Radial piston hydraulic motor

Hägglunds CAB

RE 15354
Edition: 01.2015
Replace: New

- Frame Size: CAB 10, 20, 30, 40
- Capacity: 503 ... 2 513 cm^3/rev [31 - 153 in^3/rev]
- Specific torque: 8 ... 40 Nm/bar [407 ... 2 034 lb_f·ft/1000 psi]
- Maximum speed: 260 ... 350 rpm
- Maximum operating pressure: 250 bar [3 626 psi]

Features

- High power density
- Energy efficient
- Flexibility, many sizes, few mechanical interfaces
- Insensitive to chock loads
- No vibrations i.e. no flow pulsation 100% constant displacement, the symmetrical design allows forces to be balanced- radial forces oppose each other and no centrifugal forces due to the rotation

Contents

1 Ordering code

In order to identify Hägglunds equipment exactly, the following ordering code is used. These ordering codes should be stated in full in all correspondence e.g. when ordering spare parts.

Example Hägglunds CAB motor:

CA	B		0010		0010		S		F		00	0		0	
01	02		03		04		05		06		07	08		09	

01	**Motor series**	
	Compact	**CA**

02	**Type**		
	Basic	●	**B**
	Premium	–	**P**

03	**Frame size**	
	0010	**0010**
	0020	**0020**
	0030	**0030**
	0040	**0040**

04	**Specific torque, Nm/bar** [1]				
	Frame size 10		**0008**	**0010**	**0012**
			●	●	●
	Frame size 20	**0016**	**0018**	**0020**	**0022**	**0025**
		●	●	●	●	●
	Frame size 30	**0028**	**0030**	**0032**	**0035**	**0037**
		●	●	●	●	●
	Frame size 40			**0040**	**0045**	**0050**
				●	–	–

05	**Mounting alternatives, drive shaft**	
	Spline DIN 5480 N	**S**

06	**Mounting alternatives, motor case**	**CA 10**	**CA 20**	**CA 30**	**CA 40**	
	Front flange	●	●	●[2]	–	**F**
	Center flange	–	–	●	●	**C**

07	**Prepared for brake or tandem kit**		
	No	●	**0**
	Prepared for brake	–	**1**
	Prepared for tandem kit	–	**2**
	Mounted brake		
	No	●	**0**
	Yes	–	**A**

08	**Displacement shift**		
	0=Single speed motor	●	**0**
	2=two speed motor	–	**2**

09	**Increased robustness**		
	No	●	**0**
	Yes	–	**C**

0		N		00		0		0		0		3		2002		0		0		00
10		11		12		13		14		15		16		17		18		19		20

10	**Through hole**		
	No	●	**0**
	Yes	–	**1**

11	**Type of seal**		
	Nitrile	●	**N**
	Viton	–	**V**

12	**Speed encoder precision/rotation**		
	No	●	**00**
	Yes	–	**XX**

13	**Temperature sensor**		
	No	●	**0**
	Yes	–	**1**

14	**Reinforced bearing**		
	No	●	**0**
	Yes	–	**1**

15	**Explosion proof**		
	No	●	**0**
	Yes	–	**1**

16	**Painting system** *(Refer to 4.3 Painting system page 8)*		
	C3 (normal industrial atmosphere)	●	**3**
	C5M (marine and other aggressive atmospheres)	●	**5**

17	**Painting colour**		
	std RAL 2002	●	**2002**
	Special RAL 1000 - 9023 **)Specify with RAL colour code	–	****

18	**Internal paint**		
	Painted	–	**0**
	w/o paint	●	**1**

19*	**Modification (Technical Improvment) [3)]**	**00-99**

20*	**Special design [3)]**	
	Standard	**00**
	Special index	**01-99**

● = Available – = Not available

[1)] For exact, non-rounded values of specific torque, see *4.1 Motor data page 6*
[2)] Only valid for specific torque up to 30 Nm/bar
[3)] To be filled in by Bosch Rexroth DC-IA/EHD

2 Functional description

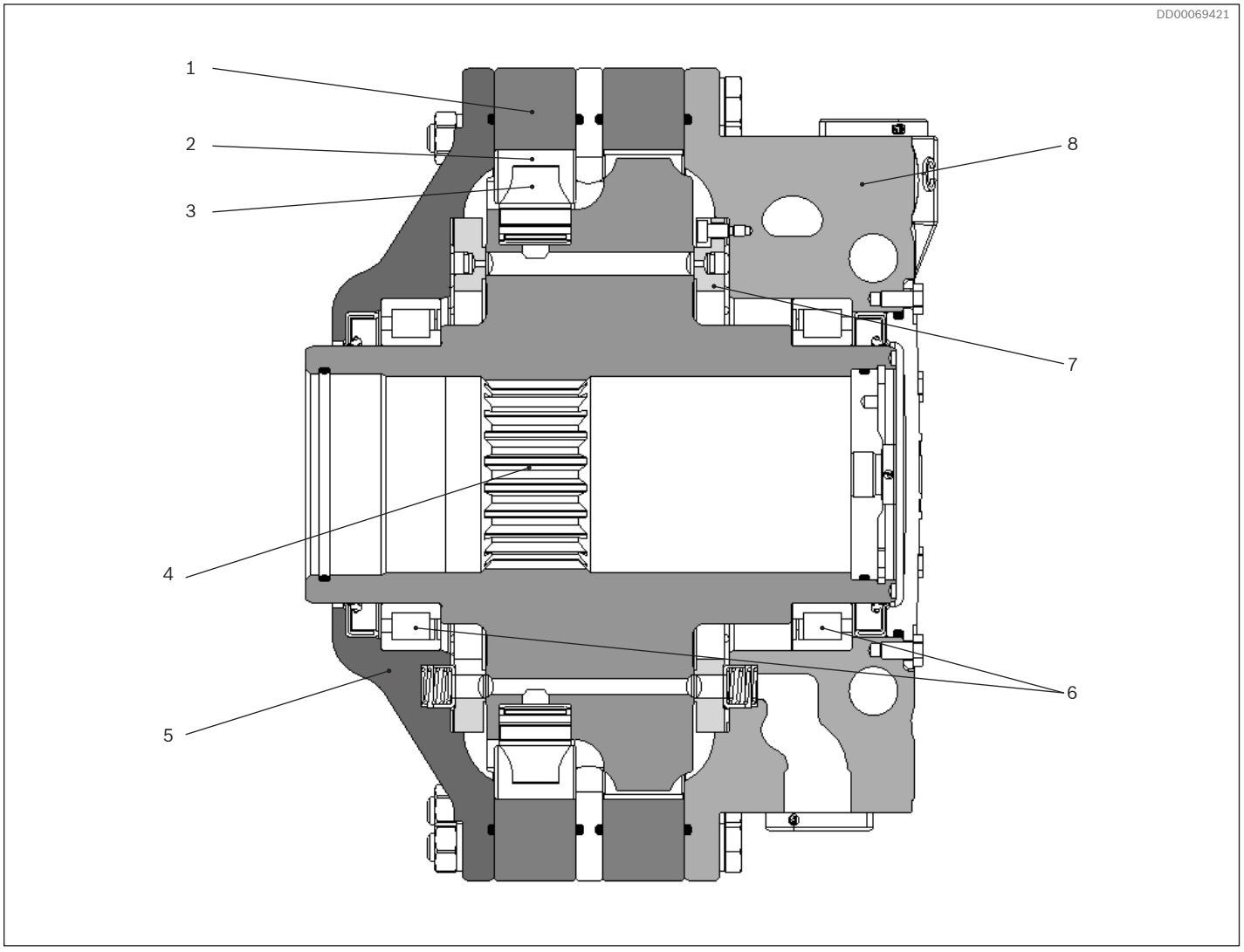

Fig. 1: Section view of radial piston hydraulic motor

1. Cam ring	**6.** Cylindrical roller bearing
2. Cam roller	**7.** Distributor
3. Piston	**8.** Connection housing
4. Cylinder block, spline	
5. Housing cover	

Bosch Rexroth‘s hydraulic industrial motor Hägglunds CAB is of the radial-piston type with a rotating cylinder block/ hollow shaft and a stationary housing. The cylinder block is mounted in fixed roller bearings in the housing. An even number of pistons are radially located in bores inside the cylinder block, and the distributor directs the incoming and outgoing oil to and from the working pistons. Each piston is working against a cam roller.

When the hydraulic pressure is acting on the pistons, the cam rollers are pushed against the slope on the cam ring that is rigidly connected to the housing, thereby producing a torque. The cam rollers transfer the reaction force to the pistons which are guided in the cylinder block. Rotation therefore occurs, and the torque available is proportional to the pressure in the system.

Oil main lines are connected to ports A and C in the connection block and drain lines to ports D1 or D2 in the motor housing.

The motor is connected to the shaft of the driven machine through the hollow shaft of the cylinder block. The torque is transmitted by splines.

Quality

To assure our quality we maintain a Quality Assurance System, certified to standard ISO 9001.

