

ENGINEERING
TOMORROW



Technical Information

THORX Motors

CLM S



Revision history

Table of revisions

Date	Changed	Rev
March 2024	First edition	0101

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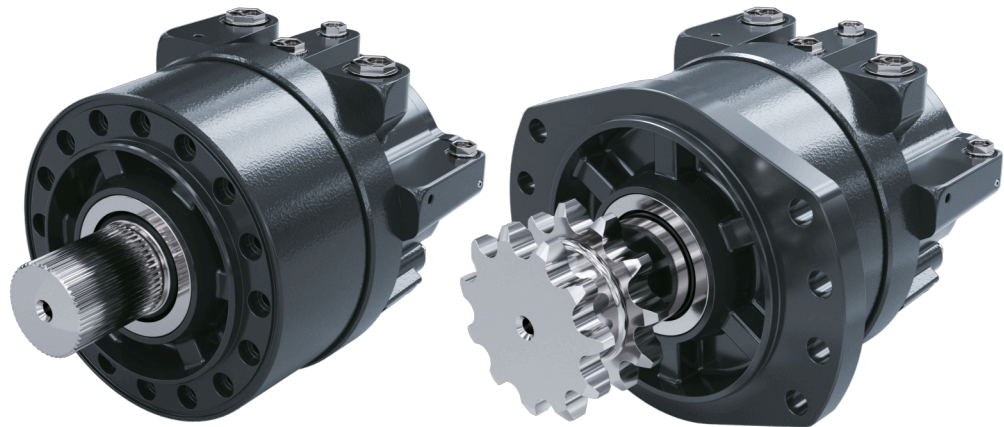
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Introduction

Our THORX Cam Lobe Motor product line delivers improved performance and higher efficiency to match the evolving customer demands in mobile transmissions. The CLM S has been developed in close collaboration with our customers and are based on a well-proven radial piston motor design, also known as a Cam Lobe motor, which is commonly used in closed-circuit medium power propel applications. THORX motors are designed to be combined with other products in systems to transfer and control hydraulic power.

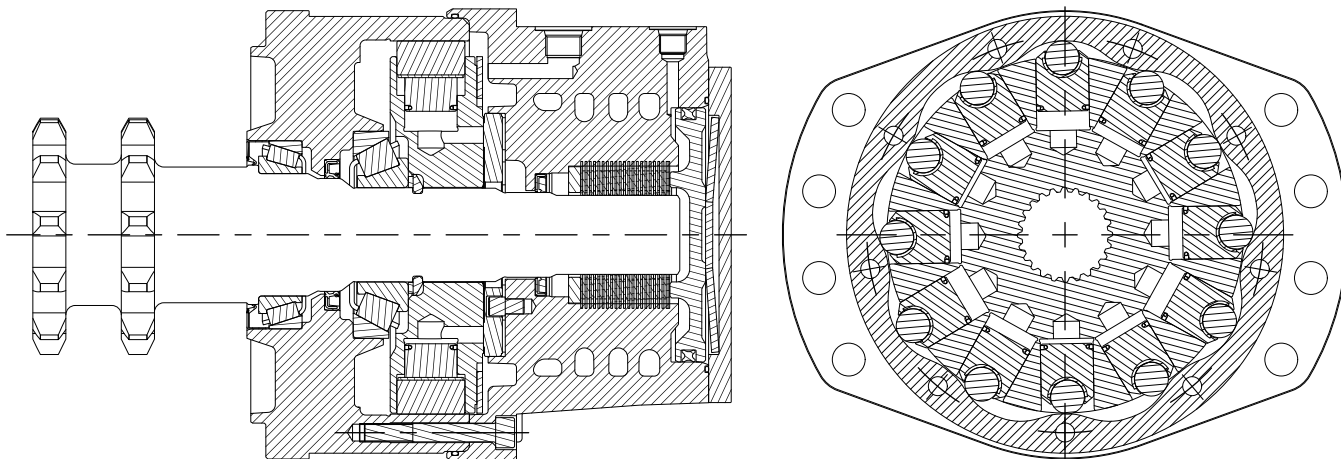
Danfoss has designed the CLM S to fit perfectly for construction machines with chain drives, such as Skid Steer Loaders. It is optimized for these applications with focus on physical size, longer lifetime, performance, and total installed cost.



Customer Benefits

The CLM S is designed to be the most compact drive solution in its displacement to make installation easier and free space for other customer needs. This means that the motors are more power dense than comparable solutions available in the market. The THORX motors also feature a smoother speed changeover than any other comparable motor.

Functional Description



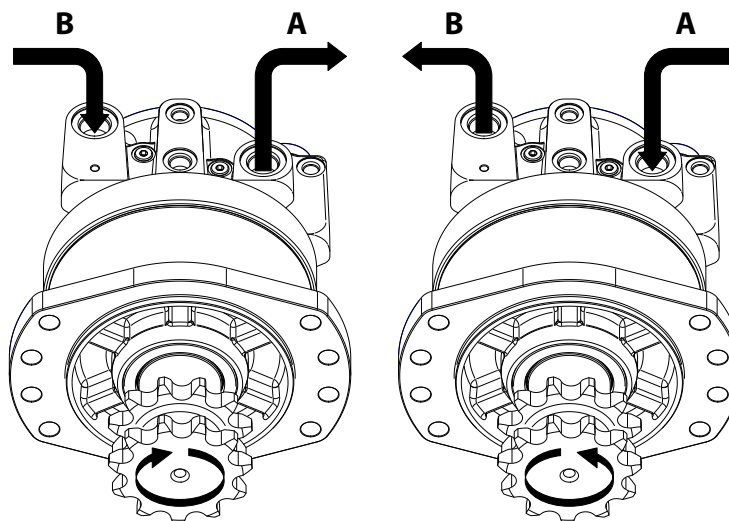
Sectional drawing of CLM 8 S

The Cam Lobe principle

A Cam Lobe Motor is a type of radial piston motor which is a Low Speed High Torque hydraulic motor. It differs from other radial piston motor designs by utilizing a cam ring with multiple lobes and pistons. The pistons move against the cam profile and thereby rotate the motor, either clockwise or counterclockwise. The design of the motors can have either stationary housing and rotating shaft, or a stationary shaft and rotating house. The Cam Lobe motor are in particular known for its high starting efficiency and high efficiency in general. It is commonly available with a two-speed valve, to make the machine go faster. This simply works by disengaging a number of pistons. As a consequence of the reduced displacement, the torque delivered by the motor is reduced.

The Cam Lobe technology is not a new technology, it has been around for more than 60 years, however Danfoss have now refined the technology to design a whole new line of hydraulic motors for mobile off-highway machinery, known as THORX Motors. Cam Lobe motors are typically applied in direct drive solutions because of its ability to provide full torque without the need for a gearbox, opposed to high-speed motors such as axial piston type.

Bidirectional design

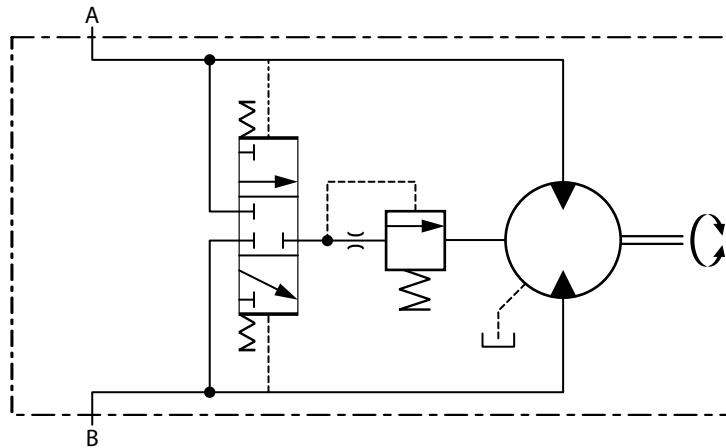


Functional Description

The THORX motors are based on a bidirectional design which provides the same performance in clockwise rotation as counterclockwise rotation. This provides a clear benefit in drivetrain solutions where the motor needs to reverse and don't go down in performance.

Rotation direction	Inlet port
Clockwise	B port
Counter-clockwise	A port

Flushing valve



Schematic diagram of flushing valve

When operating in a closed-circuit system overheating is a well-known issue to many because of the characteristics of the system design, where the same oil is circulating from the pump to the motors and back again to the pump in a continuous flow. Closed-circuit systems are the preferred system when it comes to precise regulation of propulsion of vehicles, such as Loaders, etc.

To accommodate the heat generated by the system and avoid overheating of vital system components, which can lead to damage, the THORX motors feature an integrated flushing valve option, which replaces some of the hydraulic fluid in the closed-circuit system with cooler fluid from the systems reservoir.

When operating the motor under pressure, the flushing spool opens and allow for a given flow of fluid to run through an orifice from the low-pressure side of the motor, into the motor case and from where it is directed back to the system reservoir via the motor case drain.

Closed-circuit options

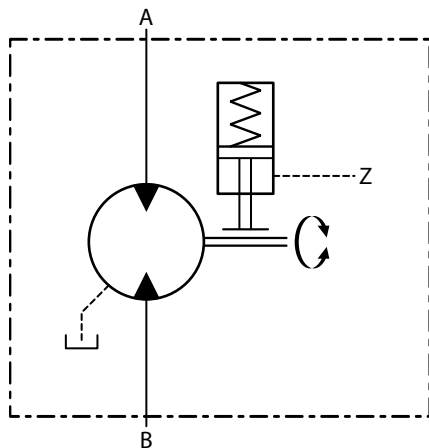
Order code	Orifice size [mm]	Flow at 24 bar [l/min]
CA	Ø0.8	2.7
CB	Ø1.4	5.6
CC	2 x Ø1.2	7.6
CD	2 x Ø1.4	9.5

Integral flushing valve set at 10.34bar [149 psi] cracking pressure to protect charge pressure.

Functional Description

Integrated parking brake

The integrated parking brake is a 2,200 Nm [19,475 lbf·in] multi-disc static friction brake. The brake discs are compressed by the disc spring and released by the application of brake pressure. To release the brake is required a release pressure of 15 bar [217 psi] via the Z port. This type of brake is commonly referred to as SAHR, or Spring Applied Hydraulic Release.



