ENGINEERING
TOMORROW

Technical Information

THORX Motors
CLM T

www.danfoss.com

Revision history

Table of revisions

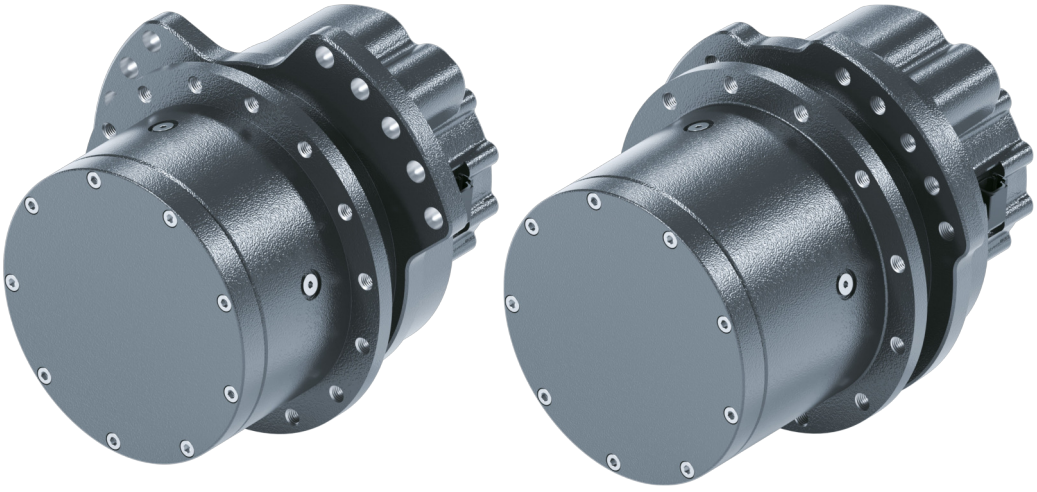
Date	Changed	Rev
October 2024	First edition	0101

Contents

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 T 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.

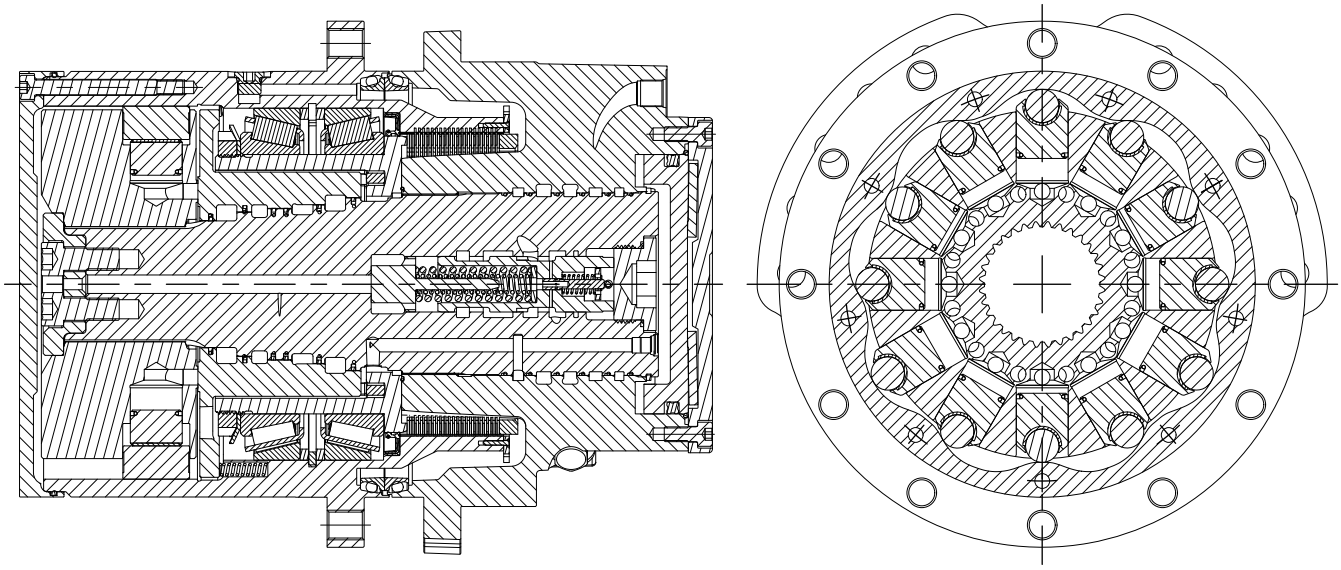
Danfoss has designed the CLM T to fit perfectly for construction machines with track drives, such as Compact Track Loaders. It is optimized for these applications with focus on physical size, longer lifetime, performance, and total installed cost.



Customer Benefits

Designed for the toughest jobs, our CLM T motors are engineered with our customers in mind. The novel shape with central flange fully utilizes the space within even the smallest tracks, making installation easier. THORX Motors features a market leading high efficiency, smooth speed changeover, longer lifetime and integrated parking brake.

