

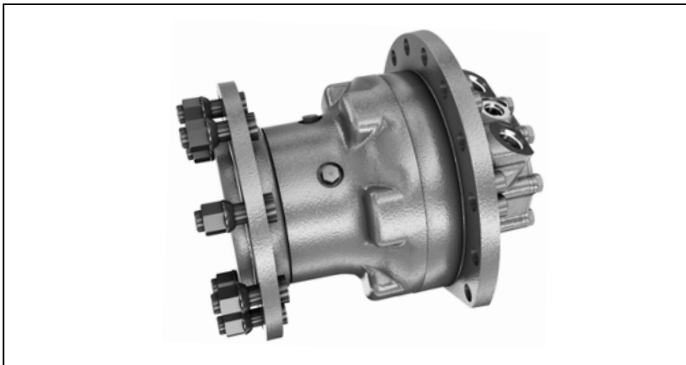
Radial piston motor for heavy duty wheel drives

MCR-W

RE 15200

Edition: 09.2017

Replaces 09.2015



- ▶ Frame size MCR3, MCR5, MCR10
- ▶ Displacement 160 cc to 1340 cc
- ▶ Differential pressure up to 450 bar
- ▶ Torque output up to 8530 Nm
- ▶ Speed up to 875 rpm
- ▶ Open and closed circuits

Features

- ▶ Compact robust construction
- ▶ High volumetric and mechanical efficiencies
- ▶ Rear case mount
- ▶ Wheel flange with wheel studs
- ▶ High reliability
- ▶ Low maintenance
- ▶ Smooth running at very low speeds
- ▶ Low noise
- ▶ Bi-directional
- ▶ Sealed tapered roller bearings
- ▶ High radial forces permitted on drive shaft
- ▶ Freewheeling possible
- ▶ Available with:
 - Holding brake (multi-disc), dynamic (drum) brake or Dynamic (disc) brake
 - Bi-directional two speed
 - Integrated flushing valve
 - Speed sensor

Contents

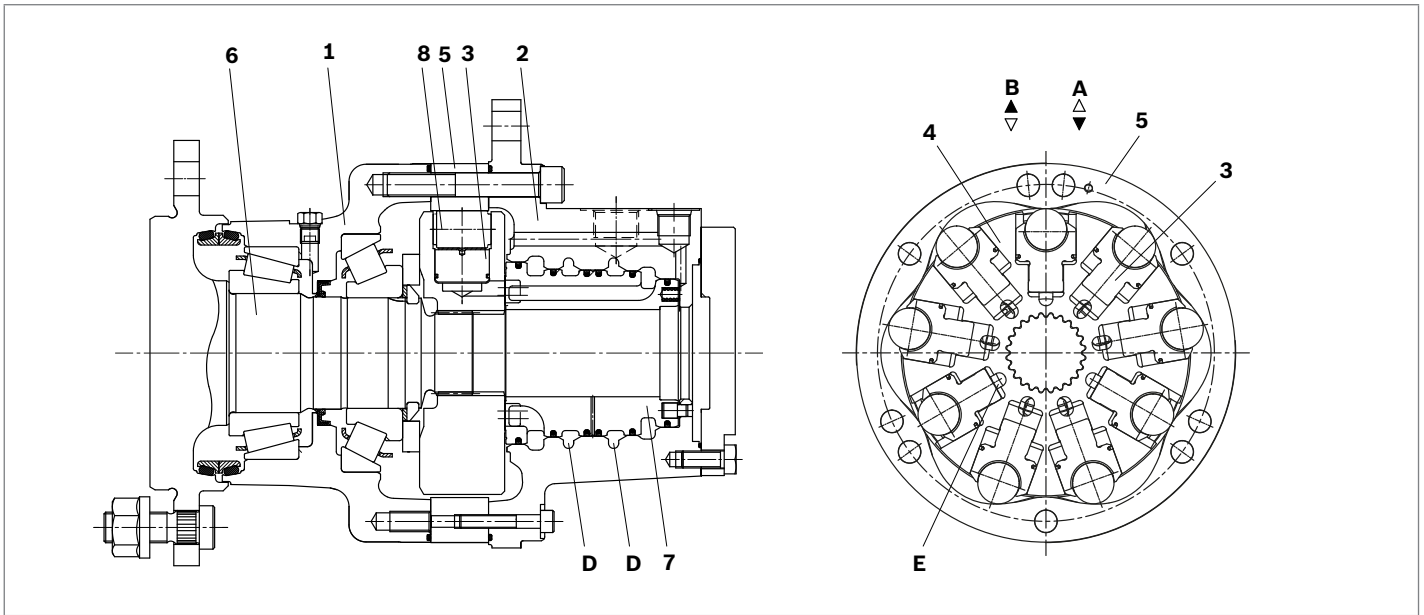
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Functional description



Hydraulic motors of the type MCR-W are radial piston motors with rear case mounting and wheel flange shaft. The MCR-W motors are intended for wheel drives in open or closed circuits. They are specially designed to withstand the most demanding conditions in different applications such as; Fork lift trucks, agricultural and forestry machines. Fitted with stronger shaft and bearings, the MCR-W provides 60 percent increase in radial load capacity compared to standard radial piston motors. The integrated wheel flange with studs allows easy installation of standard wheel rims.

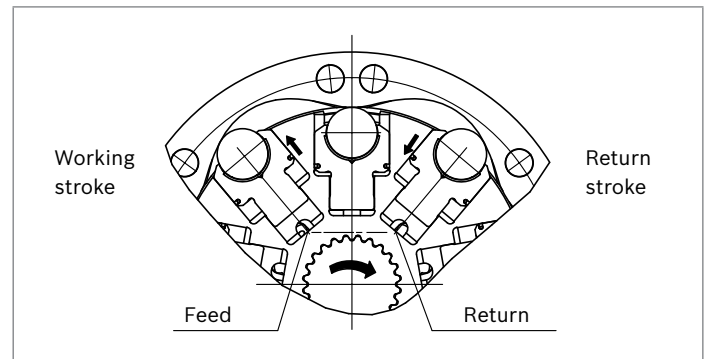
Construction

Two part housing (**1, 2**), rotary group (**3, 4, 8**), cam (**5**), drive shaft (**6**) and flow distributor (**7**)

Transmission

The cylinder block (**4**) is connected to the shaft (**6**) by means of splines. The pistons (**3**) are arranged radially in the cylinder block (**4**) and make contact with the cam (**5**) via rollers (**8**).

Torque generation



The number of working and return strokes corresponds to the number of lobes on the cam multiplied by number of pistons in the cylinder block.

Flow paths

The ports **A** and **B**, which are located in the rear case, carry oil through the distributor to the cylinder chambers (**E**).

Bearings

Tapered roller bearings capable of transmitting high axial and radial forces are fitted as standard.

Freewheeling

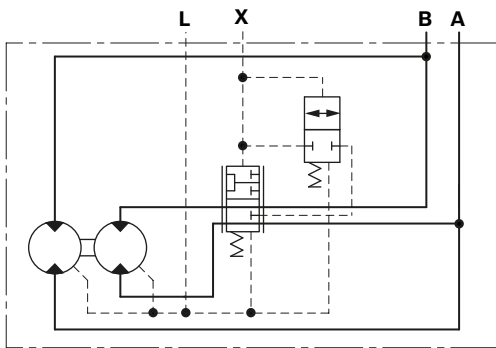
In certain applications there may be a requirement to free-wheel the motor. This may be achieved by connecting ports **A** and **B** to zero pressure and simultaneously applying a pressure of 2 bar to the housing through port **L**. In this condition, the pistons are forced into the cylinder block which forces the rollers to lose contact with the cam thus allowing free rotation of the shaft.

Two speed operation (2W)

In mobile applications where vehicles are required to operate at high speed with low motor loads, the motor can be switched to a low-torque and high-speed mode. This is achieved by operating an integrated valve which directs hydraulic fluid to only one half of the motor’s rotary group. This “reduced displacement” mode reduces the flow required for a given speed and gives the potential for cost and efficiency improvements. The motor maximum speed remains unchanged.

Bosch Rexroth has developed a special spool valve to allow smooth switching to reduced displacement whilst on the move. This is known as “soft-shift” and is a standard feature of 2W motors. The spool valve requires either an additional sequence valve or electro-proportional control to operate in “soft-shift” mode.

