DESIGN GUIDE

black bruin®

BBC

HYDRAULIC MOTORS

0905

BLACK BRUIN HYDRAULIC MOTOR DESIGN

black bruin

Index

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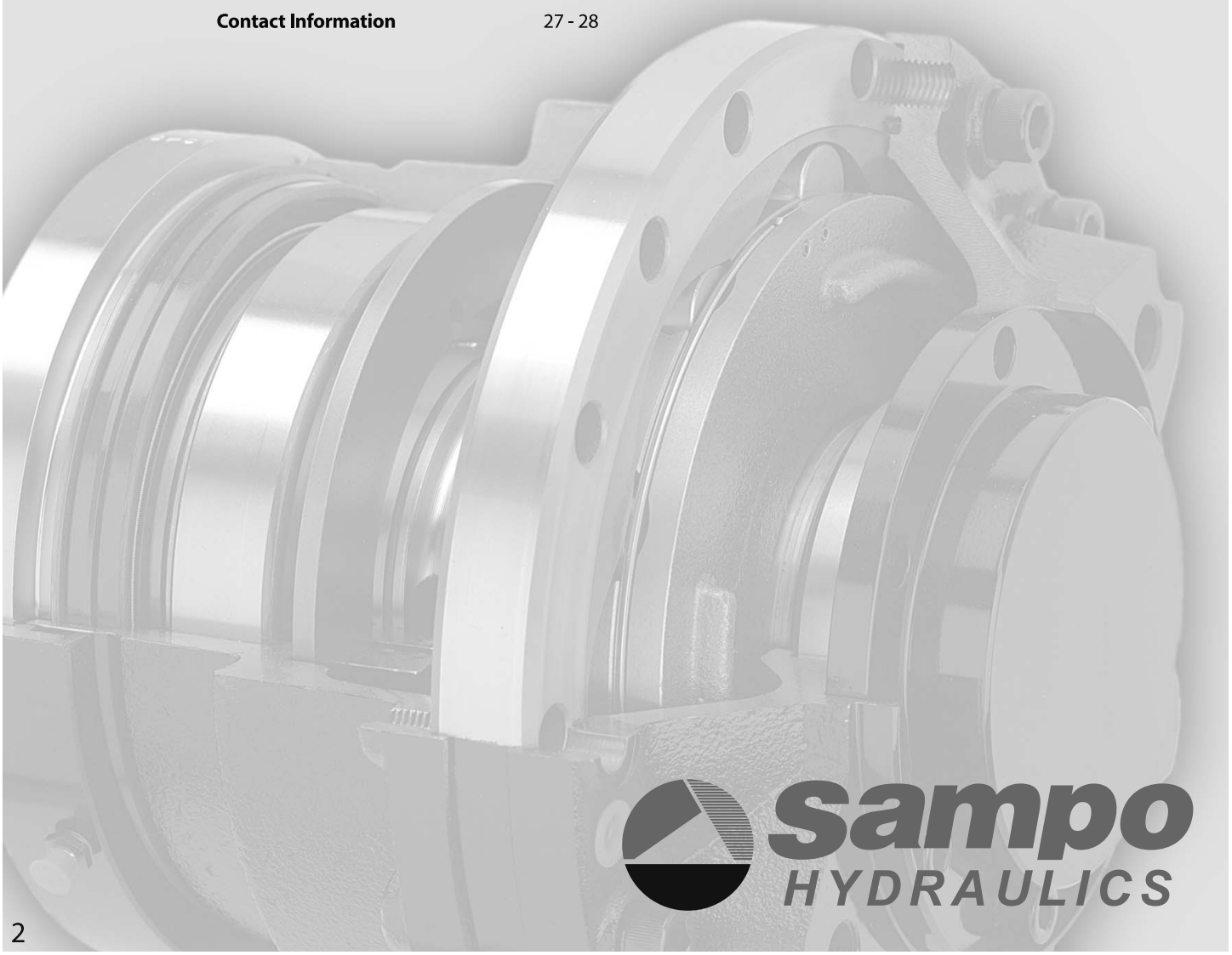


sampo HYDRAULICS

Construction and Operation

1. Speed of rotation

All tables of model specifications refer to normal rotational speeds. If motor application requires speeds different from those mentioned, please consult motor manufacturer or its representative.

2. Charge pressure

The minimum pressure required at the motor's inlet port is called the charge pressure. It is needed to guarantee continuous contact between the cam ring and the cam rollers, especially in applications where an external force rotates the motor.
For each motor size the charge pressure depends on the actual speed and case pressure. The performance curves show the charge pressure figure at minimum back pressure and with no casing pressure. With hydrostatic braking the charge pressure must be increased 1 – 2 bar (15 – 30 psi). Simultaneously, sufficient oil supply to the motor inlet port has to be assured. Especially for open circuits during hydrostatic braking using a relief valve, be sure to compensate for the drain flow and the flushing of heated oil.

3. Back pressure

In applications where the pressure in the return line is too low compared to the case pressure and actual speed, the motor may make extraneous noise in service. This is caused by the inertial force of the piston and the fact that the pistons and cam rollers tend to lose contact with the cam ring. This problem can be eliminated by increasing pressure in the return line as high as required charge pressure at current speed, which guarantees continuous contact between the cam ring and cam rollers. This back pressure must not be present at the motor ports during freewheeling.

4. Case pressure

The recommended case pressure for standard motors is 0 – 2 bar (0 – 30 psi). The maximum intermittent pressure is 10 bar (145 psi). If the motor is not rotating, a static case pressure up to 40 bar (580 psi) is allowed. Requirements for charge and back pressure increase, if the case pressure rises. For freewheeling, case filling and for regulating the case pressure, a check valve with 0.1 – 2 bar (2 – 30 psi) opening pressure is usually placed in the drain line. If freewheeling is never used and the motor is below the level of oil in the tank, the drain line is connected directly to the tank.

5. Freewheeling

To disengage the motor, both working lines (i.e. inlet line and return line) are to be connected directly to the tank. To ensure that the lines are completely without pressure they should not be connected together with lines from other hydraulic circuits if this can lead to pressure disturbances, nor should any components causing pressure peaks or increases be connected to them. In order to produce the freewheeling pressure in the case, a fluid must be supplied to the motor through case drain line "C" (1 - speed motors only). When 2 - speed motor is needed to freewheel it is recommended to use motor with 2 case drain lines (6th digit in order code = 1) and a fluid to produce free coupling pressure must be supplied to the motor case through additional case drain line "C1".

A check valve with an opening pressure of 2 bar (30 psi) in the drain line regulates the pressure in the case. Limitation of pressure peaks in the case is accomplished by dimensioning the return lines and check valves to correspond with the maximum intended speed of the motors at the moment of engaging/disengaging.

Under certain circumstances (e.g. with long length of pipe, high rotational speeds or high viscosity oil) it is recommended to connect an accumulator (with at least 1/4 nominal capacity of the motor) to the drain line "C" (1 - speed motor) or "C1" (2 - speed motor with 2 drain lines). The accumulator should be as close to the motor as possible. Hydraulic accumulators designed for storing low pressure are sufficient. At the moment of engaging or disengaging the need for increased charge pressure must be taken into account.

Closed circuit

For vehicles having several hydraulic motors, freewheeling can provide higher speed ranges, since the total pump output is divided between fewer working motors.

A. Disengaging the motor (shifting to higher speed range)

1. Motors to be freewheeled are detached to form an independent free circulation circuit.
2. A path from the motor circuit to the reservoir is rapidly opened, after which the constant small pressure in the casing disengages the motor.
3. The system charge pressure must be maintained in the pump circuit throughout the shifting procedure.
4. While shifting speed ranges, the sum of the displacement of the motors in operation changes gradually. The pump delivery is to be adjusted manually or automatically as required.
5. To avoid jerking during alteration of the pump delivery, the pump lines must be softly throttled.

B. Engaging the motor (shifting to lower speed range)

1. Disengaged motors are brought into operation by connecting the "A" and "B" ports back into closed loop.
2. A charge pressure is rapidly applied to this circulation, forcing the pistons into motion. The charge pressure must be high enough to cover the pressure losses in the free circulation circuit as well.
3. The motors are connected to the same circuit as the pump.
4. The pump delivery is adjusted as required. Jerking can be avoided in the same way as when disengaging.
5. If the charge pump is too small, an accumulator is required to maintain the charge pressure.

Accomplishment of the above is made easier by motor manufacturer's valves, which perform all the required operations except for modulating pump delivery. Some Black Bruin motors are equipped with mechanical freewheeling springs. These motors are freewheeled automatically when the motor's working lines become non-pressurized. However, a rapid disengaging requires an increase in case pressure.

6. Short circuiting connection

Short circuiting connection is used, if the motor is required to rotate by an external force faster than the circuit flow is capable to supply. In such case motor outlet oil must be connected to the motor inlet port. Max. allowed short circuit speed is 1.5 times max. speed of the motor. The required charge pressure is easily regulated with back pressure in the return line. Simultaneously flushing with fresh fluid must be insured for proper cooling.

7. Permissible external loads

The figures given in the tables refer only to non-simultaneous radial and axial loads. If applications with high combined radial and axial loads exist, please consult motor manufacturer or its representative to determine maximum permissible loading. The maximum permissible shaft loads depend on the loading point. For exact data see shaft load curves (see page 6).

8. Wet multi-disc brake

The wet multi-disc brake is basically a parking brake, but in certain cases it can also be used as an emergency brake. (Not recommended to use as service brake. When used as a service brake consult motor manufacturer or its representatives.) The minimum pressure to release the spring operated brake is shown in the performance data page, however, the operating pressure used may be not higher than 30 bar (435 psi). The brake has internal leakage (max. 0.5 l/min) and this has to take into consideration, while designing the brake release system. Notice that EP, HD and some anti-wear additives in oil can cause remarkable reduction of brake torque.

9. Operation temperature

The maximum allowed continuous operating temperature is 70˚C (160˚F) and the maximum intermittent value is 85˚C (185˚F), if the oil viscosity does not fall below 15 cSt. The lowest permissible operating temperature for a standard motor is -35˚C (-31˚F).
When starting the motor, the difference between the motor and oil temperatures must not exceed 60˚C (140˚F). To avoid thermal shocks at low temperatures we recommend the following measures:
- Run the motor at first with a low speed, unloaded. Gradually increase the speed and loading.
- Below 0˚C (32˚F) avoid disengaging and engaging of motors when the vehicle is moving and the drain line is cold.

10. Oil requirements

The mineral oil used should meet the following requirements:
- The viscosity index must be at least 100. If the oil contains additives improving the viscosity index, the effect of these ought to be as permanent as possible. The oil is to maintain the required viscosity throughout its service life.
- The minimum permissible viscosity is 15 cSt.
- The maximum viscosity is determined by the specifications of the system pump.
- The recommended viscosity range at operating temperature is 25-50 cSt. In slow use, a higher viscosity oil can be used.
- To obtain maximum service life of both oil and entire system, oil temperatures exceeding 70˚C (160˚F) are to be avoided.
- Oil additives must conform to the API – classification for SC motor oils. Hydraulic oils and SC, SD, SE and SF motor oils are recommended. Fire resistant fluids HFB and HFC or similar may be used under certain circumstances. Please always consult motor manufacturer or its representative before using these fluids.

11. Filtration

Required cleanliness level: ISO 4406 Code 18/13 (NAS 1638 Code 8) or better. Filtration requirements for the pump and other system components must also be taken into consideration. In the event that other devices operated by the same hydraulic fluid are connected to the system and thus may allow impurities to pass into the system, the hydraulic motor circuit must be isolated from these. Where pressure in the main drive power transmission system is over 250 bar (3600 psi), absolute 10 mm main flow filtering is required. The filter should be equipped with cleanliness indicators.

12. Conditions of installation and application

A questionnaire is used to help the selection and proposal of Black Bruin hydraulic motors. This questionnaire is to be completed for all models of series – produced machines and industrial applications. A filled in and signed questionnaire is a prerequisite of the motor manufacturer's warranty.

Always advise motor manufacturer or its representative when ordering motors for exceptional circumstances, like underwater applications, operation with special fluids, etc.

13. Physical motor mounting

Connection ports for working lines are marked with "A" and "B". Connection port for drain line and case pressure is marked with "C". **NOTE!** Motors with flushing line "C1" have connection port for case drain line marked with "C2". Brake pressure connection is marked with "D". 2-speed pilot connection is marked with "Y".

14. Flushing

Flushing should be performed at initial start-up, after system modifications or repairs. Before connecting the motor and pump to the system, THE CIRCUIT MUST ALWAYS BE FLUSHED, e.g. by circulating oil through a filter positioned in place of the motor. During flushing the oil is circulated with minimal pressure in the whole system, for at least one hour.

After flushing, renew all filters. Always use plastic plugs to close off open ports and hoses. Do not use or add the tank with dirty oil.

15. Bleeding or filling

DO NOT START MOTOR UNLESS THE CASE IS FILLED
WITH OIL: Place the motor in a position in which the bleed screw is in its topmost position and unscrew it half a turn. Allow the case to be filled by system charge pressure. The bleed screw is closed after all air is out. If the motor is applied in a system that does not provide charge pressure, the case must be filled by pouring the oil in until all air is out.

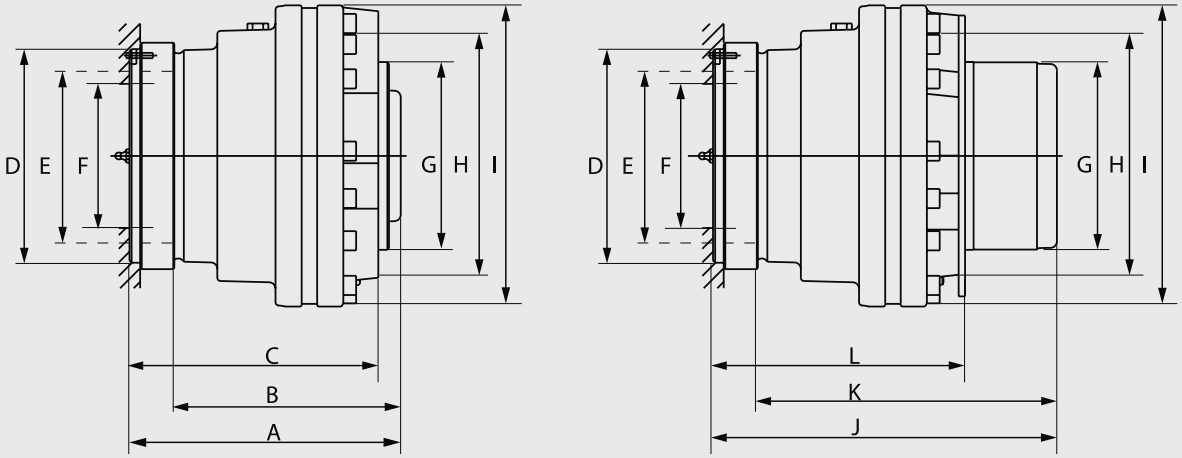
16. 2-speed motor control pressure

Use 20-30 bar pressure to engage 2-speed (half displacement) and unpressurize to return to full displacement. Do not use working pressure/high pressure in 2-speed valve control lines.

17. Motor initial start – up

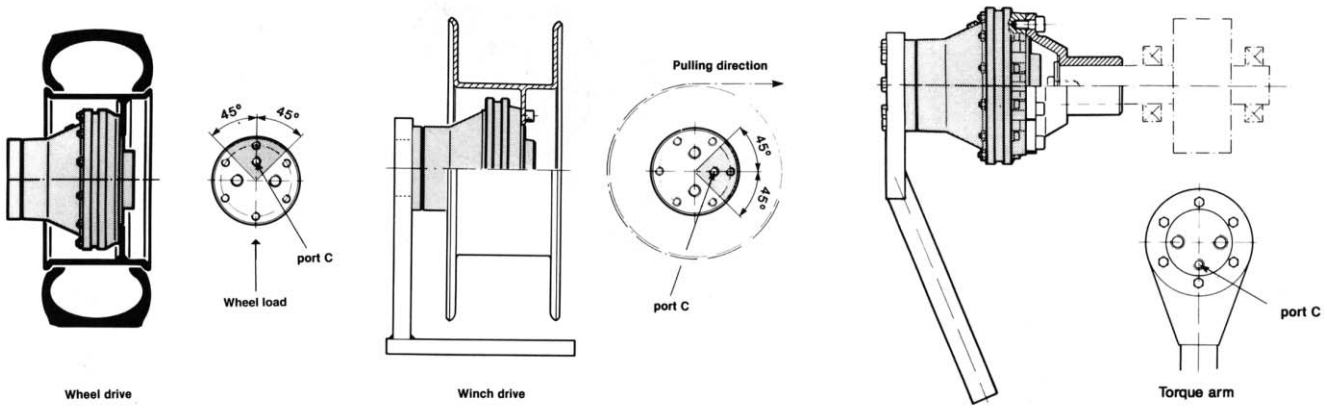
After flushing and filling, the motor is first rotated unloaded. Increase the motor speed and load gradually, and check for leaks and extraneous noise.

