Radial piston hydraulic motor

Hägglunds Atom

HÄGGLUNDS ATOM

- Torque range: up to 13.6 kNm [up to 10062 lb ft]
- Speed range: up to 400 rpm
- Power range: up to 394 kW
- Maximum operating pressure: 350 bar [5 076 psi]
- Displacement: 503 to 2 513 cm^3/rev [31–153 in^3/rev]
- Specific torque: 8 to 40 Nm/bar [407 to 2 034 lbf·ft/1000 psi]
- Frame size: 10, 20, 30, 40

FEATURES

- High power density
- High torque density
- Energy efficient
- Flexible: many sizes, few mechanical interfaces
- Insensitive for shock loads
- Very low moment of inertia
- Small footprint (total occupied volume)
- Through hole diameter 60 mm
- Ready for environmentally acceptable hydraulic fluids (no internal paint)
- Option for explosive environment available

RE 15354, Version: 10.2022, Replaces: 01.2021, EN
Bosch Rexroth AB

HÄGGLUNDS

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 Atom motor:

AM	X		0010		0010		S		F		00	0		0	
01	02		03		04		05		06		07	08		09	

01	**Motor series**	
	Atom	**AM**

02	**Feature**	
	Standard	**X**

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**
						●

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

06	**Mounting alternatives, motor case**	**AM 10**	**AM 20**	**AM 30**	**AM 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**		
	Single speed motor	●	**0**
	Two speed motor	–	**2**

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

0		N		00		0		0		0		3		2002		0		02		00
10		11		12		13		14		15		16		17		18		19		20

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

11	**Type of seal**		
	NBR (Nitrile)	●	**N**
	FPM (Viton)	●	**V**

12	**Speed sensor**		
	No	●	**00**
	Yes	●	**01**

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

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

15	**Explosive environment**		
	Non explosive environment	●	**0**
	Motor approved for ATEX gas group IIB	●	**1**
	Motor approved for ATEX gas group IIC	●	**2**

16	**Painting system**		
	C3 (corrosivity category medium)	●	**3**
	C5 (corrosivity category very high)	●	**5**
	CX (corrosivity category extreme)	●	**X**

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

18	**Internal paint**		
	Painted	–	**0**
	Without paint	●	**1**

19	**Modification**	
	Current modification	**02**

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

● = Available – = Not available

[1]) For exact, non-rounded values of specific torque, see *4.3 Motor data page 11*
[2]) Only available for specific torque up to 30 Nm/bar
[3]) See section*11* for released special index

2 Functional description

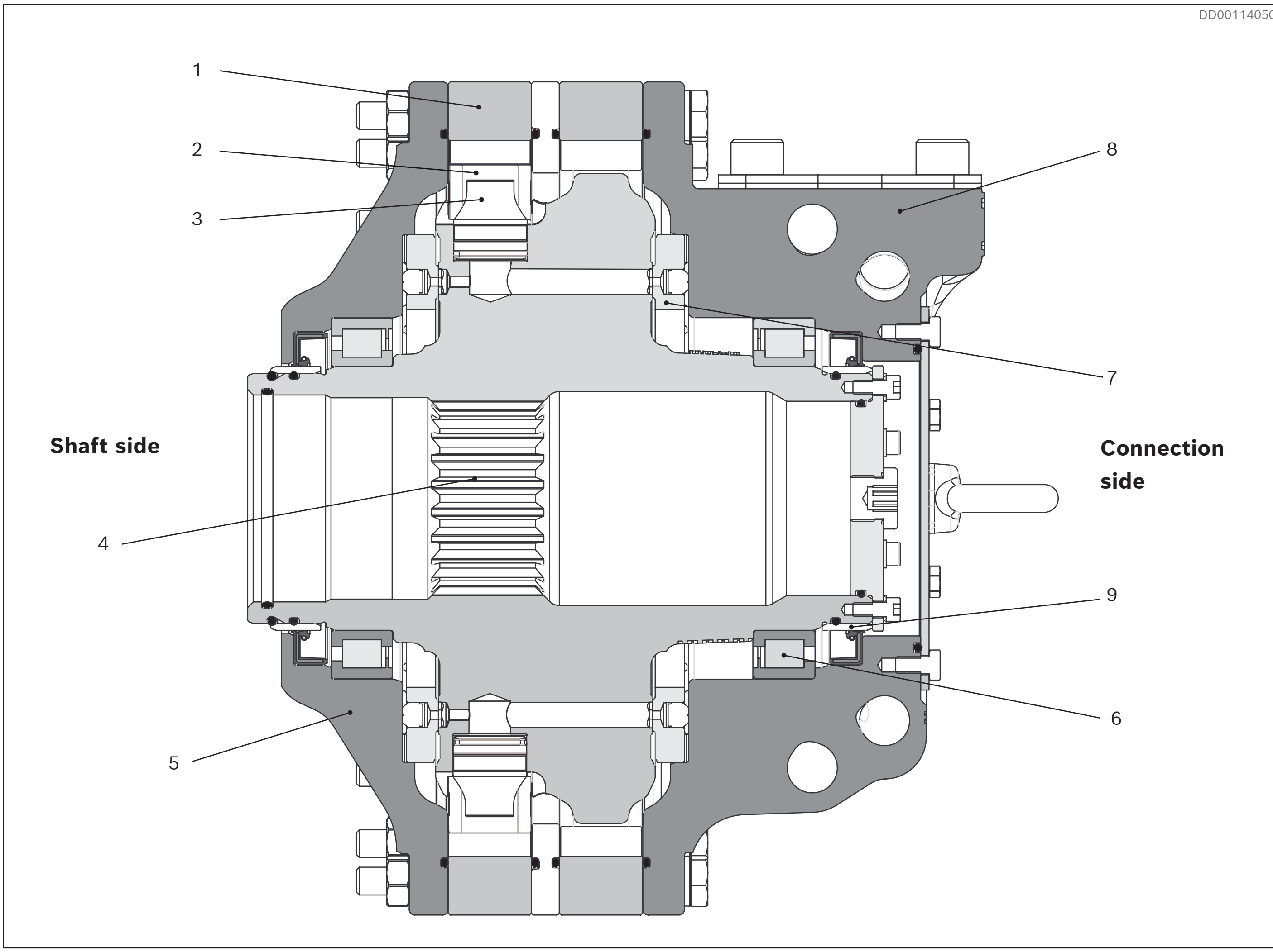

Fig. 1: Section view of radial piston hydraulic motor

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

Bosch Rexroth‘s hydraulic industrial motor Hägglunds Atom is of the high torque and low rotation 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 housing and drain lines to one of the D -ports in the motor housing. (See *3.2)*

The motor is connected to the shaft of the driven machine through 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 Fluid connections

3.1 Hydraulic symbol

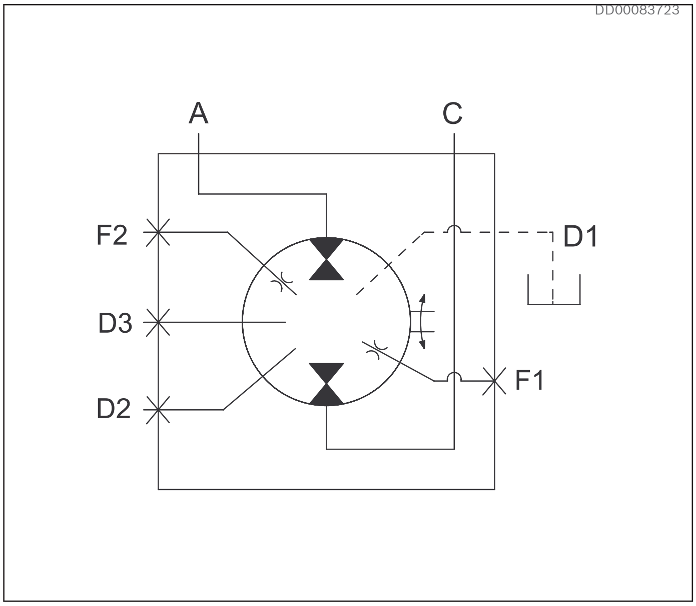

Fig. 2: Hydraulic symbol, radial piston hydraulic motor

Port locations and dimensions, see *Table 1: Port dimensions*

3.2 Port connections

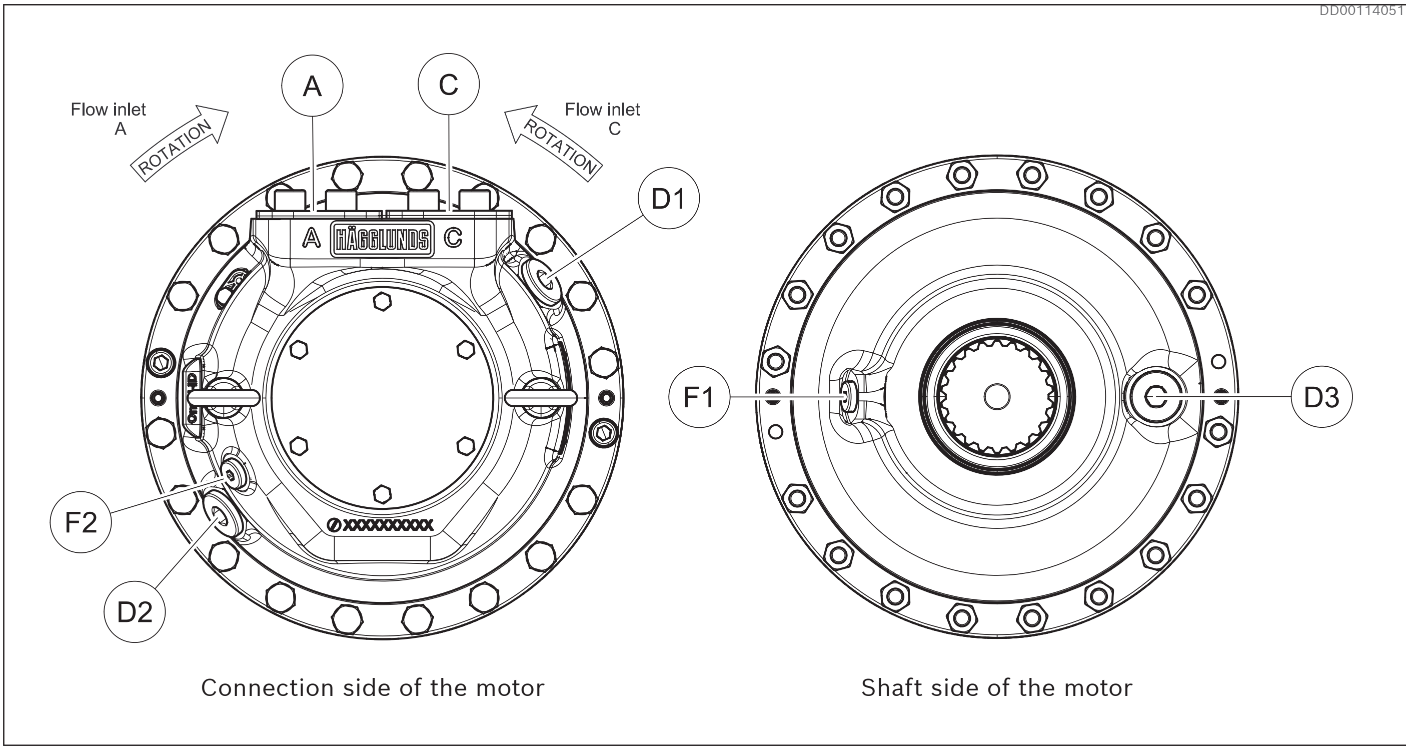

Fig. 3: Port connections Hägglunds Atom

Table 1: Port dimensions

Connection	Description	Dimensions		Remarks
		Atom 10 - Atom 20	Atom 30 - Atom 40	
A	Main connection	1¼" *)	1¼" *)	If A is used as the inlet, the motor shaft rotates counter clockwise, viewed from the motor shaft side
C	Main connection	1¼" *)	1¼" *)	If C is used as the inlet, the motor shaft rotates clockwise, viewed from the motor shaft side
D1	Drain outlet	G ¾"	G ¾"	
D2	Alternative drain outlet / or flushing inlet	G ¾"	G ¾"	
D3	Alternative drain outlet / or flushing inlet	G ¾"	G ½"	
F1	Flushing connection	G ¼"	G ⅛“	For flushing of radial lip seal.
F2	Flushing connection	G ¼"	G ¼“	For flushing of radial lip seal.

*) SAE flange J 518 , code 62, 420 bar (6000 psi).
All connections are normally plugged at delivery.

4 Technical data

Note!
Since this size of hydraulic motor often is used in open loop systems, calculations in chapter 4 Technical data, are calculated with 2 bar (29 psi)
low pressure.

4.1 Calculation fundamentals

Table 2: Calculation fundamentals.

	Metric			US		
Output power	P=	$\frac{T \cdot n}{9549}$	(kW) on driven shaft	P=	$\frac{T \cdot n}{5252}$	(hp) on driven shaft
Output torque (η_m=98%)	T=	$T_s \cdot (p - \Delta p_l - p_c) \cdot \eta_m$	(Nm)	T=	$\frac{T_s \cdot (p - \Delta p_l - p_c) \cdot \eta_m}{1000}$	(ibf·ft)
Pressure required (η_m=98%)	p=	$\frac{T}{Ts \cdot \eta m} + \Delta p_l + p_c$	(bar)	p=	$\frac{T \cdot 1000}{T_s \cdot \eta_m} + \Delta p_l + p_c$	(psi)
Flow rate required	q=	$\frac{n \cdot V_i}{1000} + q_l$	(l/min)	q=	$\frac{n \cdot V_i}{231} + q_l$	(gpm)
Output speed	n=	$\frac{q - q_l}{V_i} \cdot 1000$	(rpm)	n=	$\frac{q - q_l}{V_i} \cdot 231$	(rpm)
Inlet power	P_{in}=	$\frac{q \cdot (p - p_c)}{600}$	(kW)	P_{in}=	$\frac{q \cdot (p - p_c)}{1714}$	(hp)

Quantity	Symbol		Metric	US
Power	P	=	kW	hp
Output torque	T	=	Nm	lbf·ft
Specific torque	T_s	=	Nm/bar	lbf·ft/1000 psi
Rotational speed	n	=	rpm	rpm
Required pressure	p	=	bar	psi
Pressure loss	Δp_l	=	bar	psi
Low pressure	p_c	=	bar	psi
Flow rate required	q	=	l/min	gpm
Total volumetric loss	q_l	=	l/min	gpm
Displacement	V_i	=	cm^3/rev	in^3/rev
Mechanical efficiency	η_m	=	0,98 [1]	

[1] Not valid for starting efficiency

4.2 General data

Table 3: General data (metric)

			Frame size			
			Atom 10	**Atom 20**	**Atom 30**	**Atom 40**
Type of mounting			See *13 Mounting alternatives*			
Port connections			See *3.2 Port connections*			
External loads			See *4.13 Permissible external loads*			
Hydraulic fluids			See *4.5 Hydraulic fluids*			
Pressure	Maximum operating pressure	bar	350	350	350	350
	Maximum peak pressure 1)	bar	420	420	420	420
	Low pressure	bar	See *4.4 Recommended low pressure*			
	Maximum case pressure	bar	3	3	3	3
	Maximum case peak pressure 2)	bar	8	8	8	8
Temperature limits of case drain oil						
Seal type: NBR (Nitrile)	Minimum	°C	-35	-35	-35	-35
	Maximum	°C	+70	+70	+70	+70
Seal type: FPM (Viton)	Minimum	°C	-20	-20	-20	-20
	Maximum	°C	+100	+100	+100	+100
Oil volume in motor case		l	0.7	1.0	1.1	1.2
Moment of inertia for rotary group		$kg \cdot m^2$	0.087	0.158	0.228	0.294
Weight		kg	52	68	88	102

1) Peak pressure 420 bar maximum, allowed to occur up to 10 000 times.
2) Momentary pressure spikes t< 0.1 s of up to 8 bar are permitted

Table 4: General data (US)

			Frame size			
			Atom 10	**Atom 20**	**Atom 30**	**Atom 40**
Type of mounting			See *13 Mounting alternatives*			
Port connections			See *3.2 Port connections*			
External loads			See *4.13 Permissible external loads*			
Hydraulic fluids			See *4.5 Hydraulic fluids*			
Pressure	Maximum operating pressure	psi	5 076	5 076	5 076	5 076
	Maximum peak pressure 1)	psi	6 092	6 092	6 092	6 092
	Low pressure	psi	See *4.4 Recommended low pressure*			
	Maximum case pressure	psi	44	44	44	44
	Maximum case peak pressure 2)	psi	116	116	116	116
Temperature limits of case drain oil						
Seal type: NBR	Minimum	°F	-31	-31	-31	-31
	Maximum	°F	+158	+158	+158	+158
Seal type: FPM (Viton)	Minimum	°F	-4	-4	-4	-4
	Maximum	°F	+212	+212	+212	+212
Oil volume in motor case		US gal	0.19	0.26	0.29	0.32
Moment of inertia for rotary group		$lb_m \cdot ft^2$	2.068	3.752	5.413	6.984
Weight		lb	115	150	194	225

1) Peak pressure 6091 psi maximum, allowed to occur up to 10 000 times.
2) Momentary pressure spikes t< 0.1 s of up to 116 psi are permitted

4.3 Motor data

Table 5: Specific data (metric)

Frame size	Nominal size	Specific torque	Displacement	Maximum torque 3)	Max pressure 4)	Maximum speed	Maximum operating power 5)
		Nm/bar	cm³/rev	Nm	bar	rpm	kW
Atom 10	8	8	503	2728	350	400	113
	10	10	628	3410	350	400	140
	12.5	12.5	785	4263	350	400	173
Atom 20	16	16	1005	5457	350	400	224
	18	18	1131	6139	350	400	250
	20	20	1257	6821	350	400	277
	22.5	22.5	1414	7673	350	400	309
	25	25	1571	8526	350	400	340
Atom 30	28	28	1759	9549	350	387	364
	30	30	1885	10231	350	352	355
	32.5	32.5	2042	11084	350	315	345
	35	35	2199	11936	350	310	365
	37.5	37.5	2356	12789	350	281	355
Atom 40	40	40	2513	13642	350	293	394

3) Calculated as: Metric = Ts • (350-2) • 0,98
4) The motors are designed according to DNV-rules. Test pressure 420 bar. Peak pressure 420 bar maximum, allowed up to 10 000 times.
5) Flushing of motor case is required. See *4.10 Flushing*

Note!
For minimum speed guidance, please see section *4.14: Low speed performance*.

Table 6: Specific data (US)

Frame size	Nominal size	Specific torque	Displacement	Maximum torque 3)	Max pressure 4)	Maximum speed	Maximum operating power 5)
		lb_f·ft/1000 psi	in³/rev	lb_f·ft	psi	rpm	hp
Atom 10	8	407	30.7	2012	5076	400	151
	10	509	38.3	2515	5076	400	188
	12.5	636	47.9	3144	5076	400	232
Atom 20	16	814	61.3	4025	5076	400	300
	18	915	69.0	4528	5076	400	336
	20	1017	76.7	5031	5076	400	371
	22.5	1144	86.3	5660	5076	400	414
	25	1271	95.9	6288	5076	400	456
Atom 30	28	1424	107.3	7043	5076	387	489
	30	1526	115.0	7546	5076	352	476
	32.5	1653	124.6	8175	5076	315	462
	35	1780	134.2	8804	5076	310	490
	37.5	1907	143.8	9433	5076	281	476
Atom 40	40	2034	153.4	10062	5076	293	529

3) Calculated as: US= Ts • (5076-29) • 0,98
4) The motors are designed according to DNV-rules. Test pressure 6000 psi. Peak pressure 6000 psi maximum, allowed up to 10 000 times.
5) Flushing of motor case is required. See *4.10 Flushing*

Note!
For minimum speed guidance, please see section *4.14: Low speed performance*.

4.4 Recommended low pressure

The hydraulic system must be such that the motor will recieve sufficient low pressure at the low pressure port. This applies to all types of installations.
The pressure at the low pressure port shall be at least one bar above the case pressure.

4.4.1 The motor working in driving mode only

The required low pressure at the low pressure port, should be according to diagram. See *Fig. 4*:

Case 1: No shock loads
Required low pressure = case pressure + 1 bar (14.5 psi) during operation, but shall not be below 2 bar (29.0 psi)
Case 2: With shock loads
Required low pressure at the outlet port is according to diagram. See *Fig. 4*

4.4.2 The motor working in braking mode

Required low pressure at the inlet port is according to diagram. See *Fig. 5*.

Note!
The diagrams are valid for 1 bar (14,5 psi) case pressure. With increasing case pressure the low pressure must be increased accordingly.

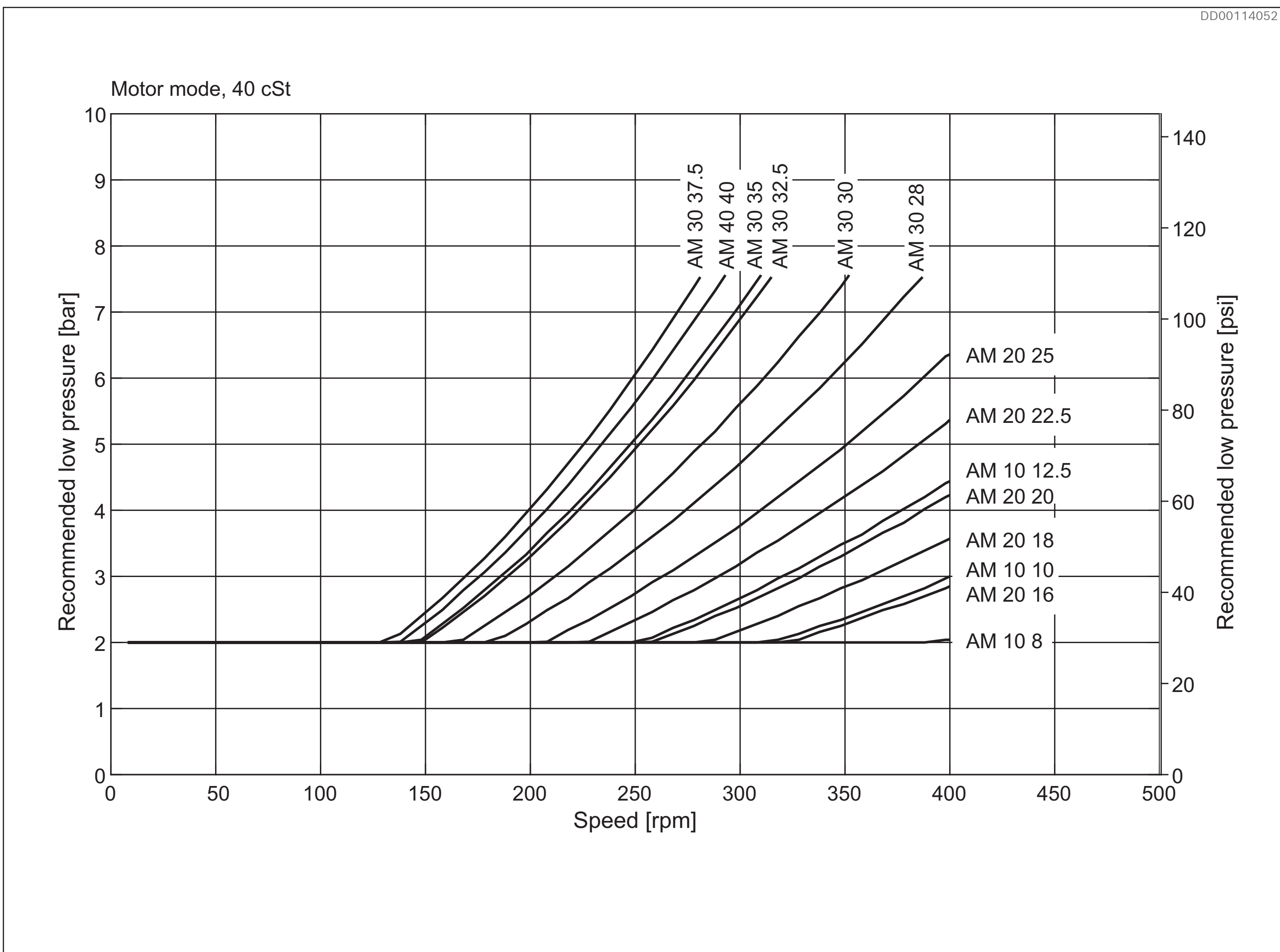

Fig. 4: Recommended low pressure for motor workning in driving mode, Hägglunds Atom 2-port connection. Valid for oil viscosity 40 cSt.