▼ **Schematic**



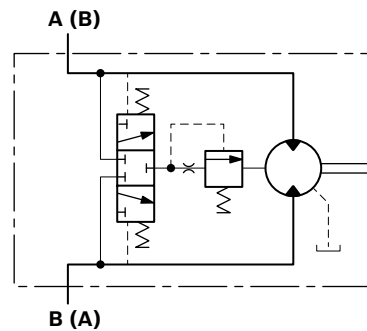
Flushing valve

In a closed circuit, the same hydraulic fluid continuously flows between the pump and the motor. This could therefore lead to overheating of the hydraulic fluid.

The function of the flushing valve option is to replace hydraulic fluid in the closed circuit with that from the reservoir. When the hydraulic motor is operated under load, either in the clockwise or anti-clockwise direction, the flushing valve opens and takes a fixed flow of fluid through an orifice from the low pressure side of the circuit. This flow is then fed to the motor housing and back to the reservoir normally via a cooler. In order to charge the low pressure side of the circuit, cool fluid is drawn from the reservoir and is fed to the pump inlet. Thus the flushing valve ensures a continuous renewal and cooling of the hydraulic fluid. The flushing feature incorporates a relief valve which is used to maintain a minimum boost pressure (options available, see data sheet 15225-01).

Different orifice sizes may be used to adjust the flushing flow to the application’s requirements. See data sheet 15225-01 for more details and available options.

▼ **Schematic**



Holding brake (multi-disc brake)

Mounting

By way of rear housing (2) and brake shaft (14).

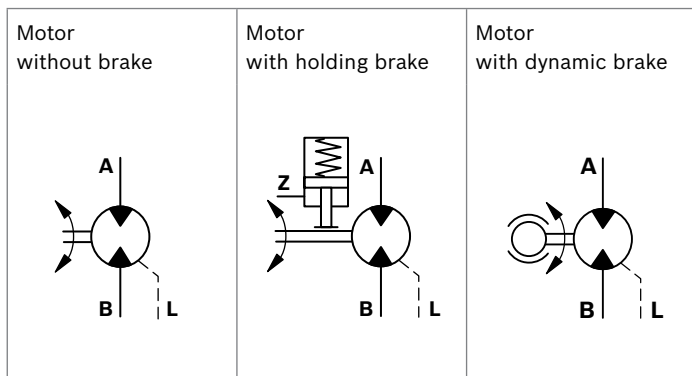
Brake application

As a safety requirement in mobile applications a parking brake may be provided to ensure that the motor cannot turn when the machine is not in use. The parking brake provides holding torque by means of discs (11) that are compressed by a disc spring (10). The brake is released when oil pressure is applied to brake port "Z" and the pressure in the annular area (9) compresses the disc spring using brake piston (12) thus allowing the brake discs (11) to turn independently.

Notice

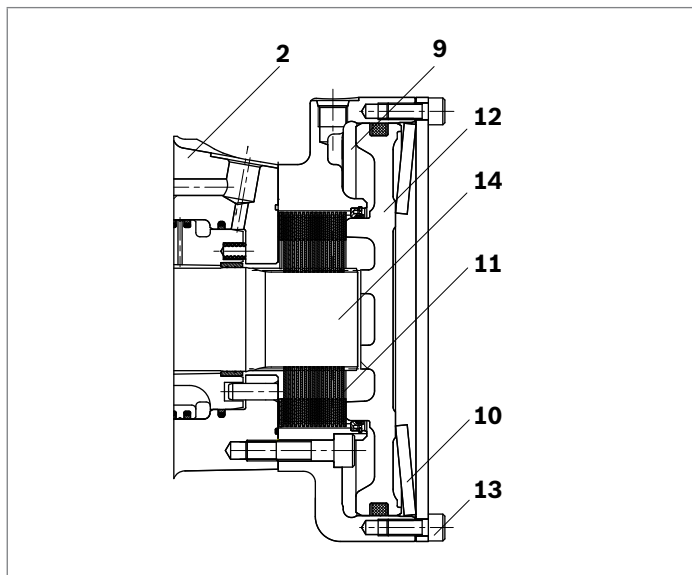
Brakes not for dynamic use!

Schematic diagrams



Manual release of holding brake

The brake may also be released manually by loosening screws (13).

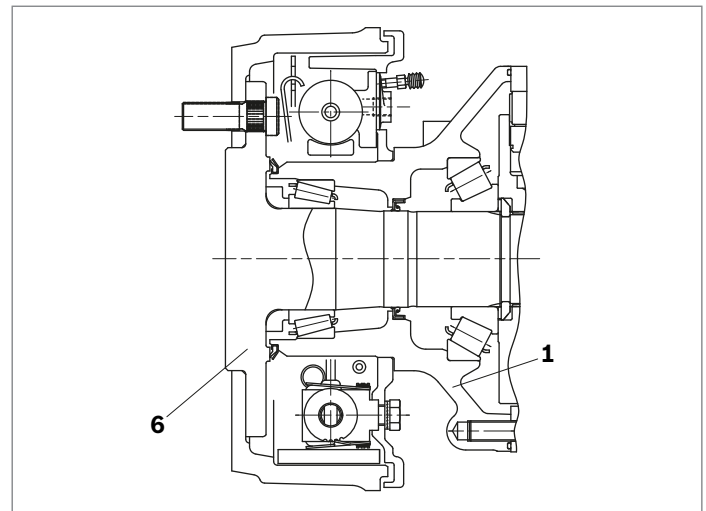


Dynamic brake

Where mechanical dynamic braking is required, a drum brake or disc brake may be specified.

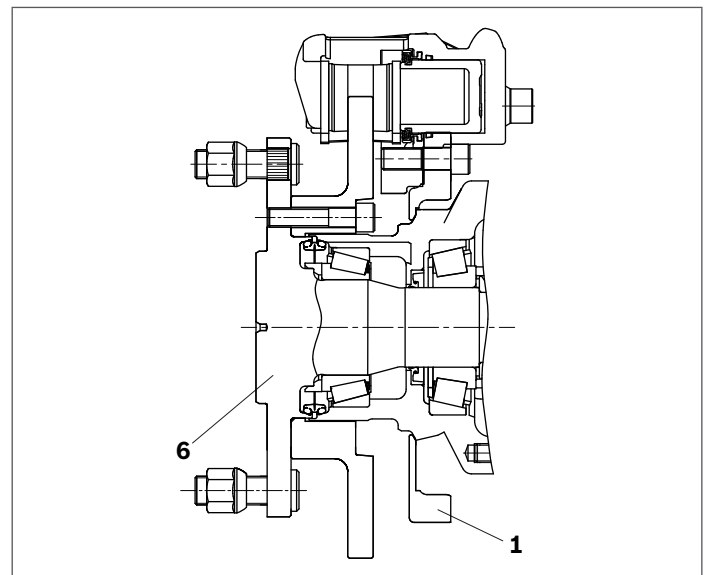
Drum brake

The drum brake is mounted directly onto the drive shaft (6) and front housing (1). Braking torque is provided by brake shoes acting on the inside of the drum. For dynamic braking the shoes are operated by a hydraulic cylinder, the shoes can also be operated mechanically by a cable to provide a static parking brake function.



Caliper disc brake

In applications where a more responsive dynamic brake is required a Caliper Disc Brake may be specified. The disc is mounted directly onto the shaft flange (6), the caliper is mounted on the motor front case via a caliper mounting bracket (1). Braking torque is provided by caliper acting on the disc. Other advantages of the Caliper Disc brake include greater reliability, faster response and less maintenance.

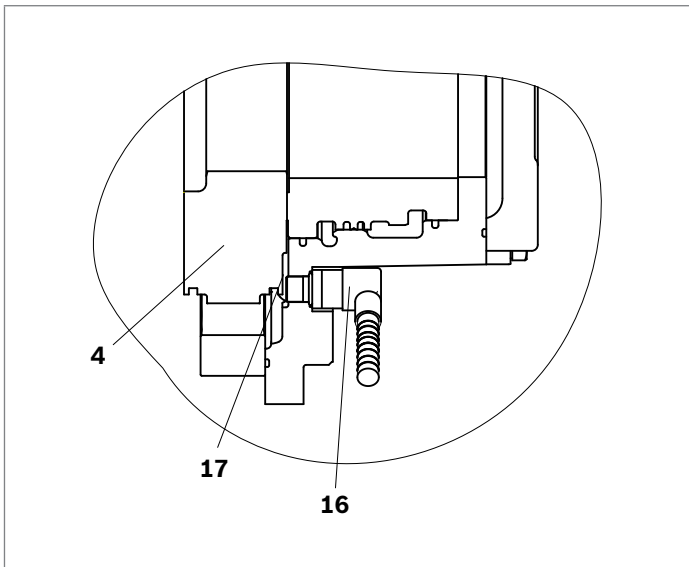


Speed sensor

A Hall-effect speed sensor (**16**) may be fitted as an option, giving a two-channel output of phase-displaced square waves, and enabling detection of speed and direction. A toothed target disc (**17**) is fitted to the motor cylinder block (**4**), and the sensor, fitted to a port in the rear case, produces a pulse on each channel as each tooth passes in front of it. The frequency of the pulses is proportional to the rotational speed.