Dimensions



Model	Weight without brake kg	A mm	Rotating part B mm	C mm	D mm	E mm	F mm	G mm	H mm	I mm	J mm	Rotating part K mm	L mm	Weight with brake kg	Model
BBC 01	41	234	193	210	172	140 12xM12	117	175,8	225 5xM22x1,5	263	299	258	213	47	**BBC 01**
BBC 02	62	254	212	233	200	160 8xM16	135	175,8	225 5xM22x1,5	282	322	280	236	71	**BBC 02**
BBC 03	80	267,5	223	241	216	175 10xM16	150	220,8	275 8xM20x1,5	315	331	286,5	241	92	**BBC 03**
BBC 04	103	281	234	246	216	175 12xM16	150	220,8	275 8xM22x1,5	343	350	303,5	250	118	**BBC 04**
BBC 05	138	298	254	259	240	200 12xM20x1,5	166	280,8	335 10xM22x1,5	376	383	339	263	159	**BBC 05**
BBC 06	180	328	279,5	290	262	215 12xM20x1,5	185	280,8	335 10xM22x1,5	420	423	374,5	295	215	**BBC 06**
BBC 07	300	387	332,5	338	310	260 12xM20x1,5	220	370,8	425 10xM22x1,5	492	535	480,5	338	400	**BBC 07**

Application areas



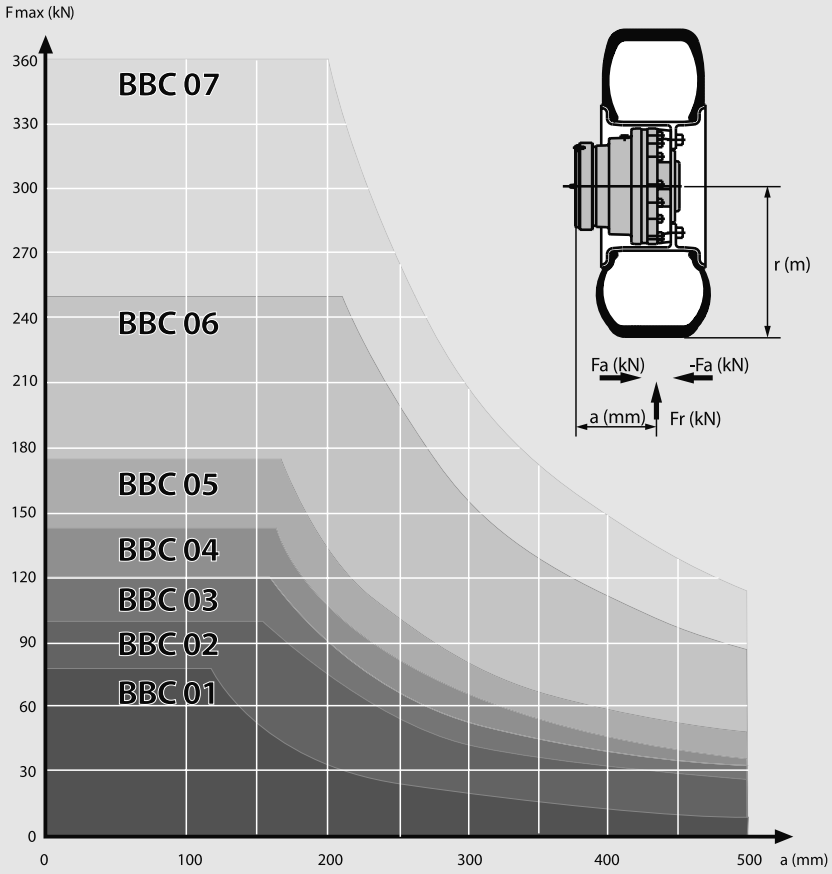
Performance Curves

Shaft load

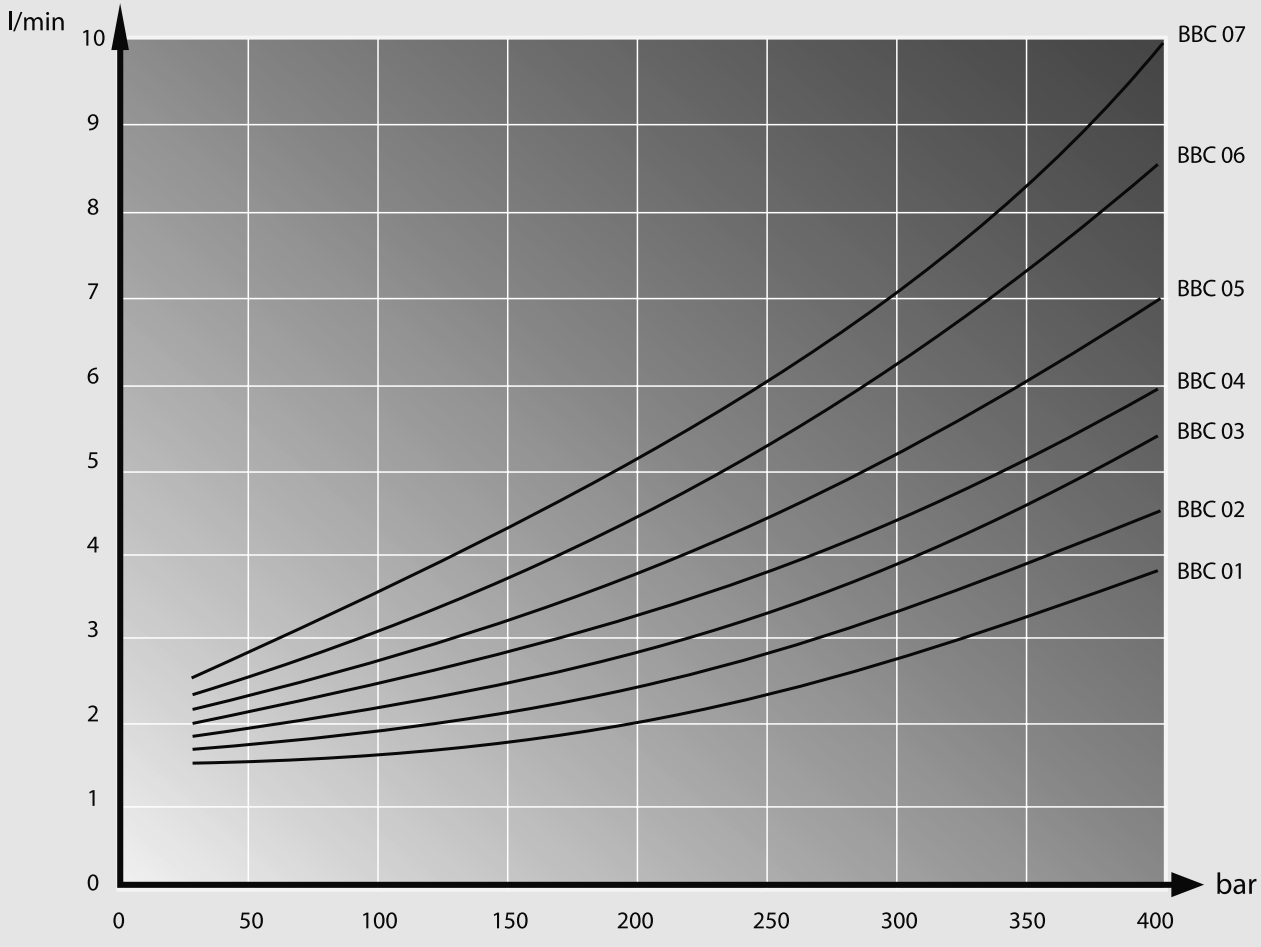
BBC 01 Fmax = α x Fr + 6,25 x r x Fa
BBC 02 Fmax = α x Fr + 5,62 x r x Fa
BBC 03 Fmax = α x Fr + 5,41 x r x Fa
BBC 04 Fmax = α x Fr + 5,01 x r x Fa
BBC 05 Fmax = α x Fr + 4,45 x r x Fa
BBC 06 Fmax = α x Fr + 4,10 x r x Fa
BBC 07 Fmax = α x Fr + 3,48 x r x Fa

Dynamic factor

· constant loading and low speed	α = 1
· variable loading	α = 1 - 1,5
· shock loads or high speed (for > 70 km/h or 45 mph)	α = 1,4 - 2

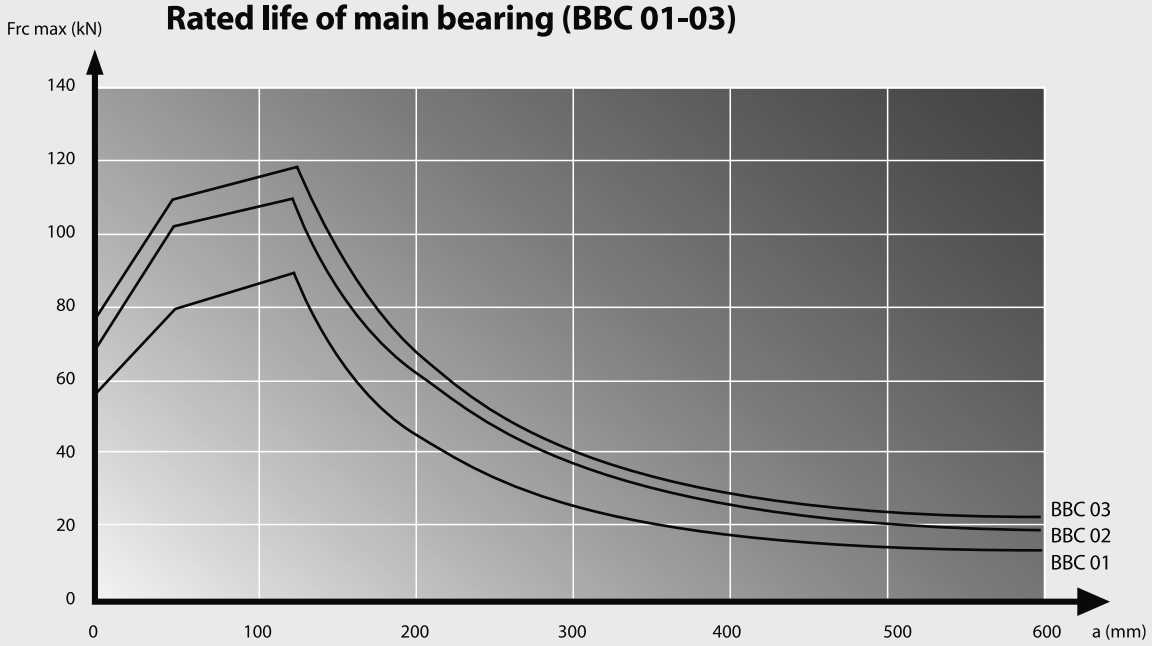


Case leakage

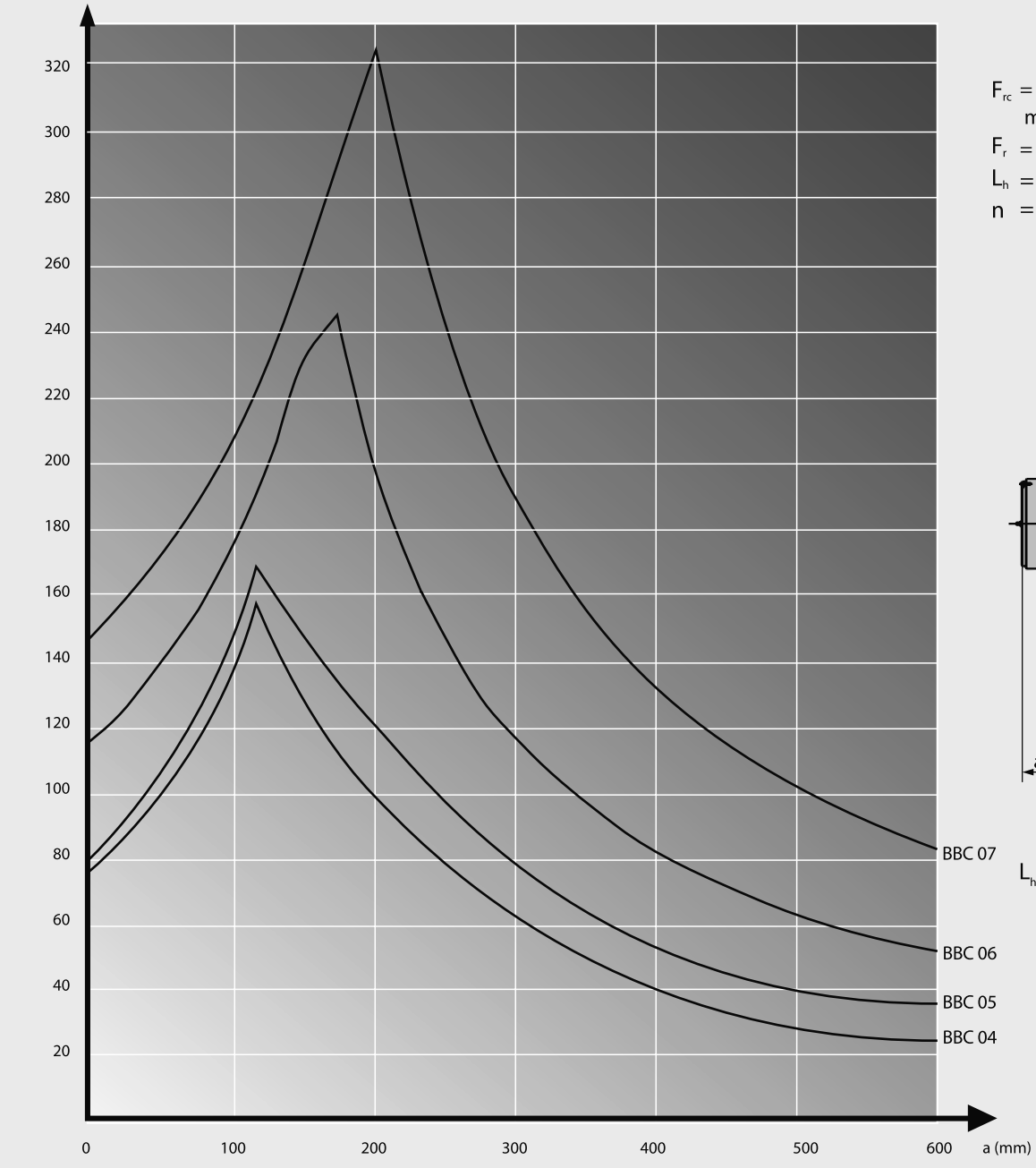


Curves based on oil viscosity 35 cSt.

Rated life of main bearing (BBC 01-03)



Rated life of main bearing (BBC 04-07)

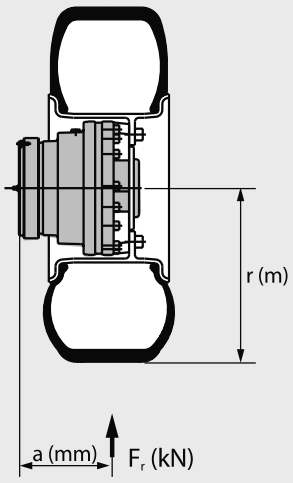


F_{rc} = Calculated load for 10 million revolutions (kN)

F_r = Applied radial load (kN)

L_h = Rated life (hours)

n = Rotation speed (1/min)



$$L_h = \frac{166666}{n} \times \left(\frac{F_{rc}}{F_r}\right)^{\frac{10}{3}}$$

Performance Data

Motor class size		BBC 01					BBC 02					BBC 03				
Percentual displacement	%	90	100	110	120	130	90	100	110	120	130	90	100	110	120	130
Displacement	ccm	462	513	564	615	667	705	783	862	940	1018	909	1010	1111	1212	1313
Peak pressure	bar	450	450	450	425	400	450	450	450	425	400	450	450	450	425	400
· Peak torque	Nm	3045	3380	3715	3830	3910	4645	5160	5680	5850	5965	5990	6655	7320	7545	7690
Intermittent* pressure	bar	400	400	400	375	350	400	400	400	375	350	400	400	400	375	350
· Intermittent torque	Nm	2710	3005	3305	3380	3420	4130	4585	5050	5165	5220	5325	5915	6510	6655	6730
Power																
· Max. displacement	kW			32					42					50		
· 1/2 displacement	kW			21					28					33		
Max. speed																
· Working	rpm	260	234	213	195	180	223	201	182	167	154	206	186	169	155	143
· 1/2 displacement	rpm	364	328	298	278	252	318	286	260	238	220	290	261	238	218	201
· Freewheeling	rpm	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200
Brake																
· Brake torque	Nm			4300					6560					8470		
· Releasing pressure	bar			16					16					16		
· Max. brake pressure	bar			30					30					30		

Motor class size		BBC 04					BBC 05				
Percentual displacement	%	90	100	110	120	130	90	100	110	120	130
Displacement	ccm	1170	1300	1430	1560	1690	1572	1747	1922	2096	2271
Peak pressure	bar	450	450	450	425	400	450	450	450	425	400
· Peak torque	Nm	7710	8670	9425	9710	9900	10360	11515	12670	13045	13305
Intermittent* pressure	bar	400	400	400	375	350	400	400	400	375	350
·Intermittent torque	Nm	6855	7615	8380	8570	8665	9210	10235	11260	11510	11640
Power											
· Max. displacement	kW			59					72		
· 1/4, 1/2, 3/4 displacement	kW			26/39/49					32/48/60		
Max. speed											
· Working	rpm	189	170	155	142	131	172	155	141	129	119
· 3/4 displacement	rpm	225	202	184	169	156	205	185	168	154	142
· 1/2 displacement	rpm	267	240	218	200	185	244	220	200	183	169
· 1/4 displacement	rpm	356	320	291	267	246	326	293	266	244	226
· Freewheeling	rpm	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Brake											
· Brake torque	Nm			10900					20600		
· Releasing pressure	bar			16					16		
· Max. brake pressure	bar			30					30		

Motor class size		BBC 06					BBC 07				
Percentual displacement	%	90	100	110	120	130	90	100	110	120	130
Displacement	ccm	2214	2460	2706	2952	3198	3825	4250	4675	5100	5525
Peak pressure	bar	450	450	450	425	400	450	450	450	425	400
· Peak torque	Nm	14590	16215	17835	18375	18735	25200	28000	30800	31740	32360
Intermittent* pressure	bar	400	400	400	375	350	400	400	400	375	350
· Intermittent torque	Nm	12970	14410	15855	16215	16395	22400	24890	27380	28000	28310
Power											
· Max. displacement	kW			91					125		
· 1/4, 1/2, 3/4 displacement	kW			40/60/76					54/81/104		
Max. speed											
· Working	rpm	154	139	126	116	107	123	110	100	92	85
· 3/4 displacement	rpm	183	165	150	137	127	136	122	111	102	94
· 1/2 displacement	rpm	217	195	177	163	150	170	153	139	127	117
· 1/4 displacement	rpm	289	260	237	217	200	226	203	185	170	156
· Freewheeling	rpm	800	800	800	800	800	650	650	650	650	650
Multi-disc brake											
· Brake torque	Nm			20600					42000		
· Releasing pressure	bar			16					16		
· Max. brake pressure	bar			30					30		

** Intermittent operation: Permissible values for max. 10% of every minute.*

Ordering Code for BBC Series

BBC Motors
standard
code

Motor class size
(nominal displacement)
1 = 513 ccm, BBC01
2 = 783 ccm, BBC02
3 = 1010 ccm, BBC03
4 = 1300 ccm, BBC04
5 = 1747 ccm, BBC05
6 = 2460 ccm, BBC06
7 = 4250 ccm, BBC07

Motor displacement of nominal displacement
1 = 90 %
2 = 100 %
3 = 110 %
4 = 120 %
5 = 130 %
Any other =special

Displacement
0 = 4 - speed, electrically controlled
1 = 1 - speed, fixed displacement
2 = 2 - speed, Vmin = 1/2 Vmax
3 = 2 - speed, Vmin = 1/4 Vmax
4 = 2 - speed, Vmin = 3/4 Vmax
5 = 1 - speed, reduced displacement, 75% of normal displacement (Not available for BBC01-03)
6 = 1 - speed, reduced displacement, 50% of normal displacement
7 = 4 - speed, hydraulically controlled
8 = 3 - speed, electrically controlled, 50, 75, 100%
9 = 3 - speed, hydraulically controlled, 50, 75, 100%
(All brake options are not available for every motor size.)