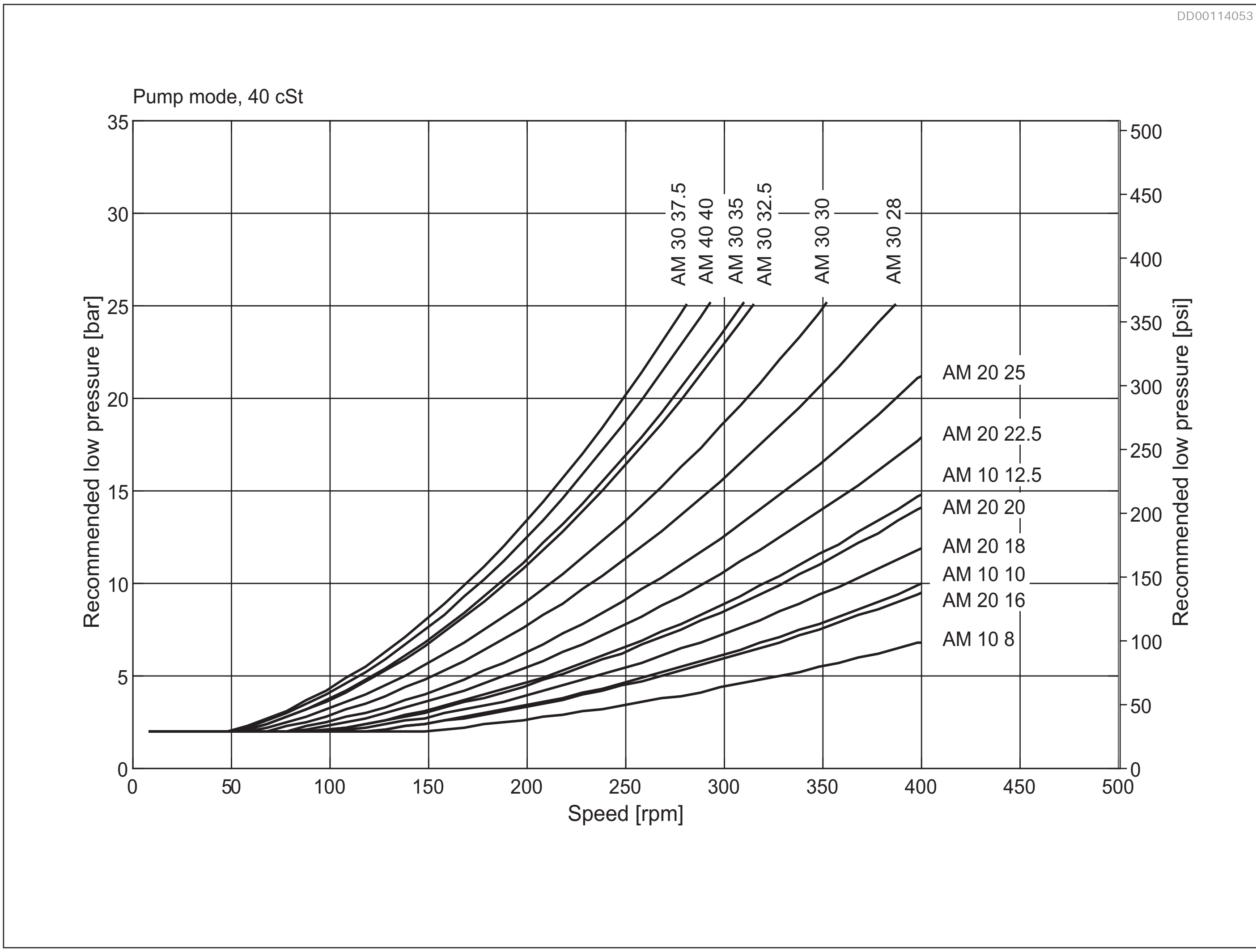

Fig. 5: Recommended low pressure for motor workning in braking mode, Hägglunds Atom 2-port connection. Valid for oil viscosity 40 cSt.

4.5 Hydraulic fluids

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

Before the start of project planning, see data sheet RE 15414, Hydraulic fluid quick reference, for detailed information on hydraulic fluids and specific additional demands.

Table 7: Applicable fluids

ISO 11158	ISO 15380	ISO 12922
Mineral oil based and mineral oil related hydraulic fluids	Environmentally acceptable hydraulic fluids	Fire resistant hydraulic fluids

Within these standards, not all fluid classes are allowed, some are recommended, and there are also additional demands (see data sheet RE 15414).

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. 6*. General recommendation is to have a system temperature of 50°C, see dotted line in *Fig. 6*. An ISO 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 10 000 cSt imparts unnecessary strain on parts.
- Running below 30 cSt may impact service life.
- Running below 20 cSt may render instant seizure.
- Running below 10 cSt for option increased robustness type C, may render instant seizure

The operating temperature is also limited by the seal type, see *Table 3: General data (metric) or Table 4: General data (US).*

> **Note!**
> Hägglunds Atom is without internal paint as standard and therefore prepared for environmentally acceptable hydraulic fluids

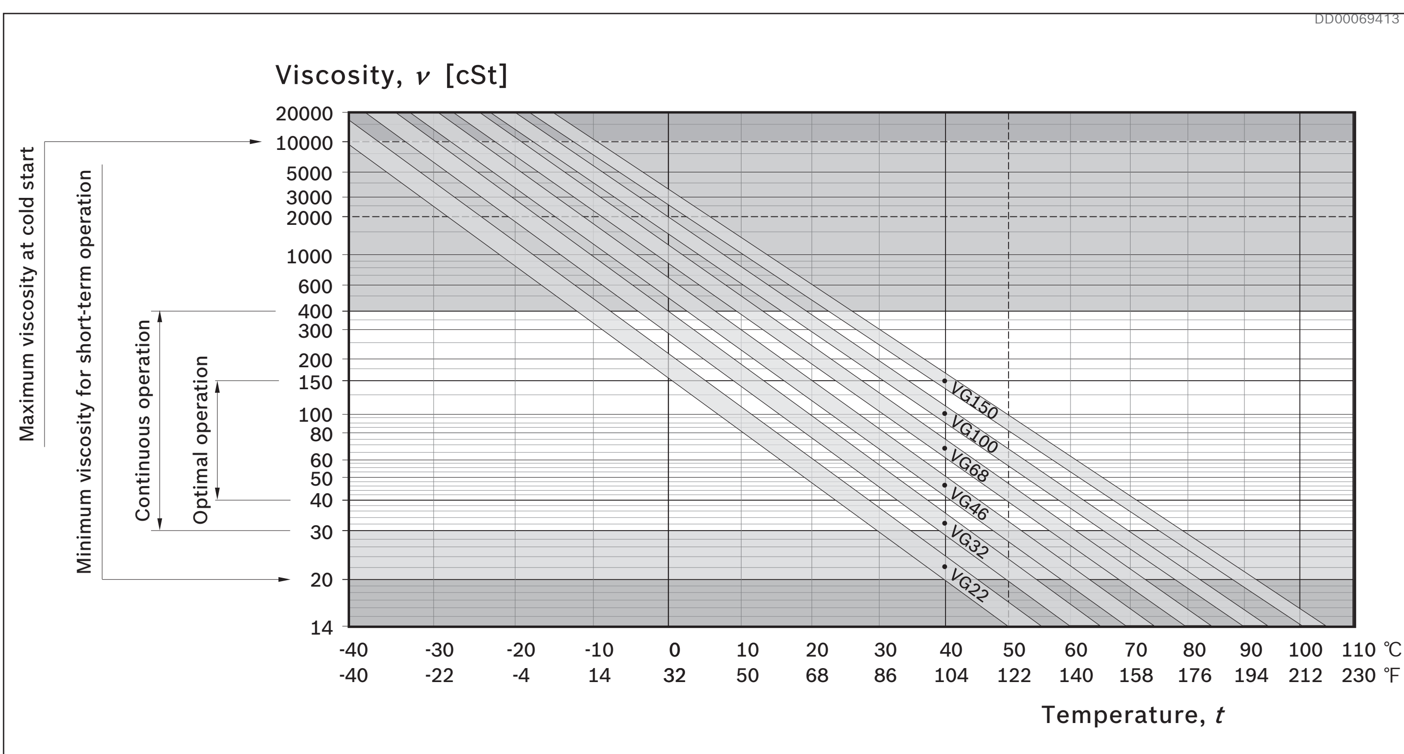

Fig. 6: Selection diagram for viscosity ranges with straight fluids, i.e. viscosity index 100

4.6 Overall efficiency

The diagrams are valid for oil viscosity 40 cSt and low pressure 2 bar (29 psi) at the motor main ports A or C.

Each diagram has the following label definitions:

1. Output power, kW
2. Constant pressure curves, bar
3. Overall efficiency, %
4. Flushing of motor case is required.

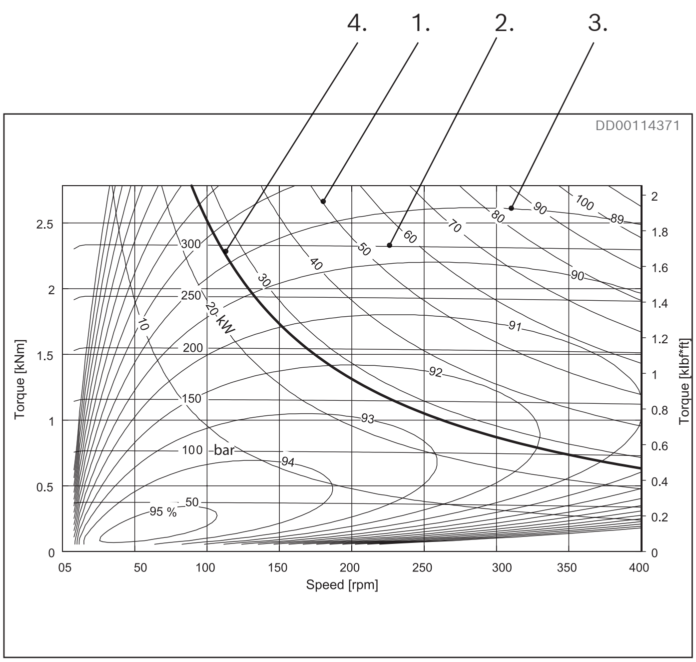

Fig. 7: Atom 10 8

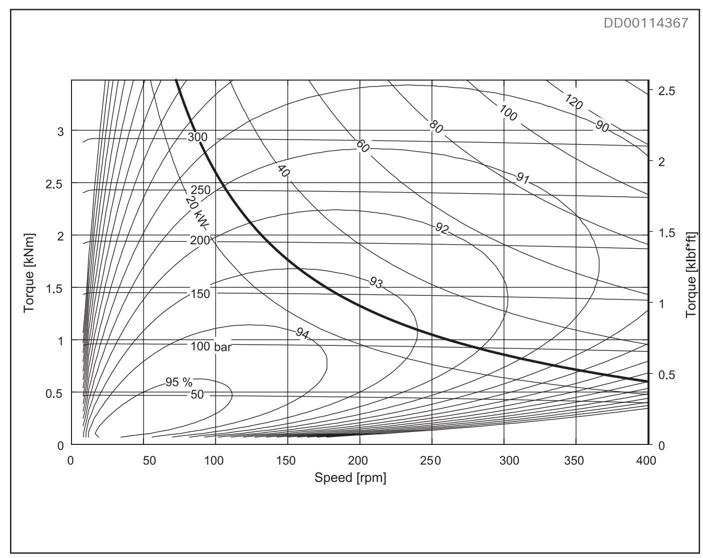

Fig. 8: Atom 10 10

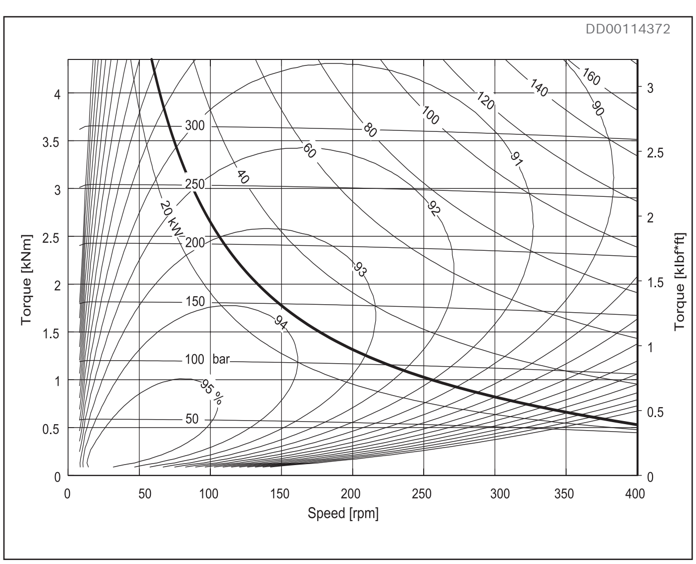

Fig. 9: Atom 10 12.5

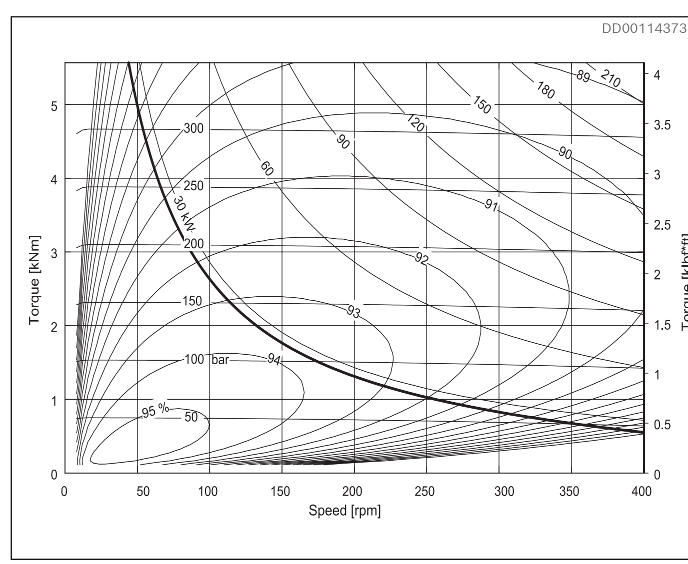

Fig. 10: Atom 20 16

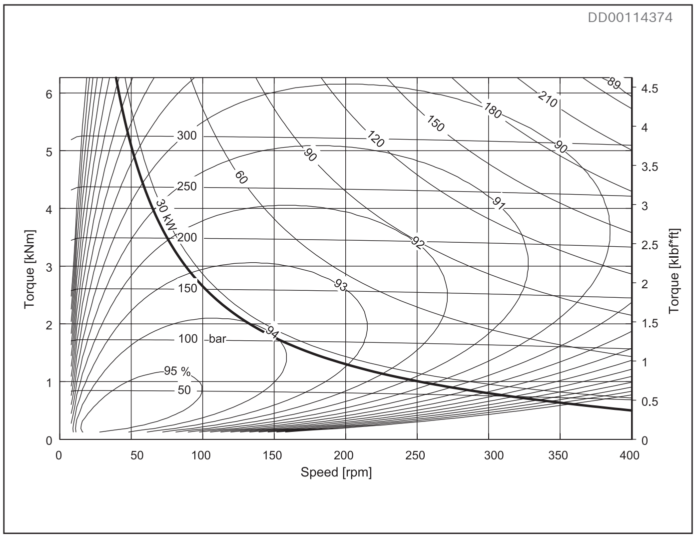

Fig. 11: Atom 20 18

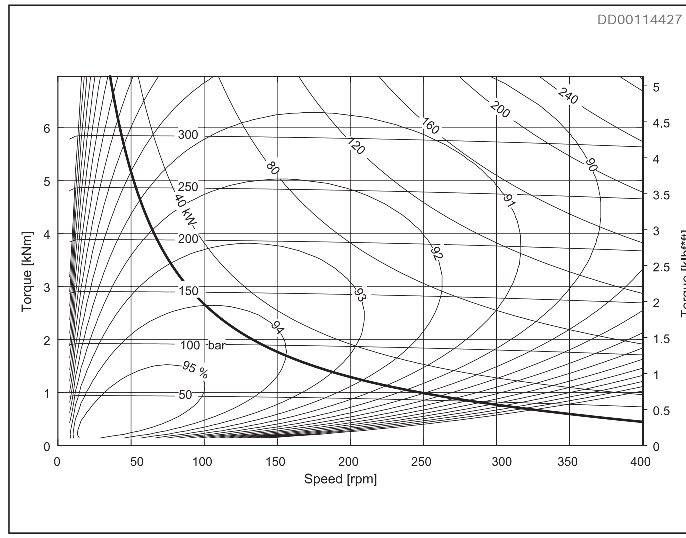

Fig. 12: Atom 20 20

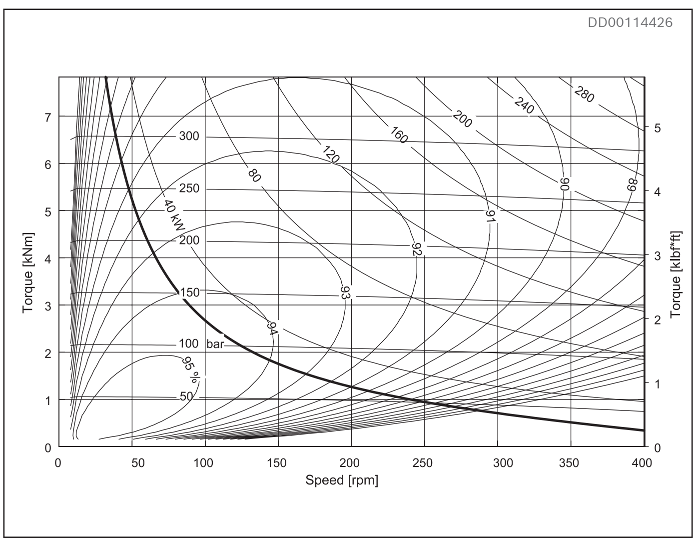

Fig. 13: Atom 20 22.5

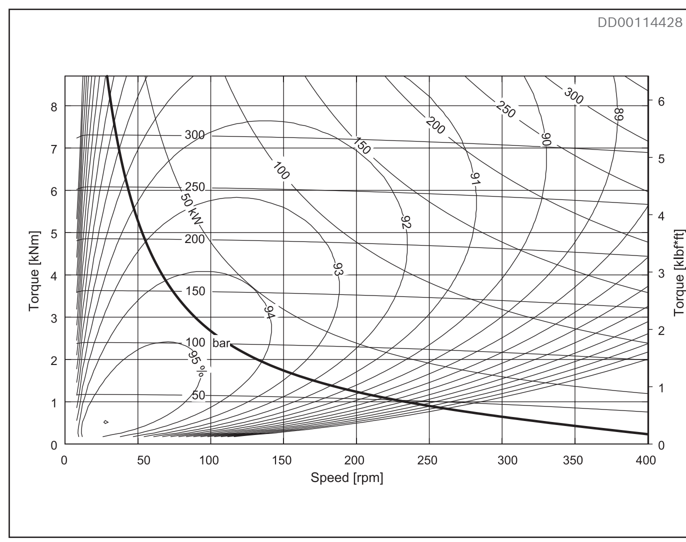

Fig. 14: Atom 20 25

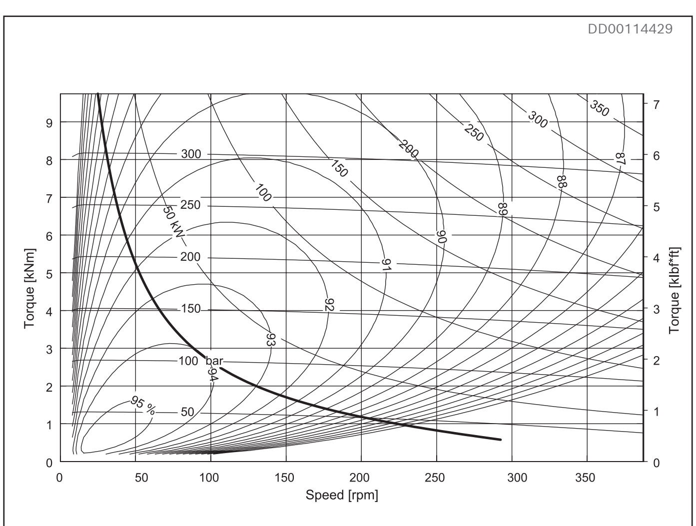

Fig. 15: Atom 30 28

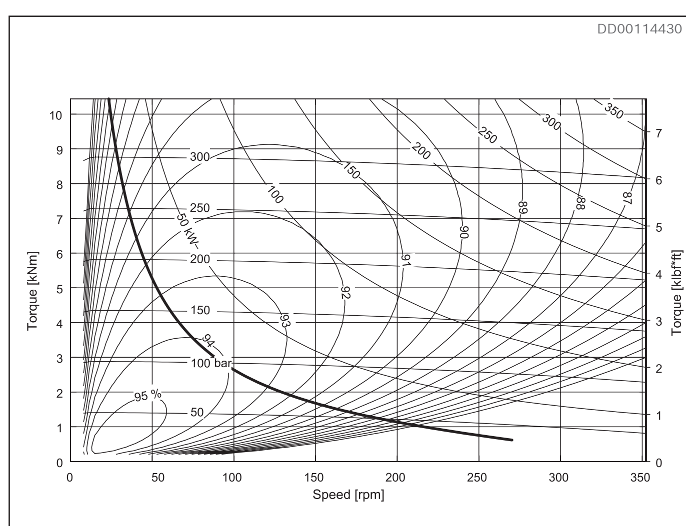

Fig. 16: Atom 30 30

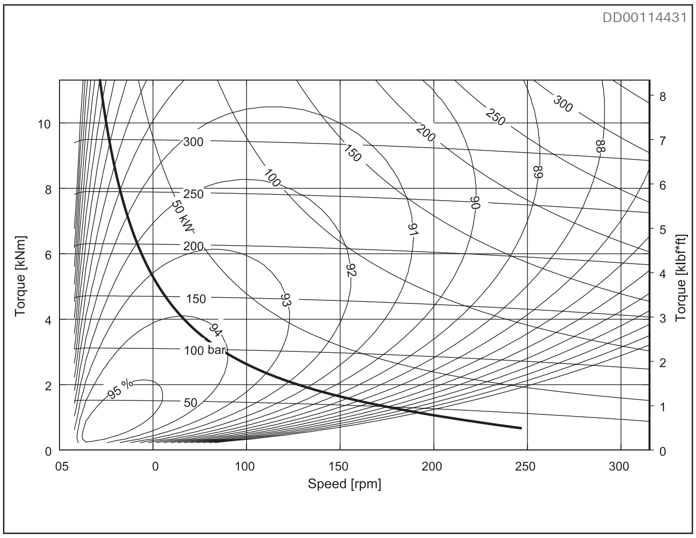

Fig. 17: Atom 30 32.5

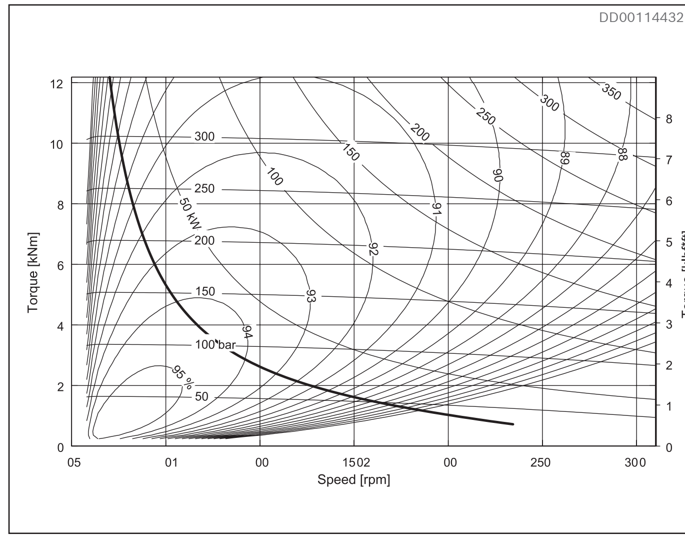

Fig. 18: Atom 30 35

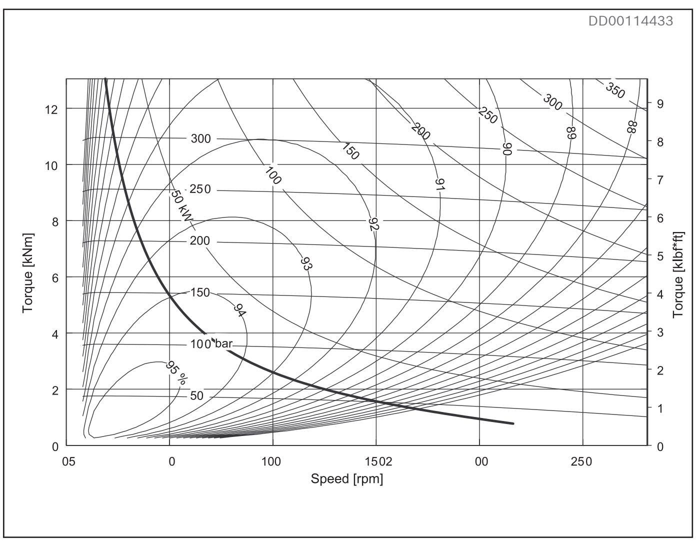

Fig. 19: Atom 30 37.5

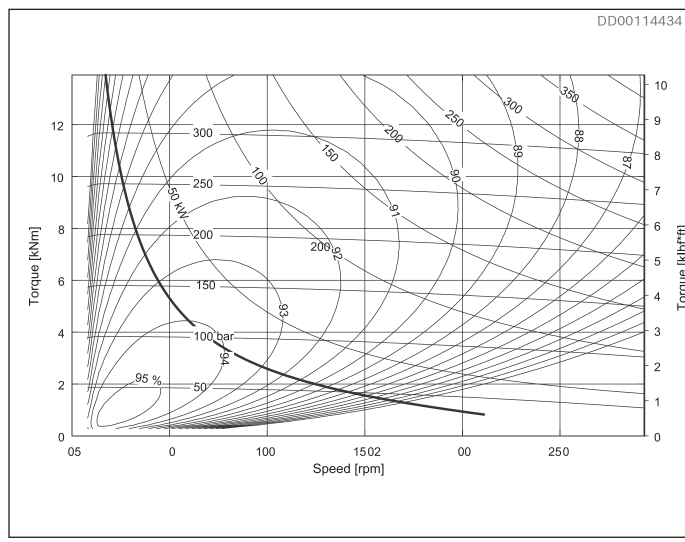

Fig. 20: Atom 40 40

4.7 Pressure loss diagrams

Oil viscosity 40 cSt

$$\text{Actual pressure difference} = \frac{\text{output torque}}{\text{specific torque} \cdot \text{mechanichal effiency}} + \text{pressure loss} \qquad \Delta p = \frac{T}{Ts \cdot \eta_m} + \Delta p_l$$

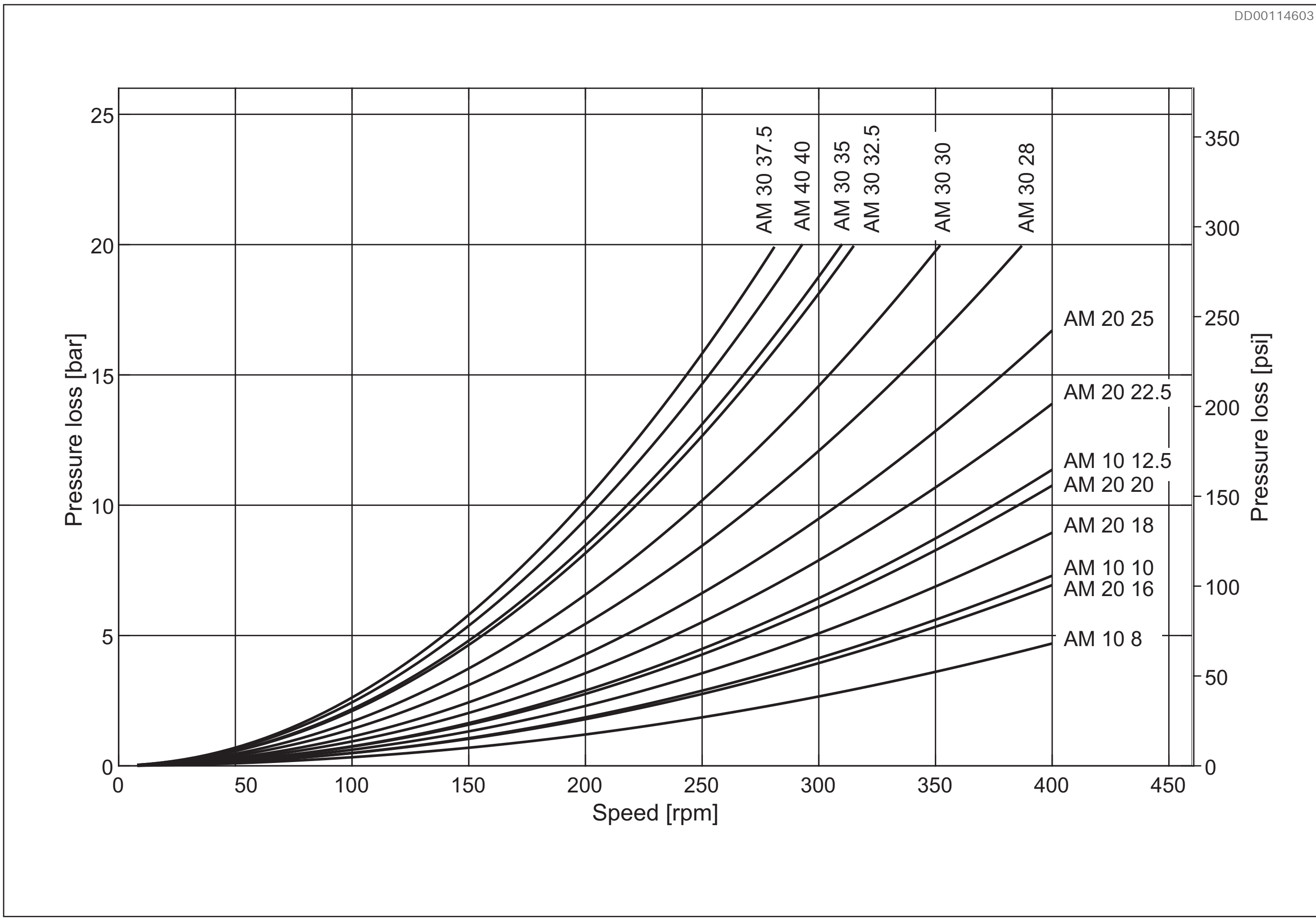

Fig. 21: Atom 10 to Atom 40 pressure loss

4.8 Quick selection diagram

Rated life for Hägglunds Atom is calculated according to DIN ISO 281 Apendix 1.