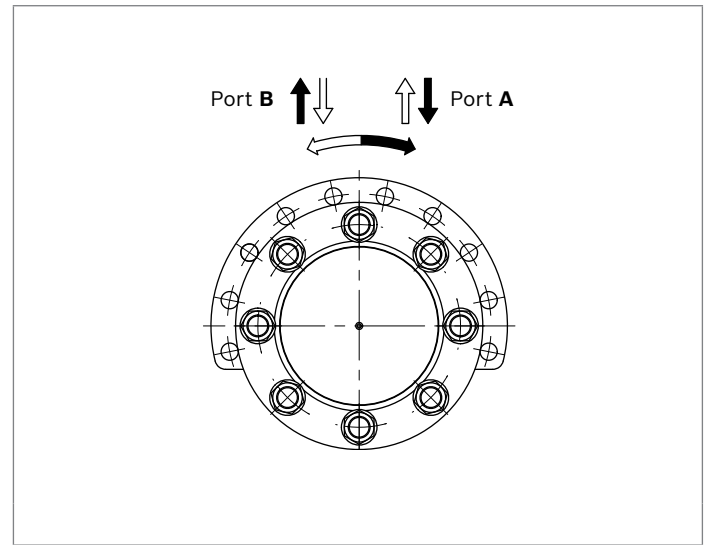
Versions are available for use with regulated supplies 10 V (Code P1) and for direct connection to a 12 V unregulated supply (Code P2).

The motor can also be supplied fitted with a target disc and with a speed sensor port machined, but covered and sealed with a blanking plate (Code P0). These “sensor-ready” motors may be fitted with a sensor at a later date.



Direction of shaft rotation with flow

(viewed from drive shaft)



Ordering code

01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
MCR		W			Z	/	33								

Radial piston motor

01	Radial-piston type, low-speed, high-torque motor	MCR
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Frame size

02	Frame size	3	3
		5	5
		10	10

Housing type

03	High radial load bearings fitted, rear case mounting flange	W
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Nominal size, displacement V_g in cm^3/rev

04	Frame size 3		160	225	255	280	325	365	400	
	Low displacement: motors use standard cylindrical pistons	LD	●	●	●	●	-	-	-	
	High displacement: motors use stepped pistons	HD	-	-	-	-	●	●	●	
	Frame size 5		380	470	520	565	620	680	750	820
	Low displacement: motors use standard cylindrical pistons	LD	●	●	●	●	-	-	-	-
	High displacement: motors use stepped pistons	HD	-	-	-	-	●	●	●	●
	Frame size 10		780	860	940	1120	1250	1340		
	Low displacement: motors use standard cylindrical pistons	LD	●	●	●	-	-	-		
	High displacement: motors use stepped pistons	HD	-	-	-	●	●	●		

Drive shaft

		MCR3	MCR5	MCR10	
05	With flange $\varnothing 180$ mm	●	-	-	F180
	With flange $\varnothing 250$ mm	-	●	-	F250
	With flange $\varnothing 280$ mm	-	-	●	F280

Rear shaft

06	Without rear shaft	Z
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Series

07	Serie 33	33¹⁾
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Brake

		MCR3	MCR5	MCR10		
08	Without brake	●	●	●	A0	
	Hydraulic release spring applied multi-disc holding brake	2200 Nm	●	●	-	B2
		4400 Nm	-	●	-	B4
		4400 Nm	-	-	●	B5
		7000 Nm	-	-	●	B7
	Dynamic brake (drum-brake) with maximum torque	4000 Nm	●	-	-	C4L/R
		6400 Nm	-	●	-	C7L/R
		12000 Nm	-	-	●	C12L/R
	Dynamic brake (disc-brake) with maximum torque	3700 Nm	●	-	-	S4L/R

Seals

09	NBR (nitrile rubber)	M
	FKM (fluoroelastomer / Viton)	V

● = Available - = Not available

01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
MCR		W			Z	/	33								

Single/two-speed operation

10	Single speed, standard direction of rotation	1L
	Bi-directional two speed, standard direction of rotation ¹⁾	2WL

Ports

11	Tapped with UNF thread (SAE J514)	12
	Tapped with UNF thread (SAE J514) (A and B ports SAE split flange metric holes)	42

Studs

12	Without studs (no code)	
	With wheel studs and nuts	S

Speed sensor

13	Without sensor (no code)	
	Sensor ready	P0
	Sensor without regulator	P1
	Sensor with regulator	P2

Flushing

14	Without flushing (no code)	
	With flushing (see table on page 3)	F1-F7

Special order

15	Special feature	SOXXX
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Other

16	Mark in text here	*
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1) This data sheet also applies to series 32.

Technical data

Frame size	MCR3			MCR5			MCR10			
Type of mounting	Front case flange mounting									
Pipe connections ¹⁾²⁾	Threaded per SAE J514; Flanged per SAE J518									
Shaft loading	see page 9									
Weight										
Single speed (1L)	<i>m</i>	kg	28	53	65					
Two speed (2WL)	<i>m</i>	kg	30	58	-					
Hydraulic fluid ³⁾										
Fluid cleanliness	ISO 4406, Class 20/18/15									
Fluid viscosity range	$v_{\min/\max}$	mm ² /s	10 to 2000							
Fluid temperature range ⁴⁾	$\theta_{\min/\max}$	°C	-20 to +85							
Pressure			Low displacement			High displacement				
Maximum differential pressure ⁵⁾⁶⁾	Δp_{\max}	bar	450				400			
Maximum pressure at ports A or B ⁵⁾⁶⁾	p_{\max}	bar	470				420			
Maximum case drain pressure	$p_{\text{case max}}$	bar	10				10			
Motor performance MCR3										
Displacement	V_g	cm ³ /rev	160	225	255	280	325	365	400	
Specific torque			3	4	4	4	5	6	6	
Maximum torque ⁵⁾	T_{\max}	Nm	1146	1611	1826	2005	2069	2324	2546	
Minimum speed for smooth running ⁷⁾	n_{\min}	rpm	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Maximum speed (1L) ⁸⁾⁹⁾	n_{\max}	rpm	670	475	420	385	330	295	270	
Maximum speed (2WL) ⁸⁾⁹⁾	n_{\max}	rpm	875	620	550	500	430	385	350	
Motor performance MCR5										
Displacement	V_g	cm ³ /rev	380	470	520	565	620	680	750	820
Specific torque			6	7	8	9	10	11	12	13
Maximum torque ⁵⁾	T_{\max}	Nm	2722	3366	3724	4047	3947	4329	4775	5220
Minimum speed for smooth running ⁷⁾	n_{\min}	rpm	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Maximum speed (1L) ⁸⁾⁹⁾	n_{\max}	rpm	475	385	350	320	290	265	240	220
Maximum speed (2WL) ⁸⁾⁹⁾	n_{\max}	rpm	570	465	420	385	350	320	290	265
Motor performance MCR10										
Displacement	V_g	cm ³ /rev	780	860	940					
Specific torque			12	14	15					
Maximum torque ⁵⁾	T_{\max}	Nm	5586	6159	6732					
Minimum speed for smooth running ⁷⁾	n_{\min}	rpm	0.5	0.5	0.5					
Maximum speed (1L and 2WL) ⁸⁾⁹⁾	n_{\max}	rpm	215	195	178	150	134	125		

Footer on page 9

			MCR3		MCR5		MCR10	
Holding brake (disc brake)			B2		B2	B4	B5	B7
Minimum holding torque	$t_{\min/\max}$	Nm	2200		2200	4400	4400	7000
Release pressure (min)	$p_{\text{rel min}}$	bar	11		11	11	11	11
Release pressure (max)	$p_{\text{rel max}}$	bar	15		15	15	15	15
Maximum pressure at brake port „Z“	p_{\max}	bar	40		40	40	30	30
Oil volume to operate brake	V_{rel}	cm ³	23		23	46	17	36
			MCR3		MCR5		MCR10	
Dynamic brake			C4L/R		C7L/R		C12L/R	
Braking torque	$t_{\min/\max}$	Nm	3000	4000	4700	6400	9000	12000
Brake cable tension		N	1270	1661	1755	2400	2580	3460
Brake port pressure	p_{\max}	bar	73	97	89	120	84	112
Brake cylinder operating volume	V	cm ³	9	9	13	13	24.91	24.91
			MCR3					
Dynamic disc brake			S4					
Braking torque ¹⁰⁾	$t_{\min/\max}$	Nm	3695					
Brake port pressure	p_{\max}	bar	125					

Note

- ▶ Motor performance values are based on theoretical calculations.
 - ▶ Efficiencies are not taken into consideration for theoretical calculations.
 - ▶ Brake torque accounts for tolerances. Values are based when used with standard mineral oil (HLP).
- Please refer the related foot notes for more details.