Functional Description



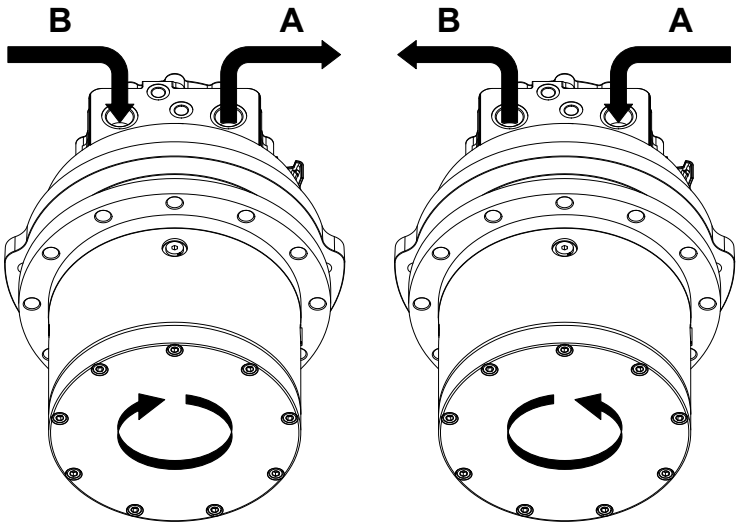
Sectional drawing of CLM 12 T

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

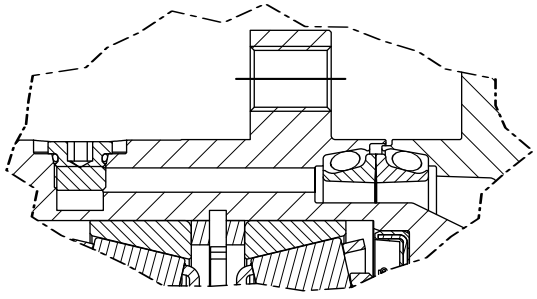
The THORX motors are based on a bidirectional design which provides the same performance in clockwise rotation as counterclockwise rotation. This provides a clear benefit in drivetrain solutions where the motor needs to reverse and don't go down in performance.

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

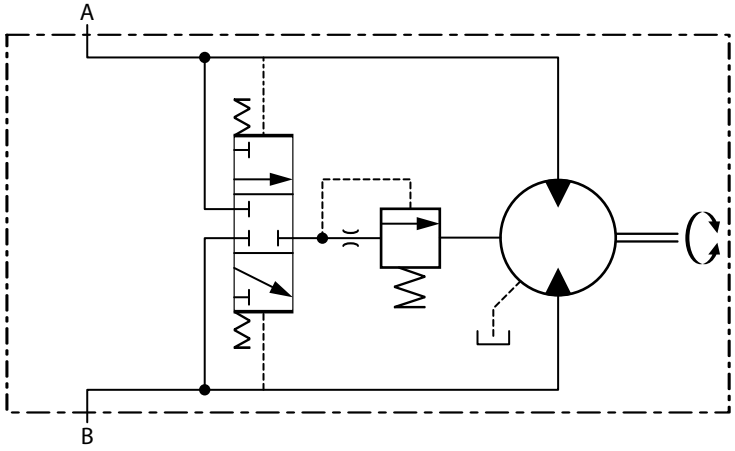
Dirt ingress sealing

The CLM T is fitted with a robust mechanical face seal to prevent dirt ingress from the track environment. High specification materials are used in the seal to provide wear and corrosion resistance with high-temperature HNBR energizers to maintain constant seal compression.

The mechanical face seal is lubricated by assembly fill of oil hydraulic oil. 3 fill and drain plugs, accessible from the front of the motor are provided for replacement at service intervals.



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.

Functional Description

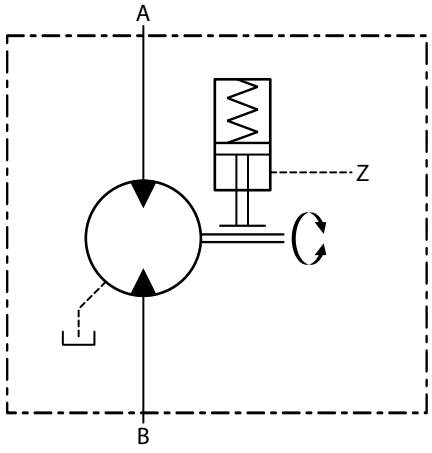
Closed-circuit options

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.

Integrated parking brake

The integrated parking brake is a 6,000 Nm [53,100 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.

Motor case sealing

The CLM T features a robust shaft seal suitable for high case pressure and temperature.

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

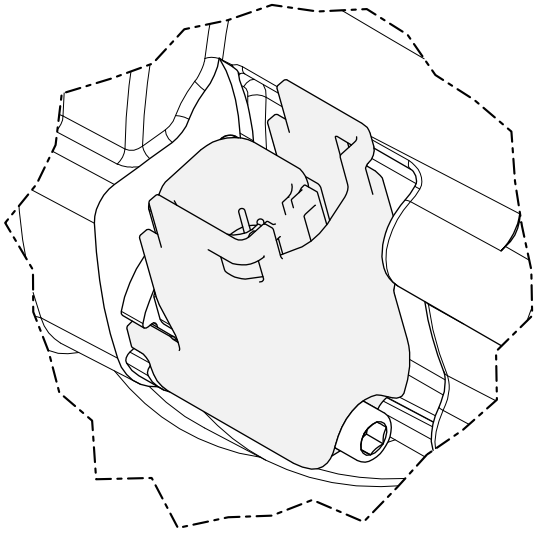
[1] Intermittent operation: the permissible value may occur for less than 1 min per incident and not exceeding 2 % of duty cycle

Functional Description

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

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.



Visualization of Danfoss speed sensor, incl. protective cover

For further details on Danfoss Speed Sensor please refer to document ID *BC152886482203en*

Target ring

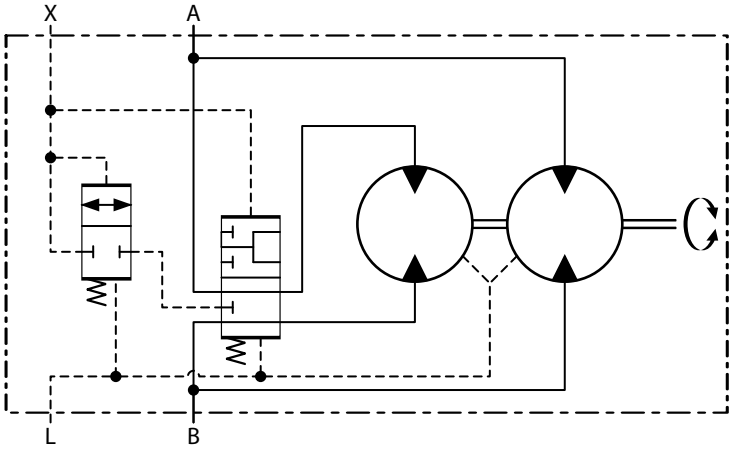
Speed (target) rings may vary according to THORX motor family and frame size, please refer to the below table for the number of teeth on your motor:

The number of speed (target) ring teeth

Motor	CLM 9 T	CLM 12 T
Teeth	100	100

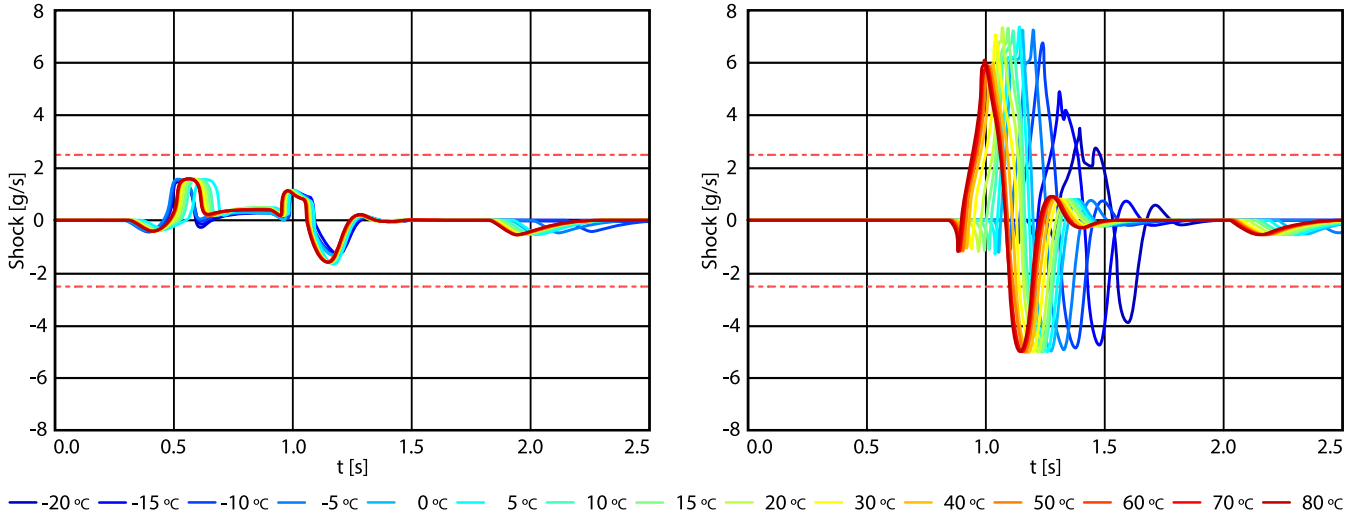
Functional Description

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.



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 T motor

On the following pages you will find technical specifications of the CLM 9 T and CLM 12 T.

CLM T motor

Technical Data

CLM 9 T specifications

Type			CLM 9 T			
Nominal size			**680**	**750**	**820**	**920**
Geometric displacement	cm^3 [in^3]	Full displacement	680 [41.5]	750 [45.8]	820 [50.0]	920 [56.1]
		Reduced displacement[1)]	453 [27.6]	500 [30.5]	547 [33.4]	613 [37.4]
Maximum speed	min^{-1} [rpm]	Single speed motor	277	251	230	205
		Two-speed motor	338	307	280	250
Maximum torque	Nm [lbf·in]	Continuous	2,705 [23,940]	2,980 [26,375]	3,260 [28,850]	3,660 [32,390]
		Peak[2)]	4,545 [40,225]	5,015 [44,375]	5,480 [48,500]	6,150 [54,425]
Maximum power	kW [hp]	Full displacement, continuous	35 [48]			
		Reduced displacement[1)], continuous	35 [48]			
Maximum working pressure	bar [psi]	Nominal pressure[3)]	250 [3,625]			
		Max differential pressure (peak[2)])	450 [6,525]			
Minimum starting torque	Nm [lbf·in]	at max. press. drop cont.	1,890 [16,725]	2,085 [18,450]	2,280 [20,180]	2,560 22,655[]
		at max. press. drop peak[2)]	3,405 [30,135]	3,760 [33,275]	4,110 [36,375]	4,610 [40,800]
Weight[4)]	kg [lbs]	Single speed motor	80 [176]			
		Two-speed motor	80 [176]			

[1)] Standard two-speed ratio is 2:3

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

[3)] Nominal values are guide values for max. continuous operation

[4)] 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 T motor

CLM 12 T specifications

Type			CLM 12 T					
Nominal size			**1070**	**1120**	**1180**	**1210**	**1270**	**1340**
Geometric displacement	cm^3 [in^3]	Full displacement	1,070 [65.3]	1,120 [68.3]	1,180 [72.0]	1,210 [73.8]	1,270 [77.5]	1,340 [81.8]
		Reduced displacement[1)]	713 [43.5]	747 [45.6]	787 [48.0]	807 [49.2]	847 [51.7]	893 [54.5]
Maximum speed	min^{-1} [rpm]	Single speed motor	185	180	170	165	160	155
		Two-speed motor	255	245	230	225	215	205
Maximum torque	Nm [lbf·in]	Continuous	4,255 [37,660]	4,455 [39,430]	4,695 [41,555]	4,810 [42,570]	5,050 [44,695]	5,330 [47,175]
		Peak[2)]	7,150 [63,280]	7,485 [66,245]	7,885 [69,790]	8,085 [71,560]	8,490 [75,140]	8,955 [79,260]
Maximum power	kW [hp]	Full displacement, continuous	50 [67]					
		Reduced displacement[1)], continuous	50 [67]					
Maximum working pressure	bar [psi]	Nominal pressure[3)]	250 [3,625]					
		Max differential pressure (peak[2)])	450 [6,525]					
Minimum starting torque	Nm [lbf·in]	at max. press. drop cont.	2,980 [26,375]	3,120 [27,615]	3,285 [29,075]	3,370 [29,825]	3,535 [31,285]	3,730 [33,015]
		at max. press. drop peak[2)]	5,365 [47,485]	5,615 [49,695]	5,915 [52,350]	6,065 [53,680]	6,365 [56,335]	6,715 [59,430]
Weight[4)]	kg [lbs]	Single speed motor	90 [198]					
		Two-speed motor	90 [198]					

