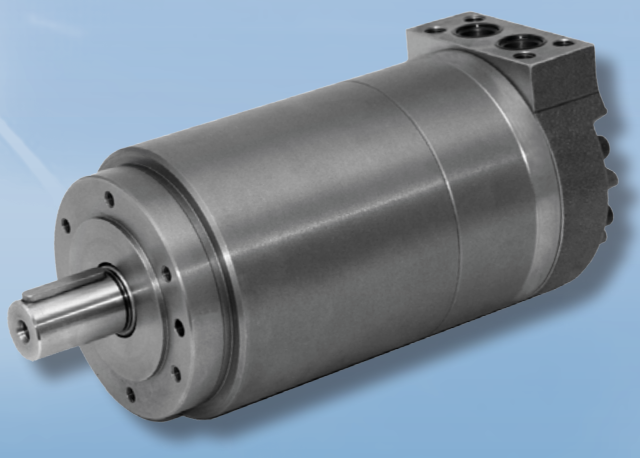
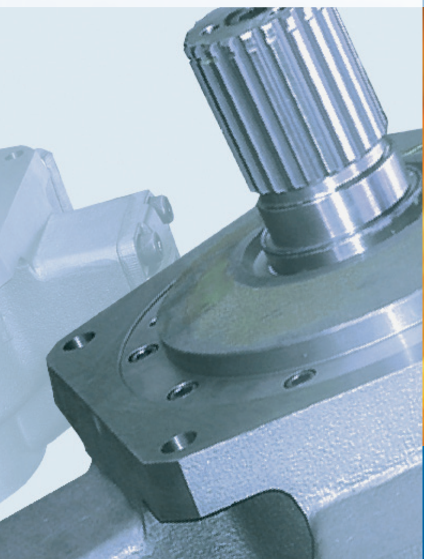
DÜSTERLOH Fluidtechnik

Axial piston motor



Axial piston motor

precision drives
with fixed displacement
series AE 3... - AE 180...
V_g = 3 cm³/rev - 180 cm³/rev



Dok.-Nr. HM1-017 EN

DÜSTERLOH Fluidtechnik GmbH · Im Vogelsang 105 · D-45527 Hattingen
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Take a close look at us and our motors ...

Performance:
- Great speed range (3 – 5,250 rpm)
- High initial torque (full torque is available across the whole speed range from zero high to max. speed)
- Drive shaft withstands radial and axial loads

Further advantages of hydraulic drive concepts:
- Using one central provider for various drive operations
- Persistent motor cooling with operating medium
- Stepless adjustable speed and torque

Efficient and cost saving:
- Overall efficiencies up to 94%
- Low maintenance costs due to the robust design
- Energy recovery and energy storage

Service of Düsterloh Fluidtechnik GmbH:
- Experienced engineering department working with the customer to find individual solutions
- even for small quantity units
- Partner for all hydraulic and pneumatic tasks, such as engineering, hydraulic / pneumatic controls and Hydraulic Power Units

Fixed displacement motor (fixed geometric displacement)

Axial piston motor	Displace-ment	Torque		Speed range		Cont. pressure	Max. pressure	Peak pressure	Power	
Type AE	V_g cm³/rev	T_{spec} Nm/bar	T_{max} Nm	n_{min}* rpm	n_{max} rpm	p_{cont} bar	p_{max} bar	p_{peak} bar	P_{cont} kW	$P_{intermit}$ kW
3	2,9	0,041	10,2	10	5250	210	250	315	3,2	3,8
4	4,0	0,057	14,3	5	3750	210	250	315	3,2	3,8
5	5,1	0,074	18,4	3	3000	210	250	315	3,2	3,8
10	11,4	0,164	40,9	10	3000	210	250	315	7,2	8,5
16	16,0	0,229	57,3	5	2500	210	250	315	8,4	10,0
21	21,3	0,305	76,3	3	2400	210	250	315	10,7	12,8
22	22,5	0,322	80,6	10	2000	210	250	315	9,0	11,0
32	31,5	0,451	112,8	5	2000	210	250	315	12,5	15,0
40	40,5	0,580	145,0	3	2000	210	250	315	16,0	19,0
45	45,0	0,645	161,2	10	2000	210	250	315	17,8	21,0
71	70,4	1,008	252,0	10	2250	210	250	315	33,2	39,6
100	98,5	1,411	352,8	5	1725	210	250	315	35,7	42,5
125	126,7	1,814	453,6	3	1420	210	250	315	37,8	45,0
140	141,1	2,022	505,4	5	1200	210	250	315	35,6	42,3
180	181,5	2,599	649,8	3	1000	210	250	315	38,1	45,4

* Speed less then 1 rpm can be achieved by using an electro hydraulic servo valve.

p_{cont} limitation by P_{cont}

p_{max} limitation by $P_{intermit.}$ and max. 10% power-on time with regards to one hour operating time

p_{peak} highest pressure at which the components will remain functional

P_{cont} Continuous power (at 10 bar back line pressure); if P_{cont} will be overextended for a long time, it is recommended to flush the engine by using cold operation fluid.

$P_{intermit}$ Power which can be supplied temporary based on max. 10% power-on time with regards to one hour operating time

Product code: **AE** [A] [B] [C] [D] [E] [F] [G] [H] **N** [I]

				Class AE 3-5	Class AE 10-21	Class AE 22-45
A	**Displacement**			3 4 5	10 16 21	22 32 40 45
B	**Drive shaft**	Z:	Cylindrical drive shaft with feather key	● ● ●	● ● ●	● ● ● ●
		Z8:	Cylindrical drive shaft ø28 x 50 long with feather key suitable in combination with F16 flange acc. IEC-norm	- - -	- - -	● ● ● ●
		Z68:	Cylindrical drive shaft ø24 x 50 long with feather key suitable in combination with F15 flange acc. IEC-norm	- - -	- - -	● ● ● ●
		Z76:	Cylindrical drive shaft ø19 x 36 long with feather key suitable in combination with F15 flange acc. IEC-norm	- - -	● ● ●	- - - -
		K:	Male involute splined drive shaft	- - -	○ ○ ○	○ ○ ○ ○
		W2:	Conical drive shaft with grub screw	- - -	● ● ●	- - - -
C	**Connections**	A:	Radial connection thread	- - -	○ ○ ○	● ● ● ●
		A1:	Connection face for valve block mountings	- - -	● ● ●	● ● ● ●
		A34:	Connection face with connection thread	- - -	● ● ●	- - - -
		B:	Axial connection thread (metric)	○ ○ ○	○ ○ ○	○ ○ ○ ○
		B5:	Axial connection thread (inch)	● ● ●	● ● ●	● ● ● ●
D	**Control version**	*:	Not specified (translatory steering disc)	● ● ●	● ● ●	● ● ● ●
		E2:	Servo quality, reduced clearance, enhanced activation piloting and concentric run-out characteristics	● ● ●	● ● ●	● ● ● ●
		E5:	Self readjusting clearance control version (temperature adaptability, reduction of intern leakage)	● ● ●	● ● ●	● ● ● ●
E	**Sealing material**	*:	Not specified (NBR sealing)	● ● ●	● ● ●	● ● ● ●
		V:	FPM sealing: Suitable for a high temperature rang as well as for special/aggressive operation fluids	● ● ●	● ● ●	● ● ● ●
F	**Measuring shaft version (optional / not suitable for combination with connections B and B5)**	M:	Cylindrical shaft ø10 with centring	- - -	● ● ●	● ● ● ●
		M39:	Cylindrical shaft ø10 without centring	- - -	● ● ●	● ● ● ●
G	**Flange version**	*:	Not specified / without flange	- - -	- - -	● ● ● ●
		F:	four hole flange	● ● ●	● ● ●	● ● ● ●
		F1:	three hole flange	- - -	● ● ●	- - - -
		F15:	four hole flange / design CEI-IEC 72-2 B5 IEC 80 (AE 10-21) / B5 IEC 90 (AE 22-45)	- - -	● ● ●	● ● ● ●
		F16:	four hole flange / design CEI-IEC 72-2 B5 IEC 100/112 Standard	- - -	○ ○ ○	● ● ● ●
H	**Special version**	S:	Several customized solutions are available on request. Appropriate product codes will be assigned by the company.	● ● ●	● ● ●	● ● ● ●
I	**ATEX (optional)**	II2G:	II 2G c T4	● ● ●	● ● ●	● ● ● ●
		II2D:	II 2D c T4	● ● ●	● ● ●	● ● ● ●
		IM2:	I M2 c T4	● ● ●	● ● ●	● ● ● ●

Underline: ● = available; ○ = on request; - = not available

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Functional description:

All mentioned hydraulic motors in this catalogue are designed with a fixed displacement and work according to the wobble plate principle.

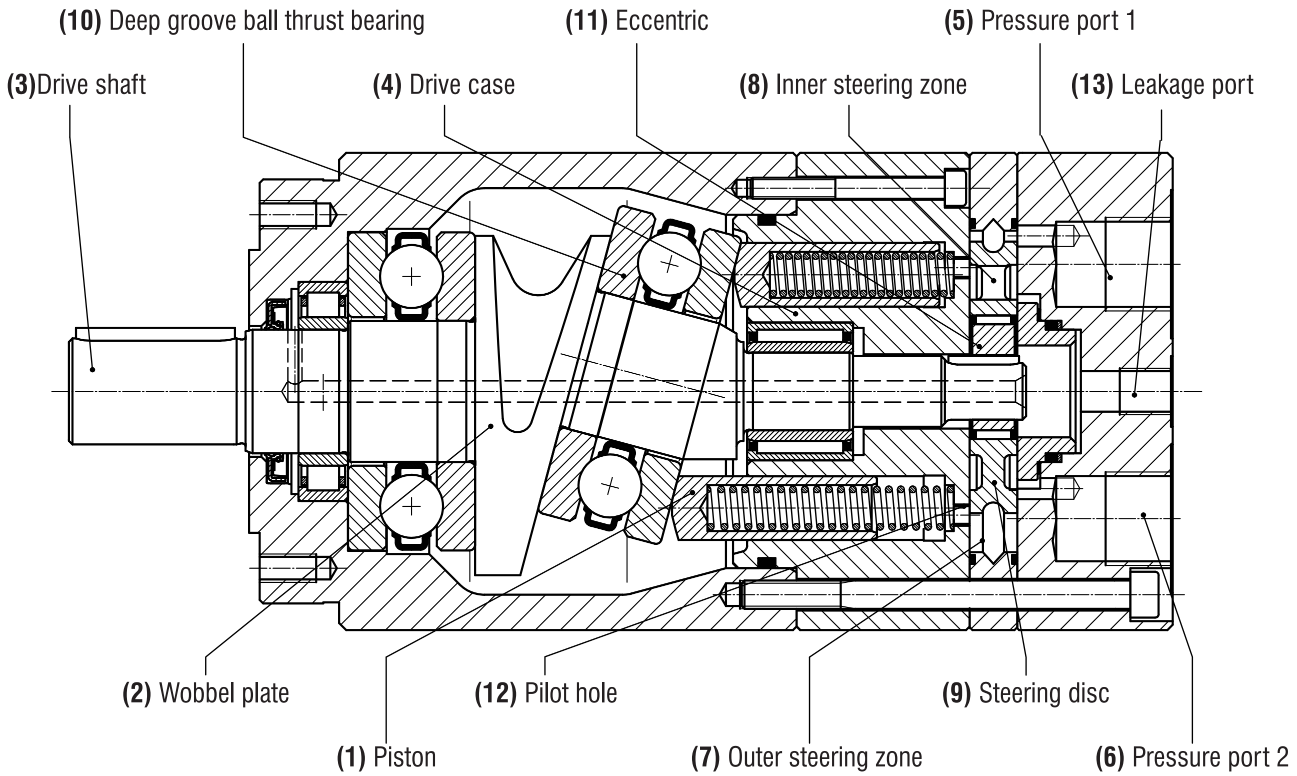
The purpose of a hydraulic drive is to transfer hydraulic power in to mechanical power. Hydraulic power is created by the hydraulic volume flow as well as the pressure difference which is pending between the motors inlet and outlet. The mechanical power results from the speed, torque and efficiency of the motor which can be directly applied from the drive shaft. The required pressure difference in order to turn the shaft will automatically adjust itself to the needed torque at the drive shaft specified by the application. Therefore the needed pressure difference will always be load-dependent. The engine speed on the other hand is directly controlled by the feed of the volume flow of the hydraulic pump.

Functional description wobble plate:

The wobble plate (2) is fixed to the drive shaft (3) mounted plate with a certain draft angel. By feeding the motor with operation medium, the parallel to the drive shaft arranged pistons (1) start to fulfill an axial load which forces the wobble plate (2) and therefore the pivoted drive shaft (3) to turn.

Functional description of Düsterloh's own axial piston motors:

Via both pressure ports (5/6) and the leakage port (13) is the motor linked to the hydraulic system. By pressurising one of the pressure ports (5/6) the operation medium gets into the steering zone (7/8) of the motor. Depending on port (5/6) and therefore on the pressurized steering zone (7/8), the rotation direction of the motor will change. Due to the steering unit (7/8), high pressurized operation fluid gets to the pistons (1) and forces them to extend against the wobble plate (2). Because of the draft angle of the wobble plate (2), the piston load results by resolution of a force and lever arm into a torsional moment. During rotation movement the fixed with the shaft (3) mounted eccentric (11) and its steering discs (9) overtravels the different pilot holes (12) which occurs in a continuous opening and closing. The pistons fully extend based on the draft angle of the wobble plate, then they are forced by the new high pressure to run back into the drive case (4). This effect causes the now low pressurized operation medium to flow via the other pressure port (5/6) back to the HPU's (Hydraulic Power Unit) tank.

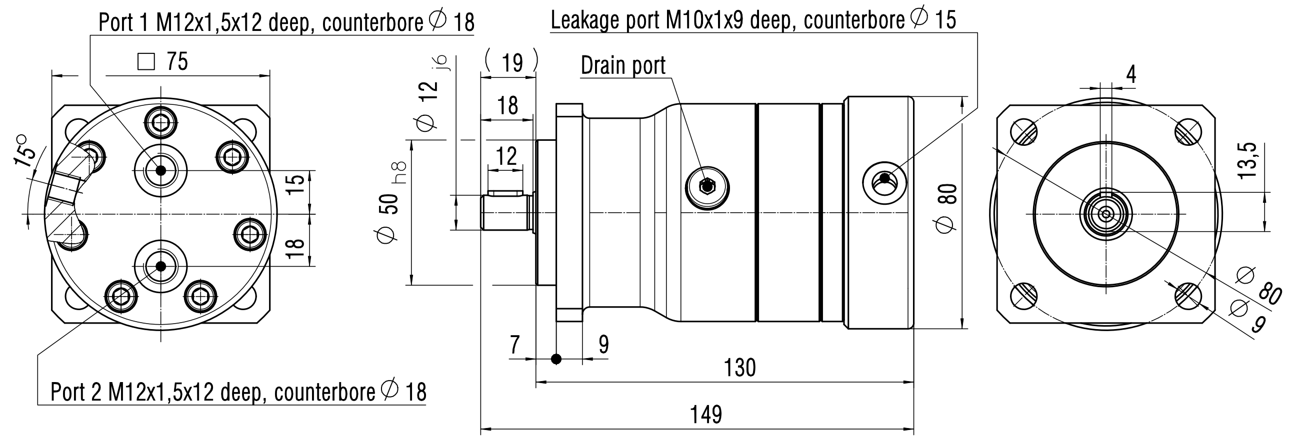


All parameters at $\nu = 32$ mm2/s; $\Theta = 40$°C; p_{outlet} = pressureless

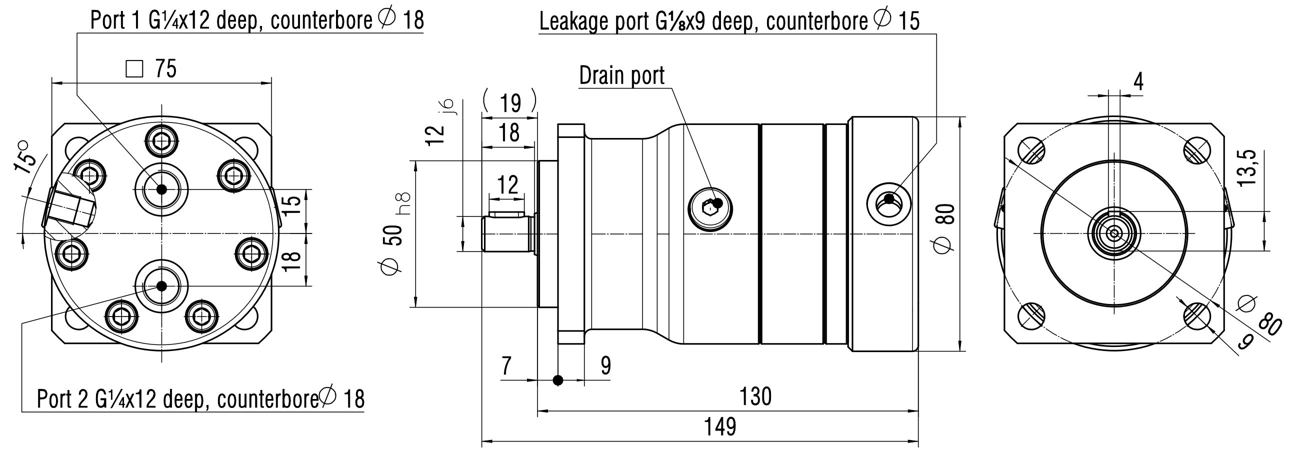
Nominal size	NS		3	4	5
Displacement	V_g	cm³/rev	2,859	4,003	5,146
Theor. specific torque	$T_{spec.theor.}$	Nm/bar	0,046	0,064	0,082
Average specific torque	$T_{spec.aver.}$	Nm/bar	0,041	0,057	0,074
Continuous torque	$T_{cont.}$	Nm	8,6	12	15,5
Max. torque	$T_{max.}$	Nm	10,25	14,25	18,5
Inlet pressure, max. cont.	$p_{cont.}$	bar	210	210	210
max.	$p_{max.}$	bar	250	250	250
peak	p_{peak}	bar	315	315	315
Total pressure	p_{total}	bar	315	315	315
Leakage pressure, max.	$p_{leak.}$	bar	1,5	1,5	1,5
Operating speed range	n	rpm	10-5250	5-3750	3-3000
Max. continuous power	$P_{cont.}$	kW	3,2	3,2	3,2
Max. intermittent power	$P_{interm.}$	kW	3,8	3,8	3,8
Mass moment of intertia	J	kgm²	0,000045	0,000045	0,000045
Mass	m	kg	3,4	3,4	3,4
Temperature range of pressure medium	Θ	°C	-30 bis +80		
Viscosity ν		mm²/s	18 till 1000, recommended: 30 till 50		

$p_{cont.}$ = admissible continuous pressure at limitation to P_{cont}
$p_{max.}$ = maximal admissible operating pressure at limitation $P_{interm.}$ and max. 10% duty cycle / hour
p_{peak} = peak pressure, where the components remain safe in function.
$P_{cont.}$ = Continuous power (at maximal 10 bar outlet pressure). Motor flushing must be carried out above P_{cont}.
$P_{interm.}$ = Power, which may be demanded temporarily (max. 10% duty cycle / hour).
p_{total} = maximum permissible pressure combined out of inlet and outlet pressure.