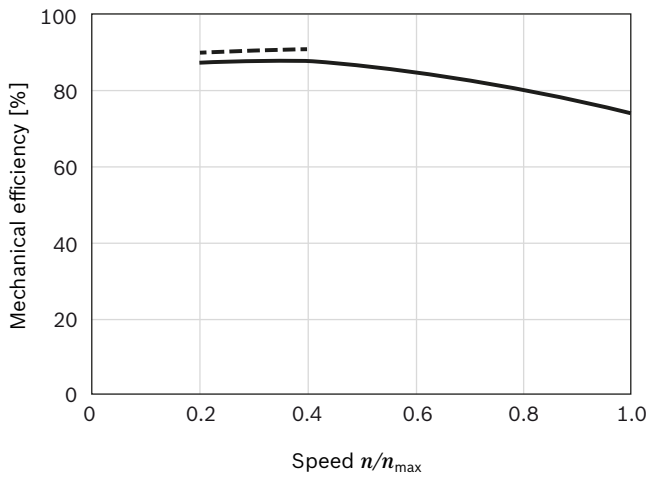
Footer from page 8 and 9

- 1) Ensure motor case is filled with oil prior to start-up. See instruction manual 15215-B.
- 2) For installation and maintenance details, please see instruction manual 15215-B.
- 3) For any other fluid type contact the Engineering Department at Bosch Rexroth, Glenrothes. For more information on hydraulic fluids, see datasheets 90220 and 90223.
- 4) Extension of the allowable temperature range may be possible depending on specification. Please consult Bosch Rexroth Engineering Department in Glenrothes for further details.
- 5) Maximum values should only be applied for a small portion of the duty cycle. Please consult Bosch Rexroth Engineering Department in Glenrothes for motor life calculations based on particular operating cases.

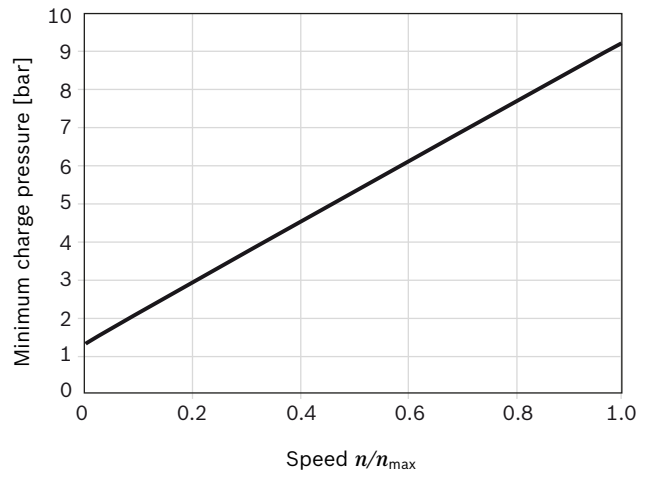
- 6) When operating motors in series, please consult Bosch Rexroth Engineering Department in Glenrothes.
- 7) For continuous operation at speeds <5 rpm please consult Bosch Rexroth Engineering Department in Glenrothes.
- 8) Based on nominal no-load Δp of 20 bar in full-displacement mode.
- 9) Warning! During the running in period of the motor (min. 20 hrs) it should not be run unloaded at >100 rpm.
- 10) For a brake disc diameter of 280 mm.

Efficiencies

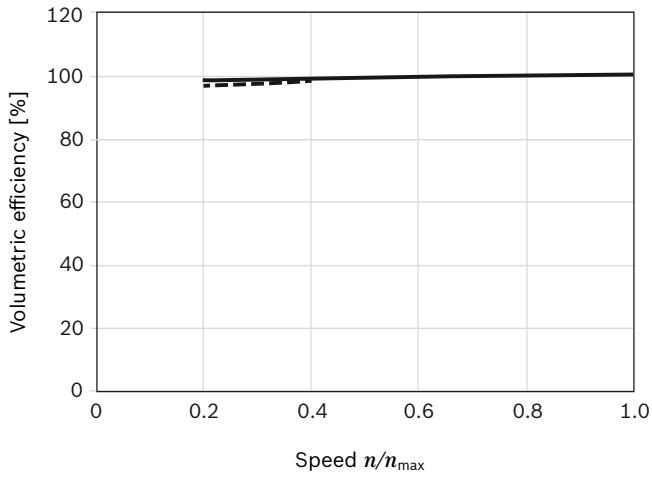
▼ Mechanical efficiency



▼ Charge pressure



▼ Volumetric efficiency



— 100 bar / 1450 psi
- - - 300 bar / 4350 psi

Note:

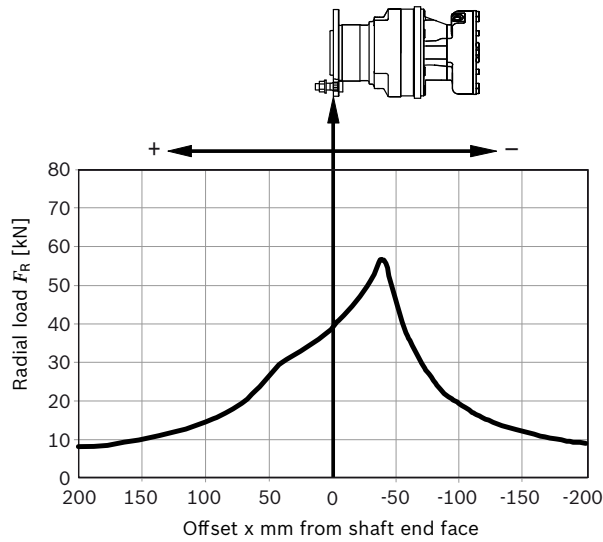
For specific performance information or operating conditions contact the Engineering Department at Bosch Rexroth, Glenrothes.

Permitted loading on drive shaft

(Speed $n = 50$ rpm, pressure differential $\Delta p = 250$ bar, 2000 hrs L10 life at 50 °C)

Drive shaft ...3W F180...

Maximum radial load $F_{R \max}$ (with axial load $F_{ax} = 0$)



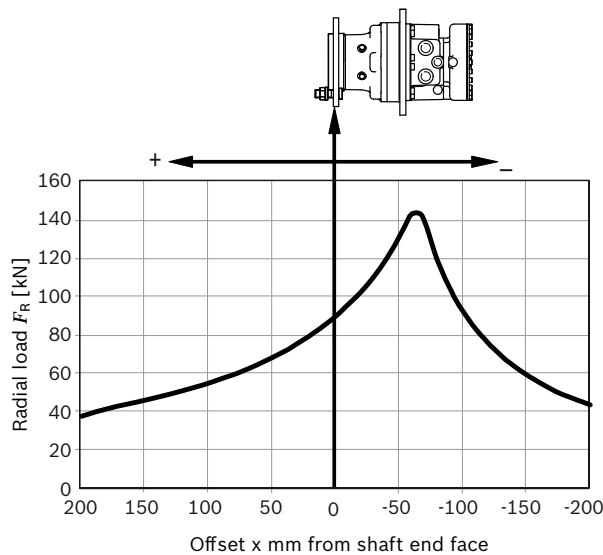
Maximum axial load $F_{ax \max}$ (with radial load $F_R = 0$):

$$F_{ax \max} = 43400 \text{ N} \leftarrow +$$

$$F_{ax \max} = 36800 \text{ N} \rightarrow -$$

Drive shaft ...5W F250...