[1)] Standard two-speed ratio is 2:3

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

[3)] Nominal values are guide values for max. continuous operation

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CLM T motor

Hydraulic fluid specifications

Features		Units	CLM T
Viscosity	Intermittent[1]	mm2/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

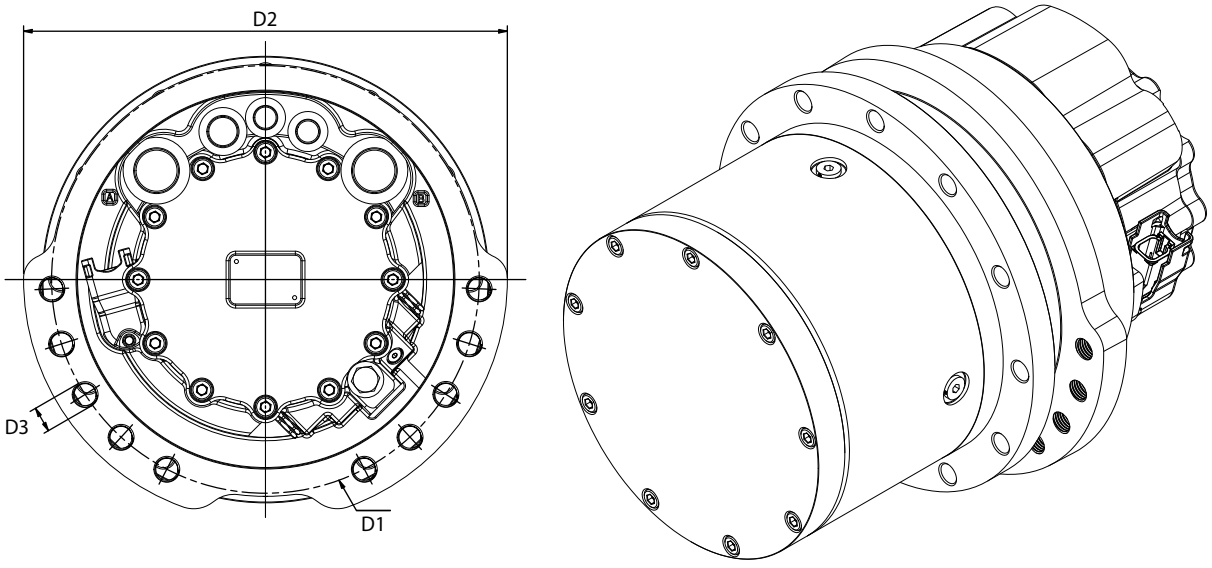
[2] Cold start is defined as less than 3 minutes and with pressure not exceeding 50 bar [725 psi]

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

CLM T motor

Housings

Tx2: 10-hole (M16) loose ear mounting flange Ø272

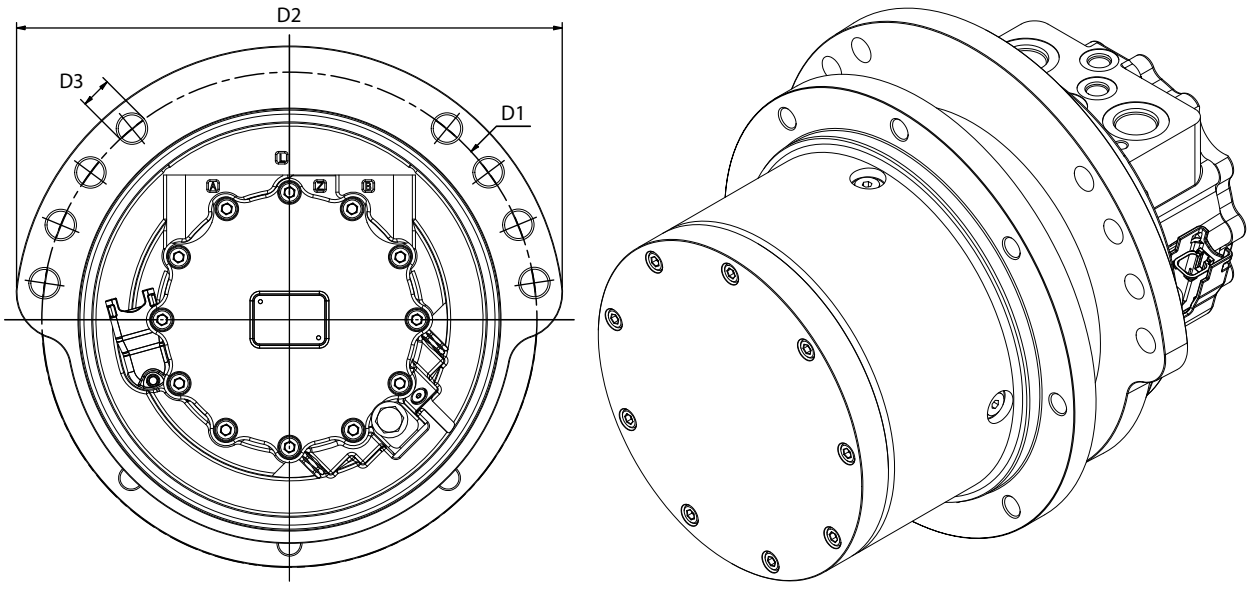


Visualization of CLM12 T with TA2 mounting flange (axial port configuration)

Motor		D1	D2	D3
CLM 9 T	mm	Ø272	Ø308	10 x M16x2.0
CLM 12 T	mm	Ø272	Ø308	10 x M16x2.0