Motor with parking brake

Warning

Never apply more than max. 40 bar pressure to the Z-port.

Warning

While the parking brake is designed for 100 emergency dynamic stops during its lifetime, it is intended solely for static use and should not be applied while the motor is in use. Applying the brake while driving can damage the brake.

Shaft seal

The CLM S features a FKM (Viton) shaft seal as standard options. This shaft seal is characterized by its ability to handle high temperature operation.

Shaft Seal		CLM S	
Max. pressure, case drain	bar [psi]	Continuous	1 [15]
		Intermittent ¹	3 [44]
		Peak ²	10 [145]

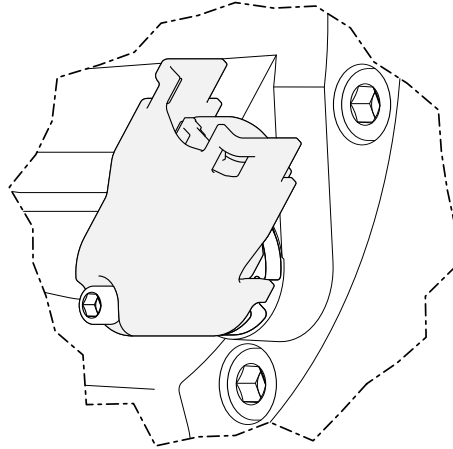
¹ Intermittent operation: the permissible value may occur for less than 1 min per incident and not exceeding 2 % of duty cycle

² Peak load: the permissible value may occur for max. 1 % of every minute

Functional Description

Speed Sensor

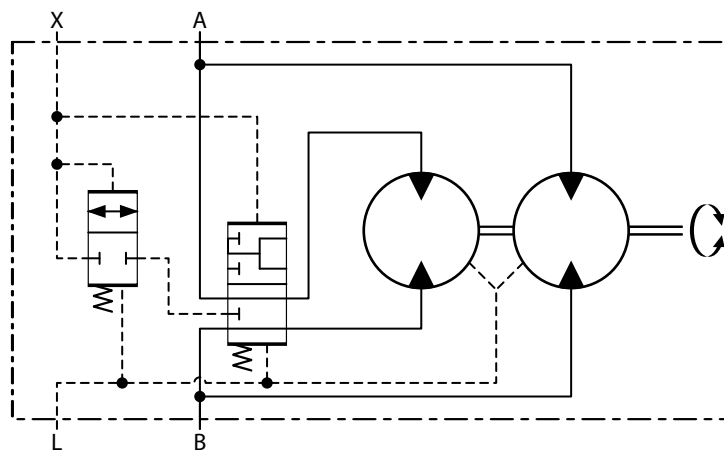
The THORX Motors are designed to be equipped with a Hall type speed sensor, which Danfoss can supply as an option. The motors are available as sensor ready or with the sensor pre-installed from the factory. The sensor is located in its own port in the rear case of the motor. It works by measuring a toothed disc that is fitted onto the cylinder block. It is possible to connect the sensor to any of the Danfoss PLUS+1 controllers. If you wish to use your own solution, please check with your local Danfoss sales team to ensure it is supported. Speed sensor resolution is 120 pulses per revolution on all CLM S motors.



Visualization of Danfoss speed sensor, incl. protective cover

[For further details on Danfoss Speed Sensor please refer to document ID BC152886482203en](#)

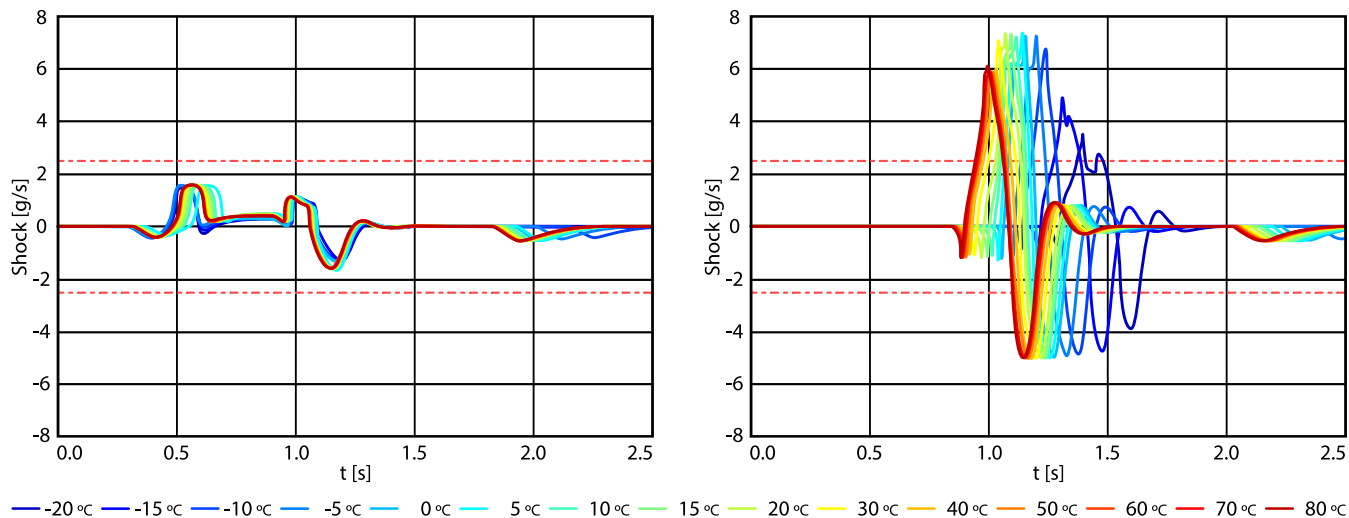
Two-speed operation



Schematic diagram of two-speed function

For mobile applications it can be beneficial for the vehicles to operate at higher speeds with low motor loads. For this purpose, the motor can shift from low speed high torque mode to high speed low torque mode. This is done by an integrated spool valve which distributes hydraulic fluid to only two-thirds of the pistons, while re-circulating the fluid from the remaining one-third. For many years shifting has been a pain point for machine operators, but thanks to the new design from Danfoss we have now introduced a much smoother speed changeover with reduced shock, across the full temperature range.

Functional Description



Danfoss solution on the left, compared to competitive solution on the right

Reach out to your local sales contact or go to danfoss.com to learn more about our two-speed smoothing system to reduce shock during displacement changeover whilst on the move.

To engage the two-speed shift functionality pressure must be applied to the X-port. When the pilot pressure is less than 4 bar above motor case drain pressure, the spool valve is in deenergized position, and the flow is distributed to the motor's full displacement.

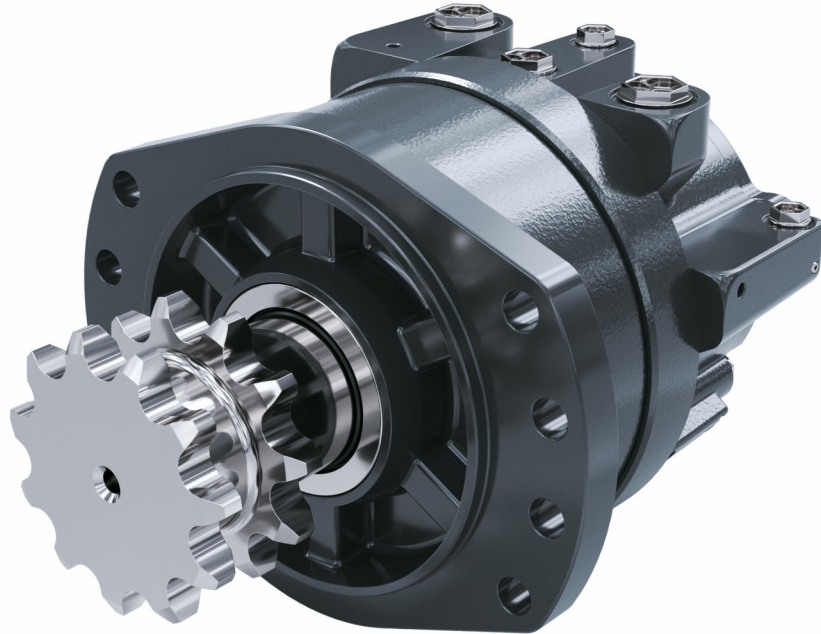
Applying more than 15 bar pressure above motor case drain pressure will make the spool move and redirect the flow to the reduced displacement, typically two-thirds of the pistons.

⚠ Warning

Never apply more than max. 40 bar pressure to the X-port.

CLM 8 S motor

On the following pages you will find technical specifications of the CLM 8 S.



CLM 8 S motor

Technical Data

Specifications

Type			CLM 8 S						
Nominal size			470	520	565	620	680	750	820
Geometric displacement	cm ³ [in ³]	Full displacement	470 [28.7]	520 [31.7]	565 [34.4]	620 [37.8]	680 [41.5]	750 [45.8]	820 [50.0]
		Reduced displacement ¹⁾	313 [19.1]	347 [21.2]	376 [23.0]	413 [25.2]	453 [27.6]	500 [30.5]	547 [33.4]
Maximum speed	min ⁻¹ [rpm]	Single speed motor	385	350	320	290	265	240	220
		Two-speed motor ²⁾	465	420	385	350	320	290	265
Maximum torque	Nm [lbf·in]	Continuous	1,870 [16,550]	2,070 [18,300]	2,240 [19,825]	2,460 [21,775]	2,700 [23,900]	2,980 [26,375]	3,260 [28,850]
		Peak ³⁾	3,150 [27,875]	3,480 [30,800]	3,780 [33,450]	4,150 [36,725]	4,550 [40,275]	5,000 [44,250]	5,480 [48,500]
Maximum power	kW [hp]	Full displacement, continuous ⁴⁾	50 [67]						
		Reduced displacement ¹⁾ , continuous	30 [40]						
Maximum working pressure	bar [psi]	Nominal pressure ⁵⁾	250 [3,625]						
		Max differential pressure (peak ³⁾)	450 [6,525]						
		Max pressure, port A or port B (peak ³⁾)	470 [6,825]						
Minimum starting torque	Nm [lbf·in]	at max. press. drop cont.	1,310 [11,600]	1,450 [12,825]	1,575 [13,950]	1,725 [15,275]	1,895 [16,775]	2,090 [18,500]	2,285 [20,225]
		at max. press. drop peak ³⁾	2,525 [22,350]	2,795 [24,725]	3,035 [26,850]	3,330 [29,475]	3,650 [32,300]	4,030 [35,675]	4,405 [39,000]
Weight ⁶⁾	kg [lbs]	Single speed motor	55 [121]						
		Two-speed motor	59 [130]						

¹⁾ Standard two-speed ratio is 2:3

²⁾ Full and reduced displacement

³⁾ Peak operation: the permissible values may occur for max. 1% of every minute

⁴⁾ Continuous values are based on a 5000 hours lifetime

⁵⁾ Nominal values are guide values for max. continuous operation

⁶⁾ Depending on product configuration

Caution

Do not exceed Δ pressure rating.

