DESIGN GUIDE

BB

HYDRAULIC MOTORS black bruin

0326

black bruin

BLACK BRUIN HYDRAULIC MOTOR DESIGN GUIDE

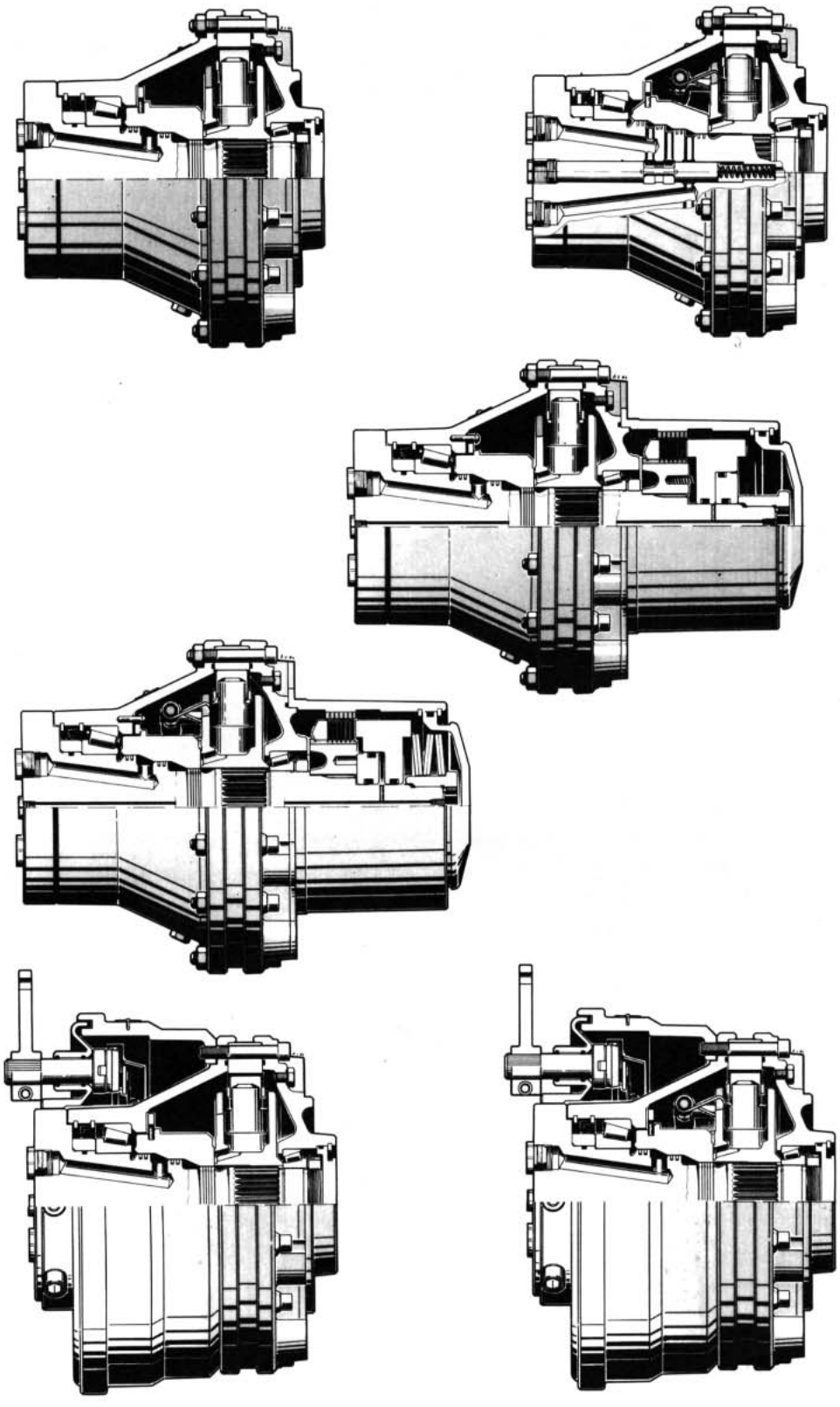
Black Bruin hydraulic motor

Black Bruin - Bear power in a small package for mobile and industrial use. The Black Bruin series consist of 18 hydraulic radial piston LSHT motors of different sizes from 125 ccm (7.6 cu.in) up to 6500 ccm (385 cu.in). The Black Bruin radial piston construction provides high torque and gives maximum tractive effort. The radial piston / cam curve-design is precisely balanced, providing a constant ripple-free output torque. The motor imposes no limitations in application design; no conventional axles or reduction gears are needed.

- Compact construction
- Outstanding low speed characteristics
- Superior starting torque
- Freewheeling and re-engagement while moving
- 2-speed options
- Variety of brake options

ATP HYDRAULIK

available at:
www.atphydraulik.ch
sales@atphydraulik.ch



BLACK BRUIN HYDRAULIC MOTORS

Mobile use

Performance and technical data for standard motors. For special motors, please contact the manufacturer.

Motor size class	2			3			4			5			6			7		
Displacement ccm	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300
Peak pressure bar		350			350			350			350			450			450	
• Intermittent * Pressure bar		300			300			300			300			400			400	
– intermittent * torque Nm	555	720	900	1120	1415	1790	2245	2825	3590	4490	5610	7180	11950	14940	18820	23900	29800	37600
– Torque (250 bar) Nm	465	600	750	935	1180	1495	1870	2355	2990	3740	4675	5985	7500	9350	11780	14965	18700	23570
• Power kW		15			25			35			50			90			130	
Max. speed • Working rpm	500	390	310	400	320	250	300	240	185	200	160	125	175	140	110	125	100	80
• Freewheeling rpm		1500			1200			1200			1200			1000			750	
Freewheeling • Hydraulic H		H			H			H			H			H			H	
• Mechanical M		M			M			M			M			M			M	
Radial load • Static kg		1400			3500			5000			9000			16000			28500	
• Dynamic kg		1000			2500			3500			6000			11000			19400	
• Axial load static kg		2200			3000			4000			6300			9270			11720	
Max. dimension standard motors • Diameter mm		195			234			282			343			416			520	
• Length mm		198			243			280			312			336			402	
• Weight kg		17			32			50			85			145			270	
• Moment of inertia kgm²		0,049			0,12			0,28			0,68			1,53			5,0	
Min. rim size inches		9			11			13			15			18,5				
Brake alternatives • Wet multi-disc = W		–			W			W			W			W			W	
• Shoe = S		S			S			S			S			—			—	
Brake Torque • Wet multi-disc Nm		–			2000			3700			8000			20000			40000	
• Shoe Nm		1100			1700			3500			6860			—			—	
2-speed motors displacement full ccm		—		250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300
• Half ccm		—		125	158	200	250	315	400	500	625	800	1000	1250	1575	2000	2500	3150
Max. speed at half displacement rpm		—		600	450	375	450	360	275	300	240	185	220	180	145	160	130	105

* Intermittent operation; Permissiable values for max 10% of every minute.

For intermittent & maximum performance data, please contact the manufacturer.

For continuous drive, please contact the manufacturer.

Mobile use

Performance and technical data for standard motors. For special motors, please contact the manufacturer.

Motor size class	2			3			4			5			6			7		
Displacement cu.in.	7.6	9.8	12.2	15.3	19.2	24.4	30.5	38.4	48.8	61.0	76.3	97.6	122.0	152.5	192.2	244.1	305.1	384.4
Peak pressure psi		5000			5000			5000			5000			6500			6500	
• Intermittent * Pressure psi		4300			4300			4300			4300			5800			5800	
– intermittent * torque lbf.ft	410	531	664	827	1045	1320	1640	2060	2620	3275	4090	5240	8820	11020	13880	17635	21990	27740
– Torque at 3600 psi lbf.ft	343	442	553	690	870	1100	1380	1735	2205	2760	3450	4415	5515	6875	8660	10970	13700	17270
• Power HP		20			33.5			47			67			120			174	
Max. speed • Working rpm	500	390	310	400	320	250	300	240	185	200	160	125	175	140	110	125	100	80
• Freewheeling rpm		1500			1200			1200			1200			1000			750	
Freewheeling • Hydraulic H • Mechanical M		H M			H M			H M			H M			H M			**H M**	
Radial load • Static lb		3080			7700			1000			19800			35200			62800	
• Dynamic lb		2200			5500			7700			13200			24200			42800	
• Axial load static lb		4840			6600			8800			13860			20450			25830	
Max. dimension standard motors • Diameter in		7.68			9.21			11.10			13.50			16.38			20.47	
• Length in		7.80			9.57			11.02			12.28			13.23			15.83	
• Weight lb		37.5			70.5			110			187			320			595	
• Moment of inertia lb.in²		167			410			957			2324			5228			17086	
Min.rim size inches		9			11			13			15			18,5				
Brake alternatives • Wet multi-disc = W		–			W			W			W			W			W	
• Shoe = S		S			S			S			S			—			—	
Brake Torque • Wet multi-disc lbf.ft		—			1475			2730			5900			14750			29500	
• Shoe lbf.ft		810			1250			2580			5060			—			—	
2-speed motors displacement full cu.in		—		15.3	19.2	24.4	30.5	38.4	48.8	61.0	76.3	97.6	122	152.5	192.1	244.1	305.1	384.4
• Half cu.in		—		7.7	9.6	12.2	15.3	19.2	24.4	30.5	38.2	48.8	61	76.3	96.0	122	152.5	192.1
Max. speed at half displacement rpm		—		600	450	375	450	360	275	300	240	185	220	180	145	160	130	105

* Intermittent operation; Permissiable values for max 10% of every minute.

For intermittent & maximum performance data, please contact the manufacturer.

For continuous drive, please contact the manufacturer.

BB HYDRAULIC MOTOR ORDERING CODE

BB40	D	VVV	Y	W	E	HH

BB40 — Black Bruin standard code

D — Motor size class
- 2 = 125–200 ccm
- 3 = 250–400 ccm
- 4 = 500–800 ccm
- 5 = 1000–1600 ccm
- 6 = 2000–3150 ccm
- 7 = 4000–6300 ccm

VVV — Motor displacement ccm/10

Y — Freewheeling
- 1 = hydraulic freewheeling (standard)
- 2 = mechanical freewheeling

W — Displacement
- 1 = fixed displacement (standard)
- 2 = 2-speed motor, clockwise rotation
- 3 = 2-speed motor, counterclockwise rotation

E — Brake alternatives
- 1 = without brake
- 2 = shoe brake (in BB2, BB3 and BB4)
- 3 = wet multi-disc brake, pressure to apply
- 4 = wet multi-disc brake, spring-operated
- 5 = disc brake
- 7 = shoe brake (in BB5 and BB6) CCW
- 8 = shoe brake (in BB5 and BB6) CW

HH — Special model code (0 = standard)

All options are not available for every model.

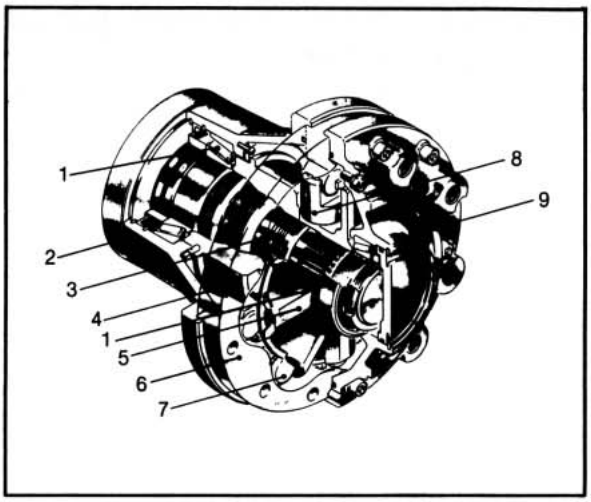
e.g. BB4051602140 = Black Bruin 1600 ccm fixed displacement motor with mechanical freewheeling and wet multi-disc spring-operated brake

CONTENTS

	Page
BLACK BRUIN MOTORS – product profile	2
BLACK BRUIN MOTORS – data summary	4 – 5
ORDERING CODE	6
BLACK BRUIN MOTORS – construction and operation	7
INSTRUCTIONS FOR SYSTEM DESIGN	8 – 10
APPLICATION AREAS	11
BLACK BRUIN 125 – 160 – 200 ccm – technical and performance data	12 – 16
BLACK BRUIN 250 – 315 – 400 ccm – technical and performance data	17 – 22
BLACK BRUIN 500 – 630 – 800 ccm – technical and performance data	23 – 28
BLACK BRUIN 1000 – 1250 – 1600 ccm – technical and performance data	29 – 34
BLACK BRUIN 2000 – 2500 – 3150 ccm – technical and performance data	35 – 39
BLACK BRUIN 4000 – 5000 – 6300 ccm – technical and performance data	40 – 44
BLACK BRUIN rated life	45 – 46
BLACK BRUIN 2-speed motors	47 – 50

CONSTRUCTION

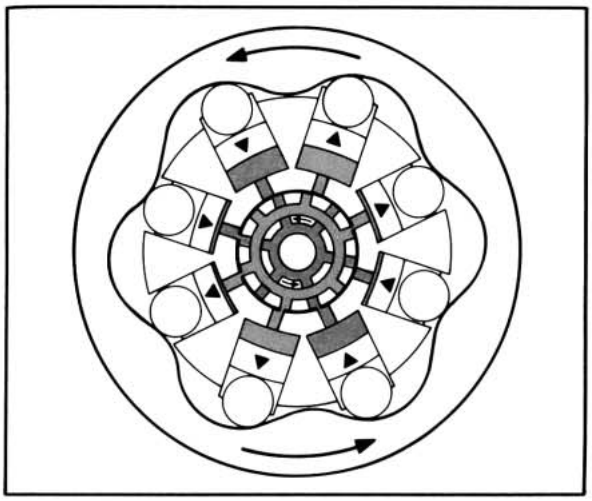
1. Bearings
2. Shaft flange
3. Shaft
4. Oil distributor
5. Cylinder block
6. Cam ring
7. Cam roller
8. Piston
9. Motor housing



WORKING PRINCIPLE

The rotation of the motor housing is achieved by feeding pressurized oil through the motor inlet port to the oil distributor. The distributor directs oil flow to pistons which are on a power stroke, driving the pistons and cam rollers outwards against the curve of the cam ring. This causes rotation of the cam ring housing assembly. When the pistons reach the end of their stroke, the distributor closes the inlet port and opens the outlet port. The next cam lobe pushes the piston back into the center of the cylinder block in preparation for the next outward power stroke.

Due to kinematic cam curve design and multistroke principle, a ripple free constant torque and an excellent starting torque are achieved. Reversed rotation is achieved simply by changing the direction of oil flow.



OPERATION

- casing pressure
- inlet pressure
- return pressure

FREEWHEELING

Freewheeling is essential in many hydraulic systems for optimal use of hydraulic power transmission, e.g. when

— the torque is not needed continuously (auxiliary power transmission)
— there is a need of shifting into a faster or a slower speed range

Black Bruin high torque motors, unlike many competitor's motors, can be freewheeled without energy loss or heating problems. Freewheeling can be done either hydraulically or mechanically.

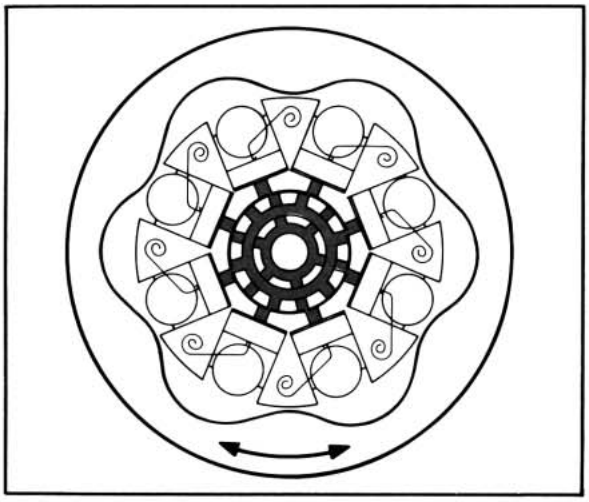
HYDRAULIC FREEWHEELING

Hydraulic freewheeling is achieved by feeding an oil flow to the drain line of the motor casing to produce a freecoupling pressure of 1.5—2 bar. Provided that pressure is removed from the working lines, the casing pressure pushes the pistons into the cylinders, holding them constantly there, thus making the motor housing rotate freely.

The motors can be disengaged (or engaged) during movement. For system design, see pages 8–10.

MECHANICAL FREEWHEELING

Black Bruin motors can also be equipped with mechanical freewheeling springs. When there is no pressure in the working and return 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 freewheeling.



FREEWHEELING

- freecoupling pressure
- without pressure

INSTRUCTIONS FOR SYSTEM DESIGN

1. SPEED OF ROTATION

All tables of model specifications refer to normal rotational speeds; where a motor application requires speeds different from those mentioned, please consult us or our representative.

2. FEED PRESSURE

The minimum pressure required at the motor inlet port is called the feed pressure. It is needed to guarantee continuous contact between the cam ring and the cam rollers, especially in applications where an external force causes the motor to rotate.

For each motor size the feed pressure depends on the actual speed and case pressure. The performance curves show the feed pressure figures at minimum back pressure and with no casing pressure.

With hydrostatic braking the feed pressure must be increased 1–2 bar (15–30 psi). Simultaneously, enough 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 casing pressure, the motor may make extraneous noise in service. This is caused by the inertial forces 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 making the return line pressure 1—5 bar (15—70 psi) higher than the casing pressure, 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. CASING PRESSURE

The recommended casing 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 casing pressure of up to 40 bar (580 psi) is allowed.
Feed pressure and back pressure requirements increase by the amount of the casing pressure.
For freewheeling, casing fill up, and regulating the casing 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 coupled directly to the tank. To ensure that the lines are completely without pressure they should not be connected together with return 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 freecoupling pressure in the casing, a fluid flow must be supplied to the motor casing. A check valve with an opening pressure of 2 bar (30 psi) in the drain line regulates the pressure in the casing. Limitation of pressure peaks in the casing 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 lengths of pipe, high rotational speeds or highly viscous oil) it is recommended to couple an accumulator (with at least 1/4 nominal capacity of the motor) to the drain line as close to the motor as possible. Hydraulic accumulators designed for storing low pressures will suffice. At the moment of engaging or disengaging, the need for increased feed 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 feed pressure must be maintained in the pump circuit throughout the shifting procedure.
4. While shifting speed ranges, the sum of the displacements 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 coupling them into independent free circulation and closing the line to the reservoir.
2. A feed pressure is rapidly applied to this circulation, forcing the pistons into motion. The feed pressure must be high enough to cover the pressure losses in the free circulation circuit as well.
3. The motors are coupled 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 feed pump is too small an accumulator is required to maintain the feed pressure.

Some Black Bruin motors are equipped with mechanical freewheeling springs. These motors are freewheeled automatically when the cylinders become pressureless. However, a rapid disengaging requires an increased casing pressure.

6. SHORT CIRCUITING

Short circuit 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 the motor return 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 feed pressure is easily regulated with back pressure in the return line. Simultaneously the flushing with fresh fluid must be insured for proper cooling.

7. PERMISSIBLE EXTERNAL LOADS

The figures given in the tables on page 4 and 5 refer only to non-simultaneous radial and axial loads. In applications with large combined radial and axial loads, please consult **us** or **BB** representative to determine maximum permissible loading.
The maximum permissible radial loads depend on the loading point. For exact data see radial load curves.

8. WET MULTI-DISC BRAKE

The wet multi-disc brake is basically a parking brake, but it can also be used as an operational brake. Note, however, that after repeated brakings the static braking torque can fall to values close to, but not below, those for dynamic braking.
There are two types of wet multi-disc brakes. The minimum pressure to release the spring operated brake is shown in the brake diagrams, however, the operating pressure used may be not higher than the maximum working pressure. The braking pressure for the pressure-operated brake must not exceed the values given in the brake diagrams. Notice that EP, HD and some antiwear additivies in oil can cause remarkable reduction of brake torque. Special discs are available.

9. OPERATING TEMPERATURE

The maximum permissible 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 20 cSt. The lowest permissible operating temperature for a standard motor is —40°C (—40°F) **and for motor with special sealing** —45°C (—49°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 all its service life
- — the minimum permissible viscosity is 20 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 more viscous oil can be used to achieve more regular rotation.
- — 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. Automatic transmission oil type A suffix A may be used provided that its antiwear additives correspond to SE motor oils. Fire resistant fluids HFB and HFC or similar may be used under certain circumstances. Please always consult our representative when intending to use these fluids.

11. FILTRATION

The minimum nominal filtration degree of the filter should be 10 µ. 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 coupled to the system and thus may allow impurities to pass into the system, the hydraulic motor circuit must be isolated from these. Where the pressure setting of the main drive power transmission system is over 250 bar (3600 psi), we recommend absolute 10 µ main flow filtering. The filters should be equipped with clogging indicators.

12. CONDITIONS OF INSTALLATION AND APPLICATION

A questionnaire is used to help the selection and proposal of **our BB** hydraulic motors. This questionnaire is to be filled for all models of series-produced machines and industrial applications.
A filled in and signed questionnaire is a prerequisite of the warranty.
Always advise **us** when ordering motors for exceptional circumstances, like underwater applications, operation with special fluids, etc.

13. PHYSICAL MOTOR MOUNTING.

For recommended motor mounting reference "application areas" as shown on page 11. Note the mounting position if radial shock loads occurs.
Connection ports with R threads are equal with BSP threads of same size.
Connection ports for working lines are marked with "A" and "B". Connection port for drain line and casing pressure is marked with "C".
Brake pressure connection is marked with "D".
2-speed pilot connection is marked with "Y".

13. FLUSHING

Flushing should be performed at initial start-up, after system modifications or repairs.
Before connecting the motor and pump to the system, THE PIPING 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 replenish the tank with dirty oil.

15. BLEEDING OR FILLING

DO NOT START MOTOR UNLESS ITS CASING IS FILLED WITH OIL.

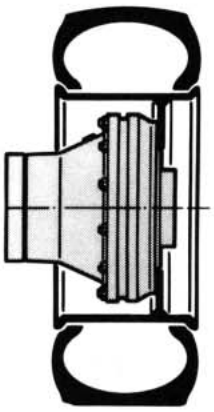
Place the motor in a position in which the bleed screw is in its topmost position. Loosen the screw 1/2 turn. Allow casing to be filled by the motor's casing pressure. The bleed screw is closed after all air is out. If the motor is coupled to a system that cannot provide casing pressure, the casing should be filled by pouring the oil in until all air is out.

16. MOTOR INITIAL START-UP

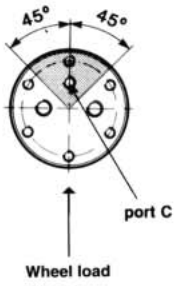
After flushing and filling, the motor is first rotated unloaded. Increase motor speed and load gradually, and check for leaks and extraneous noise.