CLM T motor

Tx5: 8-hole (Ø17.5) loose ear mounting flange Ø315



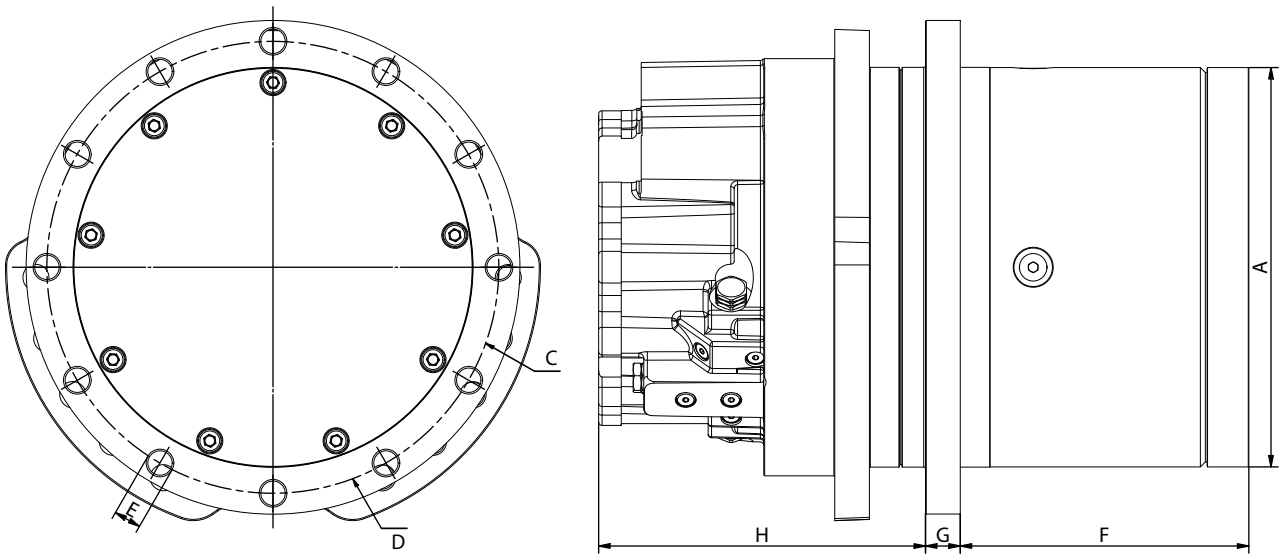
Visualization of CLM12 T with TV5 mounting flange (vertical port configuration)

Motor		D1	D2	D3
CLM 9 T	mm	Ø315	Ø350	8 x Ø17.5
CLM 12 T	mm	Ø315	Ø350	8 x Ø17.5

CLM T motor

Shafts

T01: Ø260 Wheel Drive 12 bolt (M16)

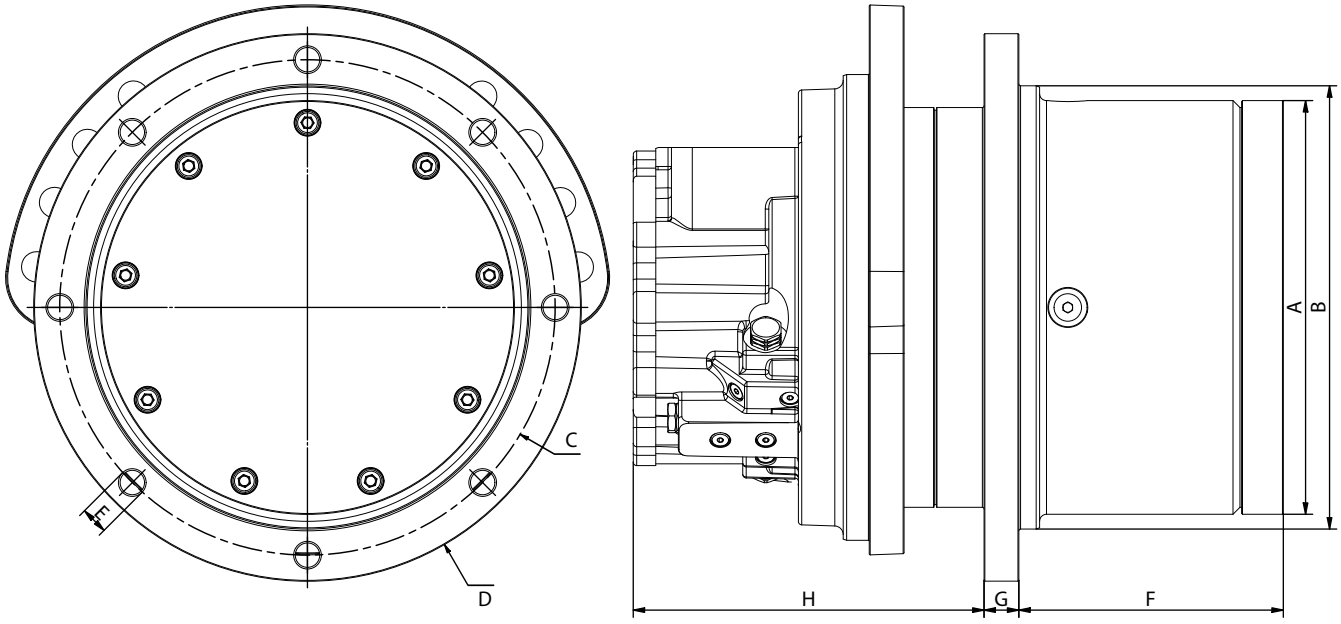


Visualization of CLM 12 T with TA2 flange (axial port configuration)

Shaft		A	C	D	E	F	G	H
CLM 9 T	mm	Ø230	Ø260	Ø284	M16x2.0	166	20	148
CLM 12 T	mm	Ø230	Ø260	Ø284	M16x2.0	166	20	188

CLM T motor

T06: Ø285 Wheel Drive 8 bolt (M16)



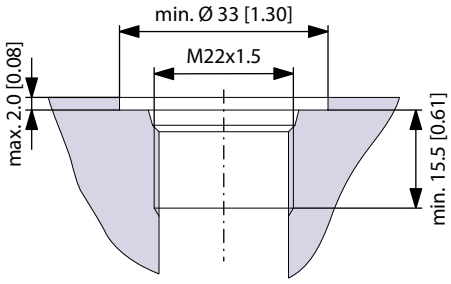
Visualization of CLM 12 T with TV5 flange (vertical port configuration)

Shaft		A	B	C	D	E	F	G	H
CLM 9 T	mm	Ø238	Ø255	Ø285	Ø315	M16x2.0	152	20	162
CLM 12 T	mm	Ø238	Ø255	Ø285	Ø315	M16x2.0	152	20	202