Example of type designation: AE (3 till 5) ZBFN



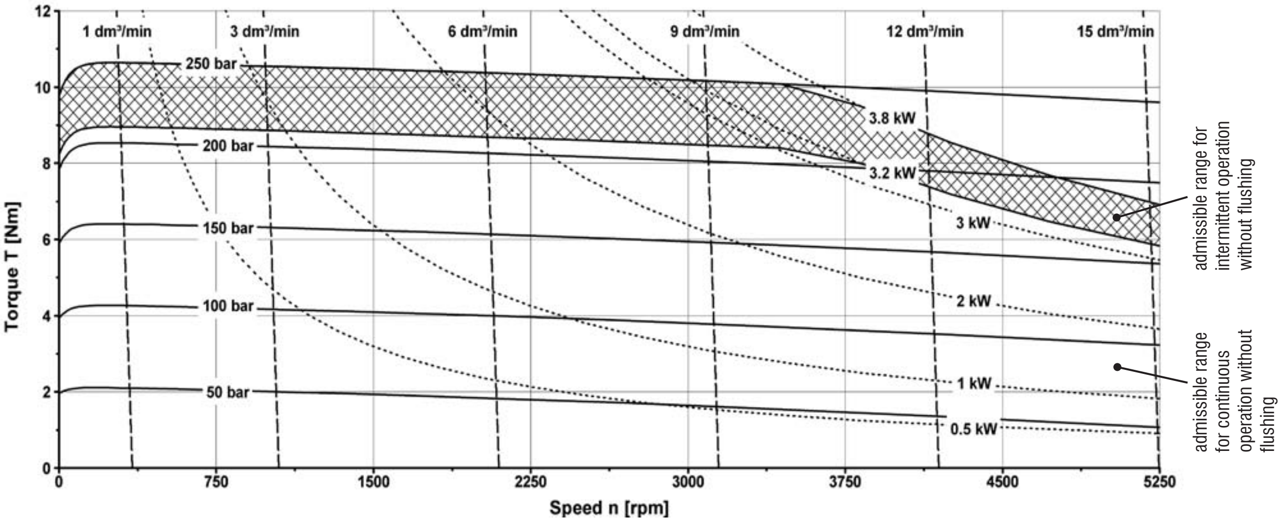
Example of type designation: AE (3 till 5) ZB5FN



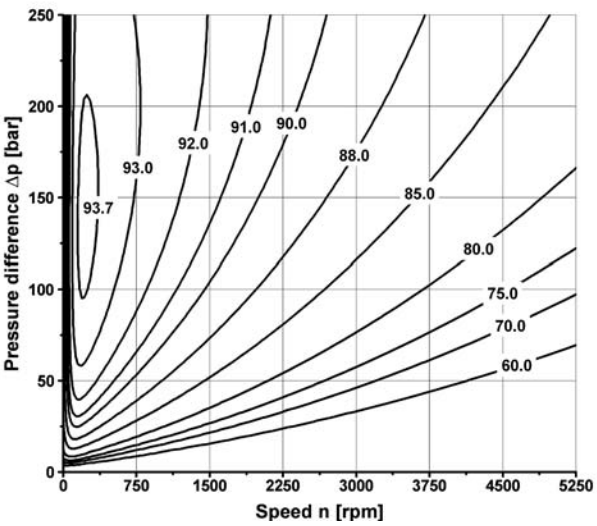
DÜSTERLOH Fluidtechnik	**Axial piston motor** AE 3 Chracteristic curve	Catalogue HM1 - 017 Page 6 Edition 2016.11/11

All parameters at $\nu = 32$ mm2/s; $\Theta = 40°C$; p_{outlet} = pressureless

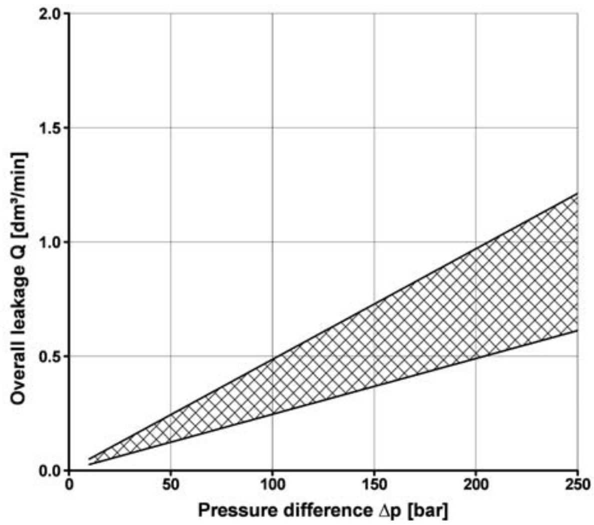
Torque curve



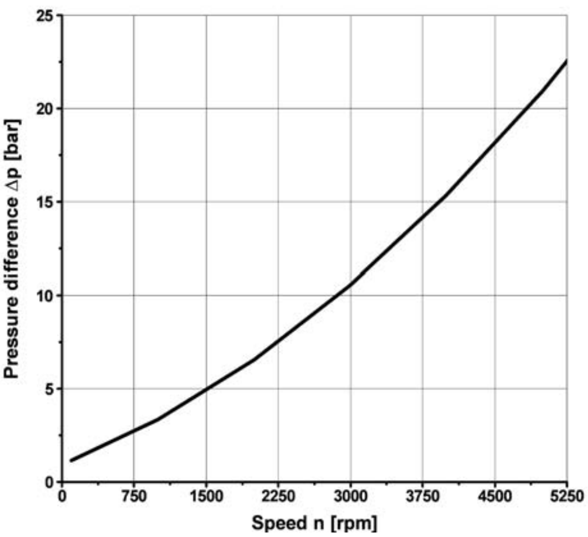
hydraulic and mechanical efficiency by %



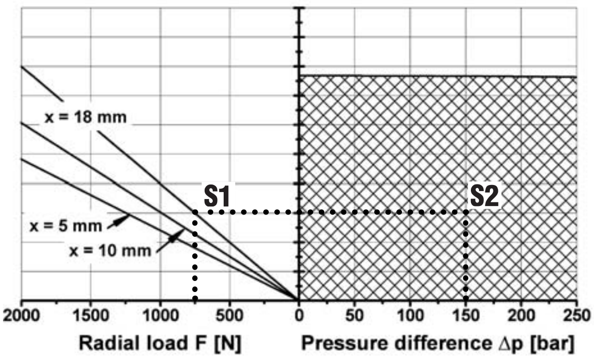
Overall leakage

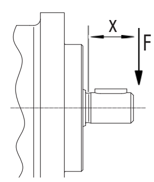


No-load characteristic



Shaft strength calculation

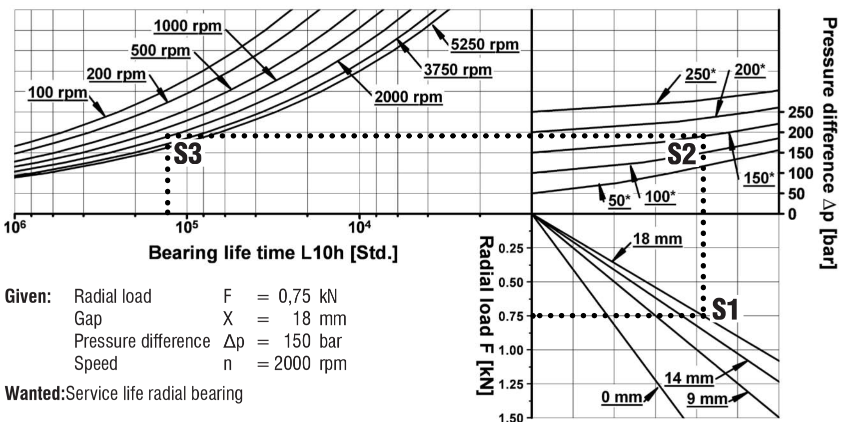




Example:
Given: F = 750 N; x = 18 mm; Δp = 150 bar
Wanted: Shaft strength
Generate intercept point S1 by using radial load F and shaft gap X. Now, S2 will be determined by using S1 and the pressure difference Δp. In case, S2 is located within the hachure's sector, shaft will be fatigue endurable.

All parameters at $\nu = 32$ mm2/s; $\Theta = 40°C$; p_{outlet} = pressureless

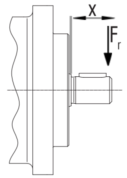
Life expectancy-nomogram of control unit faceing radial bearing



Given: Radial load F = 0,75 kN
Gap X = 18 mm
Pressure difference Δp = 150 bar
Speed n = 2000 rpm

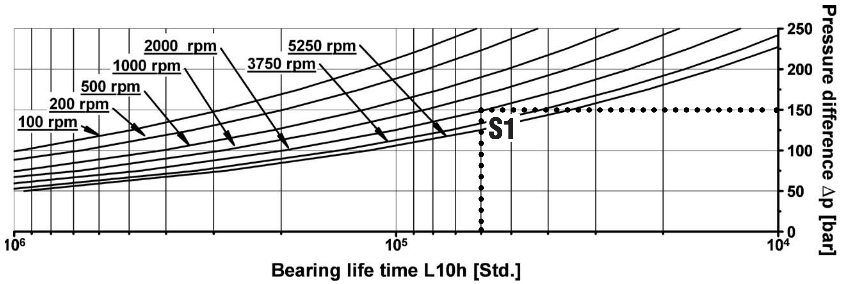
Wanted: Service life radial bearing

Graph to determine service life of radial bearing:



To determine service life of bearing, use radial load F_r **= 0,75 kN** and gap **X = 18 mm** in order to find intercept point **S1.** By using **S1**, draw a vertical line to pressure curves **Δp = 150 bar**. From this, intercept point **S2** can be determined. By drawing a horizontal line to speed curve **n = 2000 rpm**, intercept point **S3** is found. By drawing a vertical line from **S3** to the x-axis, you can determine the service life of the bearing **Lh10** by approx. **127.950 hours**.

Life expectancy-nomogram of axial bearing



Given: Radial load F = nonexistent
Gap X = nonexistent
Pressure difference Δp = 150 bar
Speed n = 2000 rpm

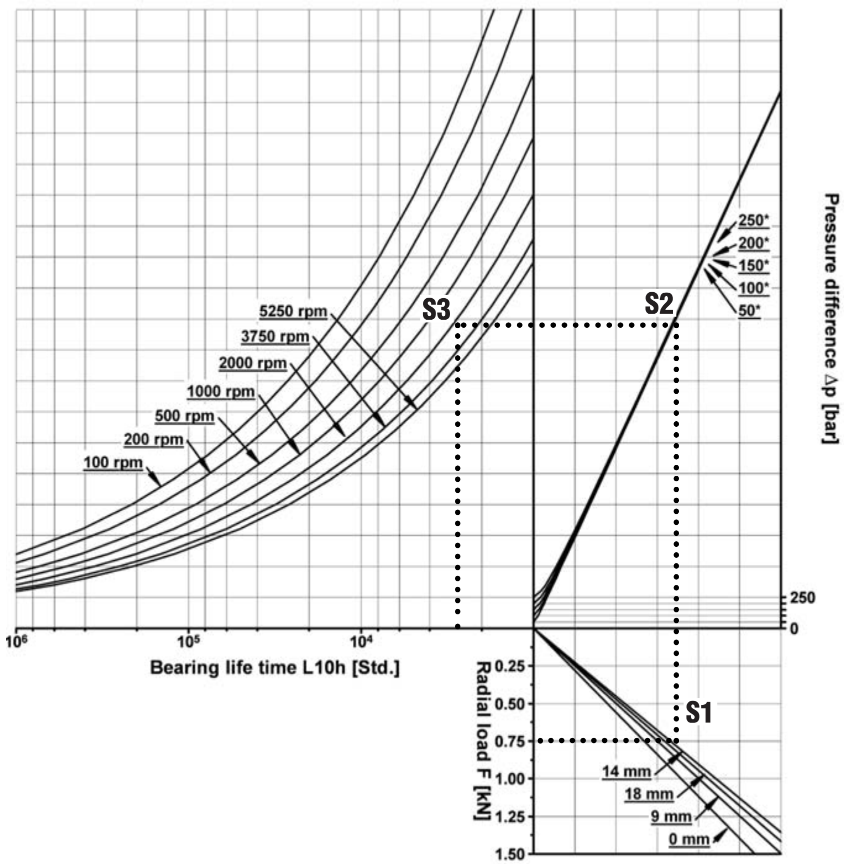
Wanted: Service life radial bearing

Graph to determine service life of axial bearing:

Axial bearings are not able to receive any radial force.

In order to determine service life of bearing, draw a horizontal line from the Y-axis **Δp =150 bar** to speed curve **n = 2000 rpm**. By drawing a vertical line from **intercept point S1** to the X-axis, you can determine the service life of the bearing **Lh10** by approx. **60.000 hours**.

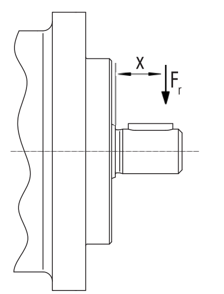
Life expectancy-nomogram of drive shaft faceing radial bearing



Given: Radial load Fr = 0,75 kN
Gap X = 18 mm
Pressure difference Δp = 150 bar
Speed n = 2000 rpm

Wanted: Service life radial bearing

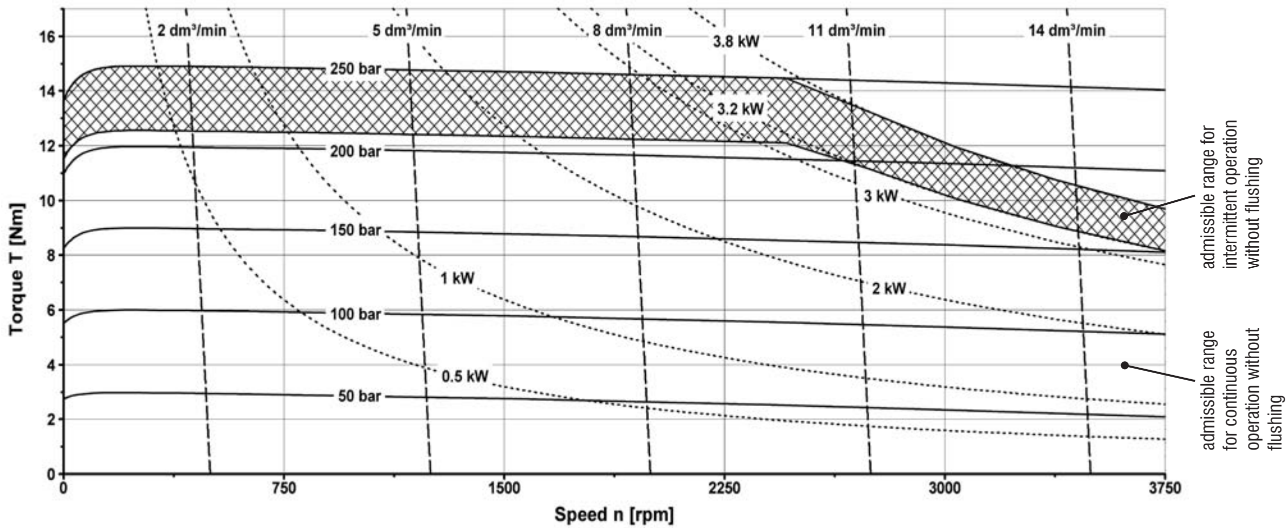
Graph to determine service life of radial bearing:



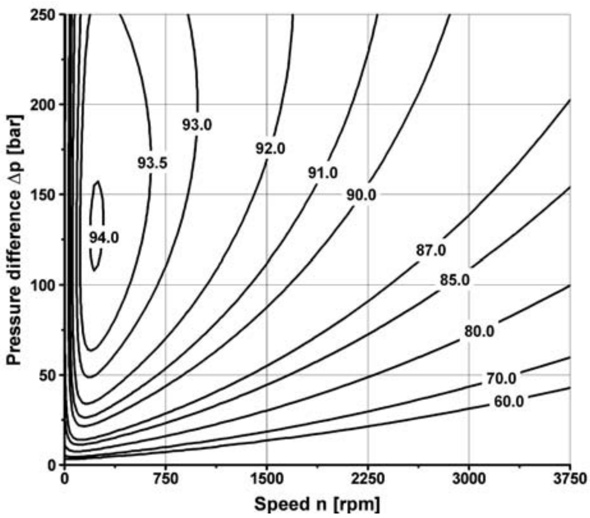
To determine service life of bearing, use radial load F_r **= 0,75 kN** and gap **X = 18 mm** in order to find intercept point **S1.** By using **S1**, draw a vertical line to pressure curves **Δp = 150 bar**. From this, intercept point **S2** can be determined. By drawing a horizontal line to speed curve **n = 2000 rpm**, intercept point **S3** is found. By drawing a vertical line from **S3** to the x-axis, you can determine the service life of the bearing **Lh10** by approx. **3.100 hours**.