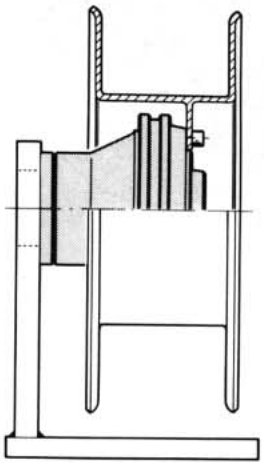
black® bruin

APPLICATION AREAS

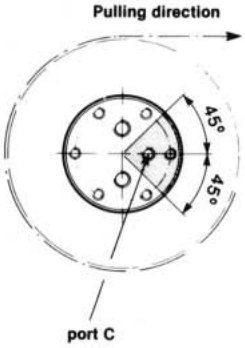


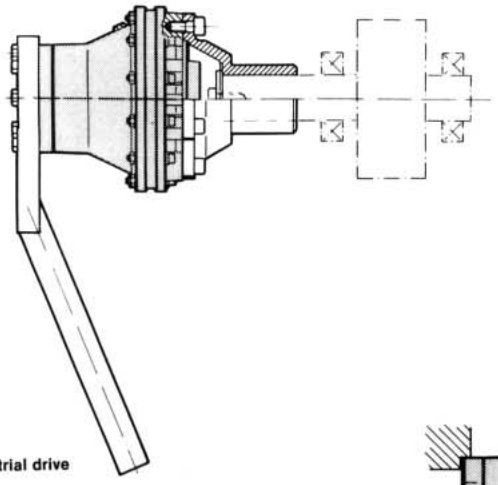
Wheel drive



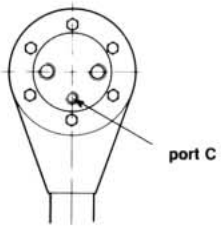


Winch drive

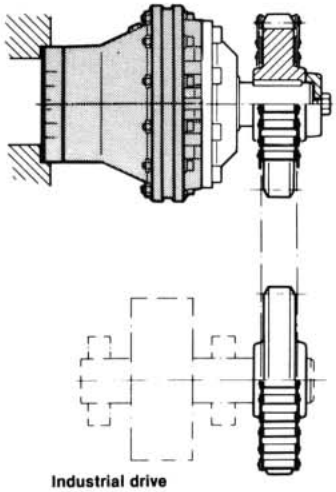




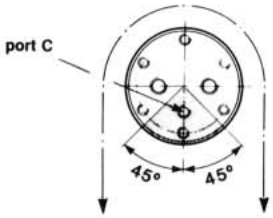
Industrial drive



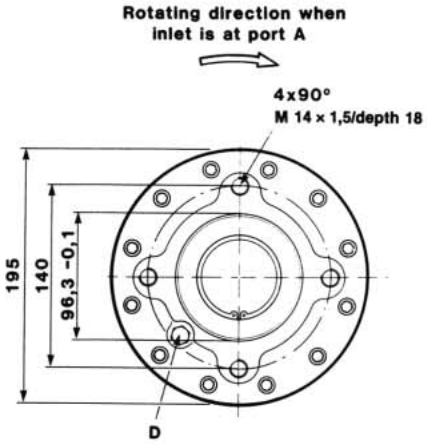
Torque arm

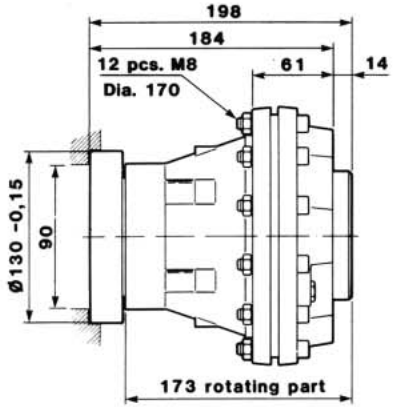


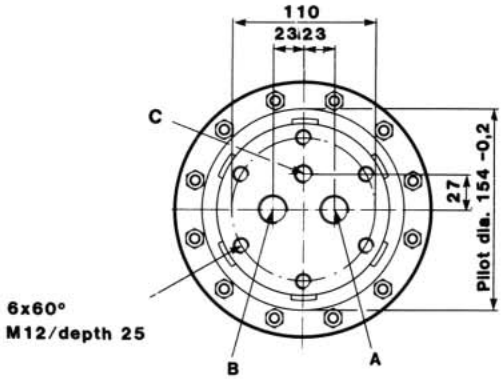
Industrial drive



Class 2
125 – 160 – 200 ccm motors
(7.6 – 9.8 – 12.2 cu.in)



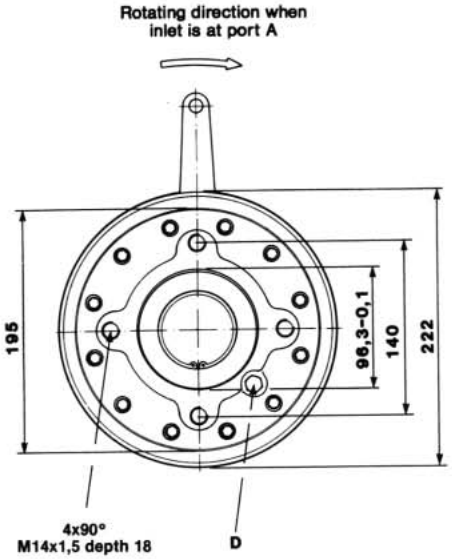


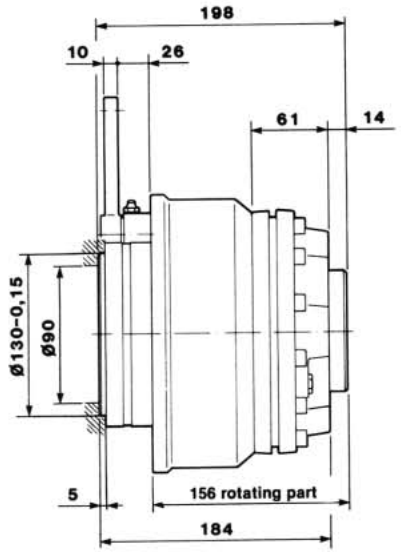


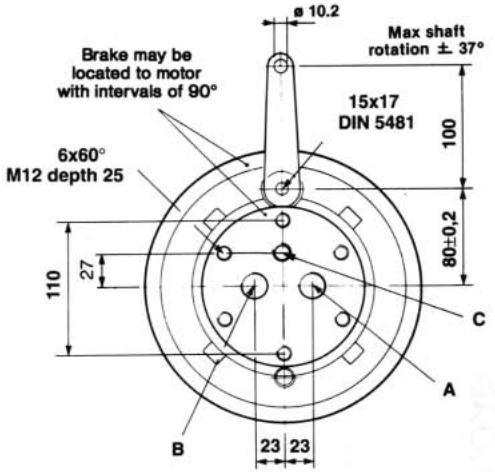
Motor part number	Displacement ccm	cu.in	
402 013 1110	125	7.6	Hydraulic freewheeling
402 016 1110	160	9.8	
402 020 1110	200	12.3	
402 013 2110	125	7.6	Freewheeling with springs
402 016 2110	160	9.8	
402 020 2110	200	12.3	

A —pressure conn. R 1/2 /depth 16
B —pressure conn. R 1/2 /depth 16
C —drain conn. R 3/8 /depth 15
D —air bleed screw

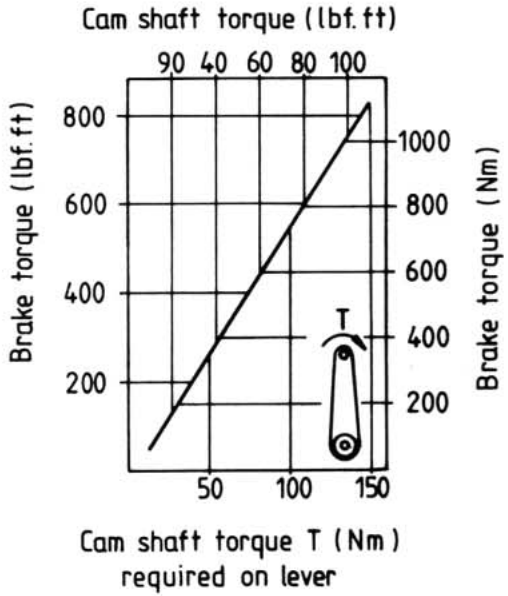
Class 2
125 – 160 – 200 ccm motors with shoe brake
(7.6 – 9.8 – 12.2 cu.in)







Motor part number	Displacement ccm	cu.in	
402 013 1120	125	7.6	Hydraulic freewheeling
402 016 1120	160	9.8	
402 020 1120	200	12.3	
402 013 2120	125	7.6	Freewheeling with springs
402 016 2120	160	9.8	
402 020 2120	200	12.3	

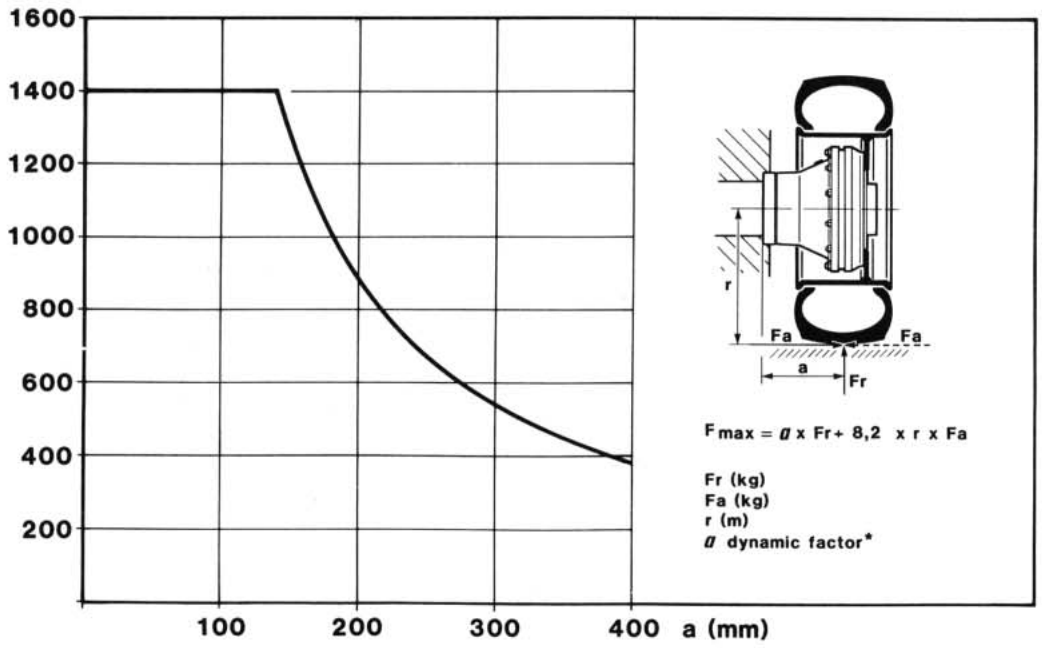


A — pressure conn. R 1/2/depth 16
B — pressure conn. R 1/2/depth 16
C — drain conn. R 3/8/depth 15
D — air bleed screw

SHAFT LOAD

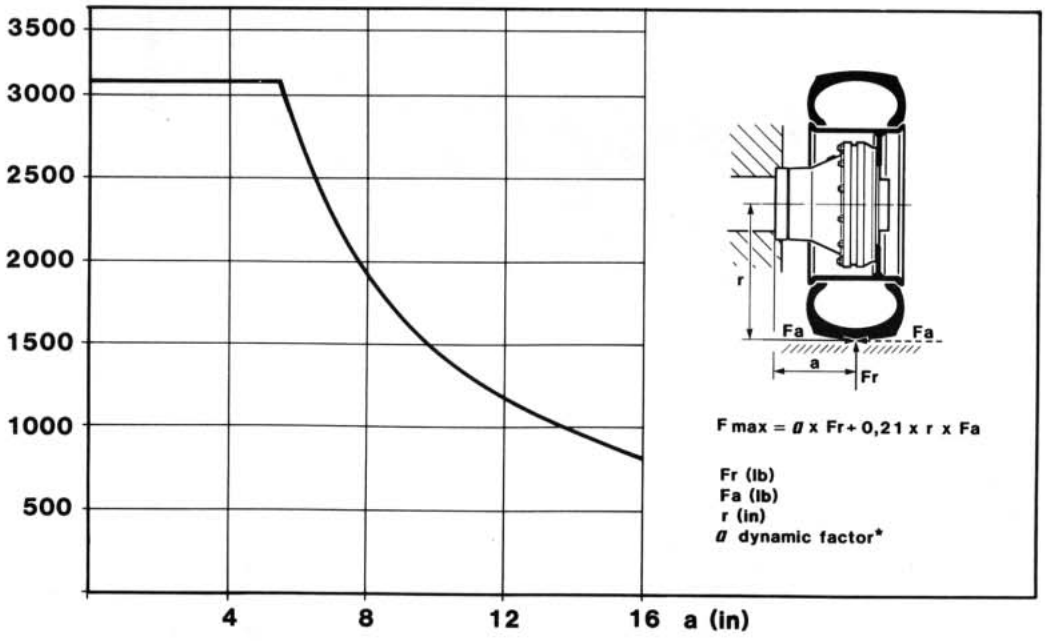
SI-standard

Class 2
125 – 160 – 200 ccm motors



US-standard

Class 2
7.6 – 9.8 – 12.2 cu.in motors



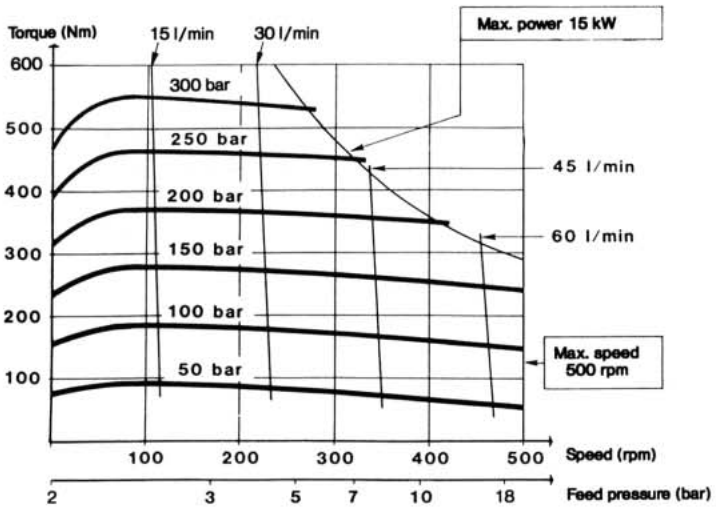
*** DYNAMIC FACTOR**

— constant loading and low speed	$\alpha = 1$
— variable loading	$\alpha = 1—1.5$
— shock loads or high speed (> 70 km/h or 45 mph)	$\alpha = 1.4—2$

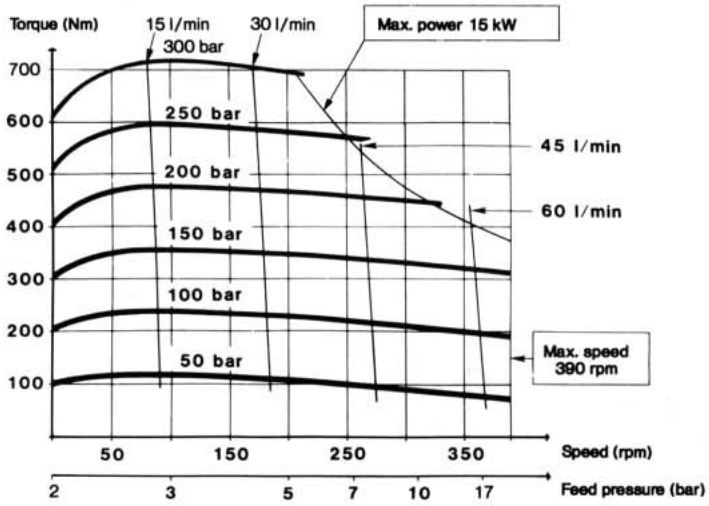
Class 2
125 – 160 – 200 ccm motors

SI-standard

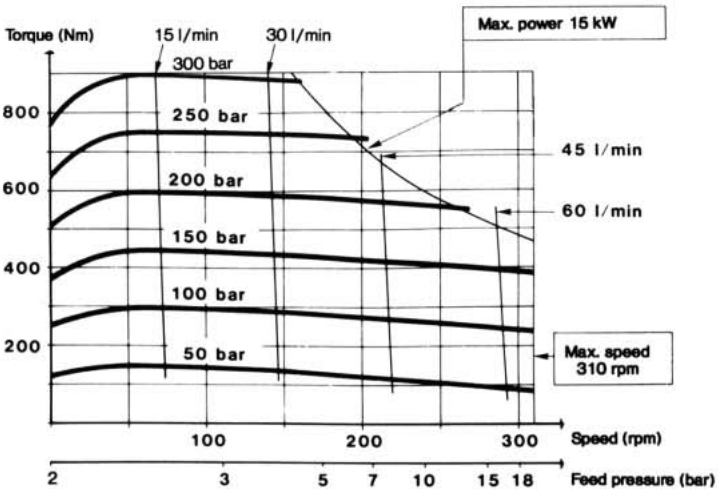
125 ccm



160 ccm



200 ccm



Performance data

Displacement ccm	125	160	200
Peak pressure bar	350	350	350
Mobile use			
— torque (Nm) at 300 bar*	555	720	900
— torque (Nm) at 250 bar	465	600	750
— power kW	15	15	15
Max. speed			
— working rpm	500	390	310
— freewheel. rpm	1500	1500	1500

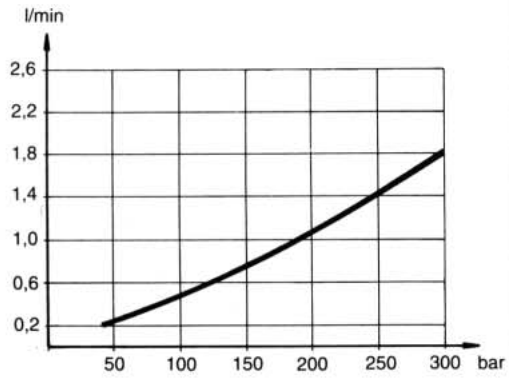
* Intermittent pressure: max. 10 % of every minute.

Technical data
125 - 160 - 200 ccm

Brake		—	shoe
Brake torque	Nm	—	1100
Radial load			
— static	kg	1400	1400
— dynamic	kg	1000	1000
Max static axial load (without radial load)			
— compression	kN	39	39
— expansion	kN	21	21
Weight	kg	17	26
Dimensions			
— diameter	mm	195	222
— length	mm	198	198
Moment of inertia	kgm²	0.049	0.098
Min. rim. size	in	9	9

Case leakage

125 – 160 – 200 ccm

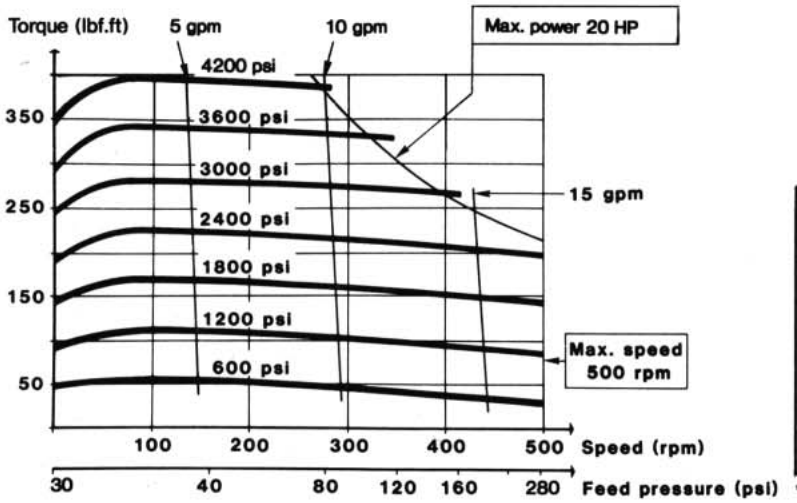


Curves based on oil viscosity 35 cSt.

Class 2
7.6 – 9.8 – 12.2 cu.in motors

US-standard

7.6 cu.in

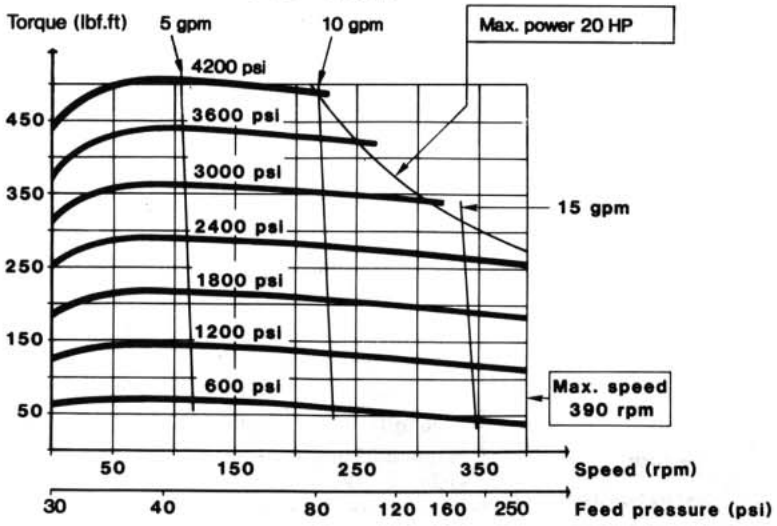


Performance data

Displacement	cu.in	7.6	9.8	12.2
Peak pressure	psi	5000	5000	5000
Mobile use				
— torque at 4350 psi*	(lbf.ft)	411	530	663
— torque at 3600 psi	(lbf.ft)	343	442	553
— power	HP	20	20	20
Max. speed				
— working	rpm	500	390	310
— freewheel.	rpm	1500	1500	1500

* Intermittent pressure: max. 10 % of every minute.

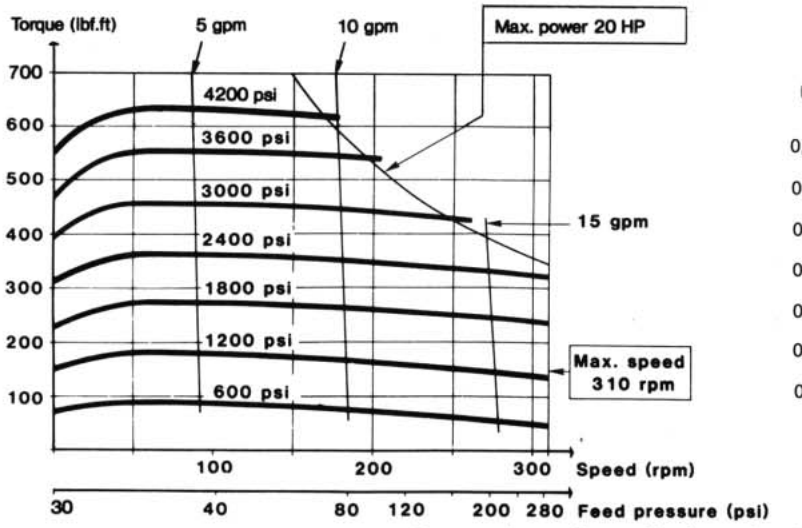
9.8 cu.in



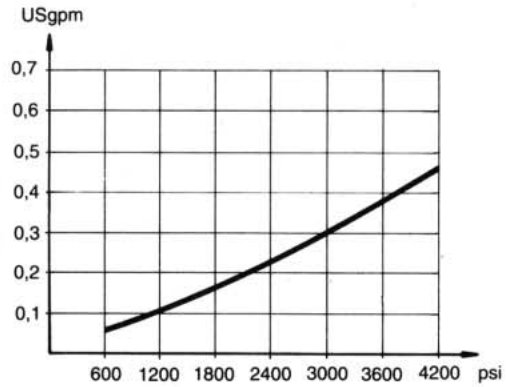
Technical data
7.6 — 9.8 — 12.2 cu.in

Brake		—	shoe
Brake torque	lbf.ft	—	810
Radial load			
— static	lb	3080	3080
— dynamic	lb	2200	2200
Max static axial load (without radial load)			
— compression	lb	8800	8800
— expansion	lb	4840	4840
Weight	lb	37.5	57
Dimensions			
— diameter	in	7.68	8.75
— length	in	7.80	7.80
Moment of inertia	ib.in²	167	334
Min.rim.size	in	9	9

12.2 cu.in

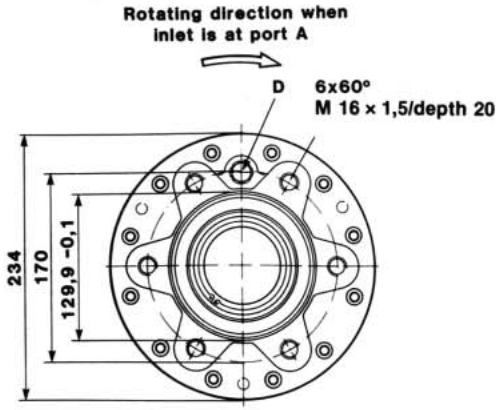


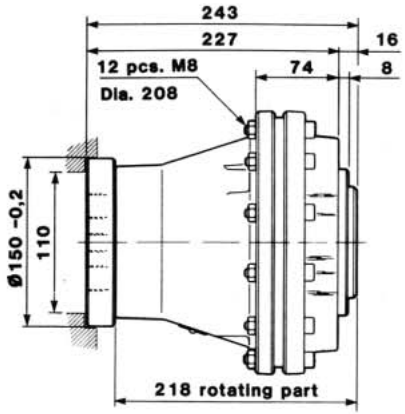
Case leakage
7.6 — 9.8 — 12.2 cu.in

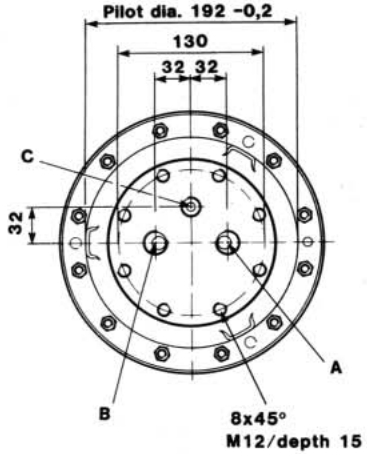


Curves based on oil viscosity 35 cSt.