3 Hydraulic symbol

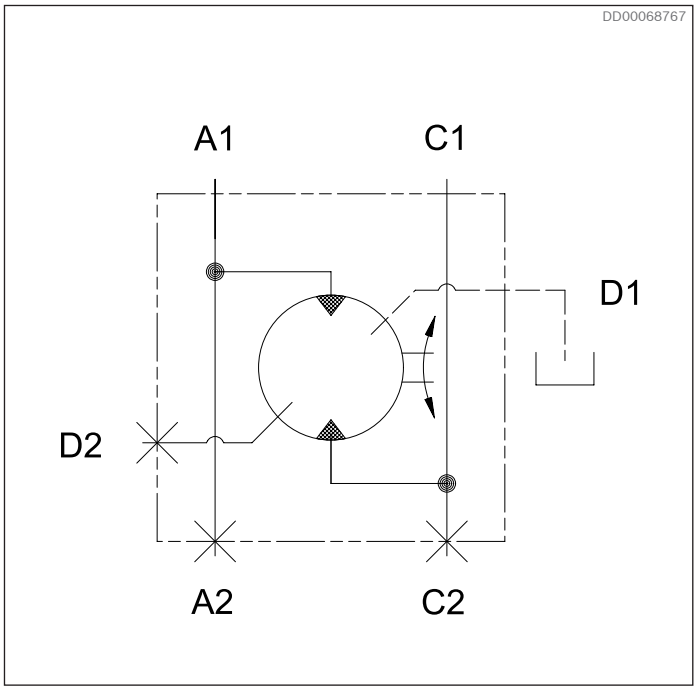

Fig. 2: Hydraulic symbol, radial piston hydraulic motor

4 Technical data

4.1 Motor data

Table 1: General data (metric)

			Frame size			
			CAB 10	**CAB 20**	**CAB 30**	**CAB 40**
Type of mounting			See 5.2 Mounting alternatives			
Pipe connections			See 5.3 Ports			
Shaft loading			See 4.8 Permitted external loads			
Hydraulic fluids			See 4.4 Hydraulic fluids			
Pressure						
	Maximum operating pressure	bar	250	250	250	250
	Maximum peak pressure	bar	320	320	320	320
	Charge pressure	bar	See 4.2 Recommended charge pressure			
	Maximum case pressure	bar	3	3	3	3
	Maximum case peak pressure [1)]	bar	8	8	8	8
Temperature limits of case drain oil Seal type: NBR						
	Minimum	°C	-30	-30	-30	-30
	Maximum	°C	+70	+70	+70	+70
Oil volume in motor case		l	0.7	1.0	1.1	1.2
Moment of inertia for rotary group		kg·m²	0.076	0.146	0.210	0.275
Weight		kg	46	63	80	95

1) Momentary pressure spikes t< 0.1 s of up to 8 bar are permitted

Table 2: Specific data (metric)

Frame size	**Specific torque**	**Displacement**	**Maximum torque**	**Maximum speed**	**Maximum operating power [2)]**
	Nm/bar	**cm³/rev**	**Nm**	**rpm**	**kW**
CAB 10	8	503	1 945	350	70
	10	628	2 430	350	86
	12.5	785	3 040	350	105
CAB 20	16	1 005	3 890	350	139
	18	1131	4 375	350	155
	20	1257	4 860	350	171
	22.5	1414	5 470	350	190
	25	1571	6 075	350	209
CAB 30	28	1 759	6 805	350	226
	30	1 885	7 290	330	226
	32.5	2 042	7 900	290	216
	35	2 199	8 505	290	233
	37.5	2 356	9 115	260	224
CAB 40	40	2513	9 720	280	257

2) Flushing of motor case is required. See 4.7 Flushing

Table 3: General data (US)

			Frame size			
			CAB 10	**CAB 20**	**CAB 30**	**CAB 40**
Type of mounting			See 5.2 Mounting alternatives			
Pipe connections			See 5.3 Ports			
Shaft loading			See 4.8 Permitted external loads			
Hydraulic fluids			See 4.4 Hydraulic fluids			
Pressure						
	Maximum operating pressure	psi	3 626	3 626	3 626	3 626
	Maximum peak pressure	psi	4 641	4 641	4 641	4 641
	Charge pressure	psi	See 5.3 Recommended charge pressure			
	Maximum case pressure	psi	44	44	44	44
	Maximum case peak pressure [3)]	psi	116	116	116	116
Temperature limits of case drain oil Seal type: NBR						
	Minimum	°F	-22	-22	-22	-22
	Maximum	°F	+158	+158	+158	+158
Oil volume in motor case		US gal	0.19	0.26	0.29	0.32
Moment of inertia for rotary group		$lb_m \cdot ft^2$	1.793	2.395	4.978	6.528
Weight		lb	102	139	177	209

3) Momentary pressure spikes t< 0.1 s of up to 116 psi are permitted

Table 4: Specific data (US)

Frame size	**Specific torque**	**Displacement**	**Maximum torque**	**Maximum speed**	**Maximum operating power [2)]**
	$lb_f \cdot ft$/1000 psi	**in^3/rev**	**$lb_f \cdot ft$**	**rpm**	**hp**
CAB 10	407	30.7	1 435	350	93
	509	38.3	1 792	350	115
	636	47.9	2 242	350	141
CAB 20	814	61.3	2 869	350	186
	915	69.0	3 227	350	208
	1 017	76.7	3 585	350	230
	1 144	86.3	4 034	350	255
	1 271	95.9	4 481	350	280
CAB 30	1 424	107.3	5 019	350	303
	1 526	115.0	5 377	330	304
	1 653	124.6	5 827	290	290
	1 780	134.2	6 273	290	312
	1 907	143.8	6 723	260	300
CAB 40	2 034	153.4	7 169	280	344

2) Flushing of motor case is required. See 4.7 Flushing

4.2 Recommended charge pressure

The hydraulic system must be such that the motor will recieve sufficient charge pressure at the low-pressure port. This applies to all types of installations.

The motor operating in driving mode only

For CAB 10 - CAB 40, 2-port or 4-port connected motors. The pressure at the low-pressure port, p_{low}, should , during operation of the motor, be at least one bar above the case pressure, p_{case}. That is

$p_{low} = p_{case} + 1$ [bar], during operation.

$p_{low} = p_{case} + 14.5$ [psi], during operation.

The motor operating in braking mode

For charge pressure data in braking mode, please contact Bosch Rexroth representative.

Note!

With increasing case pressure the charge pressure must be increased accordingly.

4.3 Painting system

Corrosion protection

The painting system of Hägglunds motors and accessories are avalible in two different corrosivity categories regarding corrosion protection in accordance with SS-EN ISO 12944:

- C3 - Corrosivity category Medium - which is recommended for normal urban and industrial atmosphere
- C5M - Corrosivity category Very High - which is recommended for marine environment with high salt load or other aggressive atmosphere

Colour

Standard colour for Hägglunds motors and accessories is orange (RAL 2002)

4.4 Hydraulic fluids

The hydraulic motor Hägglunds CAB is primarily designed for operation with hydraulic fluids according to ISO 11158 HM.

Fluids by the standards given in Table 5: Suggested fluid types are suggested. Before the start of project planning, see data sheet RE 15375, Hydraulic fluid quick reference, for detailed information on hydraulic fluids and specific additional demands

Table 5: Suggested fluid types

SO 11158	ISO 15380	ISO 12922
HM	HEES	HFB
HV	HEPG	HFC
	HEPR	HFDU

Filtration of the hydraulic fluid

A contamination level of at most 18/16/13 according to ISO 4406 is required. The less contamined the fluid, the longer the service life of the hydraulic motor.

Details regarding the selection of hydraulic fluid

The hydraulic fluid should be selected such that the operating viscosity in the temperature range, as measured in the motor housing, is within optimum operation range, see Fig. 3: Selection diagram for viscosity ranges with straight fluids, i.e. viscosity index 100.

- General recommendation is to have a system temperature of 50°C, see dotted line in Diagram 1. A VG 68 fluid will render just above 40 cSt at this point.
- Optimum viscosity range is 40 to 150 cSt.
- Running above 150 cSt or below 40 cSt results in reduced efficiency.
- Running above 400 cSt results in substantial efficiency loss.
- Starting at above 10000 cSt imparts unnecessary strain on parts.
- Running below 30cSt may impact the service life.
- Running below 20 cSt may render instant seizure.

The operating temperature is also limited by the seal type, see*Table 1: General data (metric) page 6 or Table 3: General data (US) page 7*.

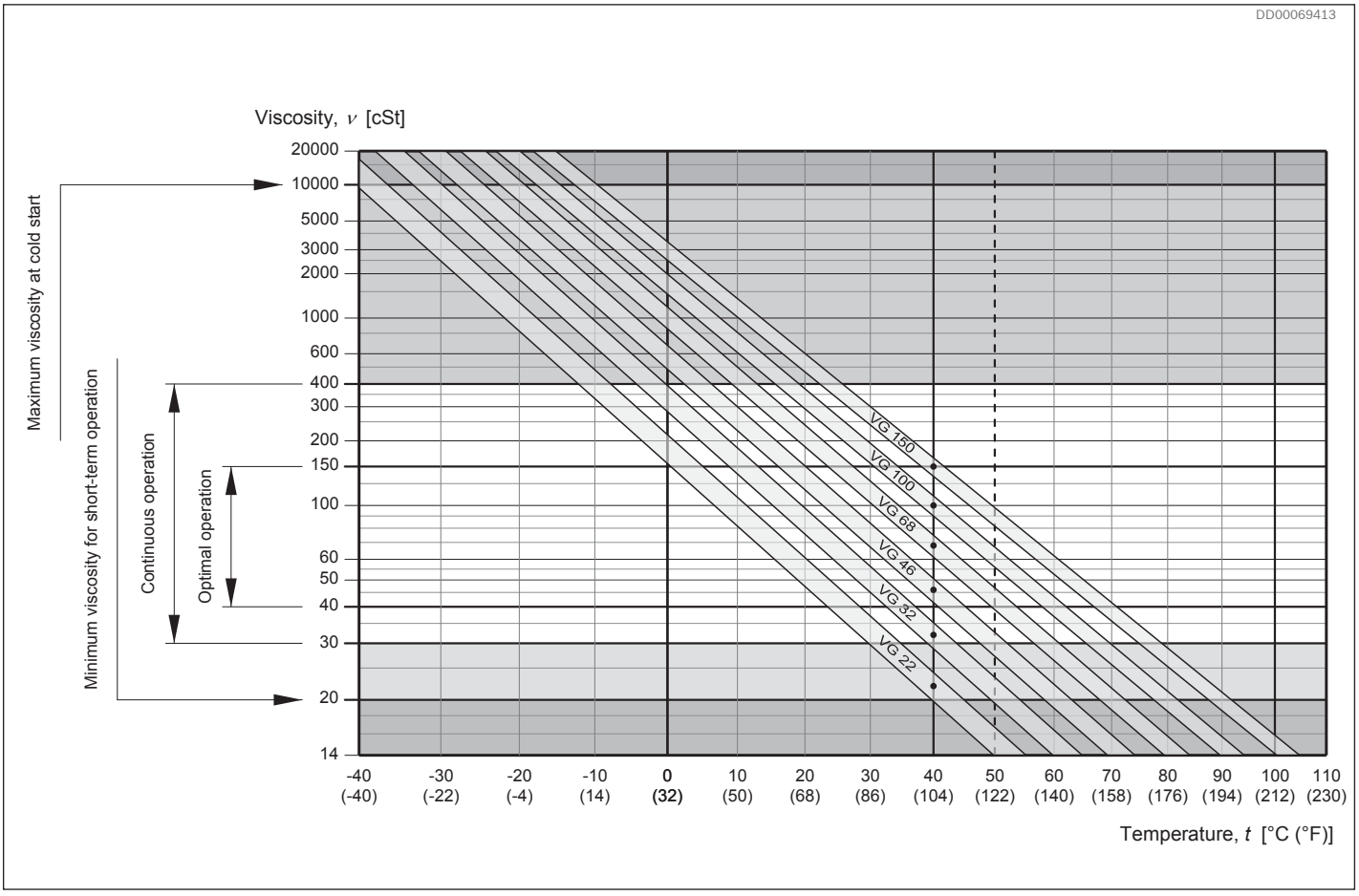

Fig. 3: Selection diagram for viscosity ranges with straight fluids, i.e. viscosity index 100

4.5 Sound

Sound emission

For general information on e.g. sound power vs. sound pressure, vibrations, dB-addition and sound proofing, please refer to RE 15411, Sound and vibrations.