All parameters at $\nu = 32$ mm2/s; $\Theta = 40$°C; p_{outlet} = pressureless

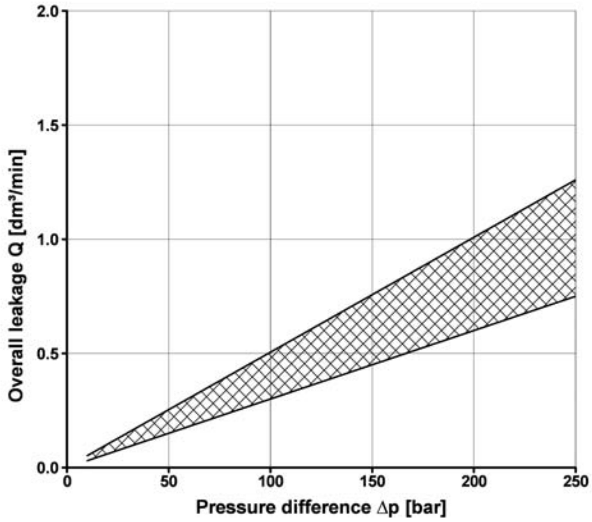
Torque curve



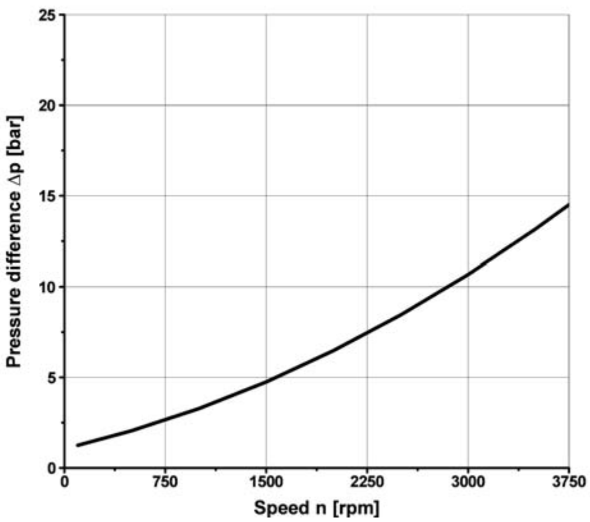
hydraulic and mechanical efficiency by %



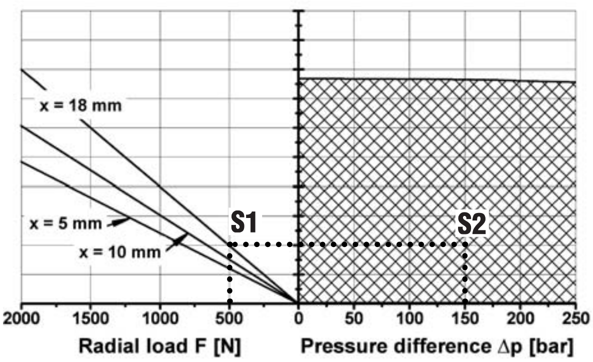
Overall leakage

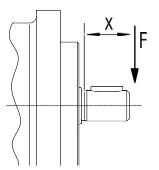


No-load characteristic



Shaft strength calculation

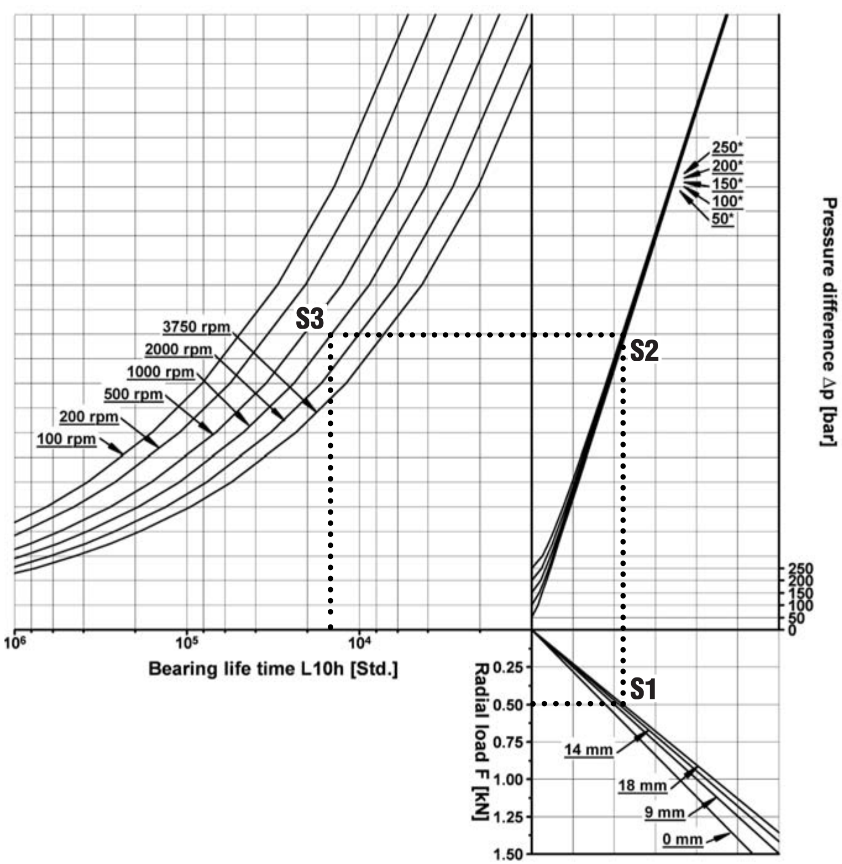


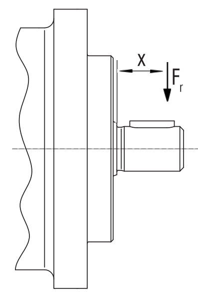


Example:
Given: F = 500 N; x = 18 mm; Δp = 150 bar
Wanted: Shaft strength
Generate intercept point S1 by using radial load F and shaft gap X. Now, S2 will be determined by using S1 and the pressure difference Δp. In case, S2 is located within the hachure's sector, shaft will be fatigue endurable.

All parameters at $\nu = 32$ mm2/s; $\Theta = 40$°C; p_{outlet} = pressureless

Life expectancy-nomogram of drive shaft faceing radial bearing



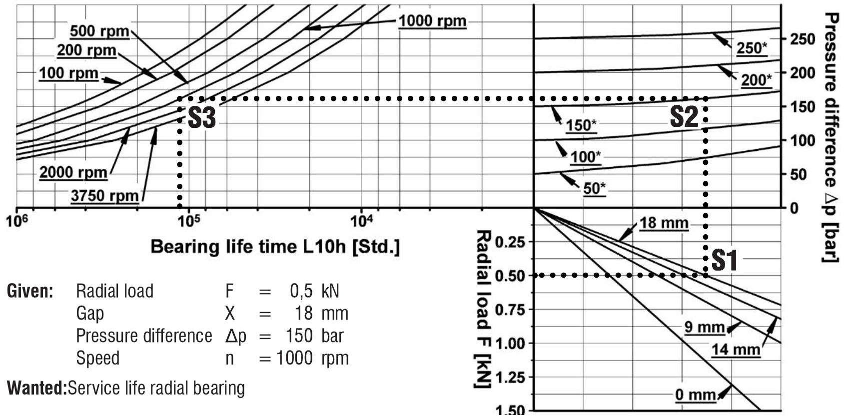


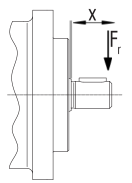
Given:	Radial load	Fr	=	0,5	kN
	Gap	X	=	18	mm
	Pressure difference	Δp	=	150	bar
	Speed	n	=	1000	rpm
Wanted:	Service life radial bearing				

Graph to determine service life of radial bearing:

To determine service life of bearing, use radial load F_r = **0,5 kN** and gap **X = 18 mm** in order to find intercept point **S1.** By using **S1**, draw a vertical line to pressure curves **Δp = 150 bar**. From this, intercept point **S2** can be determined. By drawing a horizontal line to speed curve **n = 1000 rpm**, intercept point **S3** is found. By drawing a vertical line from **S3** to the x-axis, you can determine the service life of the bearing **Lh10** by approx. **14.500 hours**.

Life expectancy-nomogram of control unit faceing radial bearing



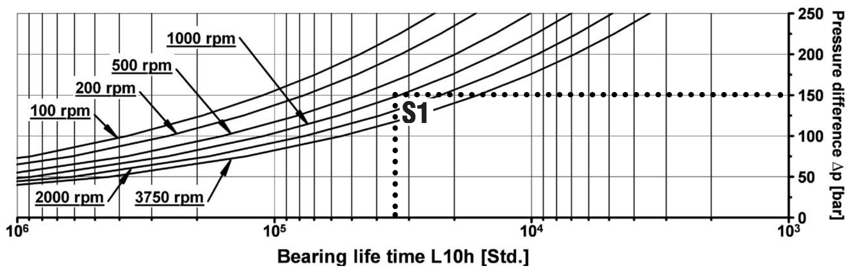


Given:	Radial load	F	=	0,5	kN
	Gap	X	=	18	mm
	Pressure difference	Δp	=	150	bar
	Speed	n	=	1000	rpm
Wanted:	Service life radial bearing				

Graph to determine service life of radial bearing:

To determine service life of bearing, use radial load F_r = **0,5 kN** and gap **X = 14 mm** in order to find intercept point **S1.** By using **S1**, draw a vertical line to pressure curves **Δp = 250 bar**. From this, intercept point **S2** can be determined. By drawing a horizontal line to speed curve **n = 2000 rpm**, intercept point **S3** is found. By drawing a vertical line from **S3** to the x-axis, you can determine the service life of the bearing **Lh10** by approx. **110.000 hours**.

Life expectancy-nomogram of axial bearing



Given:	Radial load	F	=	nonexistent
	Gap	X	=	nonexistent
	Pressure difference	Δp	=	150 bar
	Speed	n	=	1000 rpm
Wanted:	Service life radial bearing			

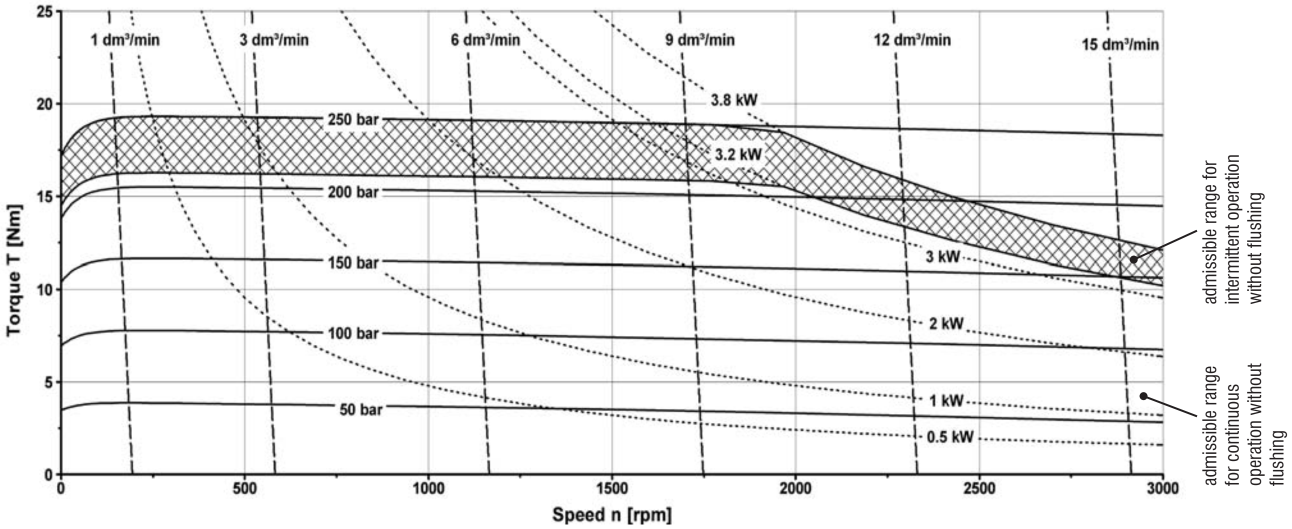
Graph to determine service life of axial bearing:

Axial bearings are not able to receive any radial force.

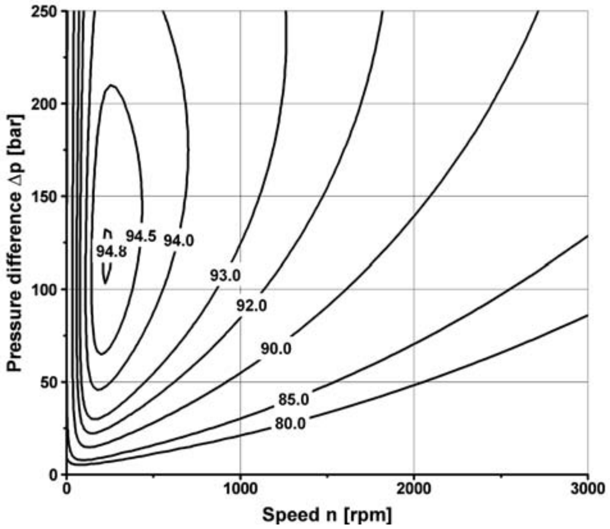
In order to determine service life of bearing, draw a horizontal line from the Y-axis **Δp =150 bar** to speed curve **n = 1000 rpm**. By drawing a vertical line from **intercept point S1** to the X-axis, you can determine the service life of the bearing **Lh10** by approx. **32.000 hours**.

All parameters at $\nu = 32$ mm2/s; $\Theta = 40°C$; p_{outlet} = pressureless

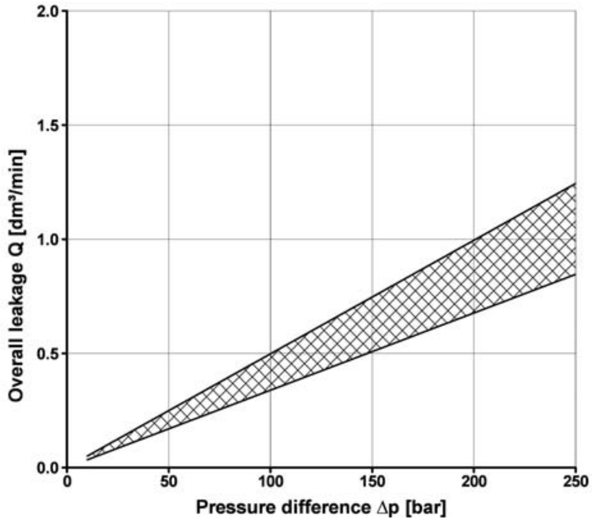
Torque curve



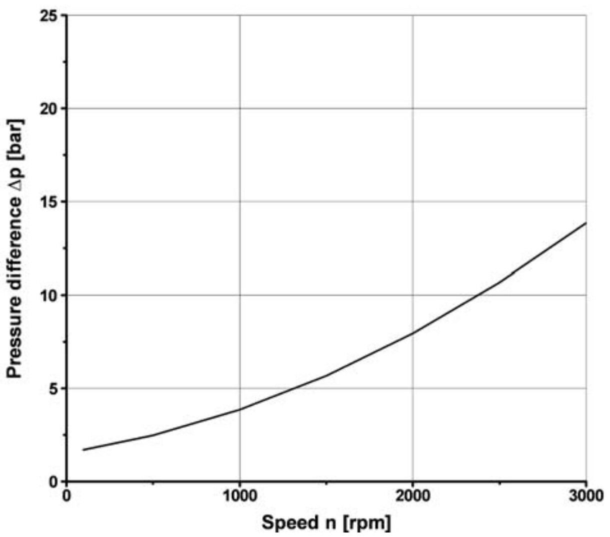
hydraulic and mechanical efficiency by %



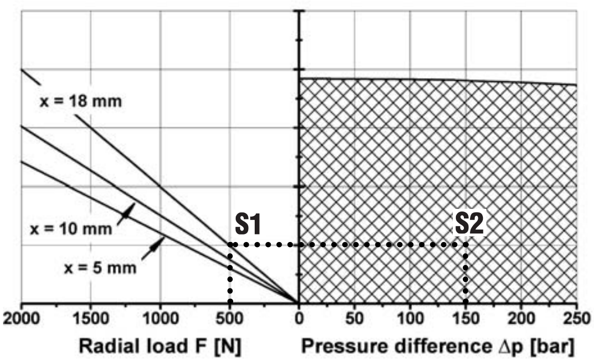
Overall leakage

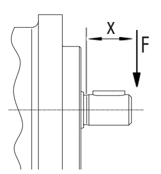


No-load characteristic



Shaft strength calculation





Example:
Given: F = 500 N; x = 18 mm; Δp = 150 bar
Wanted: Shaft strength
Generate intercept point S1 by using radial load F and shaft gap X. Now, S2 will be determined by using S1 and the pressure difference Δp. In case, S2 is located within the hachure's sector, shaft will be fatigue endurable.