Special mode code
AA = Standard
Any other = special

Speed sensor
0 = None
1 = Standard sensor
2 = 2 sensor mountings, w/o sensors
3 = 1 sensor mounting, w/o sensor
4 = Special sensor
5 = 2 sensor mountings, with sensors

Freewheeling
0 = Hydraulic freewheeling
1 = Mechanical freewheeling (not available for BBC01)
2 = Embeded freewheeling valve (not available for BBC01 and 02)

Case flushing
0 = No flushing line
1 = Flushing line (standard in 2-speed motors)

Brake options
0 = w/o brake
1 = Wet multi-disc brake, spring operated
2 = Drum brake CCW
3 = Drum brake CW
4 = External disc brake
5 = Option for external disc brake (no disc)
6 = Wet multi-disc brake & option for external disc brake (no disc)

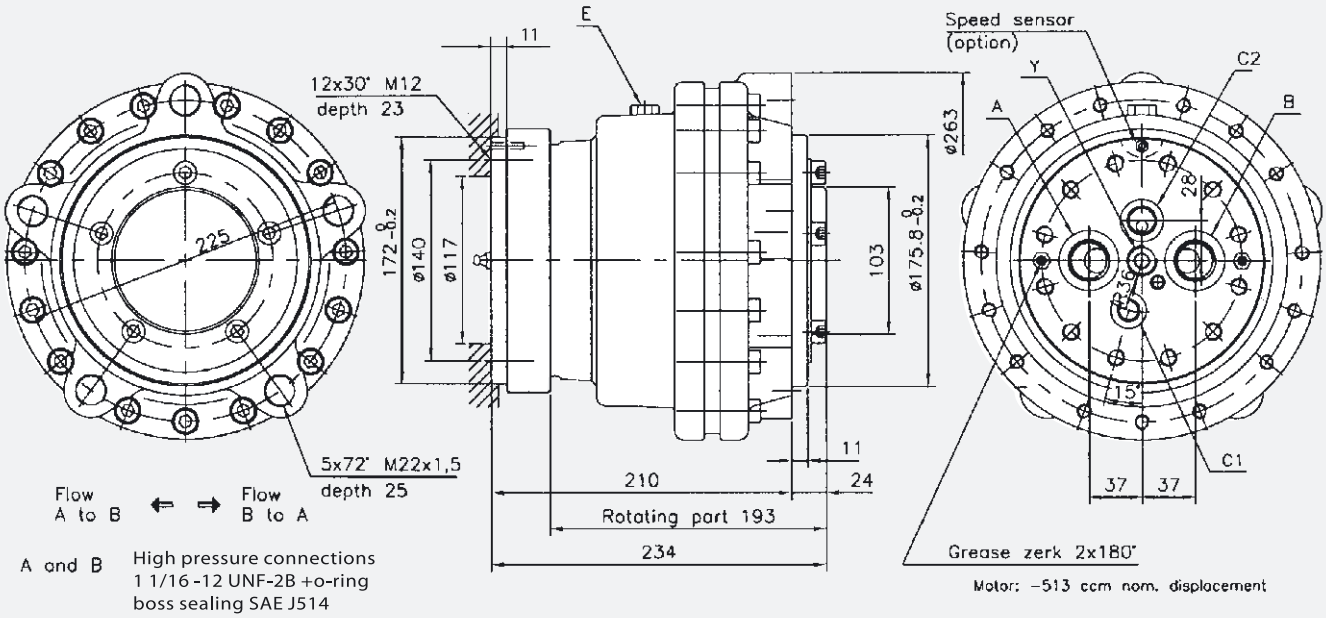
(All brake options are not available for every motor size.)

e.g. C24 211 10AA = BBC 02 2-speed, 940 ccm (1/1 displacement), 470 ccm (1/2 displacement) with multi-disk brake, additional flushing line, with mechanical freewheeling springs, no speed sensor, no special options

Product information
Black Bruin manufacturer shall in no case make any warranty with respect to information in catalogues, instructions, drawings, technical data or other specifications. All options are not available for all motors.

Product alterations
Black Bruin manufacturer reserves the right to alter products without notice. This also applies to the specifications and other information in guides and to products on which orders have been placed.

Technical Data Specifications
BBC 01



Motor: –513 ccm nom. displacement

A and B – High pressure connections
1 1/16-12 UNF-2B +o-ring
boss sealing SAE J514

C2 – Drain connection 3/4–16 UNF–2B
+ o–ring boss sealing SAE J514

C1 – Case flushing connection 9/16–18 UNF–2B
+ o–ring boss sealing SAE J514

E – Air bleed screw

Y – 2–speed connection 7/16–20 UNF–2B
+ o–ring sealing (option)

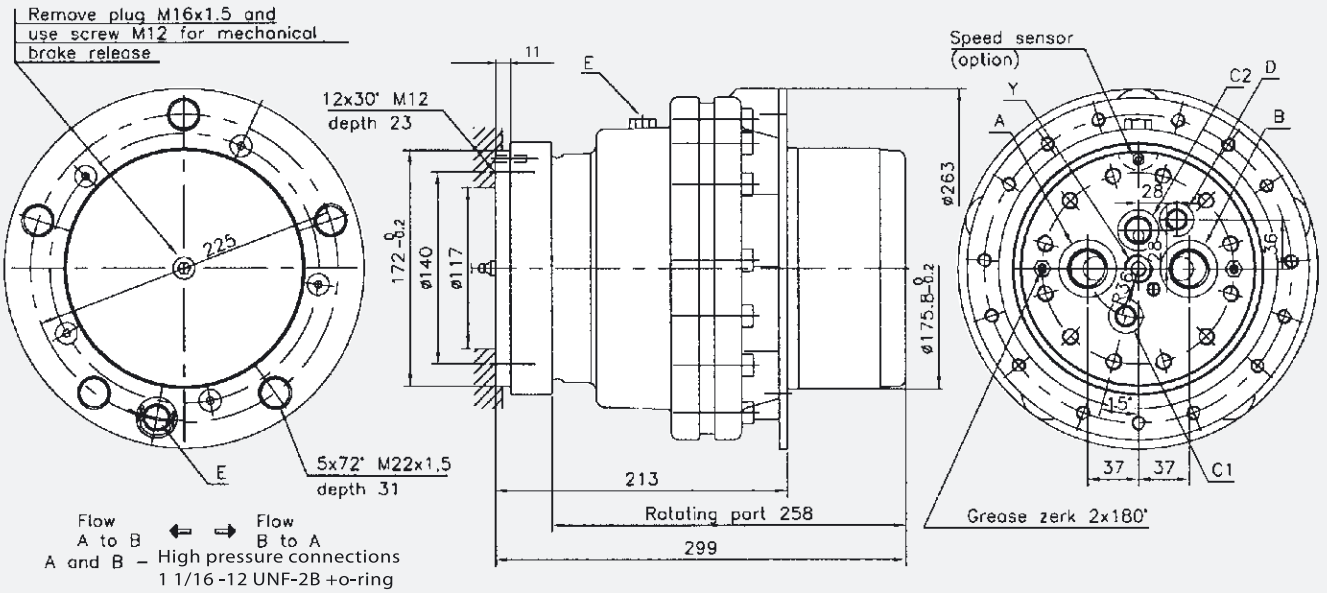
Hub connection according to DIN 74361

Black Bruin -motors tightening torque

	Hub cover Shaft end	Shaft end
Hardness	f10.9	f12.9
Size M12	110 Nm	135 Nm
Size M14	180 Nm	215 Nm
Size M16	275 Nm	330 Nm
Size M18	383 Nm	460 Nm
Size M20	540 Nm	650 Nm
Size M22	728 Nm	874 Nm

(The tightening torques are valid both for standard and fine thread.)

BBC 01 with multi- disc brake



Multi–disc brake: – static torque 4300 Nm

Motor: –513 ccm nom. displacement

A and B – High pressure connections
1 1/16-12 UNF-2B +o-ring
boss sealing SAE J514

C2 – Drain connection 3/4–16 UNF–2B
+ o–ring boss sealing SAE J514

C1 – Case flushing connection 9/16–18 UNF–2B
+ o–ring boss sealing SAE J514

E – Air bleed screw

D – Brake connection 9/16–18 UNF–2B
+ o–ring sealing

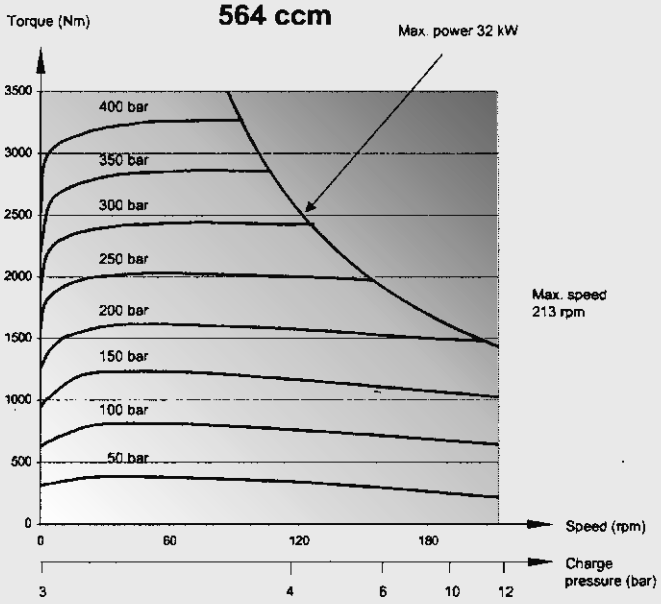
Y – 2–speed connection 7/16–20 UNF–2B
+ o–ring sealing (option)

Hub connection according to DIN 74361

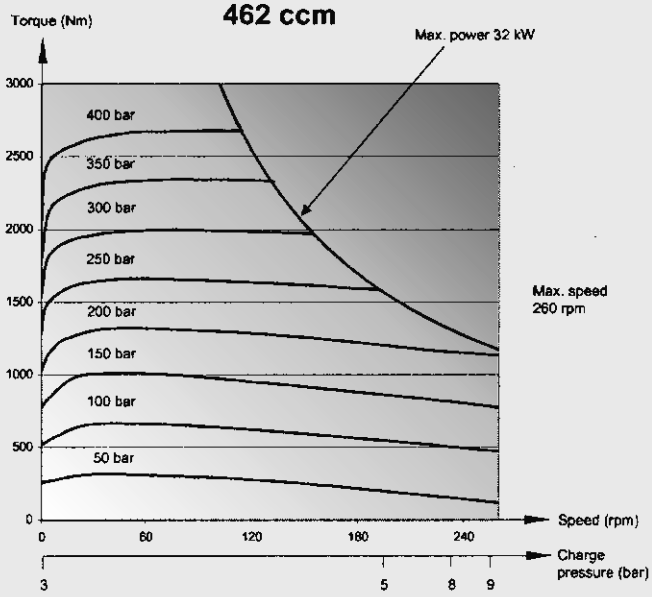
Motor class size BBC 01

Performance curves at full displacement

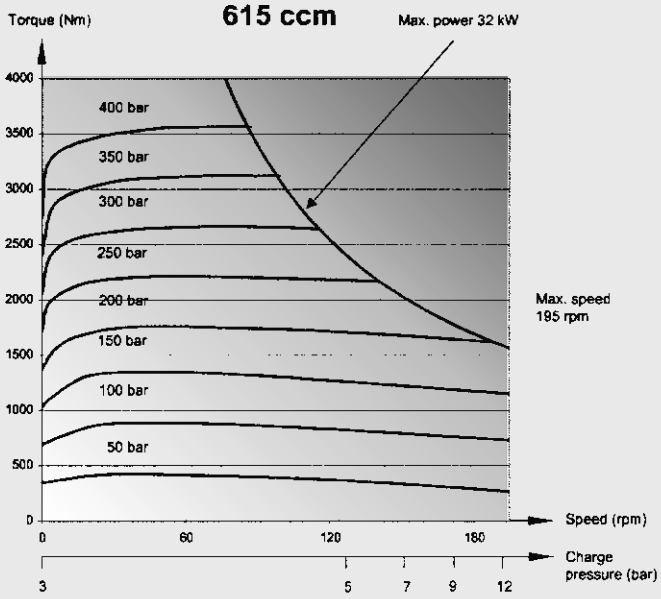
564 ccm



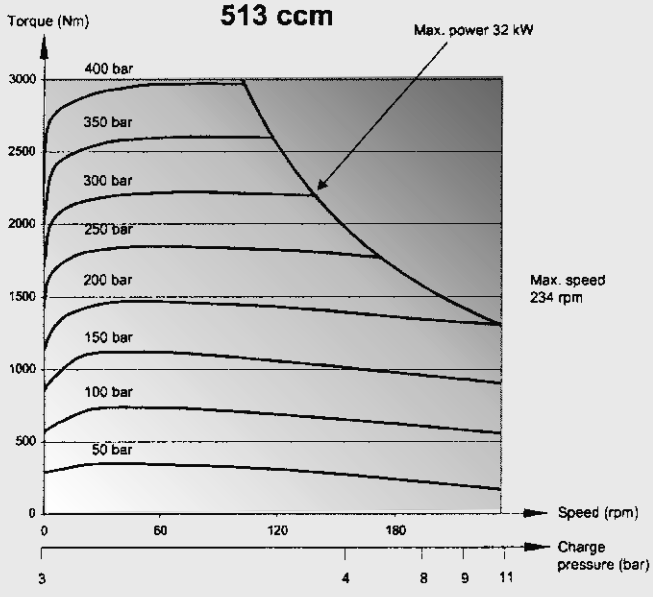
462 ccm



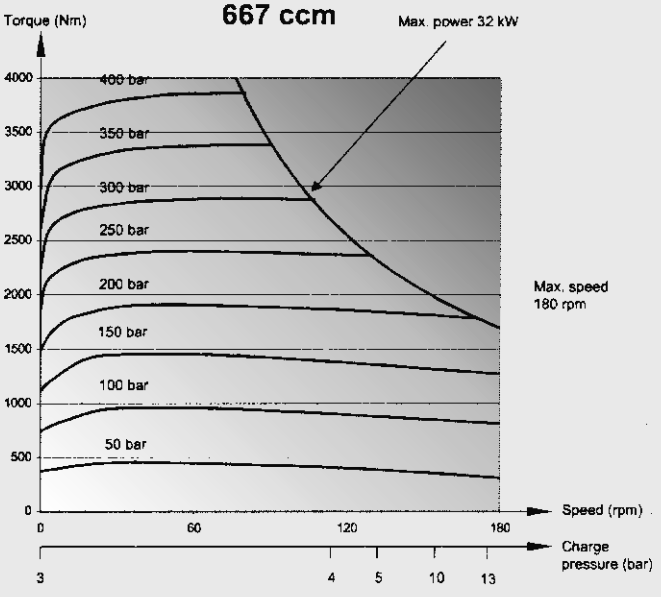
615 ccm



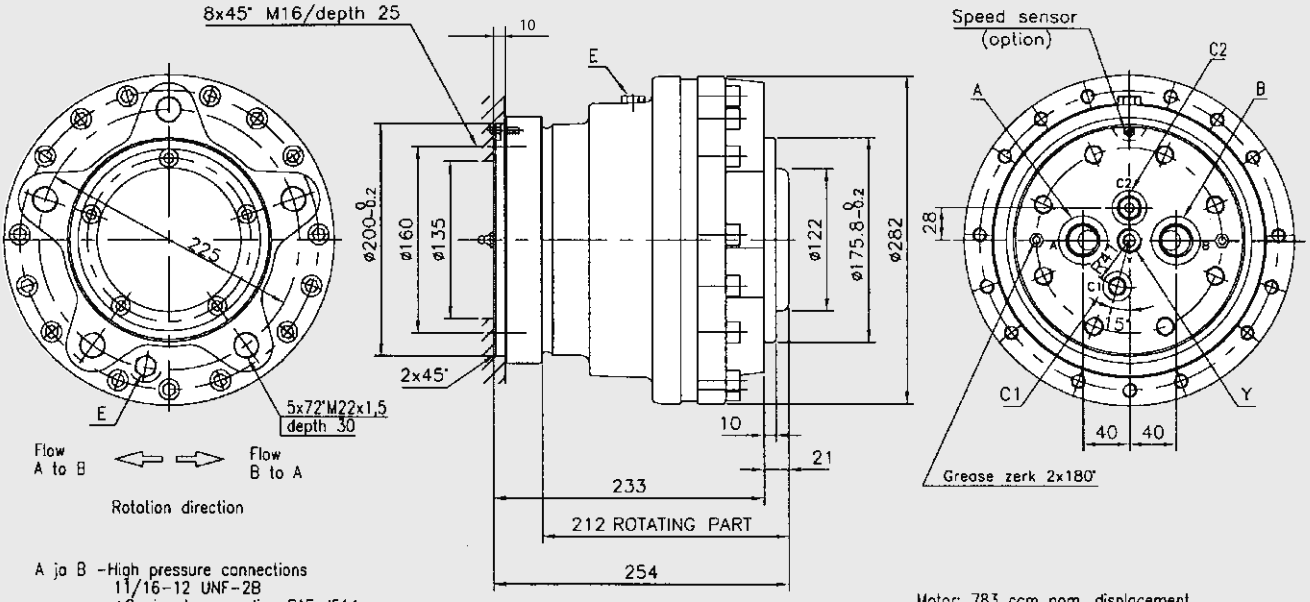
513 ccm



667 ccm



Technical Data Specifications
BBC 02



A ja B -High pressure connections
11/16-12 UNF-2B
+O-ring boss sealing SAE J514
C2 -Drain connection 3/4-16 UNF-2B
+O-ring boss sealing SAE J514
C1 -Case flushing connection 9/16-18 UNF-2B
+O-ring boss sealing SAE J514
Y -2-speed connection 7/16-20 UNF-2B
+O-ring sealing (option)
E -Air bleed screw