- The sound power levels (LWA, left vertical axis) in these charts are measured according to EN ISO 3747:2010.
- The sound pressure levels (LPA, right vertical axis) in these charts are valid for semi-spherical sound radiation (a.k.a. open field) at 1 meter distance, and are provided as guidance only. The situation at the driven machine will affect the sound pressure level.

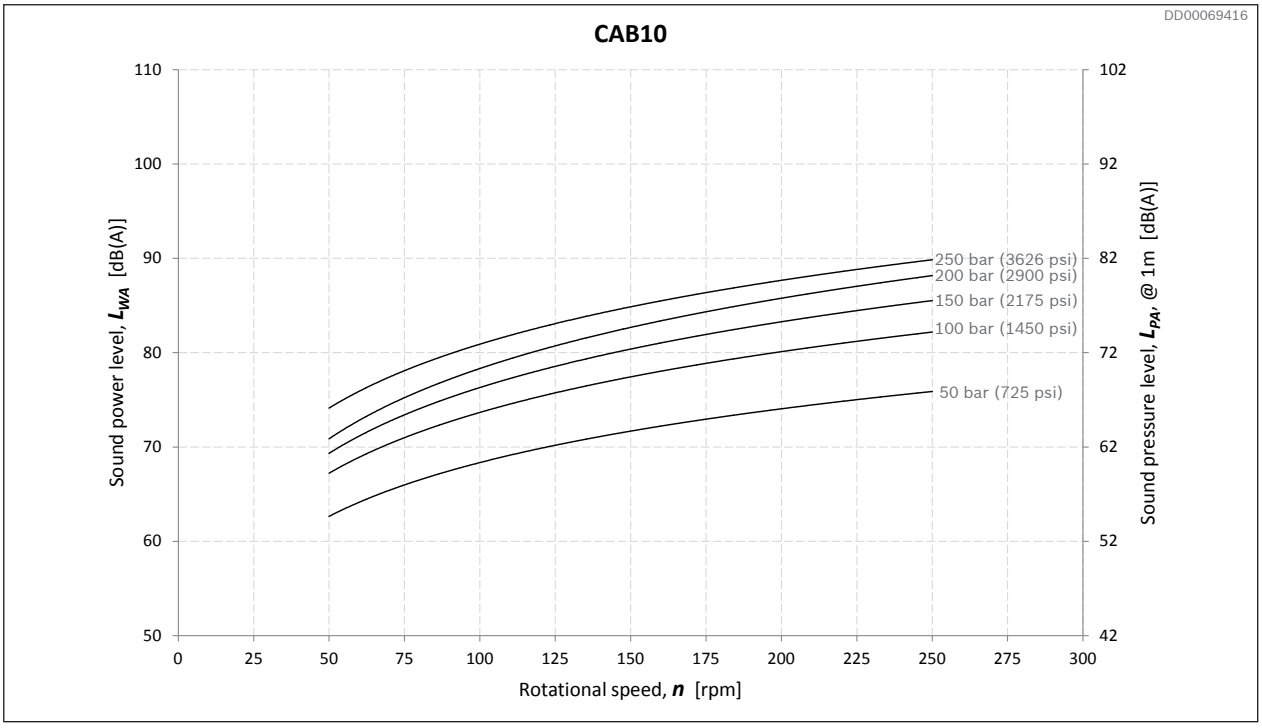

Fig. 4: Sound level CAB 10

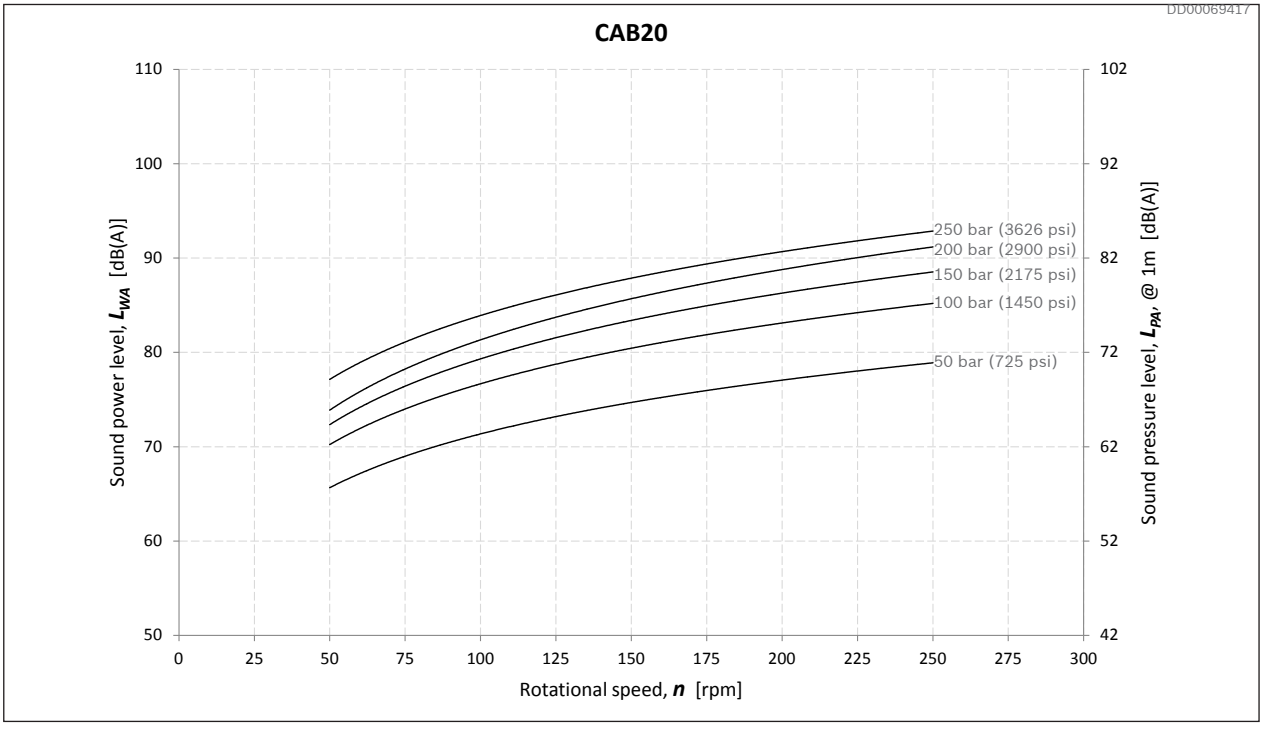

Fig. 5: Sound level CAB 20

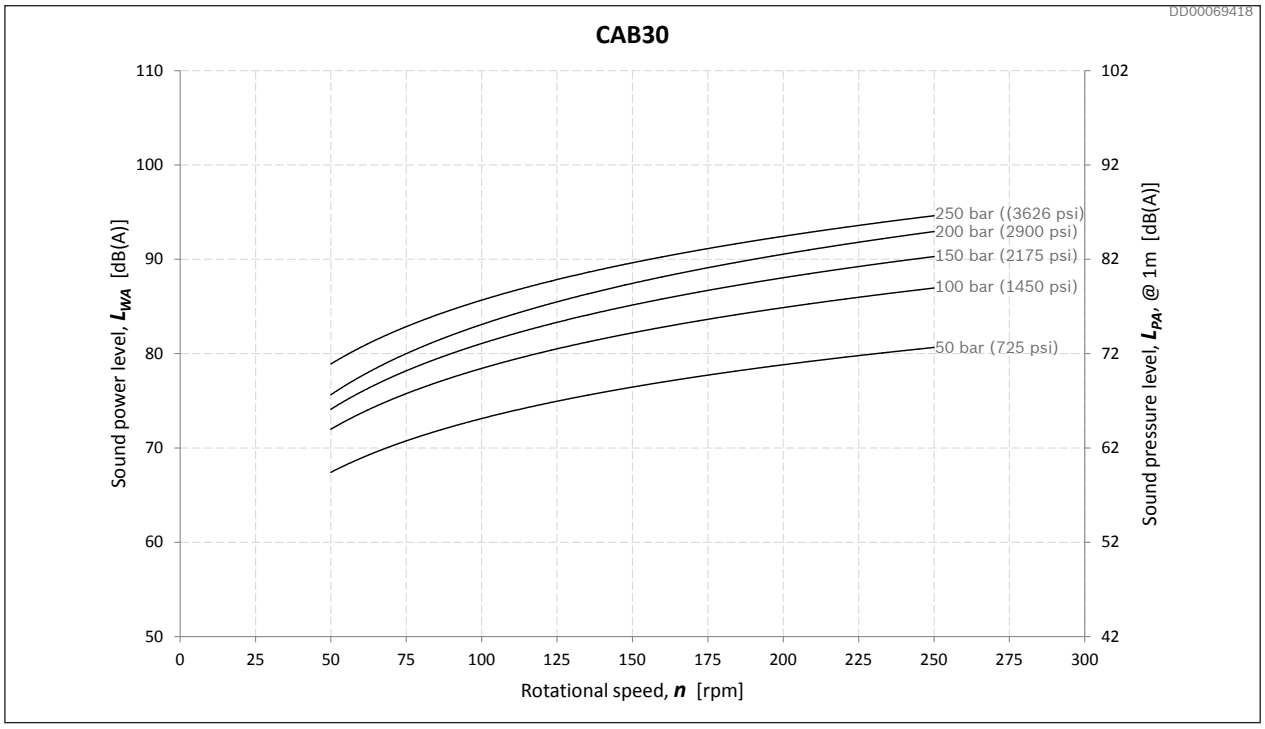

Fig. 6: Sound level CAB 30

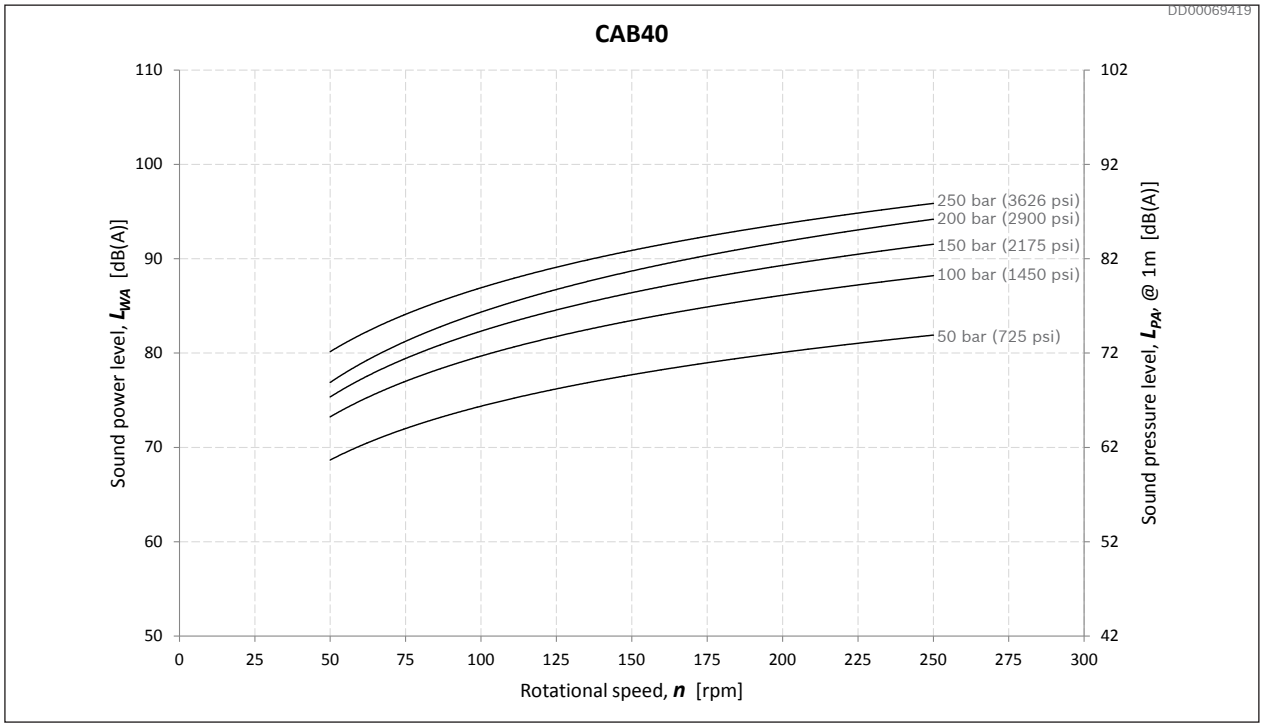

Fig. 7: Sound level CAB 40