DÜSTERLOH Fluidtechnik

Axial piston motor

AE 5

Chracteristic curve

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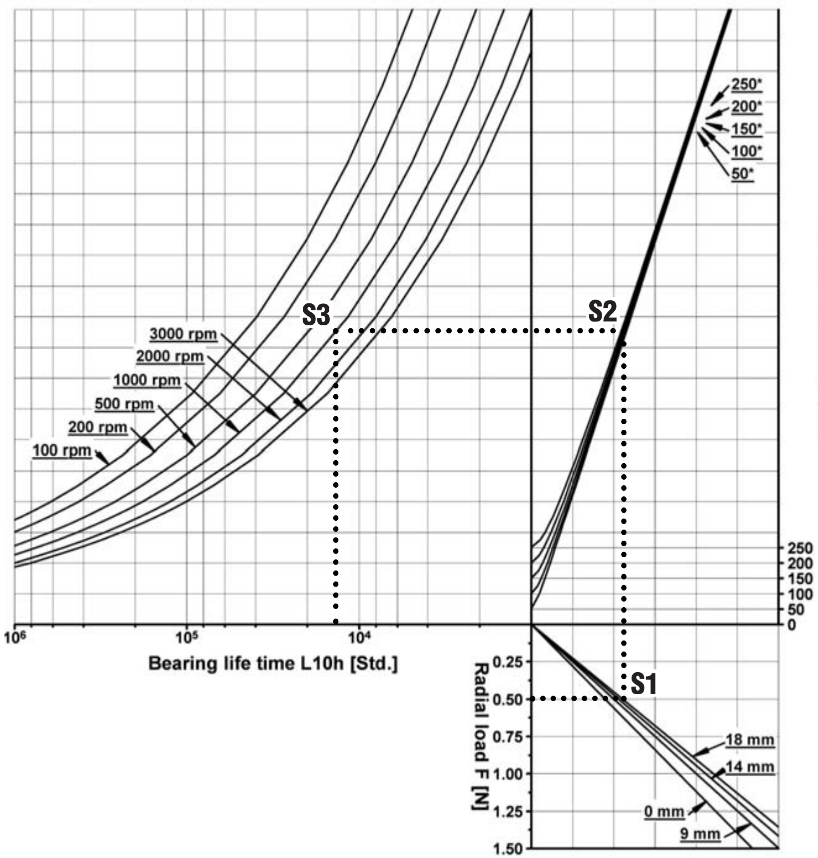
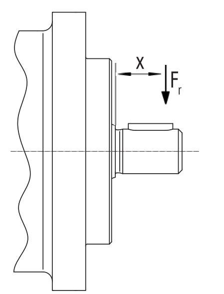
All parameters at $\nu = 32$ mm2/s; $\Theta = 40°C$; p_{outlet} = pressureless

Life expectancy-nomogram of drive shaft faceing radial bearing



Given: Radial load	Fr	=	0,5	kN
Gap	X	=	18	mm
Pressure difference	Δp	=	150	bar
Speed	n	=	1000	rpm

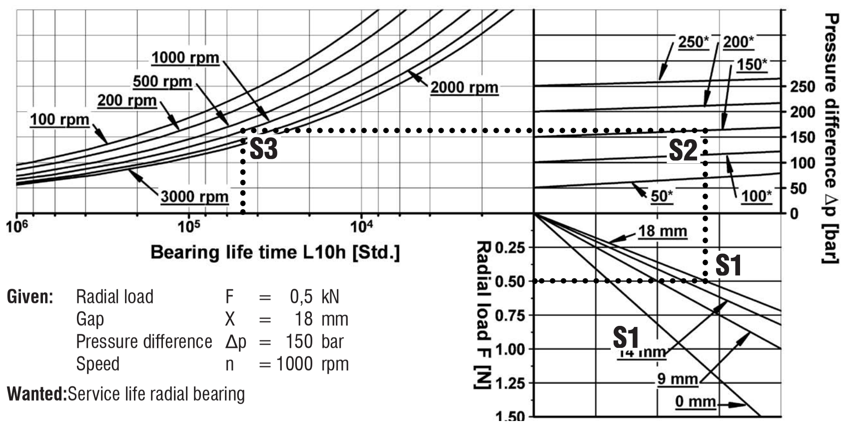
Wanted: Service life radial bearing



Graph to determine service life of radial bearing:

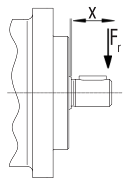
To determine service life of bearing, use radial load F_r **= 0,5 kN** and gap **X = 18 mm** in order to find intercept point **S1.** By using **S1**, draw a vertical line to pressure curves **Δp = 150 bar**. From this, intercept point **S2** can be determined. By drawing a horizontal line to speed curve **n = 1000 rpm**, intercept point **S3** is found. By drawing a vertical line from **S3** to the x-axis, you can determine the service life of the bearing **Lh10** by approx. **14.500 hours.**

Life expectancy-nomogram of control unit faceing radial bearing



Given: Radial load F = 0,5 kN
Gap X = 18 mm
Pressure difference Δp = 150 bar
Speed n = 1000 rpm

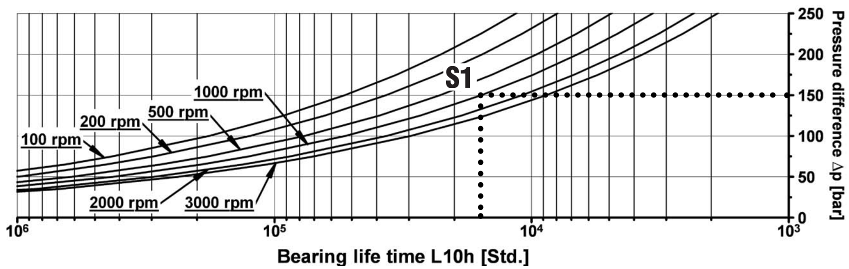
Wanted: Service life radial bearing



Graph to determine service life of radial bearing:

To determine service life of bearing, use radial load F_r **= 0,5 kN** and gap **X = 18 mm** in order to find intercept point **S1.** By using **S1**, draw a vertical line to pressure curves **Δp = 150 bar**. From this, intercept point **S2** can be determined. By drawing a horizontal line to speed curve **n = 1000 rpm**, intercept point **S3** can be determine. By drawing a vertical line from **S3** to the x-axis, you can determine the service life of the bearing **Lh10** by approx. **52.000 hours**.

Life expectancy-nomogram of axial bearing



Given: Radial load F = nonexistent
Gap X = nonexistent
Pressure difference Δp = 150 bar
Speed n = 1000 rpm

Wanted: Service life radial bearing

Graph to determine service life of axial bearing:

Axial bearings are not able to receive any radial force.

In order to determine service life of bearing, draw a horizontal line from the Y-axis **Δp =150 bar** to speed curve **n = 1000 rpm**. By drawing a vertical line from **intercept point S1** to the X-axis, you can determine the service life of the bearing **Lh10** by approx. **15.600 hours**.

Axial piston motor

AE 10 - AE 21

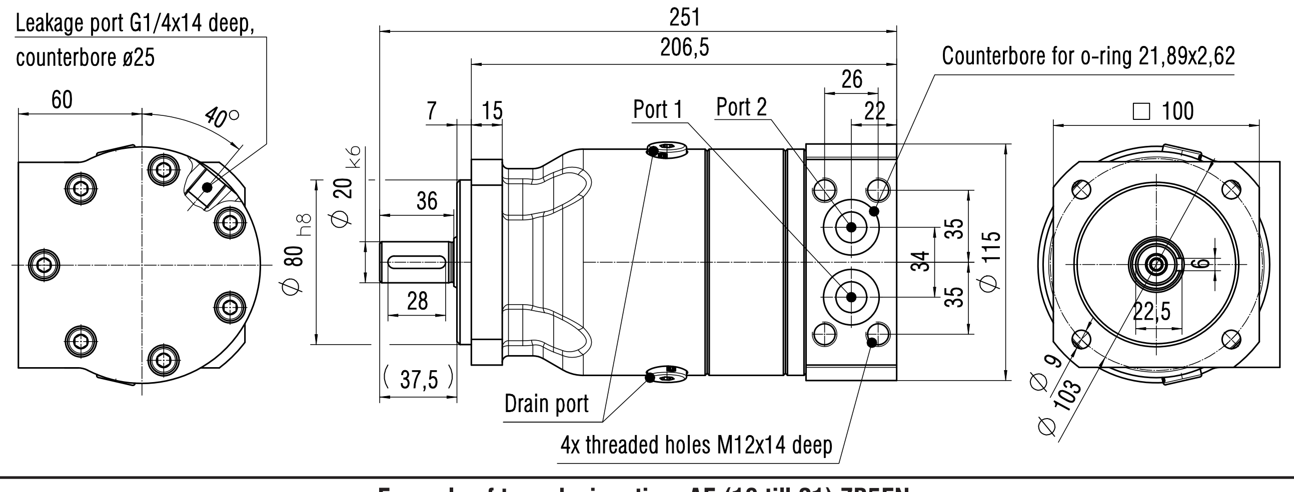
Technical data and outline drawing

All parameters at ν = 32 mm2/s; Θ = 40°C; p_{outlet} = pressureless

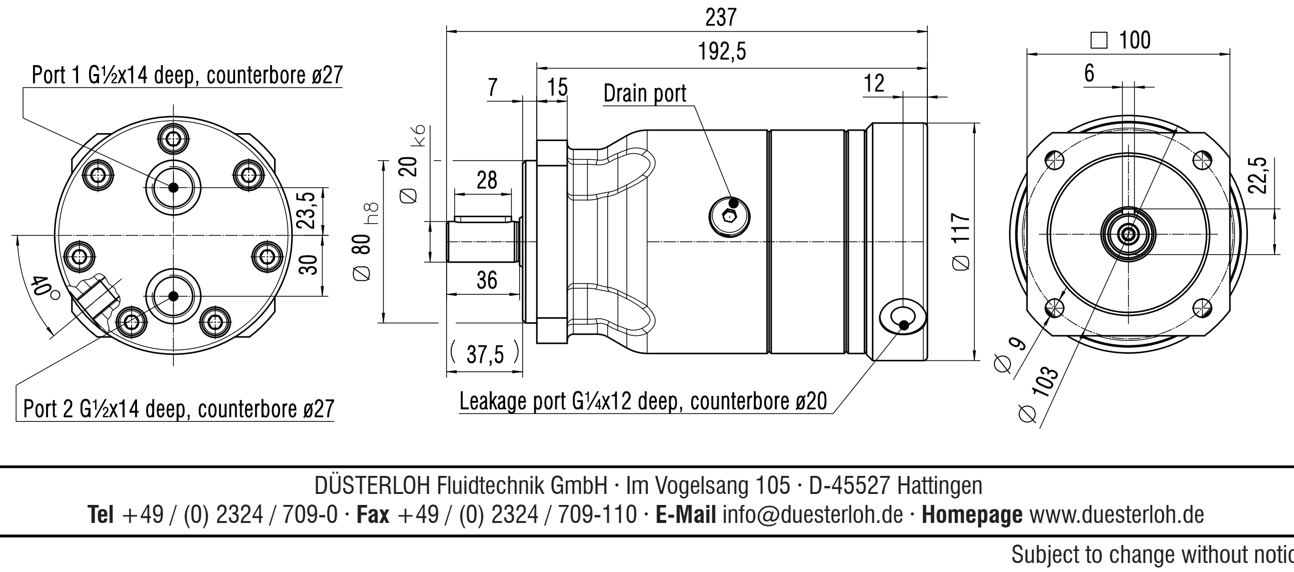
Nominal size	NS		10	16	21
Displacement	V_g	cm³/rev	11,435	16,009	21,308
Theor. specific torque	$T_{spec.theor.}$	Nm/bar	0,182	0,255	0,339
Average specific torque	$T_{spec.aver.}$	Nm/bar	0,164	0,229	0,305
Continuous torque	$T_{cont.}$	Nm	34,4	48,1	64,1
Max. torque	$T_{max.}$	Nm	41	57,3	76,3
Inlet pressure, max. cont.	$p_{cont.}$	bar	210	210	210
max.	$p_{max.}$	bar	250	250	250
peak	p_{peak}	bar	315	315	315
Total pressure	p_{total}	bar	315	315	315
Leakage pressure, max.	$p_{leak.}$	bar	1,5	1,5	1,5
Operating speed range	n	rpm	10-3000	5-2500	3-2400
Max. continuous power	$P_{cont.}$	kW	7,7	8,1	10,7
Max. intermittent power	$P_{interm.}$	kW	9,2	9,6	12,8
Mass moment of intertia	J	kgm²	0,000035	0,000035	0,000035
Mass	m	kg	12,8	12,8	12,8
Temperature range of pressure medium	Θ	°C	-30 bis +80		
Viscosity ν		mm²/s	18 till 1000, recommended: 30 till 50		

$p_{cont.}$ = admissible continuous pressure at limitation to P_{cont}
$p_{max.}$ = maximal admissible operating pressure at limitation $P_{interm.}$ and max. 10% duty cycle / hour
p_{peak} = peak pressure, where the components remain safe in function.
$P_{cont.}$ = Continuous power (at maximal 10 bar outlet pressure). Motor flushing must be carried out above P_{cont}.
$P_{interm.}$ = Power, which may be demanded temporarily (max. 10% duty cycle / hour).
p_{total} = maximum permissible pressure combined out of inlet and outlet pressure.

Example of type designation: AE (10 till 21) ZA1FN



Example of type designation: AE (10 till 21) ZB5FN



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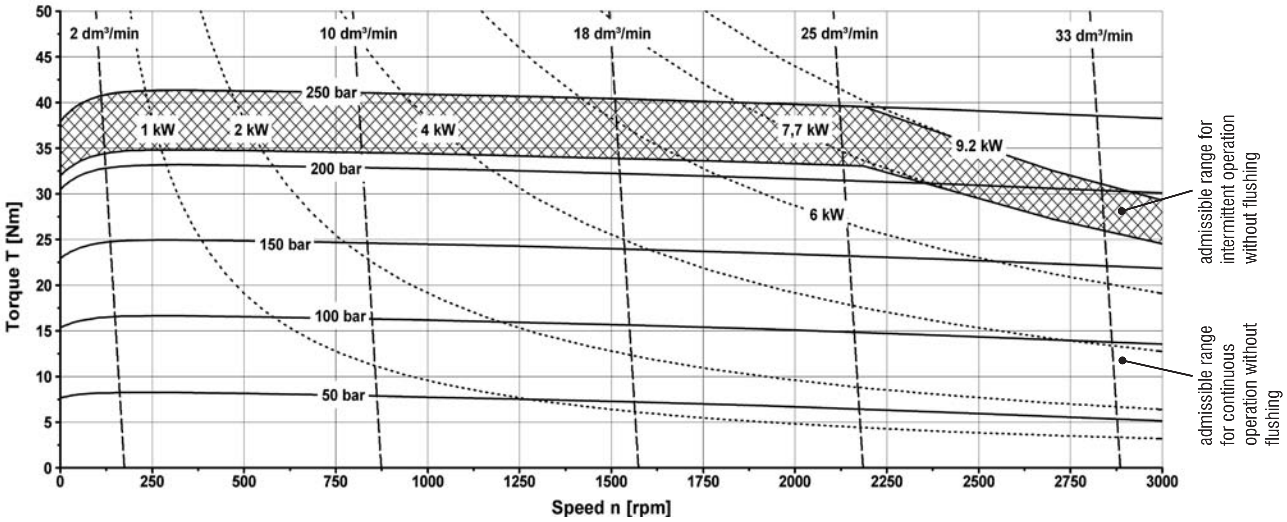
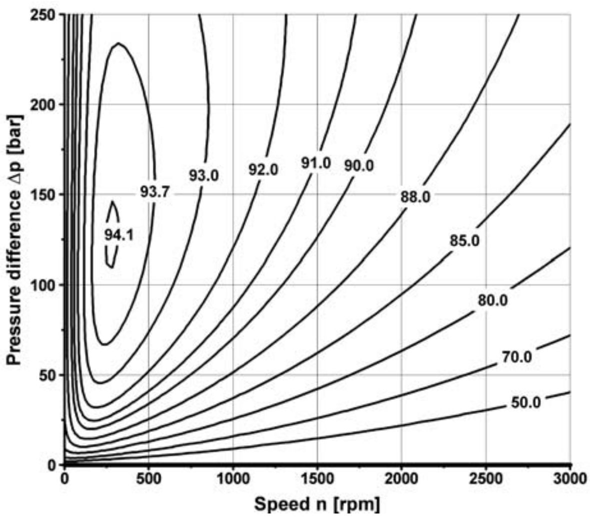
All parameters at $\nu = 32$ mm2/s; $\Theta = 40°C$; p_{outlet} = pressureless