Class 3
250 – 315 – 400 ccm motors
(15.3 – 19.2 – 24.4 cu.in)



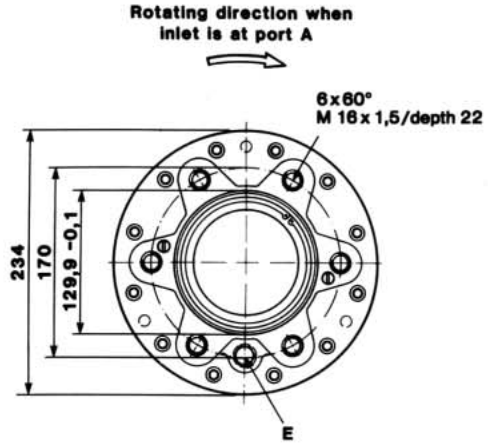


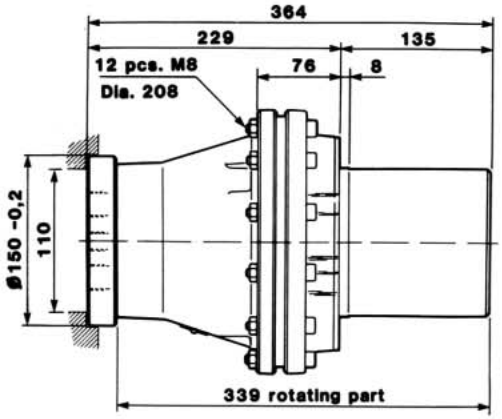


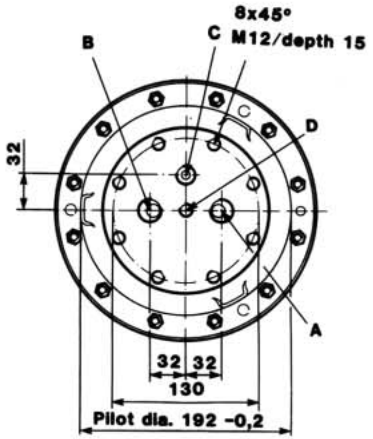
Motor part number	Displacement ccm	cu.in	
403 025 1110	250	15.3	Hydraulic freewheeling
403 032 1110	315	19.2	
403 040 1110	400	24.4	
403 025 2110	250	15.3	Freewheeling with springs
403 032 2110	315	19.2	
403 040 2110	400	24.4	

A —pressure conn. R 1/2 /depth 16
B —pressure conn. R 1/2 /depth 16
C —drain conn. R 3/8 /depth 15
D —air bleed screw

Class 3
250 – 315 – 400 ccm motors with multi-disc brake
(15.3 – 19.2 – 24.4 cu.in)





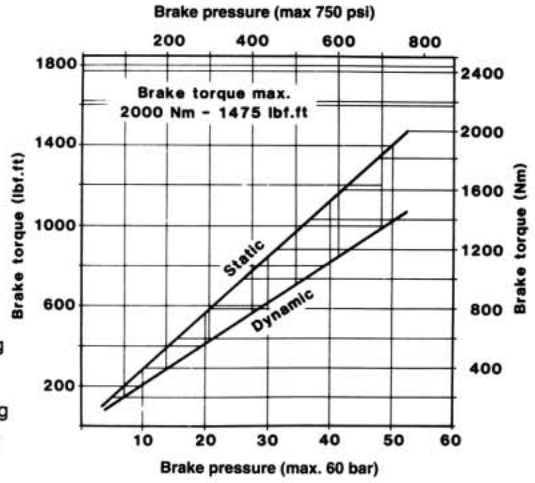


A —pressure conn. R 1/2 /depth 16
B —pressure conn. R 1/2 /depth 16
C —drain conn. R 3/8 /depth 15
D —brake conn. R 1/4 /depth 12
E —air bleed screw

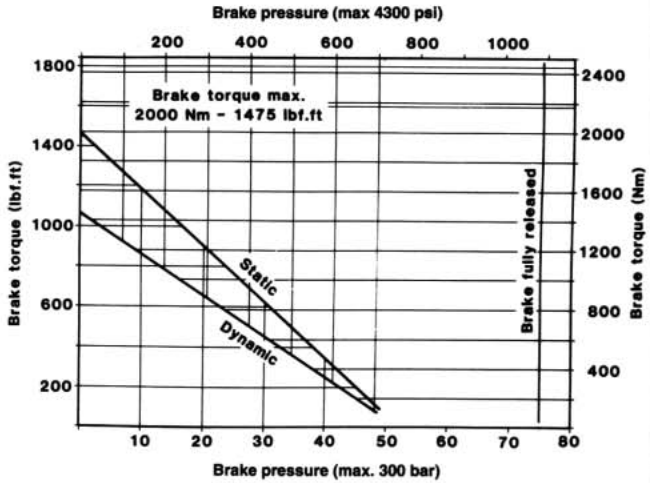
Motor part number Pressure oper. brake	Spring oper. brake	Displacement ccm	cu.in	
403 025 1130	403 025 1140	250	15.3	Hydraulic freewheeling
403 032 1130	403 032 1140	315	19.2	
403 040 1130	403 040 1140	400	24.4	
403 025 2130	403 025 2140	250	15.3	Freewheeling with springs
403 032 2130	403 032 2140	315	19.2	
403 040 2130	403 040 2140	400	24.4	

Brake torque diagrams

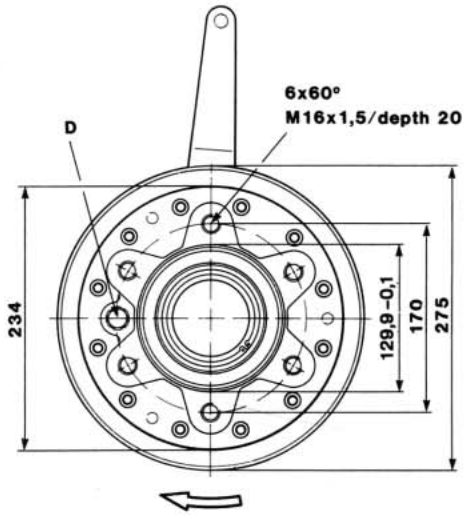
pressure operated brake

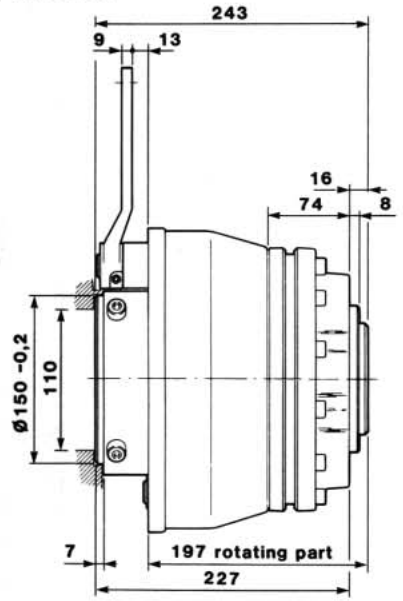


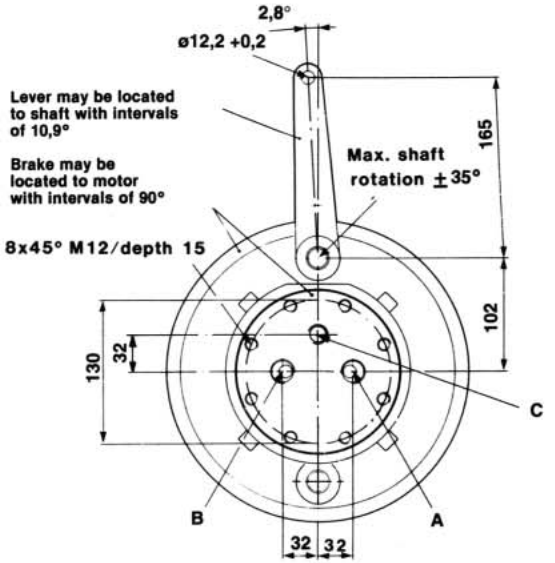
spring operated brake
(brake cylinder volume 15 ccm)



Class 3
250 – 315 – 400 ccm motors with shoe brake
(15.3 – 19.2 – 24.4 cu.in)



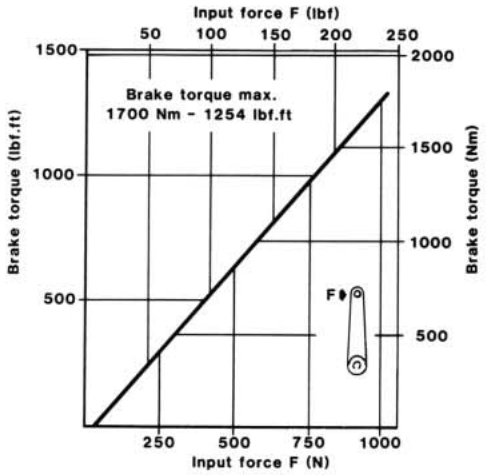




A —pressure conn. R 1/2 /depth 16
B —pressure conn. R 1/2 /depth 16
C —drain conn. R 3/8 /depth 15
D —air bleed screw

Motor part number	Displacement ccm	cu.in	
403 025 1120	250	15.3	Hydraulic freewheeling
403 032 1120	315	19.2	
403 040 1120	400	24.4	
403 025 2120	250	15.3	Freewheeling with springs
403 032 2120	315	19.2	
403 040 2120	400	24.4	

Brake torque diagram

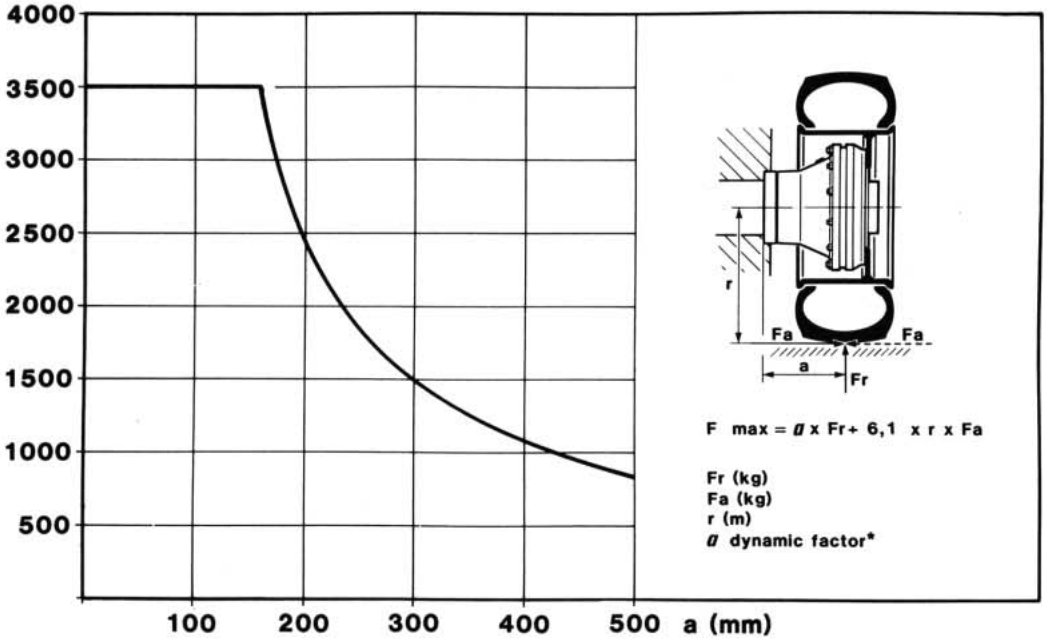


SHAFT LOAD

SI-standard

Class 3
250 – 315 – 400 ccm motors

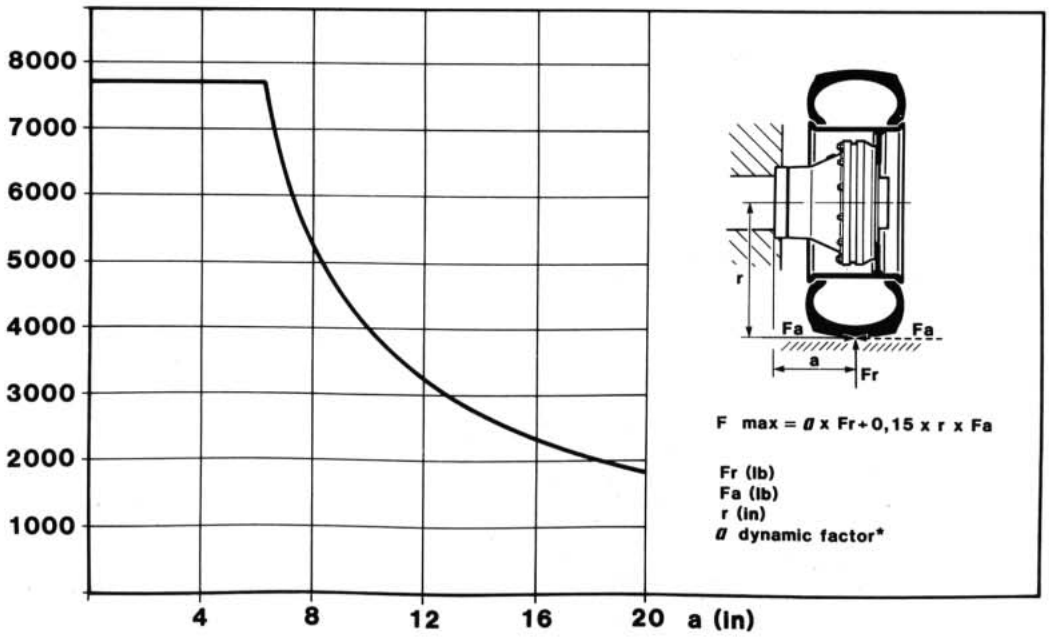
F_{max} [kg]



US-standard

Class 3
15.3 – 19.2 – 24.4 cu.in motors

Fmax [lb]



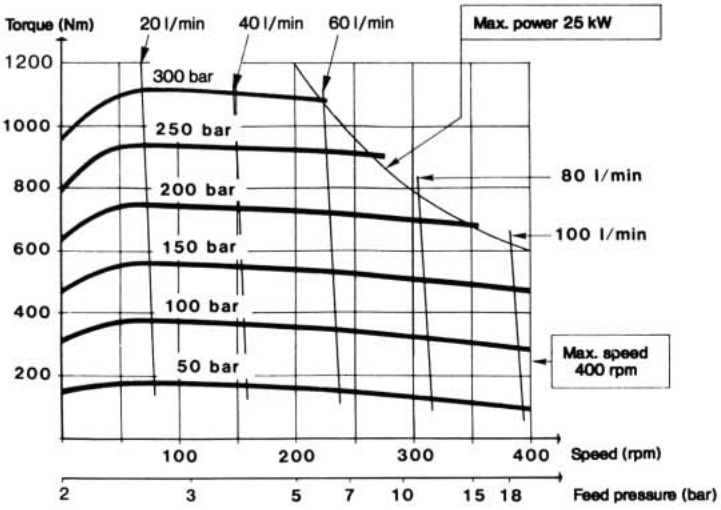
*** DYNAMIC FACTOR**

— constant loading and low speed	α = 1
— variable loading	α = 1—1.5
— shock loads or high speed (> 70 km/h or 45 mph)	α = 1.4—2

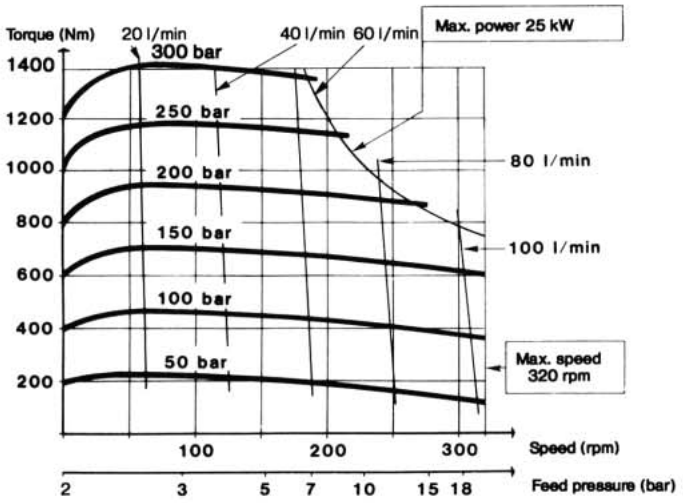
Class 3
250 – 315 – 400 ccm motors

SI-standard

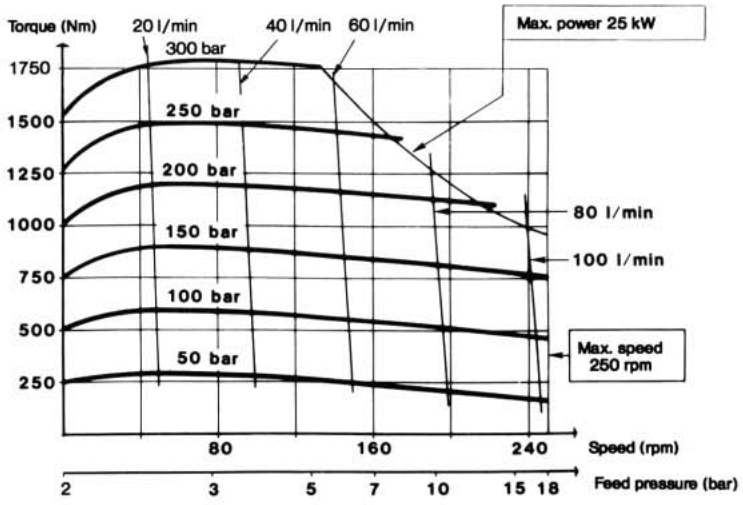
250 ccm



315 ccm



400 ccm



Performance data

Displacement ccm	250	315	400
Peak pressure bar	350	350	350
Mobile use			
— torque (Nm) at 300 bar*	1120	1415	1790
— torque (Nm) at 250 bar	935	1180	1495
— power kW	25	25	25
Max. speed			
— working rpm	400	320	250
— freewheel. rpm	1200	1200	1200

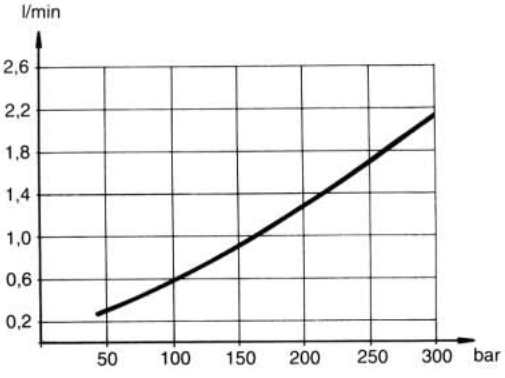
* Intermittent pressure: max. 10 % of every minute.

Technical data
250 - 315 - 400 ccm

Brake		—	multi disc	shoe
Brake torque	Nm	—	2000	1700
Radial load				
— static	kg	3500	3500	3500
— dynamic	kg	2500	2500	2500
Max static axial load (without radial load)				
— compression	kN	62	62	62
— expansion	kN	29	29	29
Weight	kg	32	42	44
Dimensions				
— diameter	mm	234	234	275
— length	mm	243	364	243
Moment of inertia	kgm^2	0,12	0,13	0,21
Min.rim size	in	11	11	11

Case leakage

250 – 315 – 400 ccm

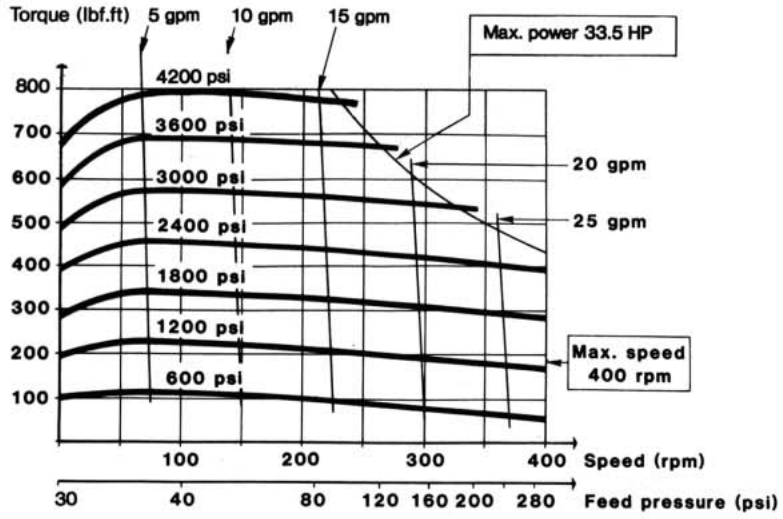


Curves based on oil viscosity 35 cSt.

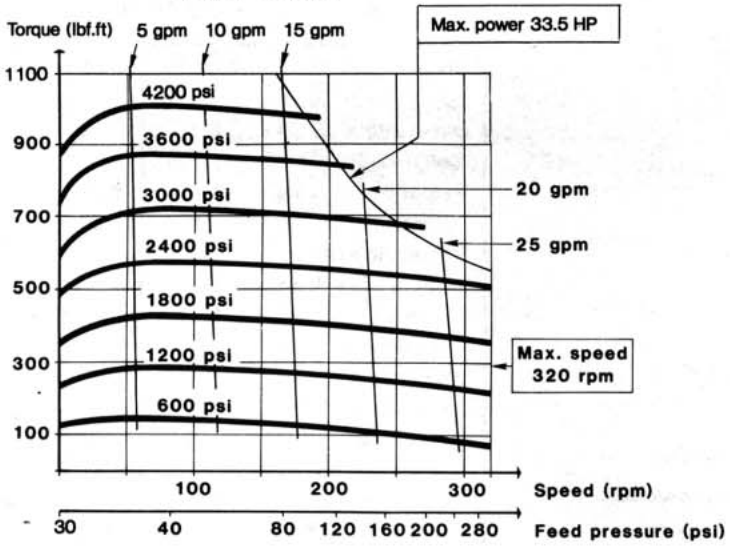
Class 3
15.3 – 19.2 – 24.4 cu.in motors

US-standard

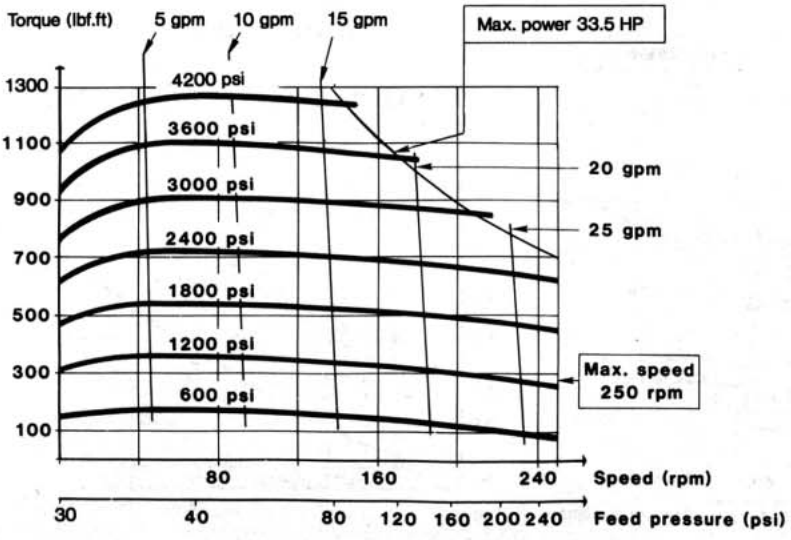
15.3 cu.in



19.2 cu.in



24.4 cu.in



Performance data

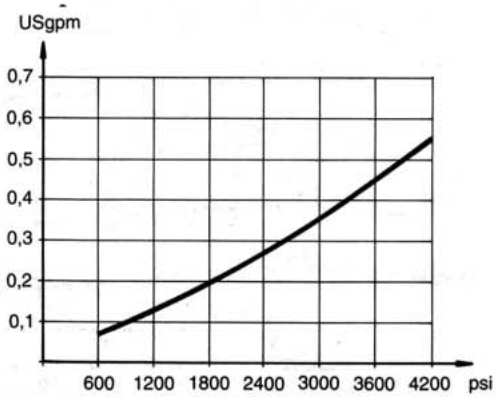
Displacement	cu.in	15.3	19.2	24.4
Peak pressure	psi	5000	5000	5000
Mobile use				
— torque at 4350 psi*	(lbf.ft)	828	1044	1320
— torque at 3600 psi	(lbf.ft)	690	870	1100
— power	HP	33.5	33.5	33.5
Max. speed				
— working	rpm	400	320	250
— freewheel.	rpm	1200	1200	1200

* Intermittent pressure: max. 10 % of every minute.

Technical data
15.3 - 19.2 - 24.4 cu.in

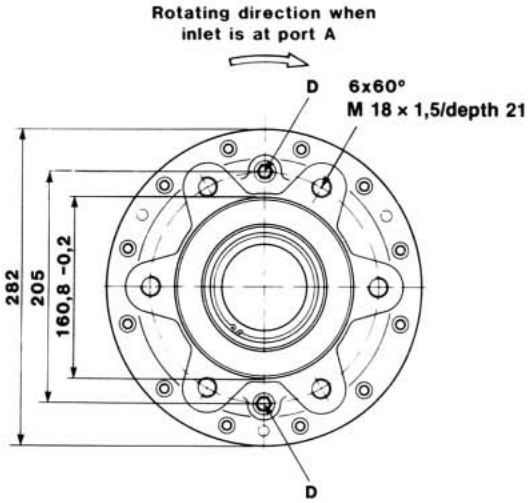
Brake	—	multi disc	shoe	
Brake torque	lbf.ft	—	1475	1250
Radial load				
— static	lb	7700	7700	7700
— dynamic	lb	5500	5500	5500
Max static axial load (without radial load)				
— compression	lb	13860	13860	13860
— expansion	lb	6600	6600	6600
Weight	lb	70.5	92.5	97.0
Dimensions				
— diameter	in	9.21	9.21	10.83
— length	in	9.57	14.33	9.57
Moment of inertia	lb.in²	410	444	718
Min.rim size	in	11	11	11

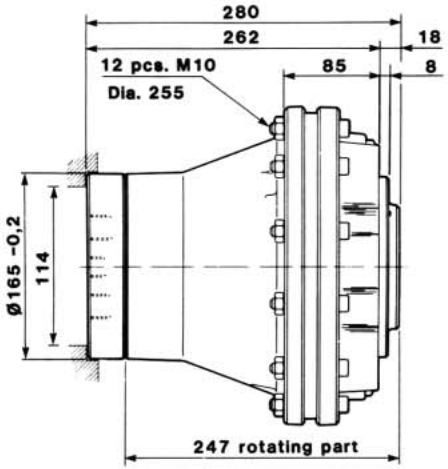
Case leakage
15.3 – 19.2 – 24.4 cu.in

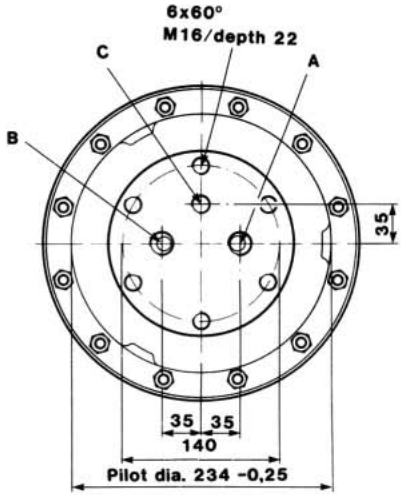


Curves based on oil viscosity 35 cSt.

