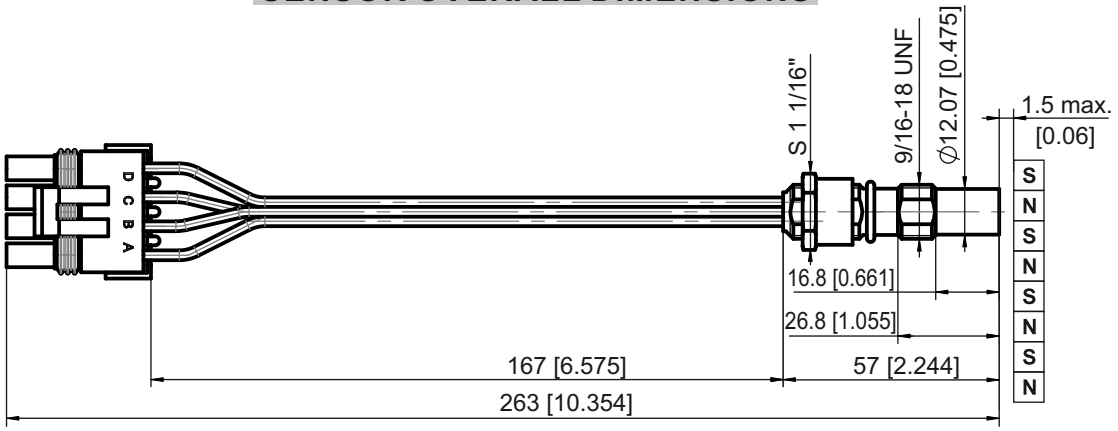
PNP



NPN



SENSOR OVERALL DIMENSIONS

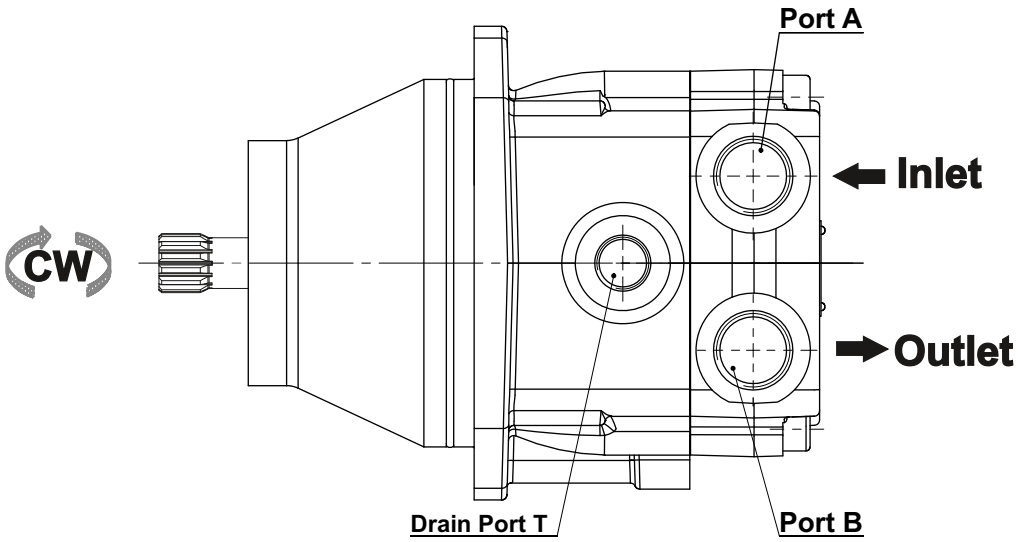


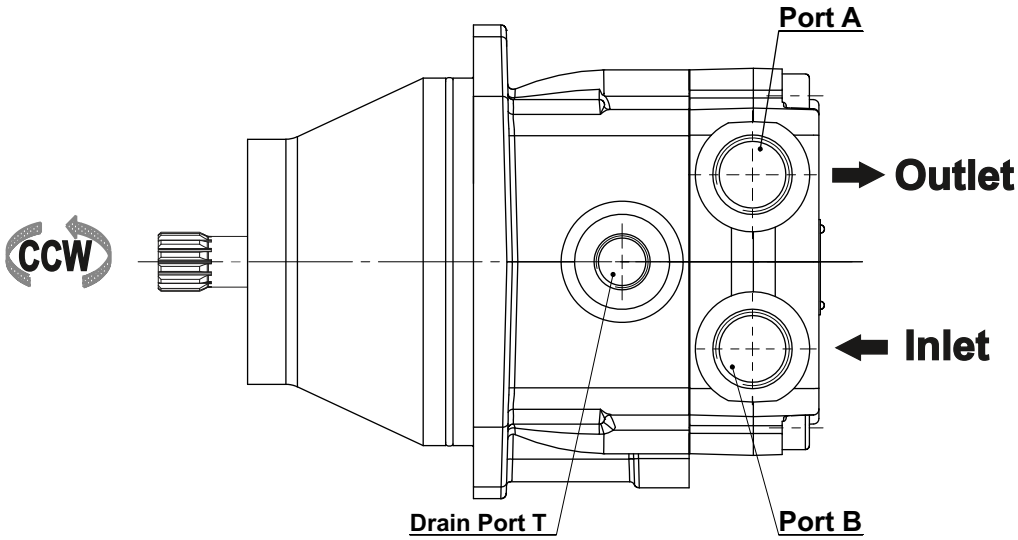
mm [in]

INSTALLATION

DIRECTION OF ROTATION

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

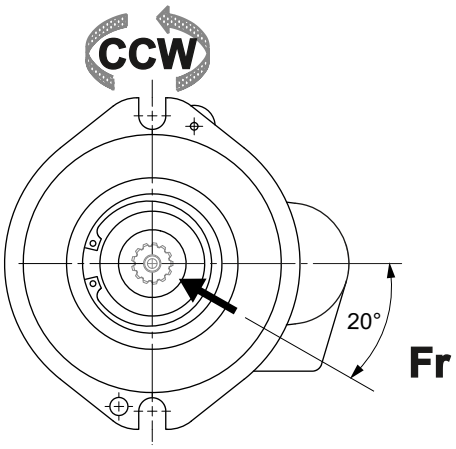