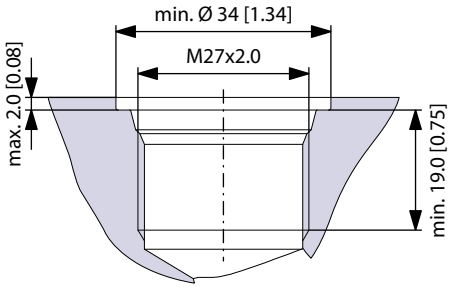
CLM T motor

Port thread options

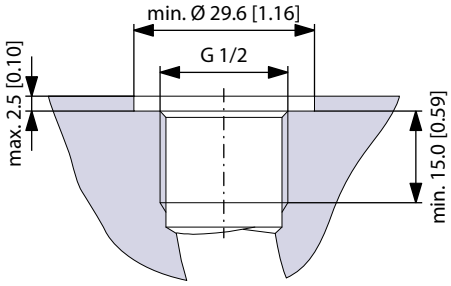
Inlet ports



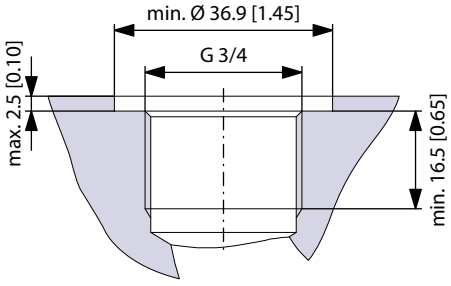
1B M22 x 1.5 ISO 6149



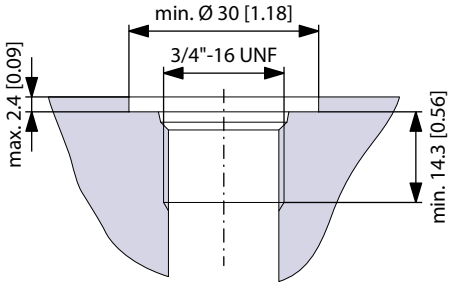
1C M27 x 2.0 ISO 6149



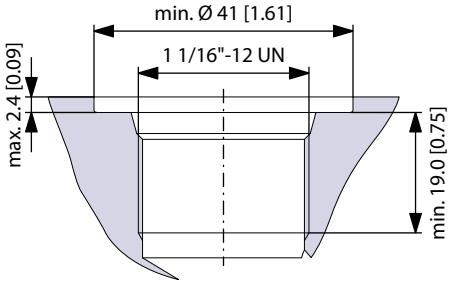
2A G 1/2 BSP, ISO 1179-1



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



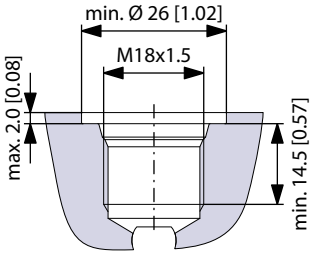
3A UNF 3/4" – 16 (SAE J514)



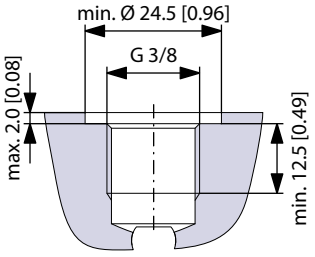
3C UN 1 1/16" – 12 (SAE J514)

CLM T motor

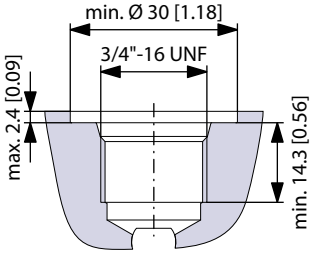
Case drain port



C M18 x 1.5 ISO 6149



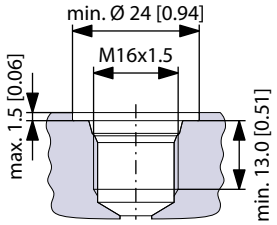
F G 3/8 BSP, ISO 1179-1



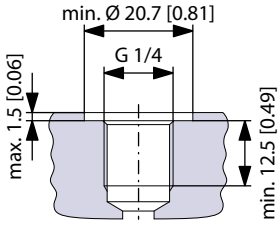
I UNF 3/4" – 16 (SAE J514)

CLM T motor

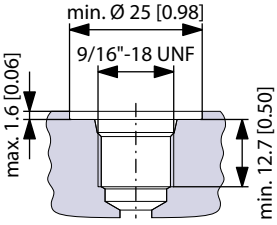
Brake release & 2-speed ports



B M16 x 1.5 ISO 6149



E G 1/4 BSP, ISO 1179-1

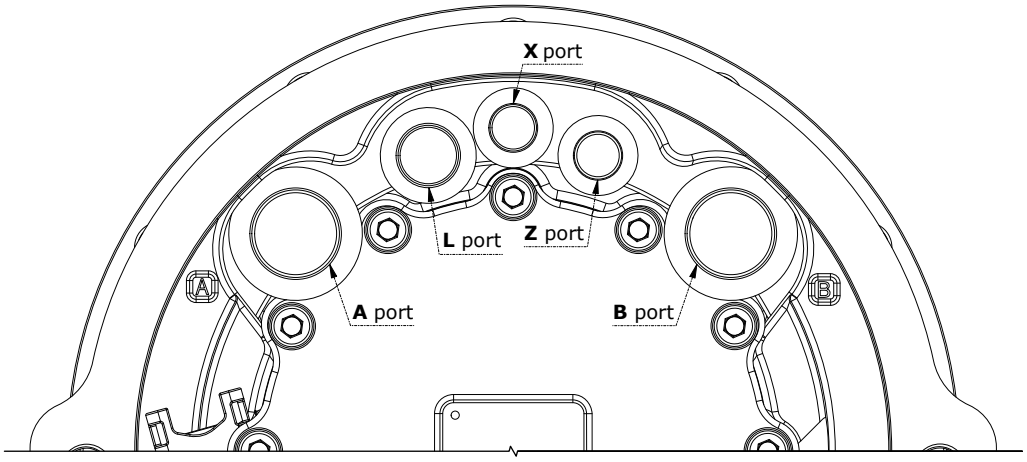


I UNF 9/16" – 18 (SAE J514)