Class 4
500 – 630 – 800 ccm motors
(30.5 – 38.4 – 48.8 cu.in)



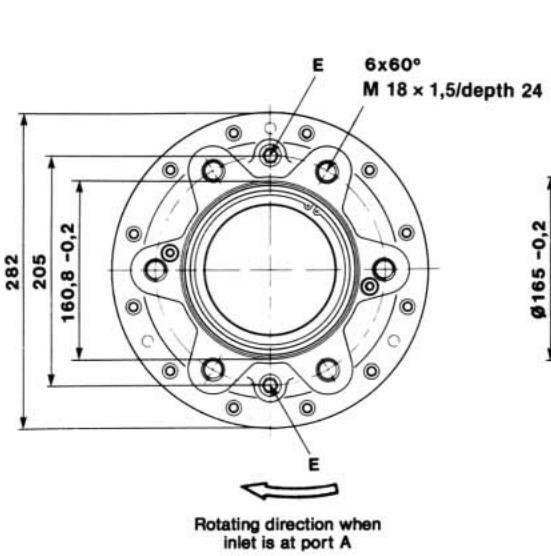


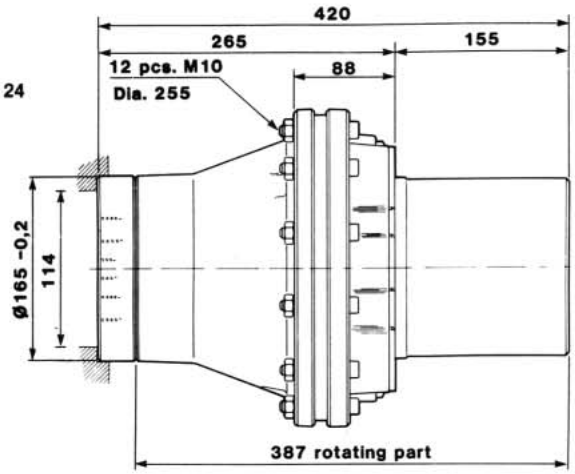


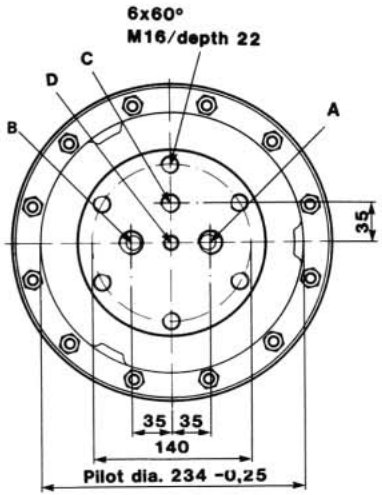
Motor part number	Displacement ccm	cu.in	
404 050 1110	500	30.5	Hydraulic freewheeling
404 063 1110	630	38.4	
404 080 1110	800	48.8	
404 050 2110	500	30.5	Freewheeling with springs
404 063 2110	630	38.4	
404 080 2110	800	48.8	

A — pressure connection R 3/4 /depth 16
B — pressure connection R 3/4 /depth 16
C — drain connection R 3/8 /depth 15
D — air bleed screw

Class 4
500 – 630 – 800 ccm motors with multi-disc brake
(30.5 – 38.4 – 48.8 cu.in)





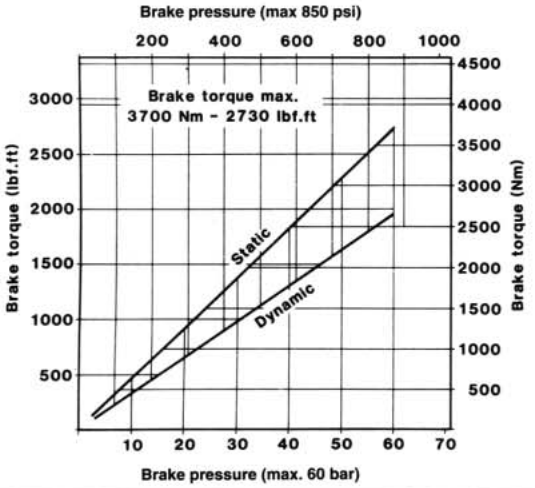


A — pressure connection R 3/4 /depth 16
B — pressure connection R 3/4 /depth 16
C — drain connection R 3/8 /depth 15
D — brake connection R 1/4 /depth 12
E — air bleed screw

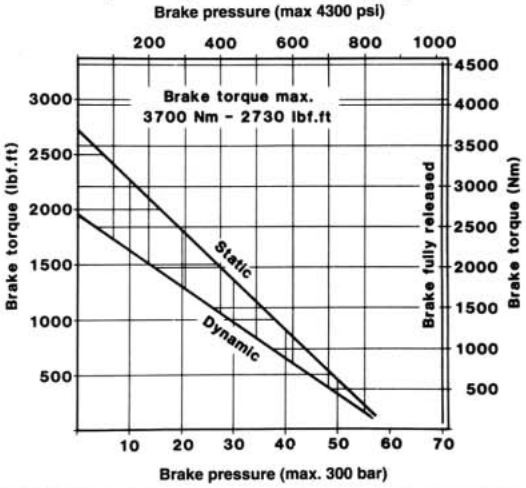
Motor part number		Displacement		
Pressure oper. brake	Spring oper. brake	ccm	cu.In	
404 050 1130	404 050 1140	500	30.5	Hydraulic freewheeling
404 063 1130	404 063 1140	630	38.4	
404 080 1130	404 080 1140	800	48.8	
404 050 2130	404 050 2140	500	30.5	Freewheeling with springs
404 063 2130	404 063 2140	630	38.4	
404 080 2130	404 080 2140	800	48.8	

Brake torque diagrams

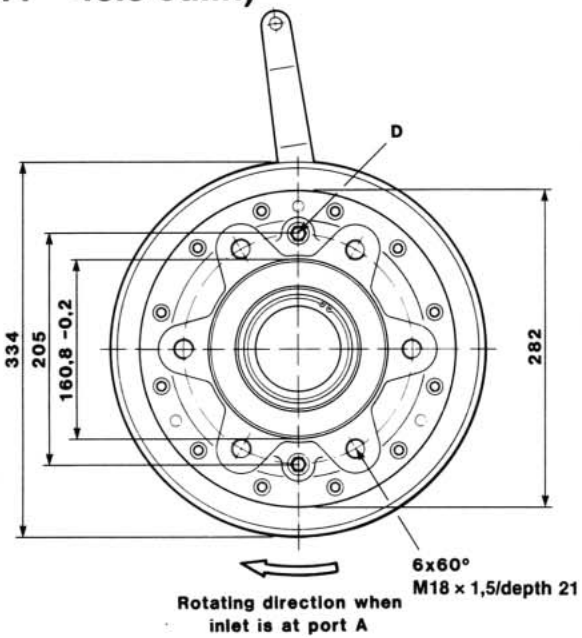
pressure operated brake

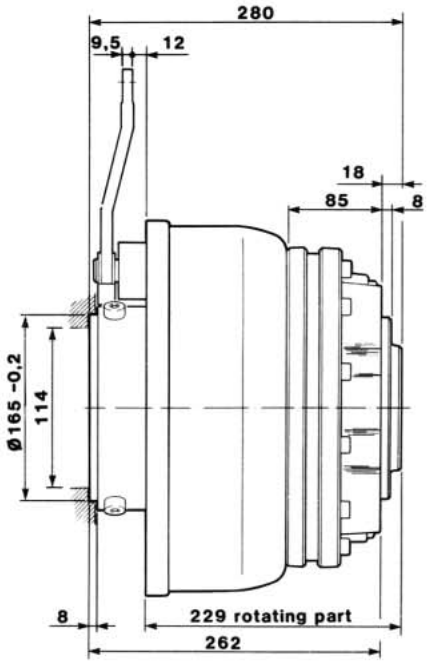


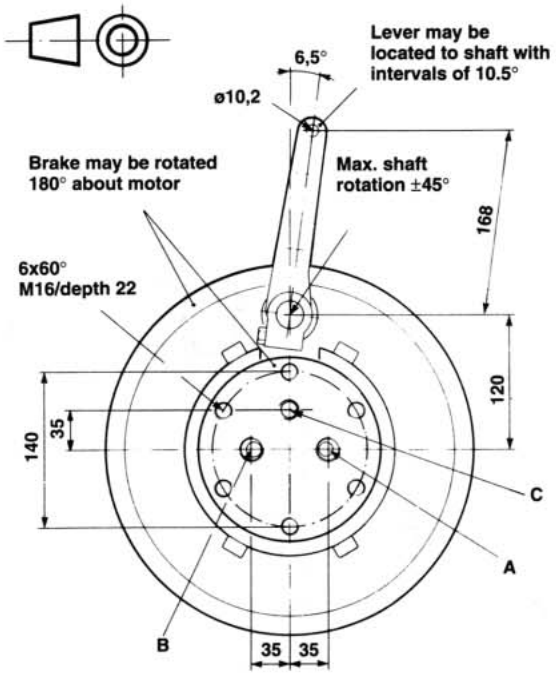
spring operated brake
(brake cylinder volume 20 ccm)



Class 4
500 – 630 – 800 ccm motors with shoe brake (30.5 – 38.4 – 48.8 cu.in)



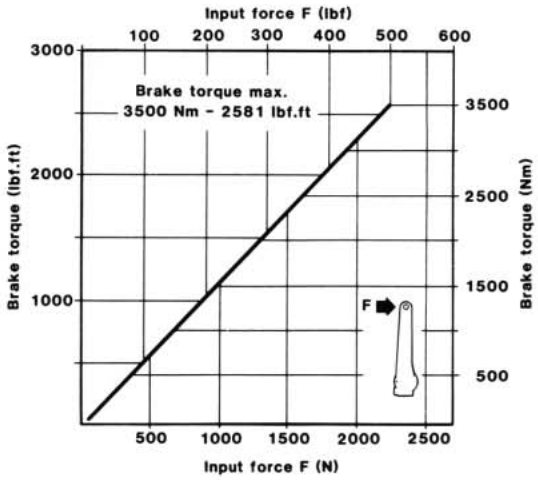




A — pressure connection R 3/4 /depth 16
B — pressure connection R 3/4 /depth 16
C — drain connection R 3/8 /depth 15
D — air bleed screw

Motor part number	Displacement ccm	cu.in	
404 050 1120	500	30.5	Hydraulic freewheeling
404 063 1120	630	38.4	
404 080 1120	800	48.8	
404 050 2120	500	30.5	Freewheeling with springs
404 063 2120	630	38.4	
404 080 2120	800	48.8	

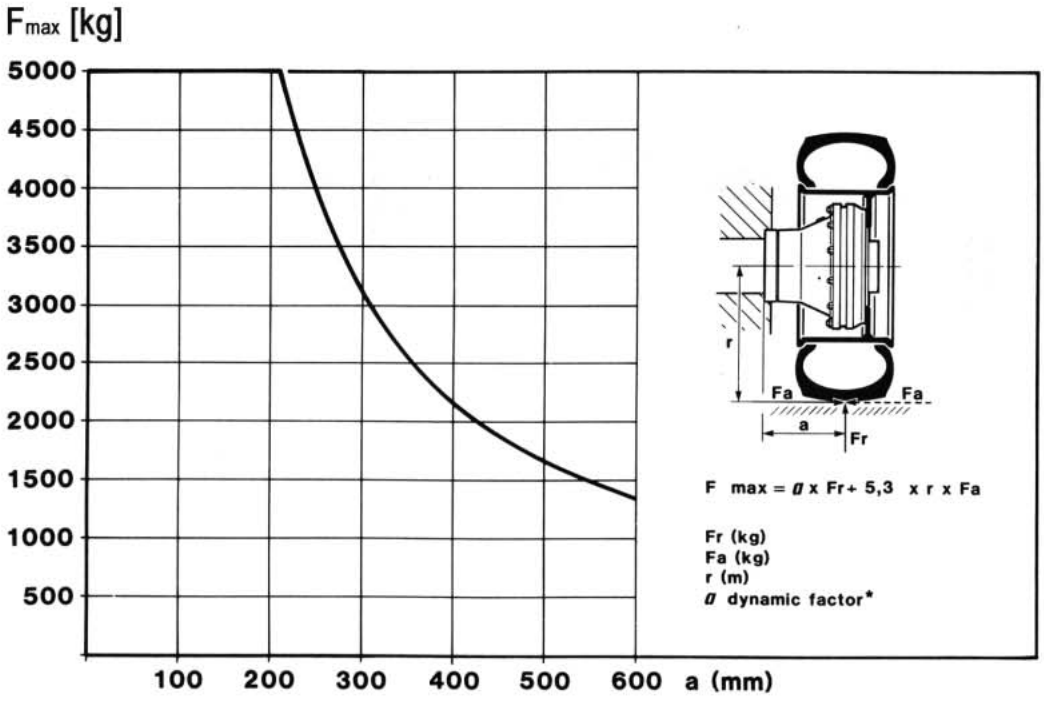
Brake torque diagram



SHAFT LOAD

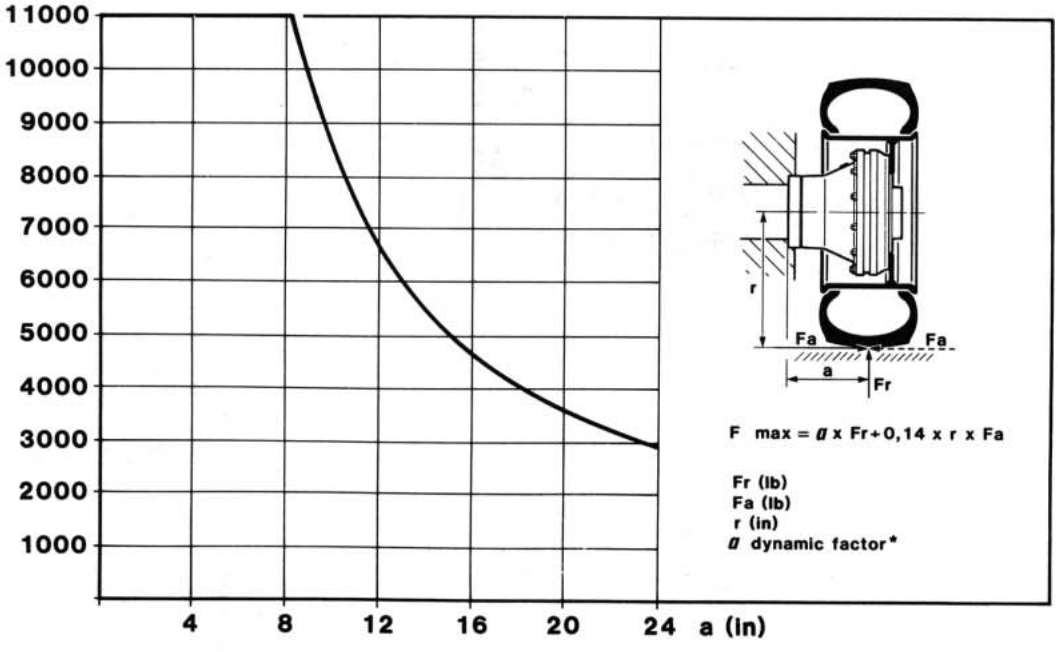
SI-standard

Class 4
500 – 630 – 800 ccm motors



Class 4
30.5 – 38.4 – 48.8 cu.in motors

US-standard



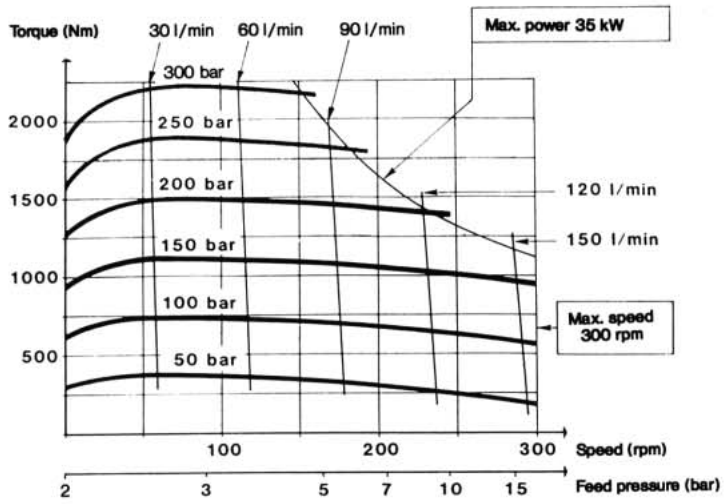
*** DYNAMIC FACTOR**

— constant loading and low speed	α = 1
— variable loading	α = 1—1.5
— shock loads or high speed (> 70 km/h or 45 mph)	α = 1.4—2

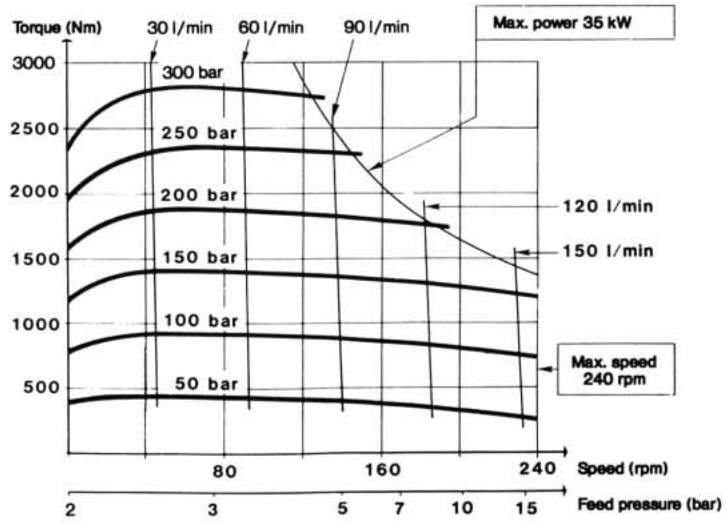
Class 4
500 – 630 – 800 ccm motors

SI-standard

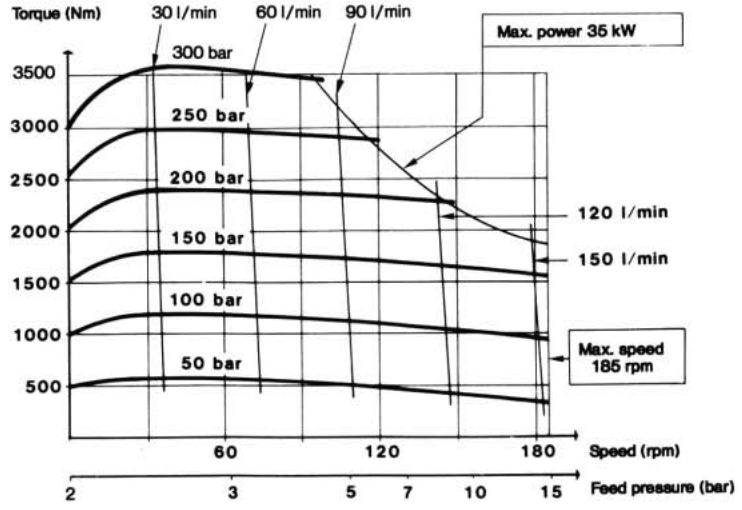
500 ccm



630 ccm



800 ccm



Performance data

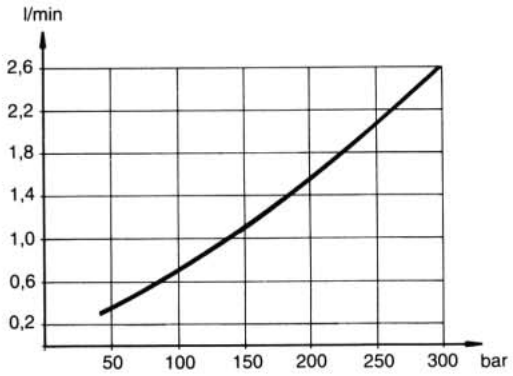
Displacement ccm	500	630	800
Peak pressure bar	350	350	350
Mobile use			
— torque (Nm) at 300 bar*	2245	2825	3590
— torque (Nm) at 250 bar	1870	2355	2990
— power kW	35	35	35
Max. speed			
— working rpm	300	240	185
— freewheel. rpm	1200	1200	1200

* Intermittent pressure: max. 10 % of every minute.

Technical data
500 - 630 - 800 ccm

Brake		—	multi disc	shoe
Brake torque	Nm	—	3700	3500
Radial load				
— static	kg	5000	5000	5000
— dynamic	kg	3500	3500	3500
Max static axial load (without radial load)				
— compression	kN	81	81	81
— expansion	kN	39	39	39
Weight	kg	50	66	72
Dimensions				
— diameter	mm	282	282	334
— length	mm	280	420	280
Moment of inertia	kgm²	0,28	0,32	0,60
Min.rim size	in	13	13	13

Case leakage
500 – 630 – 800 ccm

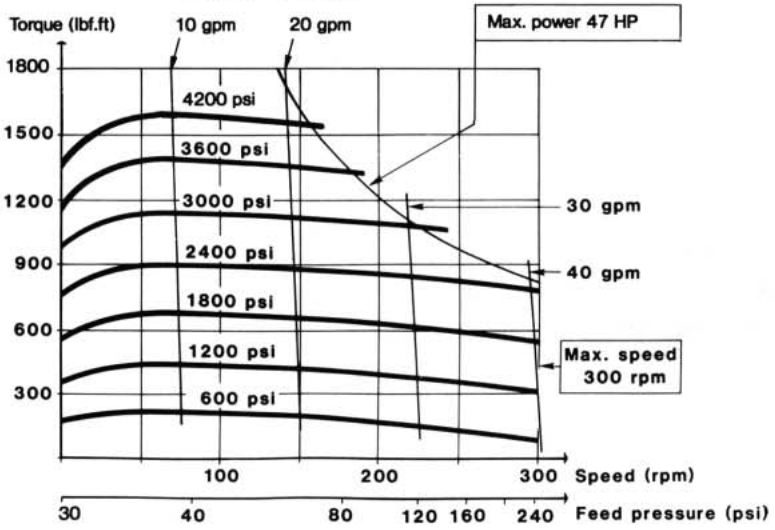


Curves based on oil viscosity 35 cSt.

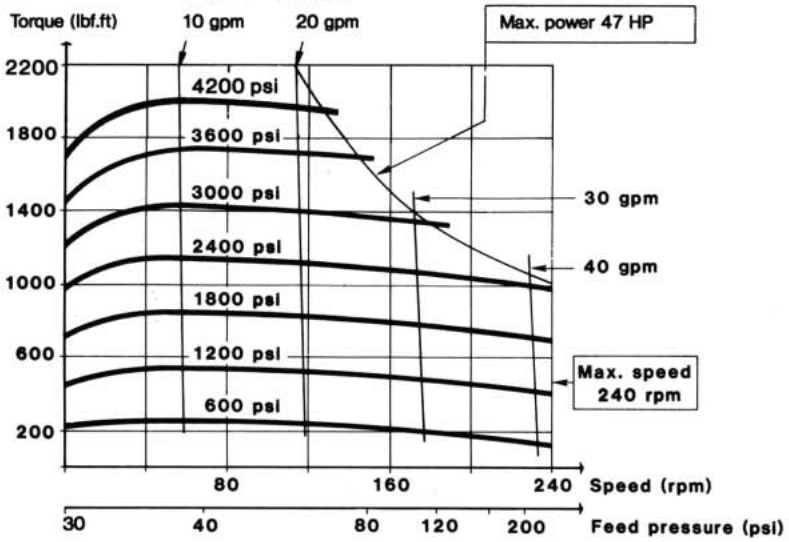
Class 4
30.5 – 38.4 – 48.8 cu.in motors

US-standard

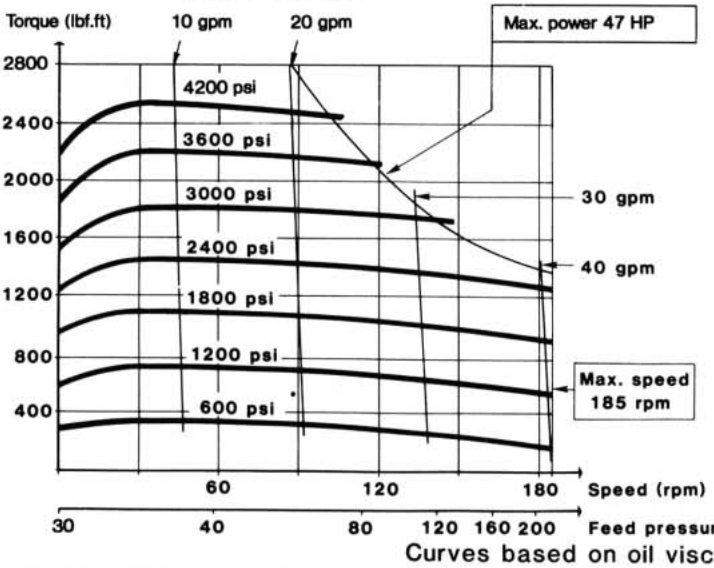
30.5 cu.in



38.4 cu.in



48.8 cu.in



Curves based on oil viscosity 35 cSt.

Performance data

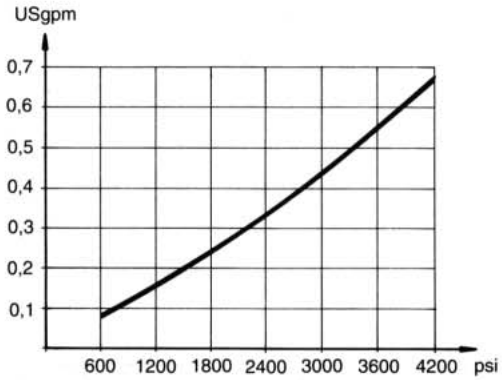
Displacement	cu.in	30.5	38.4	48.8
Peak pressure	psi	5000	5000	5000
Mobile use				
— torque at 4350 psi*	(lbf.ft)	1656	2082	2646
— torque at 3600 psi	(lbf.ft)	1380	1735	2205
— power	HP	47	47	47
Max. speed				
— working	rpm	300	240	185
— freewheel.	rpm	1200	1200	1200

* Intermittent pressure: max. 10 % of every minute.