Warning

The motor should not be run unloaded at above 100 rpm during the running in period.

For operation in series with return pressure higher than 40 bar please consult your local sales contact.

For long term operation with speeds under 5 rpm please consult your local sales contact.

CLM 8 S motor

Hydraulic fluid specifications

Features		Units	CLM S
Viscosity	Intermittent ¹⁾	mm ² /sec [SUS]	5 [42]
	Minimum		7 [49]
	Recommended range		12 - 80 [66 - 370]
	Maximum (cold start) ²⁾		2,000 [9,375]
Temperature range ³⁾	Minimum (cold start)	°C [°F]	-40 [-40]
	Maximum continuous		85 [185]
	Maximum intermittent		115 [240]
Cleanliness per ISO 4406			22/18/13
Hydraulic fluid class			ISO VG 46

¹⁾ The permissible value may occur for less than 1 min per incident and not exceeding 2 % of duty cycle

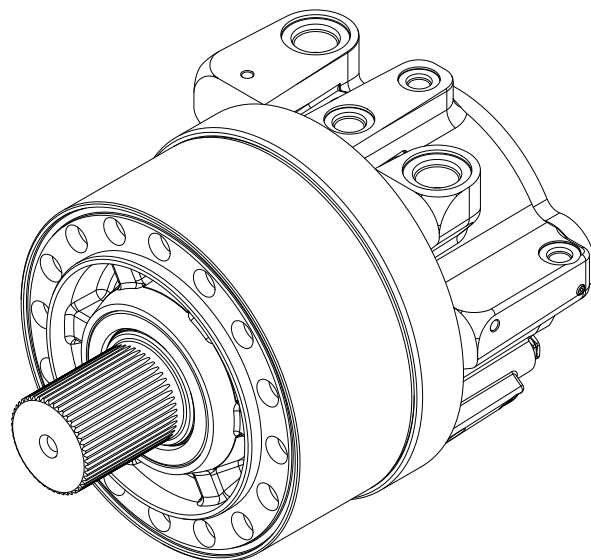
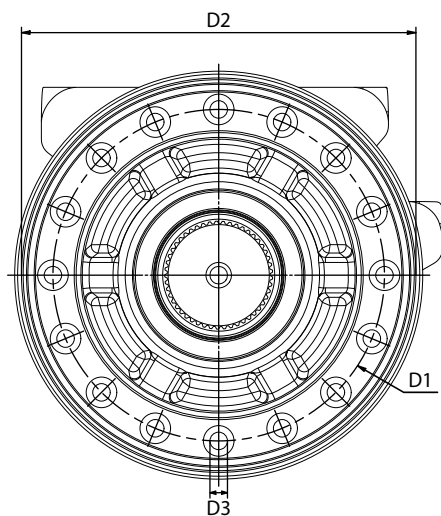
²⁾ Cold start is defined as less than 3 minutes and with pressure not exceeding 50 bar [725 psi]

³⁾ At the hottest temperature point (normally case drain port)

CLM 8 S motor

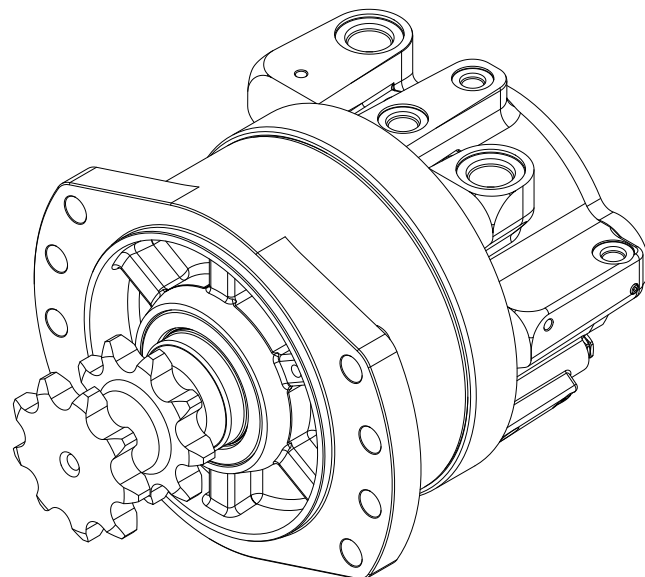
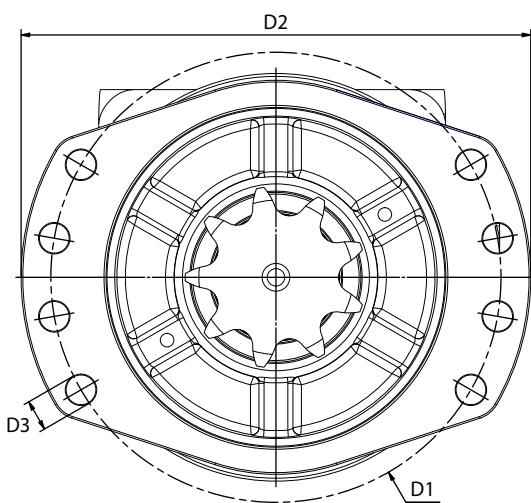
Housings

S09: 16-hole circular mounting flange



Motor		D1	D2	D3
CLM 8 S	mm	Ø195	Ø232	16 x M12

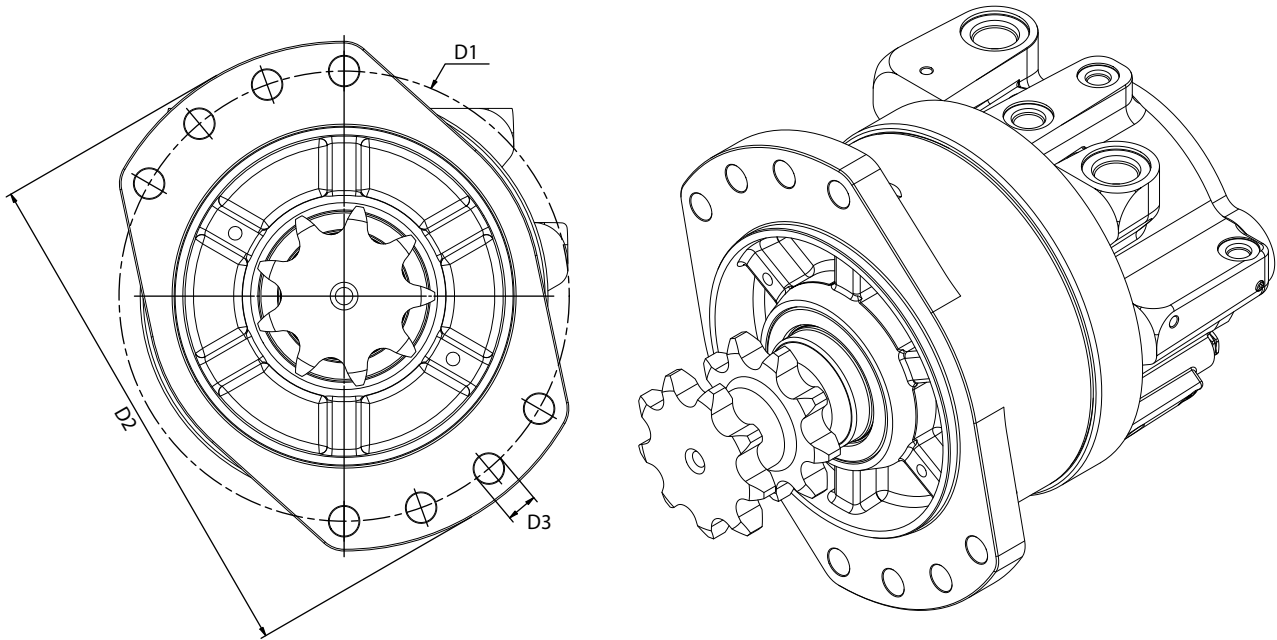
S11: 8-hole oval mounting flange - Parallel



Motor		D1	D2	D3
CLM 8 S	mm	Ø265	Ø300	8 x Ø17.5

CLM 8 S motor

S14: 8-hole oval mounting flange – 60 degrees rotation

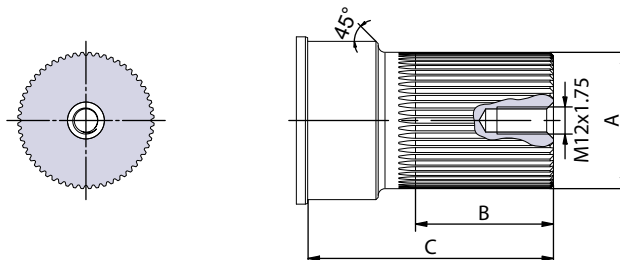


Motor		D1	D2	D3
CLM 8 S	mm	Ø265	Ø300	8 x Ø17.5

CLM 8 S motor

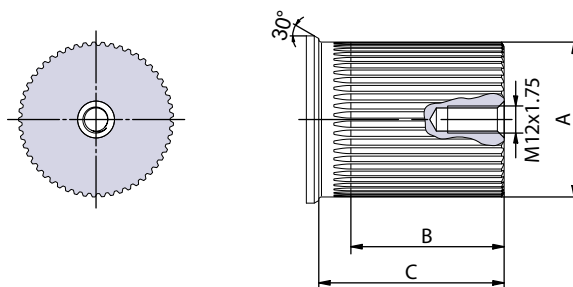
Shafts

A08: Splined – Ø60 ANSI B92.1 (56 teeth)