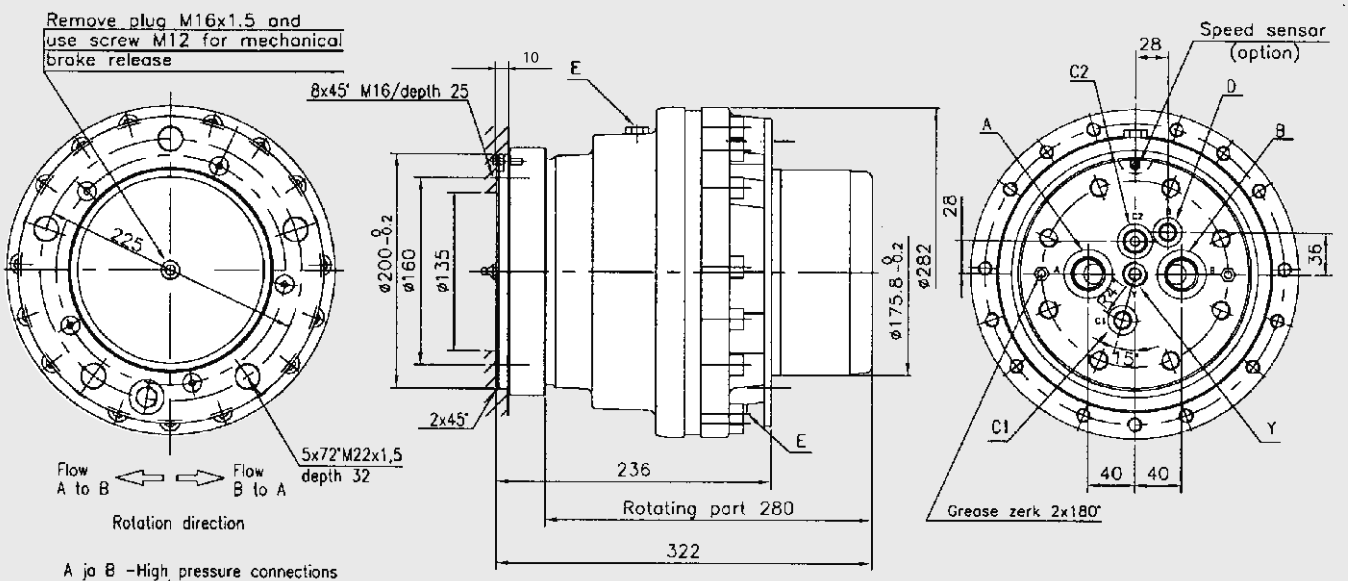
Motor: 783 ccm nom. displacement

Black Bruin -motors tightening torque

	Hub cover Shaft end	Shaft end
Hardness	f10.9	f12.9
Size M12	110 Nm	135 Nm
Size M14	180 Nm	215 Nm
Size M16	275 Nm	330 Nm
Size M18	383 Nm	460 Nm
Size M20	540 Nm	650 Nm
Size M22	728 Nm	874 Nm

(The tightening torques are valid both for standard and fine thread.)

BBC 02 with multi- disc brake



A ja B -High pressure connections
11/16-12 UNF-2B
+O-ring boss sealing SAE J514
C2 -Drain connection 3/4-16 UNF-2B
+O-ring boss sealing SAE J514
C1 -Case flushing connection 9/16-18 UNF-2B
+ O-ring sealing
D -Brake connection 9/16-18 UNF-2B
+ O-ring sealing
Y -2-speed connection 7/16-20UNF-2B
+ O-ring sealing (option)
E -Air bleed screw

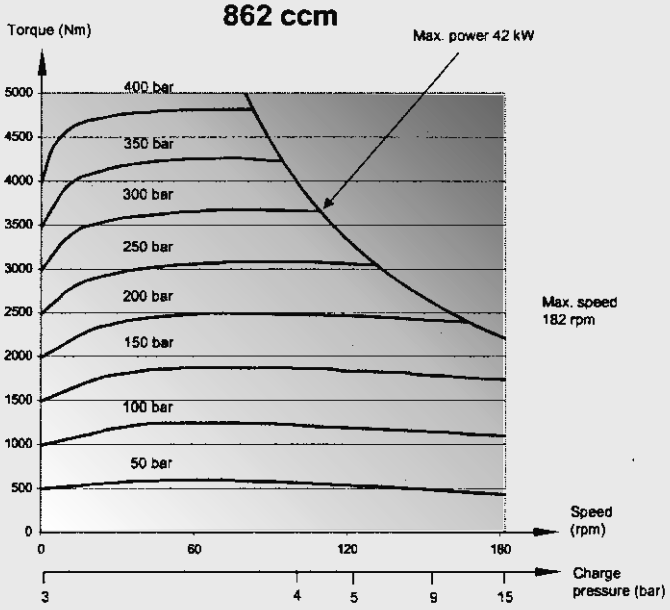
Multi-disc brake: – static torque: 6560 Nm

Motor: 783 ccm nom. displacement

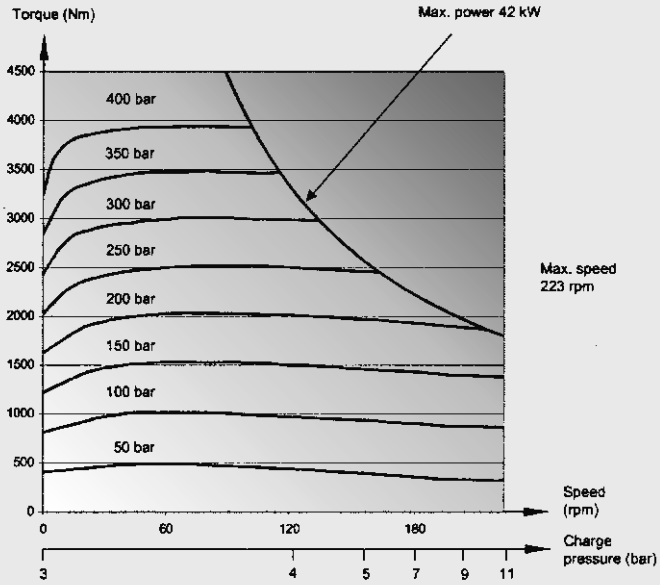
Motor class size BBC 02

Performance curves at full displacement

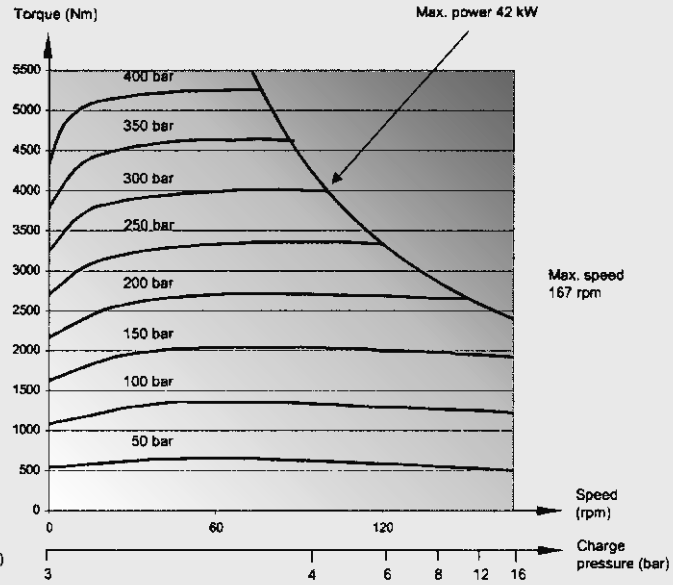
862 ccm



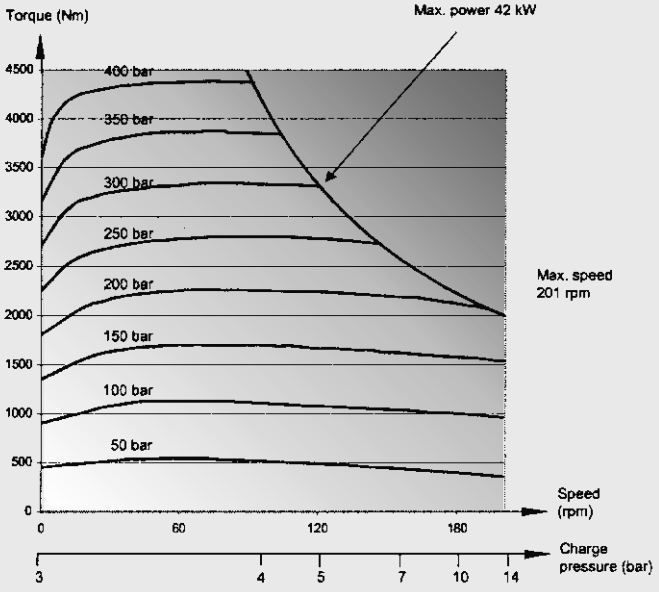
705 ccm



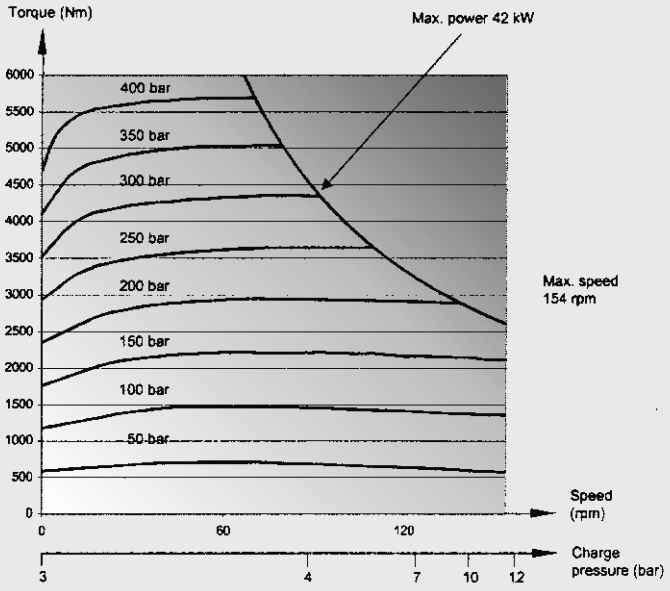
940 ccm



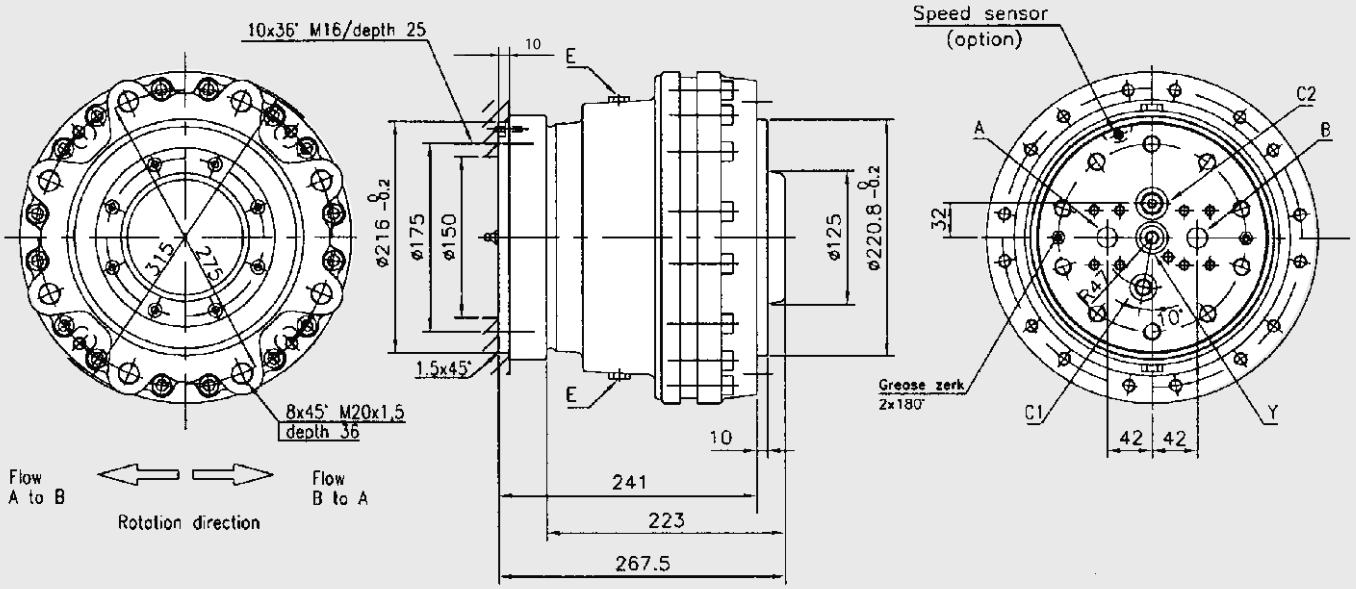
783 ccm



1018 ccm



Technical Data Specifications
BBC 03



A and B –High pressure connections
3/4 in SAE–flange 6000 psi
C2 –Drain connection 3/4–16 UNF–2B
+O–ring sealing
C1 –Case flushing connection 9/16–18 UNF–2B
+O–ring sealing
Y –2–speed connection 7/16–20 UNF–2B
+O–ring sealing (option)
E –Air bleed screw 2x180°

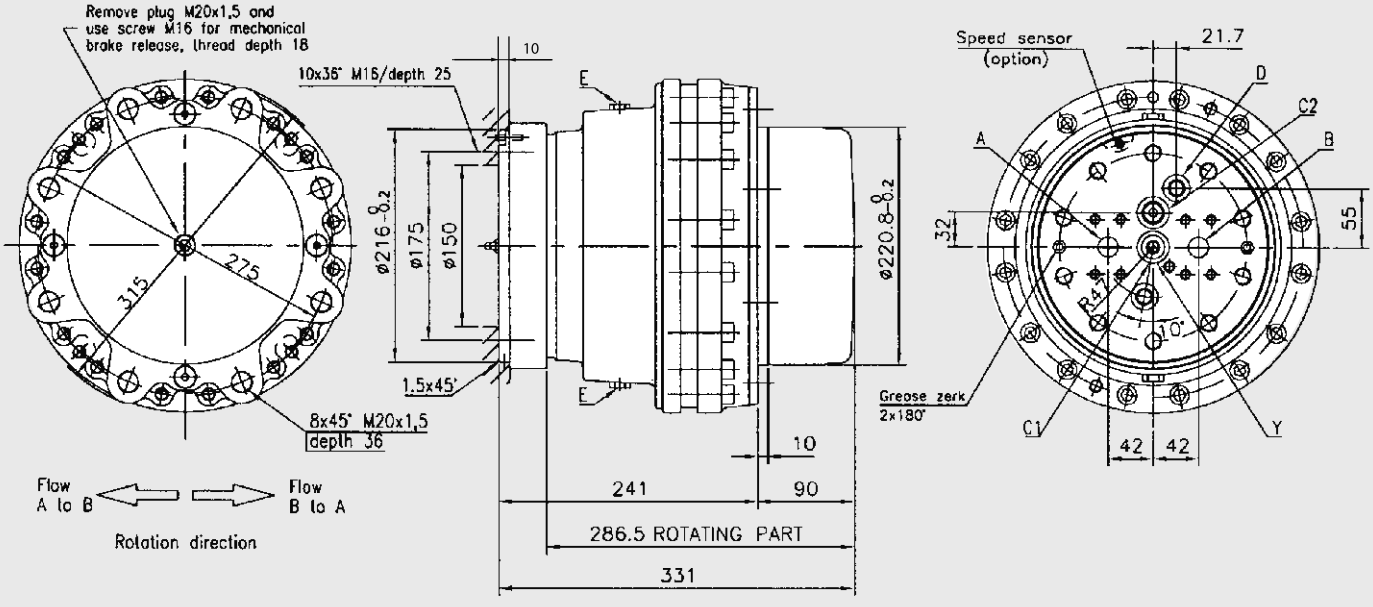
Motor: –1010 ccm nominal displacement

Black Bruin -motors tightening torque

	Hub cover Shaft end	Shaft end
Hardness	f10.9	f12.9
Size M12	110 Nm	135 Nm
Size M14	180 Nm	215 Nm
Size M16	275 Nm	330 Nm
Size M18	383 Nm	460 Nm
Size M20	540 Nm	650 Nm
Size M22	728 Nm	874 Nm

(The tightening torques are valid both for standard and fine thread.)