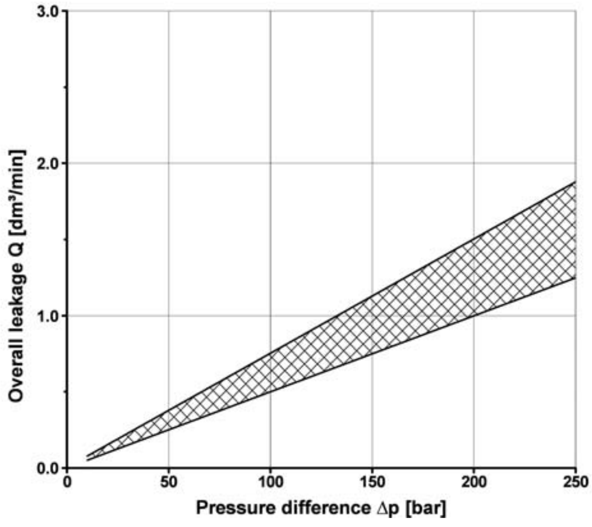
Torque curve



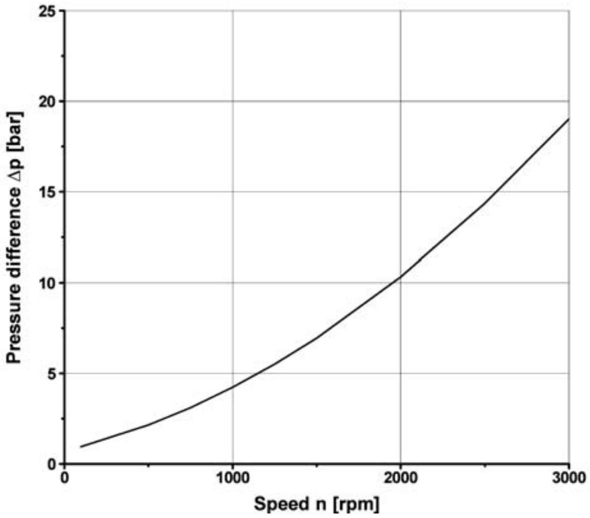
hydraulic and mechanical efficiency by %



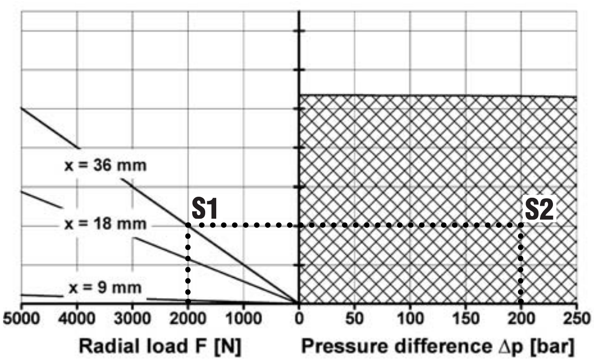
Overall leakage

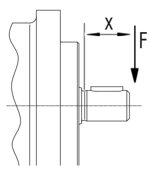


No-load characteristic



Shaft strength calculation

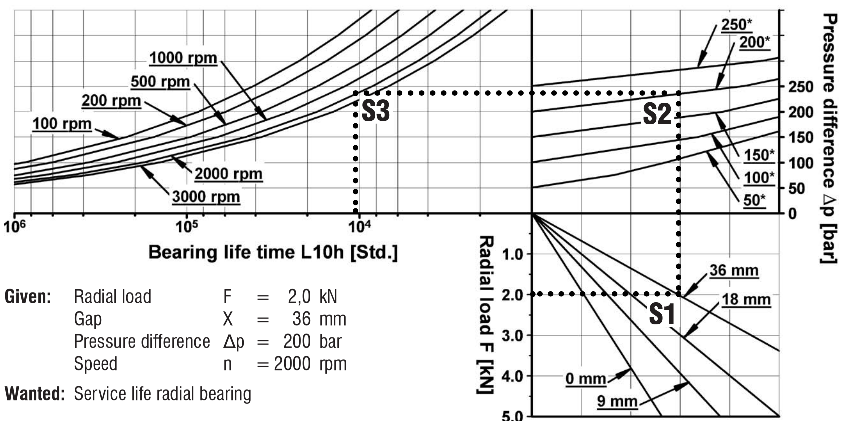




Example:
Given: F = 2000 N; x = 18 mm; Δp = 200 bar
Wanted: Shaft strength
Generate intercept point S1 by using radial load F and shaft gap X. Now, S2 will be determined by using S1 and the pressure difference Δp. In case, S2 is located within the hachure's sector, shaft will be fatigue endurable.

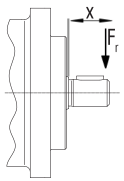
All parameters at ν = 32 mm2/s; Θ = 40°C; p_{outlet} = pressureless

Life expectancy-nomogram of control unit faceing radial bearing



Given: Radial load F = 2,0 kN
Gap X = 36 mm
Pressure difference Δp = 200 bar
Speed n = 2000 rpm

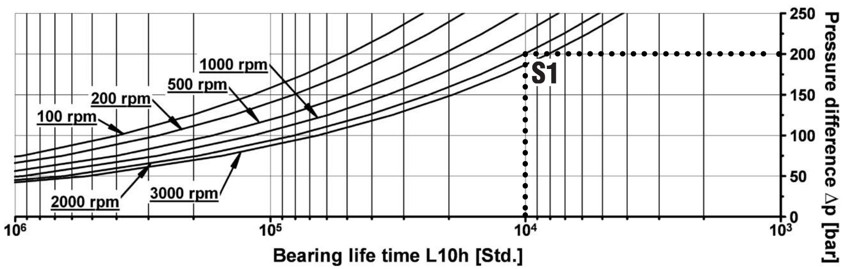
Wanted: Service life radial bearing



Graph to determine service life of radial bearing:

To determine service life of bearing, use radial load F_r **= 2,0 kN** and gap **X = 36 mm** in order to find intercept point **S1.** By using **S1**, draw a vertical line to pressure curves **Δp = 200 bar**. From this, intercept point **S2** can be determined. By drawing a horizontal line to speed curve **n = 2000 rpm**, intercept point **S3** is found. By drawing a vertical line from **S3** to the x-axis, you can determine the service life of the bearing **Lh10** by approx. **11.000 hours**.

Life expectancy-nomogram of axial bearing



Given: Radial load F =nonexistent
Gap X =nonexistent
Pressure difference Δp = 200 bar
Speed n = 2000 rpm

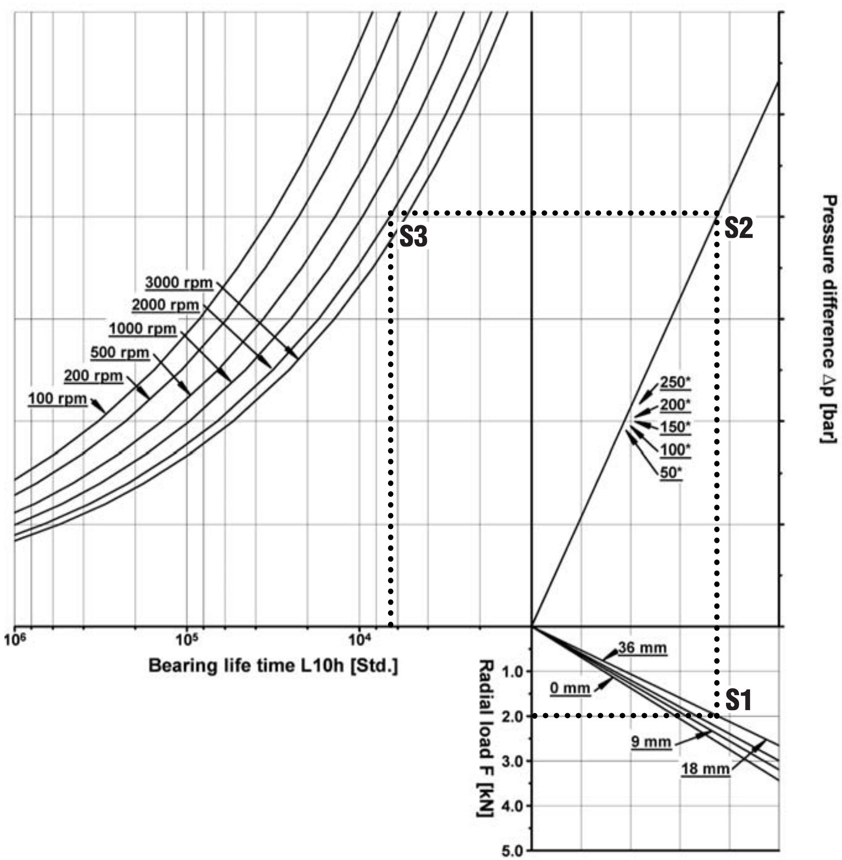
Wanted: Service life radial bearing

Graphic draft in order to determine service life of axial bearing:

Axial bearings are not able to receive any radial force.

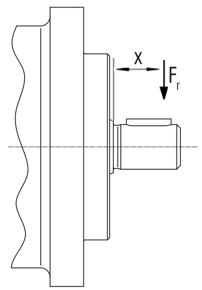
In order to determine service life of bearing, draw a horizontal line from the Y-axis **Δp =200 bar** to speed curve **n = 2000 rpm**. By drawing a vertical line from **intercept point S1** to the X-axis, you can determine the service life of the bearing **Lh10** by approx. **10.000 hours**.

Life expectancy-nomogram of drive shaft faceing radial bearing



Given: Radial load Fr = 2,0 kN
Gap X = 36 mm
Pressure difference Δp = 200 bar
Speed n = 2000 rpm

Wanted: Service life radial bearing

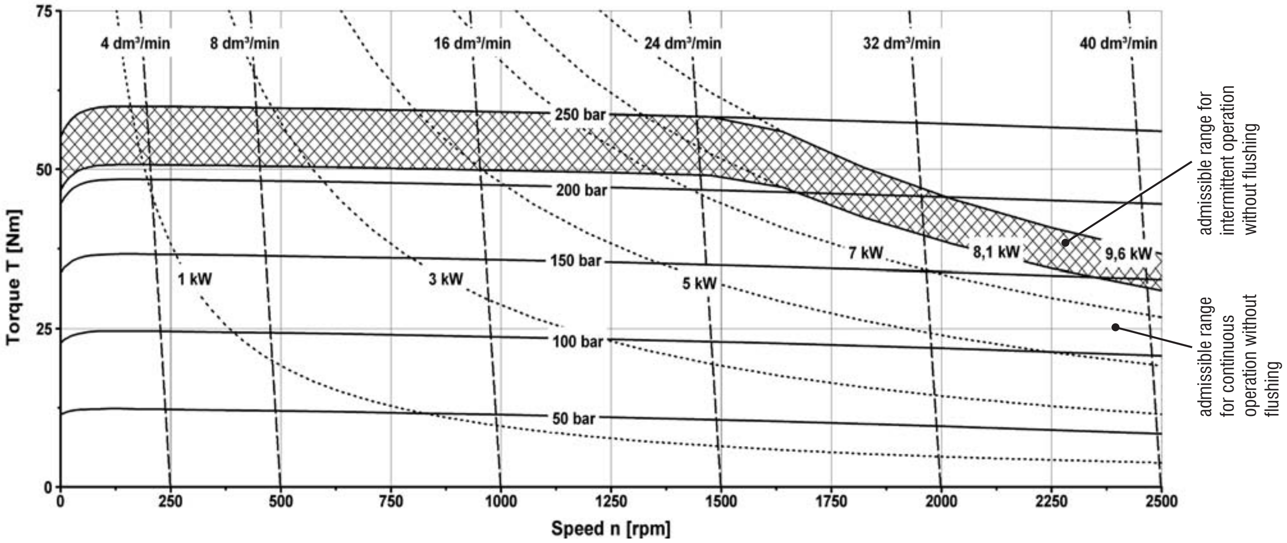


Graph to determine service life of radial bearing:

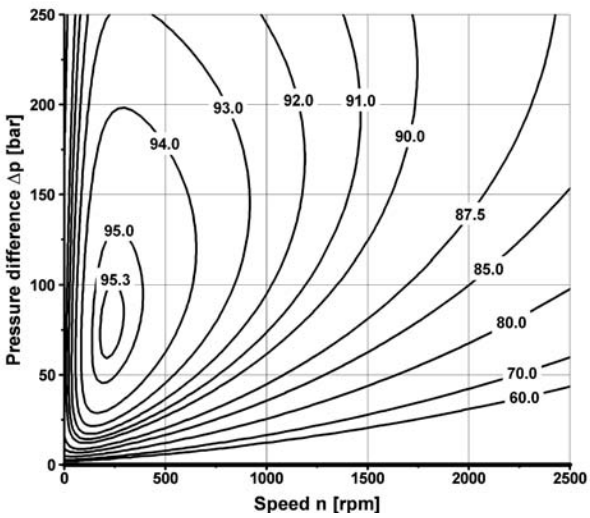
To determine service life of bearing, use radial load F_r **= 2 kN** and gap **X = 36 mm** in order to find intercept point **S1.** By using **S1**, draw a vertical line to pressure curves **Δp = 200 bar**. From this, intercept point **S2** can be determined. By drawing a horizontal line to speed curve **n = 2000 rpm**, intercept point **S3** is found. By drawing a vertical line from **S3** to the x-axis, you can determine the service life of the bearing **Lh10** by approx. **6.500 hours**.

All parameters at ν = 32 mm2/s; Θ = 40°C; p_{outlet} = pressureless

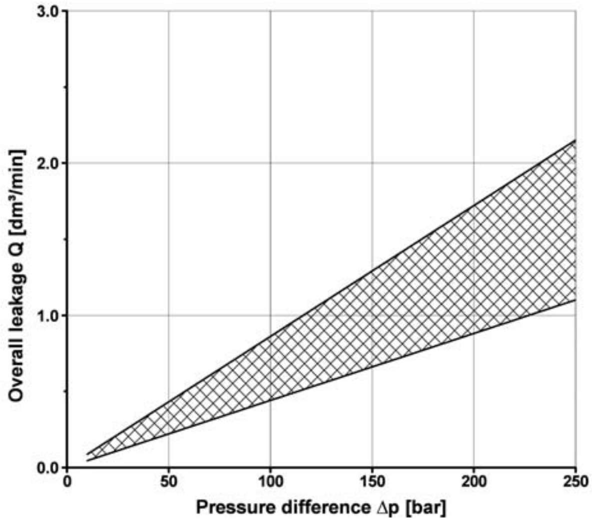
Torque curve



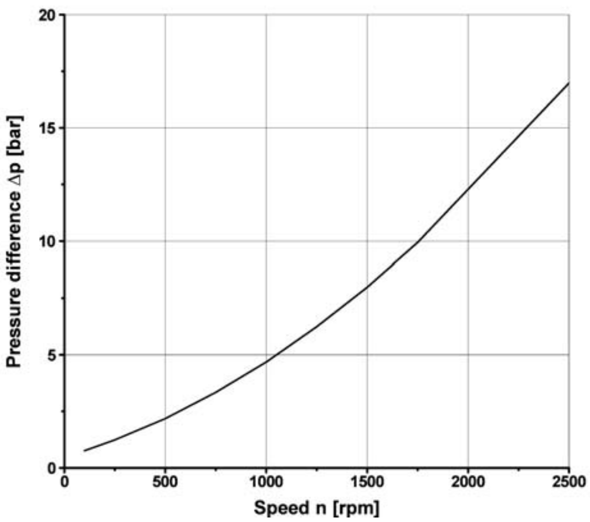
hydraulic and mechanical efficiency by %



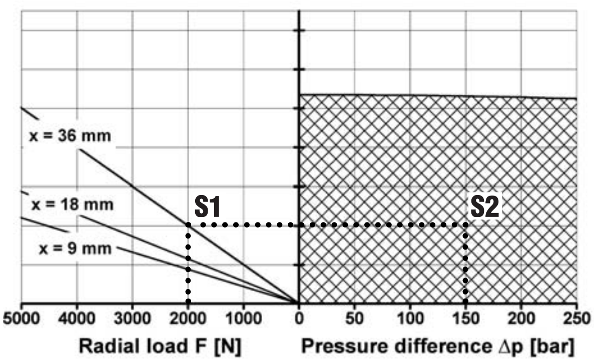
Overall leakage

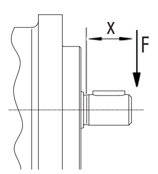


No-load characteristic



Shaft strength calculation

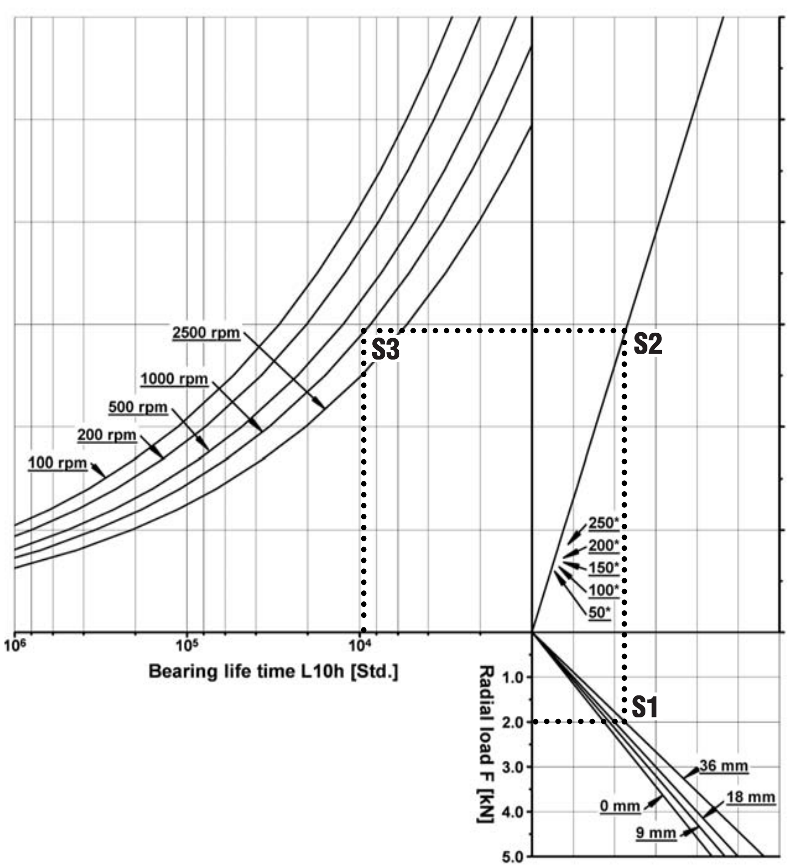




Example:
Given: F = 2000 N; x = 36 mm; Δp = 150 bar
Wanted: Shaft strength
Generate intercept point S1 by using radial load F and shaft gap X. Now, S2 will be determined by using S1 and the pressure difference Δp. In case, S2 is located within the hachure's sector, shaft will be fatigue endurable.