Shaft		A	B	C
Ø60 ANSI B92.1	mm	Ø60.3	61.0	108.7

A13: Splined – Ø68.5 ANSI B92.1 (53 teeth)



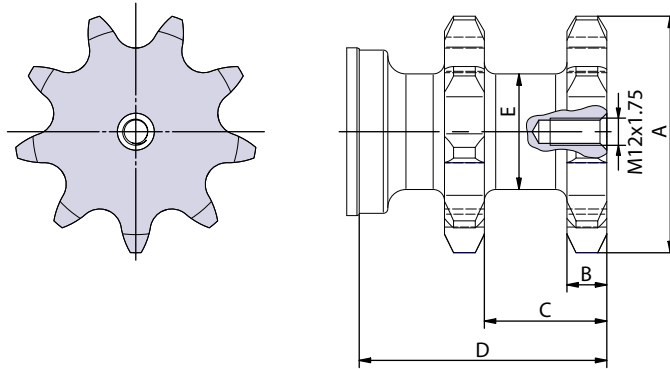
Shaft		A	B	C
Ø68.5 ANSI B92.1	mm	Ø68.5	67.8	82.0

A08 Involute splined shaft
 ANSI B92.1 - 1996 standard
 Flat root side fit
 Pitch 24/48
 Teeth 56
 Major dia. Ø60.325 mm
 Pressure angle 30°

A13 Involute splined shaft
 ANSI B92.1 - 1996 standard
 Flat root side fit
 Pitch 20/40
 Teeth 53
 Major dia. Ø68.5 mm
 Pressure angle 30°

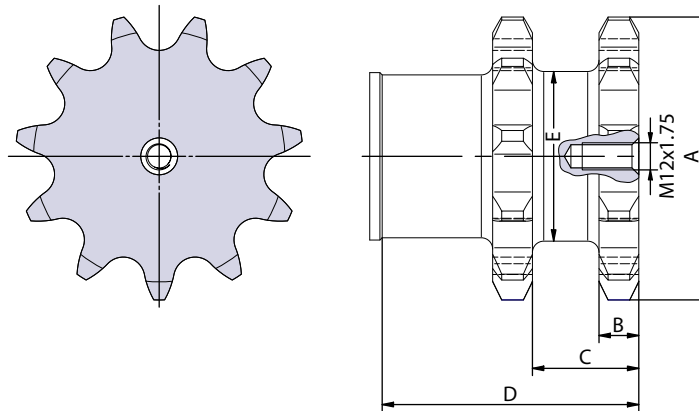
CLM 8 S motor

S11: Sprocket shaft – 9 teeth



Shaft		A	B	C	D	E
Sprocket shaft - 9 teeth	mm	Ø106.8	17.58	54.0	109.2	Ø51.0

S13: Sprocket shaft – 11 teeth



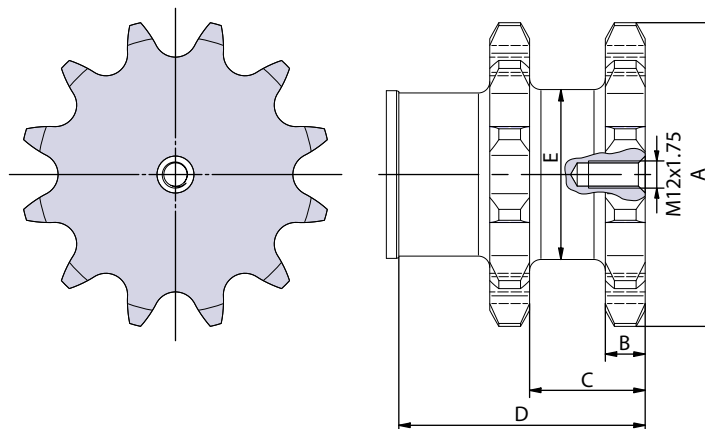
Shaft		A	B	C	D	E
Sprocket shaft - 11 teeth	mm	Ø127.0	17.58	47.0	113.4	Ø75.0

S11 Dual sprocket shaft
 ANSI B29.1 - 2011 standard
 Chain 100
 Pitch 31.75 mm
 Pitch dia. Ø92.83 mm
 Teeth 9

S13 Dual sprocket shaft
 ANSI B29.1 - 2011 standard
 Chain 100
 Pitch 31.75 mm
 Pitch dia. Ø112.69 mm
 Teeth 11

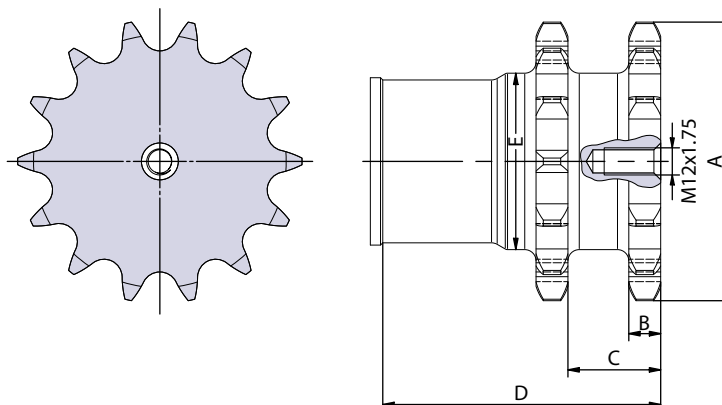
CLM 8 S motor

S14: Sprocket shaft – 12 teeth



Shaft		A	B	C	D	E
Sprocket shaft - 12 teeth	mm	Ø137.5	17.58	51.0	108.7	Ø75.0

S15: Sprocket shaft – 14 teeth



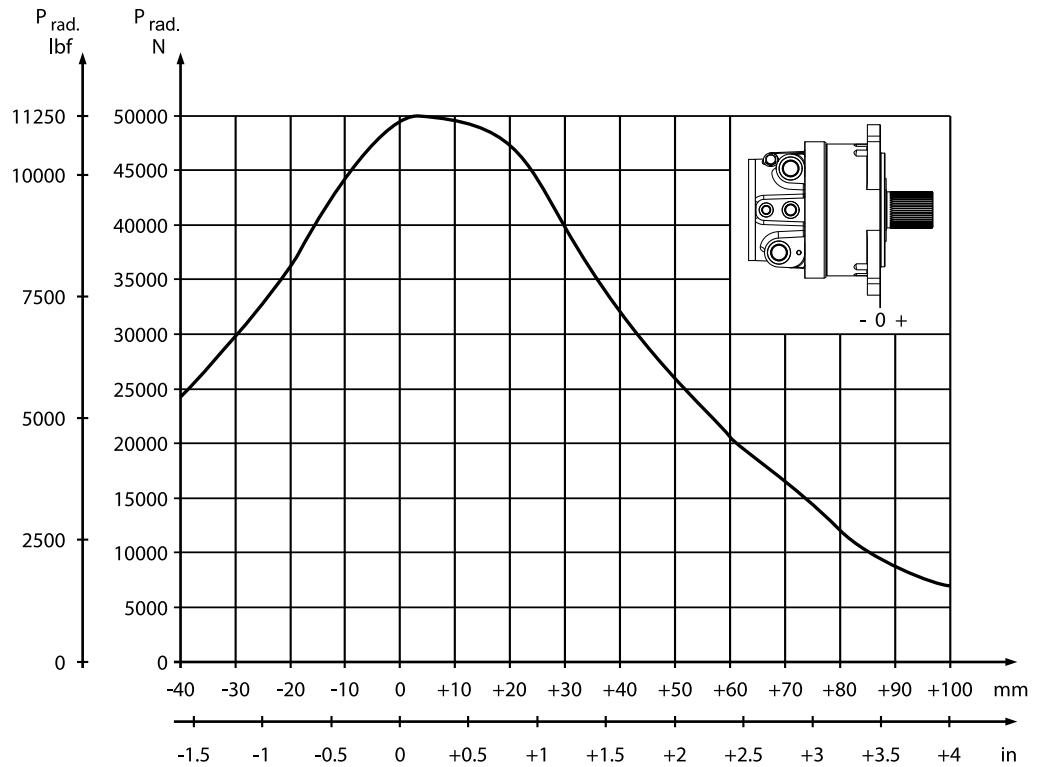
Shaft		A	B	C	D	E
Sprocket shaft - 14 teeth	mm	Ø125.7	14.10	41.1	122.85	Ø78.0

S14 Dual sprocket shaft
 ANSI B29.1 - 2011 standard
 Chain 100
 Pitch 31.75 mm
 Pitch dia. Ø122.68 mm
 Teeth 12

S15 Dual sprocket shaft
 ANSI B29.1 - 2011 standard
 Chain 80
 Pitch 25.4 mm
 Pitch dia. Ø114.15 mm
 Teeth 14

CLM 8 S motor

Shaft load curve



The permissible radial load on the shaft is shown for an axial load of 0 N as a function of the distance from the mounting flange to the point of load application, and applicable for all types of shafts.

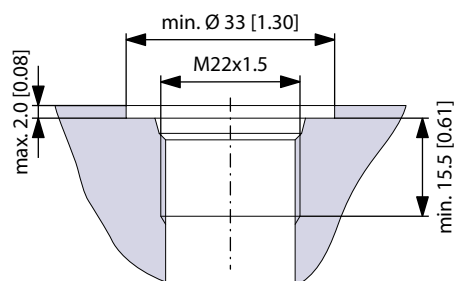
The output shaft runs in tapered roller bearings that permit high axial and radial forces.

The curve is based on B10 Bearing life (2000 hours or 12 000 000 shaft revolutions at 100 rpm) at rated output torque, when mineral-based hydraulic oil with a sufficient content of anti-wear additives, is used.