BBC 03 with multi- disc brake



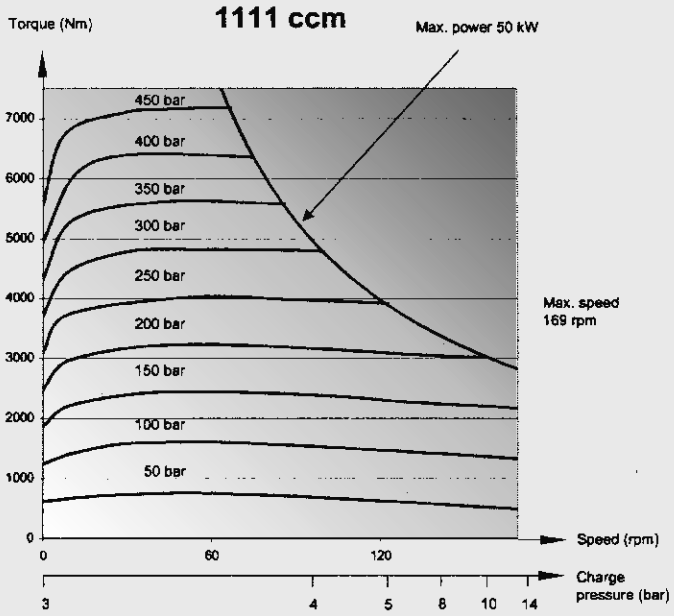
A and B –High pressure connections
3/4 in SAE–flange 6000 psi
C2 –Drain connection 3/4–16 UNF–2B
+O–ring sealing
C1 –Case flushing connection 9/16–18 UNF–2B
+O–ring sealing
D –Brake connection 9/16–18 UNF–2B
+O–ring sealing
Y –2–speed connection 7/16–20 UNF–2B
+O–ring sealing (option)
E –Air bleed screw 2x180°

Motor: –1010 ccm nominal displacement
Multi–disc brake: – static torque 8470 Nm

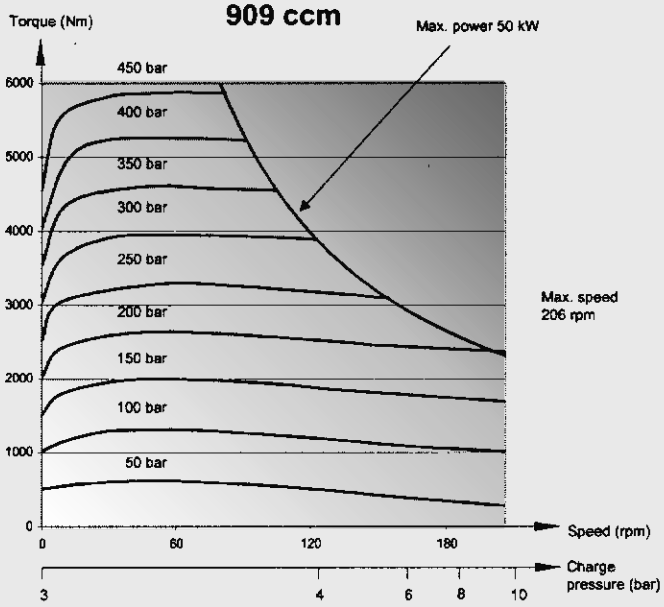
Motor class size BBC 03

Performance curves at full displacement

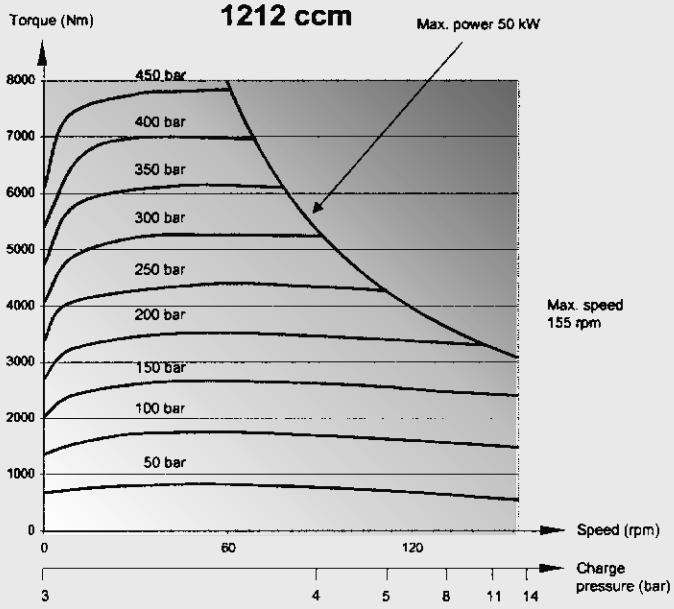
1111 ccm



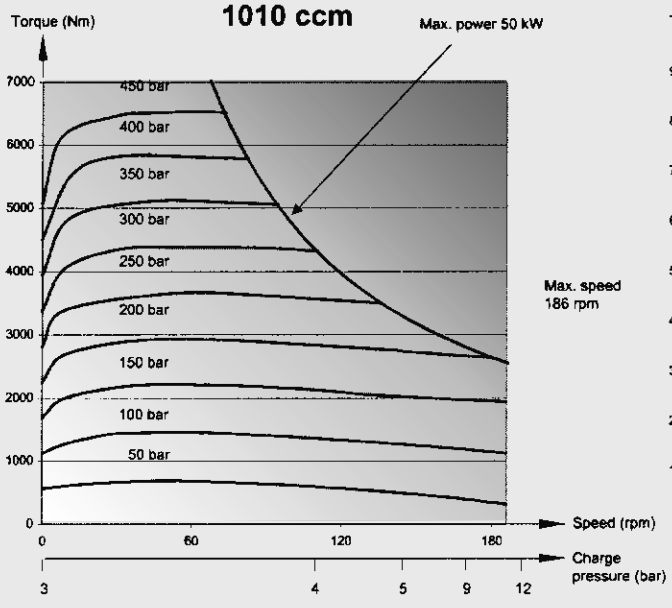
909 ccm



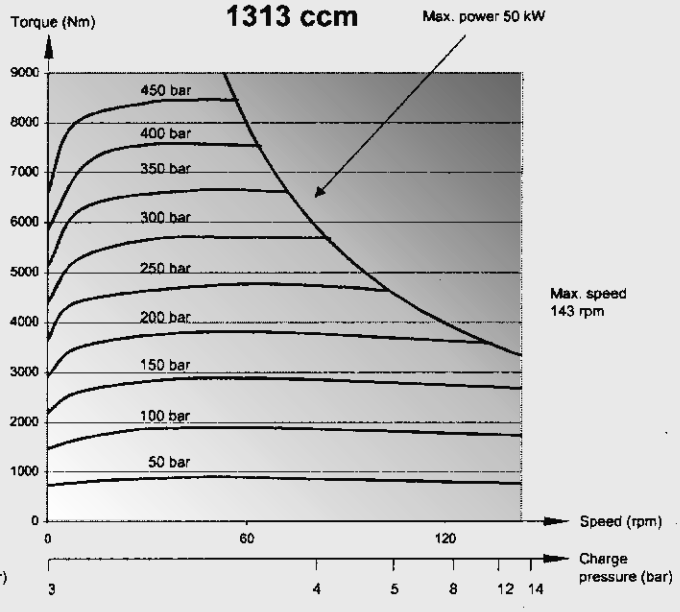
1212 ccm



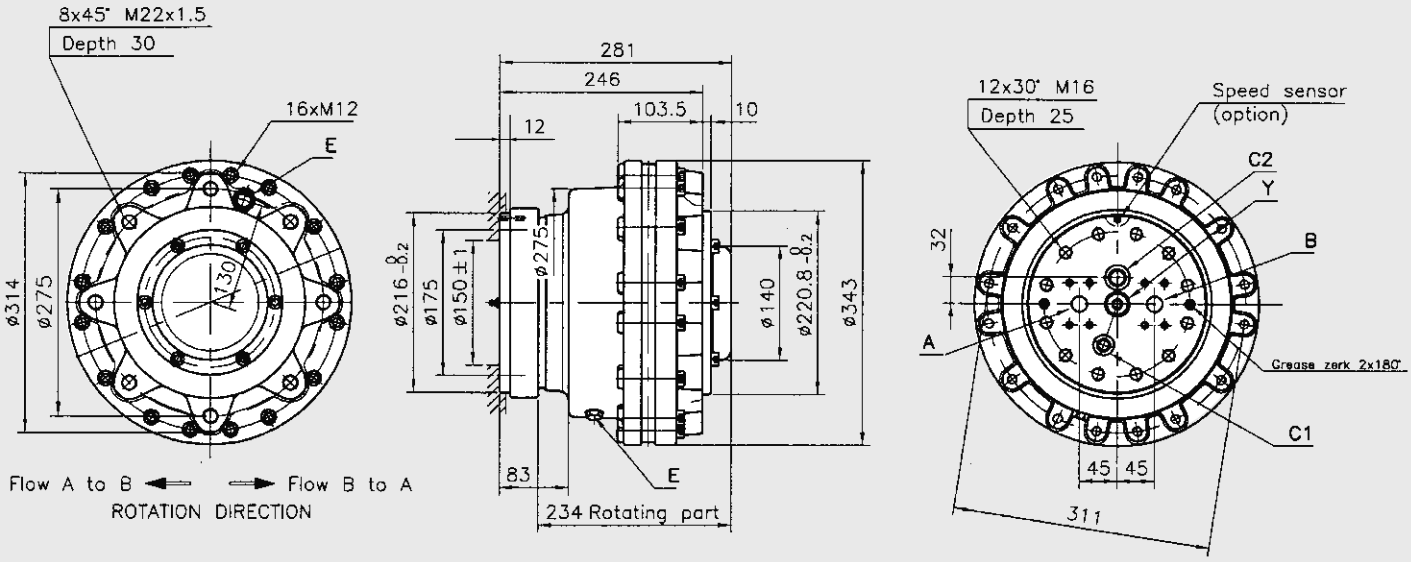
1010 ccm



1313 ccm



Technical Data Specifications
BBC 04



A and B – High pressure connections 3/4 in SAE-flange
C2 – Drain connection 3/4-16 UNF-2B + O-ring sealing
C1 – Case flushing connection 9/16-18 UNF-2B + O-ring sealing
Y – 2-speed connection 7/16-20 UNF-2B + O-ring sealing
E – Air bleed screw 2x180°

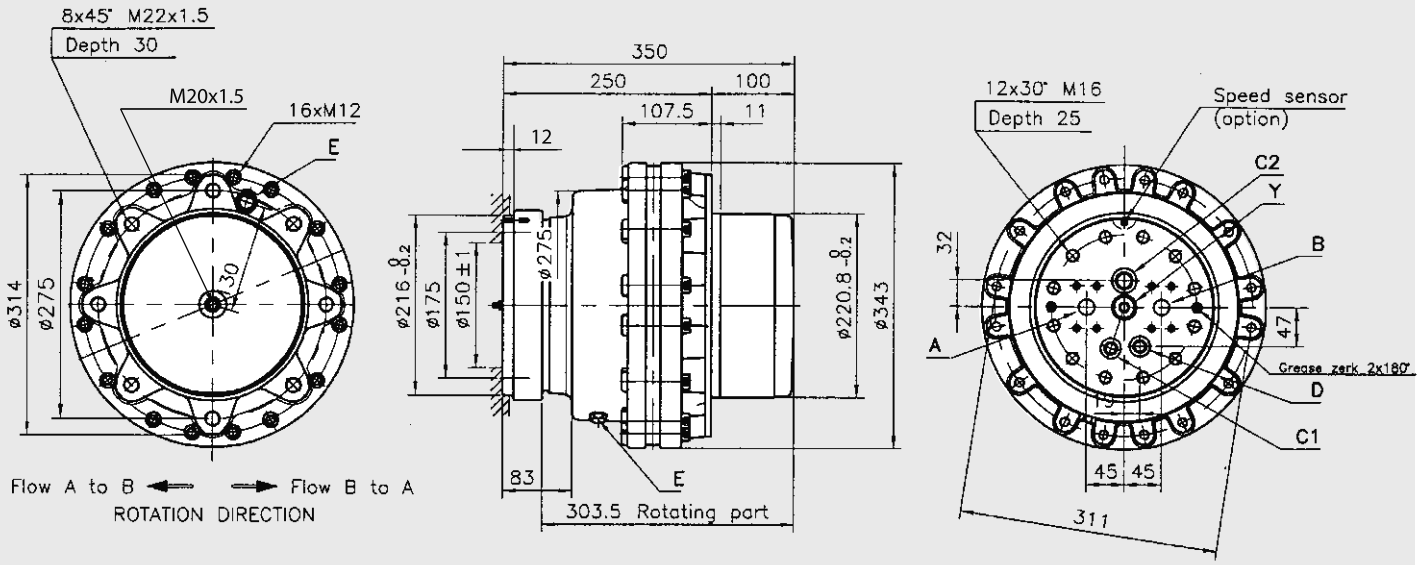
Nominal displacement 1300 ccm

Black Bruin -motors tightening torque

	Hub cover Shaft end	Shaft end
Hardness	f10.9	f12.9
Size M12	110 Nm	135 Nm
Size M14	180 Nm	215 Nm
Size M16	275 Nm	330 Nm
Size M18	383 Nm	460 Nm
Size M20	540 Nm	650 Nm
Size M22	728 Nm	874 Nm

(The tightening torques are valid both for standard and fine thread.)

BBC 04 with multi- disc brake



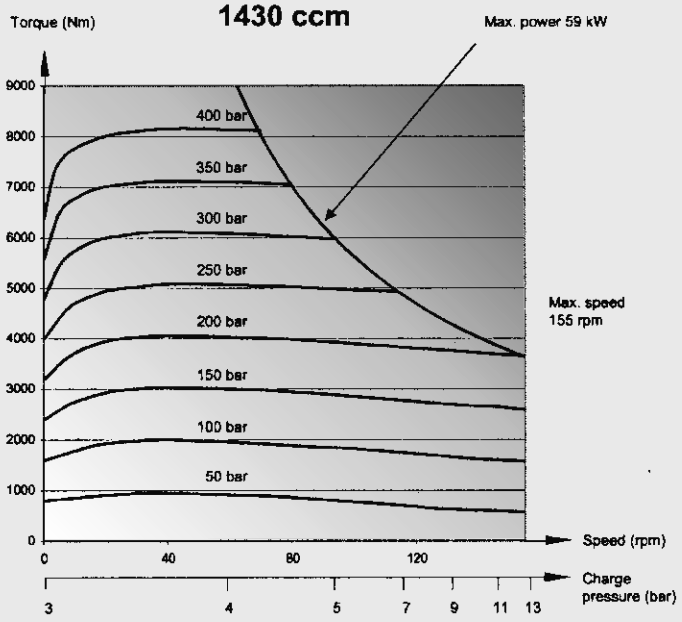
A and B – High pressure connections 3/4 in SAE-flange
C2 – Drain connection 3/4-16 UNF-2B + O-ring sealing
C1 – Case flushing connection 9/16-18 UNF-2B + O-ring sealing
D – Brake connection 9/16-18 UNF-2B + O-ring sealing
Y – 2-speed connection 7/16-20 UNF-2B + O-ring sealing
E – Air bleed screw 2x180°