Maximum radial load $F_{R \max}$ (with axial load $F_{ax} = 0$)



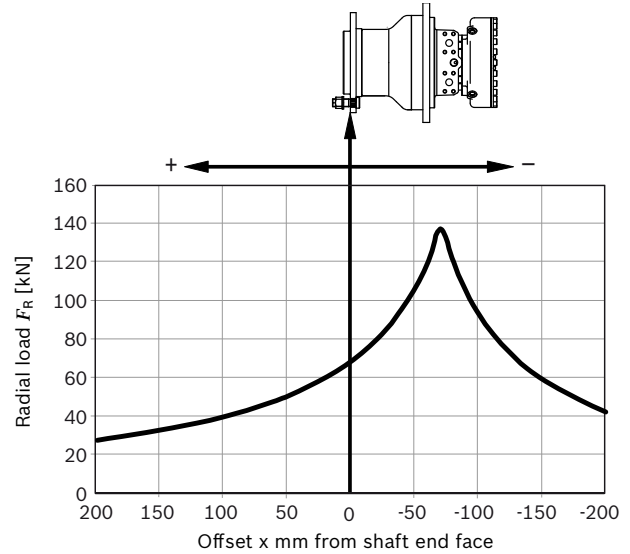
Maximum axial load $F_{ax \max}$ (with radial load $F_R = 0$):

$$F_{ax \max} = 85000 \text{ N} \leftarrow +$$

$$F_{ax \max} = 67400 \text{ N} \rightarrow -$$

Drive shaft ...10W F280...

Maximum radial load $F_{R \max}$ (with axial load $F_{ax} = 0$)



Maximum axial load $F_{ax \max}$ (with radial load $F_R = 0$):

$$F_{ax \max} = 108100 \text{ N} \leftarrow +$$

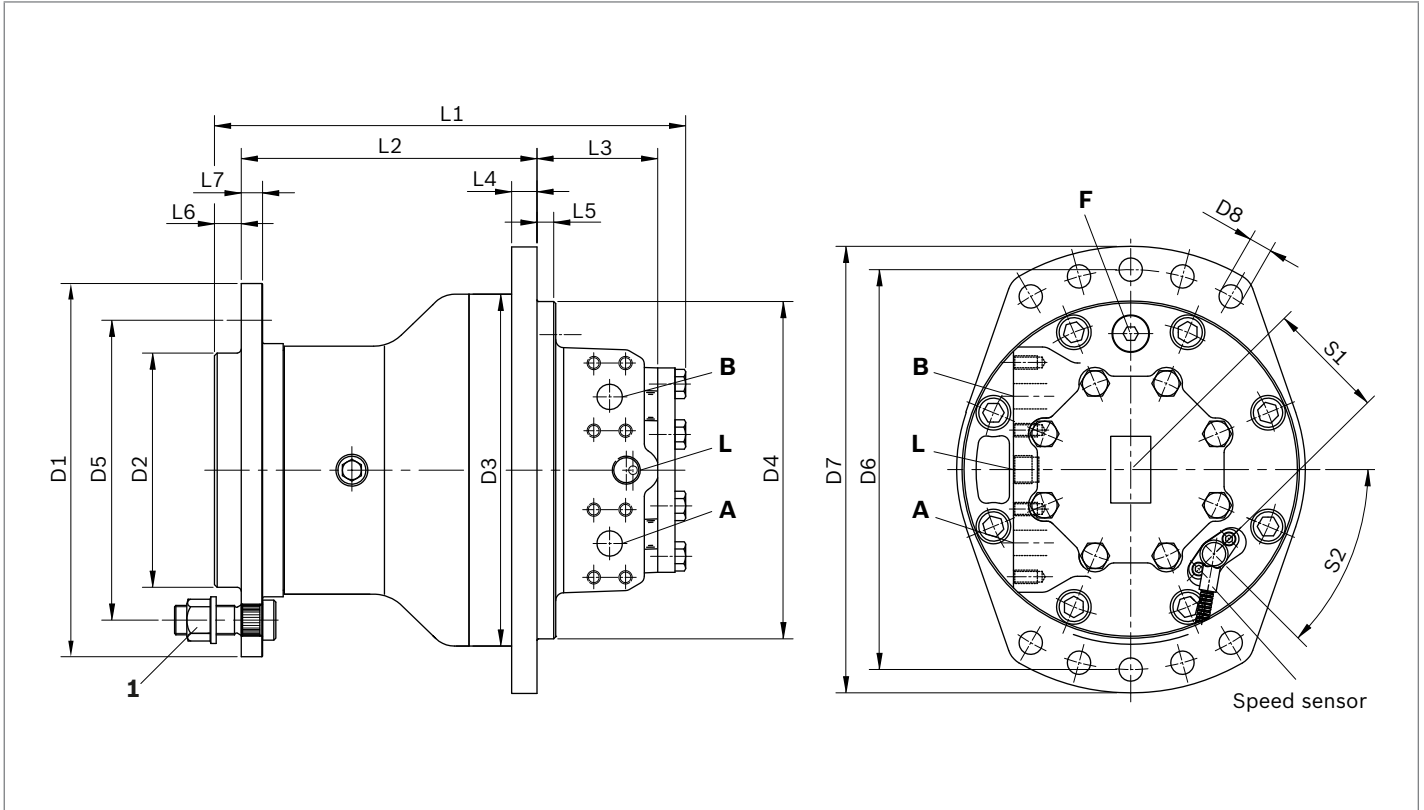
$$F_{ax \max} = 88700 \text{ N} \rightarrow -$$

Note:

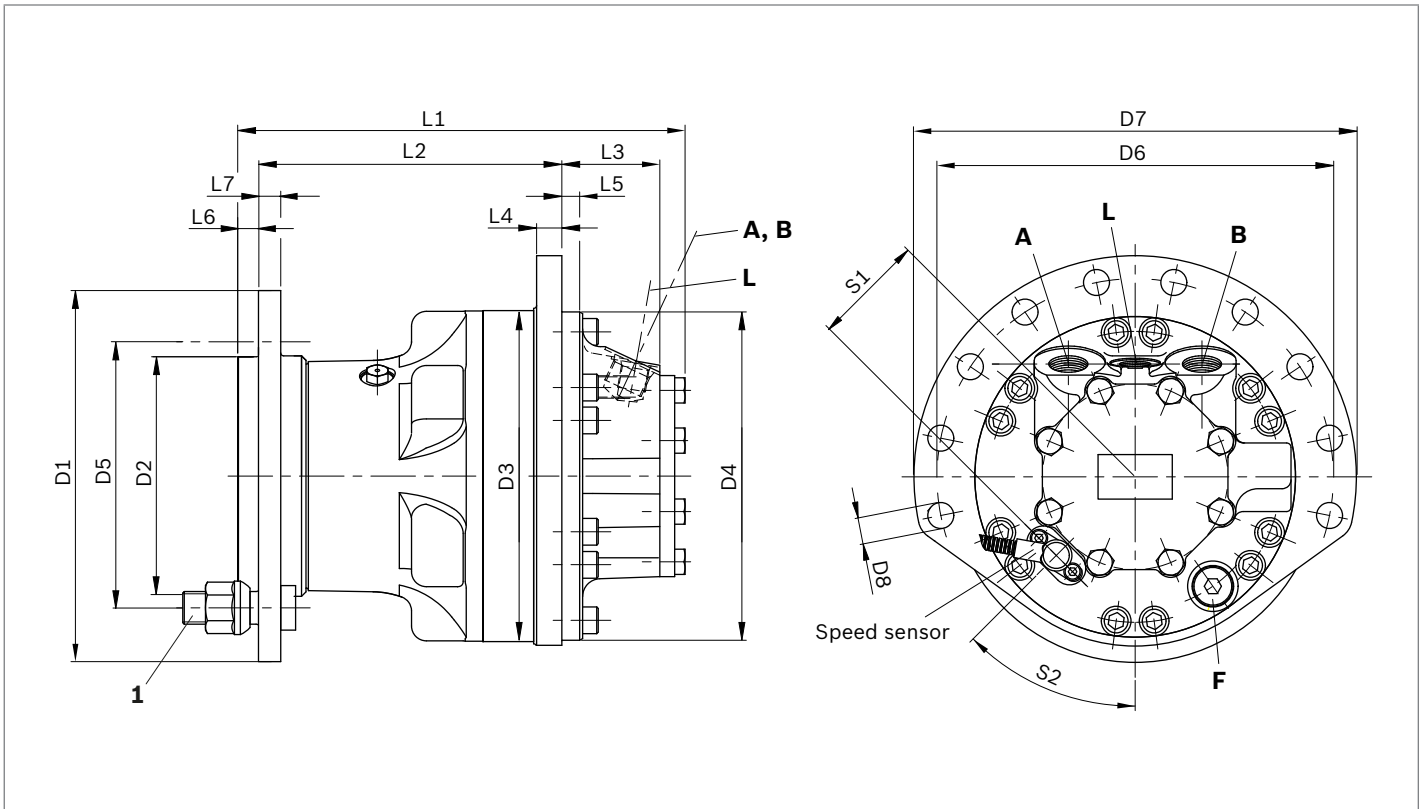
- ▶ These values and graphs are for initial guidance only
- ▶ For actual motor life calculations under typical or specified duty cycles, contact Bosch Rexroth Engineering Department in Glenrothes