The diagram below represents the torque and speed, corresponding to a modified rating life L10mh = 20 000 h. Oil viscosity in motor case 40 cSt. Contamination level not exceeding 18/16/13 according to ISO 4406 (NAS 1638, class 7).
The diagram is based on a low pressure of 2 bar (29 psi).

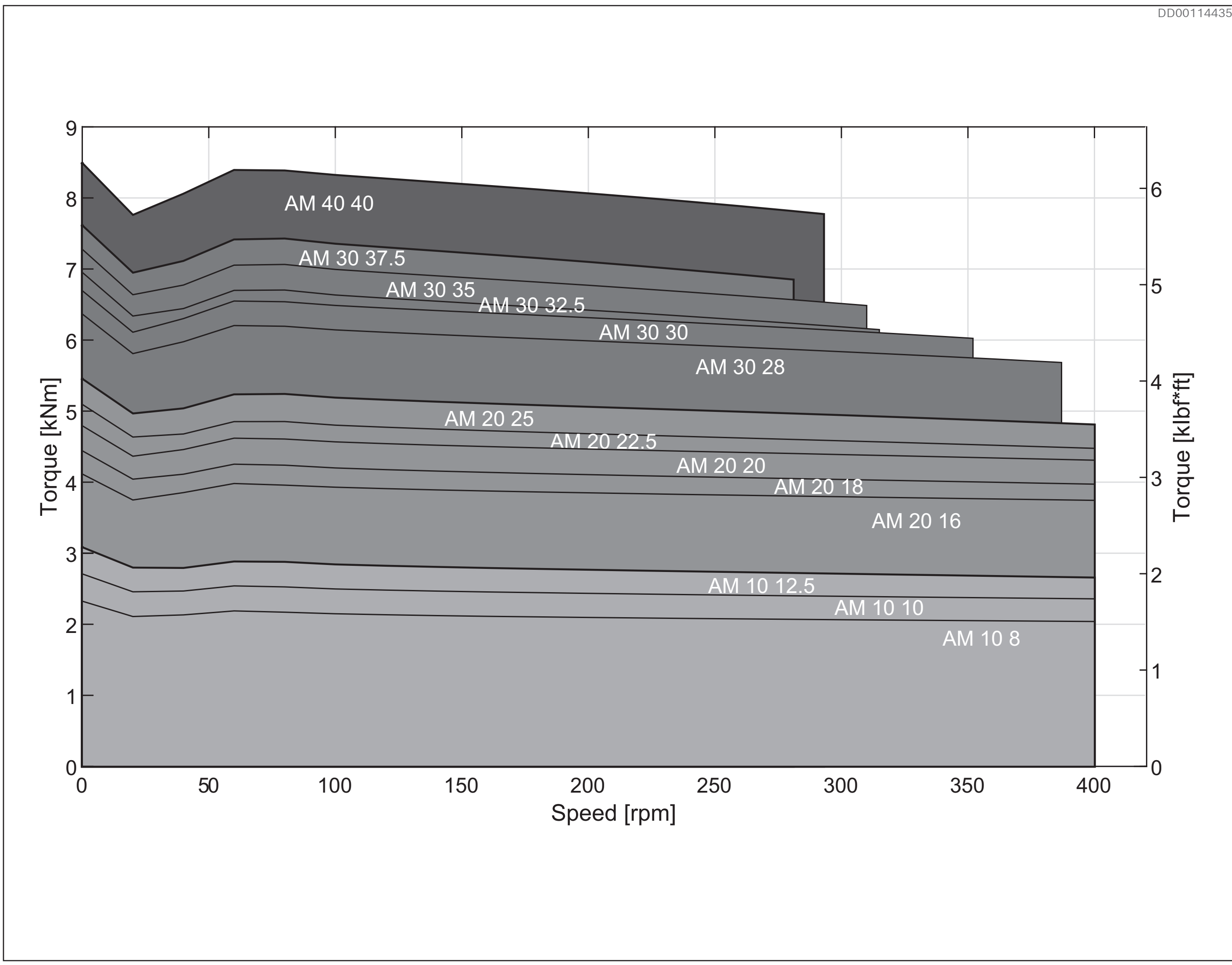

Fig. 22: Quick selection diagram

Note!
Higher case oil viscosity increases the motor rating life considerably. Reduced temperature in the motor case will increase rating life for the motor.

4.9 Draining, venting and flushing of the motor

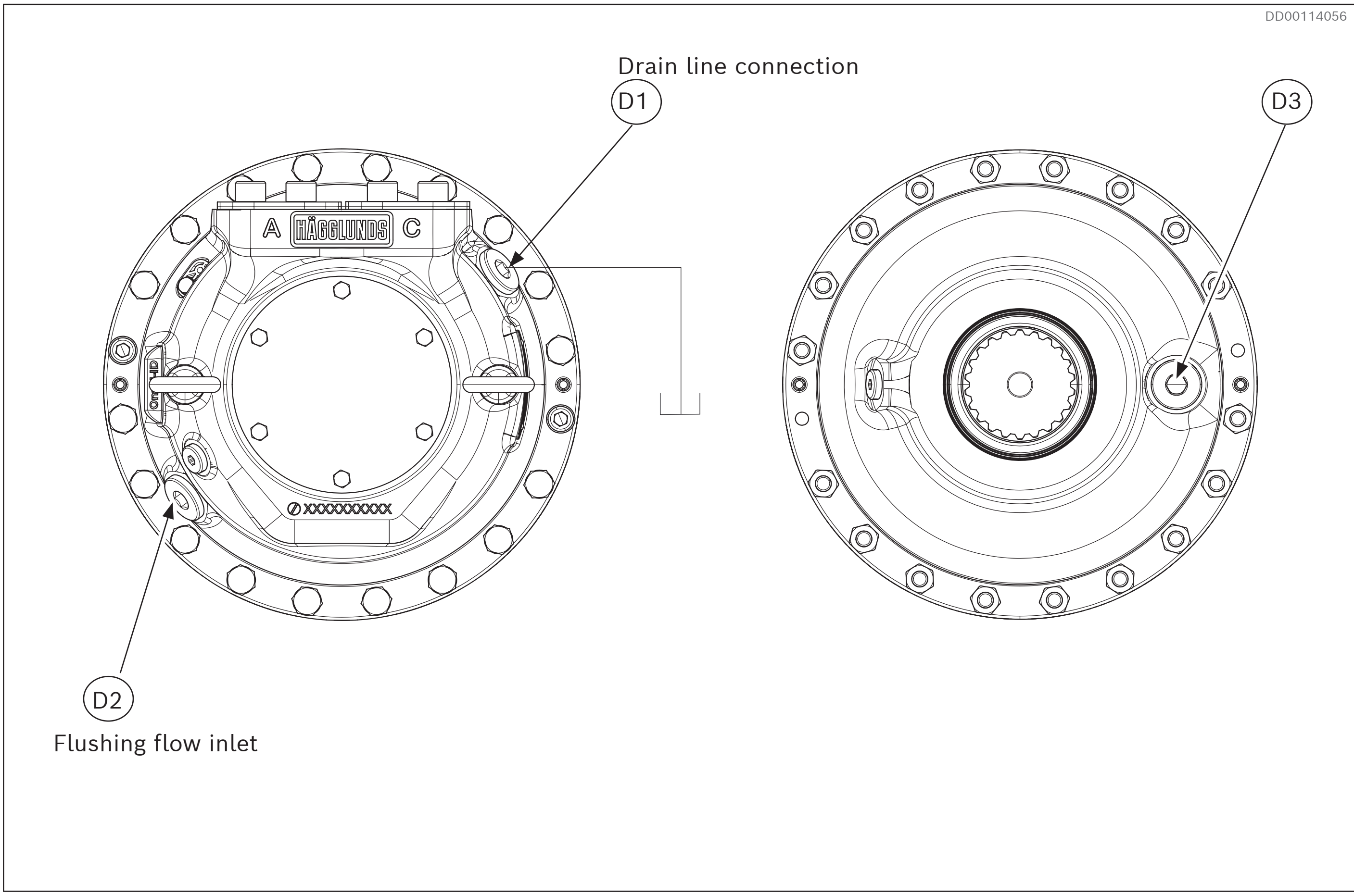

Fig. 23: Horizontal mounting

4.9.1 Horizontal mounting

When the motor is installed with the shaft in the horizontal plane, the highest of the drain outlets D1, D2 or D3 must always be used (see *Fig. 23*).
Drain line must be connected to the tank with a minimum of restrictions, to ensure that the maximum case pressure is not exceeded.

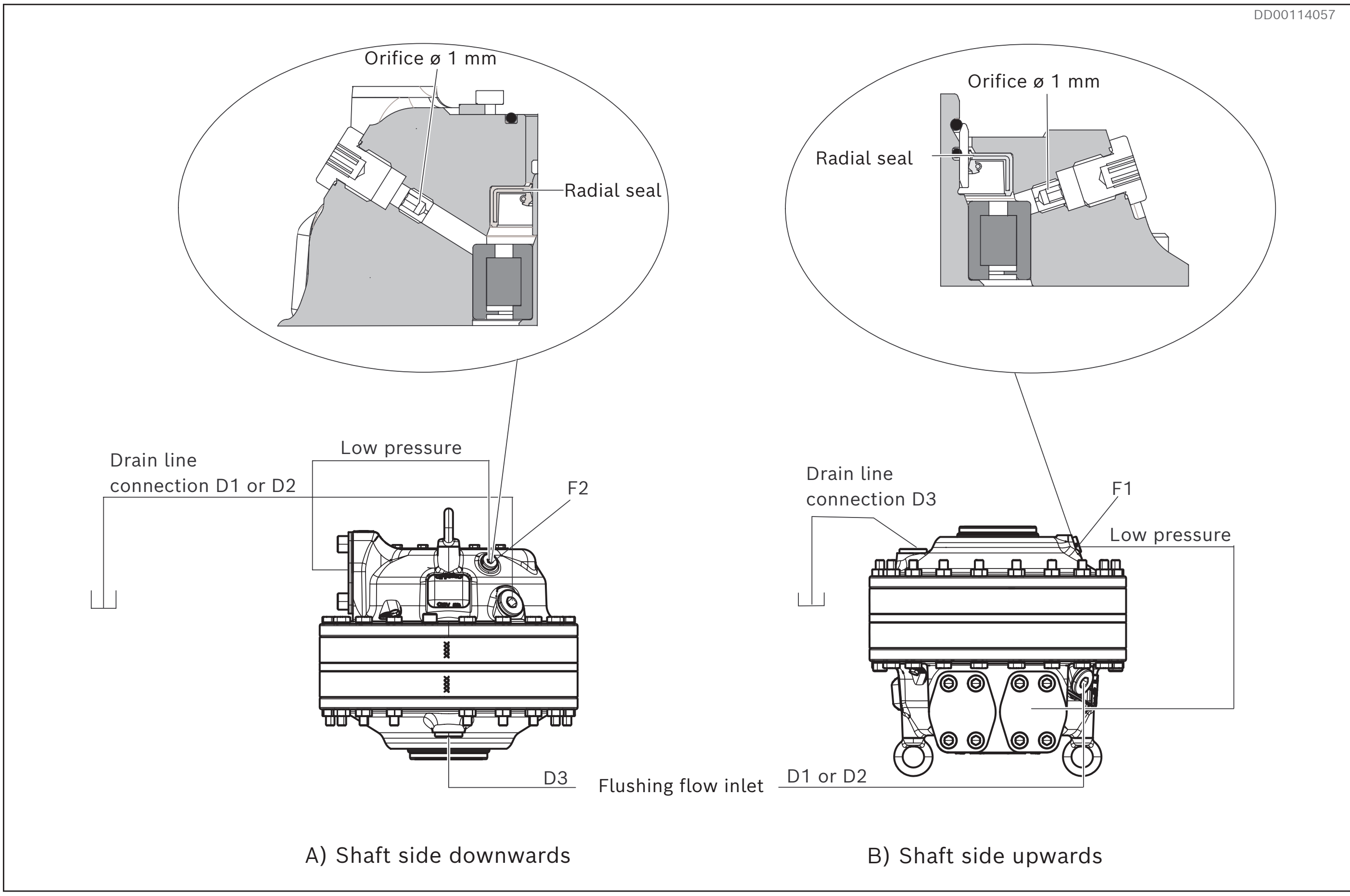

Fig. 24: Vertical mounting

4.9.2 Vertical mounting

When the motor is mounted vertically, one of the highest drain ports D1, D2 or D3 must be used.
Flushing (lubrication) of radial seal from low pressure is necessary.

A) Motor shaft pointing downwards

The drain line must be connected to one of the drain ports D1 or D2 in the connection housing. (See *Fig. 24* alt. *A) Shaft side downwards*).
The flushing connection F2 on the connection housing shall be connected to low pressure. With bidirectional drives, use the connection with lowest average pressure. (Connecting to high pressure will increase the motor drain flow).

B) Motor shaft pointing upwards

The drain line must be connected to the drain port D3 in the housing cover. (See *Fig. 24*, *alt. B) Shaft side upwards*).
The flushing connection F1 on the housing cover should be connected to the low pressure. With bidirectional drives, use the connection with lowest average pressure. (Connecting to high pressure will increase the motor drain flow).

4.10 Flushing

Flushing of motor case

Viscosity in the motor case must be controlled according to *4.5 Hydraulic fluids*. The motor must be flushed when shaft power exceeds a defined limit, EFL. 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 required viscosity in the motor case as specified in *4.5 Hydraulic fluids*.

Table 8: Maximum motor power without flushing

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

Continuously running motor

The motor power is calculated:

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

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

Intermittently running motor

The time weighted arithmetic average of the motor power is:

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

where
Δtj = the time period the motor is running with the power Ej
Ej = intermittent motor power

A Atom 10 - Atom 40 motor typically reach close to the final temperature in 200 s, after a change in the power. The calculation model is valid if the total period time of the cycle ∑Δtj is less than this time.

Required flushing

Fig. 25 shows required flushing to keep motor case temperature maximum 10 degrees Celcius (18 F) warmer than the flushing oil.

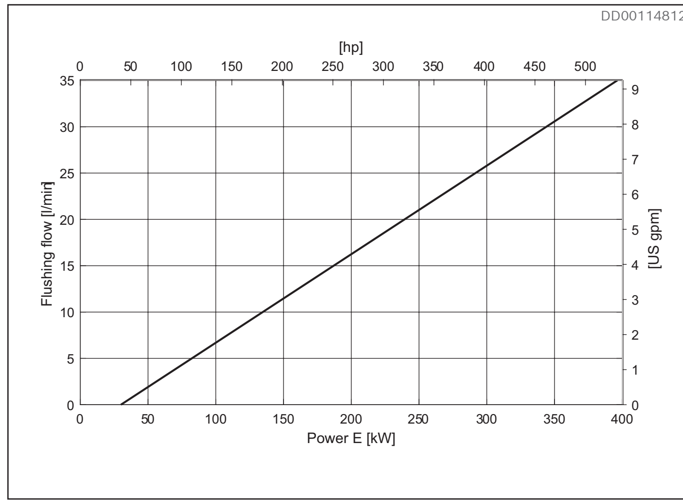

Fig. 25: Required flushing flow

Example 1: Continuously running motor

Atom 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 according to *Fig. 25*.

Example2: Intermittently running motor

Atom 20 20, working at two different conditions,

1) ph = 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) ph = 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.

4.11 External leakage

External leakage is from the distributor to the motor case and from the piston assembly to the motor case.
Valid for 40 cSt and at **1/3 of max speed.**

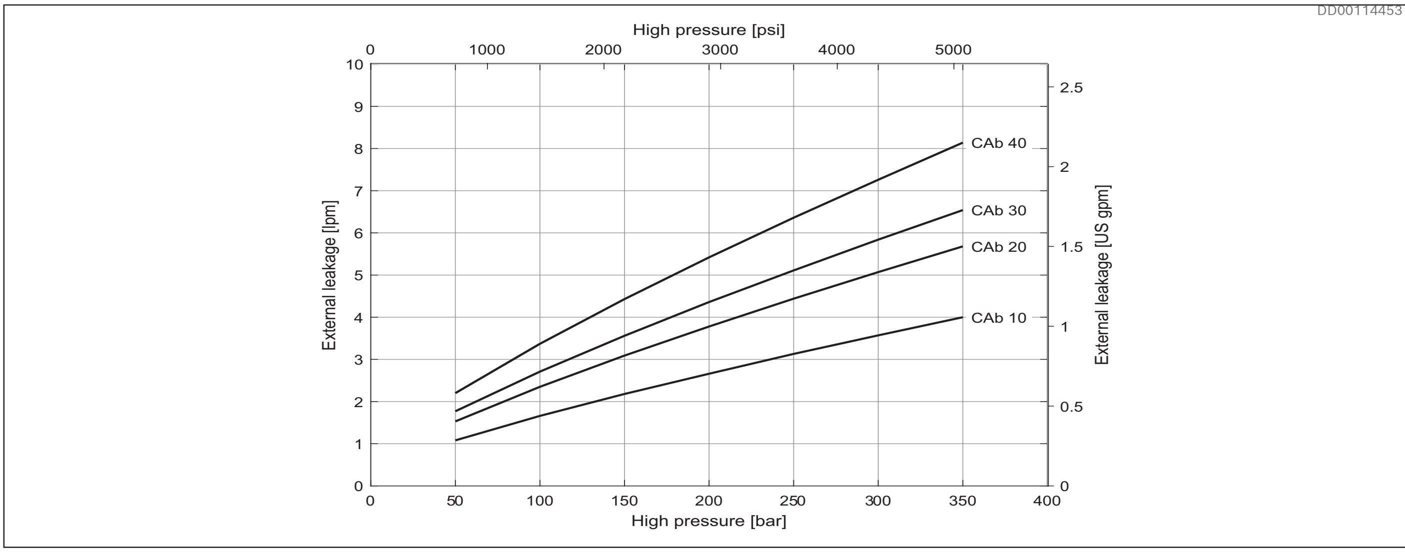

Fig. 26: External leakage. The diagram shows the average values, valid for 40 cSt and at 1/3 of max speed

4.12 Viscosity factor K

The diagram shows the average values.
Actual flow rate = speed · displacement + external leakage

$$q = \frac{n \cdot V_i}{1000} + q_i \cdot \mathrm{K} \quad [\mathrm{l/min}]$$

Variation in external leakage at different oil viscosities. When calculating external leakage using other viscosities than 40 cSt, multiply the value given in the external leakage diagram by the factor K.

$$q_{US} = \frac{n \cdot V_i}{231} + q_i \cdot \mathrm{K} \quad [\mathrm{gpm}]$$

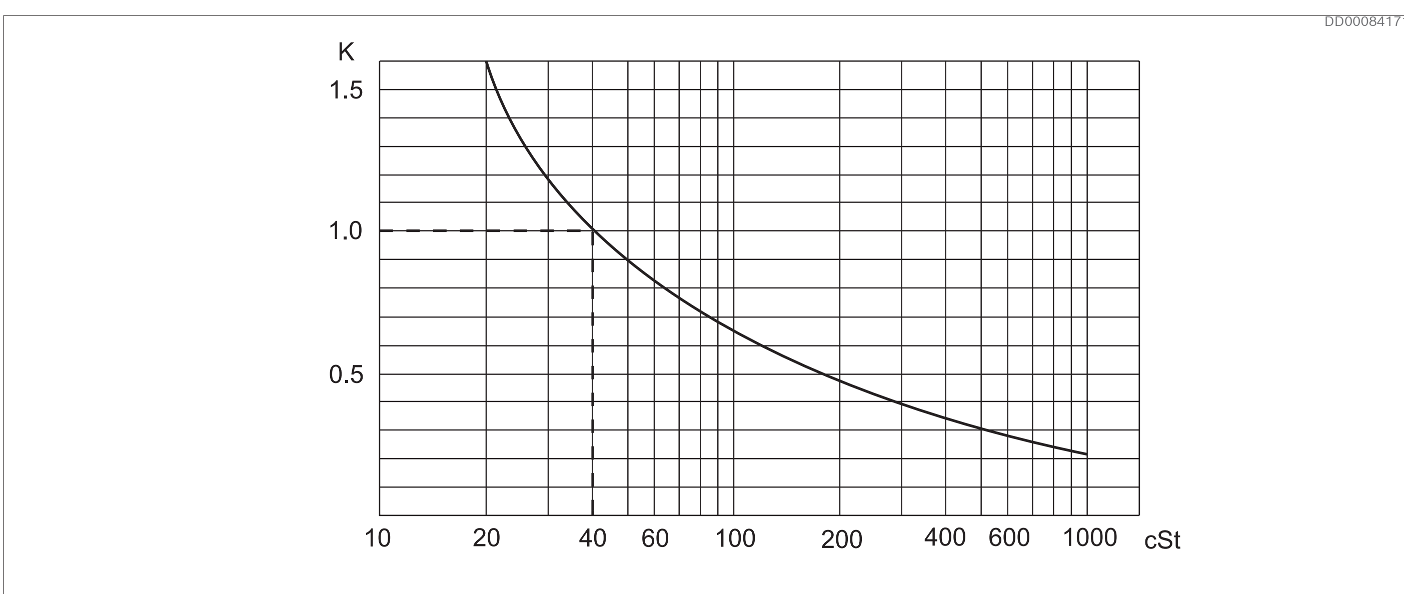

Fig. 27: Viscosity factor K

4.13 Permissible external loads

External load with torque arm mounting

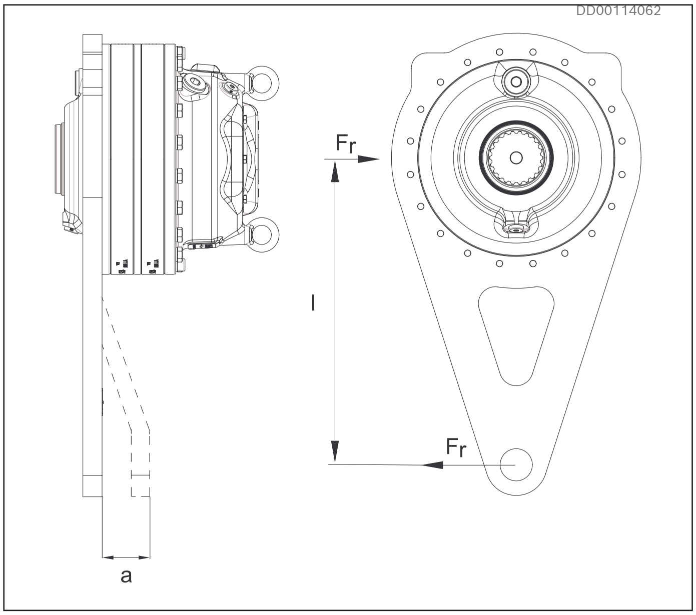

Fig. 28: Shaft mounted motor with torque arm

If non standard torque arms TCA are used, forces must be checked for main bearings.

$$F_r = \frac{T}{l}$$

F_r = Total radial force on fixed motor mounting

T = Output torque for motor

l = Lever length

a = The axial distance for action point of radial force

> **Note!**
> For flange mounted motor, be aware of required installation tolerances which will minimize the external forces on the motor. See RE 15354-WA or contact your Bosch Rexroth representative.