4.6 Draining and venting the motor

4.6.1 Horizontal mounting

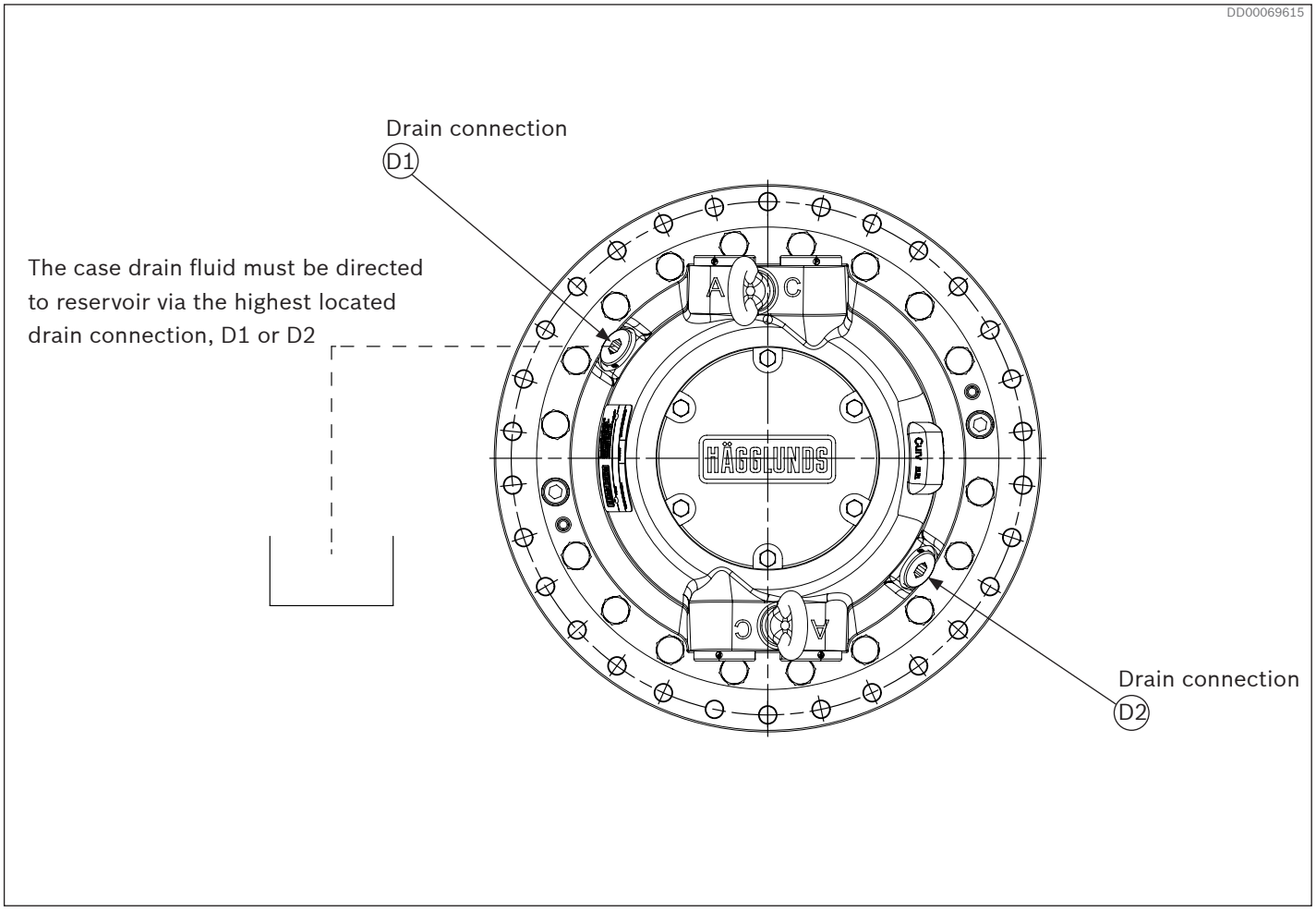

Fig. 8: Horizontal mounting motor

4.6.2 Non-horizontal mounting

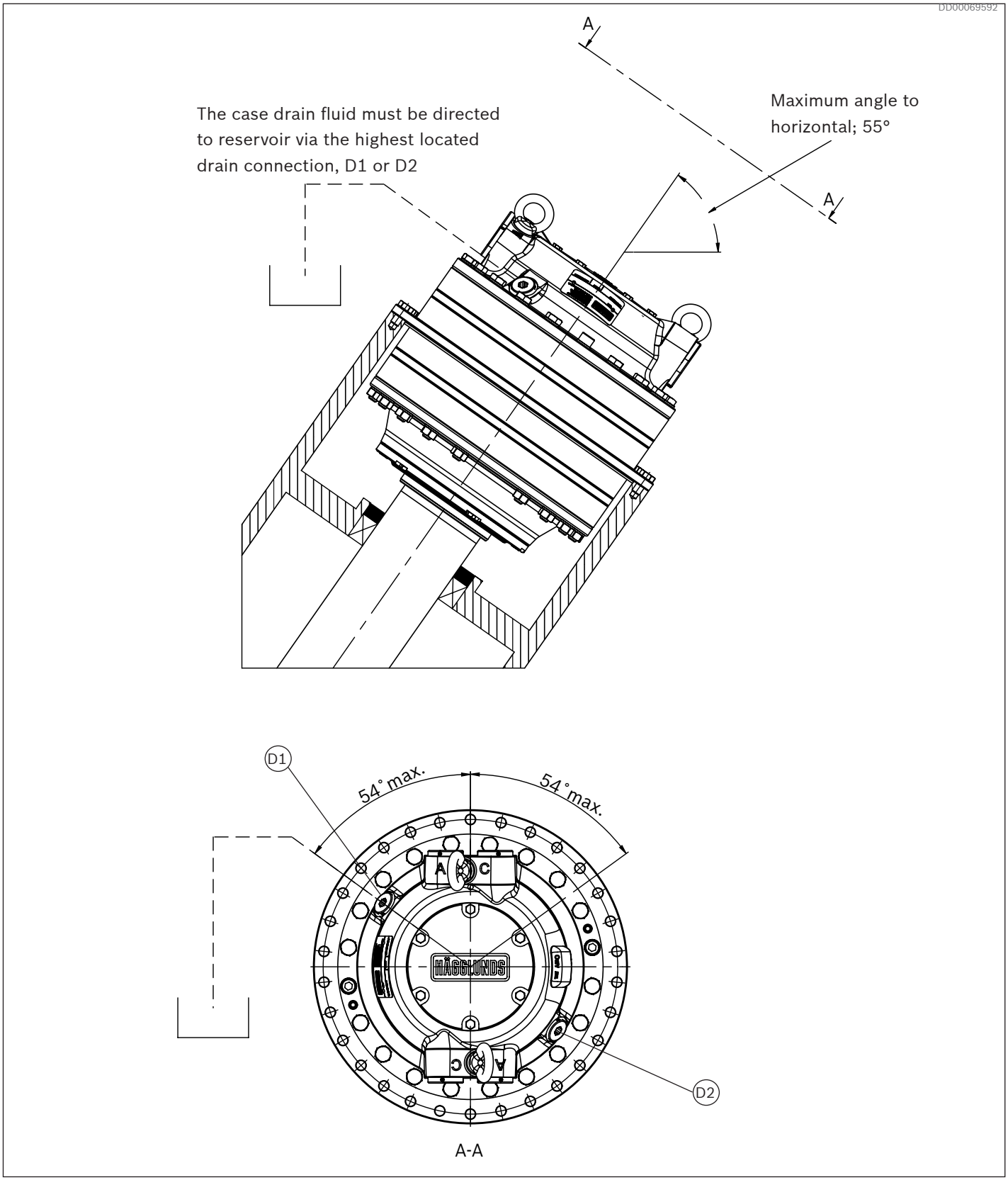

Fig. 9: Positioning of drain connection / Maximum angle of shaft

4.7 Flushing

Flushing of motor case

Viscosity in the motor case must be controlled according to 4.4 Hydraulic fluids. The motor must be flushed when shaft power exceeds a defined limit, E_{FL}. The need is also governed by the duty cycle, as shown below.
Flushing can also be necessary if the system is not able to ensure minimum viscosity in the motor case as specified in 4.4 Hydraulic fluids.