Dimensions

MCR3W and MCR10W single speed (1L)



MCR5W single speed (1L)



Motor	D1	D2	D3	D4	D5 ¹⁾	D6	D7	D8 ²⁾	1
MCR3	∅180	∅92.7	∅180	∅180	∅140	∅210	∅237	∅14	5×M14×1.5
MCR5	∅250	∅160	∅223	∅222	∅205	∅267	∅297	∅17.4	6×M18×1.5
MCR10	∅280	∅175.8	∅264	∅253	∅225	∅300	∅335	∅17.5	10×M22×1.5

Motor	L1	L2	L3	L4	L5	L6	L7	S1	S2
MCR3	251.8	181	54	13	6	5	11.5	63.5	90°
MCR5	301.1	204	66	17	12	13.5	15	75	45°
MCR10	351.4	221.9	90.5	19	12.5	18	16	90	45°

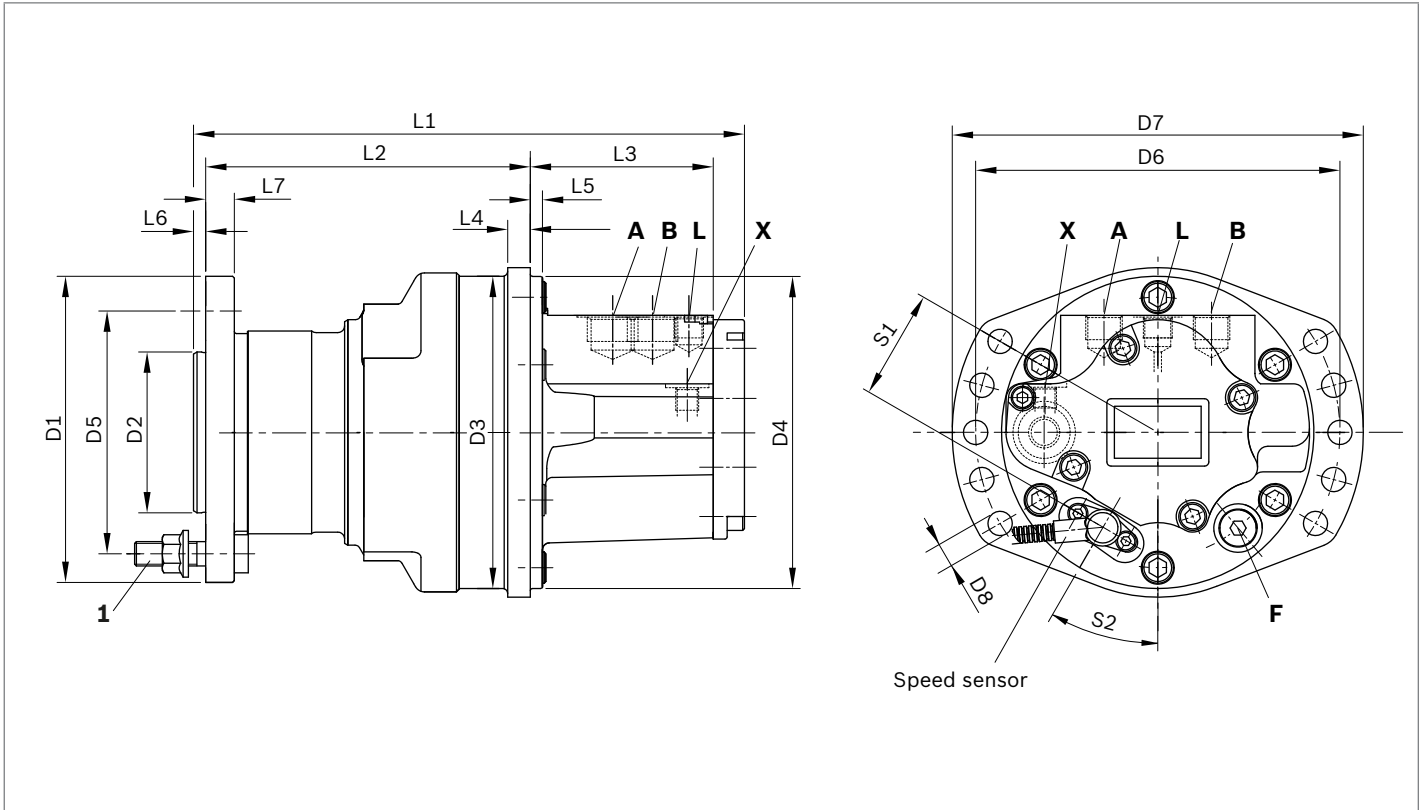
Ports

Motor	Designation	Port function	Code	Size	p_{max} [bar]	State ⁴⁾
MCR3	A, B	Inlet, outlet	SAE J514	7/8-14 UNF	470/420 ³⁾	O
	L	Case drain	SAE J514	9/16-18 UNF	10	O
	F	Filler port	SAE J514	3/4-16 UNF	10	X
MCR5	A, B	Inlet, outlet	SAE J514	1 1/16-12 UNF	470/420 ³⁾	O
	L	Case drain	SAE J514	3/4-16 UNF	10	O
	F	Filler port	SAE J514	3/4-16 UNF	10	X
MCR10	A, B	Inlet, outlet	SAE J518 ⁵⁾	3/4 in	470/420 ³⁾	O
	L	Case drain	SAE J514	3/4-16 UNF	10	O
	F	Filler port	SAE J514	3/4-16 UNF	10	X

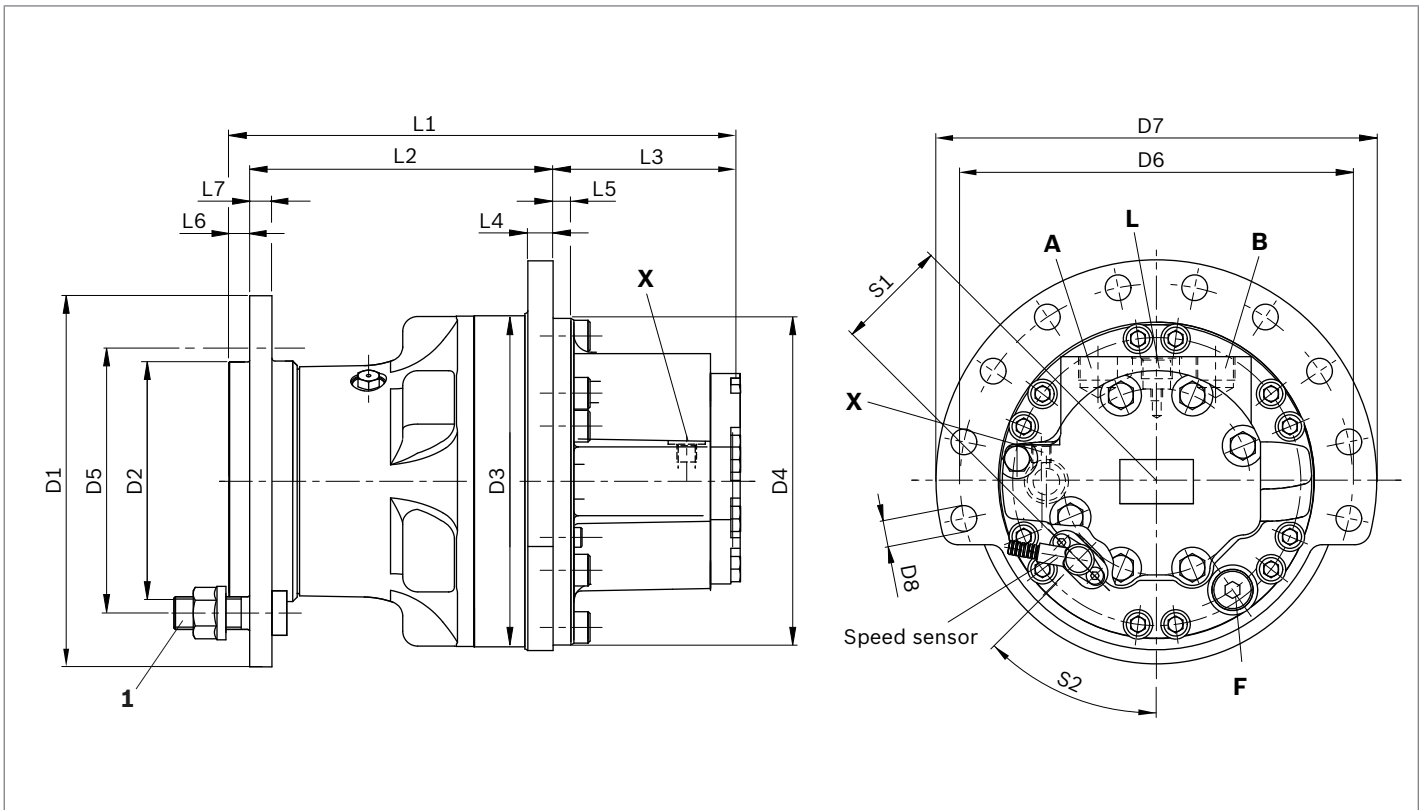
- 1) Wheel stud pitch circle diameter
- 2) Flange shape may be different for different frame sizes
- 3) Depends on nominal size
- 4) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)
- 5) Only dimensions according to SAE J518
(Code 62 - high pressure series)

Before finalizing your design, request a binding installation drawing.