Nominal displacement 1300 ccm
Multi – disk brake – static torque 10900 Nm

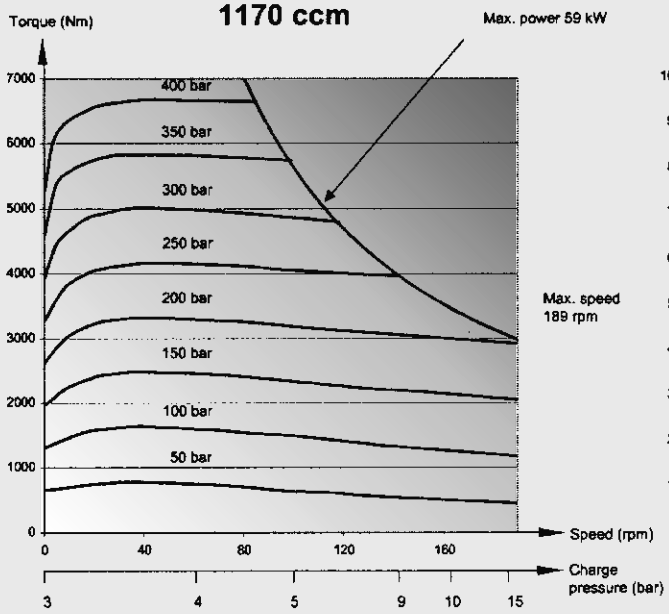
Motor class size BBC 04

Performance curves at full displacement

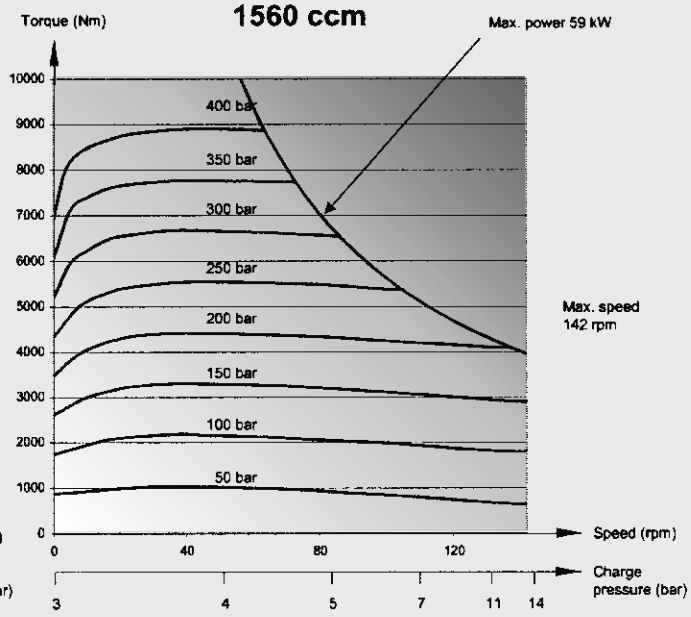
1430 ccm



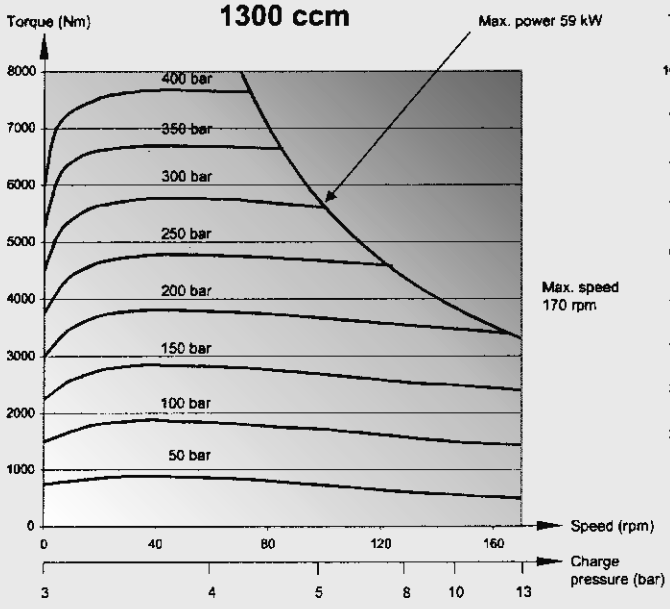
1170 ccm



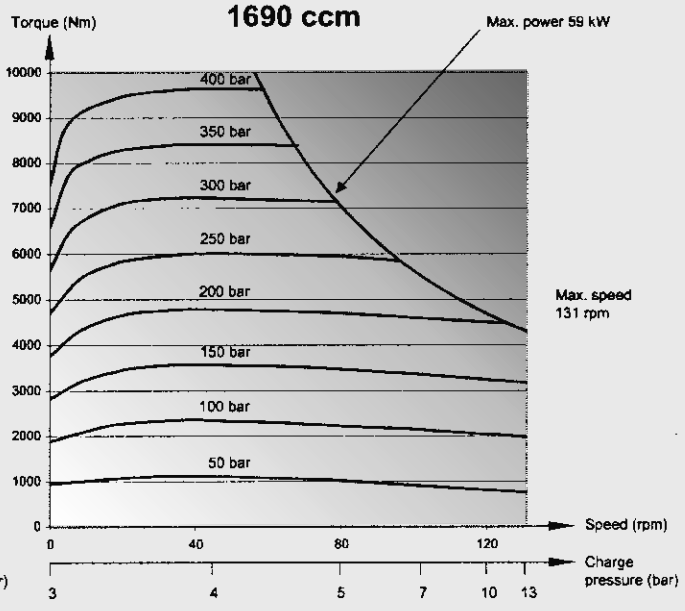
1560 ccm



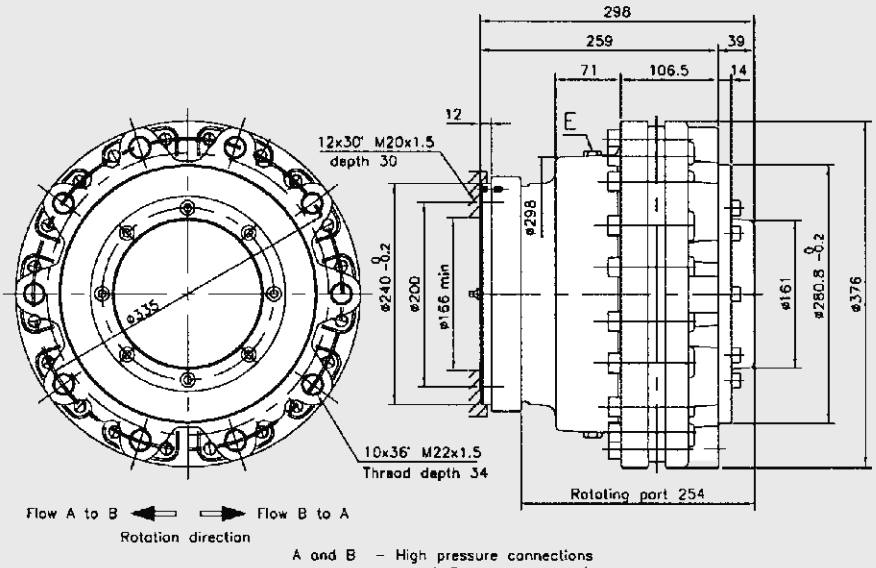
1300 ccm

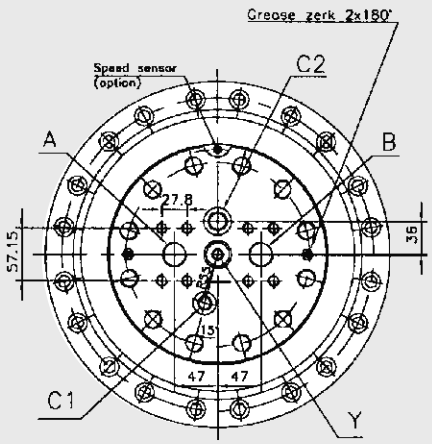


1690 ccm



Technical Data Specifications
BBC 05





A and B – High pressure connections
1 in SAE-flange and R3/4
C2 – Drain connection 3/4-16 UNF-2B
+ O-ring sealing
C1 – Case flushing connection 9/16-18 UNF-2B
+ O-ring sealing
Y – 2-speed connection 7/16-20 UNF-2B
+ O-ring sealing (option)
E – Air bleed screw 2x180°

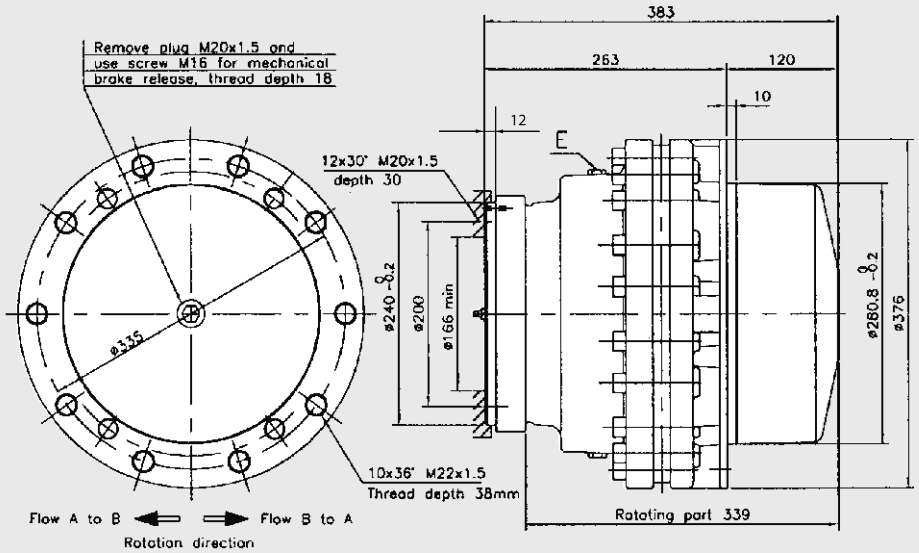
Nominal displacement 1747 ccm

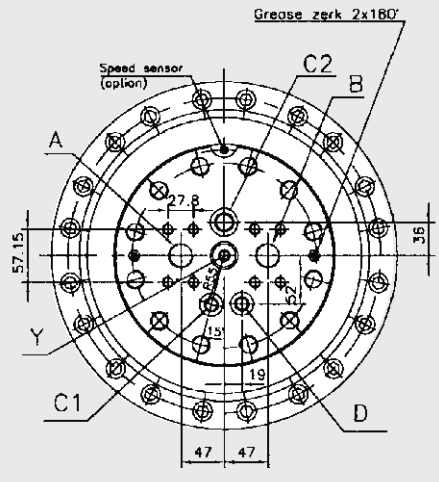
Black Bruin -motors tightening torque

	Hub cover Shaft end	Shaft end
Hardness	f10.9	f12.9
Size M12	110 Nm	135 Nm
Size M14	180 Nm	215 Nm
Size M16	275 Nm	330 Nm
Size M18	383 Nm	460 Nm
Size M20	540 Nm	650 Nm
Size M22	728 Nm	874 Nm

(The tightening torques are valid both for standard and fine thread.)

BBC 05 with multi- disc brake





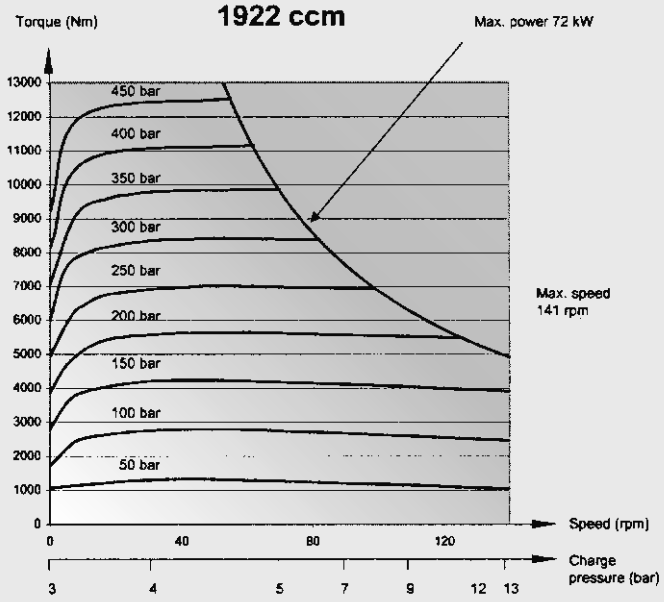
A and B – High pressure connections
1 in SAE-flange and R3/4
C2 – Drain connection 3/4-16 UNF-2B
+ O-ring sealing
C1 – Case flushing connection 9/16-18 UNF-2B
+ O-ring sealing
D – Brake connection 9/16-18 UNF-2B
+ O-ring sealing
Y – 2-speed connection 7/16-20 UNF-2B
+ O-ring sealing (option)
E – Air bleed screw 2x180°

Nominal displacement 1747 ccm
Multi-disc brake: – static torque 20600 Nm

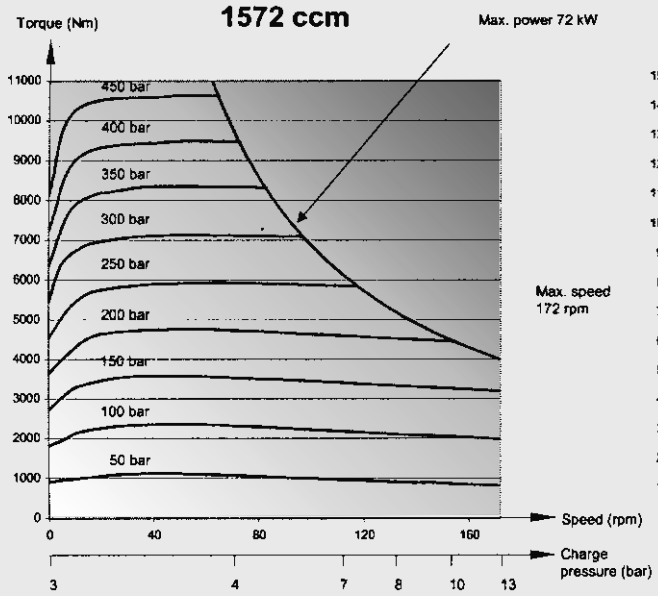
Motor class size BBC 05

Performance curves at full displacement

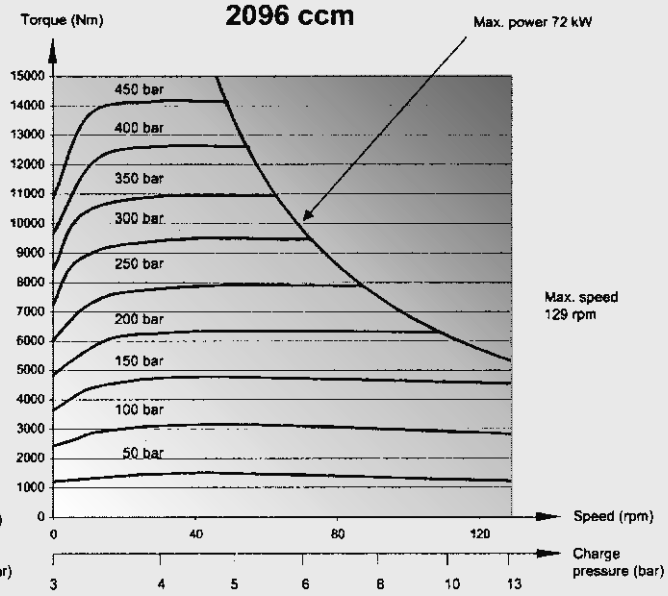
1922 ccm



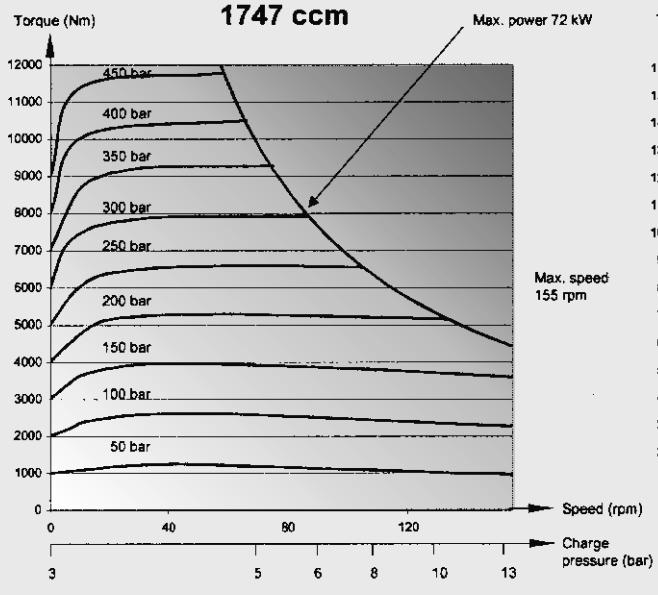
1572 ccm



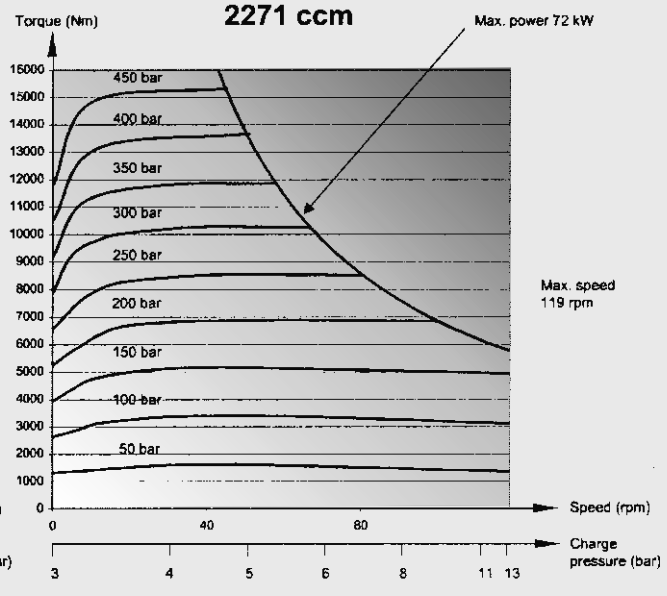
2096 ccm



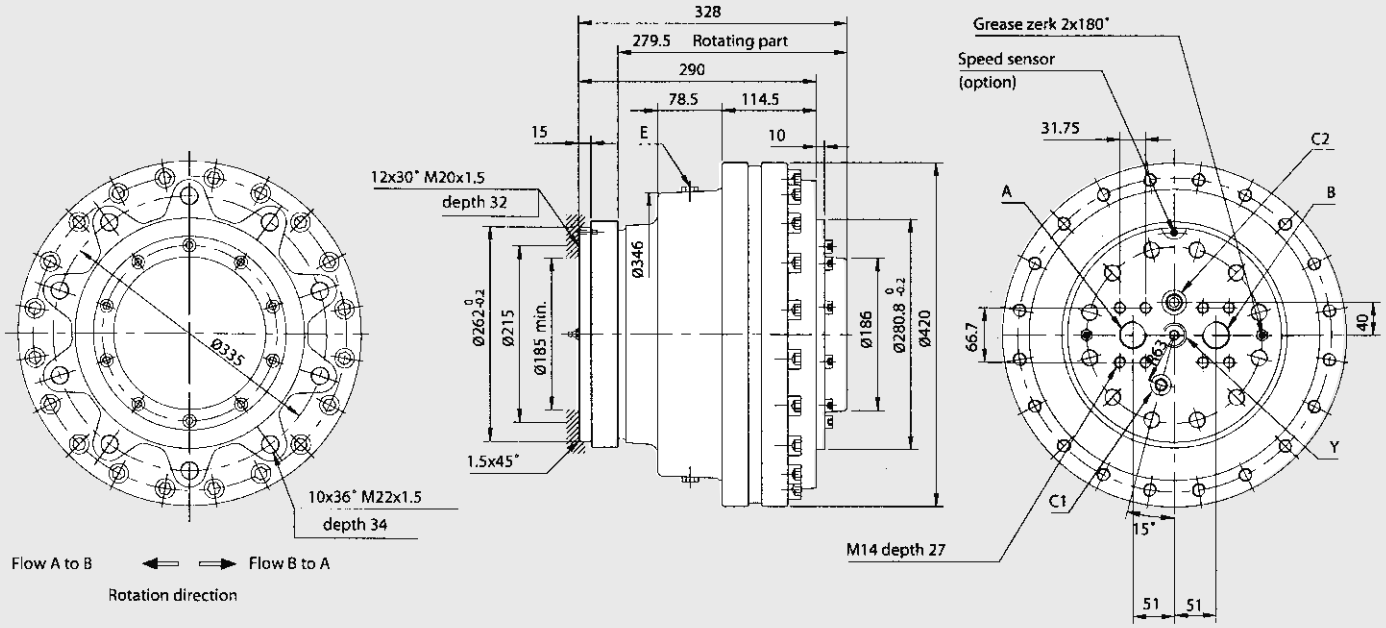
1747 ccm



2271 ccm



Technical Data Specifications
BBC 06



A and B - High pressure connections
1 1/4 in SAE-flange (6000 psi) and R1
C2 - Drain connection 3/4-16 UNF-2B
+O-ring sealing
C1 - Case flushing connection 9/16-18 UNF-2B
+O-ring sealing
Y - 2-speed connection 7/16-20 UNF-2B
+O-ring sealing
E - Air bleed screw 2x180°

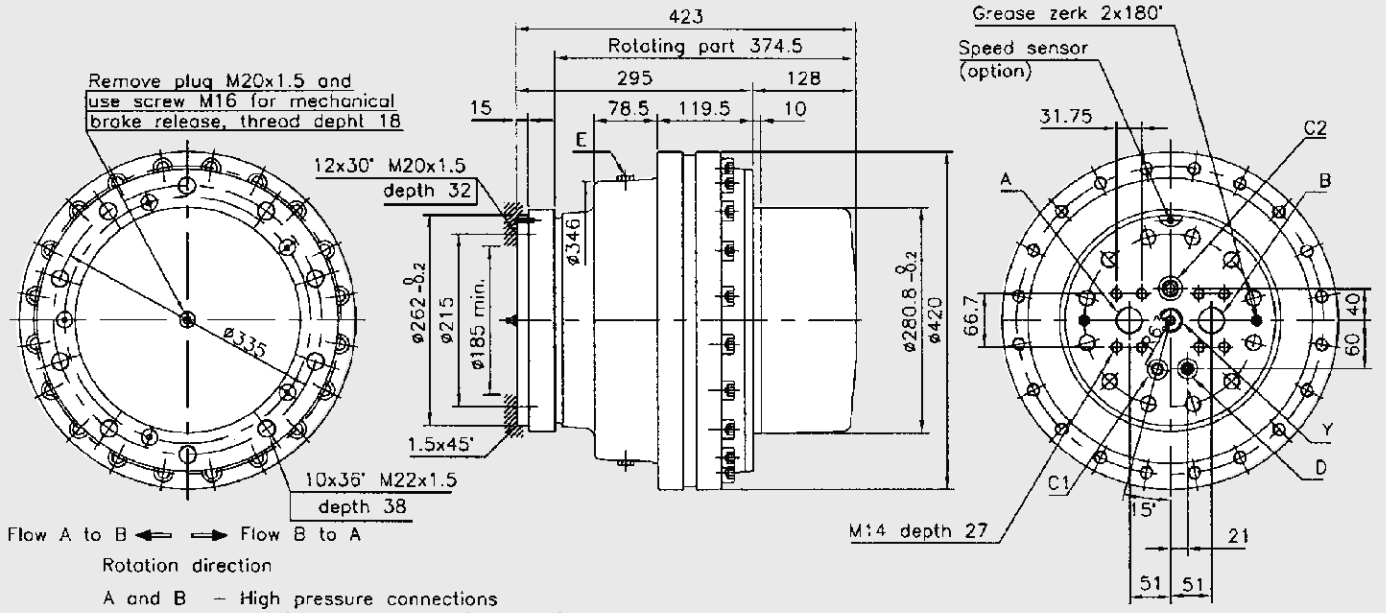
Nominal displacement 2460 ccm

Black Bruin -motors tightening torque

	Hub cover Shaft end	Shaft end
Hardness	f10.9	f12.9
Size M14	180 Nm	215 Nm
Size M20	540 Nm	650 Nm
Size M22	728 Nm	874 Nm

(The tightening torques are valid both for standard and fine thread.)