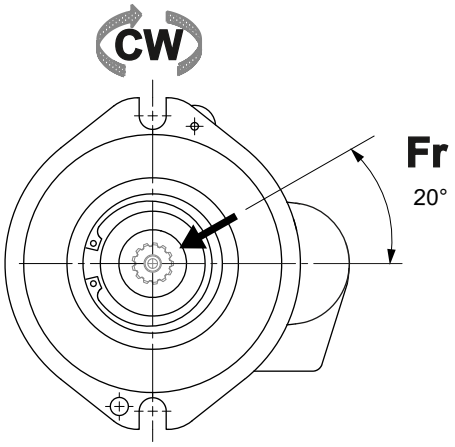
BEST POSITION FOR APPLYING RADIAL LOAD

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

Reverse Rotation

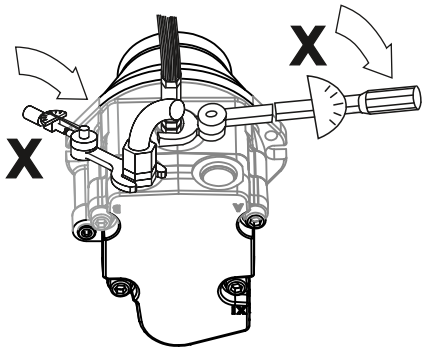


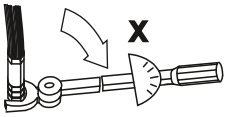
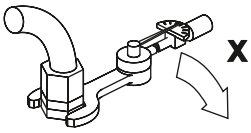
Standard Rotation