External load with bracket mounted motor

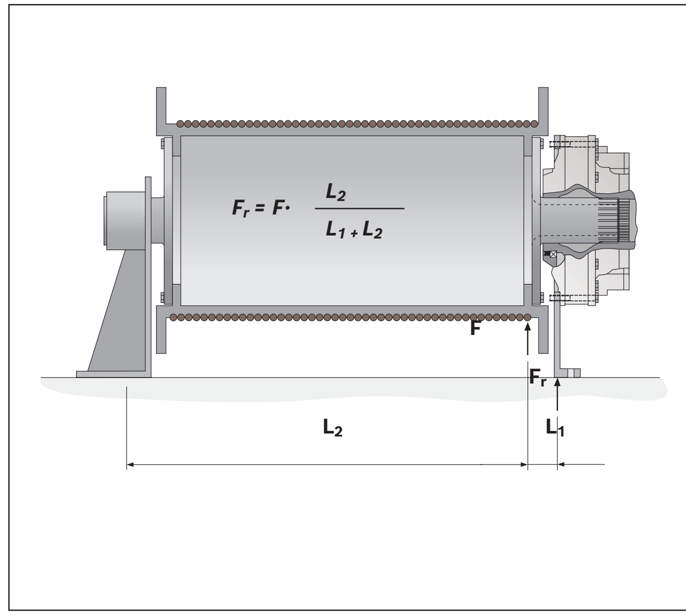

Fig. 29: Bracket mounted motor in winch - reaction forces

The bracket must be designed so it does not give extra external forces to the motor.

External load for flange mounted motor mounted with pinion drive

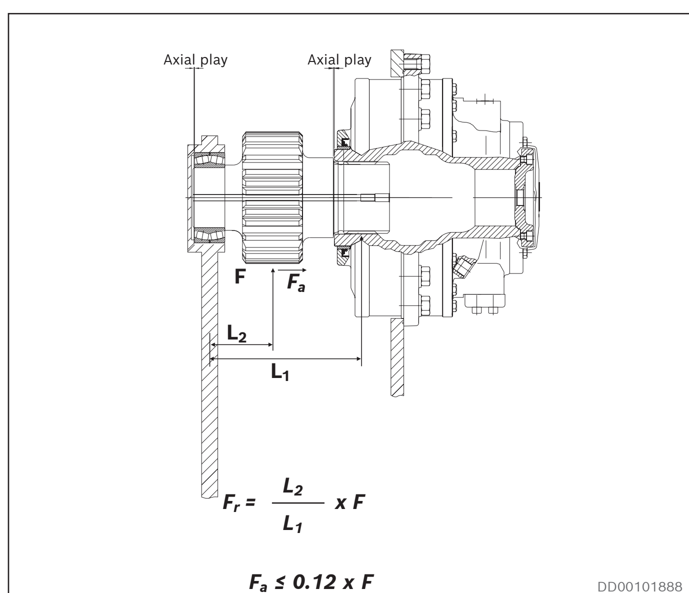

Fig. 30: Example of motor mounted with pinion drive - prefered design

4.13.1 Permissible external dynamic load

Torque arm mounted motor. Viscosity 40 cSt/187 SSU and L10mh.

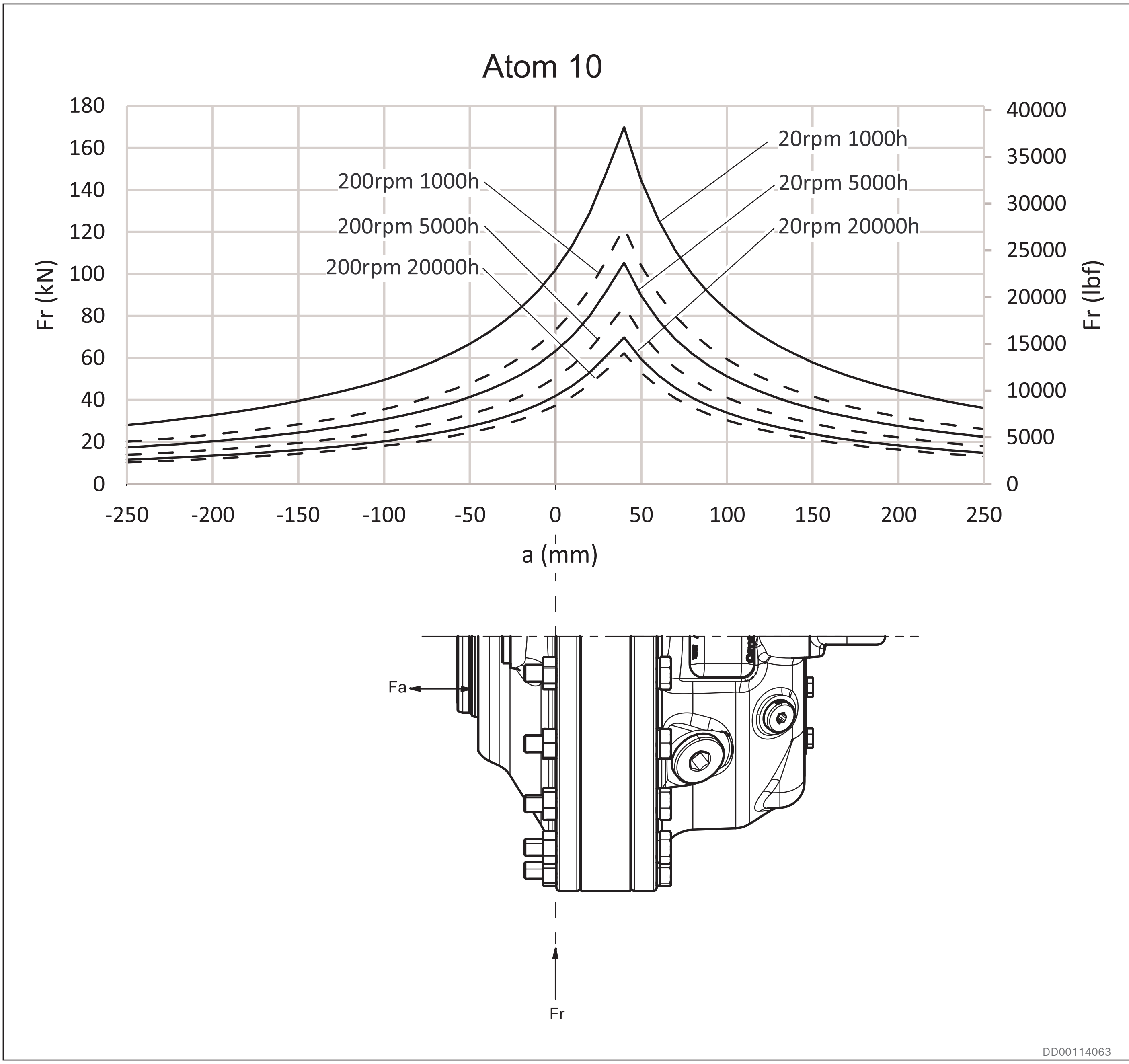

Fig. 31: Permissible external dynamic load Hägglunds Atom 10

Axial loads: Permissible axial load for intermittent duty Fa = 10 000 N (2 200 lbf).

Remark: For continuous axial load applications, please contact your Bosch Rexroth representative.

Torque arm mounted motor. Viscosity 40 cSt/187 SSU and L10mh.

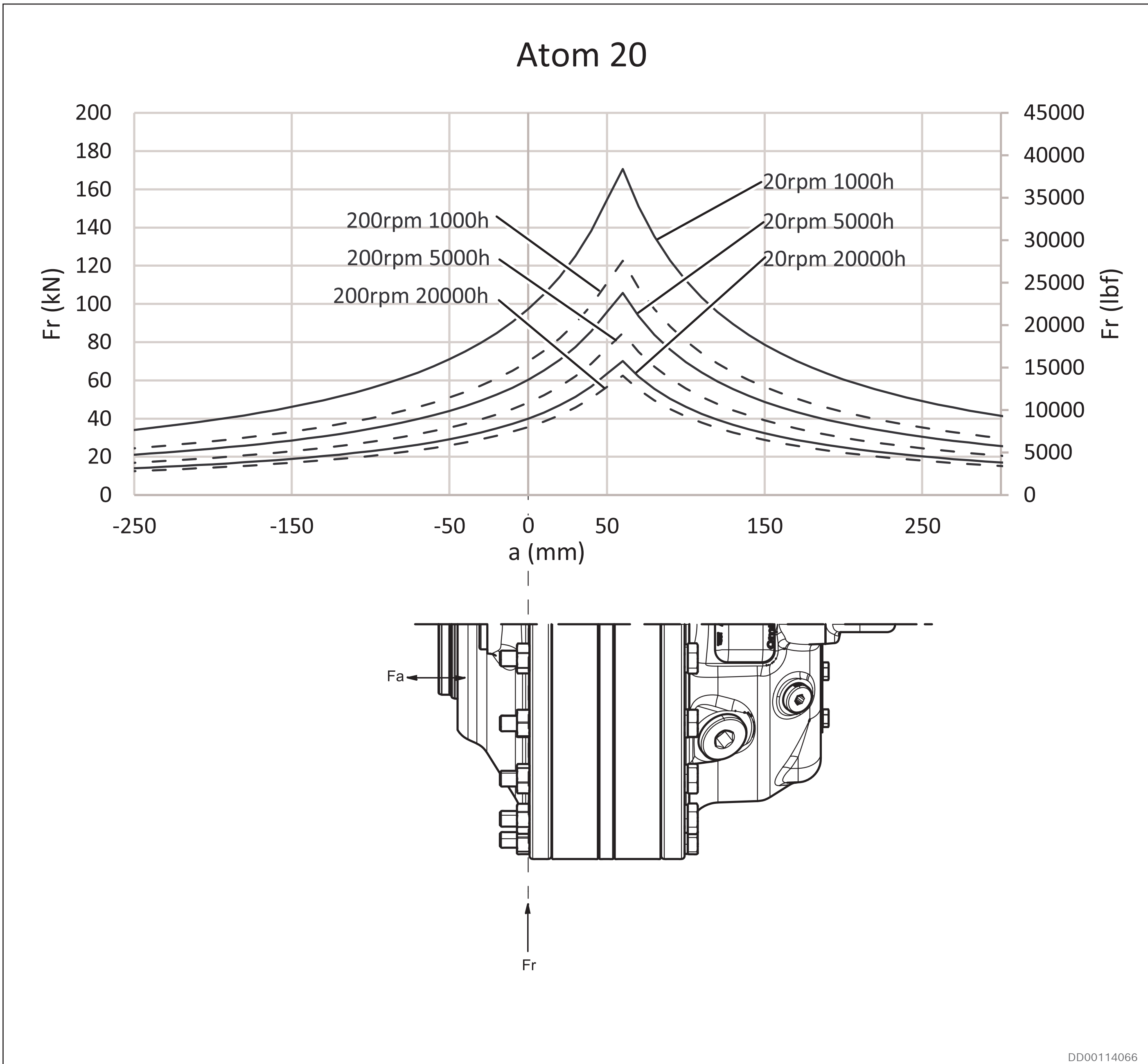

Fig. 32: Permissible external dynamic load Hägglunds Atom 20

Axial loads: Permissible axial load for intermittent duty Fa = 10 000 N (2 200 lbf).

Remark: For continuous axial load applications, please contact your Bosch Rexroth representative.

Torque arm mounted motor. Viscosity 40 cSt/187 SSU and L10mh.

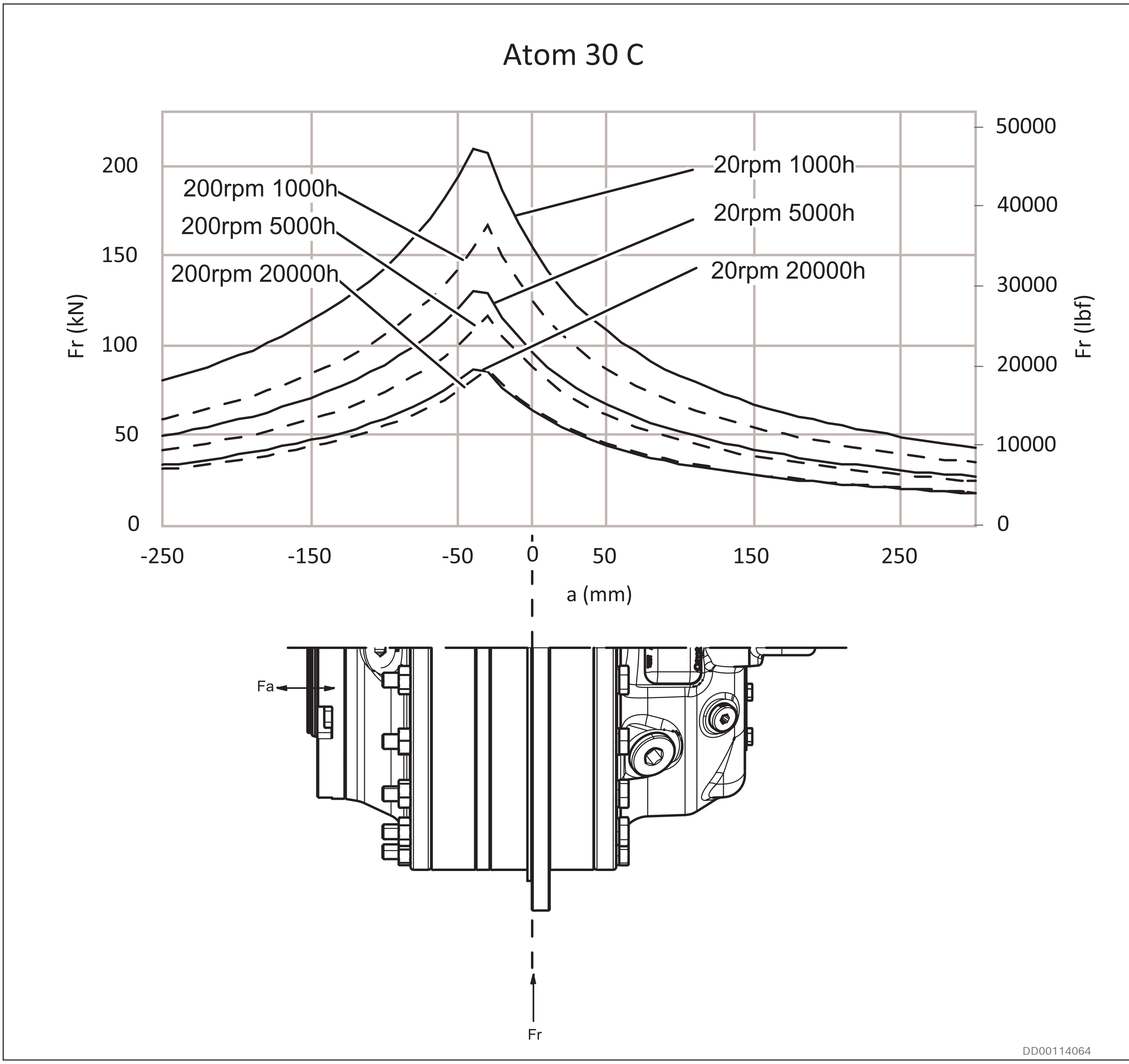

Fig. 33: Permissible external dynamic load Hägglunds Atom 30 C (center flange)

Axial loads: Permissible axial load for intermittent duty
Fa = 10 000 N (2 200 lbf).

Remark: For continuous axial load applications, please contact your Bosch Rexroth representative.

Torque arm mounted motor. Viscosity 40 cSt/187 SSU and L10mh.

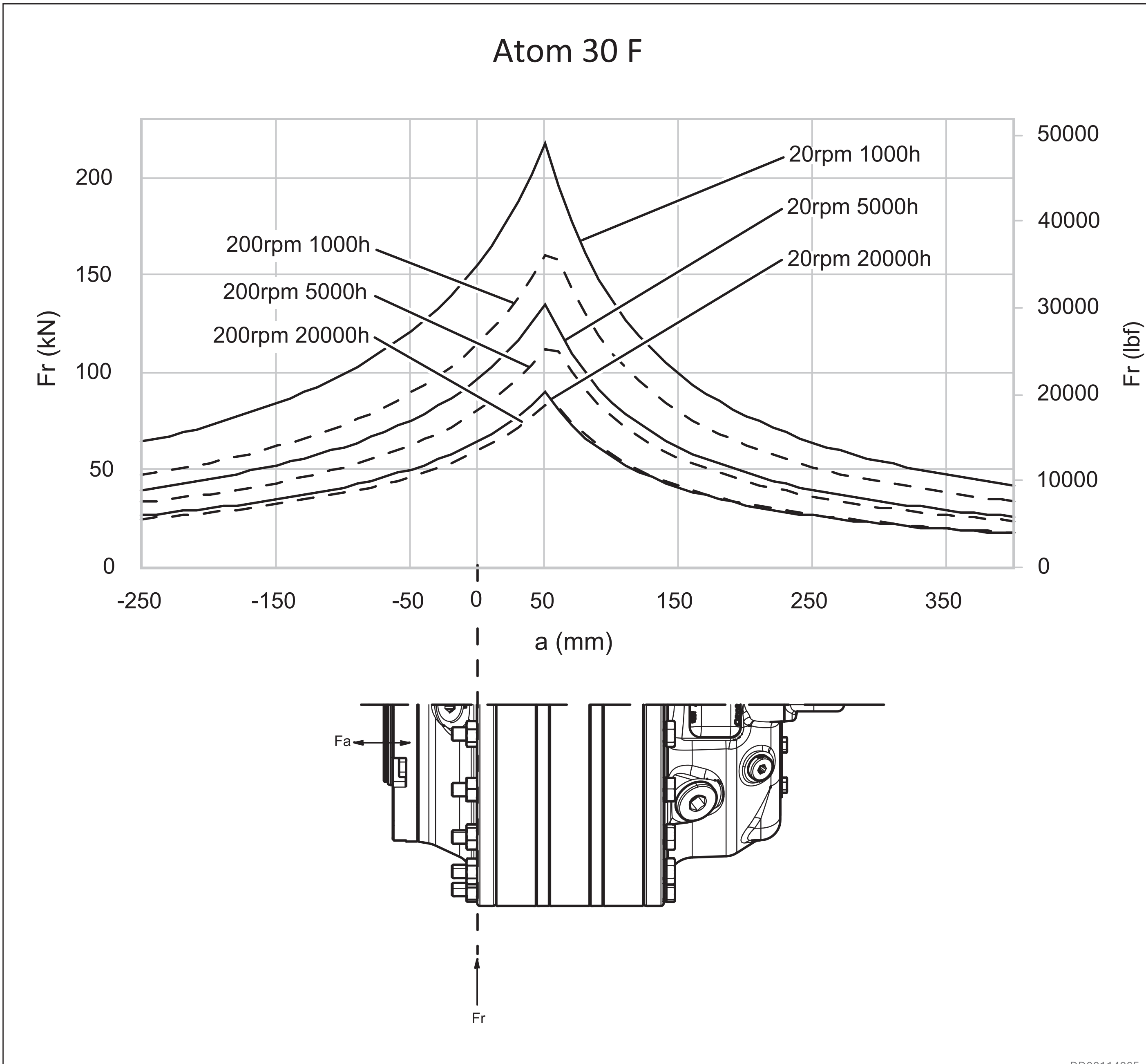

Fig. 34: Permissible external dynamic load Hägglunds Atom 30 28 F and Atom 30 30 F (front flange)

Axial loads: Permissible axial load for intermittent duty
Fa = 10 000 N (2 200 lbf).

Remark: For continuous axial load applications, please contact your Bosch Rexroth representative.

Torque arm mounted motor. Viscosity 40 cSt/187 SSU and L10mh.

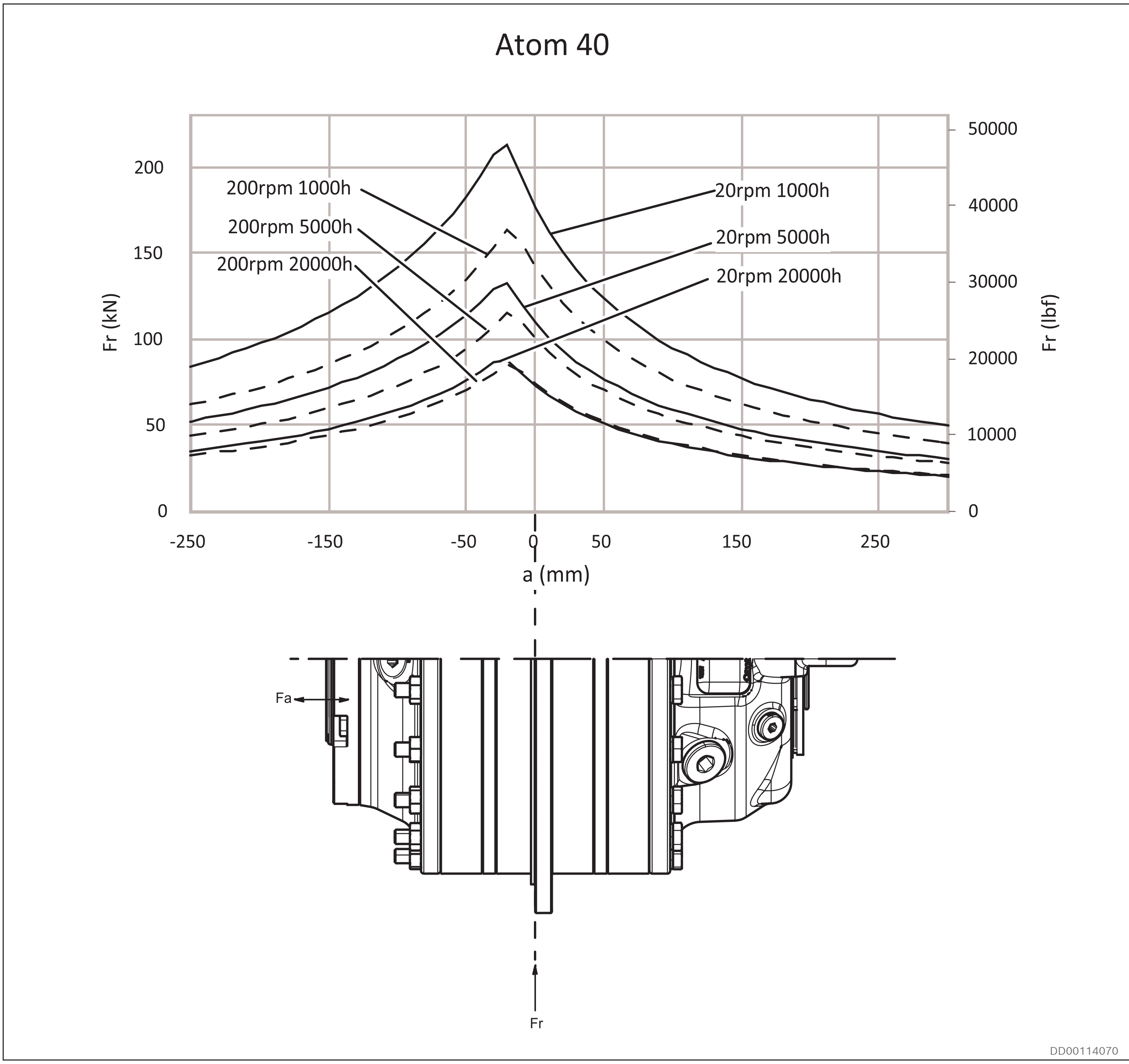

Fig. 35: Permissible external dynamic load Hägglunds Atom 40

Axial loads: Permissible axial load for intermittent duty Fa = 10 000 N (2 200 lbf).

Remark: For continuous axial load applications, please contact your Bosch Rexroth representative.