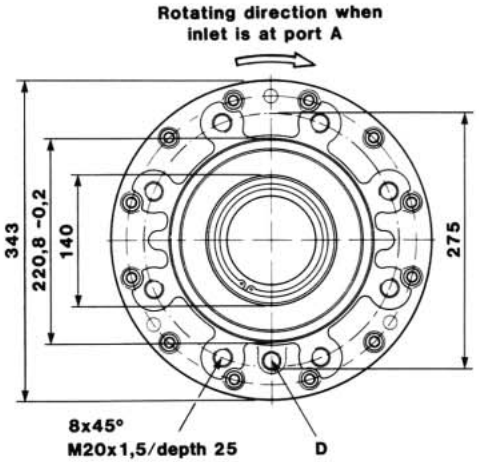
Technical data
30.5 - 38.4 - 48.8 cu.in

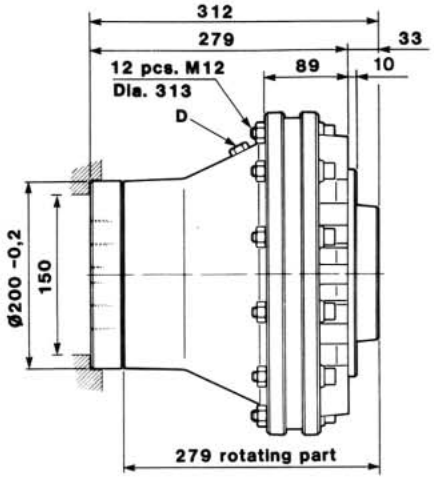
Brake		—	multi disc	shoe
Brake torque	lbf.ft	—	2730	2580
Radial load				
— static	lb	11000	11000	11000
— dynamic	lb	7700	7700	7700
Max static axial load (without radial load)				
— compression	lb	20000	20000	20000
— expansion	lb	8800	8800	8800
Weight	lb	110	145.5	158.7
Dimensions				
— diameter	in	11.10	11.10	13.15
— length	in	11.02	16.54	11.02
Moment of inertia	lb.in²	957	1093	2050
Min.rim size	in	13	13	13

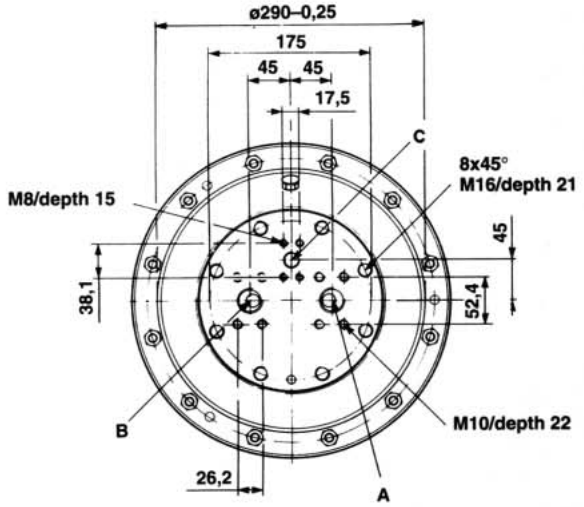
Case leakage
30.5 – 38.4 – 48.8 cu.in



Class 5
1000 – 1250 – 1600 ccm motors
(61 – 76.3 – 97.6 cu.in)



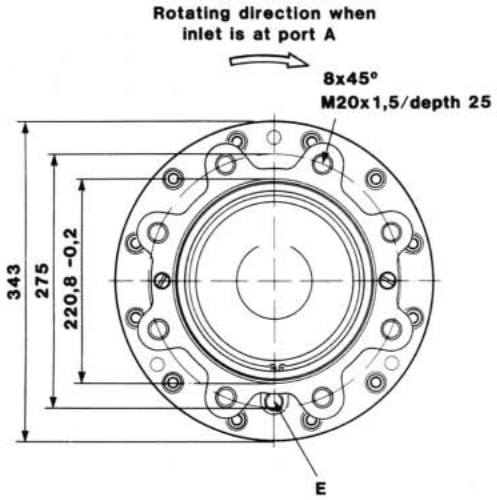


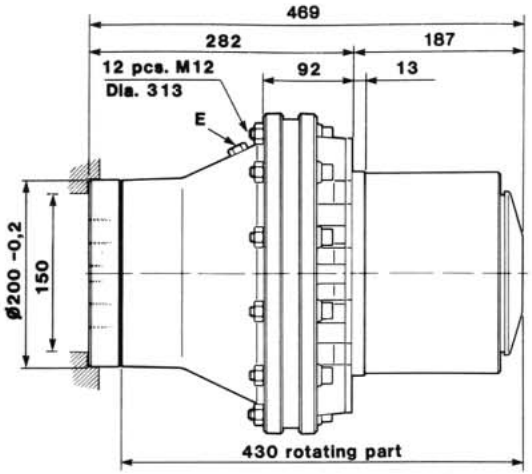


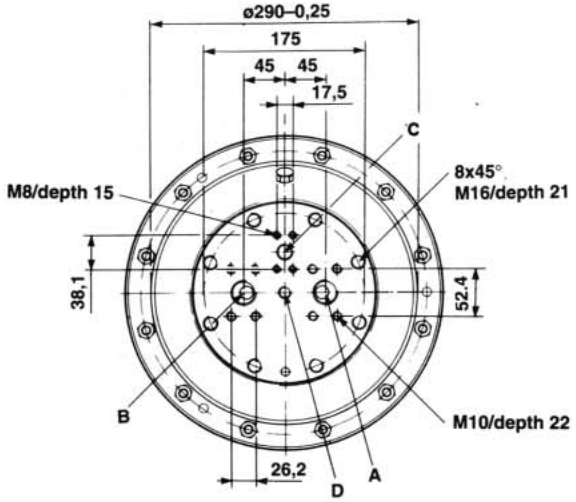
Motor part number	Displacement ccm	cu.in	
405 100 1110	1000	61	Hydraulic freewheeling
405 125 1110	1250	76.3	
405 160 1110	1600	97.6	
405 100 2110	1000	61	Freewheeling with springs
405 125 2110	1250	76.3	
405 160 2110	1600	97.6	

A —pressure conn. 1 in SAE-flange (R 3/4)
B —pressure conn. 1 in SAE-flange (R 3/4)
C —drain conn. 1/2 in SAE-flange (R 3/8)
D —air bleed screw

Class 5
1000 – 1250 – 1600 ccm motors with multi-disc brake
(61 – 76.3 – 97.6 cu.in)





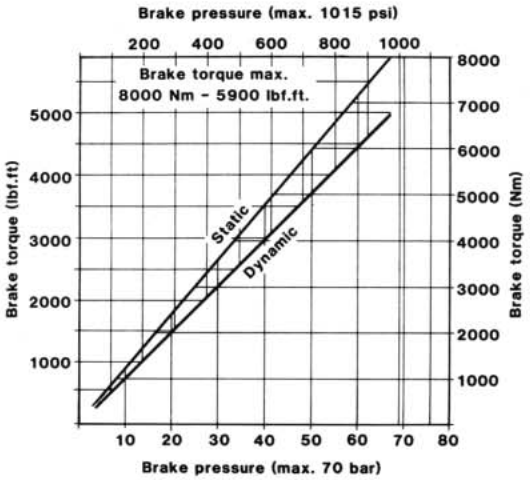


A —pressure conn. 1 in SAE-flange (R 3/4)
B —pressure conn. 1 in SAE-flange (R 3/4)
C —drain conn. 1/2 in SAE-flange (R 3/8)
D —brake conn. R 1/4
E —air bleed screw

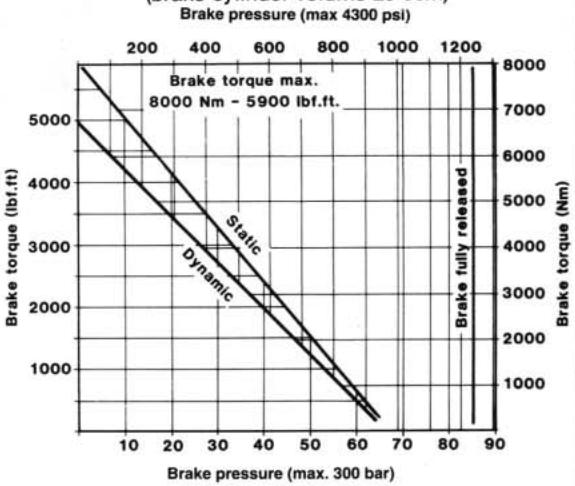
Motor part number		Displacement		
Pressure oper. brake	Spring oper. brake	ccm	cu.in	
405 100 1130	405 100 1140	1000	61	Hydraulic freewheeling
405 125 1130	405 125 1140	1250	76,3	
405 160 1130	405 160 1140	1600	97.6	
405 100 2130	405 100 2140	1000	61	Freewheeling with springs
405 125 2130	405 125 2140	1250	76.3	
405 160 2130	405 160 2140	1600	97.6	

Brake torque diagrams

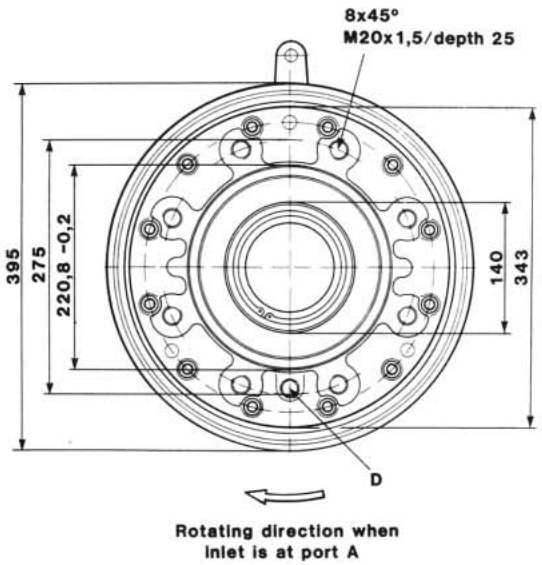
pressure operated brake



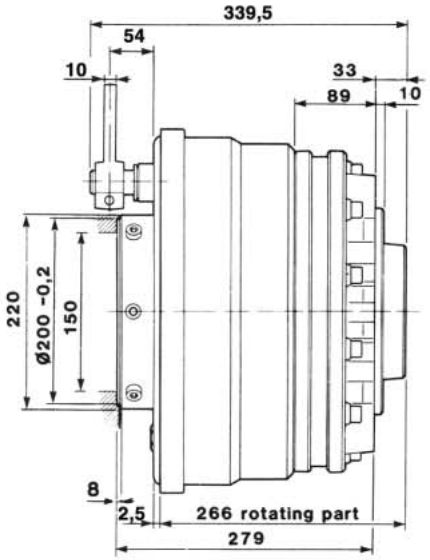
spring operated brake
(brake cylinder volume 29 ccm)

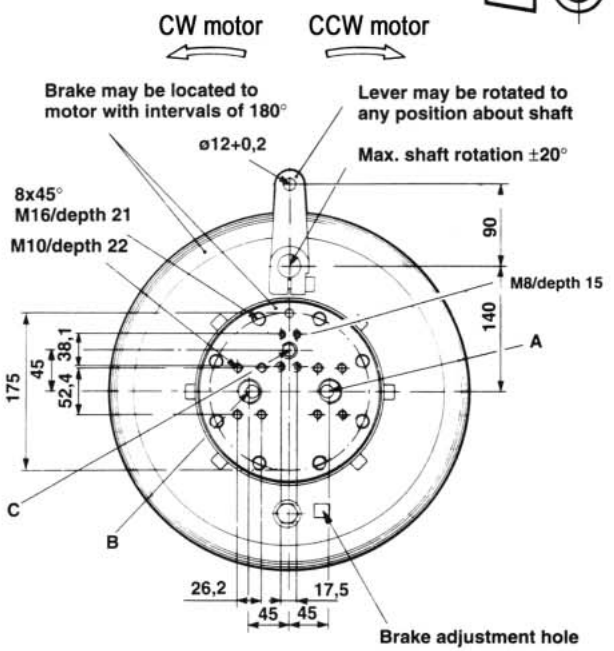


Class 5
1000 – 1250 – 1600 ccm motors with shoe brake
(61 – 76.3 – 97.6 cu.in)



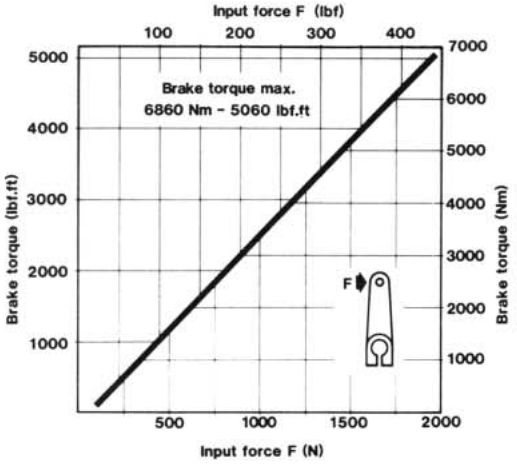
CW motor





Motor part number	Displacement ccm	cu.in	
405 100 1120	1000	61	Hydraulic freewheeling
405 125 1120	1250	76.3	
405 160 1120	1600	97.6	
405 100 2120	1000	61	Freewheeling with springs
405 125 2120	1250	76.3	
405 160 2120	1600	97.6	

Brake torque diagram



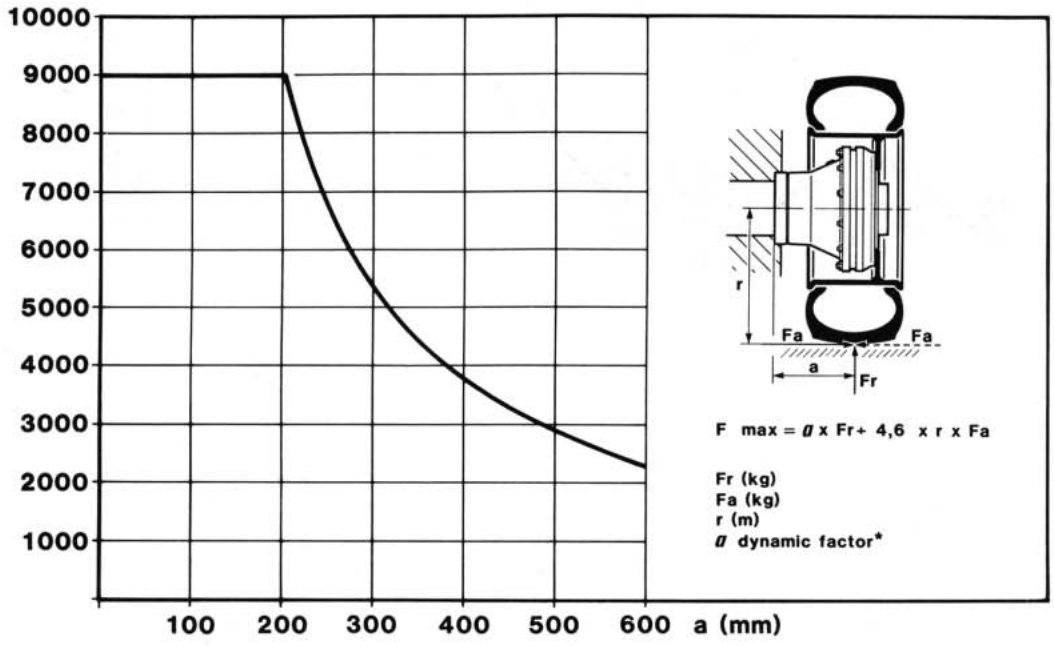
A —pressure conn. 1 in SAE-flange (R 3/4)
B —pressure conn. 1 in SAE-flange (R 3/4)
C —drain conn. 1/2 in SAE-flange (R 3/8)
D —air bleed screw

SHAFT LOAD

SI-standard

Class 5
1000 – 1250 – 1600 ccm motors

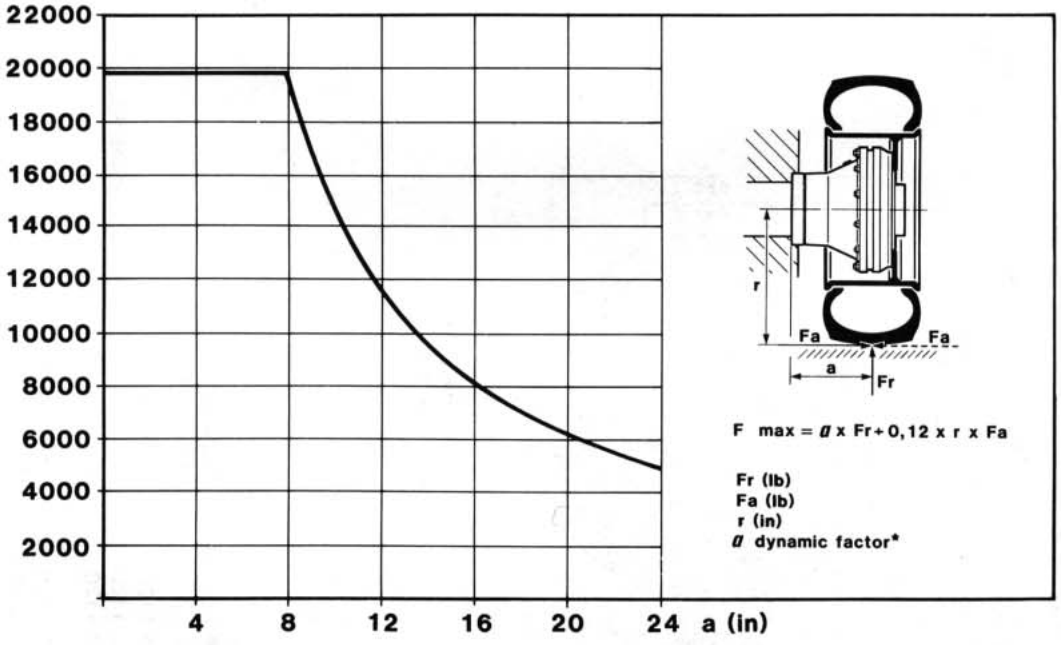
F_{max} [kg]



Class 5
61 – 76.3 – 97.6 cu.in motors

US-standard

Fmax [lb]



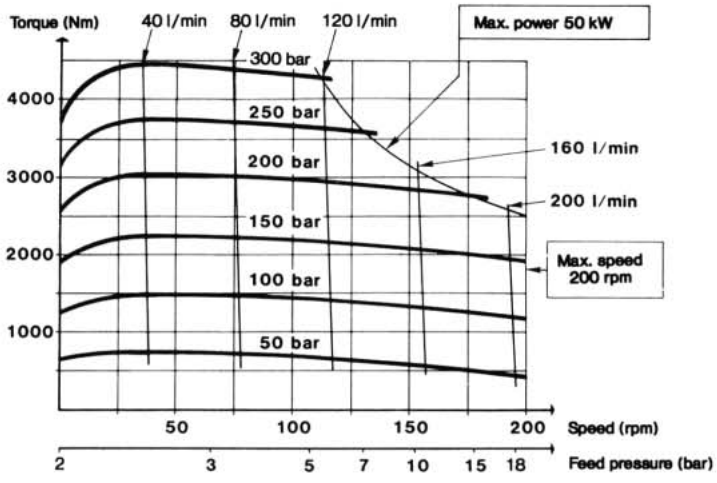
*** DYNAMIC FACTOR**

— constant loading and low speed	α = 1
— variable loading	α = 1—1.5
— shock loads or high speed (> 70 km/h or 45 mph)	α = 1.4—2

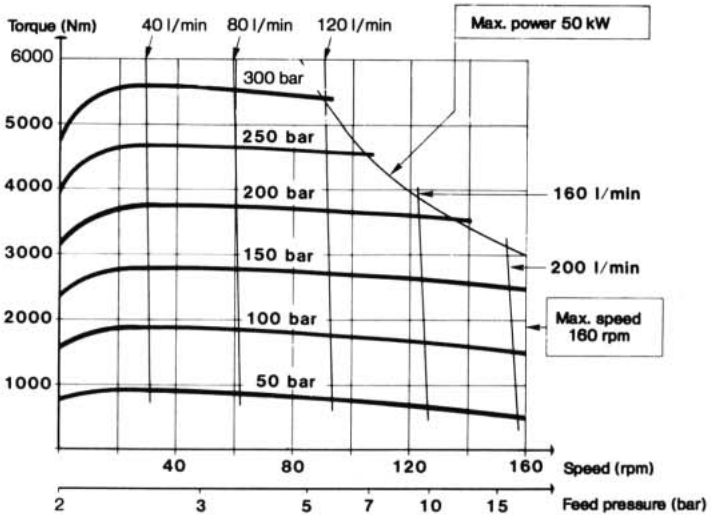
Class 5
1000 – 1250 – 1600 ccm motors

SI-standard

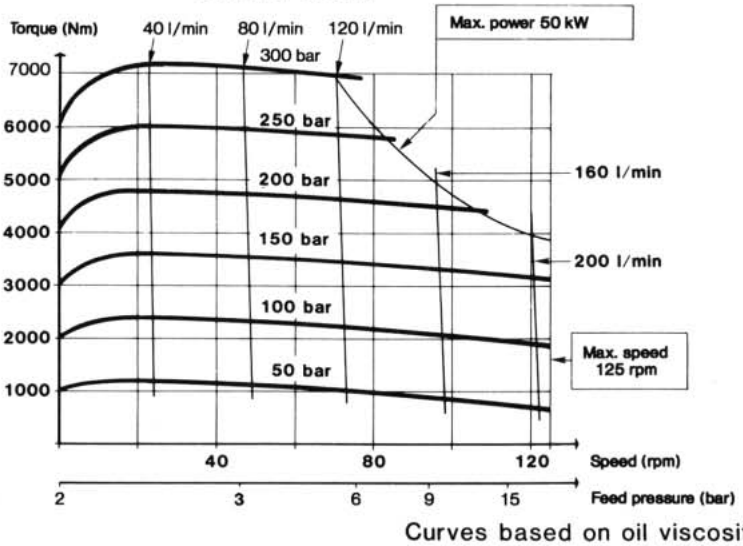
1000 ccm



1250 ccm



1600 ccm



Performance data

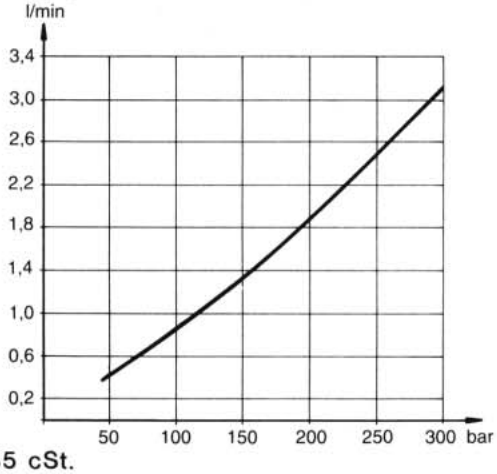
Displacement ccm	1000	1250	1600
Peak pressure bar	350	350	350
Mobile use			
— torque (Nm) at 300 bar*	4490	5610	7180
— torque (Nm) at 250 bar	3740	4675	5985
— power kW	50	50	50
Max. speed			
— working rpm	200	160	125
— freewheel. rpm	1200	1200	1200

* Intermittent pressure: max. 10 % of every minute.

Technical data
1000 - 1250 - 1600 ccm

Brake		—	multi disc	shoe
Brake torque	Nm	—	8000	6860
Radial load				
— static	kg	9000	9000	9000
— dynamic	kg	6000	6000	6000
Max static axial load (without radial load)				
— compression	kN	125	125	125
— expansion	kN	61	61	61
Weight	kg	85	110	112
Dimensions				
— diameter	mm	343	343	395
— length	mm	312	469	342
Moment of inertia	kgm^2	0,68	0,79	1,29
Min.rim size	in	15	15	15

Case leakage
1000 – 1250 – 1600 ccm

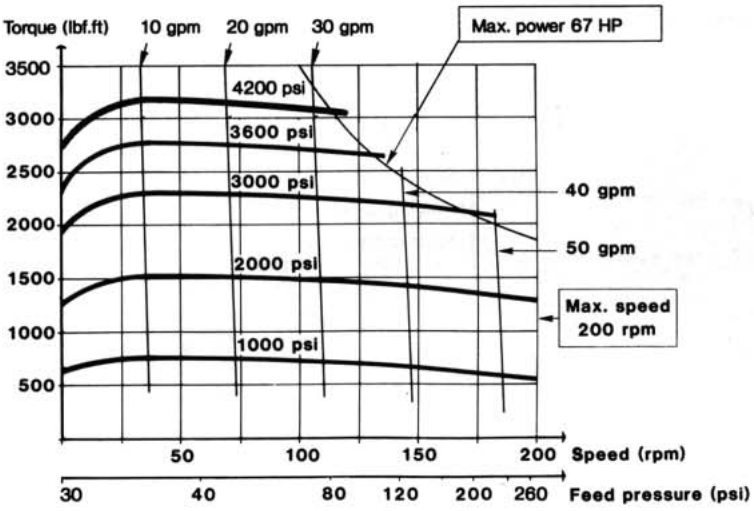


Curves based on oil viscosity 35 cSt.