BBC 06 with multi- disc brake



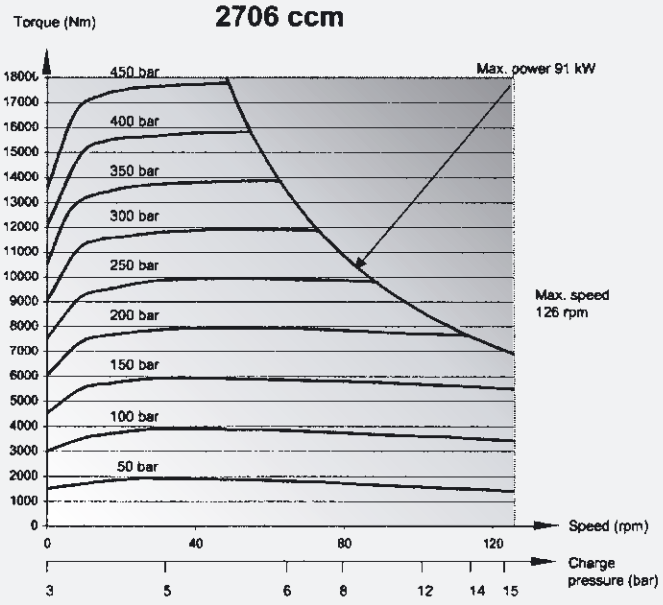
A and B – High pressure connections
1 1/4 in SAE-flange (6000 psi) and R1
C2 – Drain connection 3/4–16 UNF–2B
+O–ring sealing
C1 – Case flushing connection 9/16–18 UNF–2B
+O–ring sealing
Y – 2–speed connection 7/16–20 UNF–2B
+O–ring sealing (option)
D – Brake connection 9/16–18 UNF–2B
+O–ring sealing
E – Air bleed screw 2x180°

Nominal displacement 2460 ccm
Multi–disc brake: –Static torque 20600Nm

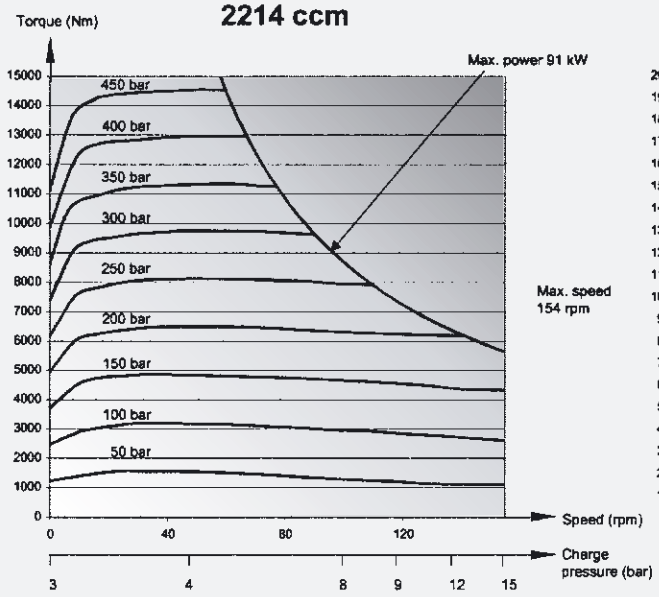
Motor class size BBC 06

Performance curves at full displacement

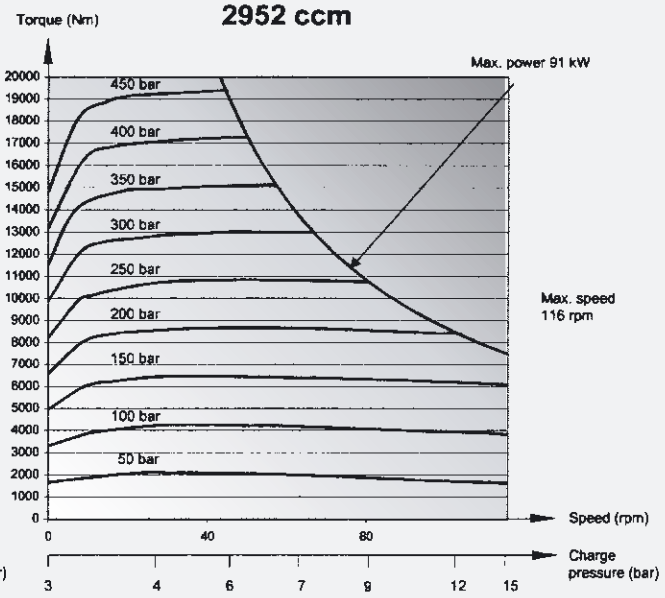
2706 ccm



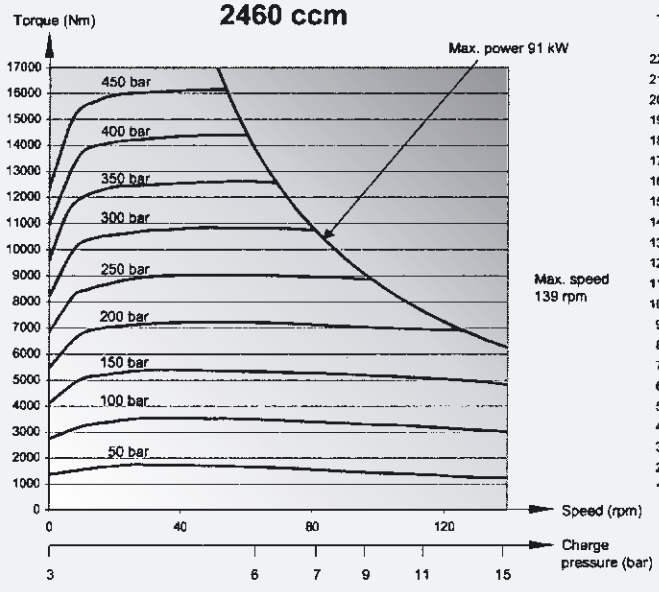
2214 ccm



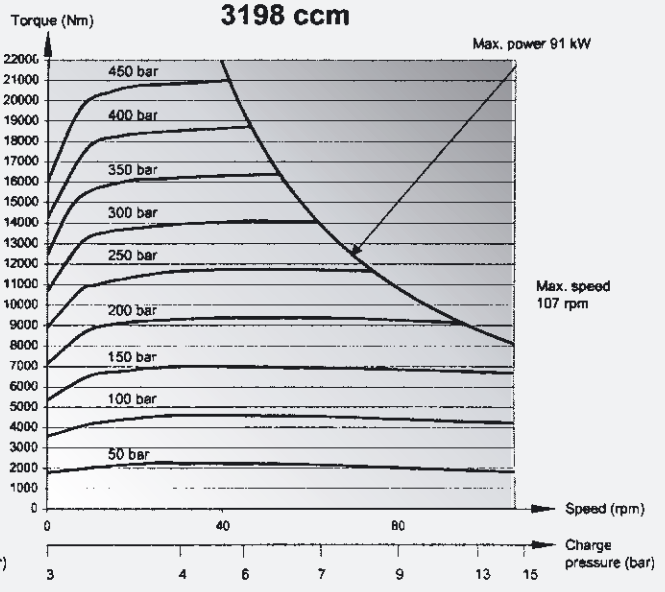
2952 ccm



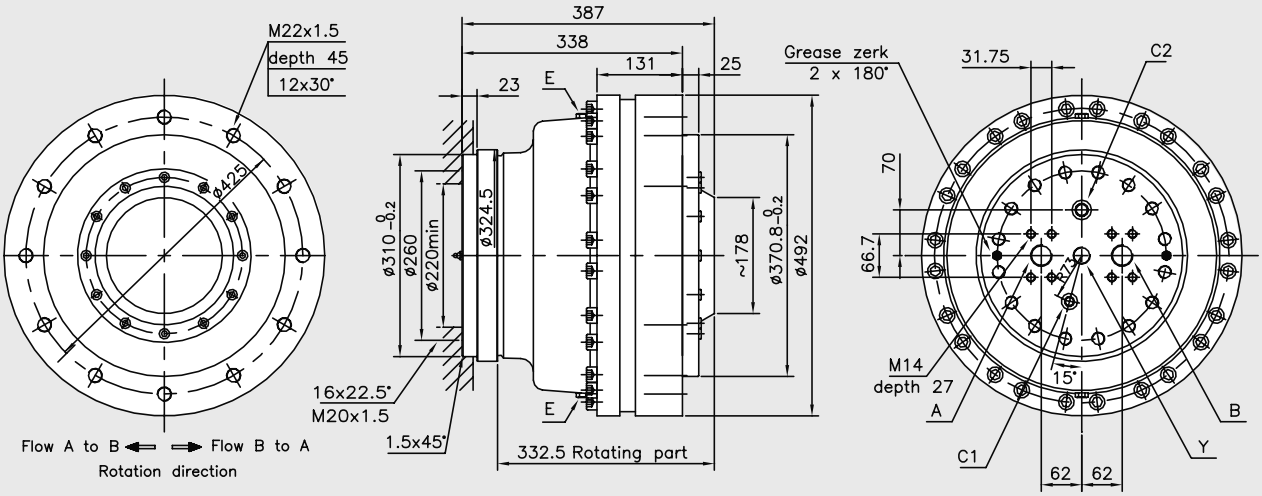
2460 ccm



3198 ccm



Technical Data Specifications
BBC 07



A and B – High pressure connections
1 1/4 in SAE–flange (6000 psi) and R1
C2 – Drain connection 3/4–16 UNF–2B
+O–ring sealing
C1 – Case flushing connection 9/16–18 UNF–2B
+O–ring sealing
Y – 2–speed connection R3/4
E – Air bleed screw 2x180°

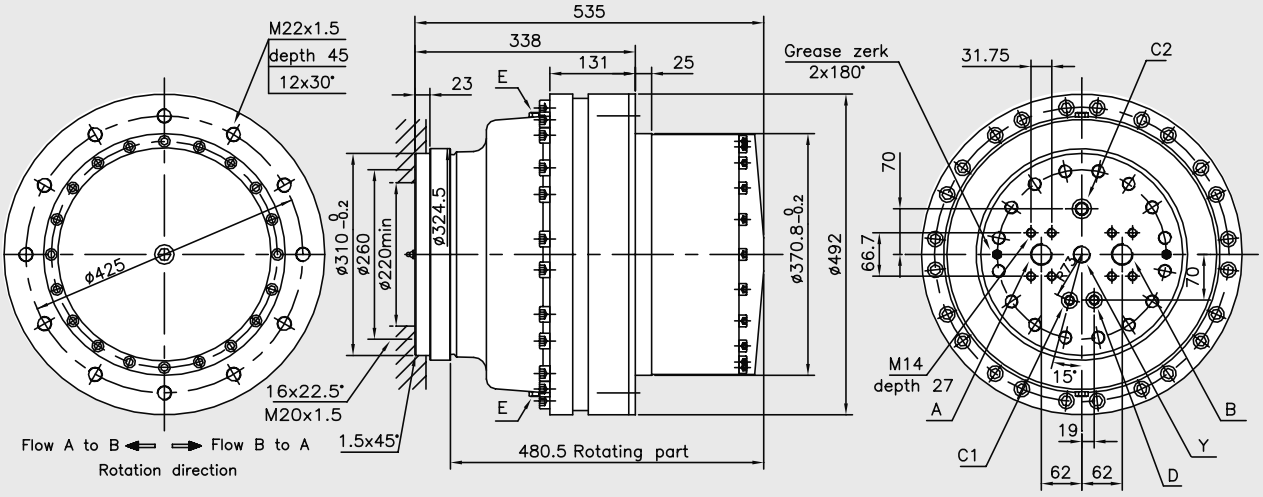
Nominal displacement 4250 ccm

Black Bruin -motors tightening torque

	Hub cover Shaft end	Shaft end
Hardness	f10.9	f12.9
Size M14	180 Nm	215 Nm
Size M20	540 Nm	650 Nm
Size M22	728 Nm	874 Nm

(The tightening torques are valid both for standard and fine thread.)

BBC 07 with multi- disc brake

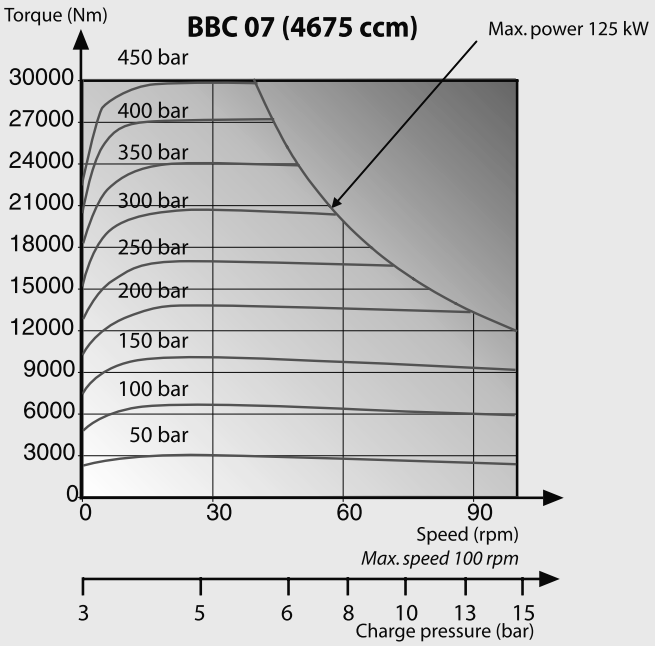


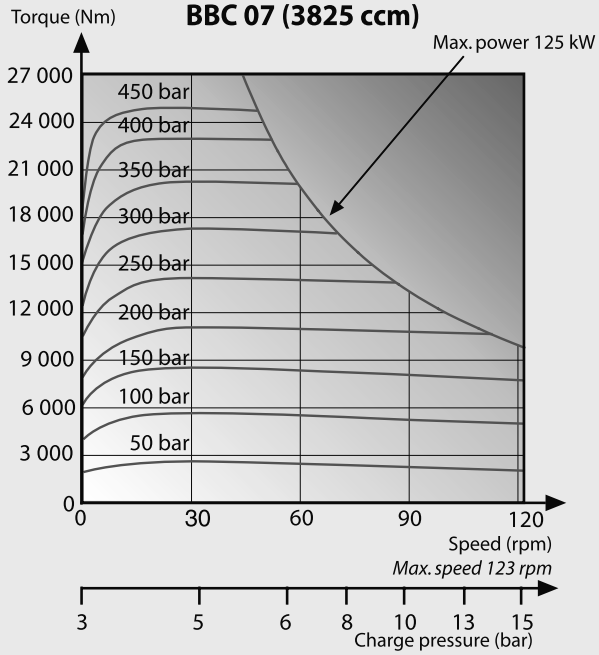
A and B – High pressure connections
1 1/4 in SAE–flange (6000 psi) and R1
C2 – Drain connection 3/4–16 UNF–2B
+O–ring sealing
C1 – Case flushing connection 9/16–18 UNF–2B
+O–ring sealing
Y – 2–speed connection R3/4
D – Brake connection 9/16–18 UNF–2B
+O–ring sealing
E – Air bleed screw 2x180°

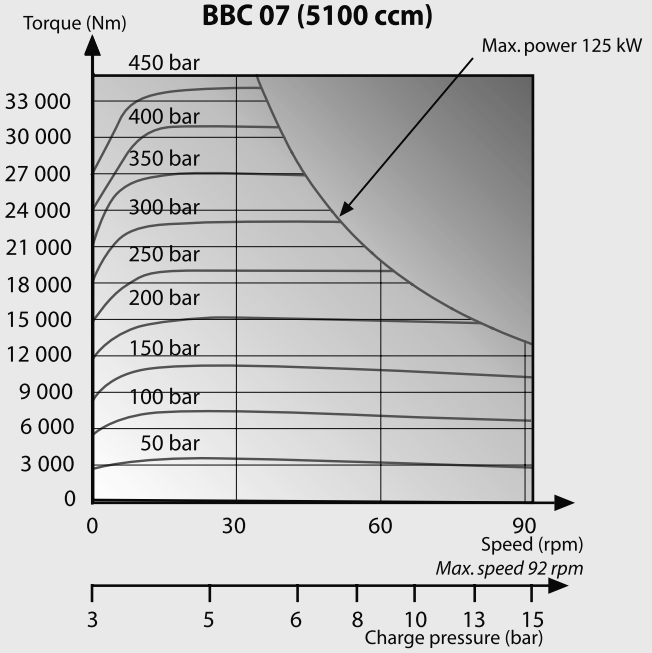
Nominal displacement 4250 ccm
Multi–disc brake: –Static torque 42000 Nm