4.13.2 Permissible external static load

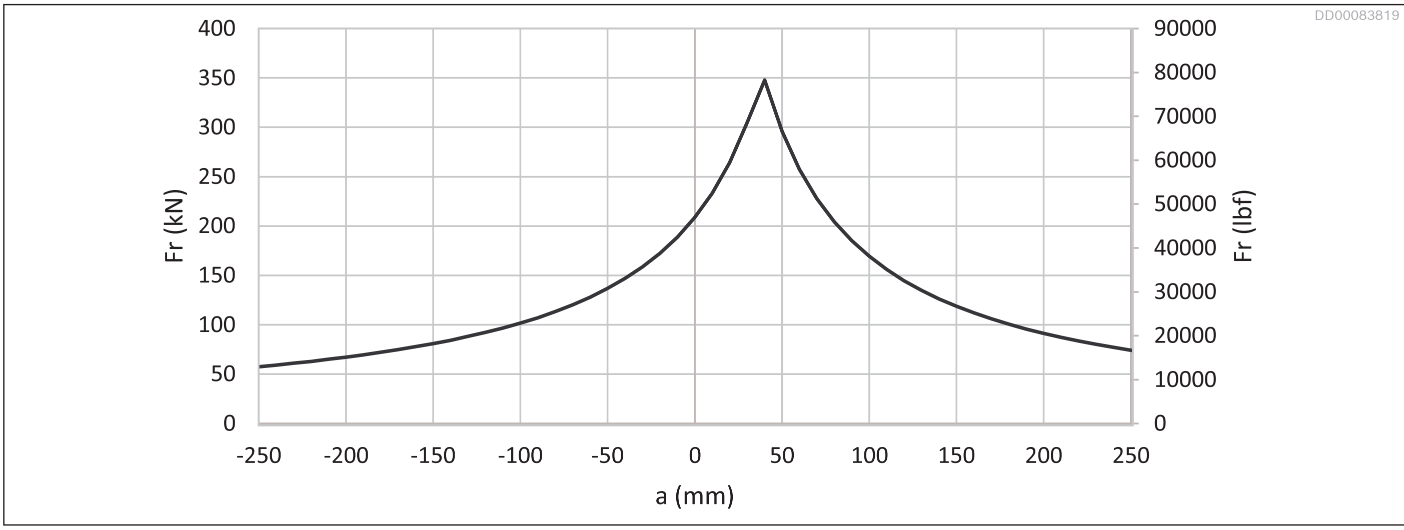

Fig. 36: Permissible external static load Hägglunds Atom 10

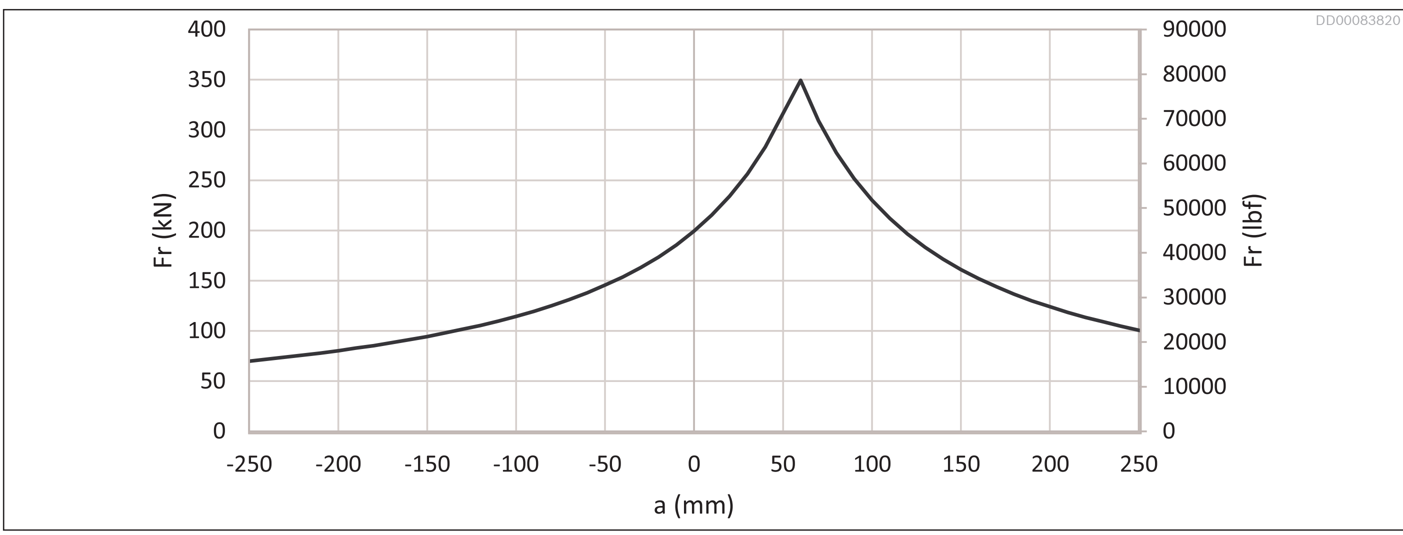

Fig. 37: Permissible external static load Hägglunds Atom 20

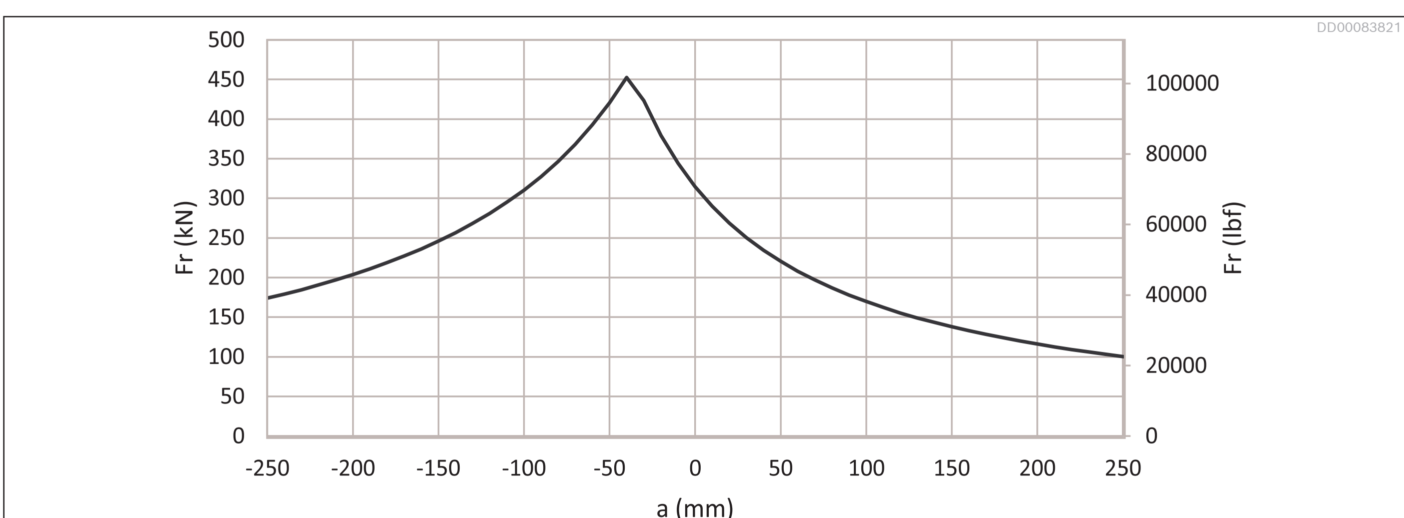

Fig. 38: Permissible external static load Hägglunds Atom 30 C (center flange)

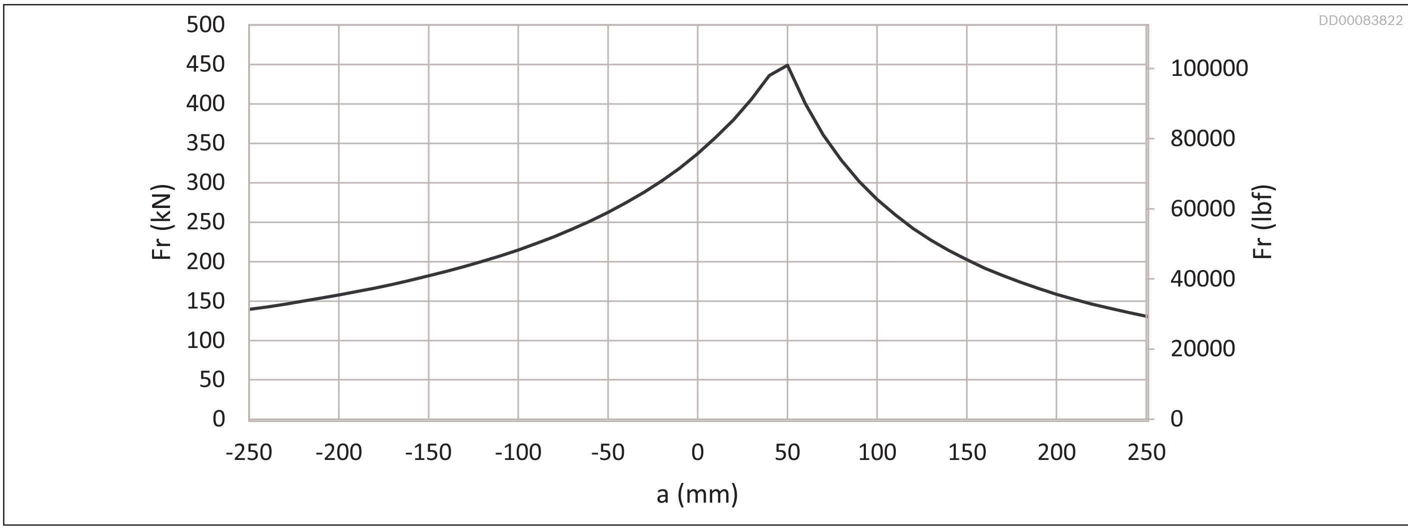

Fig. 39: Permissible external static load Hägglunds Atom 30 28 F and Atom 30 30 F (front flange)

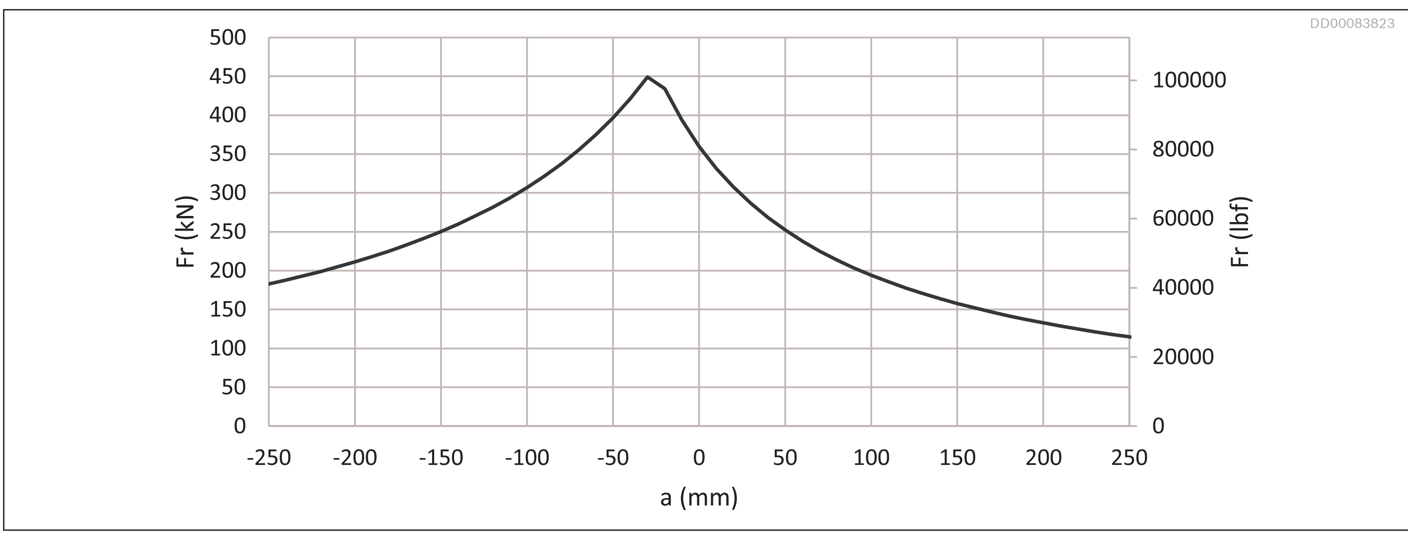

Fig. 40: Permissible external static load Hägglunds Atom 40

4.14 Low speed performance

Fig. 41 and *Fig. 42* shows speed deviation factor "i" as function of n_{av} for viscosities 40 cSt and 150 cSt respectively. Values should be seen as guiding values.
A is max. deviation from average speed in rpm.
n_{av} is average speed in rpm.

A = n_{av} * i (rpm)

n_{max} = n_{av} + A (rpm)

n_{min} = n_{av} - A (rpm)

Example for Atom:
Presume n_{av} = 3 rpm, p_{max} = 150 bar and viscosity 40 cSt
n_{av} = 3 rpm gives i = 0,2 (see *Fig. 41*) and
A = 3 * 0,2 = 0,6 rpm.
n_{max} = 3 + 0,6 = 3,6 rpm
n_{min} = 3 - 0,6 = 2,4 rpm

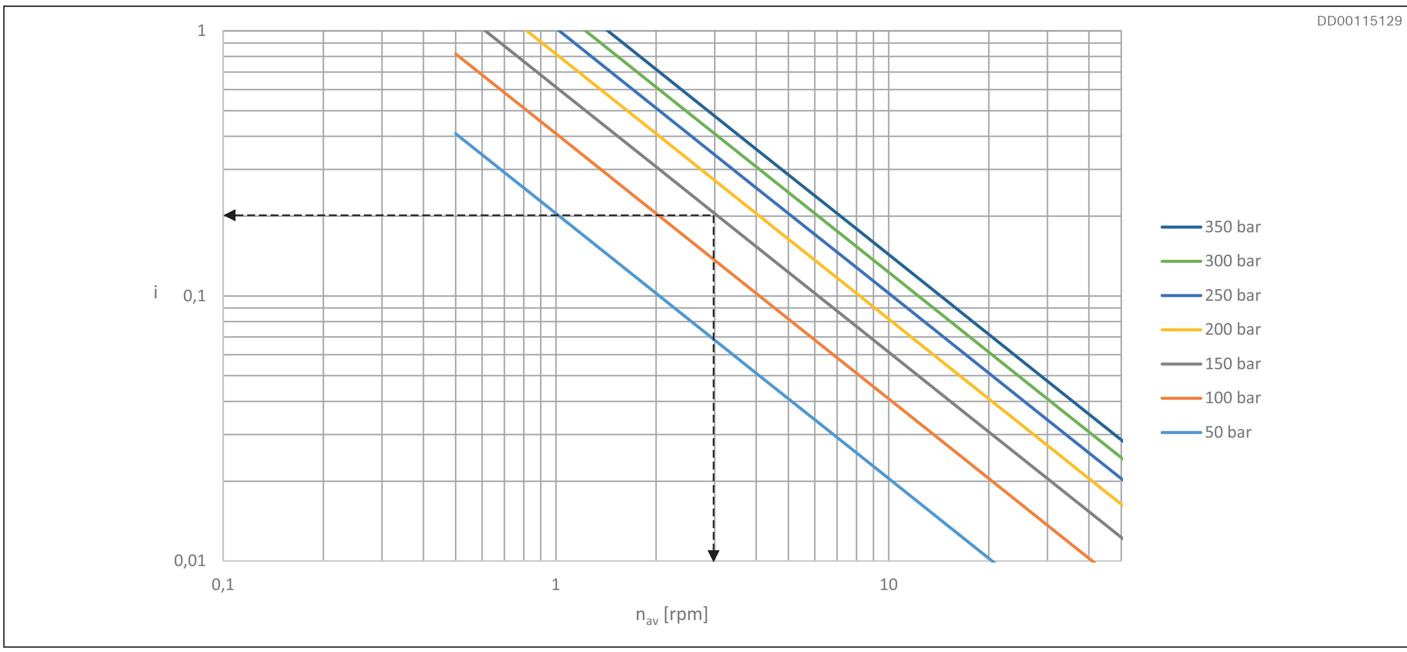

Fig. 41: Speed variation Atom, 40 cSt

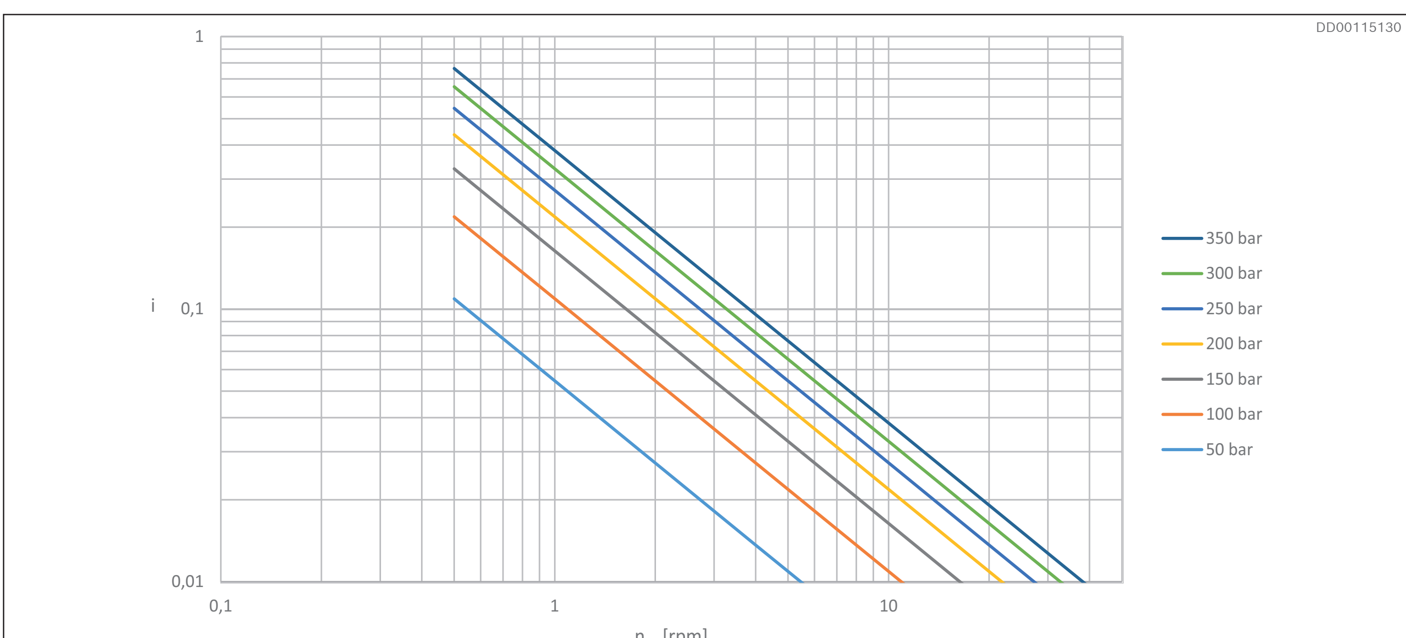

Fig. 42: Speed variation Atom, 150 cSt

Speed variation data was acquired according to ISO 4392-3 where torque on the shaft and flow into the motor is held constant.

In order to obtain smooth operation at low speed it is important to understand that the mechanisms behind speed variation are governed by leakage and friction variation in the motor together with characteristics of the load and the hydraulic system.

When the theoretical flow needed to rotate the motor is in the same order of magnitude or less than the leakage flow there is a risk for speed variation. Friction losses in the motor will increase at low speed due to reduced oil film thickness. Any variation in these friction losses may result in speed variation.

- Speed variation resulting from both friction and leakage will be lower with high case oil viscosity. Recomendation is to have a case oil viscosity between 100-150 cSt.

- The load characteristics on the shaft will also affect speed variation, for example moment of inertia, friction effects and natural frequency.

- Smooth operation at low speed is enhanced by a constant flow source, like a flow control valve or a small pump that is not operating in its lower displacement range.

- Compressibility of hydraulic oil volume between flow source and motor and deformation of hoses may also result in speed variation, especially if the natural frequency of the hydraulic system and the load is close to each other.

- Therefore, smooth operation is enhanced by a stiff hydraulic system connecting the flow source and the motor, i.e. using short pipings with small dimension.

4.15 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.