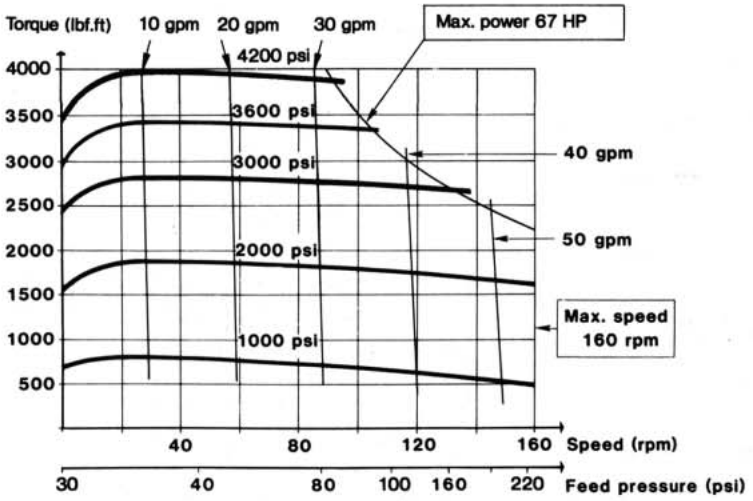
Class 5
61 – 76.3 – 97.6 cu.in motors

US-standard

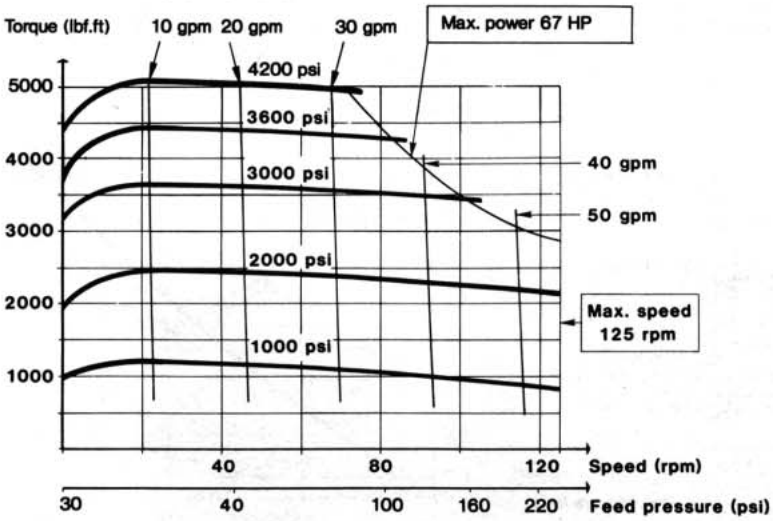
61 cu.in



76.3 cu.in



97.6 cu.in



Performance data

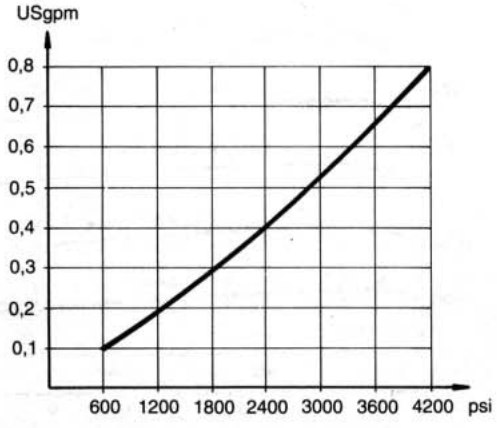
Displacement	cu.in	61	76.3	97.6
Peak pressure	psi	5000	5000	5000
Mobile use				
— torque at 4350	(lbf.ft) psi*	3312	4140	5300
— torque at 3600	(lbf.ft) psi	2760	3450	4415
— power	HP	67	67	67
Max. speed				
— working	rpm	200	160	125
— freewheel.	rpm	1200	1200	1200

* Intermittent pressure: max. 10 % of every minute.

Technical data
61 - 76.3 - 97.6 cu.in

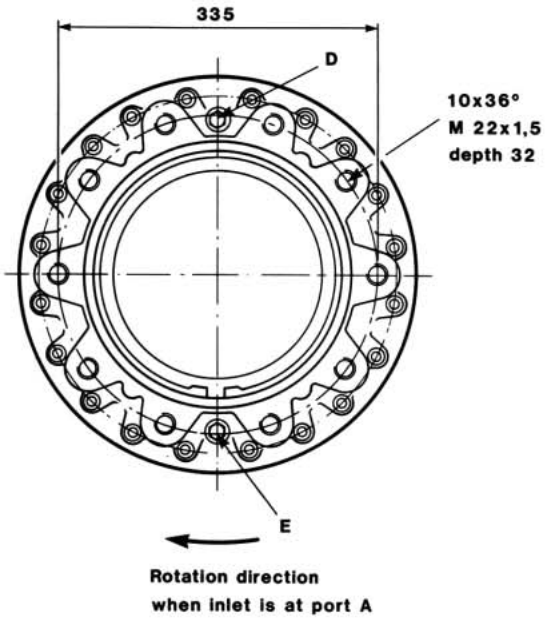
Brake		—	multi disc	shoe
Brake torque	lbf.ft	—	5900	5060
Radial load				
— static	lb	19800	19800	19800
— dynamic	lb	13200	13200	13200
Max static axial load (without radial load)				
— compression	lb	28600	28600	28600
— expansion	lb	13860	13860	13860
Weight	lb	187	243	247
Dimensions				
— diameter	in	13.50	13.50	15.55
— length	in	12.28	18.46	13.46
Moment of inertia	lb.in²	2324	2700	4408
Min.rim size	in	15	15	15

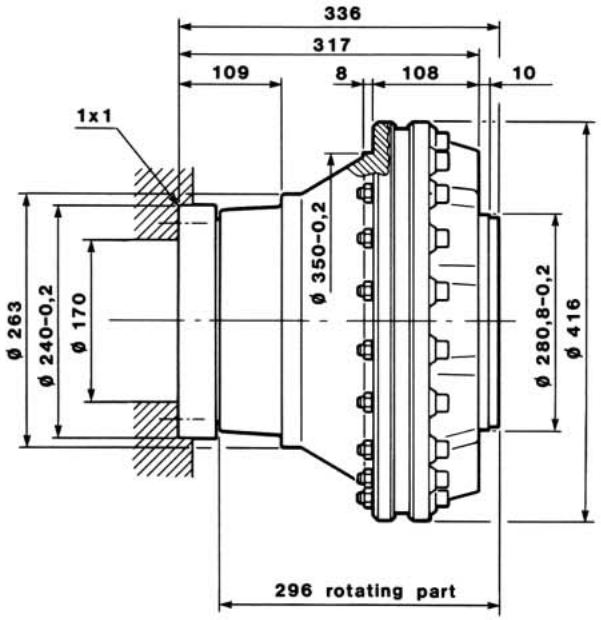
Case leakage
61 – 76.3 – 97.6 cu.in

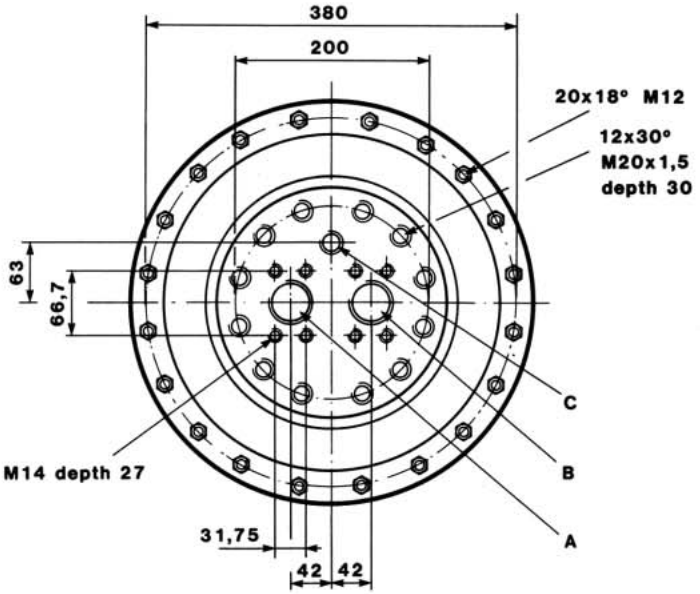


Curves based on oil viscosity 35 cSt.

Class 6
2000 – 2500 – 3150 ccm motors
(122.0 – 152.6 – 192.2 cu.in)



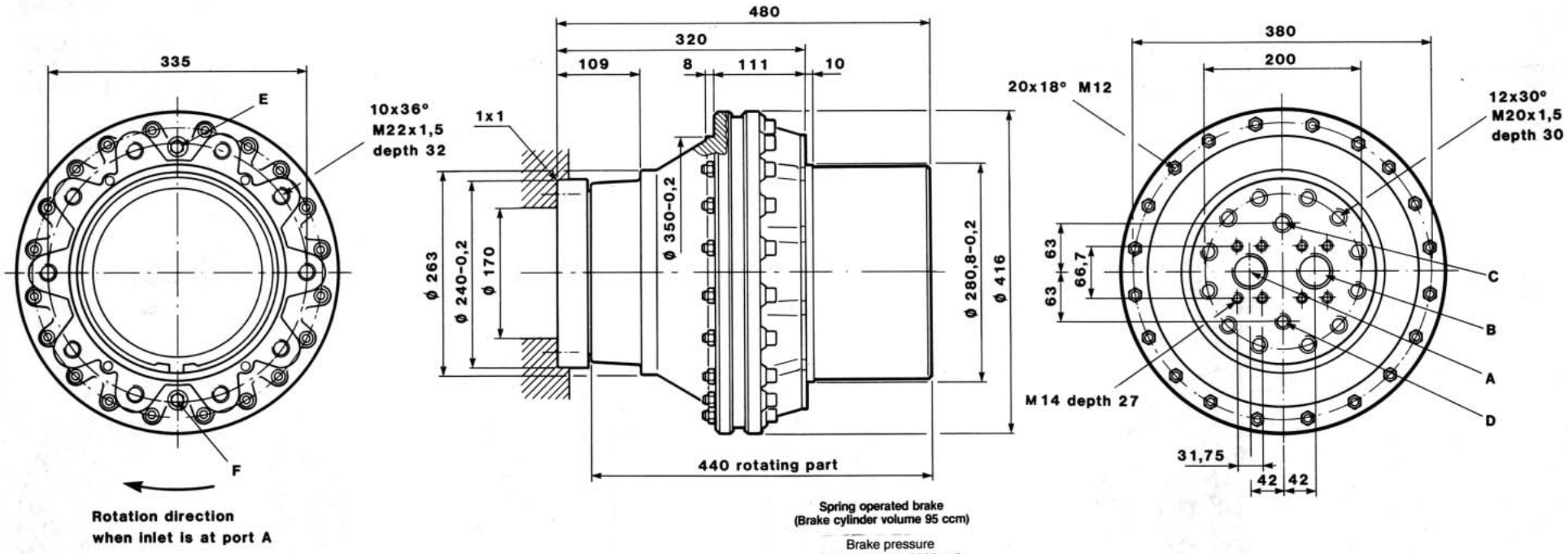




Part number	Displacement ccm	cu.in	
406 200 1110	2000	122.0	Hydraulic freewheeling
406 250 1110	2500	152.6	
406 315 1110	3150	192.2	
406 200 2110	2000	122.0	Freewheeling with springs
406 250 2110	2500	152.6	
406 315 2110	3150	192.2	

A — pressure connection R 1 in and 1 1/4 in SAE flange (6000 psi)
B — pressure connection R 1 in and 1 1/4 in SAE flange (6000 psi)
C — drain connection R 3/4 in depth 18
D and E — air bleed screw

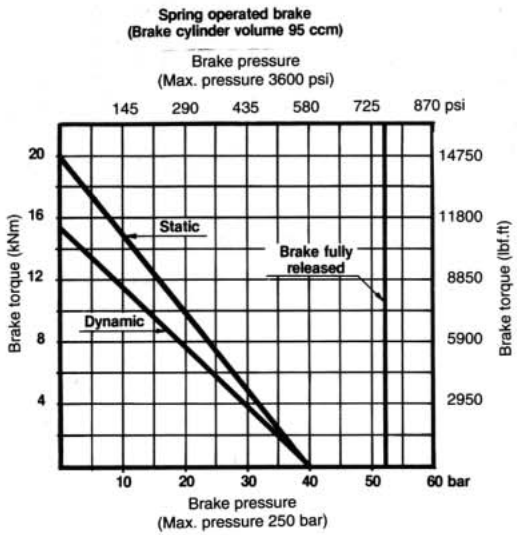
Class 6
2000 – 2500 – 3150 ccm motors with multi-disc brake (122.0 – 152.6 – 192.2 cu.in)



Rotation direction when inlet is at port A

A — pressure connection R 1 in and 1 1/4 in SAE flange (6000 psi)
B — pressure connection R 1 in and 1 1/4 in SAE flange (6000 psi)
C — drain connection R 3/4 in depth 18
D — brake connection R 3/8 in depth 15
E and F — air bleed screw

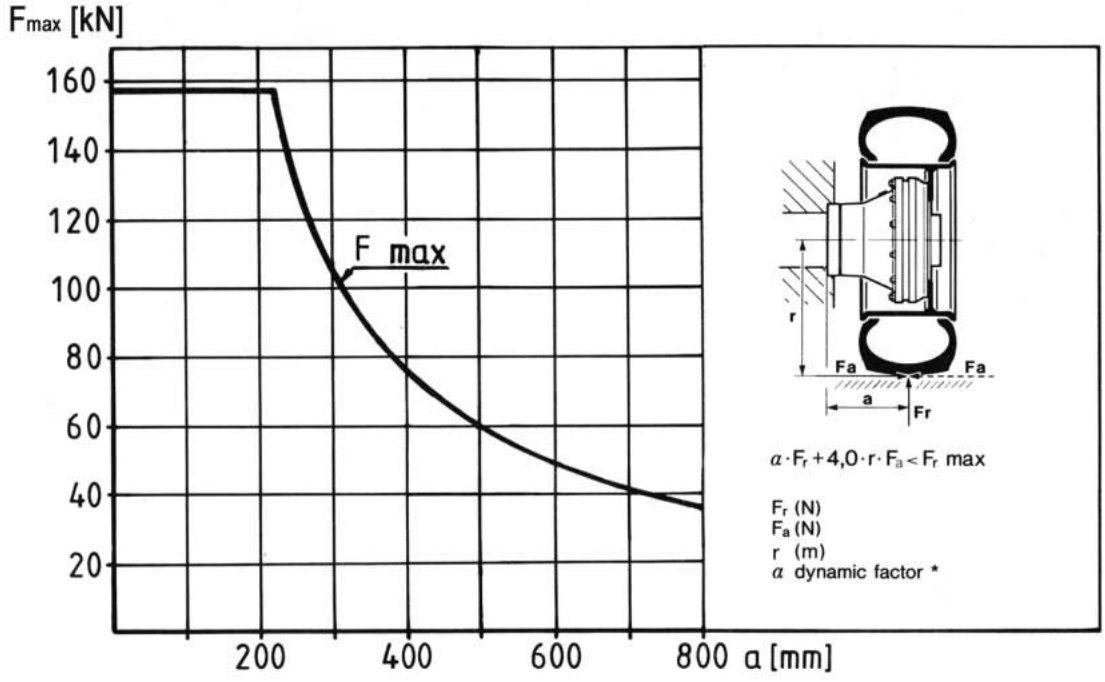
Part number — spring operated brake	Displacement ccm	cu.in	
406 200 1140	2000	122.0	Hydraulic freewheeling
406 250 1140	2500	152.6	
406 315 1140	3150	192.2	
406 200 2140	2000	122.0	Freewheeling with springs
406 250 2140	2500	152.6	
406 315 2140	3150	192.2	



SHAFT LOAD

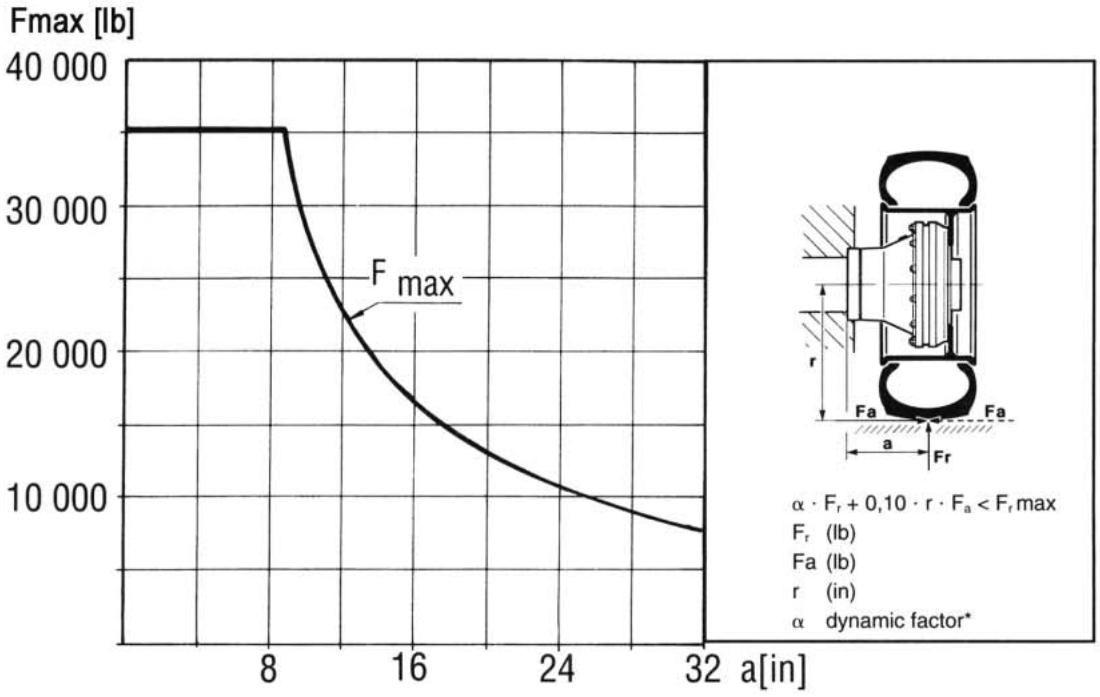
SI-standard

Class 6
2000 – 2500 – 3150 ccm motors



Class 6
122 – 152,6 – 192,2 cu.in motors

US-standard



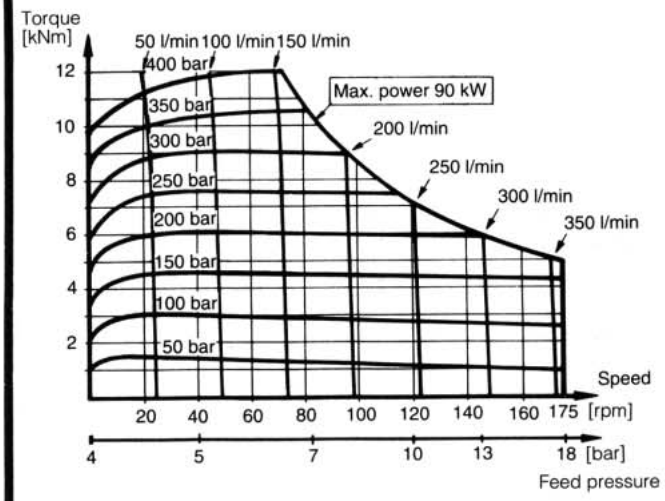
*** DYNAMIC FACTOR**

— constant loading and low speed	α = 1
— variable loading	α = 1—1.5
— shock loads or high speed (> 70 km/h or 45 mph)	α = 1.4—2

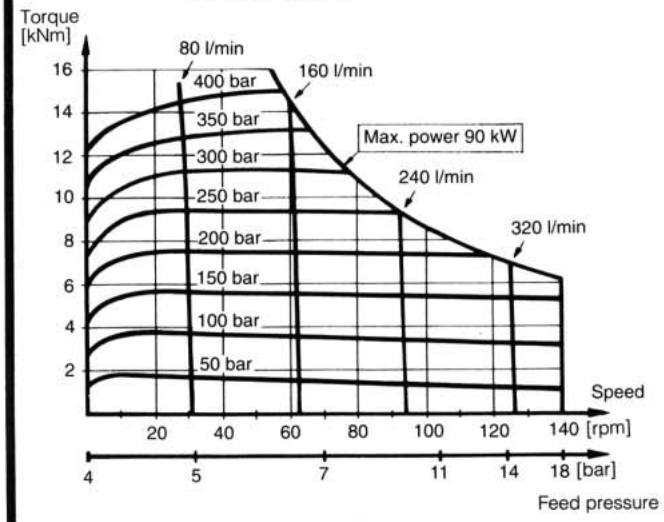
Class 6
2000 — 2500 — 3150 ccm motors

SI-standard

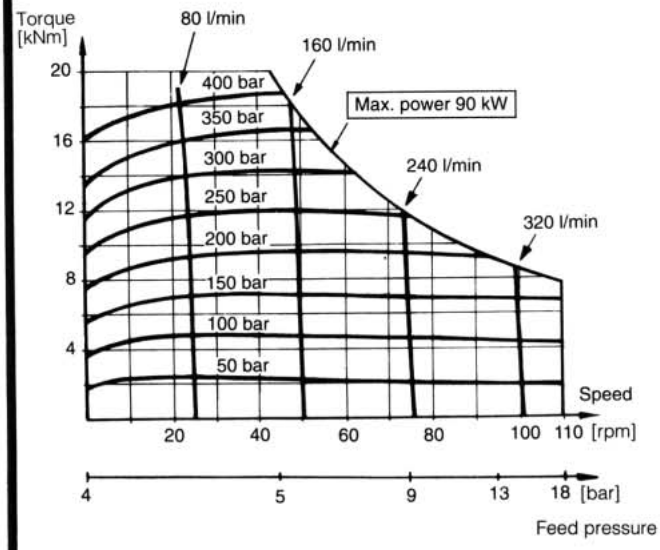
2000 ccm



2500 ccm



3150 ccm



Performance data

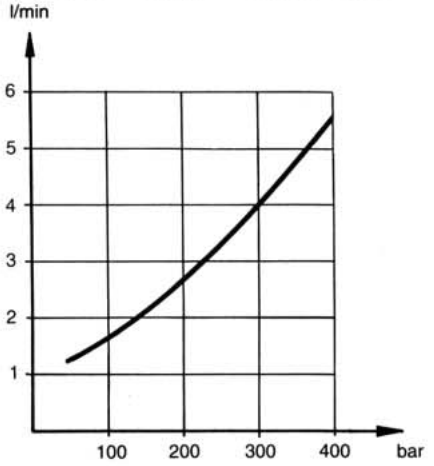
Displacement	ccm	2000	2500	3150
Peak pressure	bar	450	450	450
Mobile use				
– torque	(Nm) at 400 bar *	11950	14940	18820
– torque	(Nm) at 250 bar	7500	9350	11780
– power	kW	90	90	90
Max. speed				
– working	rpm	175	140	110
– freewheel.	rpm	1000	1000	1000

* Intermittent pressure; max. 10 % of every minute

Technical data
2000 – 2500 – 3150 ccm

Brake		–	Multi-disc
Brake torque			
– static	kNm	–	20
– dynamic	kNm	–	15.3
Radial load			
– static	kN	157	157
– dynamic	kN	105	105
Max. static axial load (without radial load)			
– compression	kN	123	123
– expansion	kN	91	91
Weight	kg	145	187
Dimensions			
– diameter	mm	416	416
– length	mm	336	480
Moment of inertia	kgm^2	1,53	1,76
Min.rim size	in	18.5	18.5

Case leakage
2000 – 2500 – 3150 ccm

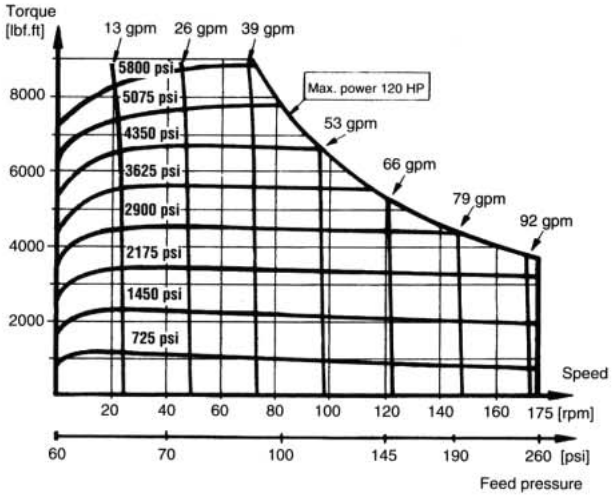


Curves based on oil viscosity 35 cSt.