CLM T motor

Manifold layout

Axial port configuration

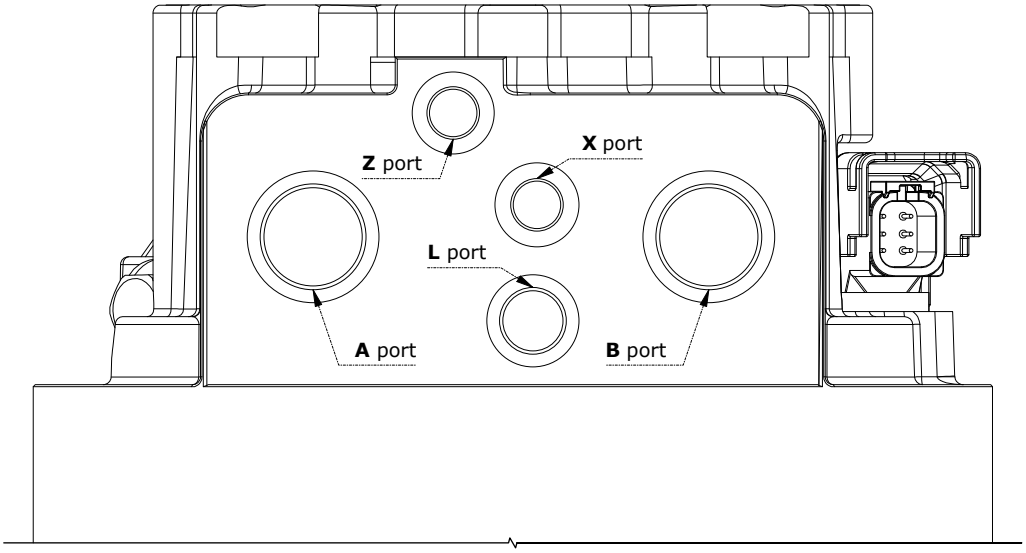


Thread type	Inlet ports (A+B)	Case drain port (L)	Brake release port (Z)	2-speed port (X)
Metric (ISO 6149-1)	M22 x 1.5	M18 x 1.5	M16 x 1.5	M16 x 1.5
	M27 x 2.0			
BSP (ISO 1179-1)	G 1/2	G 3/8	G 1/4	G 1/4
	G 3/4			
UNF (SAE J514)	3/4 " - 16 UNF	3/4 " - 16 UNF	9/16 " - 18 UNF	9/16 " - 18 UNF
	1 1/16 "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

Dimensions for port positions see: See Dimensions.

CLM T motor

Vertical port configuration



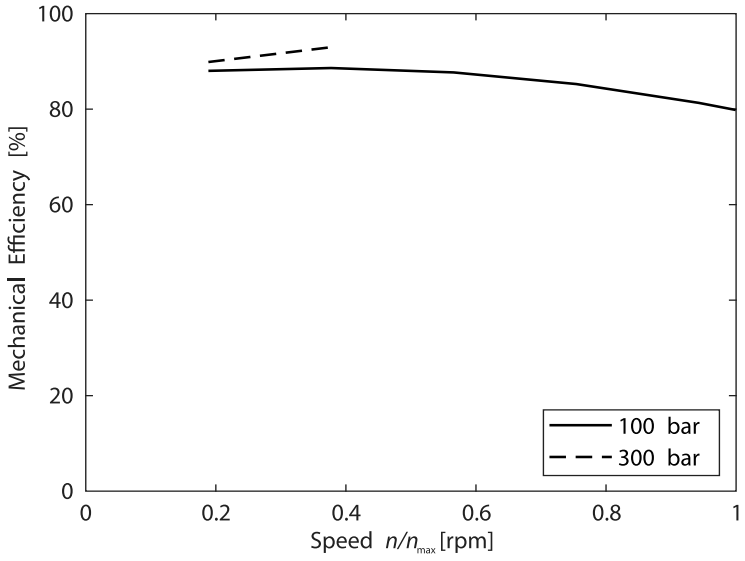
Thread type	Inlet ports (A+B)	Case drain port (L)	Brake release port (Z)	2-speed port (X)
Metric (ISO 6149-1)	M22 x 1.5	M18 x 1.5	M16 x 1.5	M16 x 1.5
	M27 x 2.0			
BSP (ISO 1179-1)	G 1/2	G 3/8	G 1/4	G 1/4
	G 3/4			
UNF (SAE J514)	3/4 " - 16 UNF	3/4 " - 16 UNF	9/16 " - 18 UNF	9/16 " - 18 UNF
	1 1/16 " - 12 UN			
Split flange (SAE J518)	3/4 " - SAE J518	3/4 " - 16 UNF	9/16 " - 18 UNF	9/16 " - 18 UNF

Dimensions for port positions see: See Dimensions.