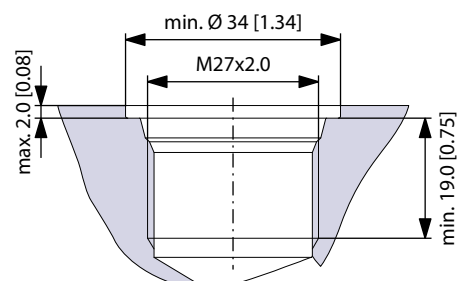
CLM 8 S motor

Port thread options

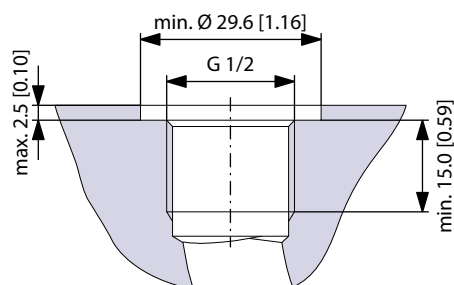
Inlet ports



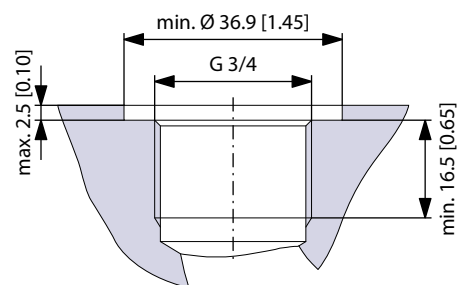
1B M22 x 1.5 ISO 6149



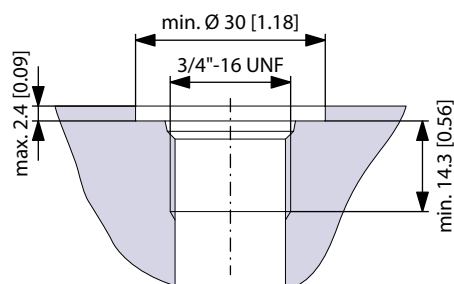
1C M27 x 2.0 ISO 6149



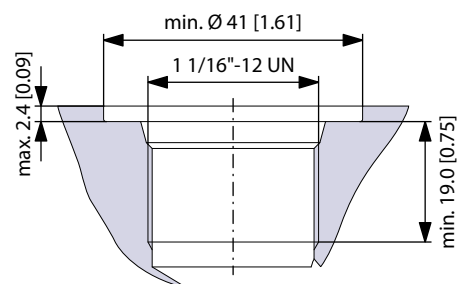
2A G 1/2 BSP, ISO 1179-1



2B G 3/4 BSP, ISO 1179-1



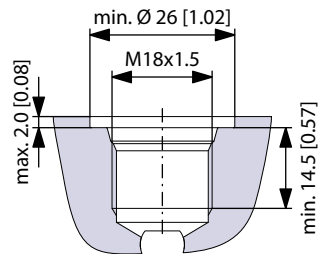
3A UNF 3/4" - 16 (SAE J514)



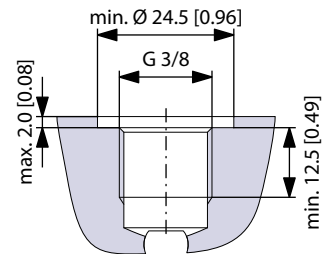
3C UN 1 1/16" - 12 (SAE J514)

CLM 8 S motor

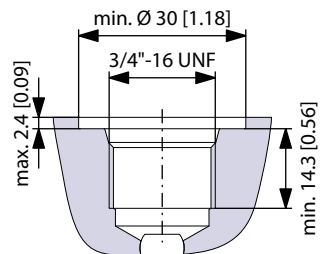
Case drain port



C M18 x 1.5 ISO 6149



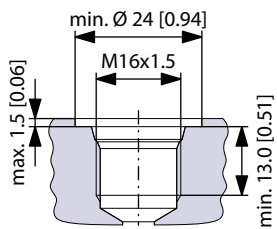
F G 3/8 BSP, ISO 1179-1



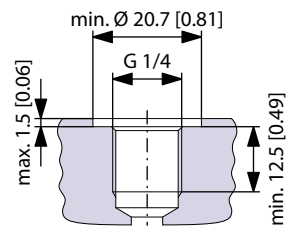
I UNF 3/4" - 16 (SAE J514)

CLM 8 S motor

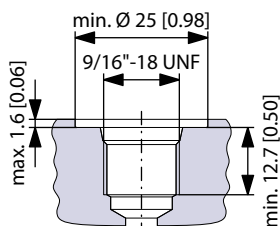
Brake release & 2-speed ports



B M16 x 1.5 ISO 6149



E G 1/4 BSP, ISO 1179-1

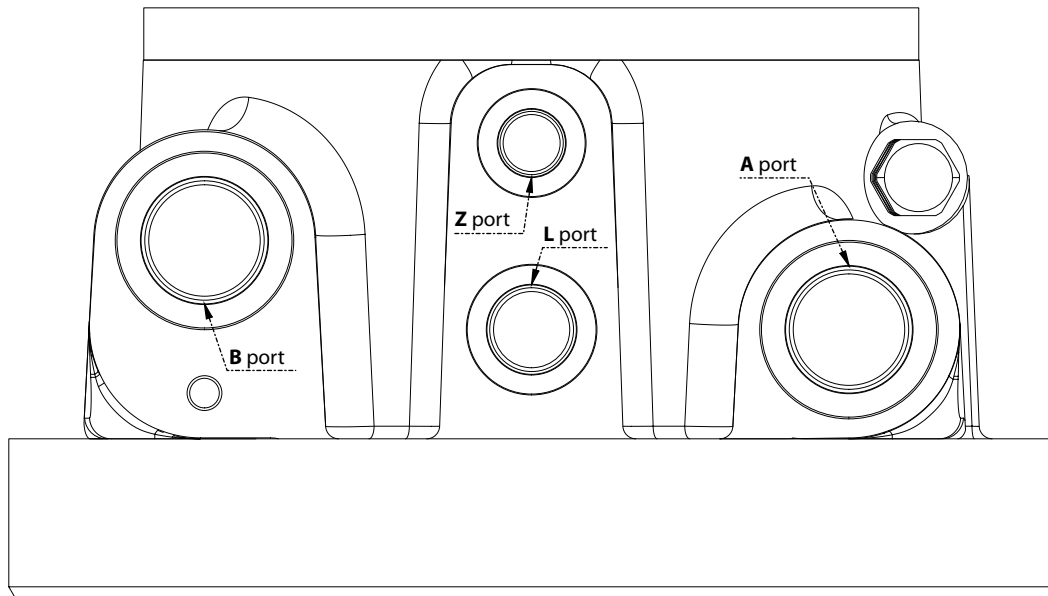


I UNF 9/16" - 18 (SAE J514)

CLM 8 S motor

Manifold layout

Single speed motor

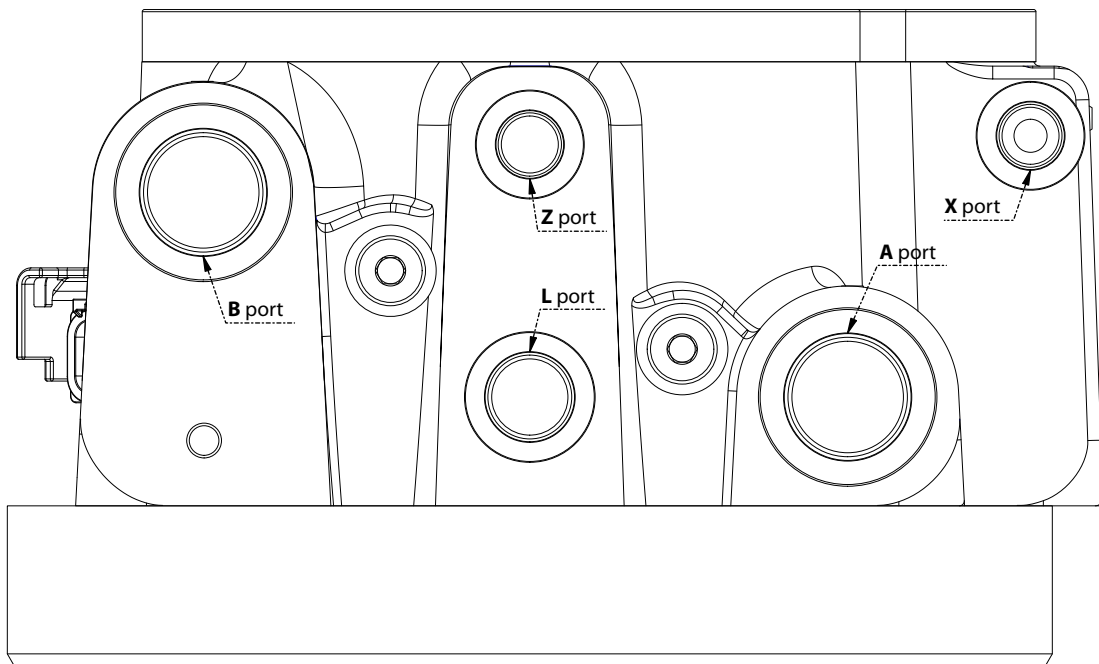


Thread type	Inlet ports (A+B)	Case drain port (L)	Brake release port (Z)
Metric (ISO 6149-1)	M22 x 1.5	M18 x 1.5	M16 x 1.5
	M27 x 2.0		
BSP (ISO 1179-1)	G 1/2	G 3/8	G 1/4
	G 3/4		
UNF (SAE J514)	3/4" - 16 UNF	3/4" - 16 UNF	9/16" - 18 UNF
	1 1/16" - 12 UN		

Dimensions for port positions, see [Single speed motor](#) on page 24.