MCR3W and MCR10W two speed (2WL)



MCR5W two speed (2WL)



Motor	D1	D2	D3	D4	D5 ¹⁾	D6	D7	D8 ²⁾	1
MCR3	∅182	∅95.7	∅180	∅180	∅160	∅210	∅237	∅14	5×M14
MCR5	∅250	∅160.8	∅223	∅222	∅205	∅267	∅298	∅17.4	6×M18×1.5
MCR10	∅280	∅175.8	∅264	∅253	∅225	∅300	∅330	∅17.5	

Motor	L1	L2	L3	L4	L5	L6	L7	S1	S2
MCR3	311.5	181	123.5	13	6	7	11.5	63.5	30°
MCR5	344.1	204	126	17	12	13.5	15	75	45°
MCR10	382.9	221.9	115.5	19	12.5	18	16	89	45°

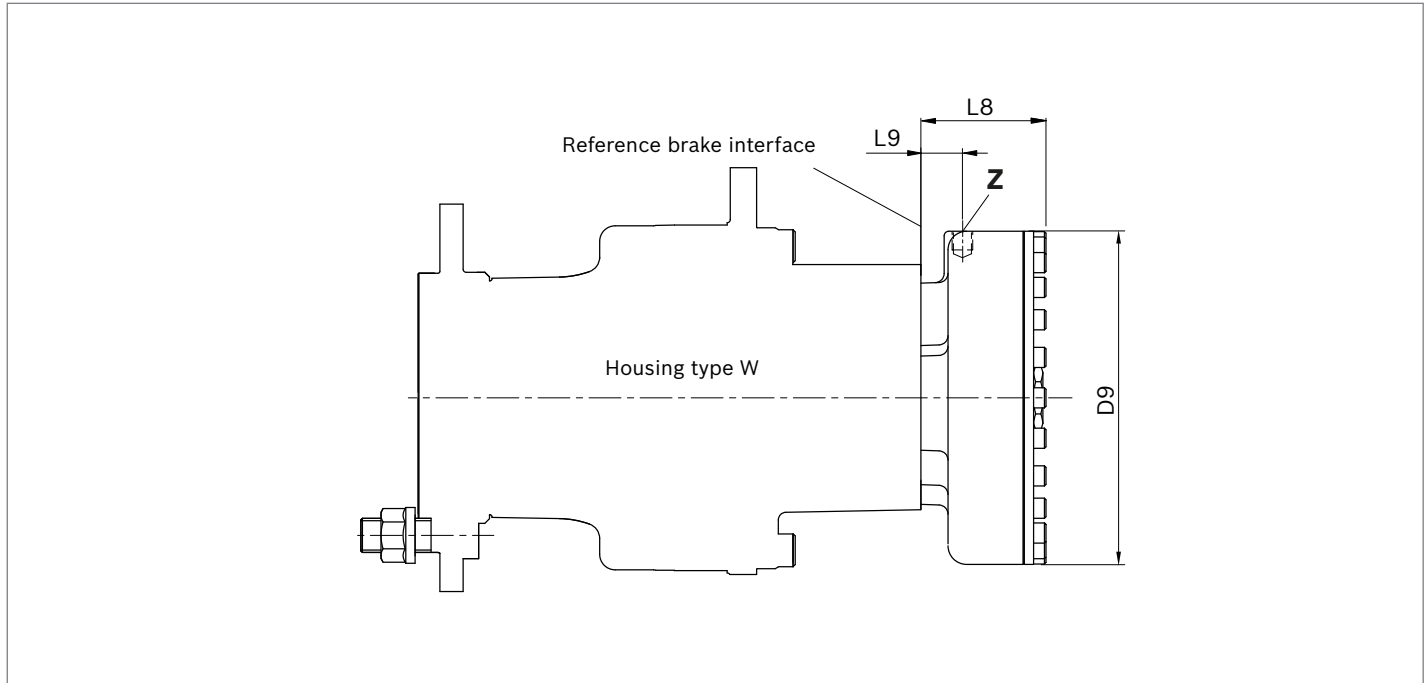
Ports

Motor	Designation	Port function	Code	Size	p_{max} [bar]	State ⁴⁾
MCR3	A, B	Inlet, outlet	SAE J514	1 1/16-12 UNF	470/420 ³⁾	O
	L	Case drain	SAE J514	9/16-18 UNF	10	O
	F	Filler port	SAE J514	3/4-16 UNF	10	X
	X	2 speed port	SAE J514	9/16-18 UNF	35	O
MCR5	A, B	Inlet, outlet	SAE J514	1 1/16-12 UNF	470/420 ³⁾	O
	L	Case drain	SAE J514	3/4-16 UNF	10	O
	F	Filler port	SAE J514	3/4-16 UNF	10	X
	X	2 speed port	SAE J514	9/16-18 UNF	35	O

- 1) Wheel stud pitch circle diameter
- 2) Flange shape may be different for different frame sizes
- 3) Depends on nominal size
- 4) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Before finalizing your design, request a binding installation drawing.

Holding brake (multi-disc brake)



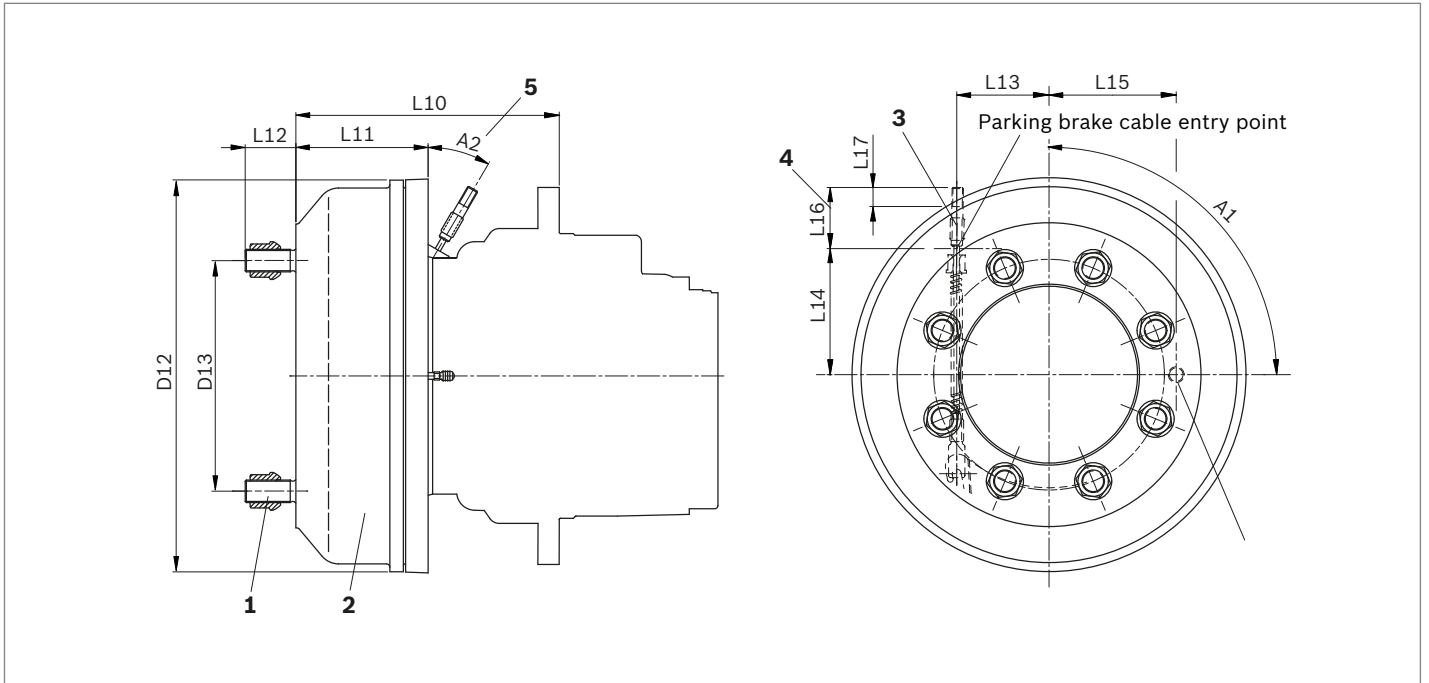
Motor	Brake	L8	L9	D9
MCR3	B2	67.3	22	ø172
MCR5	B2	67.3	22	ø172
	B4	80.7	26.5	ø215
MCR10	B5	84.7	26.5	ø215
	B7	98	29	ø251