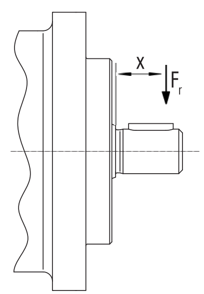
All parameters at ν = 32 mm2/s; Θ = 40°C; p_{outlet} = pressureless

Life expectancy-nomogram of drive shaft faceing radial bearing



Given: Radial load	Fr	=	2,0	kN
Gap	X	=	36	mm
Pressure difference	Δp	=	150	bar
Speed	n	=	1000	rpm

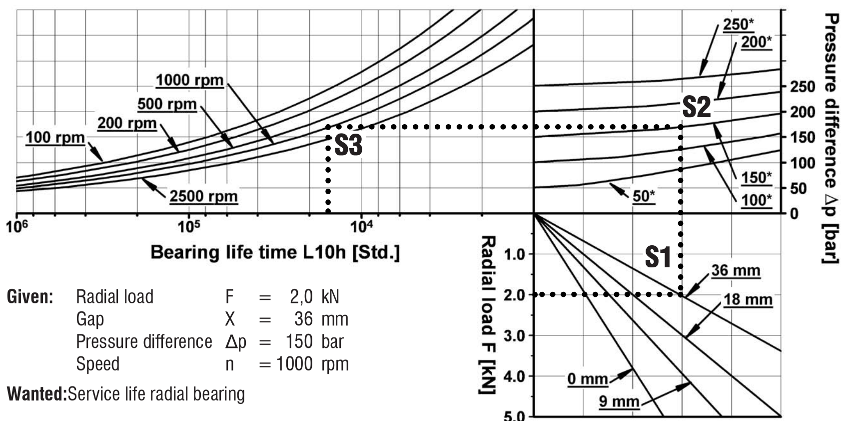
Wanted: Service life radial bearing



Graph to determine service life of radial bearing:

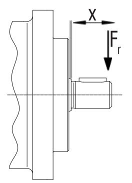
To determine service life of bearing, use radial load F_r = **2 kN** and gap **X = 36 mm** in order to find intercept point **S1.** By using **S1**, draw a vertical line to pressure curves **Δp = 150 bar**. From this, intercept point **S2** can be determined. By drawing a horizontal line to speed curve **n = 1000 rpm**, intercept point **S3** is found. By drawing a vertical line from **S3** to the x-axis, you can determine the service life of the bearing **Lh10** by approx. **9.500 hours**.

Life expectancy-nomogram of control unit faceing radial bearing



Given: Radial load	F	=	2,0	kN
Gap	X	=	36	mm
Pressure difference	Δp	=	150	bar
Speed	n	=	1000	rpm

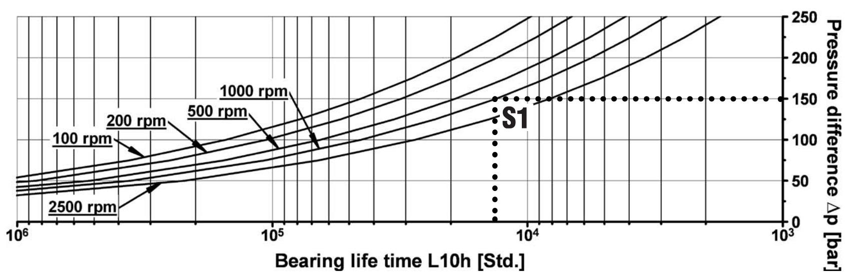
Wanted: Service life radial bearing



Graph to determine service life of radial bearing:

To determine service life of bearing, use radial load F_r = **2,0 kN** and gap **X = 36 mm** in order to find intercept point **S1.** By using **S1**, draw a vertical line to pressure curves **Δp = 150 bar**. From this, intercept point **S2** can be determined. By drawing a horizontal line to speed curve **n = 1000 rpm**, intercept point **S3** is found. By drawing a vertical line from **S3** to the x-axis, you can determine the service life of the bearing **Lh10** by approx. **15.300 hours**.

Life expectancy-nomogram of axial bearing



Given: Radial load	F	=	nonexistent	
Gap	X	=	nonexistent	
Pressure difference	Δp	=	150	bar
Speed	n	=	1000	rpm

Wanted: Service life radial bearing

Graph to determine service life of axial bearing:

Axial bearings are not able to receive any radial force.

In order to determine service life of bearing, draw a horizontal line from the Y-axis **Δp = 150 bar** to speed curve **n = 1000 rpm**. By drawing a vertical line from **intercept point S1** to the X-axis, you can determine the service life of the bearing **Lh10** by approx. **13.200 hours**.

DÜSTERLOH Fluidtechnik

Axial piston motor

AE 21

Chracteristic curve

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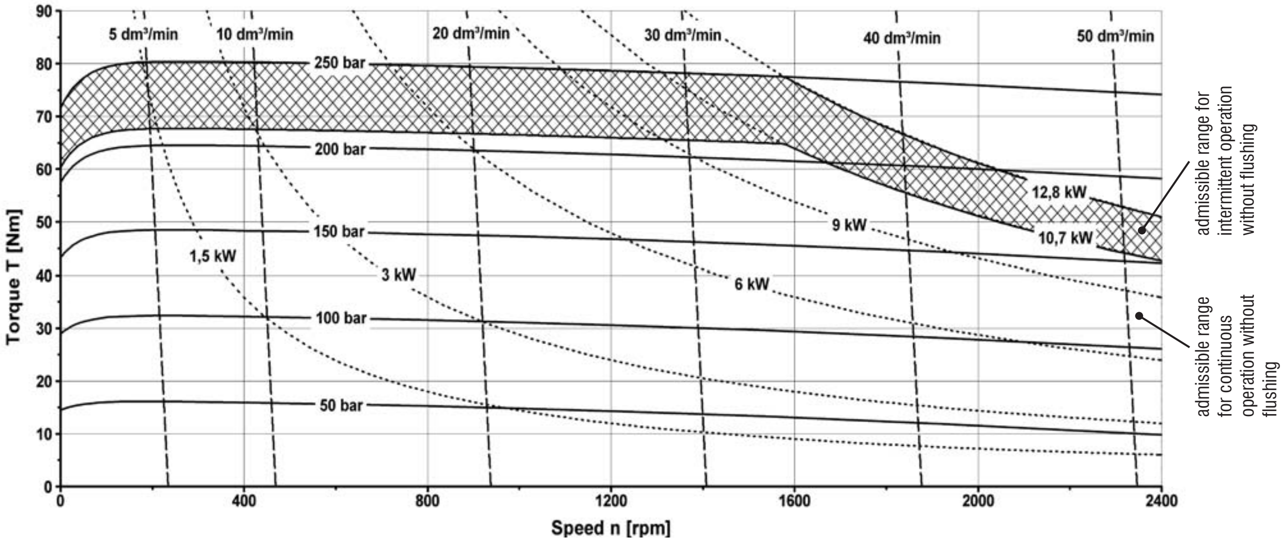
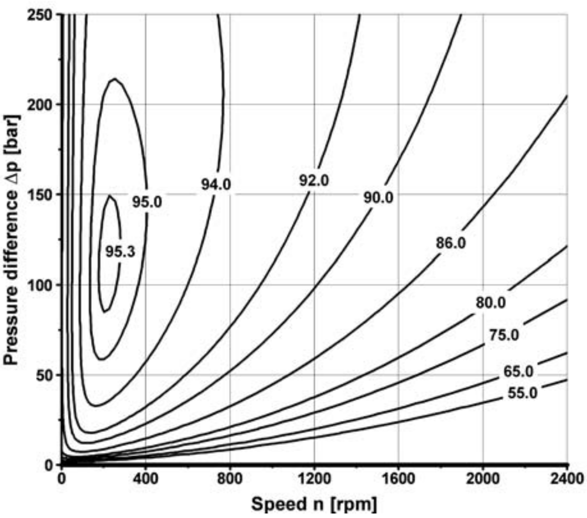
All parameters at $\nu = 32$ mm2/s; $\Theta = 40°C$; p_{outlet} = pressureless

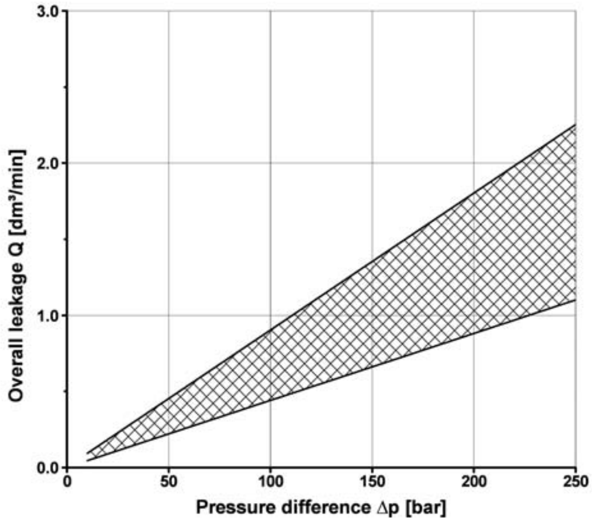
Torque curve



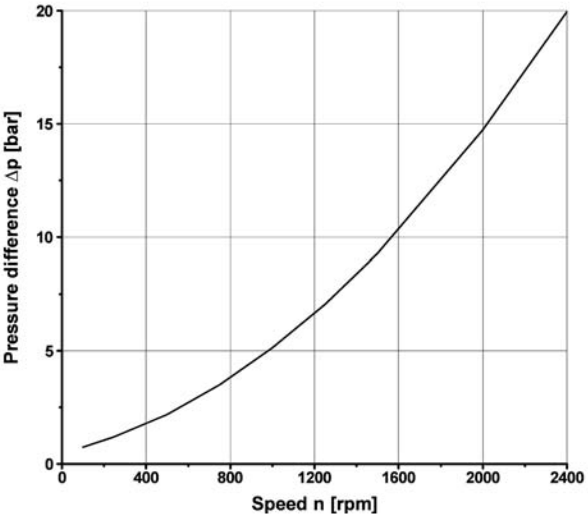
hydraulic and mechanical efficiency by %



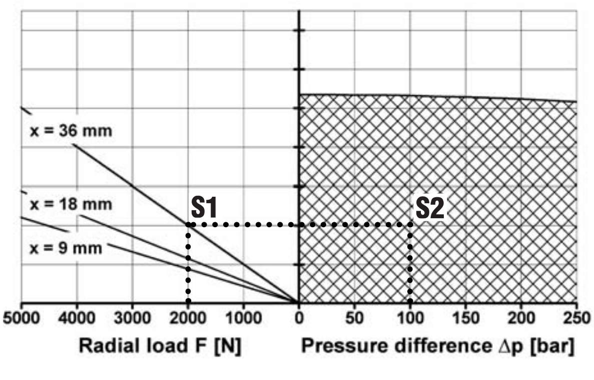
Overall leakage

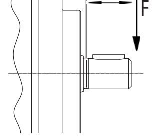


No-load characteristic



Shaft strength calculation

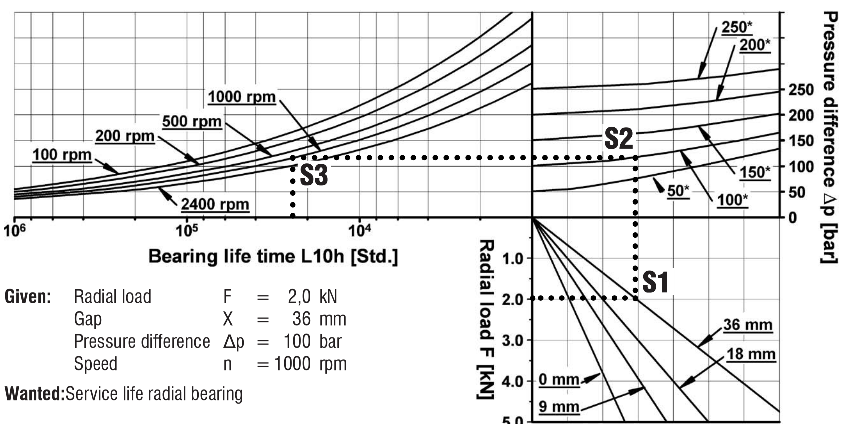




Example:
Given: F = 2000 N; x = 36 mm; Δp = 100 bar
Wanted: Shaft strength
Generate intercept point S1 by using radial load F and shaft gap X. Now, S2 will be determined by using S1 and the pressure difference Δp. In case, S2 is located within the hachure's sector, shaft will be fatigue endurable.

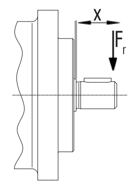
All parameters at $\nu = 32$ mm2/s; $\Theta = 40°C$; p_{outlet} = pressureless

Life expectancy-nomogram of control unit faceing radial bearing



Given:	Radial load	F	=	2,0	kN
	Gap	X	=	36	mm
	Pressure difference	Δp	=	100	bar
	Speed	n	=	1000	rpm

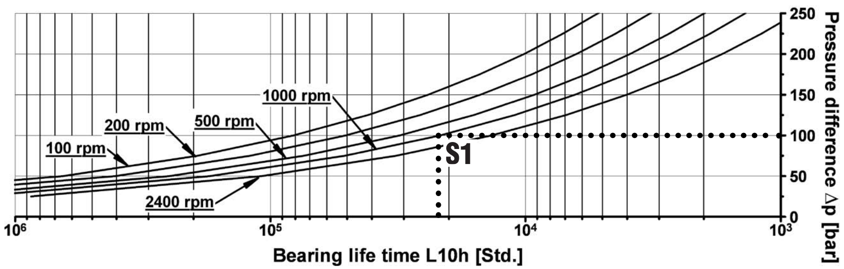
Wanted: Service life radial bearing



Graph to determine service life of radial bearing:

To determine service life of bearing, use radial load F_r **= 2,0 kN** and gap **X = 36 mm** in order to find intercept point **S1.** By using **S1**, draw a vertical line to pressure curves **Δp = 100 bar**. From this, intercept point **S2** can be determined. By drawing a horizontal line to speed curve **n = 1000 rpm**, intercept point **S3** is found. By drawing a vertical line from **S3** to the x-axis, you can determine the service life of the bearing **Lh10** by approx. **23.400 hours**.