CLM 8 S motor

Two-speed motor



Thread type	Inlet ports (A+B)	Case drain port (L)	Brake release port (Z)	Two-speed port (X)
Metric (ISO 6149-1)	M22 x 1.5	M18 x 1.5	M16 x 1.5	M16 x 1.5
	M27 x 2.0			
BSP (ISO 1179-1)	G 1/2	G 3/8	G 1/4	G 1/4
	G 3/4			
UNF (SAE J514)	3/4" - 16 UNF	3/4" - 16 UNF	9/16" - 18 UNF	9/16" - 18 UNF
	1 1/16" - 12 UN			

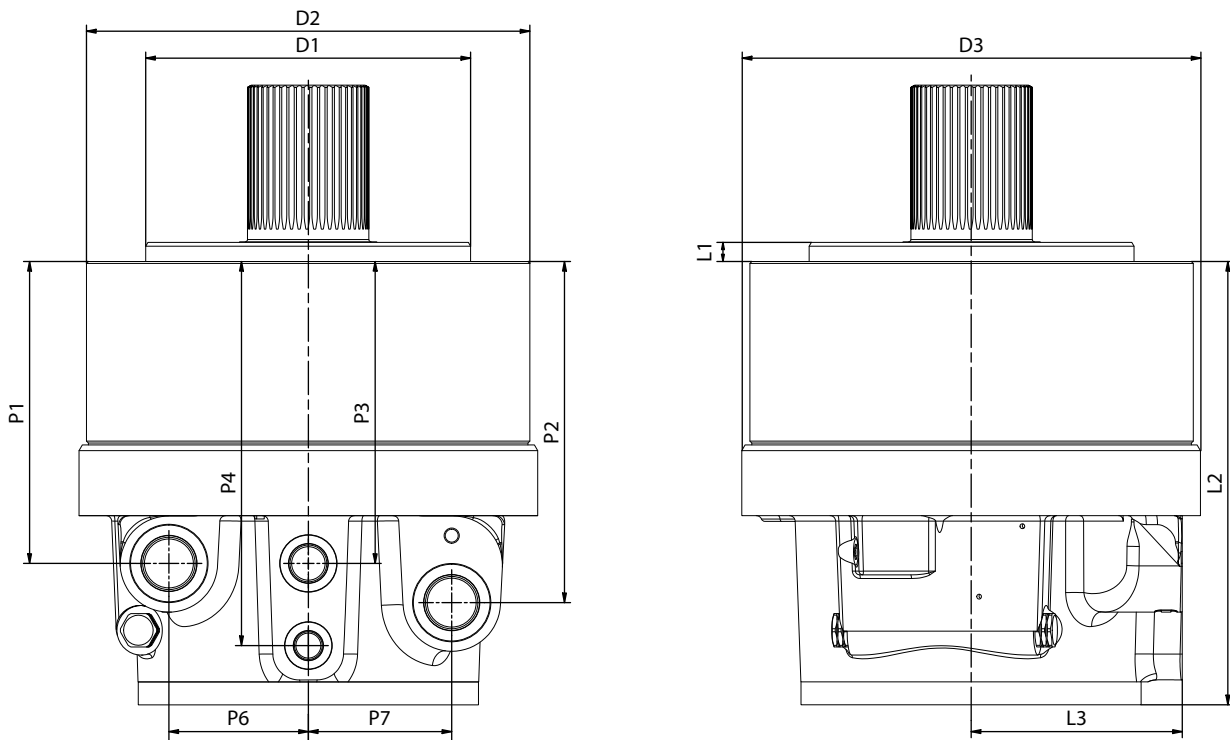
Dimensions for port positions, see [Two-speed motor](#) on page 27.

CLM 8 S motor

Dimensions

Single speed motor

S09: 16-hole circular mounting flange



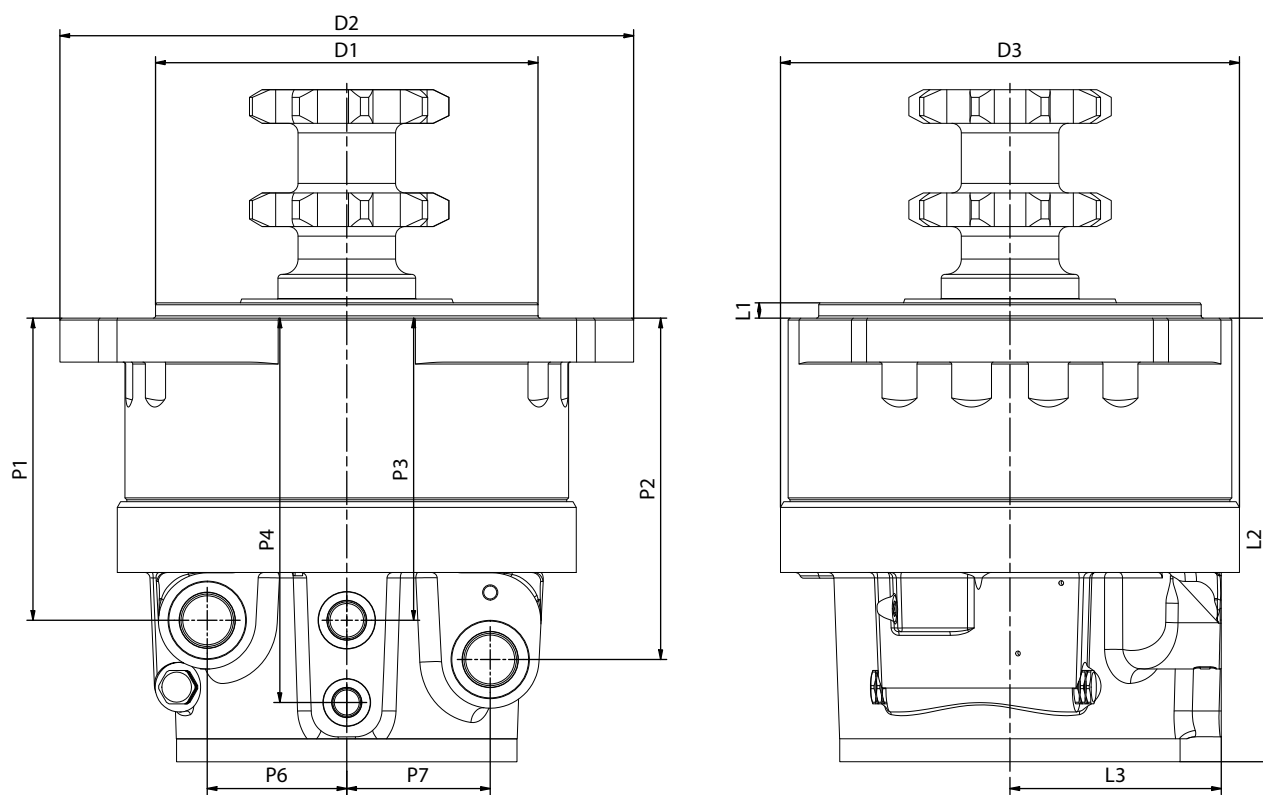
Motor		L1	L2	L3
CLM 8 S single speed	mm	10	232	110.5

Motor		D1	D2	D3
CLM 8 S single speed	mm	Ø170	Ø232	Ø240

Motor		P1	P2	P3	P4	P6	P7
CLM 8 S single speed	mm	158	178.5	158	201	73	75

CLM 8 S motor

S11: 8-hole oval mounting flange - Parallel



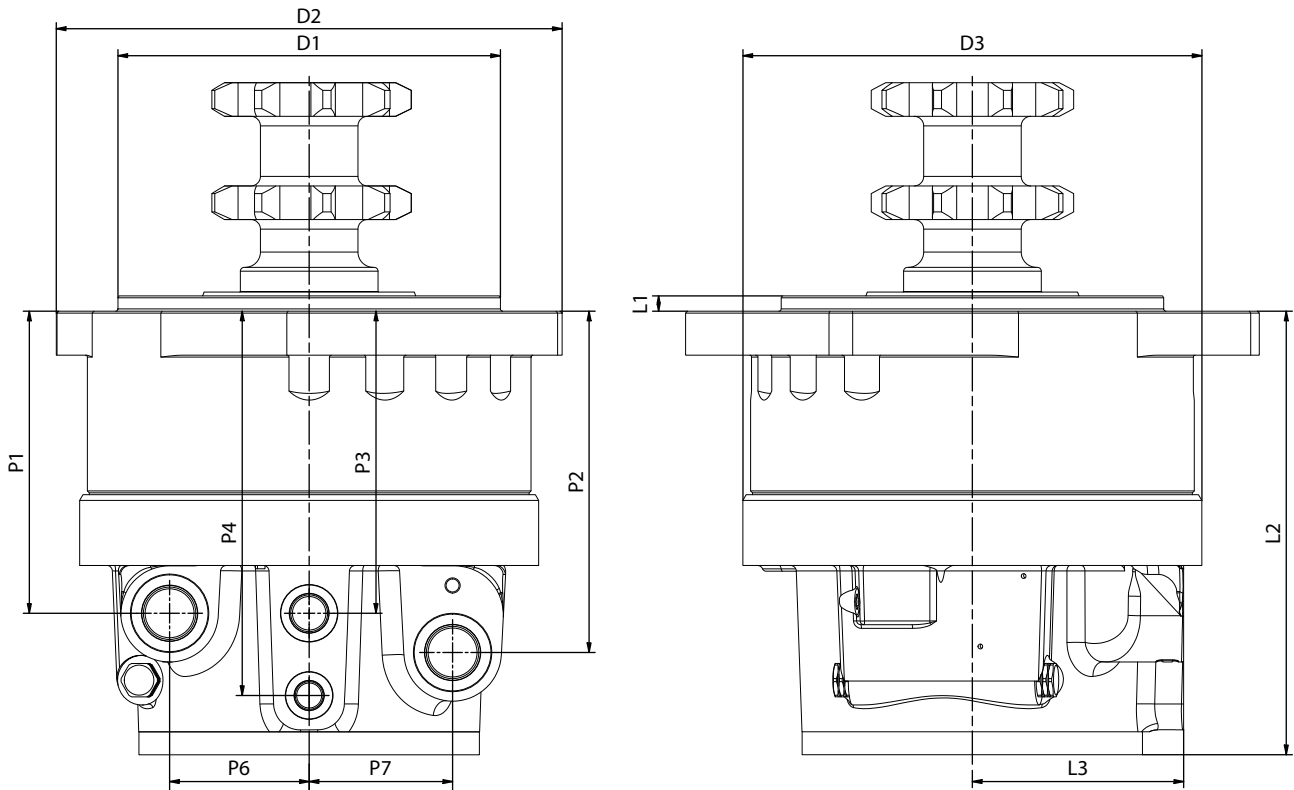
Motor		L1	L2	L3
CLM 8 S single speed	mm	8	232	110.5