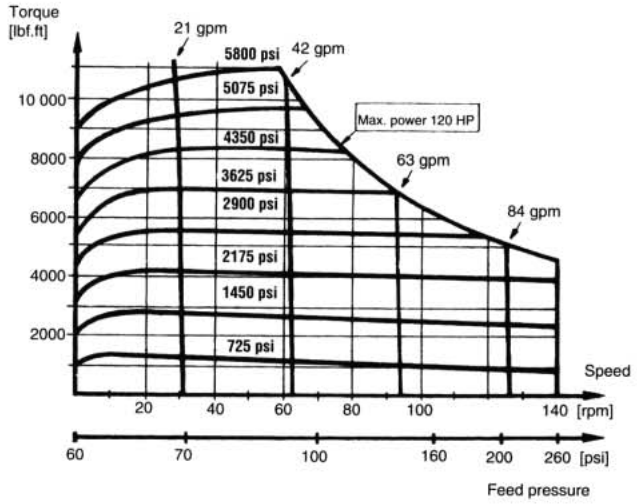
Class 6
122 – 152,6 – 192,2 cu.in motor

US-standard

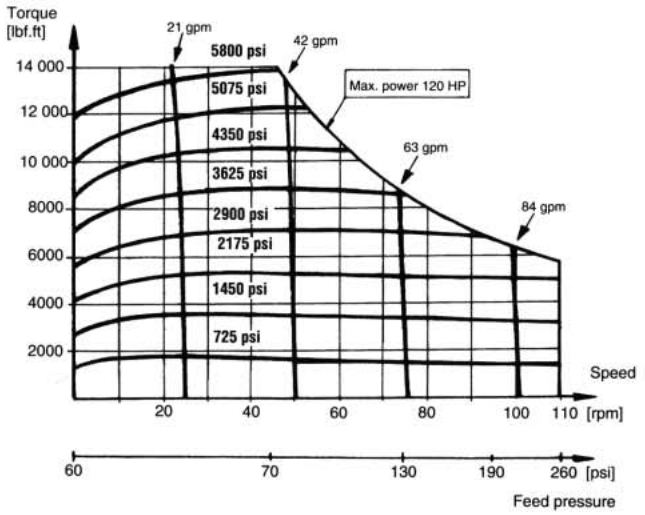
122 cu.in



152,6 cu.in



192,2 cu.in



Performance data

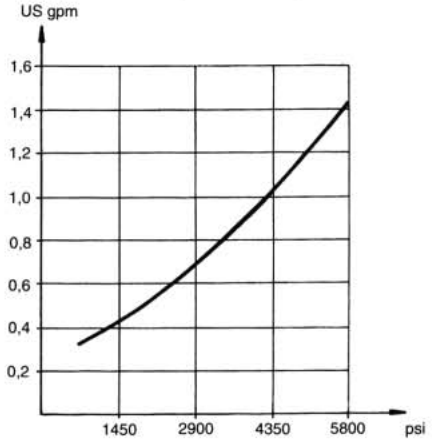
Displacement	cu.in	122	152.6	192.2
Peak pressure	psi	6500	6500	6500
Mobile use				
– torque	(lbf.ft)			
at 5800	psi*	8880	11070	13950
– torque	(lbf.ft)			
at 3600	psi	5515	6875	8660
– power	HP	120	120	120
Max. speed				
– working	rpm	175	140	110
– freewheel.	rpm	1000	1000	1000

*Intermittent pressure: max. 10 % of every minute.

Technical data
122–152.6–192.2

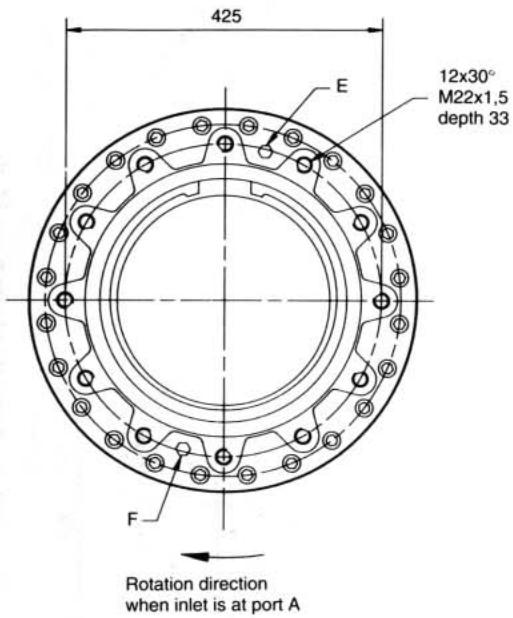
Brake		–	multi disc
Brake torque			
– static	lbf.ft	–	14750
– dynamic	lbf.ft	–	11280
Radial load			
– static	lb	35200	35200
– dynamic	lb	24200	24200
Max. static axial load (without radial load)			
– compression	lb	27600	27600
– expansion	lb	20400	20400
Weight	lb	320	410
Dimensions			
– diameter	in	16.38	16.38
– length	in	13.23	18.9
Moment of inertia	$lb.in^2$	5228	6014
Min.rim size	in	18.5	18.5

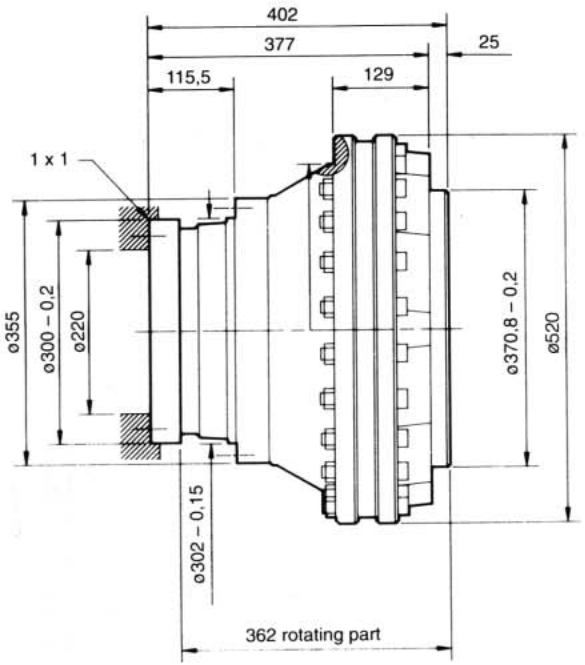
Case leakage
122 – 152,6 – 192,2 cu.in

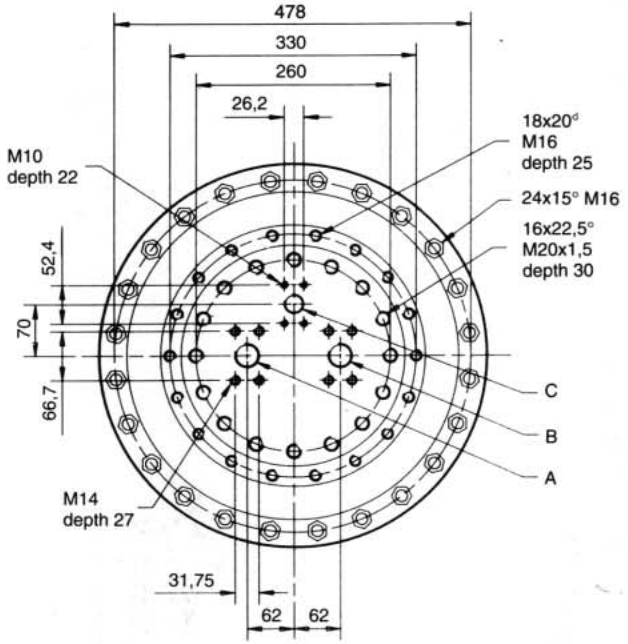


Curves based on oil viscosity 35 cSt.

Class 7
4000 – 5000 – 6300 ccm motors
(244.1 – 305.1 – 384.4 cu.in.)



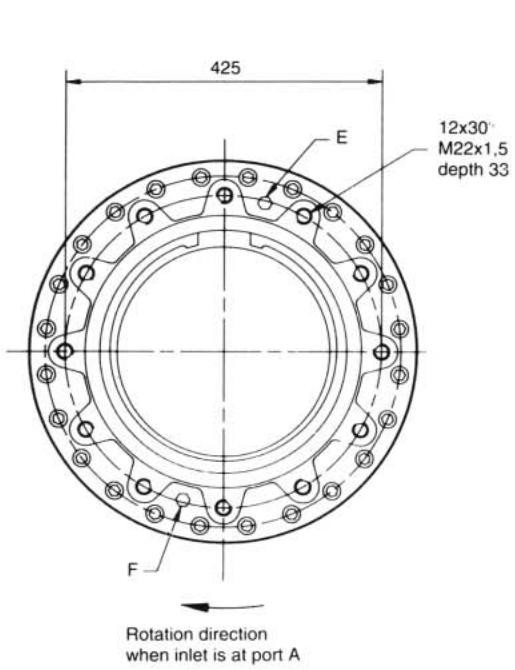


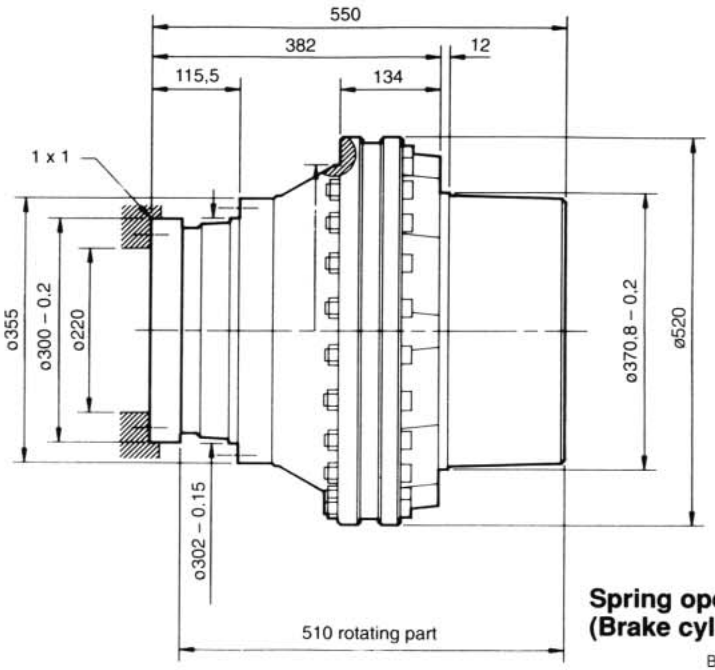


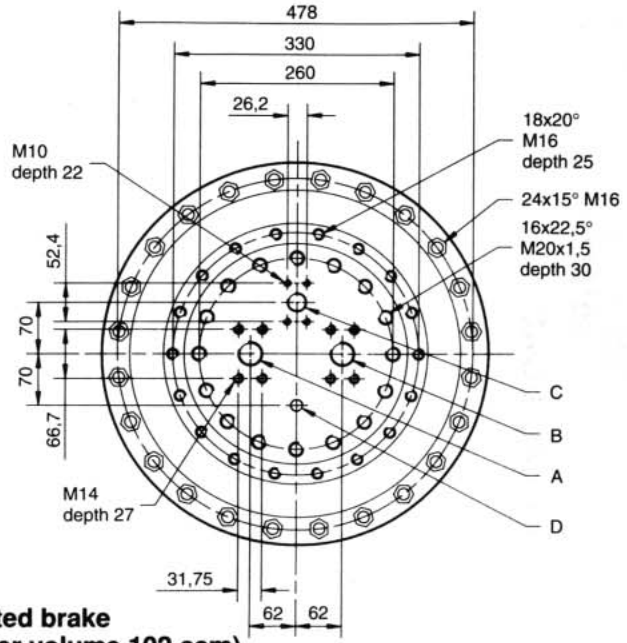
Part number	Displacement ccm	cu.in.
407 400 1110	4000	244,1
407 500 1110	5000	305,1
407 630 1110	6300	384,4

A – pressure connection R 1 and 1 1/4" SAE flange (6000 psi)
B – pressure connection R 1 and 1 1/4" SAE flange (6000 psi)
C – drain connection R 3/4 in depth 18 in and 1" SAE flange (3000 psi)
E and F – air bleed screw

Class 7
4000 – 5000 – 6300 – ccm motors with multi-disc brake
(244.1 – 305.1 – 384.4 cu.in)



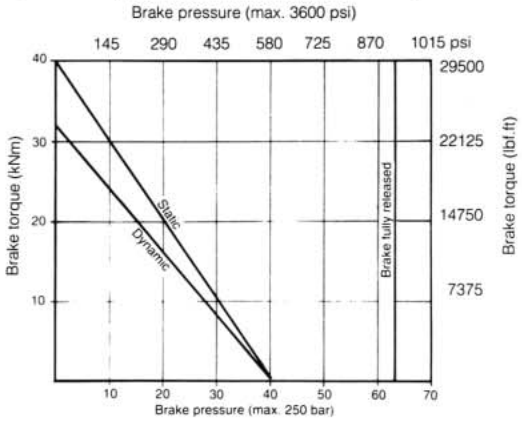




A – pressure connection R 1 and 1 1/4" SAE flange (6000 psi)
B – pressure connection R 1 and 1 1/4" SAE flange (6000 psi)
C – drain connection R 3/4 depth 18 and 1" SAE flange (3000 psi)
D – brake connection R 3/8 depth 15
E and F – air bleed screw

Part number	Displacement	
	ccm	cu.in
407 400 1140	4000	244.1
407 500 1140	5000	305.1
407 630 1140	6300	384.4

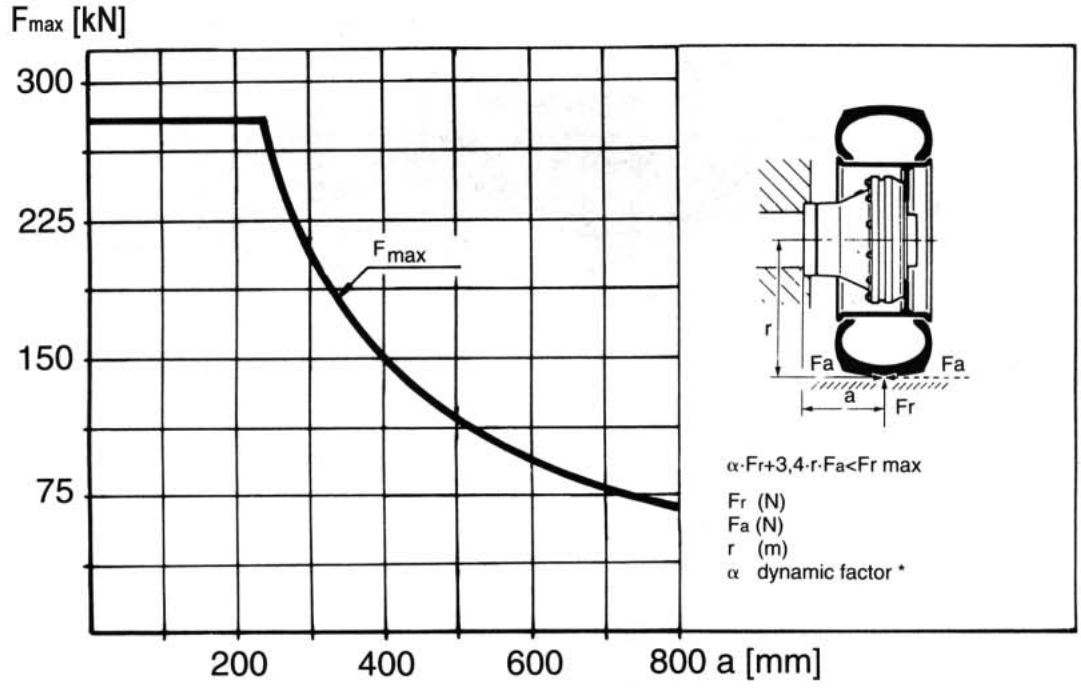
Spring operated brake
(Brake cylinder volume 102 ccm)



SHAFT LOAD

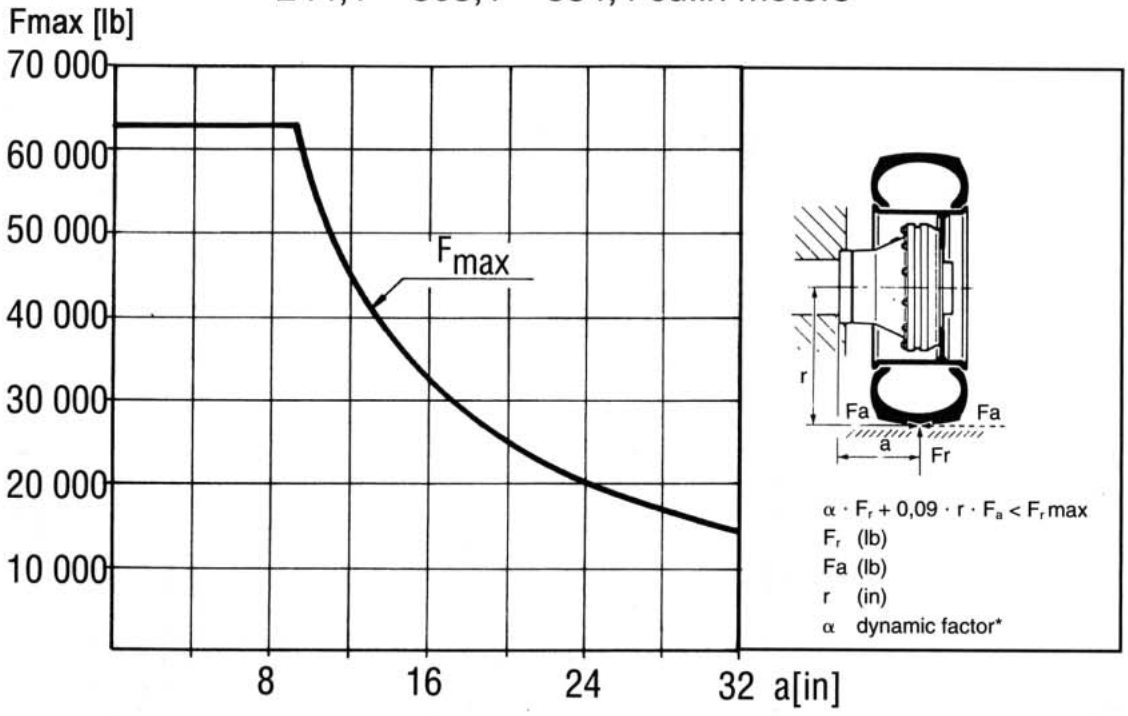
SI-standard

Class 7
4000 ccm – 5000 ccm – 6300 ccm motors



US-standard

Class 7
244,1 – 305,1 – 384,4 cu.in motors



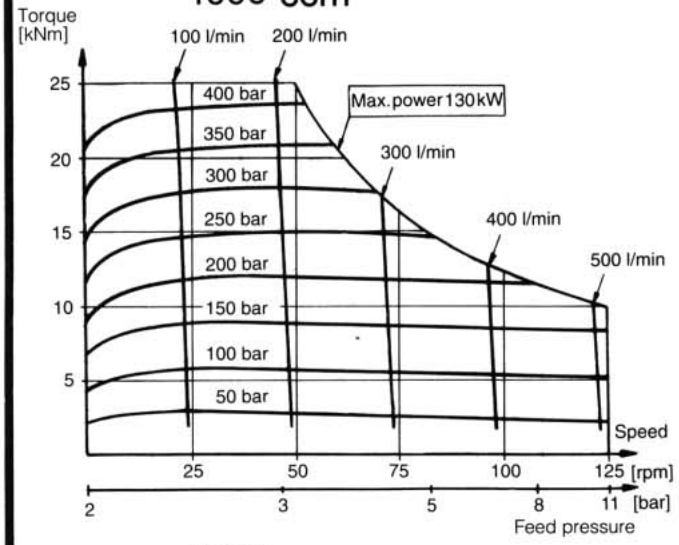
*** DYNAMIC FACTOR**

— constant loading and low speed	α = 1
— variable loading	α = 1—1.5
— shock loads or high speed (> 70 km/h or 45 mph)	α = 1.4—2

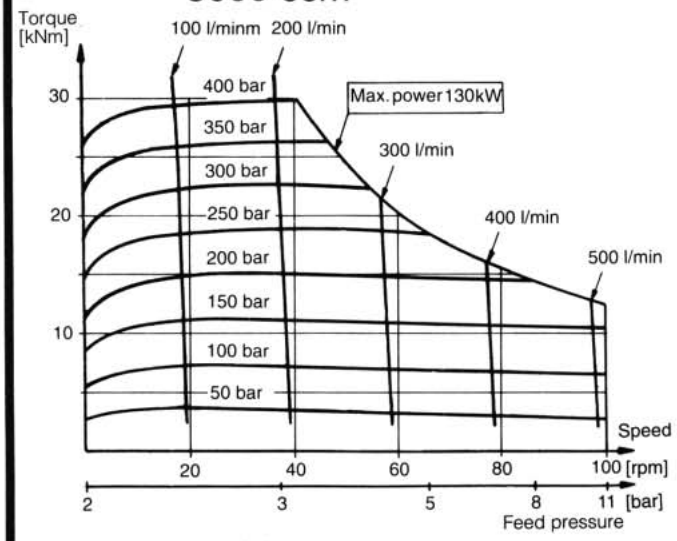
Class 7
4000 – 5000 – 6300 ccm motors

SI-standard

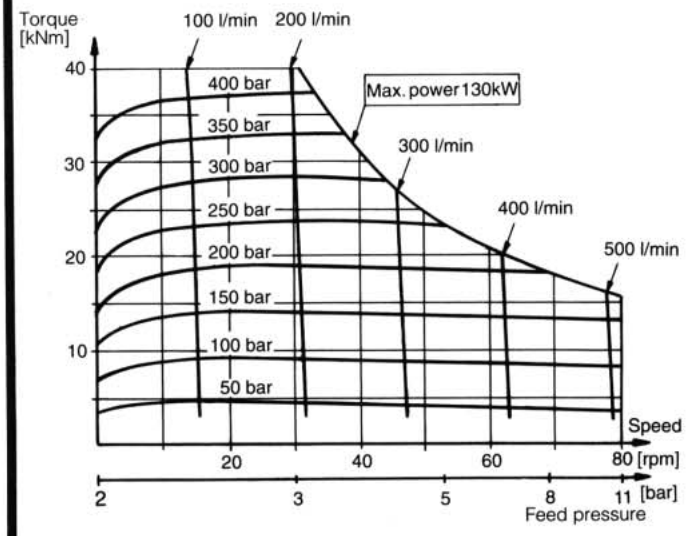
4000 ccm



5000 ccm



6300 ccm



Performance data

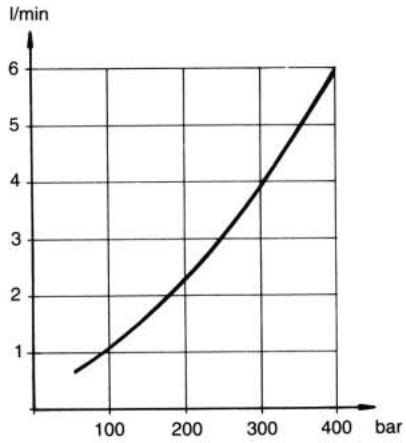
Displacement	ccm	4000	5000	6300
Peak pressure	bar	450	450	450
Mobile use				
– torque	(Nm)			
	at 400 bar *	23900	29800	37600
– torque	(Nm)			
	at 250 bar	14965	18700	23570
– power	kW	130	130	130
Max. speed				
– working	rpm	125	100	80
– freewheel.	rpm	750	750	750

* Intermittent pressure; max. 10 % of every minute

Technical data
4000 – 5000 – 6300 ccm

Brake		–	Multi-disc
Brake torque			
– static	kNm	–	40 000
– dynaamic	kNm	–	32 000
Radial load			
– static	kN	280	280
– dynamic	kN	190	190
Max. static axial load (without radial load)			
– compression	kN	185	185
– expansion	kN	115	115
Weight	kg	270	340
Dimensions			
– diameter	mm	520	520
– length	mm	402	550
Moment of inertia	kgm^2	5,0	5,4

Case leakage
4000 – 5000 – 6300 ccm

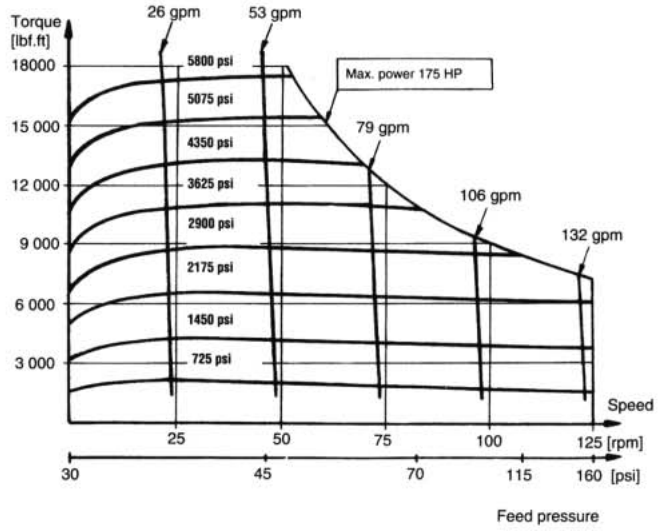


Curves based on oil viscosity 35 cSt.