Life expectancy-nomogram of axial bearing



Given:	Radial load	F	=	nonexistent
	Gap	X	=	nonexistent
	Pressure difference	Δp	=	100 bar
	Speed	n	=	1000 rpm

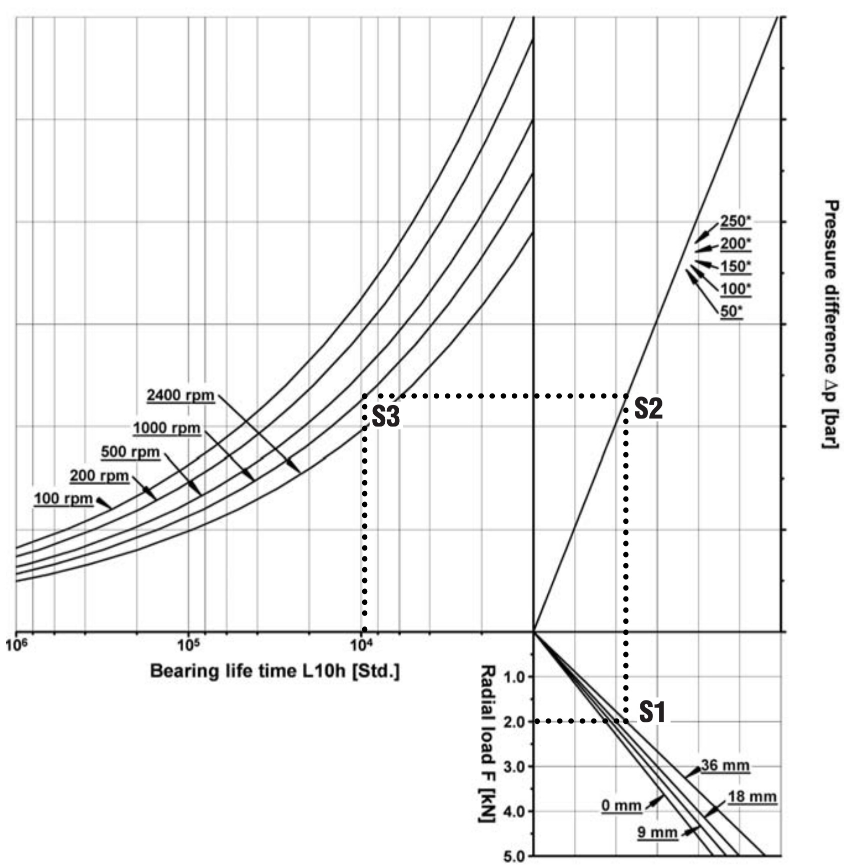
Wanted: Service life radial bearing

Graph to determine service life of axial bearing:

Axial bearings are not able to receive any radial force.

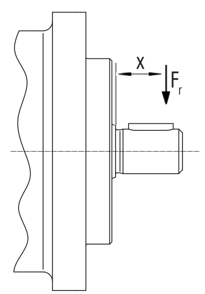
In order to determine service life of bearing, draw a horizontal line from the Y-axis **Δp =100 bar** to speed curve **n = 1000 rpm**. By drawing a vertical line from **intercept point S1** to the X-axis, you can determine the service life of the bearing **Lh10** by approx. **21.500 hours**.

Life expectancy-nomogram of drive shaft faceing radial bearing



Given:	Radial load	Fr	=	2,0	kN
	Gap	X	=	36	mm
	Pressure difference	Δp	=	100	bar
	Speed	n	=	1000	rpm

Wanted: Service life radial bearing



Graph to determine service life of radial bearing:

To determine service life of bearing, use radial load F_r **= 2 kN** and gap **X = 36 mm** in order to find intercept point **S1.** By using **S1**, draw a vertical line to pressure curves **Δp = 100 bar**. From this, intercept point **S2** can be determined. By drawing a horizontal line to speed curve **n = 1000 rpm**, intercept point **S3** is found. By drawing a vertical line from **S3** to the x-axis, you can determine the service life of the bearing **Lh10** by approx. **9.500 hours**.

Axial piston motor

AE 22 - AE 45

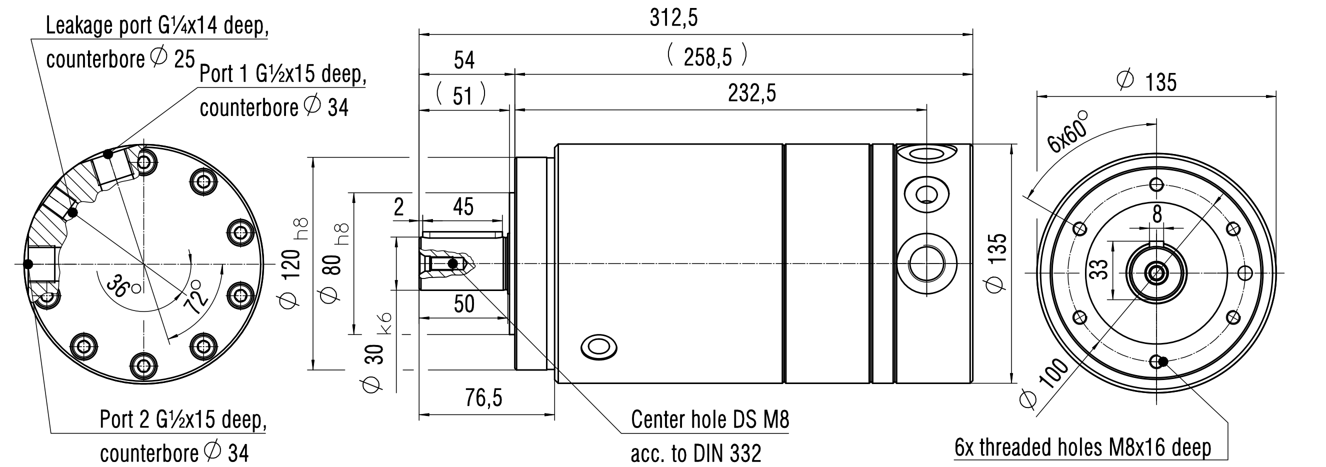
Technical data and outline drawing

All parameters at $\nu = 32$ mm2/s; $\Theta = 40$°C; p_{outlet} = pressureless

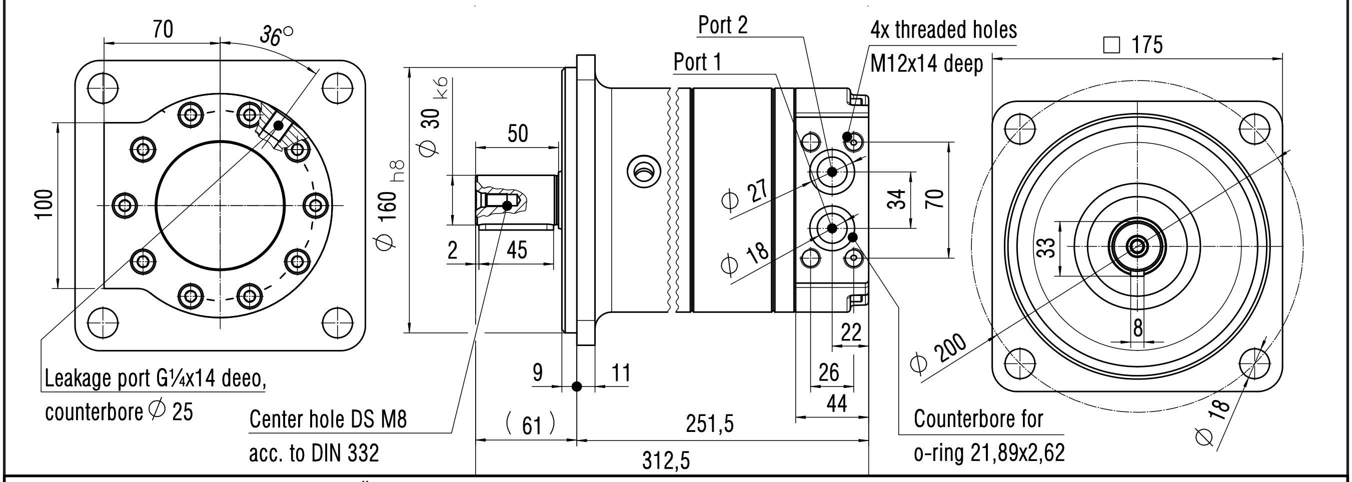
Nominal size	NS		22	32	40	45
Displacement	V_g	cm3/rev	22,501	31,501	40,502	45,002
Theor. specific torque	$T_{spec.theor.}$	Nm/bar	0,358	0,501	0,645	0,716
Average specific torque	$T_{spec.aver.}$	Nm/bar	0,322	0,451	0,580	0,645
Continuous torque	$T_{cont.}$	Nm	68	95	122	135
Max. torque	$T_{max.}$	Nm	81	113	145	161
Inlet pressure, max. cont.	$p_{cont.}$	bar	210	210	210	210
max.	$p_{max.}$	bar	250	250	250	250
peak	p_{peak}	bar	315	315	315	315
Total pressure	p_{total}	bar	315	315	315	315
Leakage pressure, max.	$p_{leak.}$	bar	1,5	1,5	1,5	1,5
Operating speed range	n	rpm	10-2000	5-2000	3-2000	10-2000
Max. continuous power	$P_{cont.}$	kW	9,0	12,5	16,0	18,0
Max. intermittent power	$P_{interm.}$	kW	11,0	15,0	19,0	21,5
Mass moment of intertia	J	kgm2	0,00195	0,00195	0,00195	0,00195
Mass	m	kg	22	22	22	22
Temperature range of pressure medium	Θ	°C	-30 bis +80			
Viscosity	ν	mm2/s	18 till 1000, recommended: 30 till 50			

$p_{cont.}$ = admissible continuous pressure at limitation to P_{cont}
$p_{max.}$ = maximal admissible operating pressure at limitation $P_{interm.}$ and max. 10% duty cycle / hour
p_{peak} = peak pressure, where the components remain safe in function.
$P_{cont.}$ = Continuous power (at maximal 10 bar outlet pressure). Motor flushing must be carried out above P_{cont}.
$P_{interm.}$ = Power, which may be demanded temporarily (max. 10% duty cycle / hour).
p_{total} = maximum permissible pressure combined out of inlet and outlet pressure.

Example of type designation: AE (22 till 45) ZAN



Example of type designation: AE (22 till 45) ZA1FN



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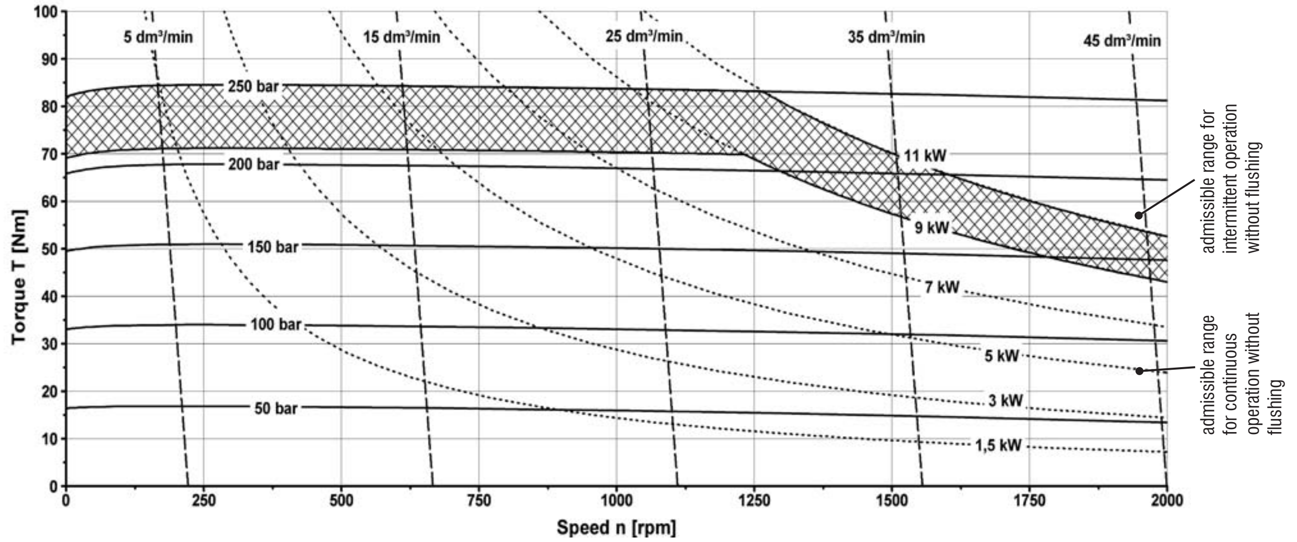
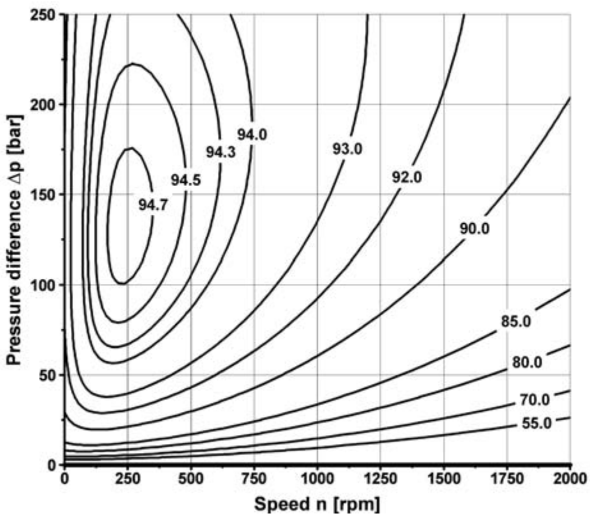
All parameters at $\nu = 32$ mm2/s; $\Theta = 40°C$; p_{outlet} = pressureless

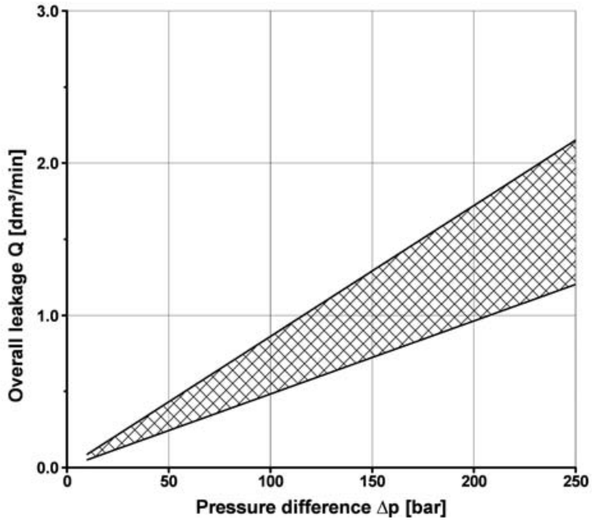
Torque curve



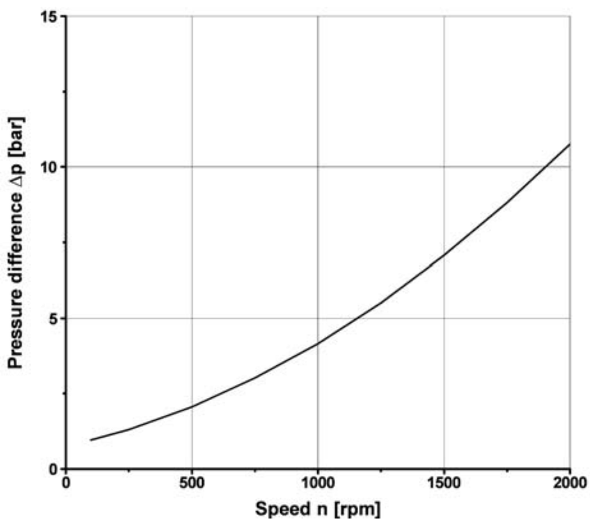
hydraulic and mechanical efficiency by %



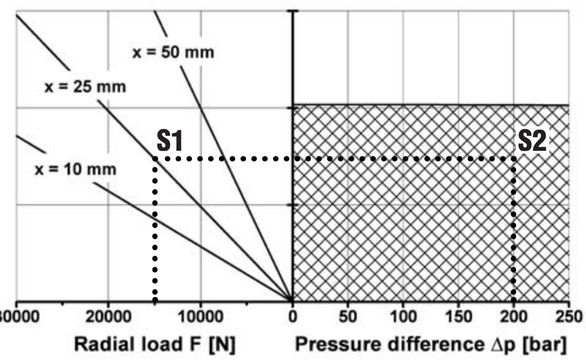
Overall leakage

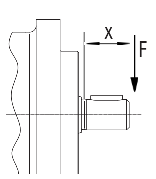


No-load characteristic



Shaft strength calculation

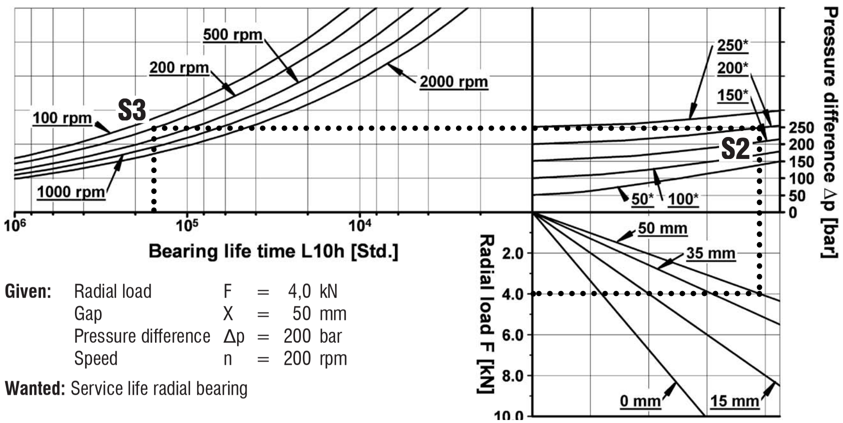




Example:
Given: F = 15000 N; x = 25 mm; Δp = 200 bar
Wanted: Shaft strength
Generate intercept point S1 by using radial load F and shaft gap X. Now, S2 will be determined by using S1 and the pressure difference Δp. In case, S2 is located within the hachure's sector, shaft will be fatigue endurable.