Motor		D1	D2	D3
CLM 8 S single speed	mm	Ø200	Ø300	Ø240

Motor		P1	P2	P3	P4	P6	P7
CLM 8 S single speed	mm	158	178.5	158	201	73	75

CLM 8 S motor

S14: 8-hole oval mounting flange – 60 degrees rotation



Motor		L1	L2	L3
CLM 8 S single speed	mm	8	232	110.5

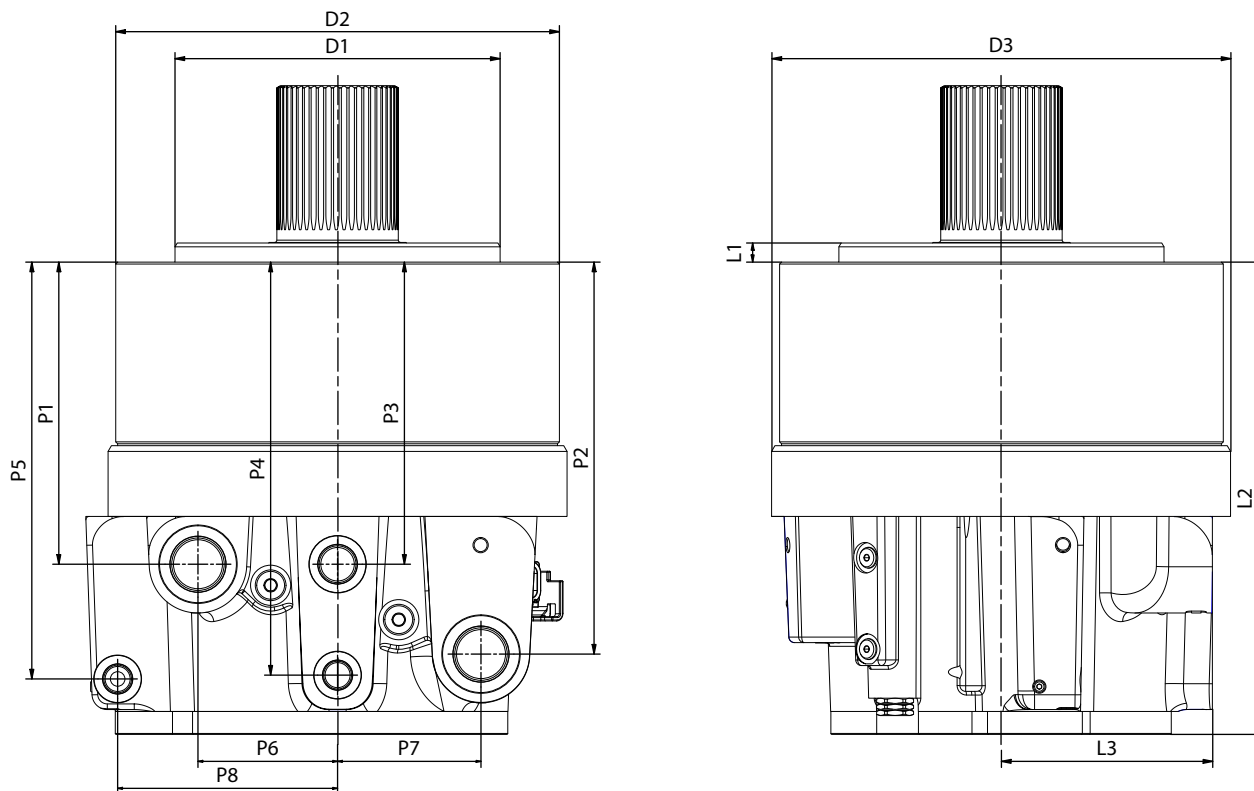
Motor		D1	D2	D3
CLM 8 S single speed	mm	Ø200	Ø300	Ø240

Motor		P1	P2	P3	P4	P6	P7
CLM 8 S single speed	mm	158	178.5	158	201	73	75

CLM 8 S motor

Two-speed motor

S09: 16-hole circular mounting flange



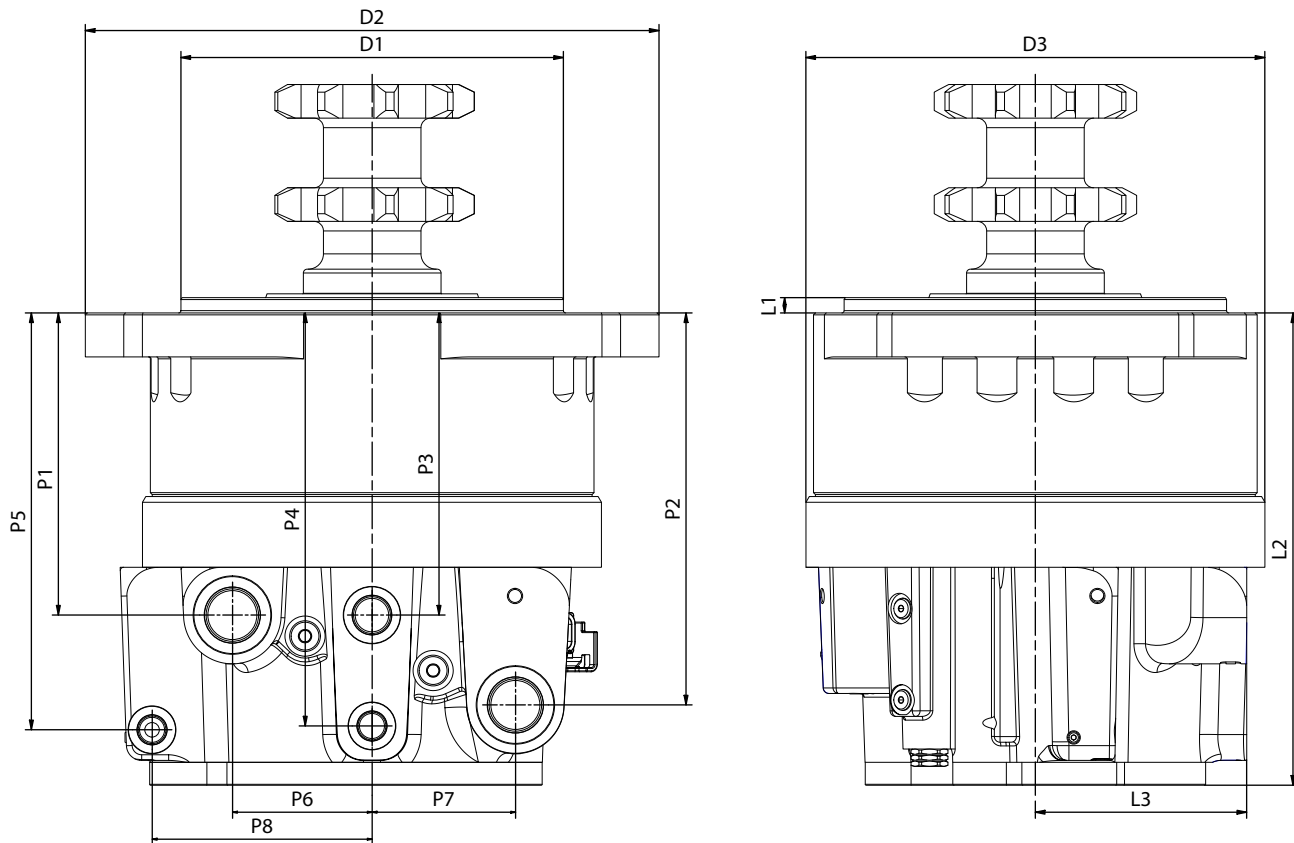
Motor		L1	L2	L3
CLM 8 S two-speed	mm	10	247	110.5

Motor		D1	D2	D3
CLM 8 S two-speed	mm	Ø170	Ø232	Ø240

Motor		P1	P2	P3	P4	P5	P6	P7	P8
CLM 8 S two-speed	mm	158	205	158	216	218	73	75	115

CLM 8 S motor

S11: 8-hole oval mounting flange - Parallel



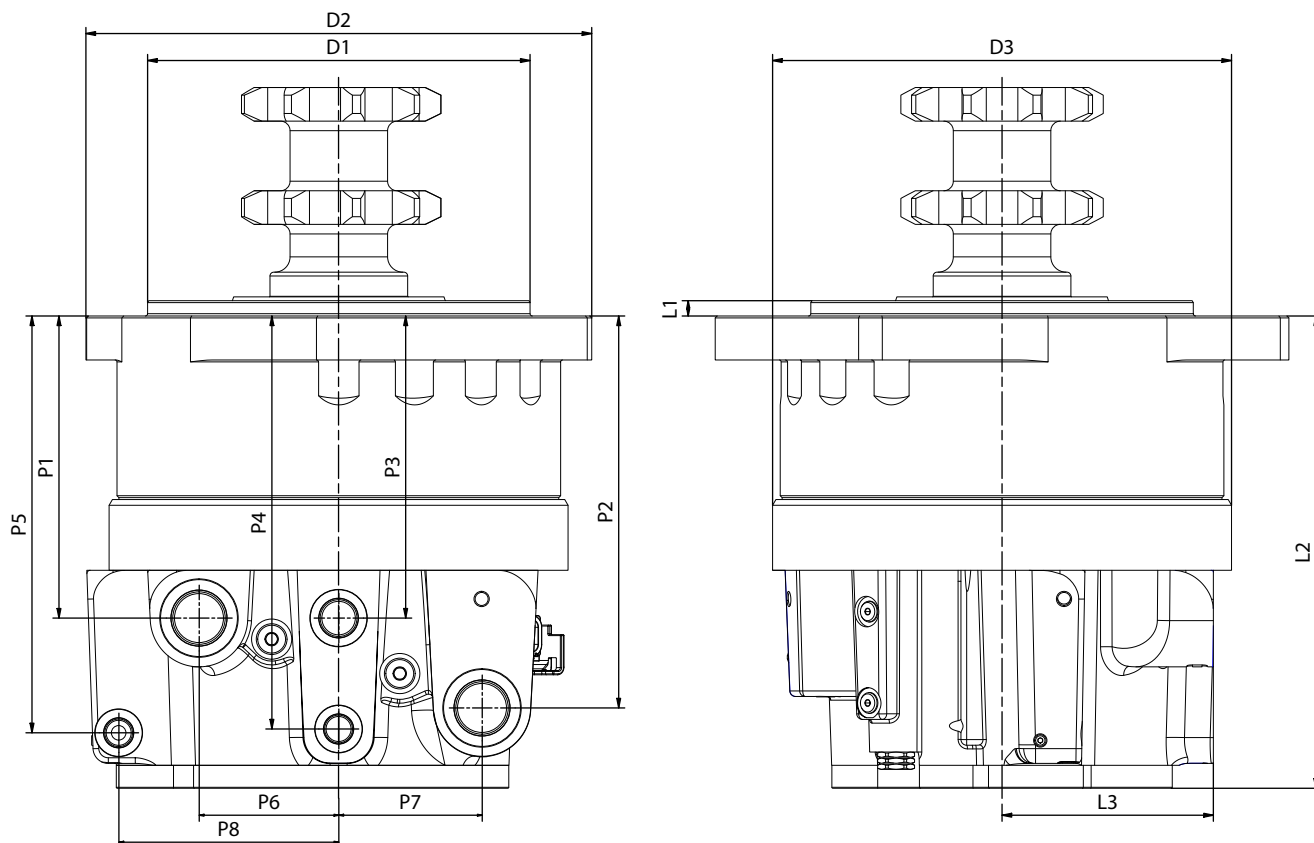
Motor		L1	L2	L3
CLM 8 S two-speed	mm	8	247	110.5