Motor	Designation	Port function	Code	Size	p_{max} [bar]	State
MCR3	Z	Brake port	SAE J515	9/16-18 SAE	40	O
MCR5	Z	Brake port	SAE J515	9/16-18 SAE	40	O
MCR10	Z	Brake port	SAE J515	9/16-18 SAE	30	O

1) O = Must be connected (plugged on delivery)

Before finalizing your design, request a binding installation drawing.

Dynamic brake (drum brake)



Motor	Brake	L10	L11	L12	L13	L14	L15	L16	L17	D12	D13	A1	A2
MCR3	C4	192	95	32.5	65	86	89	83	19	ø272	ø160	30°	30°
MCR5	C7	234.1	117.5	45	82	-	113	54	17	ø348	ø205	90°	30°
MCR10	C12	294.6	132	36	80	-	120	40	17	ø365	ø225	90°	30°

- 1** **C4** 10 Studs M18x1.5 with spherical wheel nuts
- C7** 8 Studs M20x1.5 with spherical wheel nuts
- C12** 10 Studs M22x1.5 with spherical wheel nuts

- 2** Dynamic drum brake for use with brake fluid DOT 3+5 or SAE JI 703. If brake is to be used with mineral oil a special order is to be made. Please state if seals for mineral oil are required when placing order.

- 3** Brake cable (Bowden cable) can be connected from right side for C*R and left side for C*L (left is a mirror image of the right type) (* = 2, 4, 7, 12). Mechanical brake cable is not supplied with the motor.

- 4** Brake cable length.

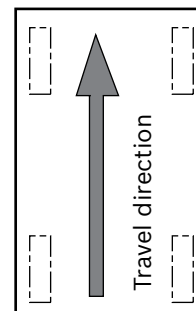
- 5** Angular position of brake cable.

Before finalizing your design, request a binding installation drawing.

Dynamic drum brake run-in procedure

- ▶ Brake the machine hard in forward and reverse directions until the brake drum temperature reaches 200 °C.
- ▶ Allow the brake to cool.
- ▶ To remove residue, brake gently 2 times each in the forward and reverse directions.

Left side of vehicle
Ordering code C4L

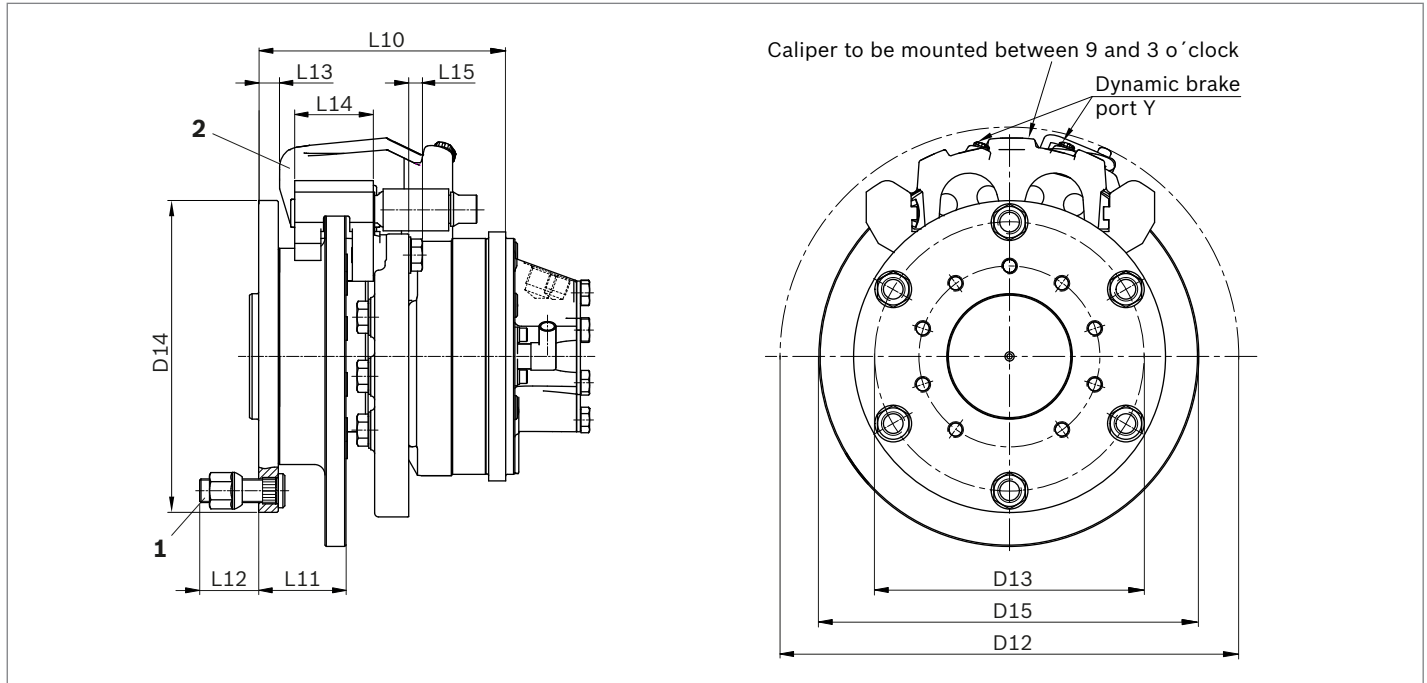


Right side of vehicle
Ordering code C4R

Note:

The drum brake cylinder port must be oriented as instructed in the installation drawing. The drum brake also has an influence on permitted radial loading due to its offset.

Dynamic brake (Disc brake)



Motor	Brake	L10	L11	L12	L13	L14	L15	D12	D13	D14	D15
MCR3	S4	188.6	66.6	45	16	60	10.5	ø350	ø205	ø238	ø290

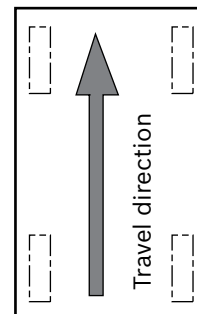
- 1 S4** 6 Studs M18x1.5 with spherical wheel nuts
- 2** Caliper disc brake for use with fluid DOT 3 or DOT 4 SAE JI 703
If brake is to be used with mineral oil a special order is to be made.
Please state if seals for mineral oil are required when placing order

Before finalizing your design, request a binding installation drawing.

Dynamic disc brake run-in procedure

- ▶ Perform a few braking stops to create enough heat to release in the lining











Left side of vehicle
Ordering code S4L



Right side of vehicle
Ordering code S4R



Selection guide

Data sheet	Motor type Application		Frame size					
			3 160..400 cc	5 380..820 cc	6 820..920 cc	10 780..1340 cc	15 1130..2150 cc	20 1750..3000 cc
15198	MCR-F Wheel drives		•	•	-	•	•	-
15200	MCR-W Heavy duty wheel drives		•	•	-	•	-	-
15195	MCR-A Frame integrated drives		•	•	-	•	•	-
15199	MCR-H Integrated drives		•	•	-	•	•	•
15221	MCR-T Track drives		-	•	•	•	-	-
15223	MCR-R Series 41 Hydraulic drive assist		-	-	-	•	-	-
15214	MCR-X Slew drives		•	•	-	-	-	-
15197	MCR-C Compact drives		-	-	-	-	-	•
15196	MCR-D Industrial applications		•	•	-	•	-	-
	MCR-E Industrial applications		-	•	-	-	-	-

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