INSTALLATION

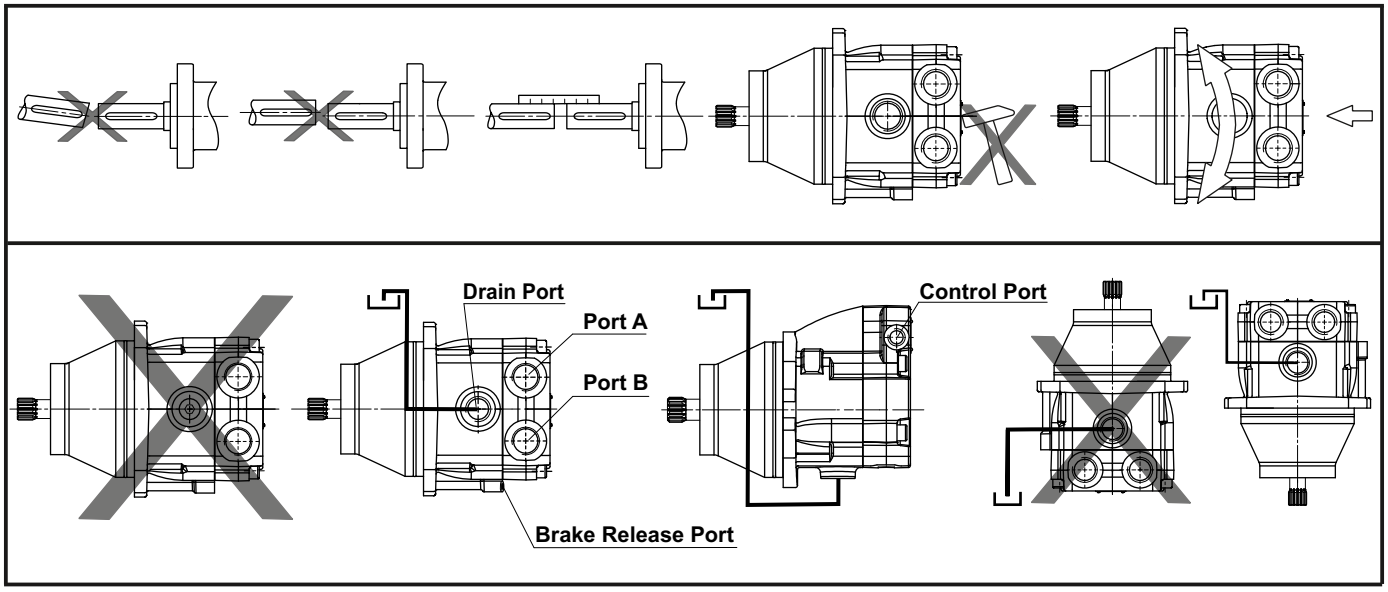
Recommended max. tightening torque X for metal plugs



Screwed connection Anschlussart Raccord Tipo di collegamento Especie de unir Присоединительные резьбы	 Max. Tightening Torque X, daNm [lb-in] Max. Anzugsmoment X, daNm [lb-in] Couple de serrage maxi X, daNm [lb-in] Momento di serraggio max. X, daNm [lb-in] Momento d'apretadura max. X, daNm [lb-in] Момент затяжки X, daNm [lb-in] 			
	With copper washer Mit Kupferscheibe Avec rondelle en cuivre Con rondella di rame De arandela de cobre С медной шайбой	With aluminium washer Mit Aluminiumscheibe Avec rondelle en aluminium Con rondella di alluminio De arandela d'aluminio С алюминиевой шайбой	With cutting edge Mit Dichtkante Tranchant Con tagliente di guarnizione De borde compactar С крутым бортиком	With "O" ring Mit "O" Ring Avec joint torique Con "O"-anello De "O"-anillo С резиновым кольцом
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]

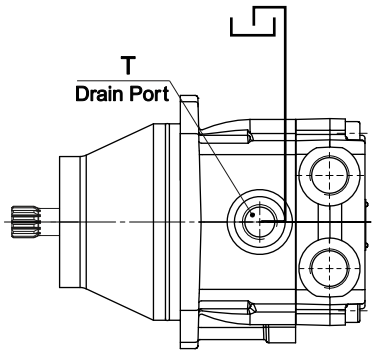
INSTALLATION

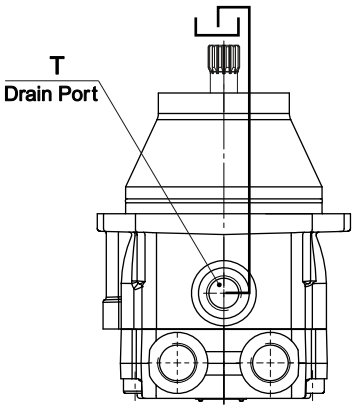
At start-up and during operation the motor housing has to be filled up with hydraulic fluid. Start-up has to be carried out at low or moderate speed and without load (for example 1000 rpm and pressure 50 [725] bar [PSI]) till the motor and the hydraulic scheme are filled up with oil. Generally the start-up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



Installation below the tank level (recommended)

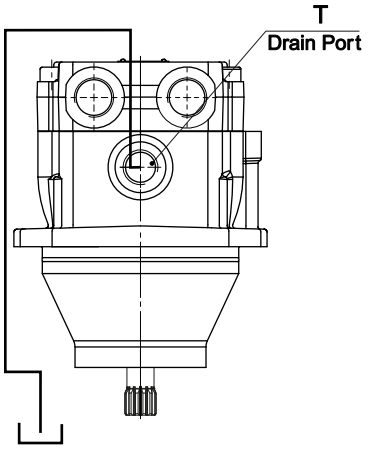
- Fill up the axial piston motor before the start-up through the highest positioned drain port T;
- Operate the motor at low speed till the motor system is completely filled up;
- The minimum immersion depth of the drain line in the tank is 200 mm relative to the minimum oil level in the tank.