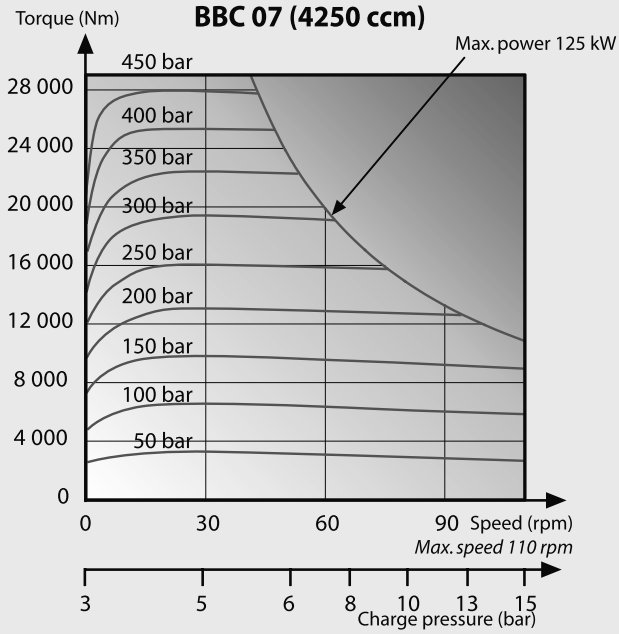
Motor class size BBC 07

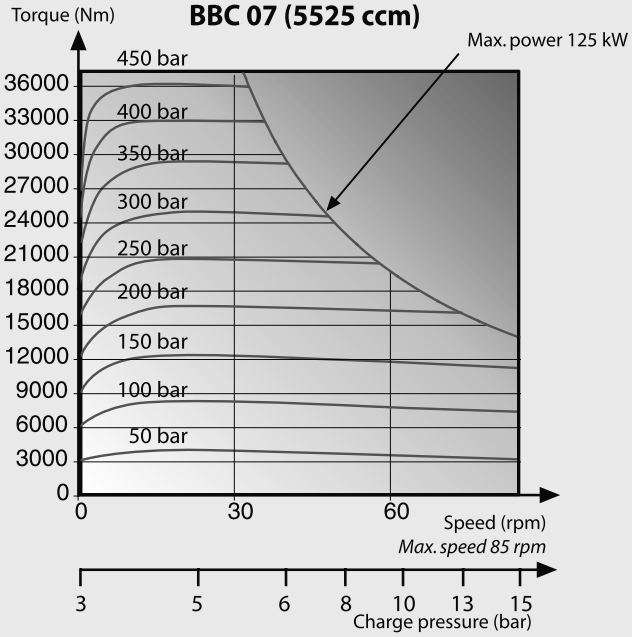
Performance curves at full displacement







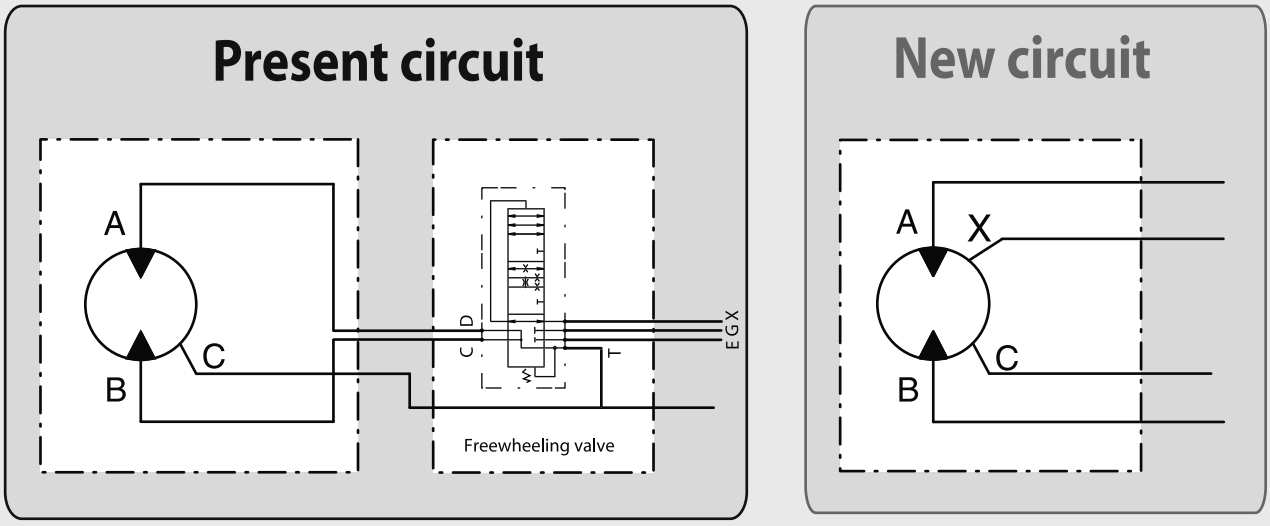




Options for BBC Series

Freewheeling motor with an integrated valve and mechanical freewheeling

- **Simplified construction**
- **Faster and more reliable shifting**
- **Eliminates the need for external valves**
- **Less hoses or pipies, less potential for leaking connections**
- **Unique in radial piston motors**



Sampo Hydraulics is responding to growing needs of assist drives with the new patented solution: Black Bruin® LSHT-motor with integrated freewheeling valve. In assist drives freewheeling is essential and with Sampo's solution simple to construct.

Compared to conventional solution, no freewheeling valves nor freewheeling pumps are needed while shifting is faster and more reliable. Motor also contains an in-built fail-safe system: if for some reason system's hydraulic pressure is lost, the motor shifts automatically to freewheeling preventing a potential failure.

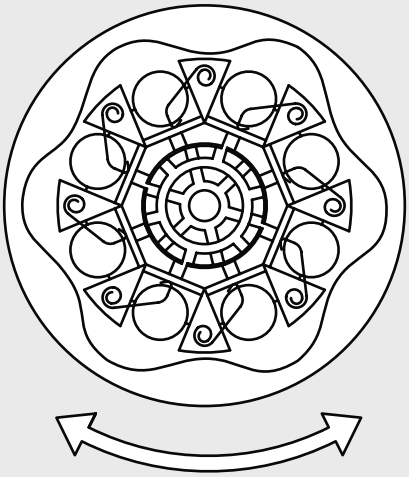
Options for BBC Series

Mechanical freewheeling

Black Bruin motors can be freewheeled without energy loss or over heating problems (stationary cylinder block - no centrifugal forces), even with high speeds.

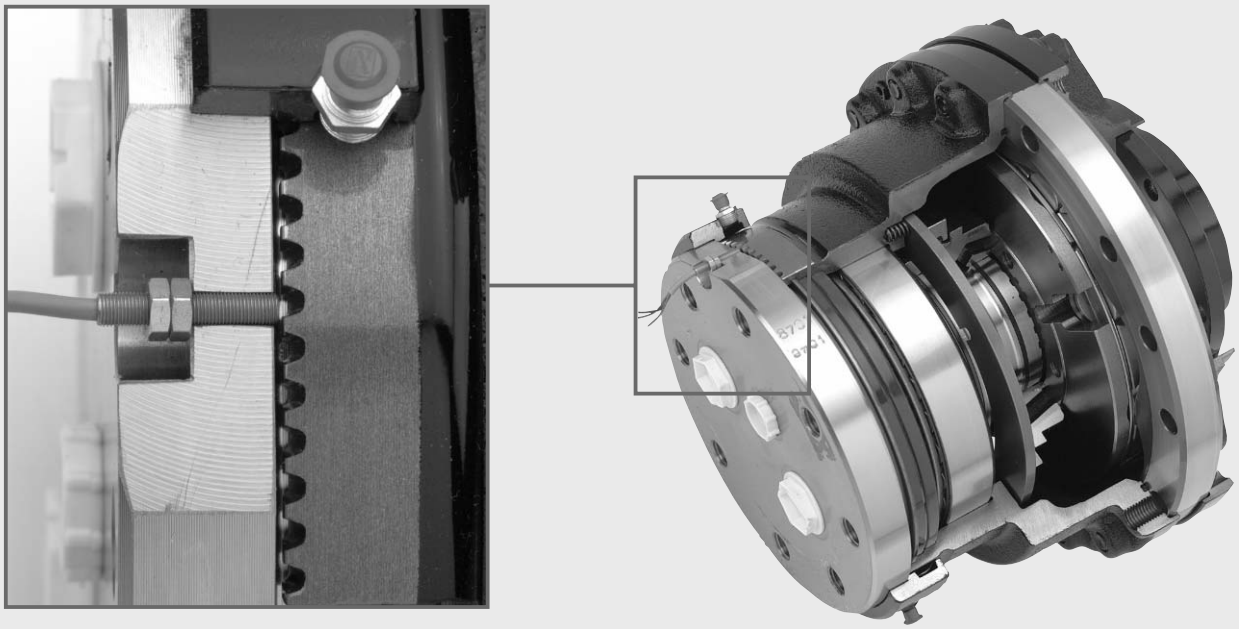
Black Bruin motors can be equipped with mechanical freewheeling springs. When there is no pressure in the working lines of the motor, the springs push the pistons down into the cylinders and hold them there. Thus, no pump output is needed to keep the motor freewheeled.

The motors can be re - engaged, or disengaged during movement.

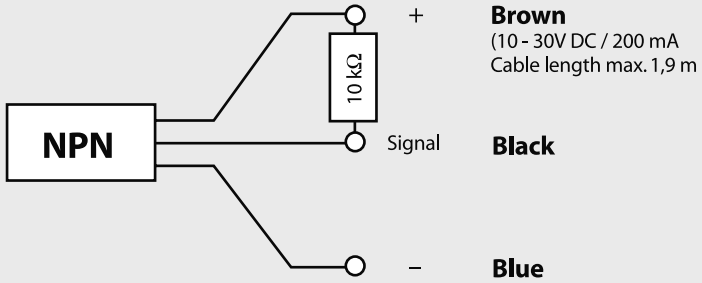


Speed sensor

Black Bruin motors can be equipped with speed sensor. Inductive sensor is placed inside shaft flange, where it is well protected.



Coupling of a speed sensor



Brown
(10 - 30V DC / 200 mA
Cable length max. 1,9 m

Black

Blue

MOTOR	PULSES
BBC01	128
BBC02	152
BBC02 special	80
BBC02 special	94
BBC03	135
BBC04	135
BBC05	92
BBC06	150

Options for BBC Series

Flushing line

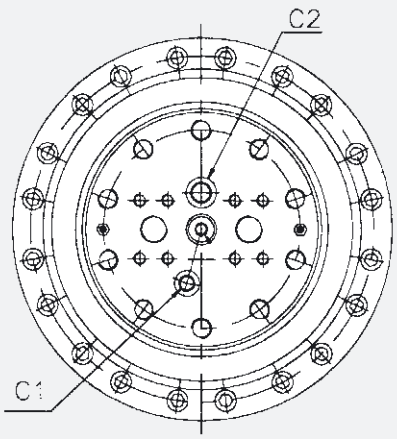
Flushing line is an extra case line. From feed pump cool oil is fed inside the motor housing through flushing line (C1) and it will return to tank through drain line (C2).

Knuckle mounting

Possibility to incorporating steering yoke directly to shaft flange (in some motor models).

Brakes

Black Bruin motors are usually equipped with wet multi - disc brake. Shoe brakes or external disc brakes are also available in some models.



C1 - Case flushing connection
+ O - ring sealing
C2 - Drain connection
+ O - ring sealing

black bruin®

Black Bruin hydraulic motors - small size giants for mobile and industrial use

black bruin®

Small compact construction
Black Bruin motors - with standard rim attachments, built-in brakes, and small overall size - are easy to adapt and mount. Light compact construction for individual wheel-hub units imposes no limitation in vehicle design; no conventional axles or reduction gears are needed.

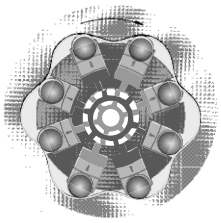
Remarkable low speed characteristics
Black Bruin motors run smoothly at speed close to zero. The radial piston cam curve design motors are precisely balanced, providing constant ripple free output torque.

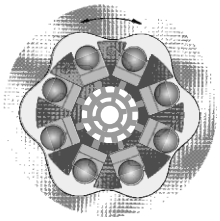
Superior starting torque
Black Bruin radial piston construction provides high starting torque to achieve maximum tractive effort when starting from standstill or for smooth steady traction in low speed conditions.

Freewheeling and re-engagement while moving
Black Bruin motors can be free-wheeled either hydraulically or mechanically. This feature allows the motors to work in multi-speed transmission designs, or to be free-wheeled on towed vehicles at high speeds. The motors can be re-engaged, or disengaged while the vehicle is moving. Hydraulic power is not required when the mechanical free-wheeling option is installed.

Variety of brake options
- Wet multi-disc, spring loaded, pressure to release
- Mechanical shoe or external disc

Wide speed range
- 2-, 3- and 4-speed options





Sampo HYDRAULICS

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Sampo Hydraulics as Part of Sampo Rosenlew Ltd

Sampo ROSENLEW

SAMPO ROSENLEW Ltd was founded in 1991 through a management buy-out from the Rauma Group. Today's Sampo Rosenlew Ltd originates from the family business of W.ROSENLEW Ltd, which was established in Pori, Finland, in 1853. In the very beginning the company shipped timber from a harbour located at that time in the middle of the town.
Gradually the manufacture of agricultural machines and implements was started, and at the beginning of the 20th century the factory produced stationary threshing machines. Ploughs and harrows constituted an important part of production, and the product range was enormous.

Simultaneously the household appliance sector was expanding. Castings from the factory's own foundry were machined for various products.

In 1957 the combine harvester was introduces, and gradually became the most successful agricultural product in the product range. By 1975 it was the only farm implement still in production.
In 1991 the business and production of combine harvesters was bought out from the Rauma Group

Since then, Sampo Rosenlew Ltd, now as an independent medium-sized industrial company, under the direction of its sole owner, Mr. Timo Prihti, has been pursuing an ambitious strategy to make the company more diversified and competitive through product research and development based on synergy and high technology.

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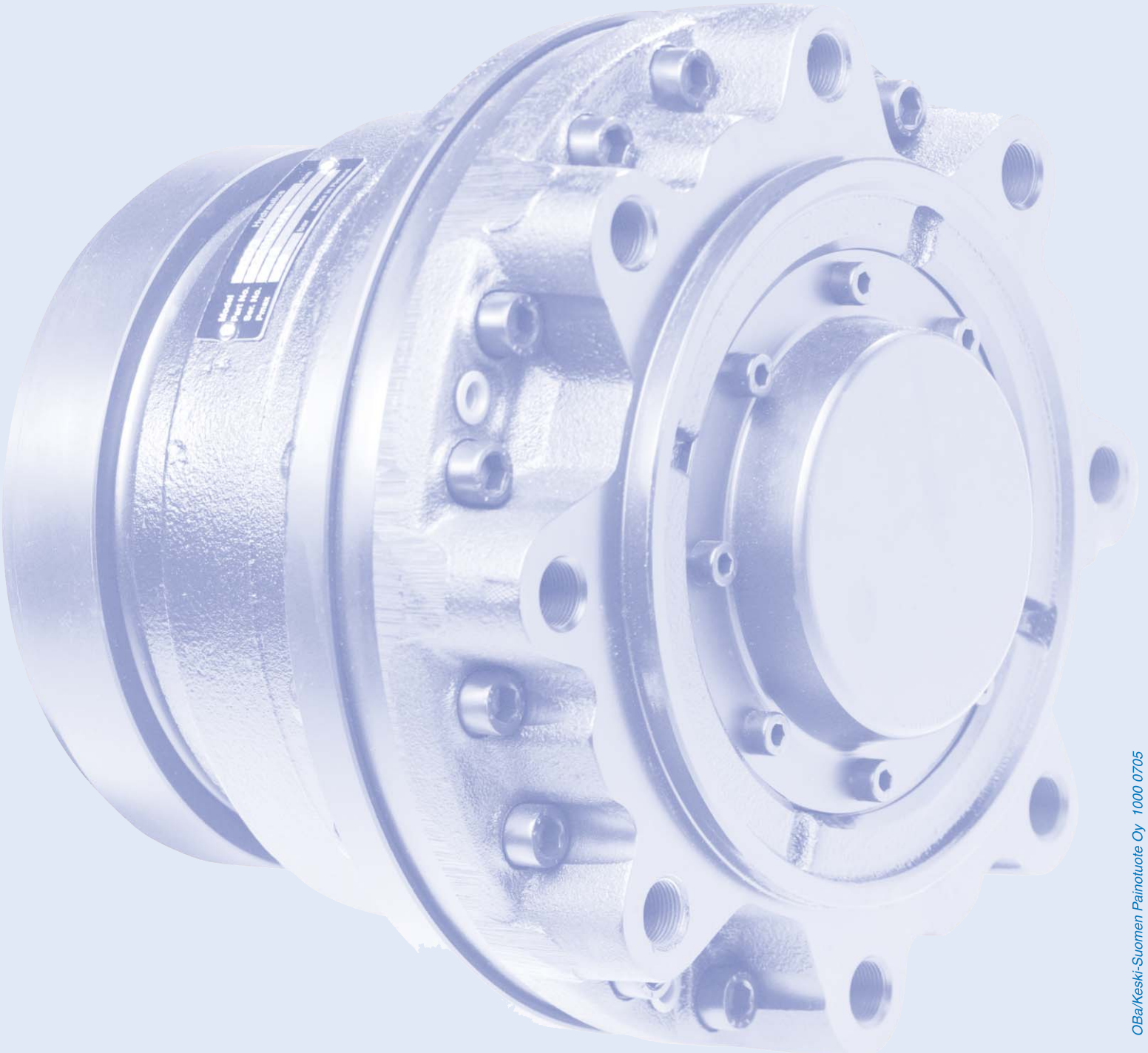
ISO 9001 DNV CERTIFICATED FIRM

ISO 14001 DNV CERTIFICATED FIRM



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