Table 6: Maximum motor power without flushing

Frame size	Flushing limit power, E_{FL}	
	kW	hp
CAB 10 - CAB 40	30	40

Continuously running motor

The motor power is calculated:

$$E = \frac{p_h \times n \times V_i}{600 \times 1000}\,[\text{kW}], \qquad E_{US} = \frac{p_h \times n \times V_i}{1714 \times 231}\,[\text{hp}]$$

where
p_h = motor high pressure [bar] [psi]
n = motor speed [rpm]
V_i = motor displacement [cm³/rev] [in³/rev]

Intermittently running motor

The time weighted arithmetic average of the motor power is:

$$E = \frac{\sum \Delta t_j \times E_j}{\sum \Delta t_j}, \qquad E_{US} = \frac{\sum \Delta t_j \times E_j}{\sum \Delta t_j}$$

where
Δt_j = the time period the motor is running with the power E_j
E_j = intermittent motor power

A CAB 10 - CAB 40 motor typically reach close to the final temperature in 200 s, after a step change in the power. The calculation model is valid if the total period time of the cycle $\sum \Delta t_j$ is less than this time.

Required flushing

When the maximum motor power is exceeded, the required flushing to keep motor case maximum 10 °C (18 °F) warmer than flushing oil is,

Table 7: Motor case flushing flow

Frame size	Flushing flow	
	lpm	gpm
CAB 10	5	1.3
CAB 20	10	2.6
CAB 30	15	4.0
CAB 40	20	5.3

Example 1: Continuously running motor

CAB 20 20
p_h = 150 bar
V_i = 1257 cm³/rev
n = 160 rpm.
The motor power is calculated:

$$E = \frac{150 \times 160 \times 1257}{600 \times 1000} = 50.3\ \text{kW}$$

$E > E_{FL}$, the motor should be flushed see Table 7: Motor case flushing flow for CAB 20 20

Example2: Intermittently running motor

CAB 20 20, working at two different conditions,

1) p_h = 150 bar
   n = 160 rpm
   t = 5 s
The motor power is calculated:

$$E = \frac{150 \times 160 \times 1257}{600 \times 1000} = 50.3\ \text{kW}$$

2) p_h = 0 bar
   n = 0 rpm
   t = 25 s
The motor power is calculated:

$$E = \frac{0 \times 0 \times 1257}{600 \times 1000} = 0\ \text{kW}$$

The average motor power is calculated:

$$E = \frac{\sum \Delta t_j \times E_j}{\sum \Delta t_j} = \frac{5 \times 50.3 + 25 \times 0}{5 + 25} = 8.4\ \text{kW}$$

$E < E_{FL}$, no need for flushing.

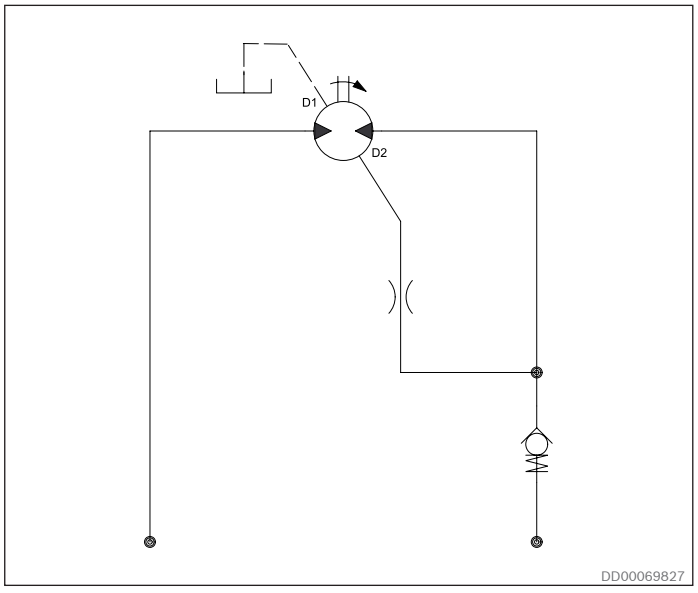

Fig. 10: Circuit design for flushing of motor case

4.8 Permitted external loads

For external loads, please contact Bosch Rexroth representative.

4.9 External leakage

External leakage is from the distributor to the motor case and from the piston assembly to the motor case.
The external leakage is calculated:

$$q_l = i_{cam} \times 0.1 \times p_h^{0.65} \times \left(1 + 0.25 \times \left(\frac{n}{350}\right)\right)$$

$$q_{lUS} = i_{cam} \times 0.00464 \times p_h^{0.65} \times \left(1 + 0.25 \times \left(\frac{n}{350}\right)\right)$$

where
q_l = external leakage out from motor house [l/min] [gpm]
p_h = high pressure [bar] [psi]
n = motor speed [rpm]
i_{cam} = number of cam-rings as:

Table 8: Number of camrings

Frame size	i_{cam}
CAB 10	1
CAB 20	2
CAB 30	3
CAB 40	4

Example 1: Drain flow external leakage
CAB 20 20
p_h = 150 bar
n = 160 rpm
i_{cam} = 2 (From table Table 8: Number of camrings)

$$q_l = 2 \times 0.1 \times 150^{0.65} \times \left(1 + 0.25 \times \left(\frac{160}{350}\right)\right)$$

q_l = 5.8 l/min

5 Dimensions / Interface

5.1 Dimensions

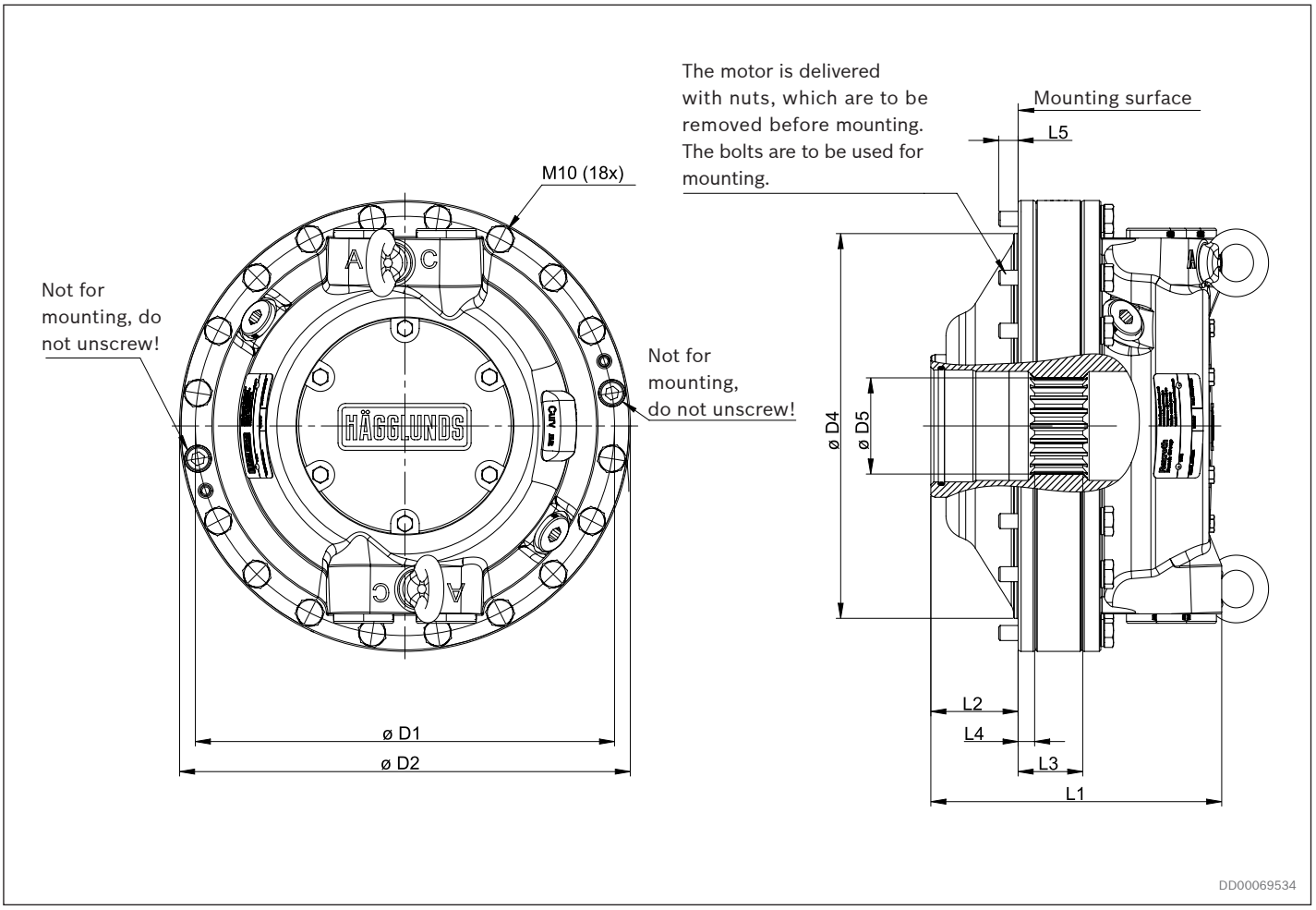

Fig. 11: CAB 10

Table 9: Dimensions CAB 10

		Dimensions	
		mm	in
D1	Pitch diameter	279	10.98
D2	Outer diameter	300	11.81
D4	Guide diameter	256	10.08
D5	Spline size	DIN 5480 N70 x 3 x30 x 22	
L1	Total length	194	7.62
L2	Length to shaft	58	2.28
L3	Length to spline end	43	1.69
L4	Length to spline	11	0.43
L5	Protruding length of screws	13	0.51