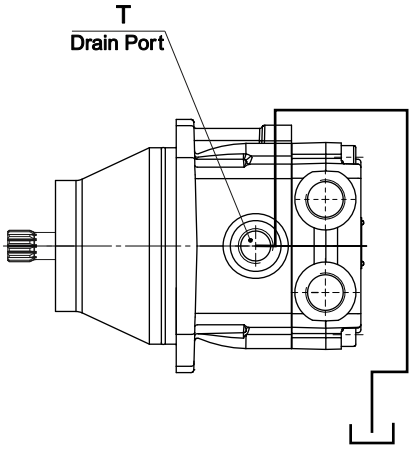




Installation on top of the tank level

- Fill up the axial piston motor before the start-up through the highest positioned drain port T;
- Operate the motor 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.

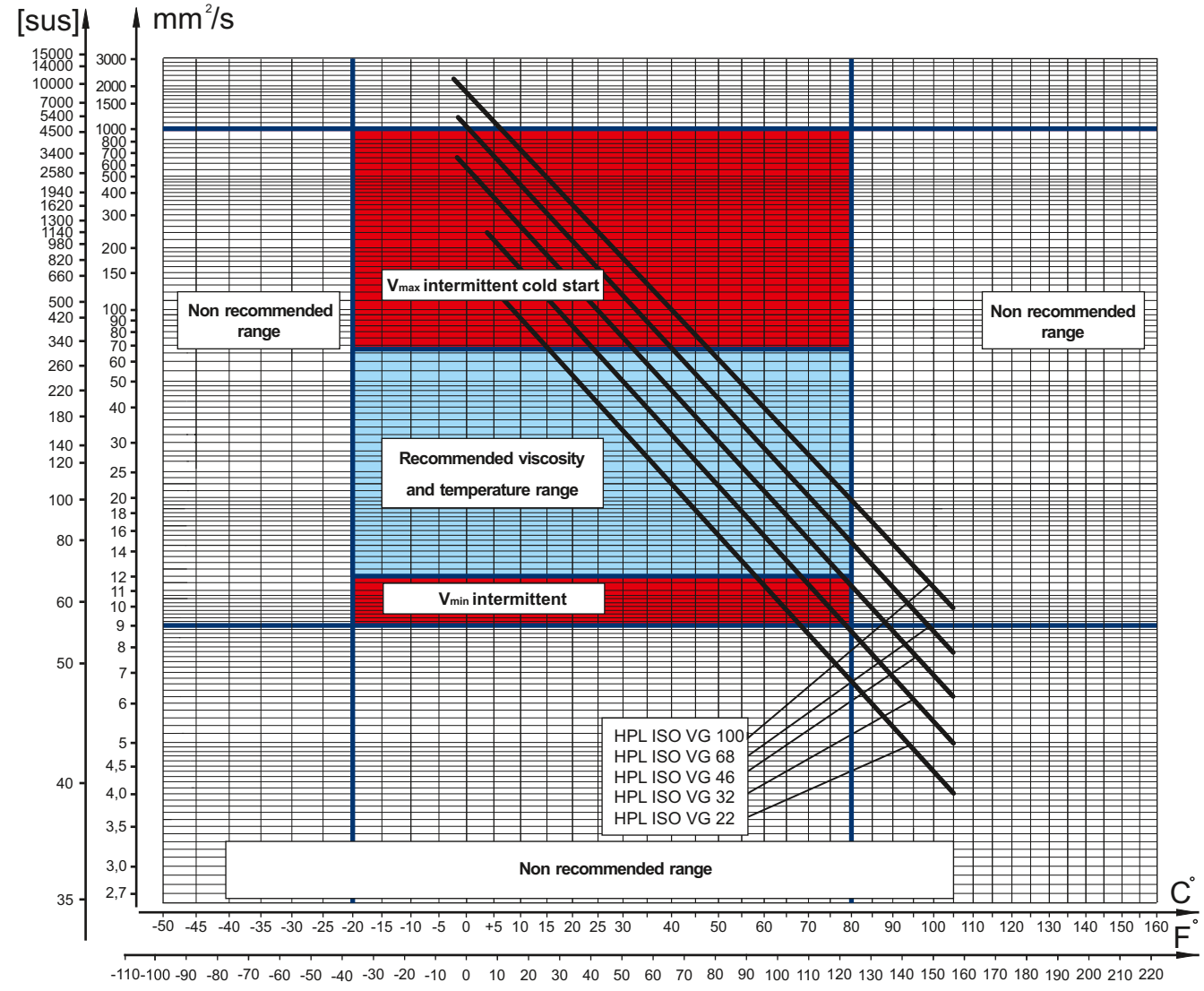




FLUID VISCOSITY LIMITS

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



Temperature

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

BASIC FORMULAS

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

Metric System

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

Input flow $Q = \frac{Vg \cdot n}{1000 \cdot \eta_v}$ [l/min]

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

Output power $P = \frac{M \cdot n}{9550} = \frac{Q \cdot \Delta p \cdot \eta_t}{600}$ [kW]

Speed $n = \frac{Q \cdot 1000 \cdot \eta_v}{Vg}$ or $n = Q \cdot N_{con.}$ [min^{-1}]

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

Inch System

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

Input flow $Q = \frac{Vg \cdot n}{231 \cdot \eta_v}$ [GPM]

Output torque $M = \frac{Vg \cdot \Delta p \cdot \eta_{mh}}{2,\pi}$ or $M = \Delta p \cdot T_{con.}$ [lb-in]

Output power $P = \frac{Vg \cdot n \cdot \Delta p \cdot \eta_t}{396000}$ [hp]

Speed $n = \frac{Q \cdot 231 \cdot \eta_v}{Vg}$ or $n = Q \cdot N_{con.}$ [min^{-1}]

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

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

Table 1

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

APPLICATION FORMULAS

1.Motor speed: n, RPM

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

v_{km} - vehicle speed [km/h]
v_{mi} - vehicle speed [mil/h]
R_m - wheel rolling radius [m]
R_{in} - wheel rolling radius [in]
i - gear ratio between motor and wheels.
If no gearbox, use i=1.

2.Rolling resistance: RR, daN [lbs]
The resistance force resulted in wheels contact with different surfaces:

$$RR=G\,.\,\rho$$

G- total weight loaded on vehicle, daN [lbs];
ρ - rolling resistance coefficient (Table 1).

3.Grade resistance: GR, daN [lbs]

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

α - gradient negotiation angle (Table 2)

Table 2

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