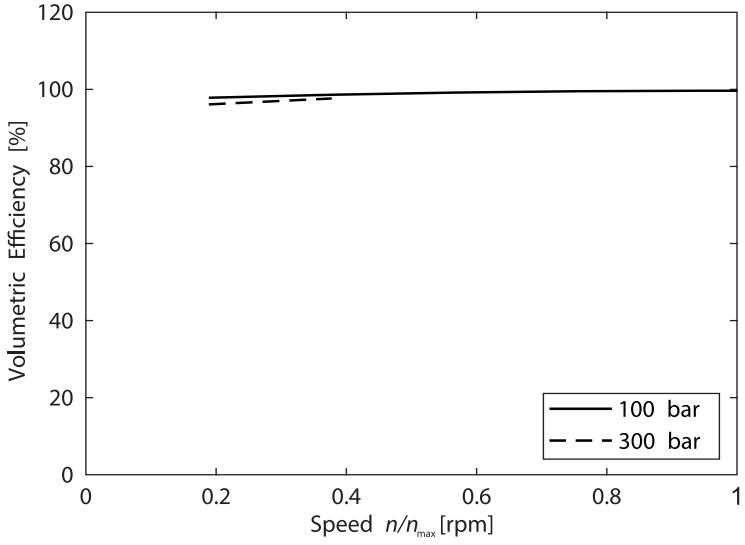
CLM T motor

Efficiency curves

Mechanical efficiency

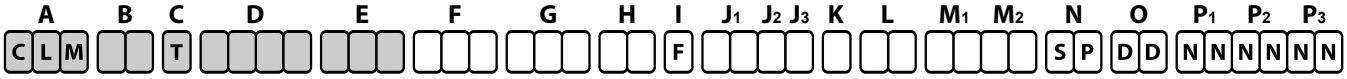


Volumetric efficiency



Ordering Information

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



A – Product type

Code	Description
CLM	THORX motor

B – Frame size

Code	Description
09	Frame size
12	Frame size

C – Housing type

Code	Description
T	Track drive motor

D – Nominal size

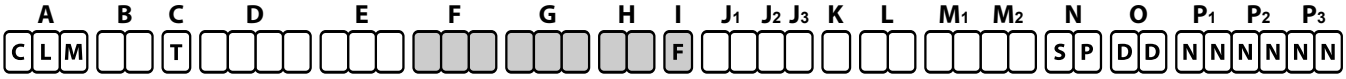
Code	Type	Description
0680	Frame size 09	680 cc/rev (453 cc/rev reduced displacement)
0750		750 cc/rev (500 cc/rev reduced displacement)
0820		820 cc/rev (547 cc/rev reduced displacement)
0920		920 cc/rev (613 cc/rev reduced displacement)
1070	Frame size 12	1,070 cc/rev (713 cc/rev reduced displacement)
1120		1,120 cc/rev (747 cc/rev reduced displacement)
1180		1,180 cc/rev (787 cc/rev reduced displacement)
1210		1,210 cc/rev (807 cc/rev reduced displacement)
1270		1,270 cc/rev (847 cc/rev reduced displacement)
1340		1,340 cc/rev (893 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)

Ordering Information

Model Code (F-G-H-I)



F – Mounting flange

Code	Type	Description
TA1	Axial Port configuration	10-hole (Ø16.5) loose ear mounting flange Ø264
TA2		10-hole (Ø16.5) loose ear mounting flange Ø272
TA3		10-hole (Ø17.5) loose ear mounting flange Ø323
TA4		8-hole (Ø17.5) loose ear mounting flange Ø342
TA5		8-hole (Ø17.5) loose ear mounting flange Ø315
TV1	Vertical Port configuration	10-hole (Ø16.5) loose ear mounting flange Ø264
TV2		10-hole (Ø16.5) loose ear mounting flange Ø272
TV3		10-hole (Ø17.5) loose ear mounting flange Ø323
TV4		8-hole (Ø17.5) loose ear mounting flange Ø342
TV5		8-hole (Ø17.5) loose ear mounting flange Ø315

G – Drive shaft

Code	Type	Description
T22	Metric	Ø260 Wheel Drive 12 bolt (M14x2)
T01		Ø260 Wheel Drive 12 bolt (M16x2)
T03		Ø285 Wheel Drive 12 bolt (M16x2)
T06		Ø285 Wheel Drive 8 bolt (M16x2)
T04	UNC	Ø260 Wheel Drive 12 bolt (1/2-13 UNC 2B)
T05		Ø285 Wheel Drive 12 bolt (5/8-11 UNC 2)

H – Brake options

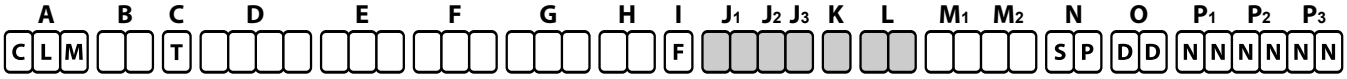
Code	Description
NN	Without brake
TA	6,000 Nm spring applied hydraulic release multi-disc holding brake (ISO10265)

I – Sealing options

Code	Description
F	High temperature sealing

Ordering Information

Model Code (J-K-L)



J_1 – 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
SA	Split flange	3/4 " (SAE J518)

J_2 – 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

J_3 – Porting options – Brake release & 2-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

K – Speed sensor

Code	Description
N	Without speed sensor
R	Speed sensor Ready
A	Danfoss Speed sensor w. DEUTSCH 6-Pin DTM 04 connector

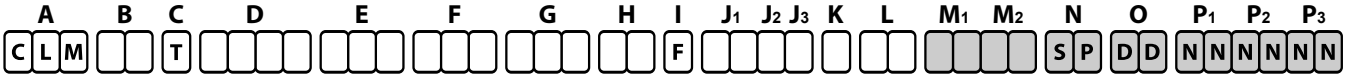
L – Valve options

Code	Type	Description
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

Ordering Information

Model Code (M-N-O-P)



M_1 – Paint options – Color

Code	Description
NN	No paint
SB	Standard black primer

M_2 – Paint options – Masking

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

N – Packaging

Code	Description
SP	Single pack

O – Name tag

Code	Description
DD	Danfoss name tag - with data matrix

P_1 – Special features – Internal

Code	Description
NN	None

P_2 – Special features – External

Code	Description
NN	None

P_3 – Special features – Other

Code	Description
NN	None

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Danfoss
Power Solutions (US) Company
2800 East 13th Street
Ames, IA 50010, USA
Phone: +1 515 239 6000

Danfoss
Power Solutions GmbH & Co. OHG
Krokamp 35
D-24539 Neumünster, Germany
Phone: +49 4321 871 0

Danfoss
Power Solutions ApS
Nordborgvej 81
DK-6430 Nordborg, Denmark
Phone: +45 7488 2222

Danfoss
Power Solutions Trading (Shanghai) Co., Ltd.
Building #22, No. 1000 Jin Hai Rd
Jin Qiao, Pudong New District
Shanghai, China 201206
Phone: +86 21 2080 6201