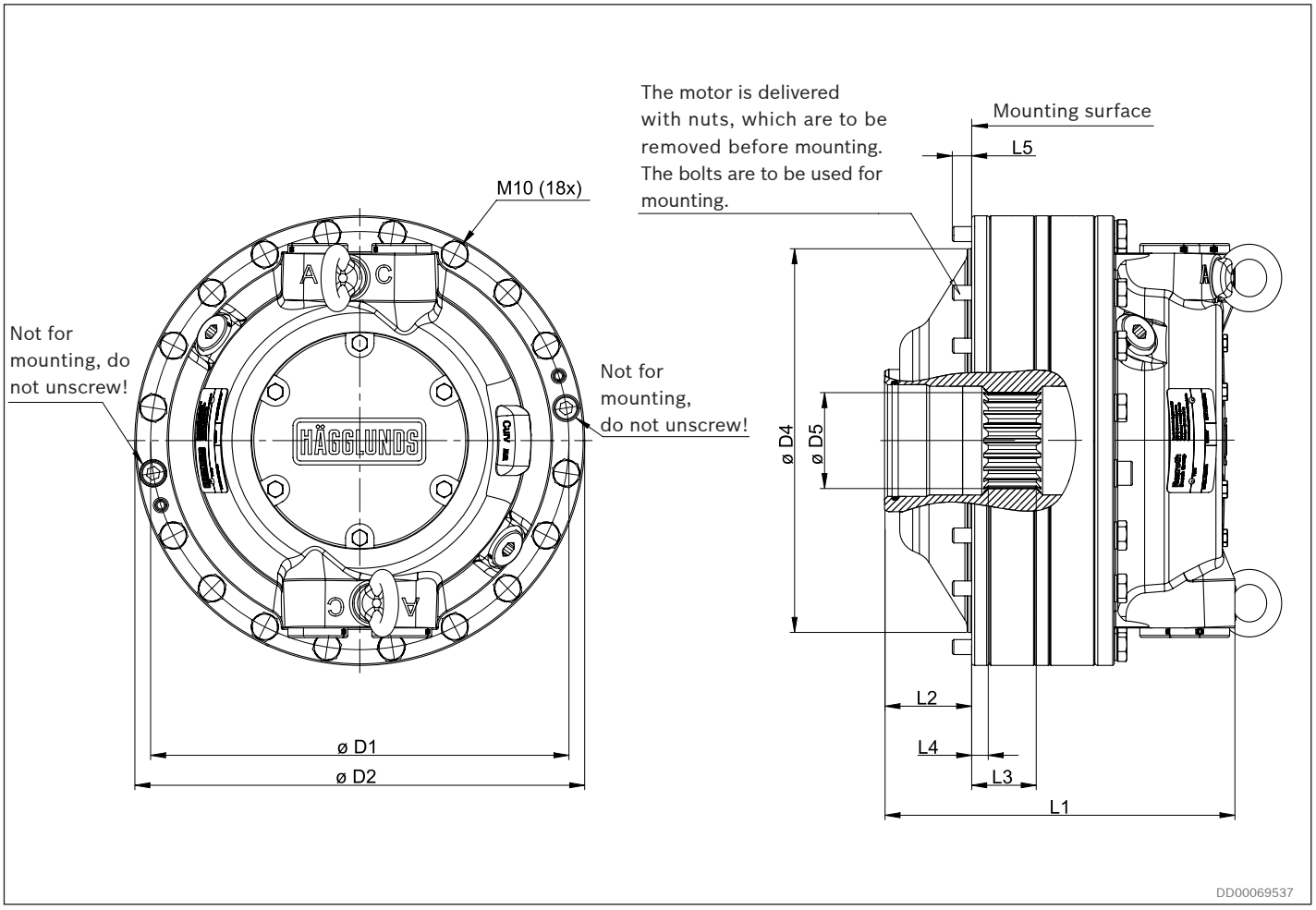

Fig. 12: CAB 20

Table 10: Dimensions CAB 20

		Dimensions	
		mm	**in**
D1	Pitch diameter	279	10.98
D2	Outer diameter	300	11.81
D4	Diameter of guide edge	256	10.08
D5	Spline size	DIN 5480 N70 x 3 x30 x 22	
L1	Total length	234	9.20
L2	Length to flange	58	2.28
L3	Length to spline end	43	1.69
L4	Length to spline	11	0.43
L5	Protruding length of screws	13	0.51

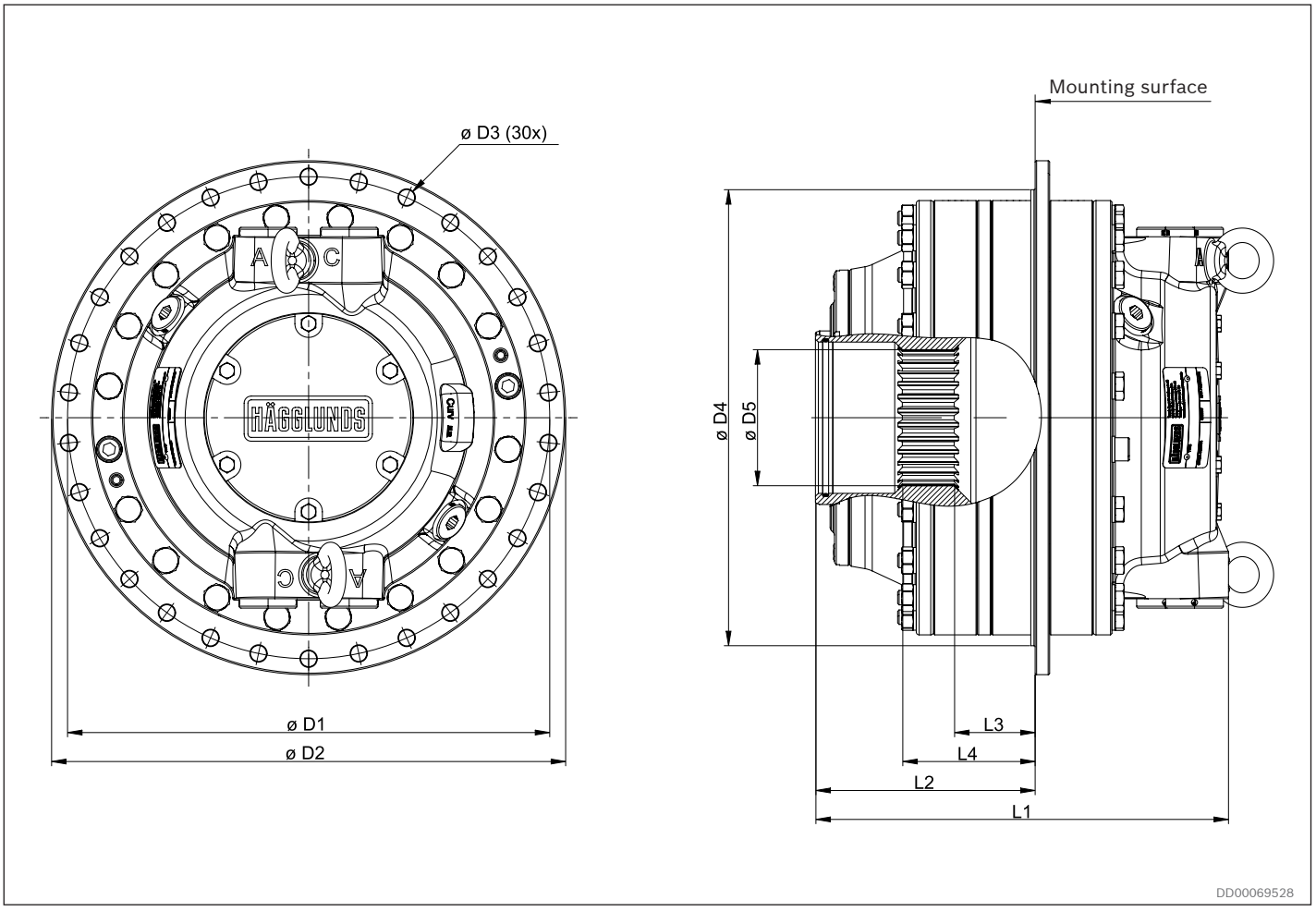

Fig. 13: CAB 30

Table 11: Dimensions CAB 30

		Dimensions	
		mm	**in**
D1	Pitch diameter	333	13.11
D2	Outer diameter	355	13.98
D3	Screw hole	11	0,43
D4	Guide diameter	315	12.40
D5	Spline size	DIN 5480 N100 x 3 x30 x32	
L1	Total length	285	11.23
L2	Length to shaft	151	5.96
L3	Length to spline end	56	2.19
L4	Length to spline	91	3.58