Motor		D1	D2	D3
CLM 8 S two-speed	mm	Ø200	Ø300	Ø240

Motor		P1	P2	P3	P4	P5	P6	P7	P8
CLM 8 S two-speed	mm	158	205	158	216	218	73	75	115

CLM 8 S motor

S14: 8-hole oval mounting flange – 60 degrees rotation



Motor		L1	L2	L3
CLM 8 S two-speed	mm	8	247	110.5

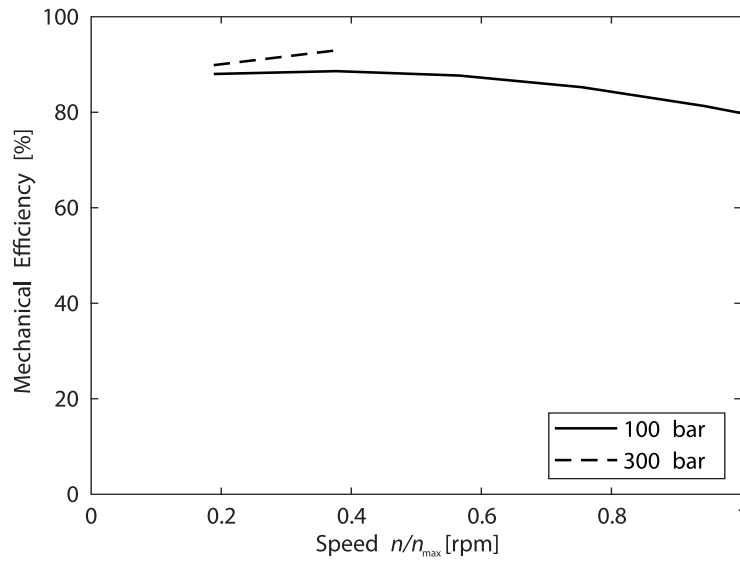
Motor		D1	D2	D3
CLM 8 S two-speed	mm	Ø200	Ø300	Ø240

Motor		P1	P2	P3	P4	P5	P6	P7	P8
CLM 8 S two-speed	mm	158	205	158	216	218	73	75	115

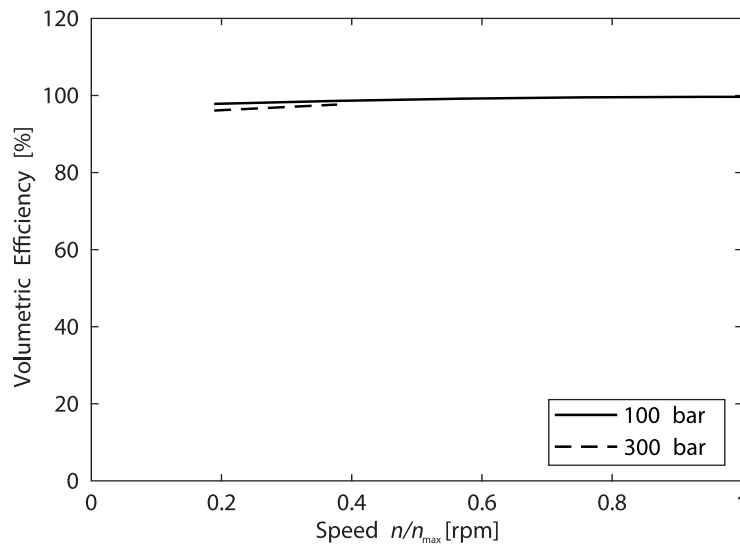
CLM 8 S motor

Efficiency curves

Mechanical efficiency



Volumetric efficiency



Ordering Information

Model Code (A-B-C-D-E-F)

A	B	C	D	E	F	G	H	I	J₁	J₂	J₃	K	L	M₁	M₂	N	O	P₁	P₂	P₃						
C	L	M	0	8	S												S	P	D	D	N	N	N	N	N	N

A – Product type

Code	Description
CLM	THORX motor

B – Frame size

Code	Description
08	Frame size

C – Housing type

Code	Description
S	Front case mounting flange

D – Nominal size

Code	Description
0470	470 cc/rev (313 cc/rev reduced displacement)
0520	520 cc/rev (347 cc/rev reduced displacement)
0565	565 cc/rev (376 cc/rev reduced displacement)
0620	620 cc/rev (413 cc/rev reduced displacement)
0680	680 cc/rev (453 cc/rev reduced displacement)
0750	750 cc/rev (500 cc/rev reduced displacement)
0820	820 cc/rev (547 cc/rev reduced displacement)

E – Single/Two-speed operation

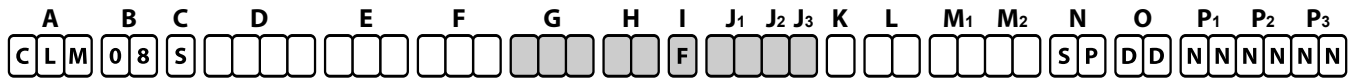
Code	Type	Description
1AN	Single Speed	Clockwise rotation (pressure to port B)
1BN		Counter-clockwise rotation (pressure to port B)
2AX	Two-Speed	Clockwise rotation (pressure to port B)
2BX		Counter-clockwise rotation (pressure to port B)

F – Mounting flange

Code	Type	Description
S08	Universal flange	6-hole circular mounting flange Ø232
S09		16-hole circular mounting flange Ø232
S11	A flange	8-hole oval mounting flange Ø300 – Parallel
S14		8-hole oval mounting flange Ø300 – 60 degrees rotation

Ordering Information

Model Code (G-H-I-J)



G – Drive shaft

Code	Type	Description
A08	Splined shaft	Ø60 ANSI B92.1
A13		Ø68.5 ANSI B92.1
S11	Sprocket shaft (ANSI B29.1)	Sprocket shaft - 9 teeth
S13		Sprocket shaft - 11 teeth
S14		Sprocket shaft - 12 teeth
S15		Sprocket shaft - 14 teeth

H – Brake options

Code	Description
NN	Without brake
SA	2,200 Nm spring applied hydraulic release multi-disc holding brake (ISO10265)

I – Sealing options

Code	Description
F	FKM (Viton) high temperature seal – Standard sealing

J₁ – Porting options – Inlet ports

Code	Type	Description
1B	Metric threads	ISO Metric 6149-1, M22 x 1.5
1C		ISO Metric 6149-1, M27 x 2.0
2A	BSP threads	ISO 1179-1, G 1/2 BSP
2B		ISO 1179-1, G 3/4 BSP
3A	UNF threads	UNF (SAE J514), 3/4 " - 16 UNF
3C		UN (SAE J514), 1 1/16 " - 12 UN

J₂ – Porting options – Case drain port

Code	Type	Description
C	Metric threads	ISO Metric 6149-1, M18 x 1.5
F	BSP threads	ISO 1179-1, G 3/8 BSP
I	UNF threads	UNF (SAE J514), 3/4 " - 16 UNF

J₃ – Porting options – Brake release & Two-speed ports

Code	Type	Description
B	Metric threads	ISO Metric 6149-1, M16 x 1.5
E	BSP threads	ISO 1179-1, G 1/4 BSP
I	UNF threads	UNF (SAE J514), 9/16 " - 18 UNF

Ordering Information

Model Code (K-L-M)



K – Speed sensor

Code	Description
N	Without speed sensor
R	Speed sensor Ready
A	Danfoss Speed sensor with 120 pulses/rev., DEUTSCH 6-Pin DTM 04 connector

L – Valve options

Code	Type	Description
NN	No flushing	No flushing
CA	Closed circuit systems ¹⁾	Ø0.8mm orifice, 2.7 l/min flow at 24 bar
CB		Ø1.4mm orifice, 5.6 l/min flow at 24 bar
CC		Ø1.2mm orifice x 2, 7.6 l/min flow at 24 bar
CD		Ø1.4mm orifice x 2, 9.5 l/min flow at 24 bar

¹⁾ Cracking pressure = 10.34 bar

M₁ – Paint options – Color

Code	Description
NN	No paint
SB	Standard black primer

M₂ – Paint options – Masking

Code	Type	Description
NN	No paint	No masking
10	Painted	Shaft and Mounting flange

Ordering Information

Model Code (N-O-P)

A	B	C	D	E	F	G	H	I	J₁	J₂	J₃	K	L	M₁	M₂	N	O	P₁	P₂	P₃						
C	L	M	0	8	S							F					S	P	D	D	N	N	N	N	N	N

N – Packaging

Code	Description
SP	Single pack

O – Name tag

Code	Description
DD	Danfoss name tag - with data matrix

P₁ – Special features – Internal

Code	Description
NN	None

P₂ – Special features – External

Code	Description
NN	None

P₃ – Special features – Other

Code	Description
NN	None

Products we offer:

- Cartridge valves
- DCV directional control valves
- Electric converters
- Electric machines
- Electric motors
- Gear motors
- Gear pumps
- Hydraulic integrated circuits (HICs)
- Hydrostatic motors
- Hydrostatic pumps
- Orbital motors
- PLUS+1® controllers
- PLUS+1® displays
- PLUS+1® joysticks and pedals
- PLUS+1® operator interfaces
- PLUS+1® sensors
- PLUS+1® software
- PLUS+1® software services, support and training
- Position controls and sensors
- PVG proportional valves
- Steering components and systems
- Telematics

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