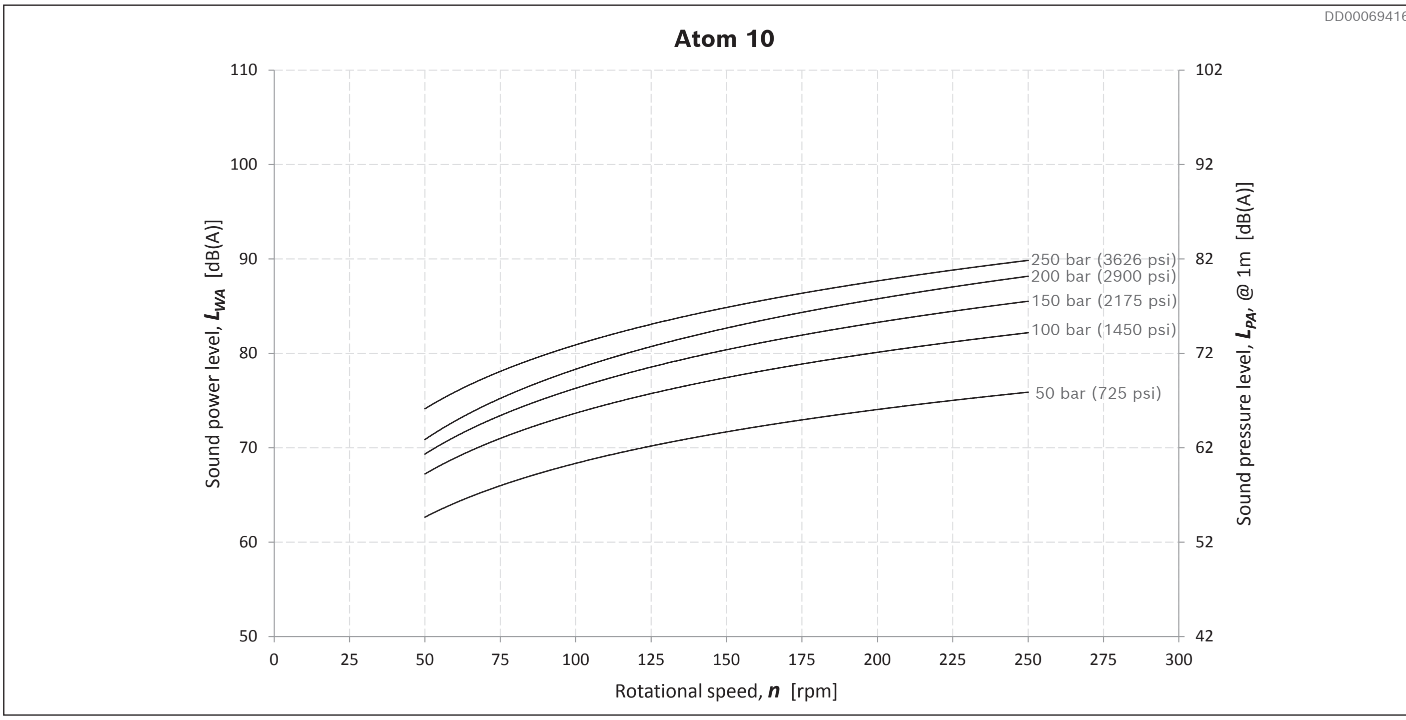

Fig. 43: Sound level Atom 10

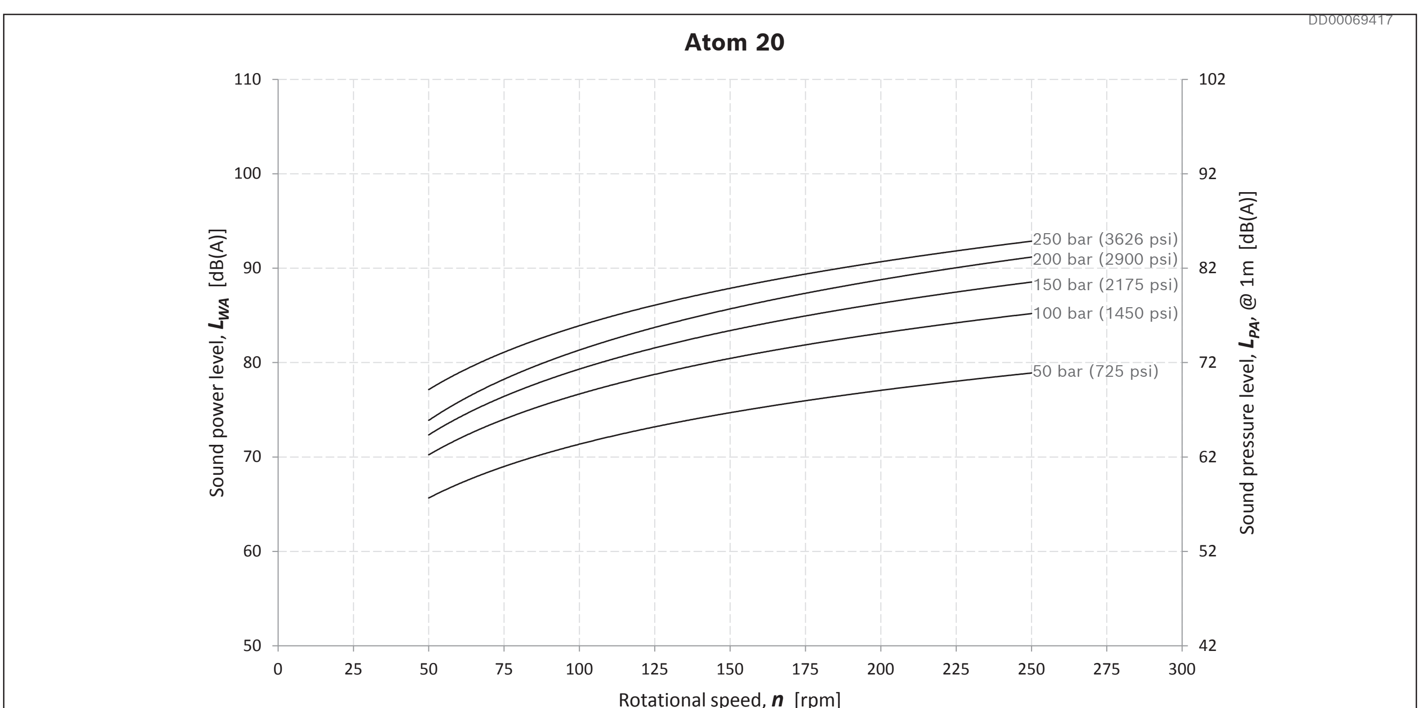

Fig. 44: Sound level Atom 20

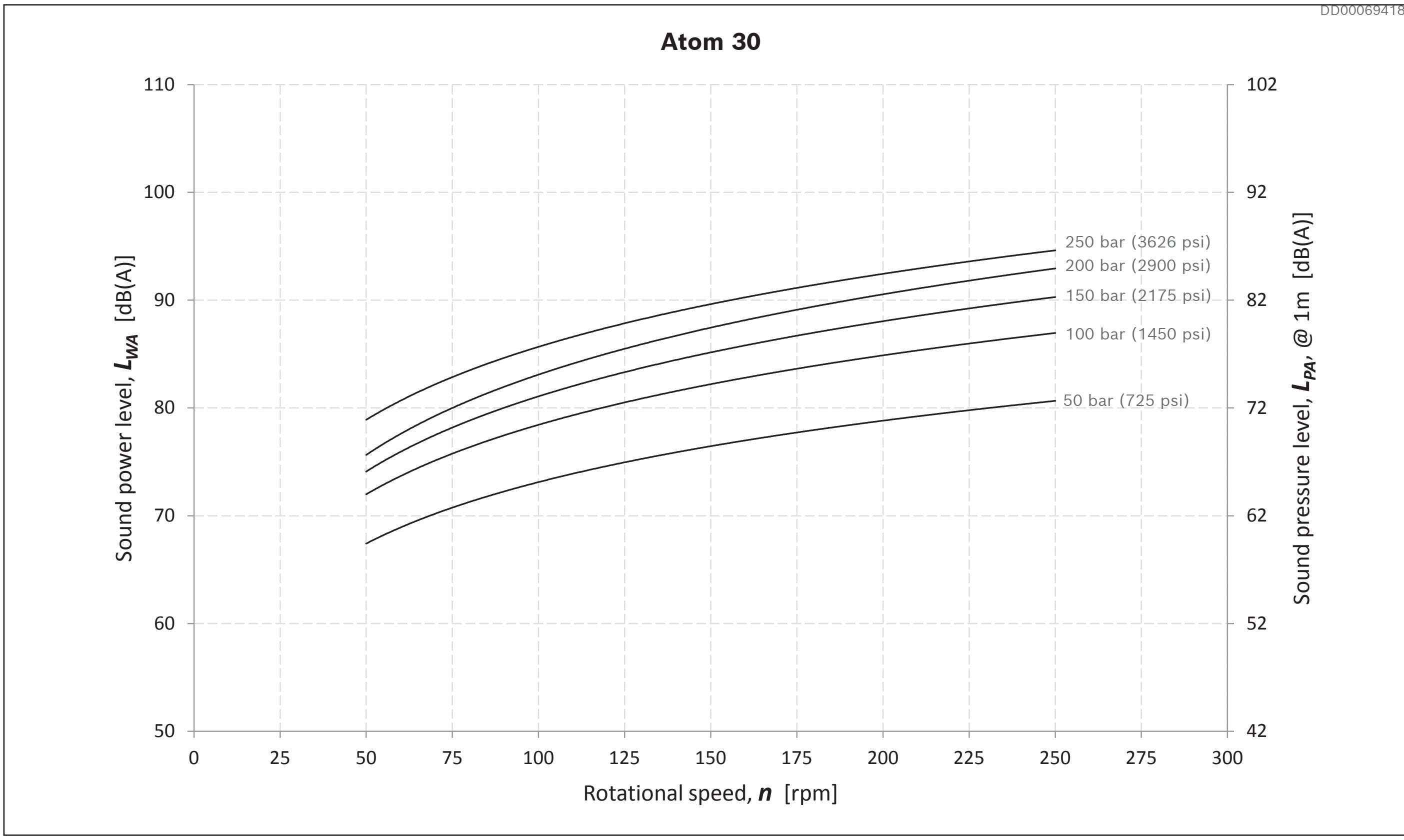

Fig. 45: Sound level Atom 30

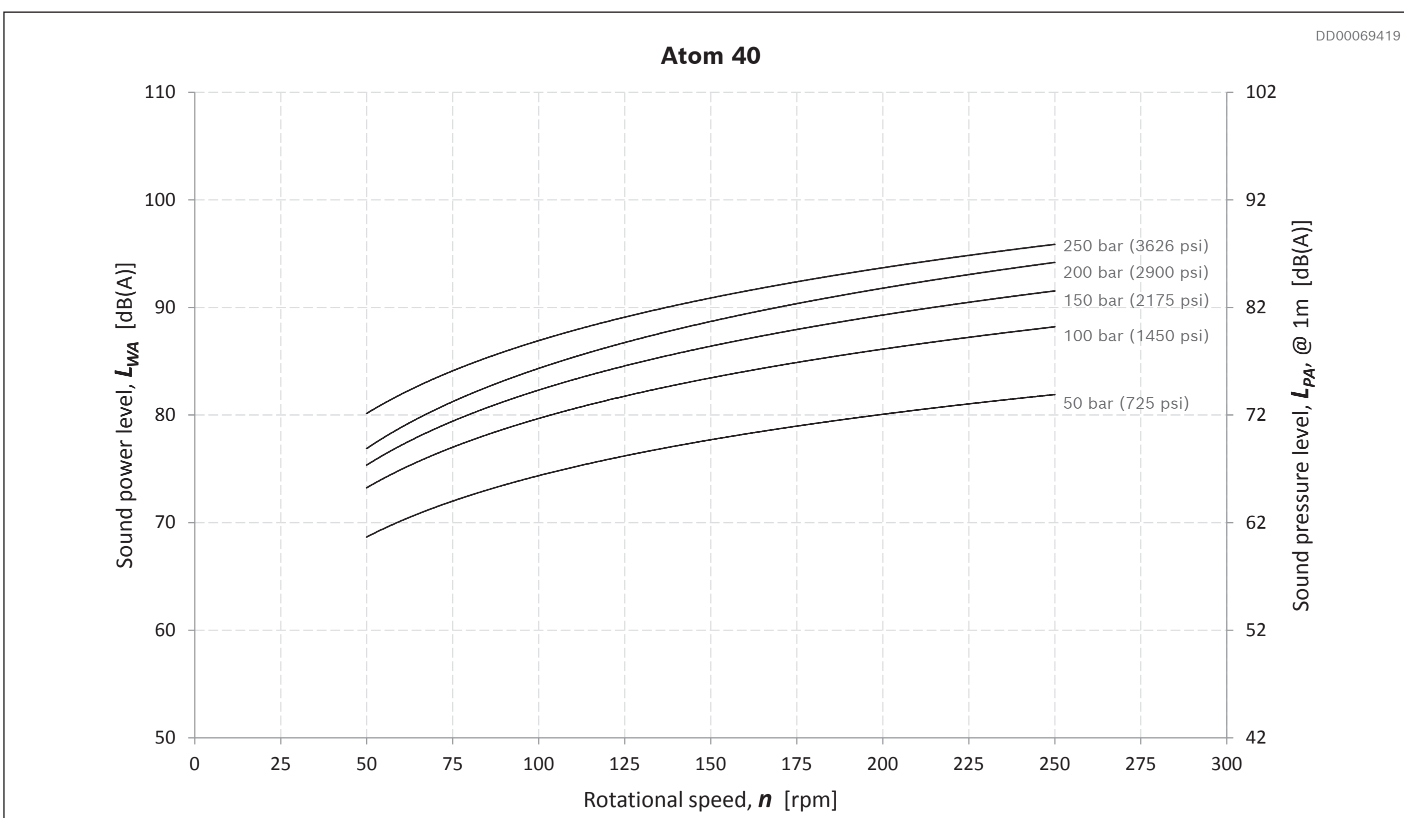

Fig. 46: Sound level Atom 40

5 Increased robustness

Option 0:
Atom has un-coated pistons and cam rollers as standard configuration.
Option C:
DLC (Diamond-Like Carbon) coated pistons and cam rollers are recommended in the following cases:
- If operating speed ≤ 8 rpm
- If operating speed > 250 rpm
- If there is a risk for cavitation (e.g. in shock-load applications)

6 Through hole kit

Option 0:
Motor delivered without through hole.
Option 1:
Through hole kit enables e.g. flushing through the motor to the driven machine or the possibility to draw electric cables through the motor.

Dimension drawing
See section *15: Related documents*

Table 9: Dimensions Hägglunds Atom with through hole kit

	L1	
Motor	**mm**	**in**
Atom 10	220	8.66
Atom 20	260	10.24
Atom 30	311	12.24
Atom 40	351	13.82

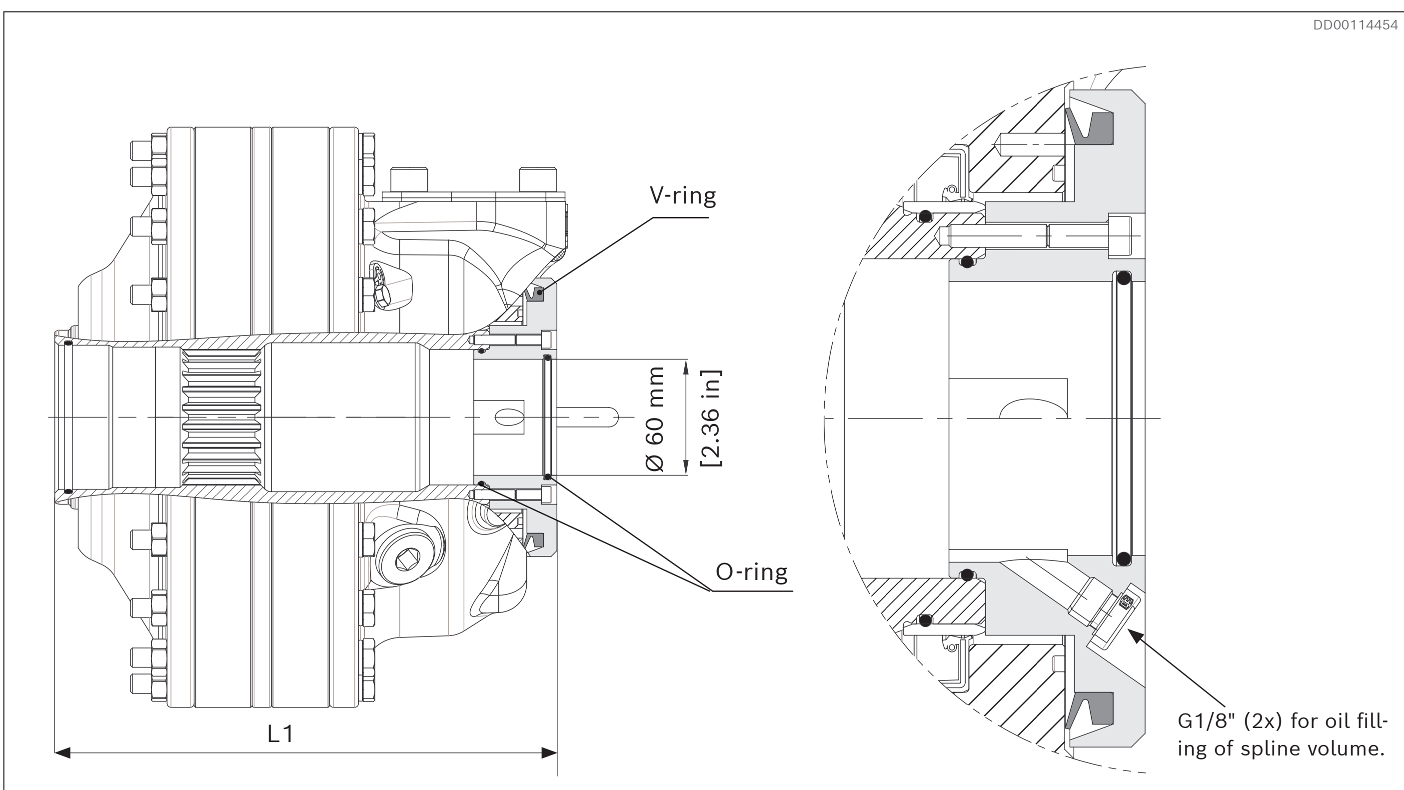

Fig. 47: Example: Hägglunds Atom 20 with through hole kit.

7 Type of seal

Option N:
NBR (Nitrile) Preferred alternative at low ambient temperatures and moderate case oil temperatures. See *4.2: General data*
Option V:
FPM (Viton) Preferred alternative at higher case oil temperatures or when operating with fire resistant fluids. See section *4.2: General data* and *4.5: Hydraulic fluids*

8 Speed sensor

Option 0: Motor without speed sensor

Option 1: Motor delivered with speed sensor DSA series 12

8.1 DSA series 12

The speed sensor is of hall-effect type for contactless sensing. The sensor has two sensing elements and will give two incremental pulse trains (S1 and S2) with 16 pulses per revolution. The signals can also be used to sense rotational direction.

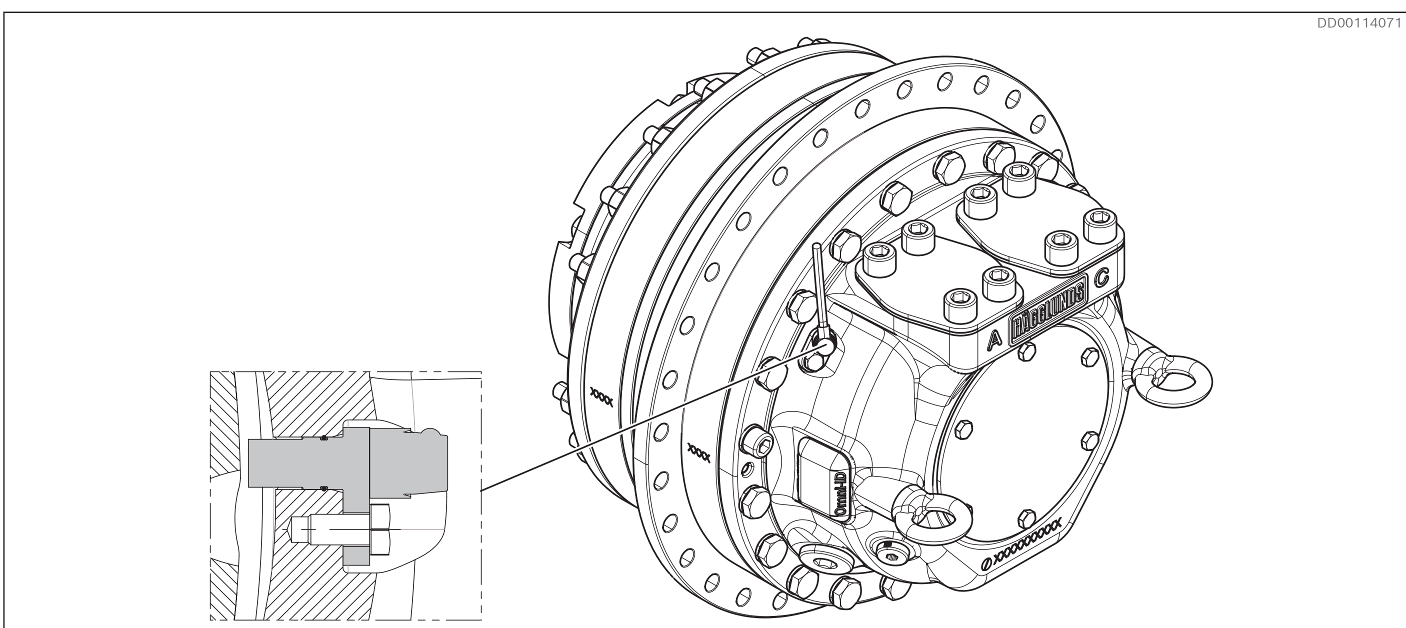

Fig. 48: Speed sensor DSA series 12

8.1.1 Technical information

Connection

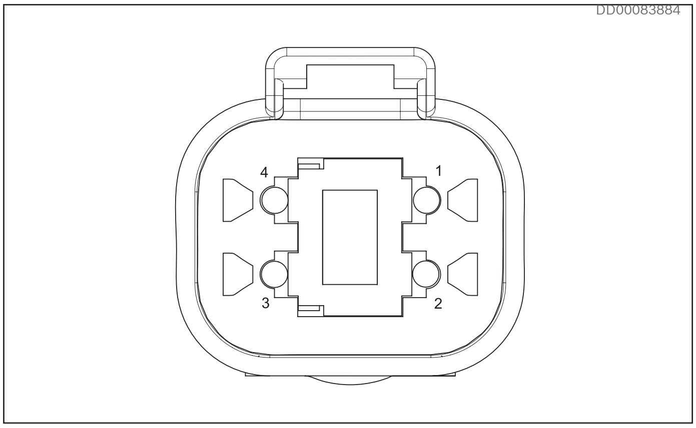

Table 10: Mating pin connector

Pin	Function
1	Supply voltage U_B , 24 V_{DC}
2	Ground GND
3	S1 signal
4	S2 signal
Cable length 1.5 m (78.74 ft)	

Table 11: Mating socket connector

	Material number
Socket	R902601805
Socket including cable	R939065113

Socket is not included in the delivery contents. This can be supplied by Bosch Rexroth on request.

Socket including extension cable. Length 30 m and open end. Not included in the delivery contents. This can be supplied by Bosch Rexroth on request.

Table 12: Output pulses

		Pulse	Gap	Tooth
Per revolution	n	16	16	16
Angle of a turn	α	22,5°	10,09°	12,41°
Duty		100%	44,84%	55,16%
S1 signal			$0*U_B$	$1*U_B$
S2 signal			$1*U_B$	$0*U_B$
Correction factor for 50%/50%	cf50	0,5	1,115	0,907

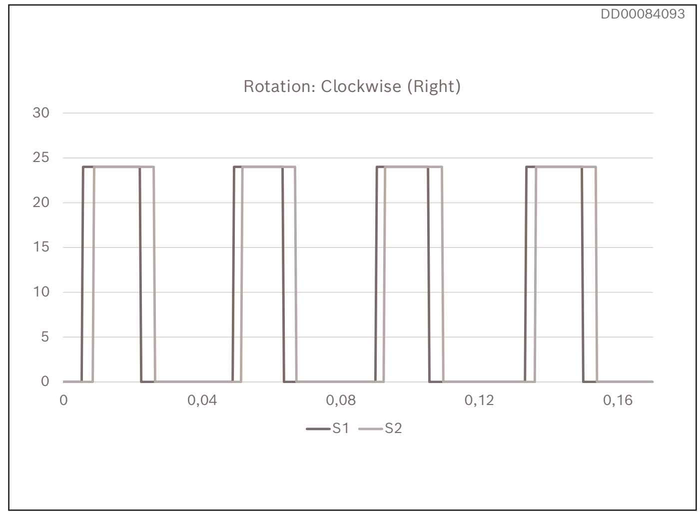

Fig. 51: Output pulses, clockwise

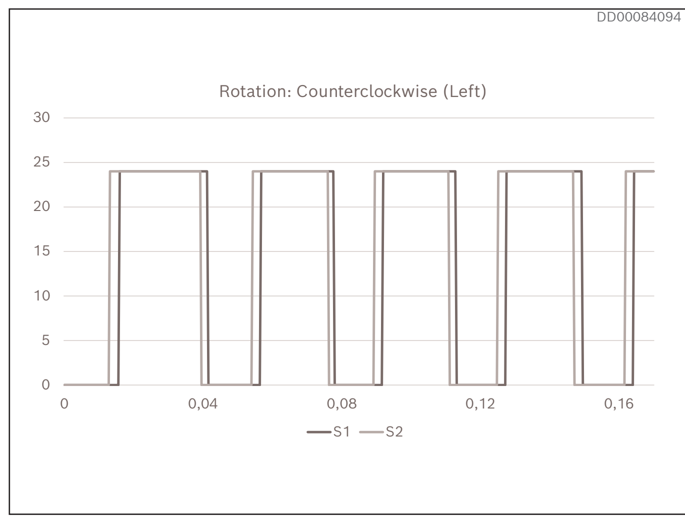

Fig. 52: Output pulses, counter clockwise

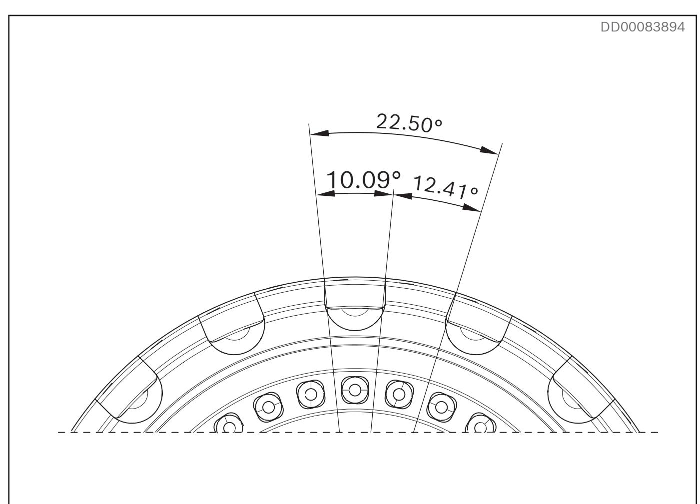

Fig. 53: Angle of turn per pulse at hydraulic motor cylinder block

For technical data, see document nr: RE 95133

9 Explosive environment

Note! Important to also consult additional ATEX related documentation RE 15424-X-B2 and RE 15417-X-B1

Option 0: Standard Atom motor, not approved for ATEX.

Option 1: Motor approved for ATEX gas group: IIB (gas atmospheres).
All dust atmospheres are also approved for option 1.

Option 2: Motor approved for ATEX gas group: IIC (gas atmospheres). To meet the most strict requirements for electrostatic charges (gas group IIC), a conductive (dissipative) coating is used to ensure that no hazardous energy levels can occur on the motor surface.

9.1 Limitations & Requirements

Speed limitation

For temperature class T4 (T135 °C), the motor speed is limited to 230 rpm (or acc. to maximum speed in *Table 5*/ *Table 6* whichever is lowest).

Voltage equalization

All ATEX motors are delivered with a terminal lug for connection of a grounding cable.

Temperature monitoring

Temperature monitoring in drain line is required in ATEX zone 1 /21. Temperature monitoring in drain line is recommended when flushing of radial seals is used. For ATEX environment, a special temperature sensor kit is available, see *Table 15*.

Flushing of radial seals

Flushing of the radial seals and bearings is in some circumstances a precondition to fulfill the ATEX requirements, see *Table 13* and *Table 14*. For ATEX environment, a special flushing kit is required, see *Table 15*.

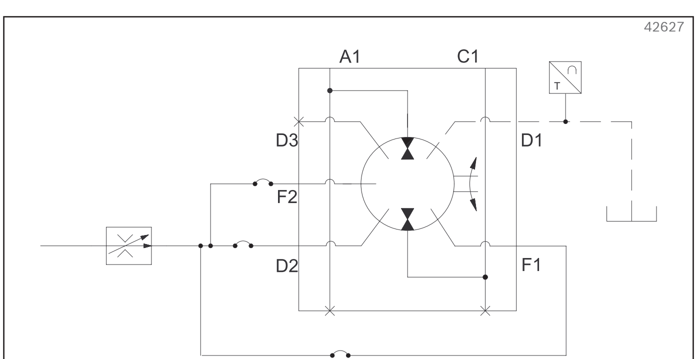

Fig. 54: Hydraulic circuit: ATEX flushing of radial seals

Vertical installations:
Independent of ATEX zone, ATEX flushing should be used for all vertical installations. Flushing kit is to be ordered separately, see *Table 15*.

Table 13: Conditions for ATEX flushing (vertical installation)

Temperature class	ATEX zone 1/21	ATEX zone 2/22
All classes	Yes	Yes

Horizontal installations:
Depending on specific ATEX conditions (zone, temperature class), ATEX flushing of seals and bearings may be required for horizontally mounted motors. See *Table 14* for circumstances when ATEX flushing of seals is required.

Table 14: Conditions for ATEX flushing (horizontal installation)

Temperature class	ATEX zone	
	1/21	2/22
T4/135°C	Yes	Yes
T3/200°C	Yes	>200 rpm: Yes
		<200 rpm: No
T2-T1/300-450°C	Yes	No

9.2 To be ordered separately

Depending on ATEX conditions, additional equipment can be needed and must be ordered separately (see *9.1*).

Table 15: Add-on kit (to be ordered separately)

Material number	Description
R939080752	Temperature sensor kit, Pt100 4-wire
R939080726	Flushing kit

10 Painting system

Corrosion protection

The painting system of Hägglunds motors and accessories are avalible in three 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
- C5 - Corrosivity category Very High - which is recommended for coastal environment with high salinity or aggressive industrial atmosphere
- CX - Corrosivity category Extreme - which is recommended for extreme industrial areas, offshore environment with high salinity or extreme humidity

Colour

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

11 Special index motors

11.1 Special index 06: Mounting flange positioned closer to shaft side

- Available for Atom 30
- Available for center-flange mounted motors

Mounting flange position is changed to alternative position, closer to shaft-side of motor.

Dimension drawing

See section *16: Related documents*.

Axial loads: Permissible axial load for intermittent duty Fa = 10 000 N (2 200 lbf).

Remark: For continuous axial load applications, please contact your Bosch Rexroth representative.