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:

$$FA=\frac{v_{km}\,.\,G}{3{,}6\,.\,t}\ [daN] \qquad FA=\frac{v_{mi}\,.\,G}{2{,}2\,.\,t}\ [lbs]$$

FA- acceleration force, daN [lbs]
t- time, [s]

5.Tractive effort: DP,daN [lbs]
Tractive effort DP is the additional force of trailer. This value will be established as follows:
-acc.to constructor's assessment;
-as calculating forces in items 2, 3 and 4 of trailer. The calculated sum corresponds to the tractive effort requested.

6.Total tractive effort: TE, daN [lbs]
Total tractive effort **TE** is total effort necessary for vehicle motion; that the sum of forces calculated in items from 2 to 5 and increased with 10 % because of air resistance.

$$TE=1{,}1.(RR+GR+FA+DP)$$

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:

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

N- motor numbers;
η_M - mechanical gear efficiency (if it is available).

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

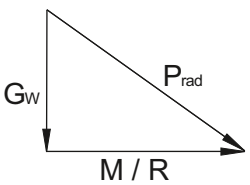
$$M_W=\frac{G_W\,.\,f\,.\,R_m[R_{in}]}{i\,.\,\eta_M}$$

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.

Notes

WARRANTY

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

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

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

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

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

Warranty periods

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

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

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

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

HES HYDRAULIC ELEMENTS AND SYSTEMS OVERVIEW



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

M+S HYDRAULIC OVERVIEW



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

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

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

M+S HYDRAULIC - DEVOTED TO THE QUALITY


Certificate

ISO 9001:2015

M+S HYDRAULIC AD


BUREAU VERITAS Certification

M+S HYDRAULIC PLC

ISO 14001:2004


BUREAU VERITAS Certification

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OHSAS 18001:2007


РОССИЙСКАЯ ФЕДЕРАЦИЯ

СЕРТИФИКАТ СООТВЕТСТВИЯ