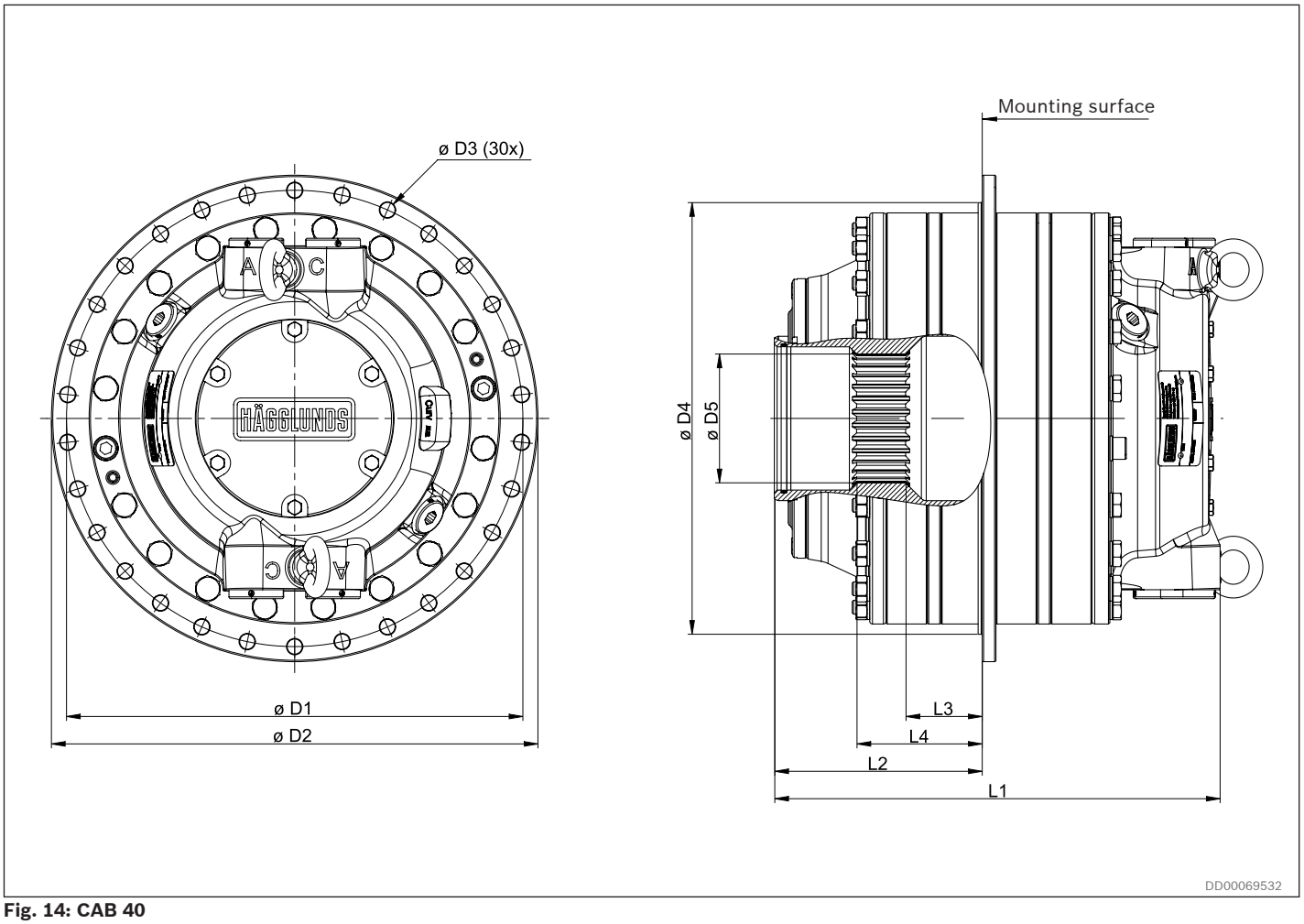

Fig. 14: CAB 40

Table 12: Dimensions CAB 40

		Dimensions	
		mm	**in**
D1	Pitch diameter	333	13.11
D2	Outer diameter	355	13.98
D3	Screw hole	11	0.43
D4	Guide diameter	315	12.40
D5	Spline size	DIN 5480 N100 x 3 x30 x32	
L1	Total length	325	12.81
L2	Length to shaft	151	5.96
L3	Length to spline end	56	2.19
L4	Length to spline	91	3.58

5.2 Mounting alternatives

Flange mounting

With splines for flange or torque arm mounting.

The splines shall be lubricated, either oiled with hydraulic oil at assembly, or filled with transmission oil from the connected gearbox. To avoid wear in the splines, the installation must be within the specified tolerances in *Fig. 15: Shaft installation tolerances CAB 10 - CAB 20 page 20, Fig. 16: Shaft installation tolerances CAB 30 - CAB 40 page 21* and *Table 13: Dimensions installation tolerances page 21* The splines must be accordning to *Table 15: Spline designation shaft page 21*

For production of shaft, see drawing 078 3098 and 078 3099.

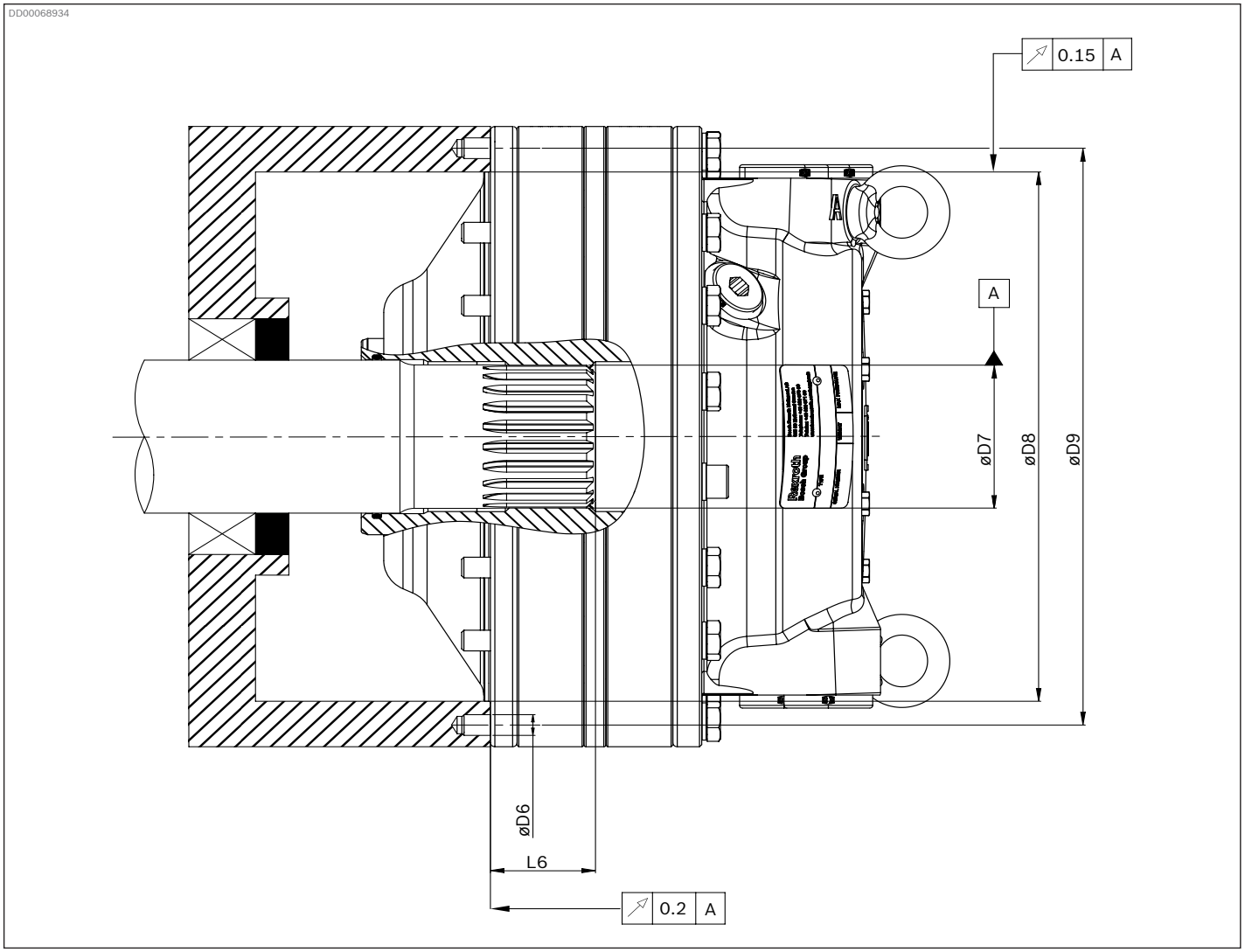

Fig. 15: Shaft installation tolerances CAB 10 - CAB 20

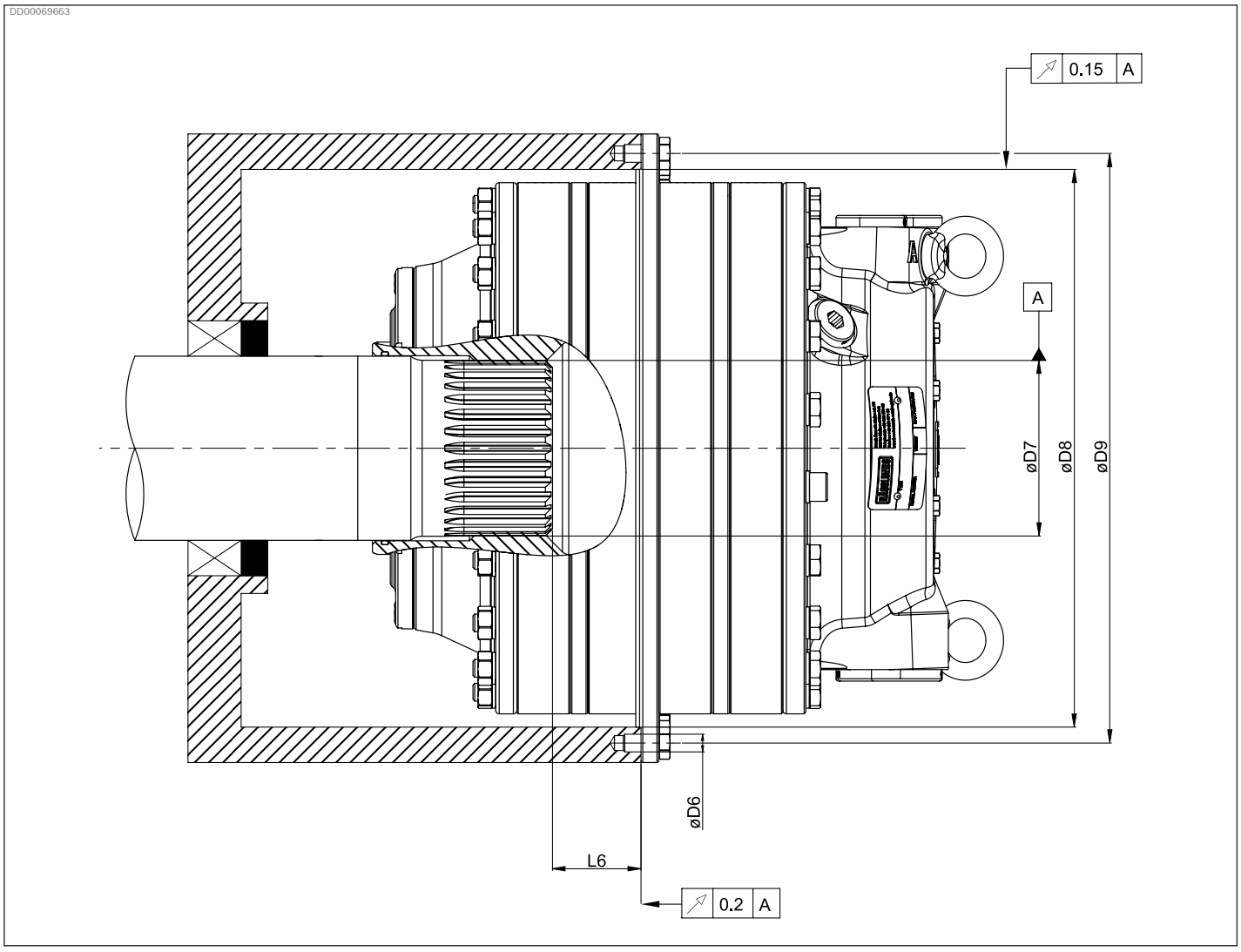

Fig. 16: Shaft installation tolerances CAB 30 - CAB 40

Table 13: Dimensions installation tolerances

		Frame size				
		CAB 10 - CAB 20		CAB 30 - CAB 40		
		mm	in	mm	in	Tolerance
D6	Screw hole	M10		M10		
D7	Spline size shaft	DIN 5480 W70		DIN 5480 W100		
D8	Guide diameter	256	10.08	315	12.40	H11
D9	Pitch diameter	279	10.98	333	13.11	
L6	Length to spline	47	1.86	47	1.86	