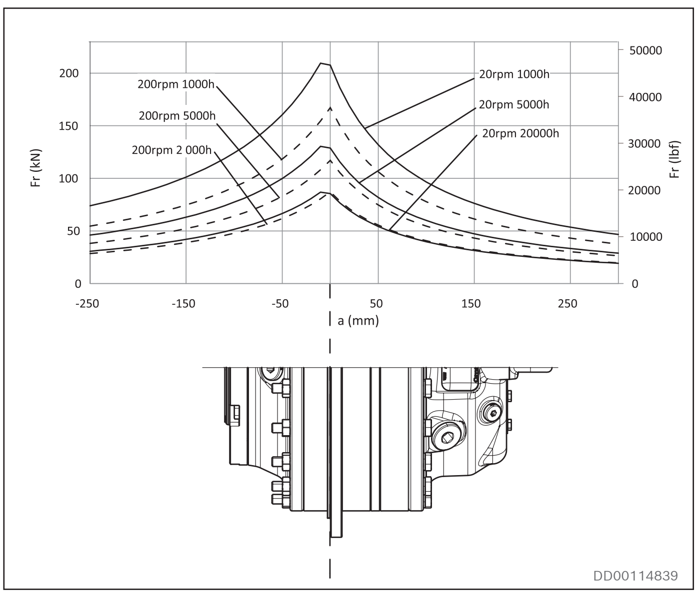

Fig. 55: Permissable external dynamic load for Atom 30 C special index 06

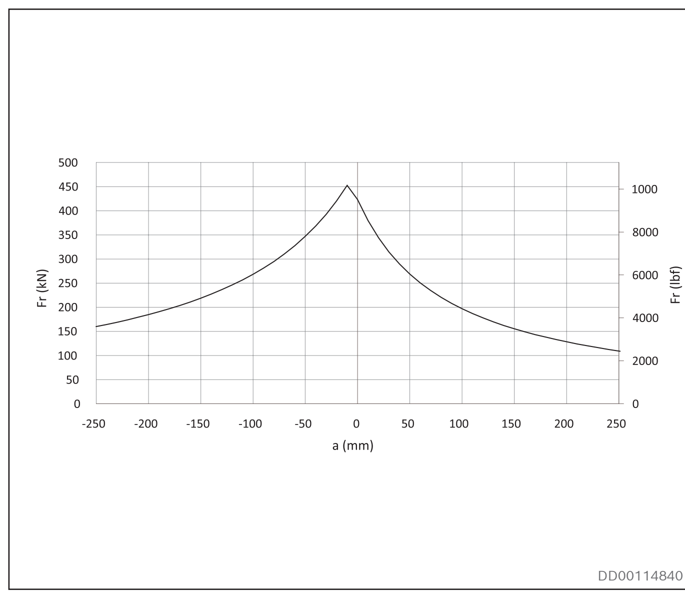

Fig. 56: Permissable external static load for Atom 30 C special index 06

11.2 Special index 33: Motor for marine environment

- Available for Atom 10 to Atom 40
- Motor equipped with shaft side wear ring of stainless steel

To be ordered separately

- Painting system C5 -Corrosivity category Very High is recommended

12 Dimensions / Interface

12.1 Dimensions

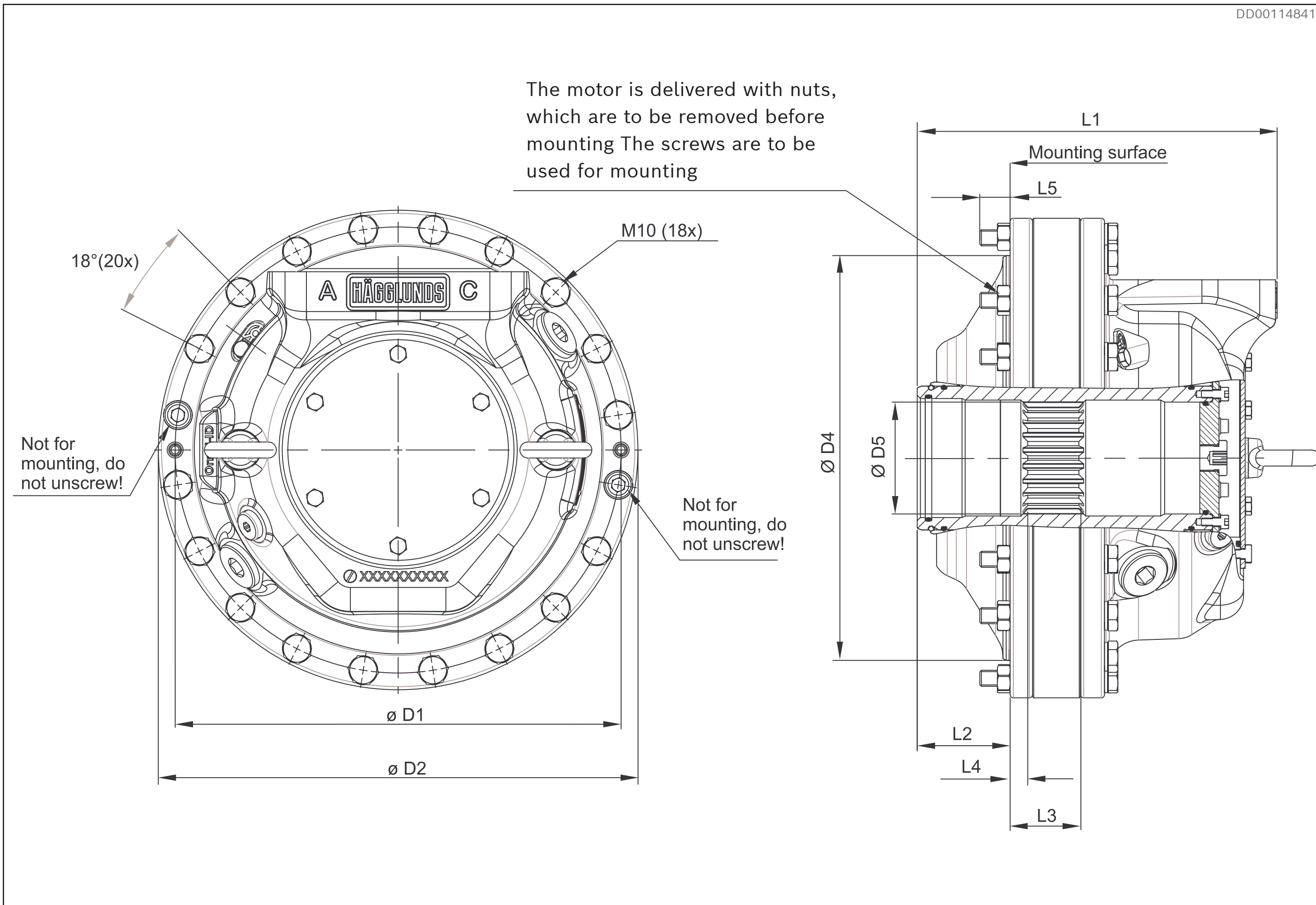

Fig. 57: Atom 10

Table 16: Dimensions Atom 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 x 30 x 22	
L1	Total length	225	8.86
L2	Length to mounting surface	58	2.28
L3	Length to spline end	43	1.69
L4	Length to spline	11	0.43
L5	Protruding length of screws	19	0.75

For dimensional drawings Atom 10, see chapter *16 Related documents*

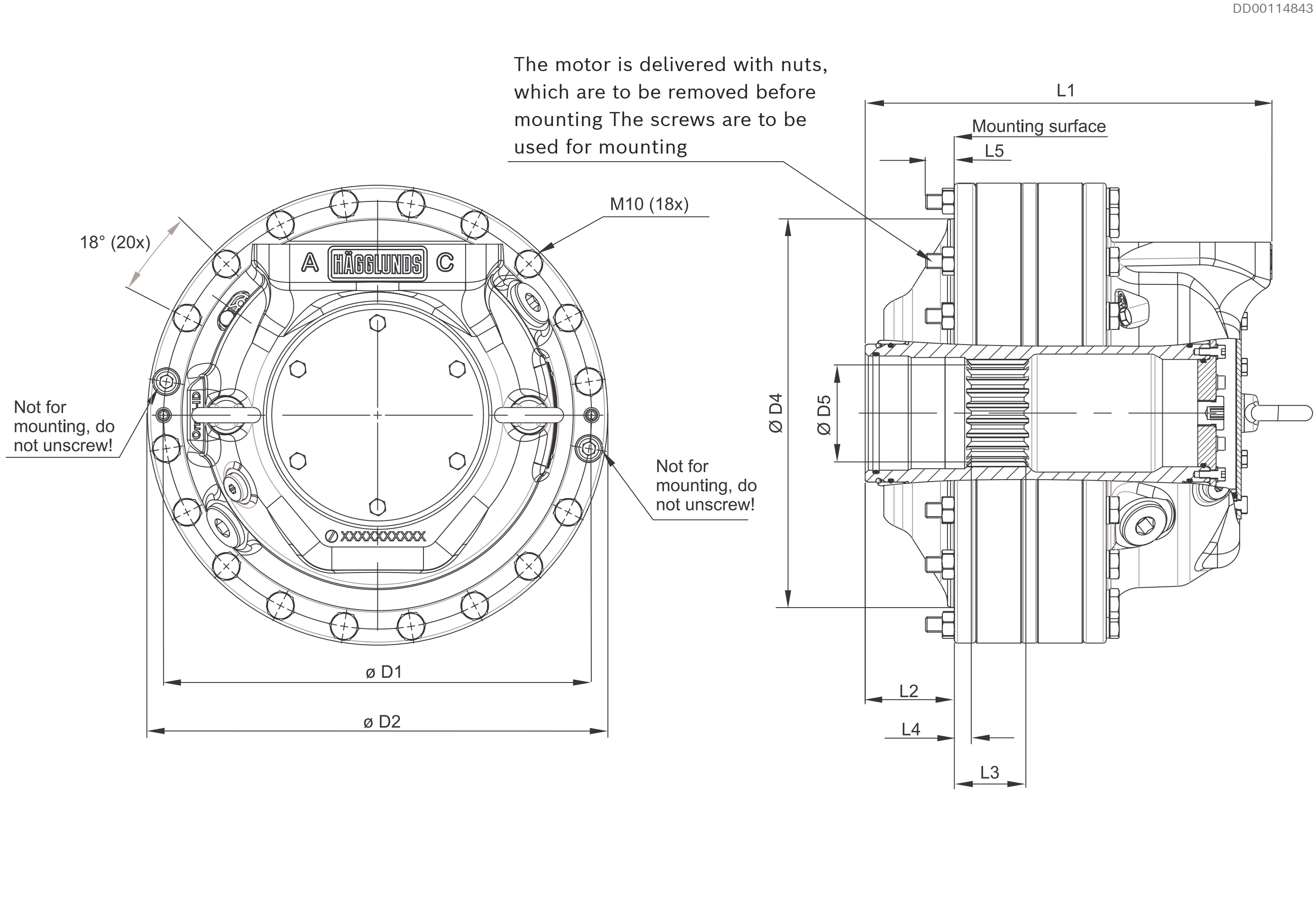

Fig. 58: Atom 20

Table 17: Dimensions Atom 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 x 30 x 22	
L1	Total length	265	10.44
L2	Length to mounting surface	58	2.28
L3	Length to spline end	43	1.69
L4	Length to spline	11	0.43
L5	Protruding length of screws	19	0.75

For dimensional drawings Atom 20, see chapter *16 Related documents*

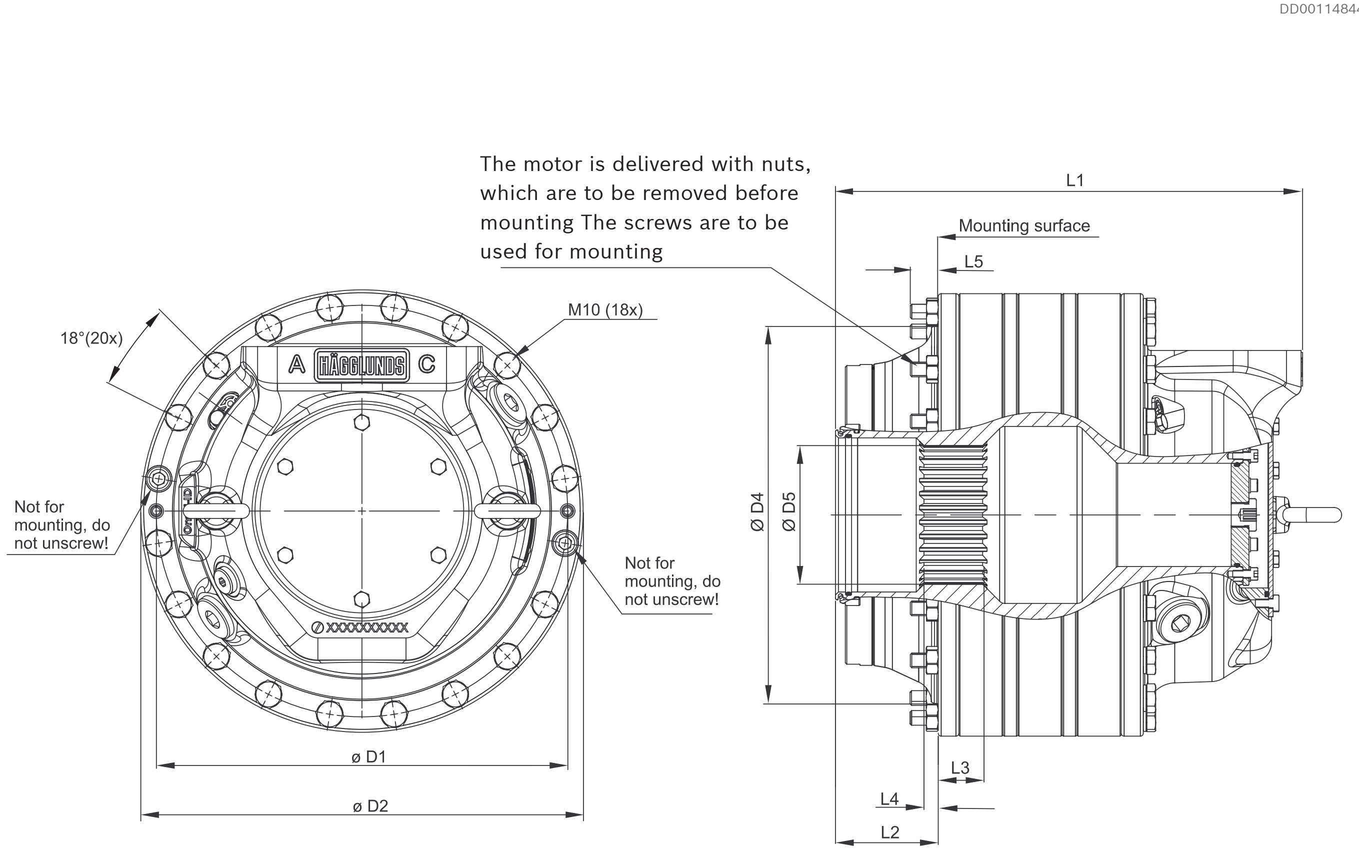

Fig. 59: Atom 30 28 F and Atom 30 30 F (front flange)

Table 18: Dimensions Atom 30 28 F and Atom 30 30 F (front flange).

		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 N100 x 3 x 30 x32	
L1	Total length	317	12.47
L2	Length to mounting surface	70	2.76
L3	Length to spline end	30	1.18
L4	Length to spline	10	0.39
L5	Protruding length of screws	19	0.75

For dimensional drawings Atom 30, see chapter *16 Related documents*

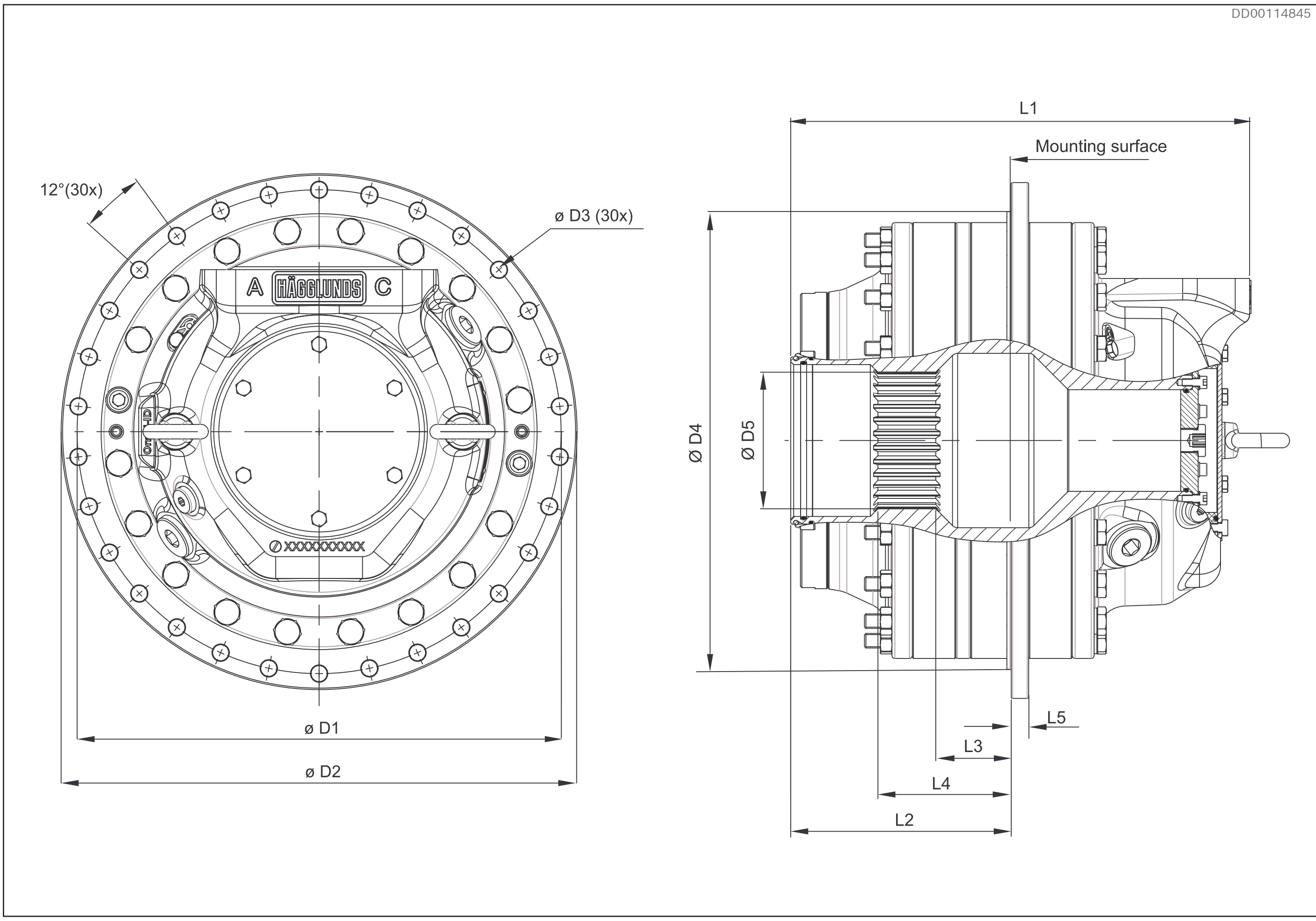

Fig. 60: Atom 30 C (center flange)

Table 19: Dimensions Atom 30 C (center flange)

		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 x 30 x32	
L1	Total length	317	12.47
L2	Length to mounting surface	152	5.98
L3	Length to spline end	52	2.05
L4	Length to spline	92	3.62
L5	Thickness of mounting ring	12	0.47

For dimensional drawings Atom 30, see chapter *16 Related documents*

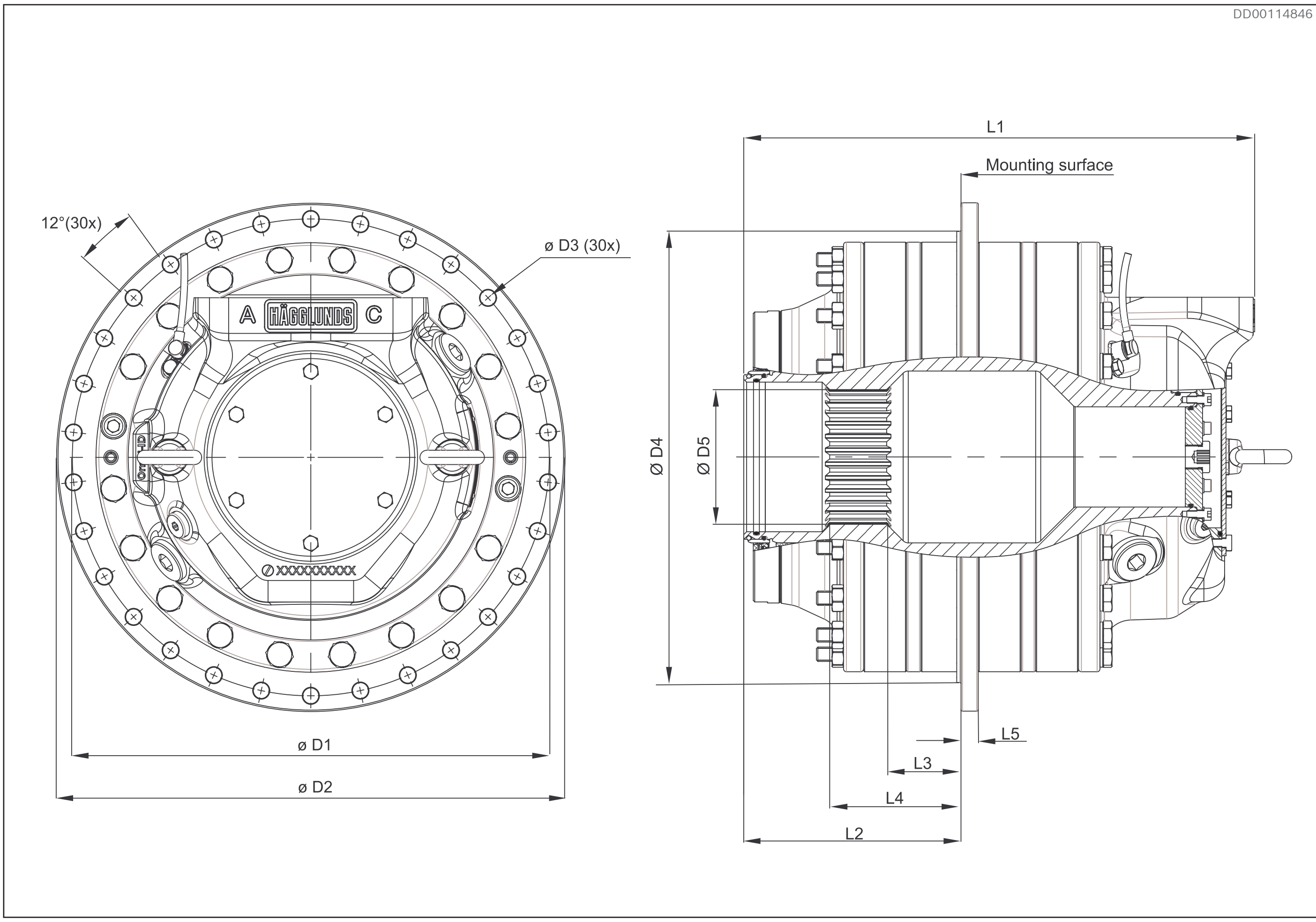

Fig. 61: Atom 40

Table 20: Dimensions Atom 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	357	14.04
L2	Length to mounting surface	152	5.98
L3	Length to spline end	52	2.05
L4	Length to spline	92	3.62
L5	Thickness of mounting ring	12	0.47

For dimensional drawings Atom 40, see chapter *16 Related documents*

13 Mounting alternatives

13.1 General information

With splines for flange or torque arm mounting.
The splines shall be lubricated and filled 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. 62, Fig. 63, Table 21. and Table 22* The splines must be accordning to *Table 23*. For production of driven shaft, see chapter *16 Related documents*.

13.2 Flange mounting

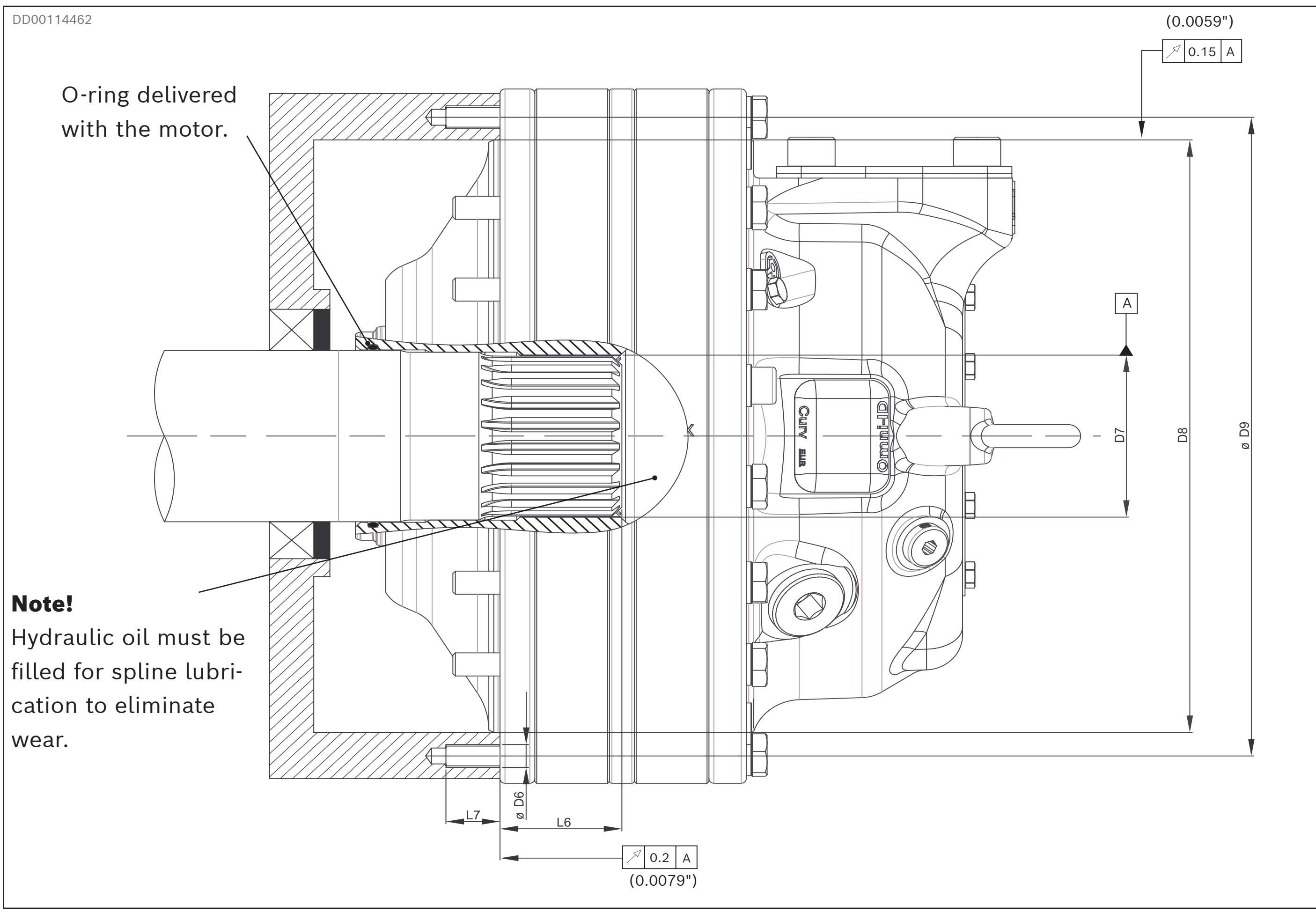

Fig. 62: Shaft installation tolerances Atom 10, Atom 20, and Atom 30 F (front flange)

Table 21: Dimensions installation tolerances Atom 10, Atom 20, and Atom 30 F

		Frame size Atom 10, Atom 20			Frame size Atom 30 F		
		mm	**in**	**Tolerance**	**mm**	**in**	**Tolerance**
D6	Screw hole	M10			M10		
D7	Spline size shaft	DIN 5480 W70			DIN 5480 W100		
D8	Guide diameter	256	10.08	H11	256	10.08	H11
D9	Pitch diameter	279	10.98		279	10.98	
L6	Length to spline	47	1.86		35	1.38	
L7	Length of thread	min. 20	min 0.79		min. 20	min 0.79	