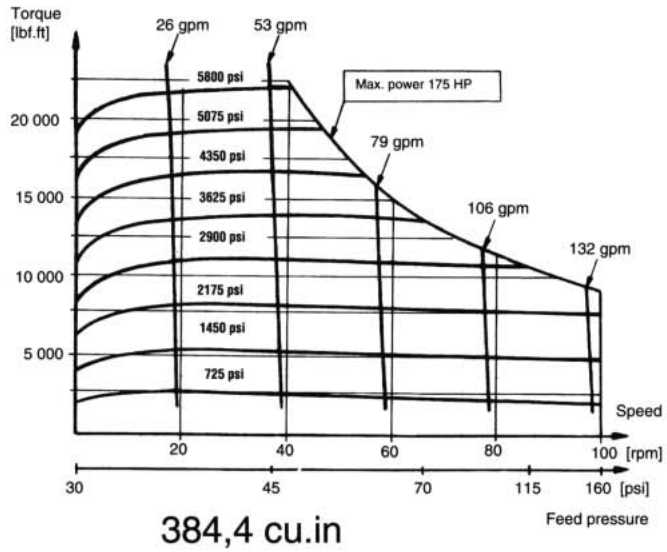
Class 7
244,1 – 305,1 – 384,4 cu.in motors

US-standard

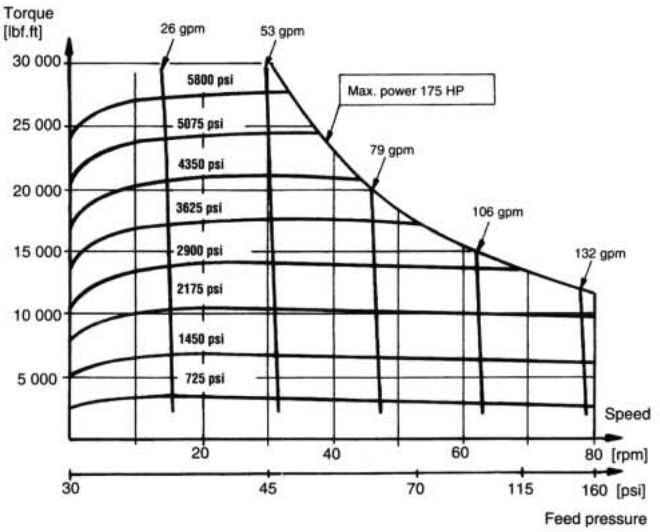
244,1 cu.in



305,1 cu.in



384,4 cu.in



Performance data

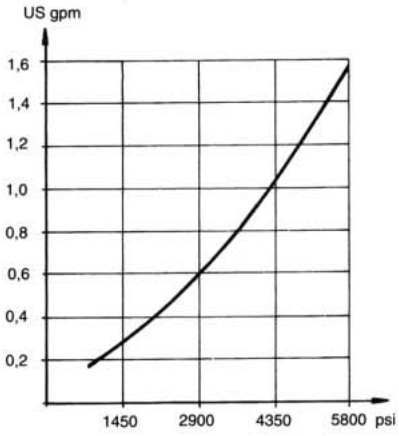
Displacement	cu.in	244.1	305.1	384.4
Peak pressure	psi	6500	6500	6500
Mobile use				
– torque	(lbf.ft)			
at 5800	psi*	17650	22050	27800
– torque	(lbf.ft)			
at 3600	psi	5515	6875	8660
– power	HP	175	175	175
Max. speed				
– working	rpm	125	100	80
– freewheel.	rpm	750	750	750

*Intermittent pressure: max. 10 % of every minute.

Technical data
244,1–305,1–384,4

Brake		–	multi disc
Brake torque			
– static	lbf.ft	–	29500
– dynamic	lbf.ft	–	23600
Radial load			
– static	lb	62800	62800
– dynamic	lb	42800	42800
Max. static axial load (without radial load)			
– compression	lb	41550	41550
– expansion	lb	25800	25800
Weight	lb	595	750
Dimensions			
– diameter	in	20.47	20.47
– length	in	15.83	21.65
Moment of inertia	lb.in²	17085	18450

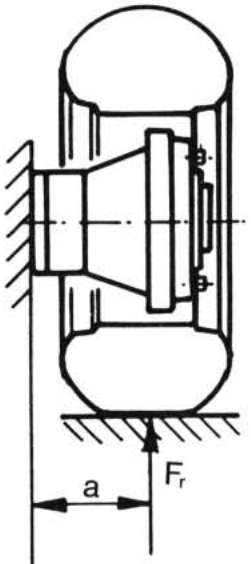
Case leakage
244,1 – 305,1 – 384,4 cu.in

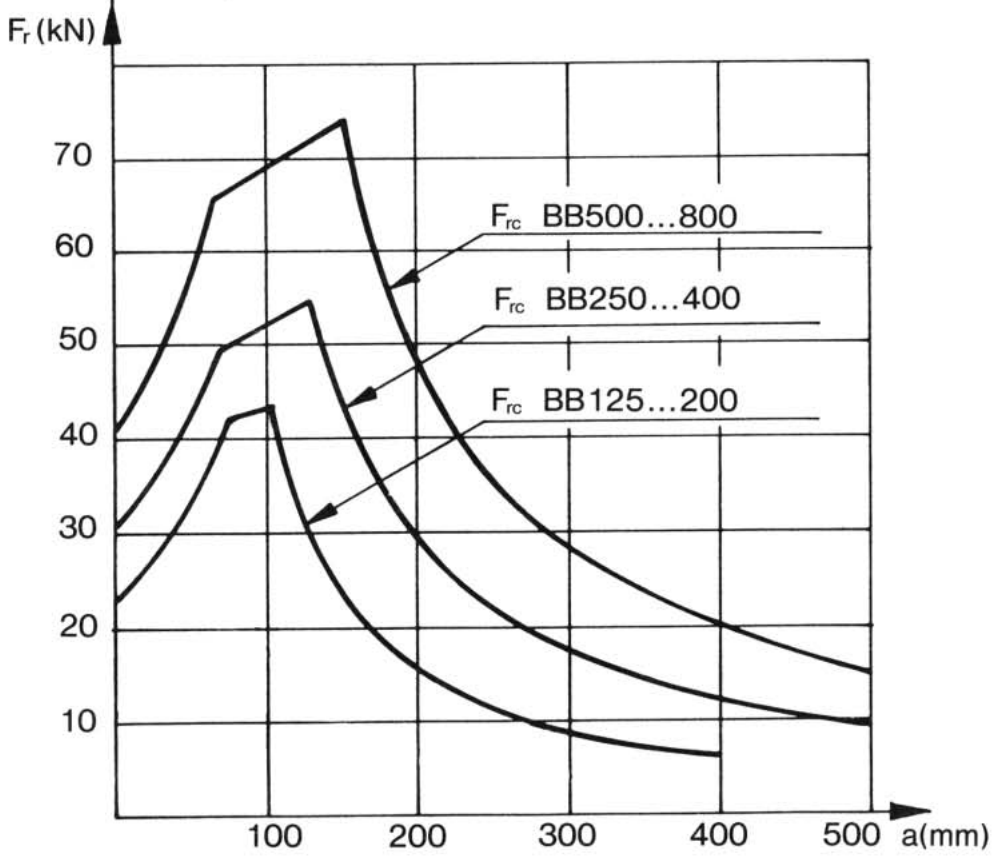


Curves based on oil viscosity 35 cSt.

Rated life of main bearings
125 – 800 ccm motors

SI-standard



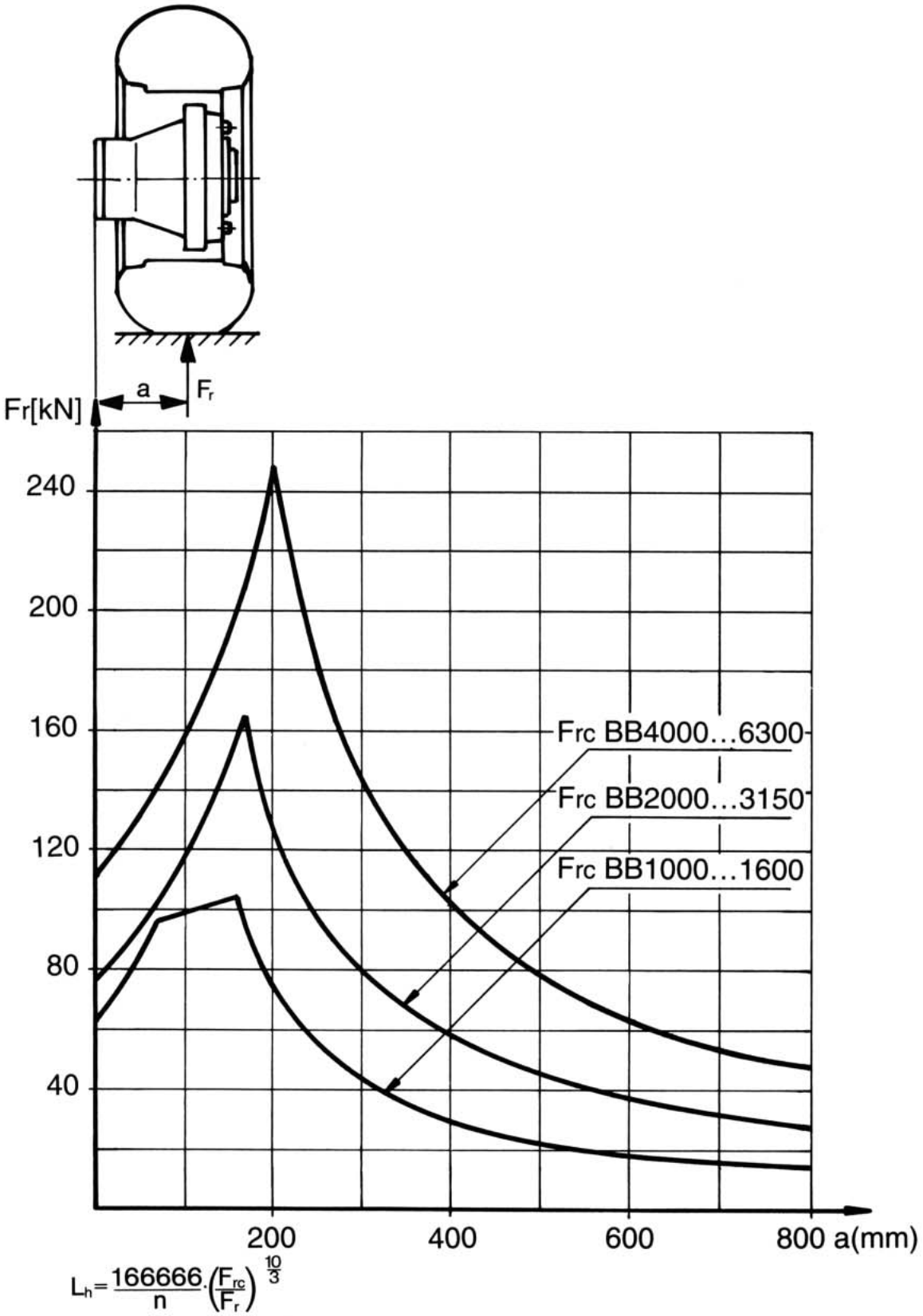


$$L_h = \frac{166666}{n} \cdot \left(\frac{F_{rc}}{F_r}\right)^{\frac{10}{3}}$$

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)

Rated life of main bearings
1000 – 6300 ccm motors

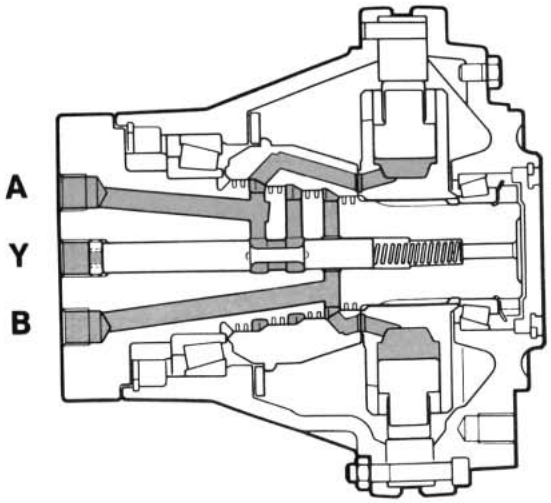
SI-standard



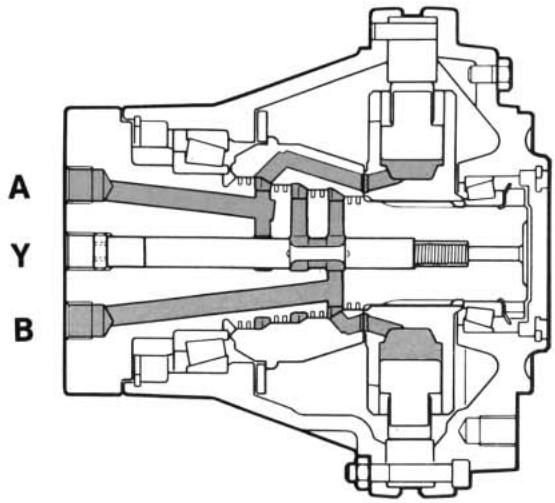
$$L_h = \frac{166666}{n} \cdot \left(\frac{F_{rc}}{F_r}\right)^{\frac{10}{3}}$$

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)

2-Speed motors



Full displacement



Half displacement

Working principle

Black Bruin 2-speed motors have an in-build hydraulic pilot controlled valve for changing the speed range. When the control valve is shifted to half displacement position the motor will rotate with double speed but half torque output compared with full displacement and the same fluid supply. (The max. permissible speed, see page 4 and 5).

In half displacement mode the pistons are making idle strokes on every second lobe, simultaneously being in connection to port B. The resistance of return flow keeps the pistons in contact with the cam ring which enables the change of speed range even during motion.

Prefered direction of rotation has to be chosen so that at half displacement mode the fluid inlet is at port A.

In case the fluid is supplied at port B, the idle strokes will expire high pressure which will reduce the efficiency, and the torque output.

The not-prefered direction of rotation is suitable for intermittent use only.

The function of the 2-speed motors at full displacement are equal to the 1-speed motors in both direction.

When ordering 2-speed motors use ordering codes ending 2 (clockwise rotation) or 3 (counter clockwise rotation) see page 6. The prefered direction of any 2-speed motor can be changed by dismantling the motor and turning the oil distributor from cw pos. to ccw pos. visa versa.

Control pressure:

y = 0... 2 bar — full displacement

y = 7...30 bar (max 350 bar) — half displacement

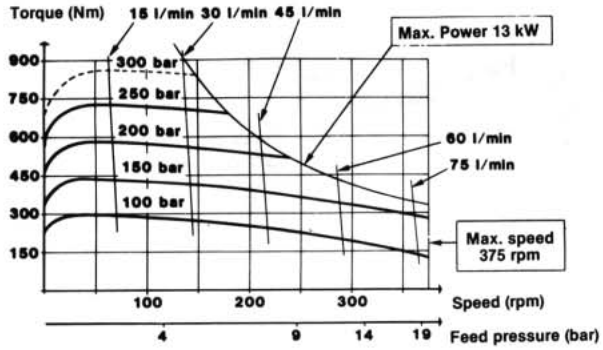
If y is higher than 30 bar, the y-line should be throttled.

Important:

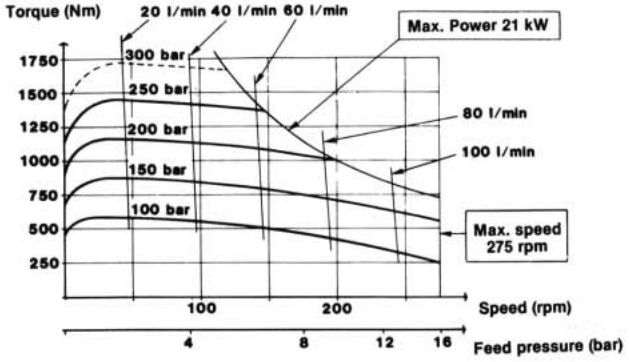
When changing the speed range during motion the pump flow should be adjusted correspondingly.

Two-speed Hydraulic motors 250-6300 ccm
Performance data at half displacement.

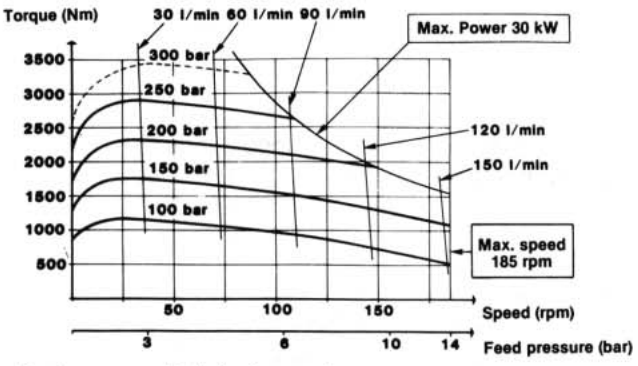
BB 400/200



BB 800/400



BB 1600/800



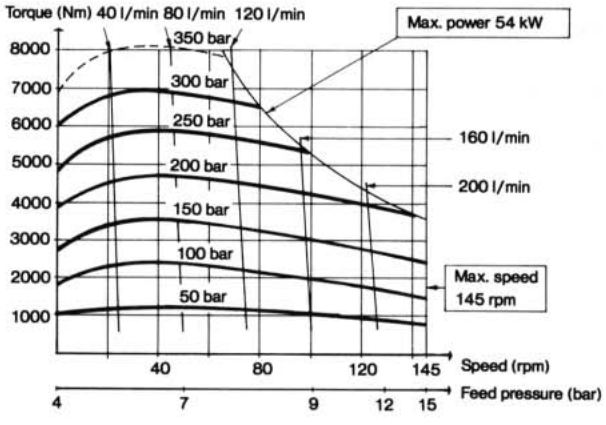
Performance at full displacement see corresponding 1-speed motor.

Performance data (mobile use)

Motor	cm^3/r	250/125	315/157	400/200
Torque (300 bar)*	Nm	535	675	860
Torque (250 bar)*	Nm	455	570	725
Max. power	kW	13	13	13
Max. speed	r/min	600	450	375
Motor	cm^3/r	500/250	630/315	800/400
Torque (300 bar)*	Nm	1070	1350	1715
Torque (250 bar)*	Nm	905	1140	1450
Max. power	kW	21	21	21
Max. speed	r/min	450	360	275
Motor	cm^3/r	1000/500	1250/625	1600/800
Torque (300 bar)*	Nm	2140	2685	3450
Torque (250 bar)*	Nm	1810	2265	2910
Max. power	kW	30	30	30
Max. speed	r/min	300	240	185
Motor	cm^3/r	2000/1000	2500/1250	3150/1575
Torque (350 bar)*	Nm	5100	6370	8030
Torque (250 bar)*	Nm	3720	4650	5860
Max. power	kW	54	54	54
Max. speed	r/min	220	180	145
Motor	cm^3/r	4000/2000	5000/2500	6300/3150
Torque (350 bar)*	Nm	10190	12740	16050
Torque (250 bar)*	Nm	7440	9300	11720
Max. power	kW	80	80	80
Max. speed	r/min	160	130	105

* Intermittent pressure: max 10% of every minute

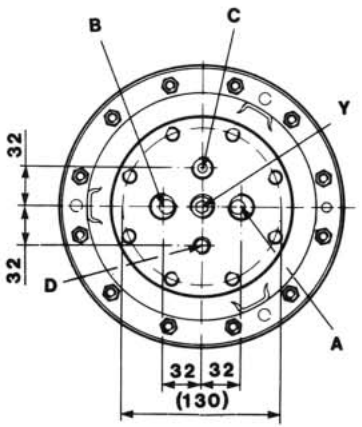
BB 3150/1575



Class 3, Class 4, Class 5
2- speed motors

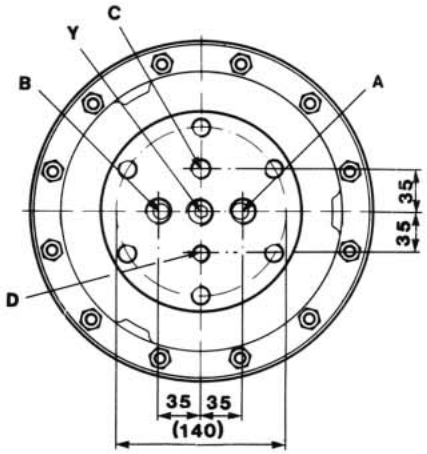
Connection ports

Part number	Displacement ccm	
403 025 1210	250/125	Clock wise
403 032 1210	315/157	—„—
403 040 1210	400/200	—„—
403 025 1310	250/125	Counter cw
403 032 1310	315/157	—„—
403 040 1310	400/200	—„—



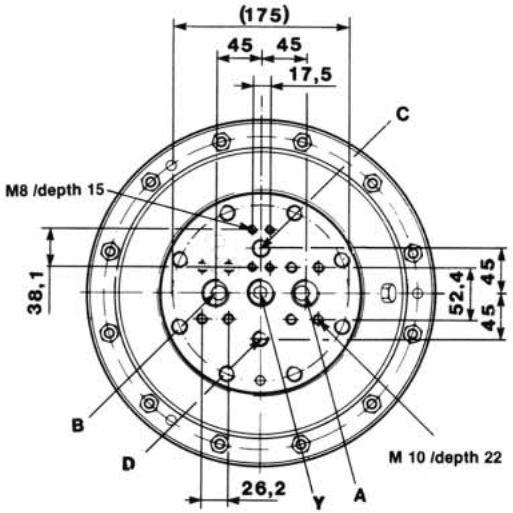
A — Pressure conn. R 1/2 /depth 16
B — Pressure conn. R 1/2 /depth 16
C — Drain conn. R 3/8 /depth 15
D — Brake conn. R 1/4 /depth 12
Y — 2-speed pilot conn. R 3/8

Part number	Displacement ccm	
404 050 1210	500/250	Clock wise
404 063 1210	630/315	—„—
404 080 1210	800/400	—„—
404 050 1310	500/250	Counter cw
404 063 1310	630/315	—„—
404 080 1310	800/400	—„—



A – Pressure conn. R 1/2 /depth 16
B – Pressure conn. R 1/2 /depth 16
C – Drain conn. R 3/8 /depth 15
D – Brake conn. R 1/4 /depth 12
Y — 2-speed pilot conn. R 1/2

Part Number	Displacement ccm	
405 100 1210	1000/500	Clock wise
405 125 1210	1250/625	—„—
405 160 1210	1600/800	—„—
405 100 1310	1000/500	Counter cw
405 125 1310	1250/625	—„—
405 160 1310	1600/800	—„—



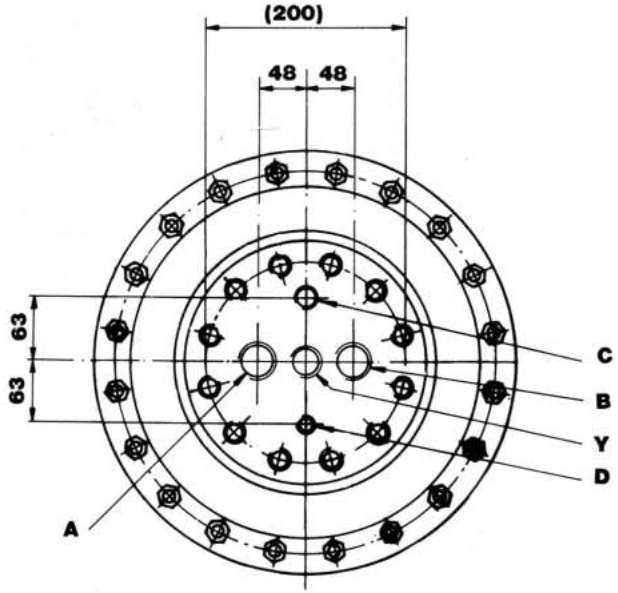
A – Pressure conn. 1 in. SAE-flange (R 3/4)
B – Pressure conn. 1 in. SAE-flange (R 3/4)
C – Drain conn. 1/2 in. SAE-flange (R 3/8)
D – Brake conn. R 1/4 /depth 12
Y – 2-speed pilot conn. R 3/4

For other dimensions see corresponding 1-speed motor.

Class 6, Class 7
2- speed motors

Connection ports

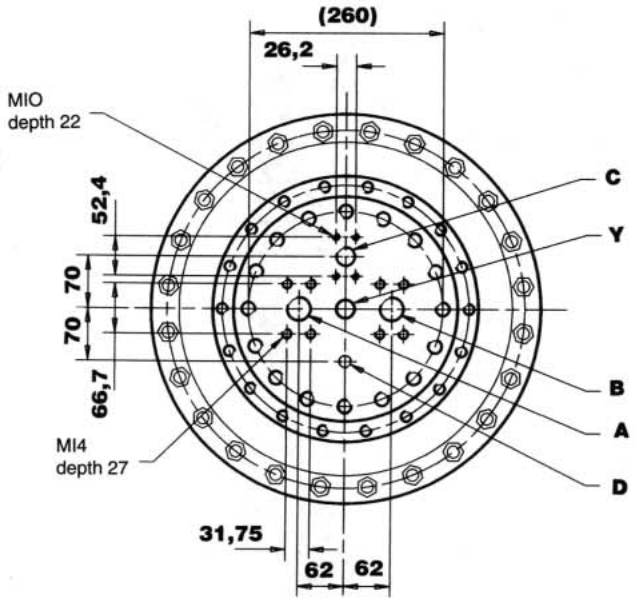
Part Number	Displacement ccm	
406 200 1210	2000/1000	Clock wise
406 250 1210	2500/1250	–„–
406 315 1210	3150/1575	–„–
406 200 1310	2000/1000	Counter cw
406 250 1310	2500/1250	–„–
406 315 1310	3150/1575	–„–



A – Pressure conn. R 1/ depth 22
B – Pressure conn. R 1/ depth 22
C – Drain conn. R 3/4 /depth 18
D – Brake conn. R 3/8 /depth 15
Y – 2-speed pilot conn. R 3/4 depth 15

For other dimensions see corresponding 1-speed motor

Part Number	Displacement ccm	
407 400 1210	4000/2000	Clock wise
407 500 1210	5000/2500	–"–
407 630 1210	6300/3150	–"–
407 400 1310	4000/2000	Counter cw
407 500 1310	5000/2500	–"–
407 630 1310	6300/3150	–"–



A – Pressure conn.1 1/4 in. SAE-flange (R1)
B – Pressure conn.1 1/4 in. SAE-flange (R1)
C – Drain conn.1 in. SAE-flange (R 3/4)
D – Brake conn. R 3/8 /depth 15
Y – 2-speed pilot conn. R 3/4

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