Table 14: Recommended material in the shaft

Drive	Steel with yield strenght
Unidirectional drive	Rel_{min} = 450 N/mm²
Bidirectional drive	Rel_{min} = 700 N/mm²

Table 15: Spline designation shaft

	Spline	
Frame size	**CAB 10 - CAB 20**	**CAB 30 - CAB 40**
Designation Standard DIN 5480	W70x3x30x22x8f	W100x3x30x32x8f

5.3 Ports

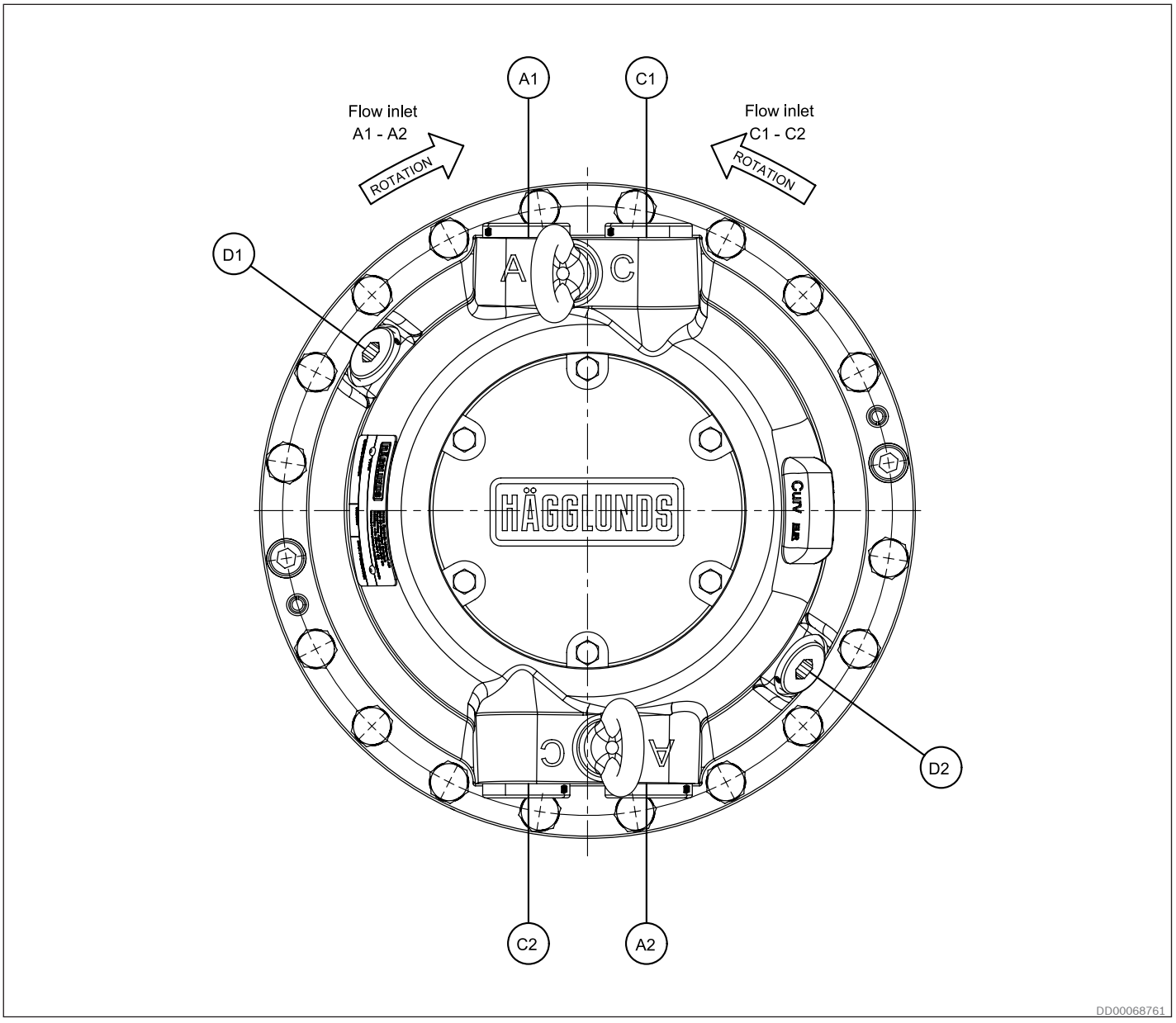

Fig. 17: Ports

Table 16: Port dimensions

Connection	Description	Port connection
A1	Main connection	G 1"
C1	Main connection	G 1“
A2	Alternative main connection	G 1“
C2	Alternative main connection	G 1“
D1	Drain connection	G ½“
D2	Alternative drain connection	G ½“

6 Circuit design

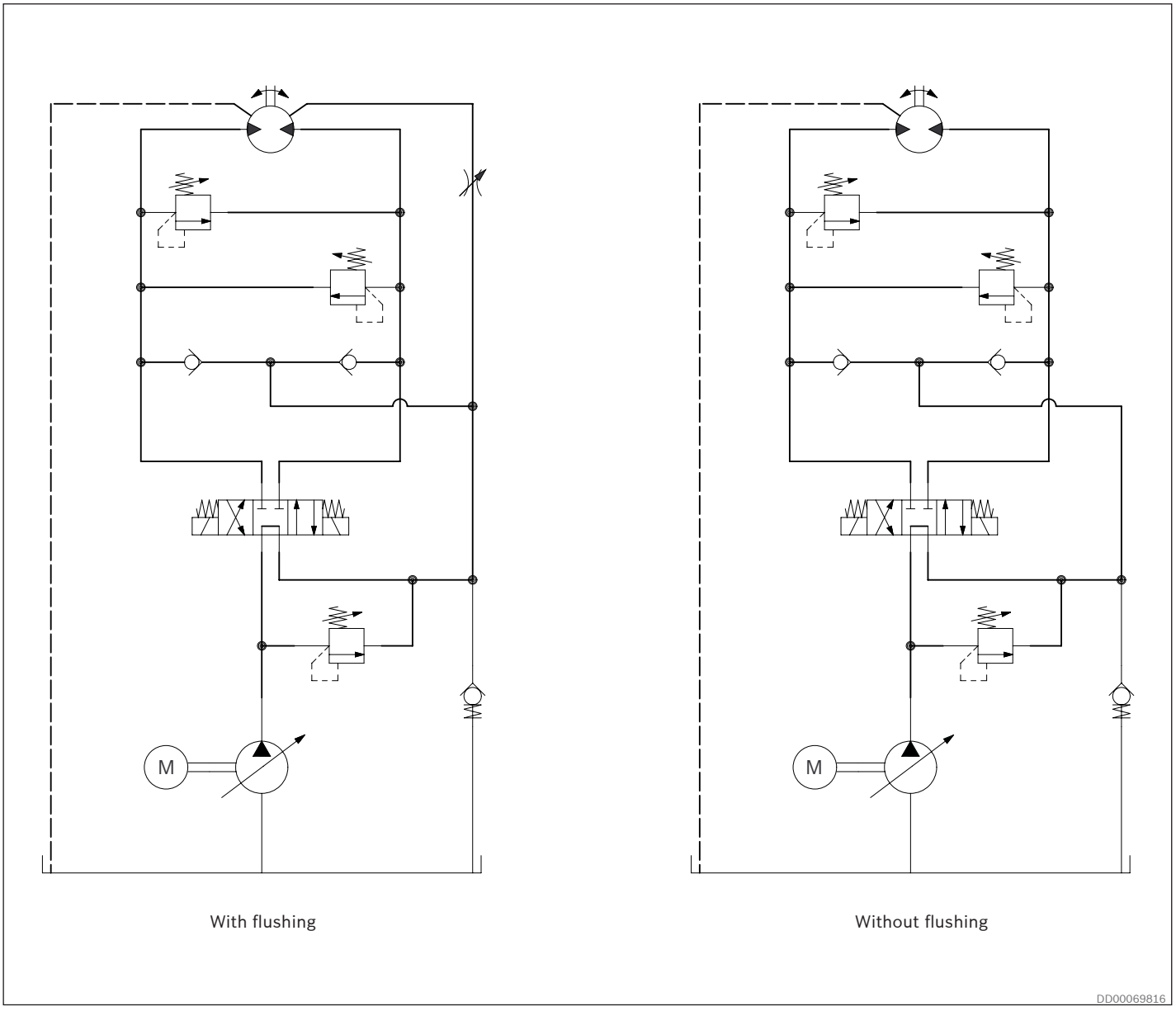

Fig. 18: Circuit design

7 Required and additional documents

	Title	Document no	Document type
🕮	Hydraulic fluid quick reference	RE 15414	Data sheet
🕮	Sound and vibrations	RE 15411	Data sheet
🕮	Radial piston motor CA 10	078 3058	Dimension drawing
🕮	Radial piston motor CA 20	078 3059	Dimension drawing
🕮	Radial piston motor CA 30	078 3060	Dimension drawing
🕮	Radial piston motor CA 40	078 3061	Dimension drawing
🕮	Splined shaft CA 10- 20	078 3098	Dimension drawing
🕮	Splined shaft CA 30- 40	078 3099	Dimension drawing

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