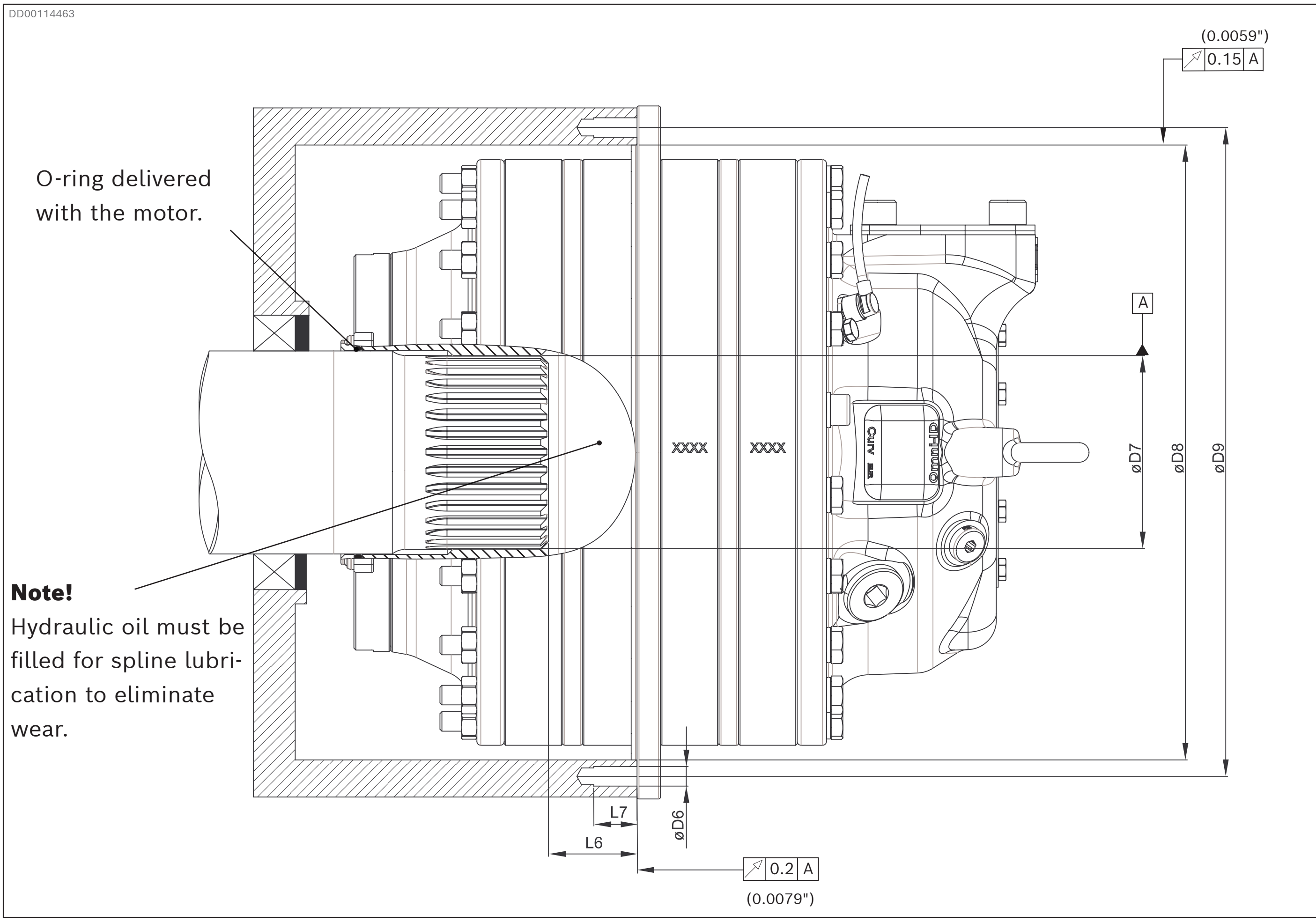

Fig. 63: Shaft installation tolerances Atom 30 C (center flange), Atom 40

Table 22: Dimensions installation tolerances Atom 30 C, Atom 40

		Frame size Atom 30 C, Atom 40		
		mm	**in**	**Tolerance**
D6	Screw hole	M10		
D7	Spline size shaft	DIN 5480 W100		
D8	Guide diameter	315	12.40	H11
D9	Pitch diameter	333	13.11	
L6	Length to spline	48	1.89	
L7	Length of thread	min. 20	min 0.79	

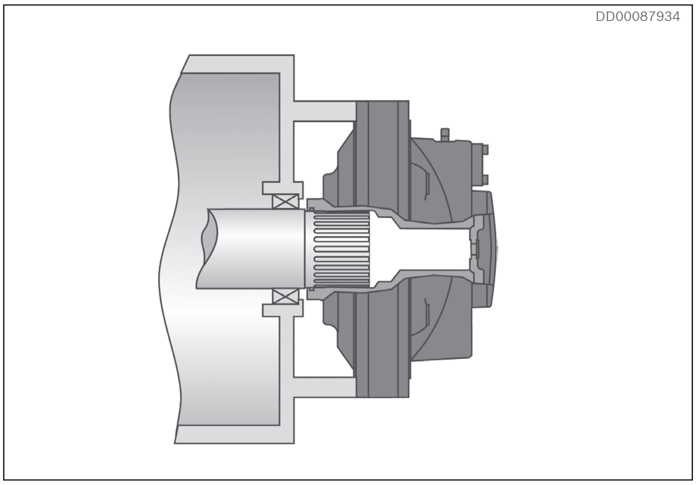

Fig. 64: Example: Flange mounted motor with spline and low radial load from driven shaft.

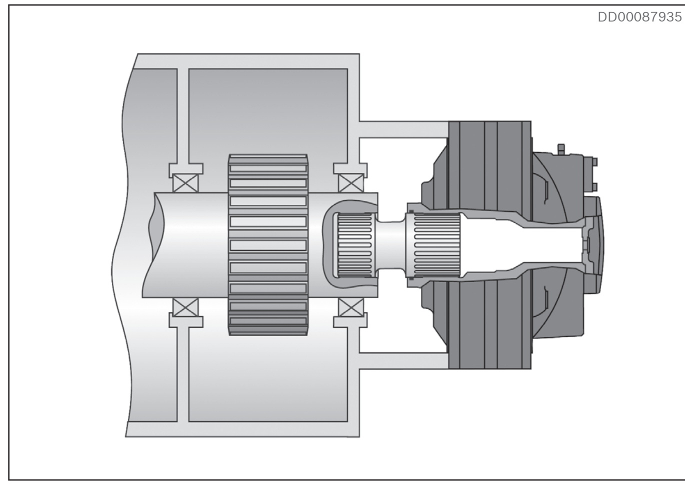

Fig. 65: Example: Flange mounted motor with spline to avoid high radial load from driven shaft.

Design of spline shaft

Table 23: Spline designation shaft

	Spline	
Frame size	**Atom 10, Atom 20**	**Atom 30, Atom 40**
Designation Standard DIN 5480	W70x3x30x22x8f	W100x3x30x32x8f

Table 24: Recommended material in the spline shaft

Drive	Steel with yield strenght
Unidirectional drive	Rel_{min} = 450 N/mm² (65 000 lb/ft²)
Bidirectional drive	Rel_{min} = 700 N/mm² (101800 lb/ft²)

For shaft dimension drawings see section *16: Related documents*

13.2.1 Torque arm mounting with splines

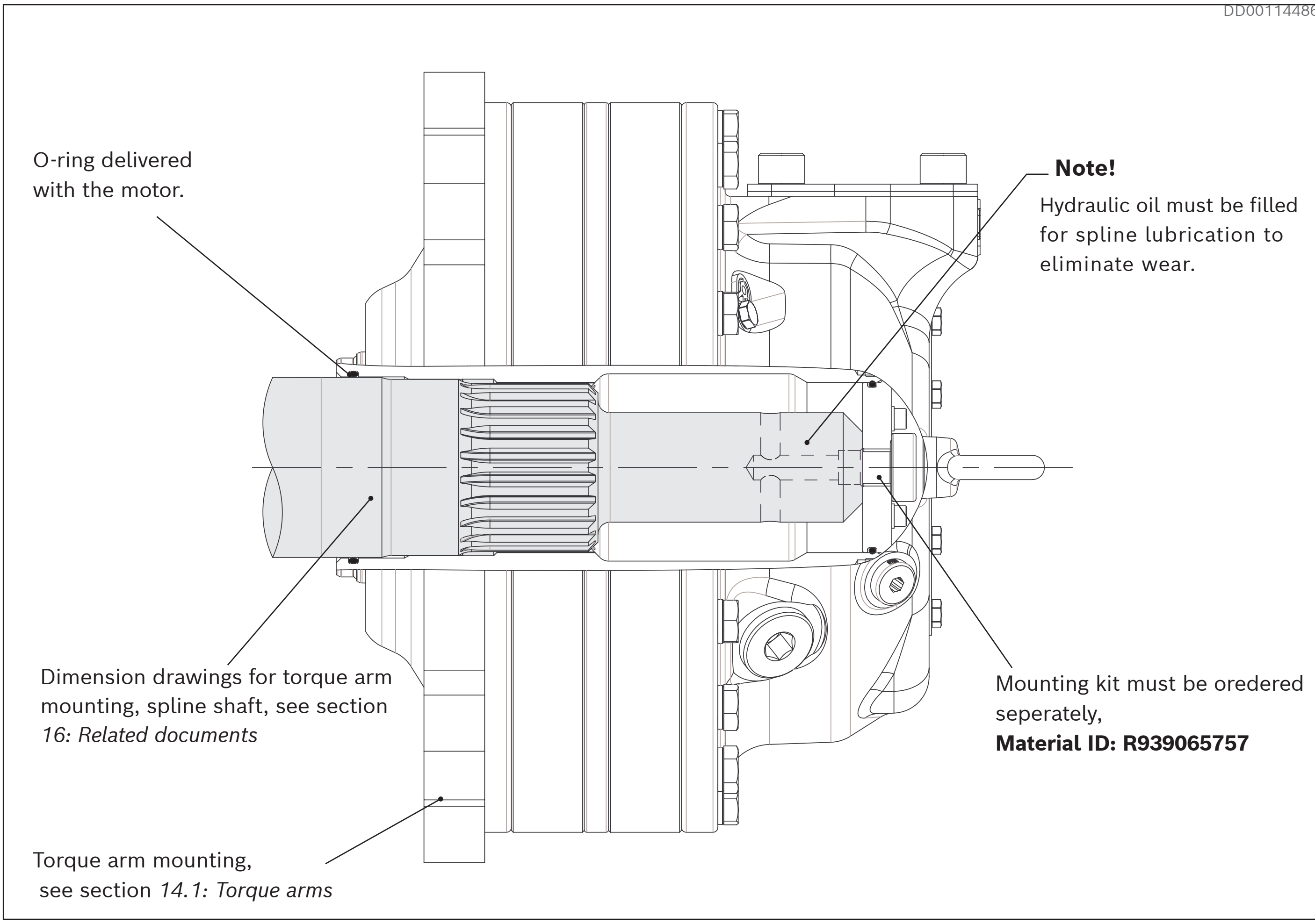

Fig. 66: Example: Torque arm mounting of Atom 20

Spline designation shaft, see *Table 23*.
Recommended material in the shaft, see *Table 24*.

14 Accessories

14.1 Torque arms

Mounting alternatives

Dimensions, techical data, order code and material ID for torque arms, see separate data sheet: **RE 15355**

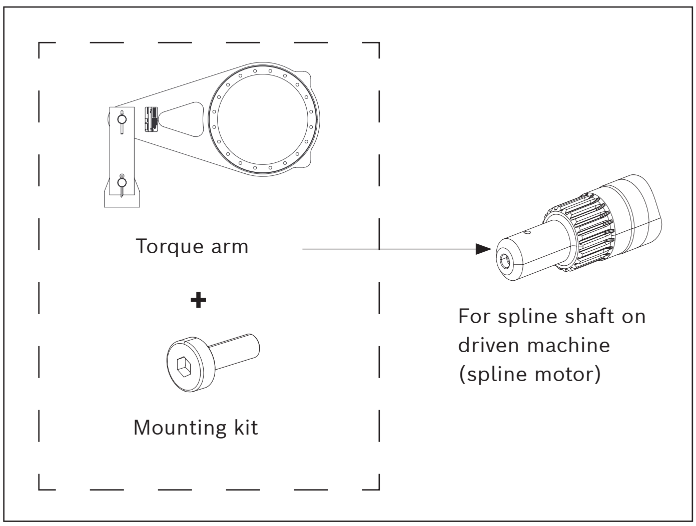

Fig. 67: Single ended torque arm mounting for spline shaft

Features

- Easy mounting i.e. no alignment problems
- Quick mounting of motor to driven shaft
- Robust torque-transmitting
- Controlled external forces on driven shaft
- Space saving. i.e. close mounting to the driven machine

14.2 Kit for harsh environment

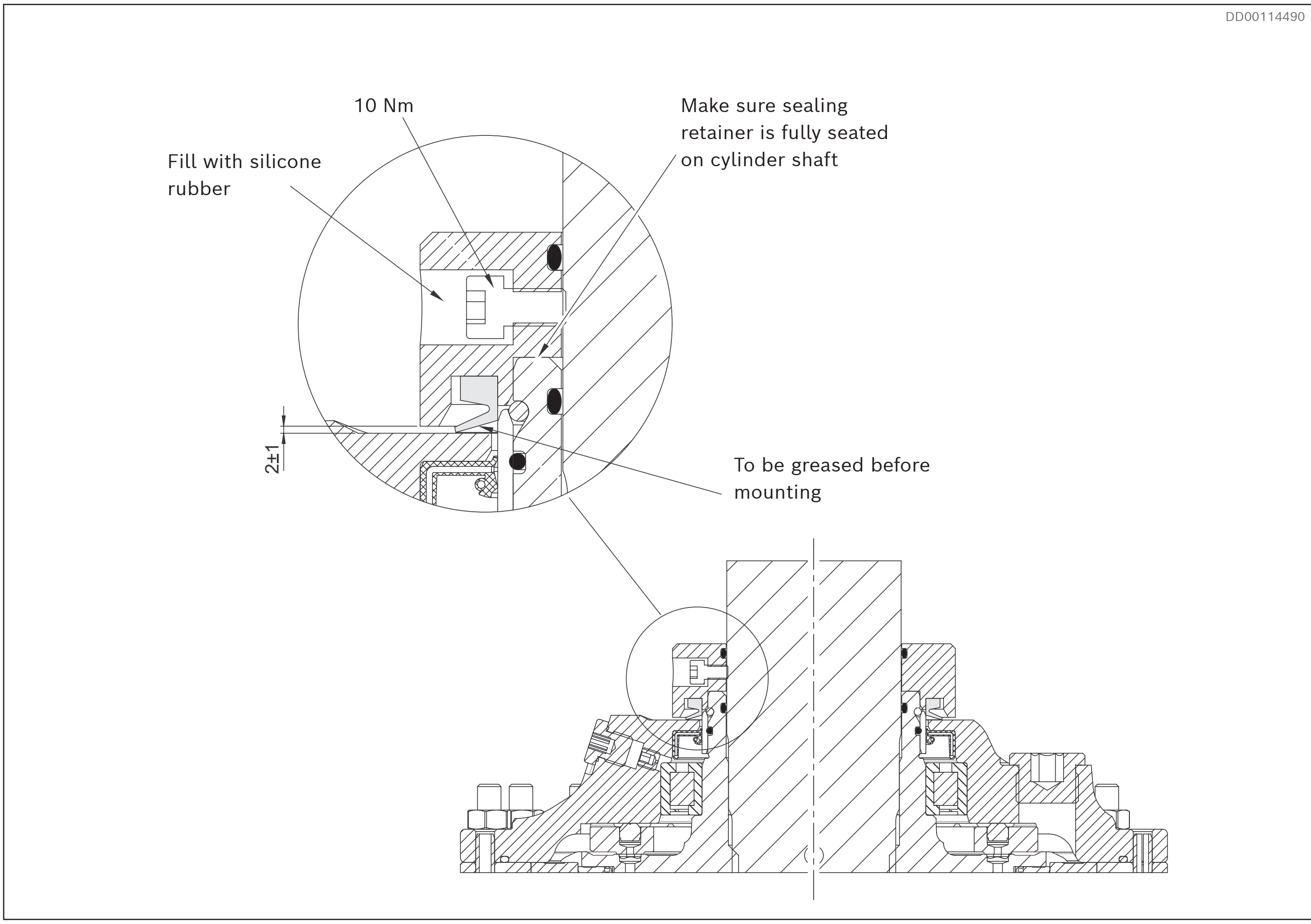

Fig. 68: Kit for harsh environment

For technical data, see document nr: **RE 15364** (Not available yet. Please contact your Bosch Rexroth representative)

Features

- Protects the motor main seal
- Designed for harsh environments
- Extends the life time of the main sealings

15 Circuit design

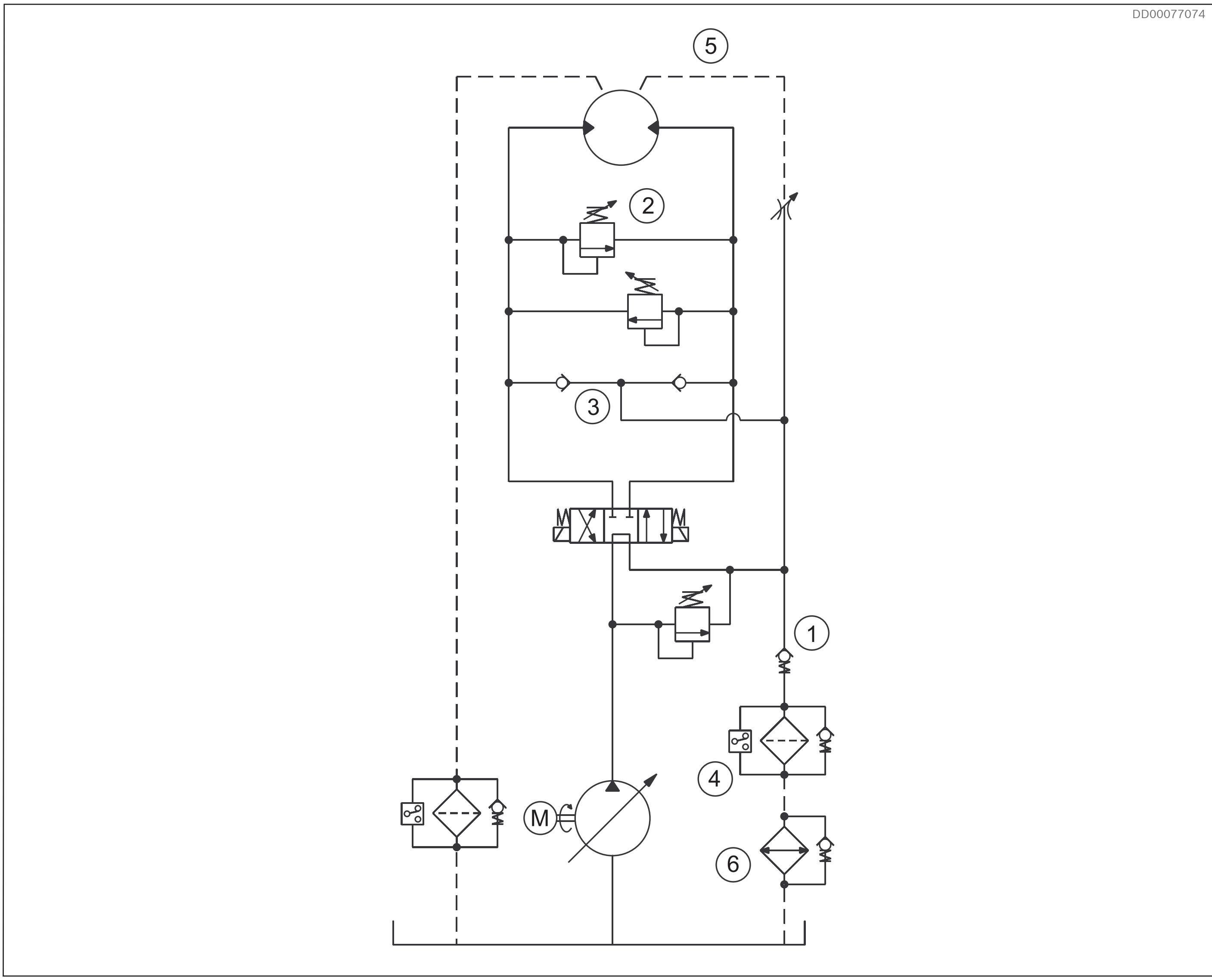

Fig. 69: Simplified open circuit design example

Things to consider:

1. Counter pressure required minimum 2 bar to ensure recommended charge pressure
2. Cross over relief valves for reduction of pressure spikes
3. Anticavitation valves
4. Return line filter
5. Case flushing
6. Cooler

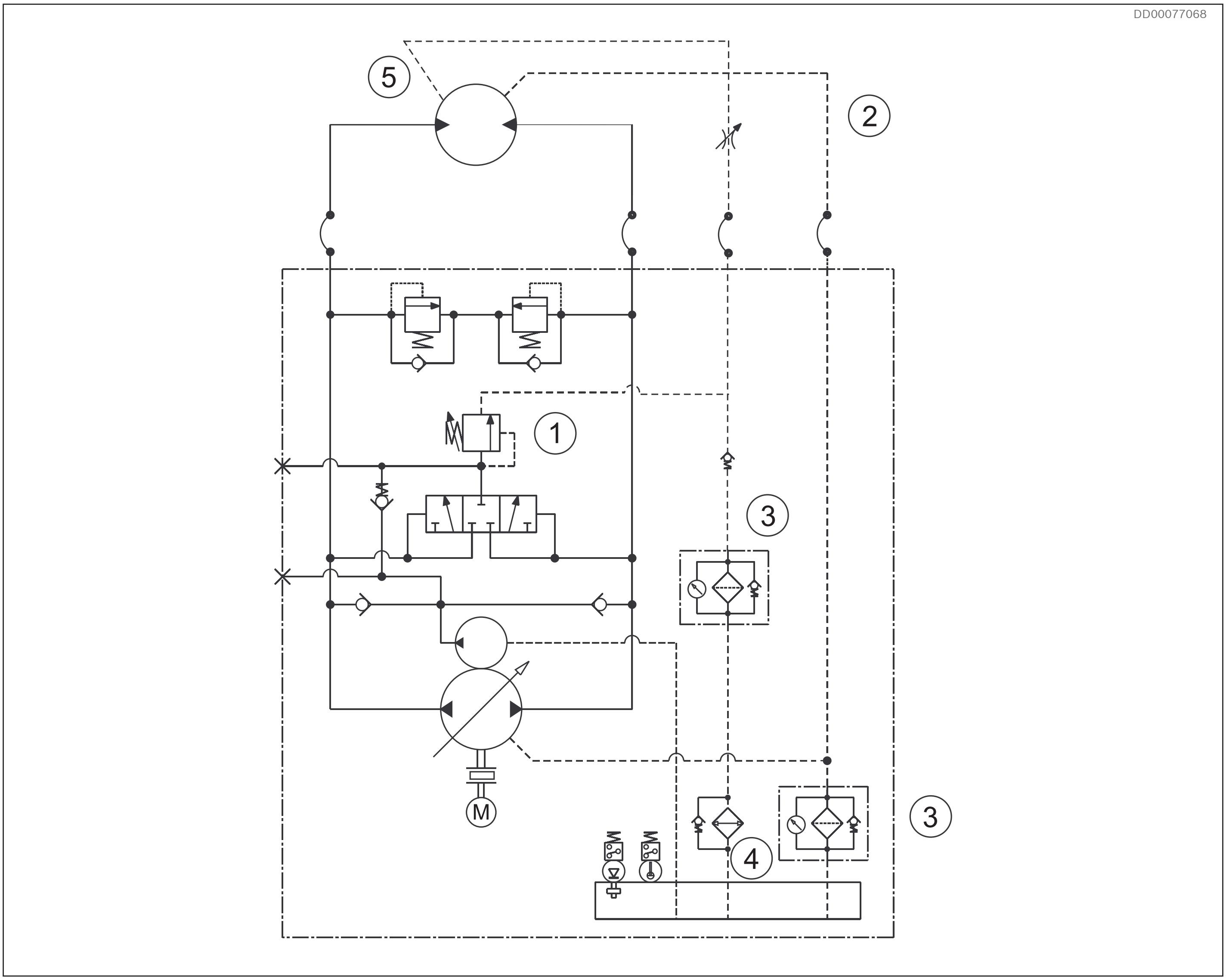

Fig. 70: Simplified closed circuit design example

Things to consider:

1. Level of charge pressure
2. Case drain flow
3. Filter
4. Cooler
5. Case flushing

16 Related documents

	Title	Document no	Document type
	Installation and maintenance manual Atom	RE 15354-WA	Installation & maintenance manual
	Hägglunds Atom for explosive environment	RE 15424-X-B2	ATEX appendix-Installation & maintenance manual
	Hydraulic fluid quick reference	RE 15414	Data sheet
	Sound and vibrations	RE 15411	Data sheet
	Hägglunds Torque arms	RE 15355	Data sheet
	Kit for harsh and marin environment	RE 15364	Data sheet
	Speed sensor DSA series 12	RE 95133	Data sheet
	Radial piston motor Atom 10	078 5961	Dimension drawing
	Radial piston motor Atom 20	078 5962	Dimension drawing
	Radial piston motor Atom 30	078 5963	Dimension drawing
	Radial piston motor Atom 40	078 5964	Dimension drawing
	Radial piston motor Atom 30 S06	078 5963-06	Dimension drawing
	Splined shaft Atom 10-20, flange mounted	078 3098	Dimension drawing
	Splined shaft Atom 30-40, flange mounted	078 3099	Dimension drawing
	Splined shaft Atom 10, external load and torque arm	078 6189	Dimension drawing
	Splined shaft Atom 20, external load and torque arm	078 6197	Dimension drawing
	Splined shaft Atom 30, external load and torque arm	078 6190	Dimension drawing
	Splined shaft Atom 40, external load and torque arm	078 6191	Dimension drawing
	Through hole unit	078 5969	Dimension drawing

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