All parameters at $\nu = 32$ mm2/s; $\Theta = 40°C$; p_{outlet} = pressureless

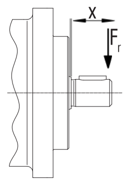
Life expectancy-nomogram of control unit faceing radial bearing



Given:

Radial load	F	=	4,0	kN
Gap	X	=	50	mm
Pressure difference	Δp	=	200	bar
Speed	n	=	200	rpm

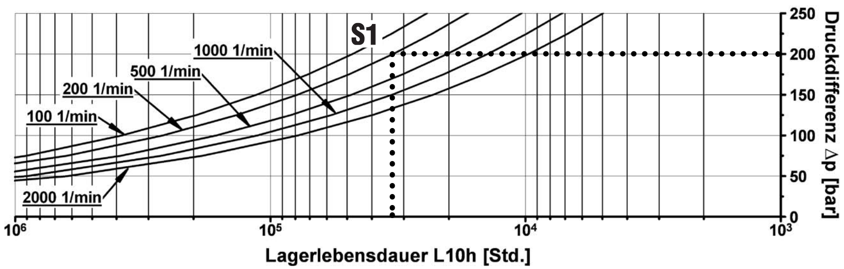
Wanted: Service life radial bearing



Graph to determine service life of radial bearing:

To determine service life of bearing, use radial load **F_r = 4,0 kN** and gap **X = 50 mm** in order to find intercept point **S1.** By using **S1**, draw a vertical line to pressure curves **Δp = 200 bar**. From this, intercept point **S2** can be determined. By drawing a horizontal line to speed curve **n = 200 rpm**, intercept point **S3** can be found. By drawing a vertical line from **S3** to the x-axis, you can determine the service life of the bearing **Lh10** by approx. **154.000 hours**.

Life expectancy-nomogram of axial bearing



Given:

Radial load	F	=	nonexistent	
Gap	X	=	nonexistent	
Pressure difference	Δp	=	200	bar
Speed	n	=	200	rpm

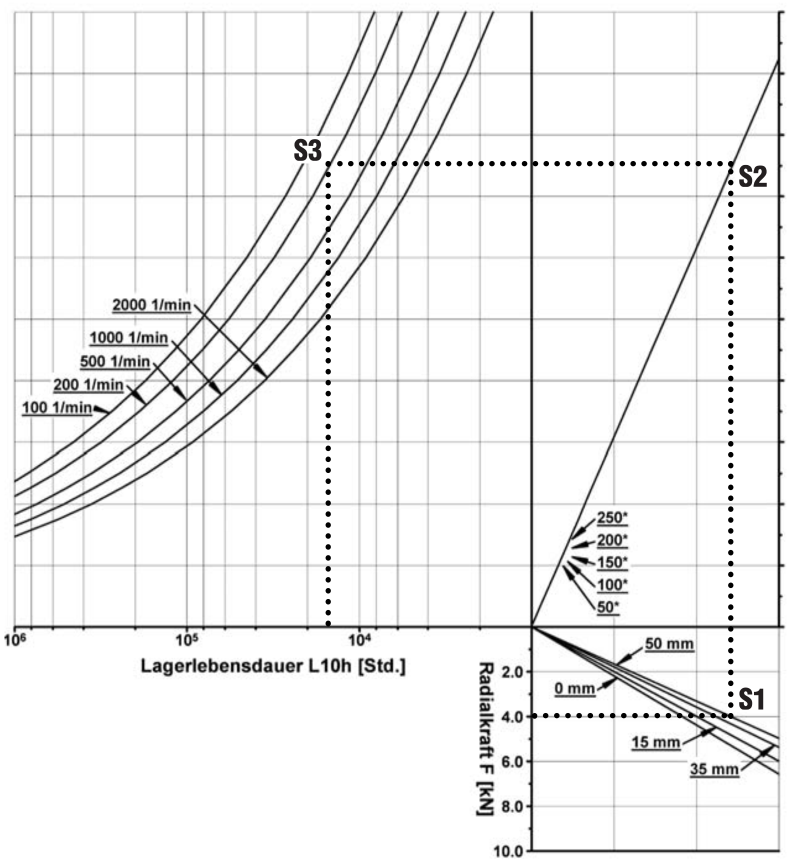
Wanted: Service life radial bearing

Graph to determine service life of axial bearing:

Axial bearings are not able to receive any radial force.

In order to determine service life of bearing, draft a horizontal line from the Y-axis **Δp =200 bar** to speed curve **n = 2000 rpm**. By drawing a vertical line from **intercept point S1** to the X-axis, you can determine the service life of the bearing **Lh10** by approx. **33.000 hours**.

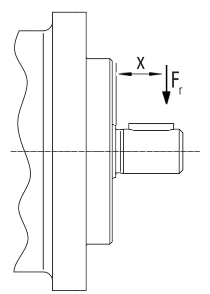
Life expectancy-nomogram of drive shaft faceing radial bearing



Given:

Radial load	Fr	=	4,0	kN
Gap	X	=	50	mm
Pressure difference	Δp	=	200	bar
Speed	n	=	200	rpm

Wanted: Service life radial bearing

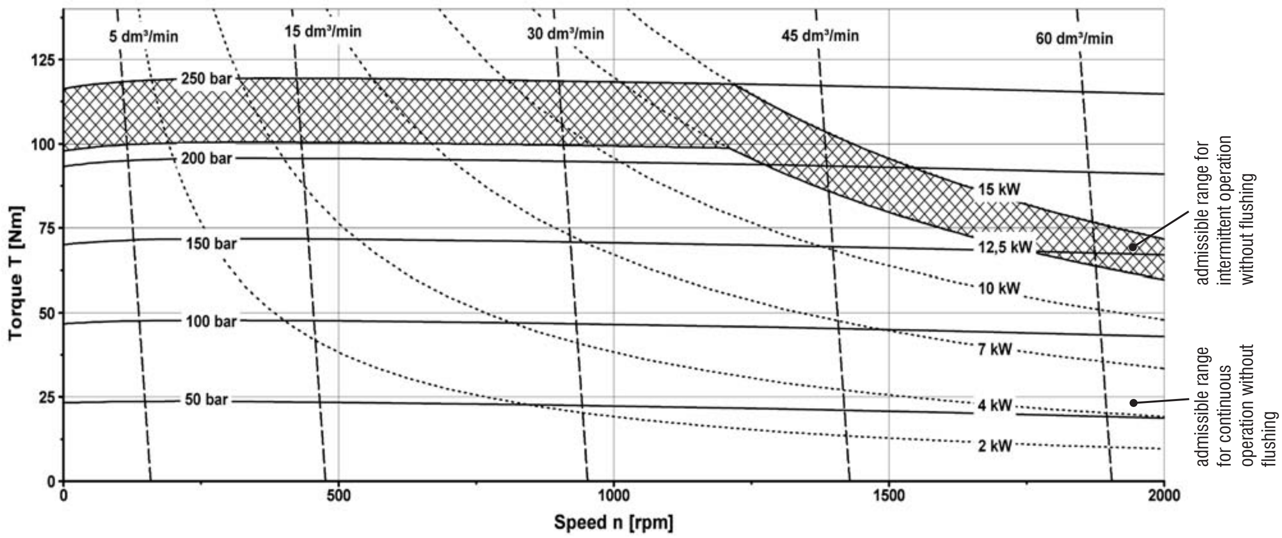


Graph to determine service life of radial bearing:

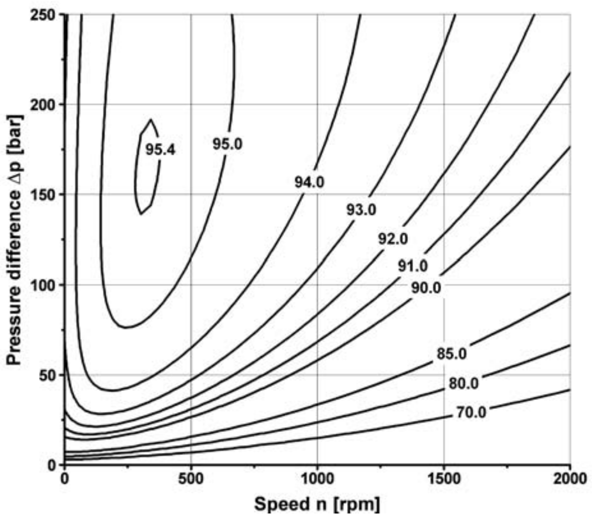
To determine service life of bearing, use radial load **F_r = 4 kN** and gap **X = 50 mm** in order to find intercept point **S1.** By using **S1**, draw a vertical line to pressure curves **Δp = 200 bar**. From this, intercept point **S2** can be determined. By drawing a horizontal line to speed curve **n = 200 rpm**, intercept point **S3** is found. By drawing a vertical line from **S3** to the x-axis, you can determine the service life of the bearing **Lh10** by approx. **15.300 hours**.

All parameters at $\nu = 32$ mm2/s; $\Theta = 40°C$; p_{outlet} = pressureless

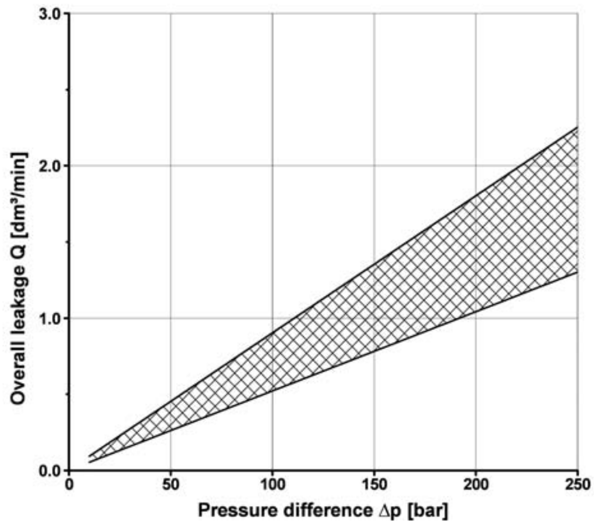
Torque curve



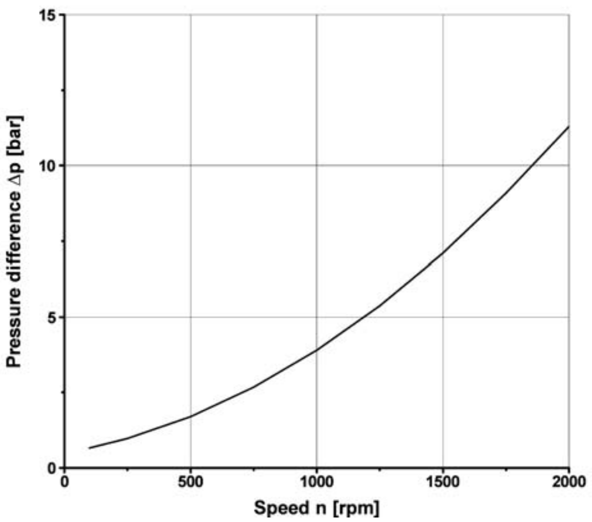
hydraulic and mechanical efficiency by %



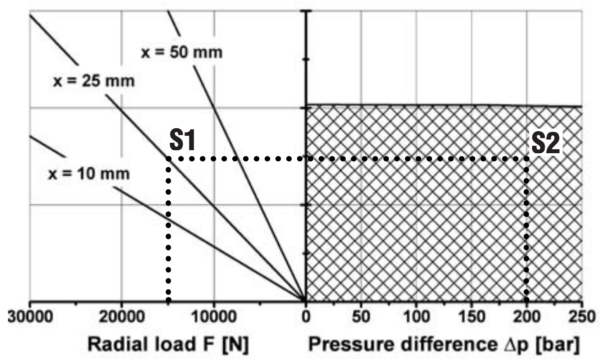
Overall leakage

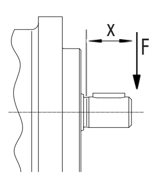


No-load characteristic



Shaft strength calculation

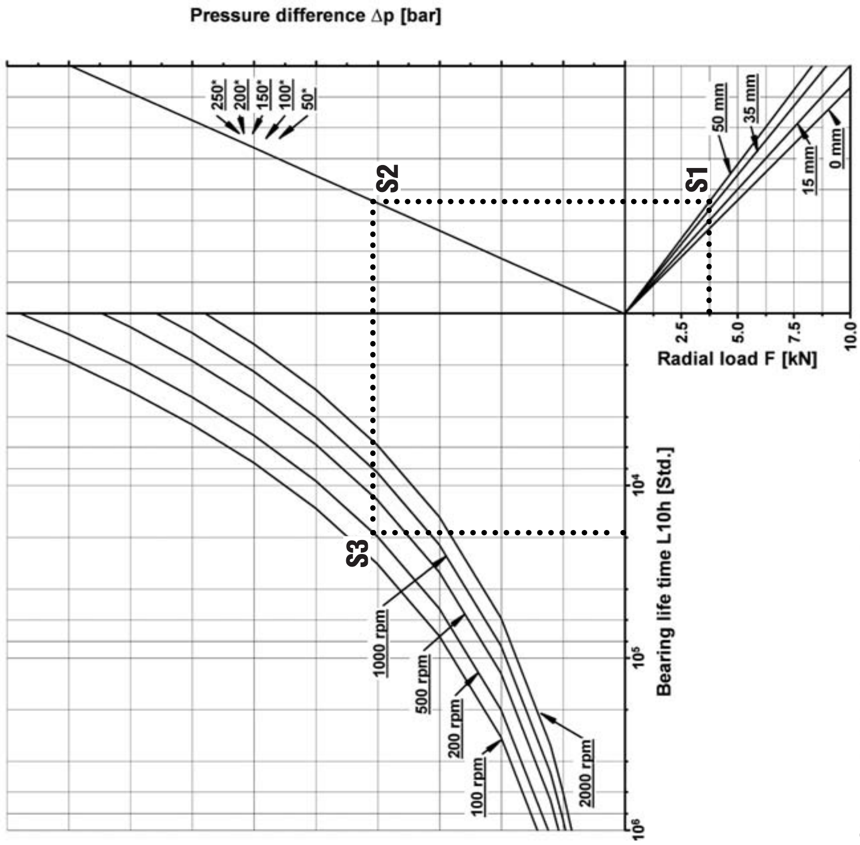


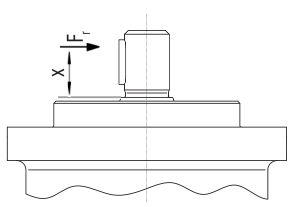


Example:
Given: F = 15000 N; x = 25 mm; Δp = 200 bar
Wanted: Shaft strength
Generate intercept point S1 by using radial load F and shaft gap X. Now, S2 will be determined by using S1 and the pressure difference Δp. In case, S2 is located within the hachure's sector, shaft will be fatigue endurable.

All parameters at ν = 32 mm2/s; Θ = 40°C; p_{outlet} = pressureless

Life expectancy-nomogram of drive shaft faceing radial bearing





Given:

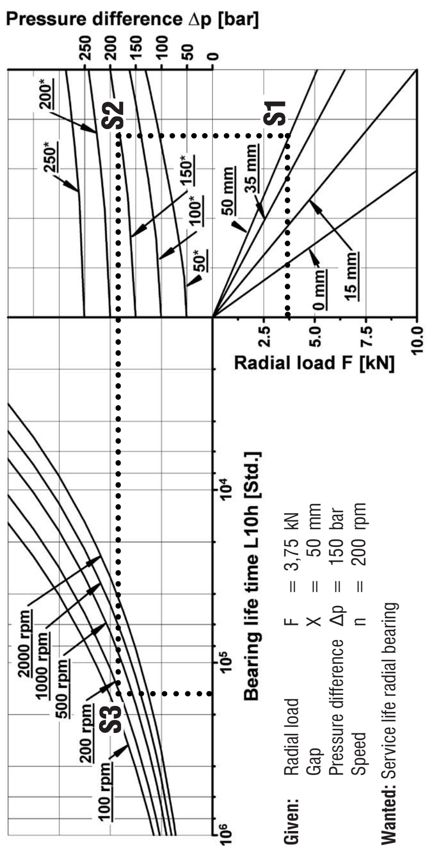
Radial load	Fr =	3,75	kN
Gap	X =	50	mm
Pressure difference	Δp =	150	bar
Speed	n =	200	rpm

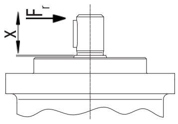
Wanted: Service life radial bearing

Graph to determine service life of radial bearing:

To determine service life of bearing, use radial load **F_r = 3,75 kN** and gap **X = 50 mm** in order to find intercept point **S1**. By using **S1**, draw a vertical line to pressure curves **Δp = 150 bar**. From this, intercept point **S2** can be determined. By drawing a horizontal line to speed curve **n = 200 rpm**, intercept point **S3** can be found. By drawing a vertical line from **S3** to the x-axis, you can determine the service life of the bearing **Lh10** by approx. **19.000 hours**.

Life expectancy-nomogram of control unit faceing radial bearing





Given:

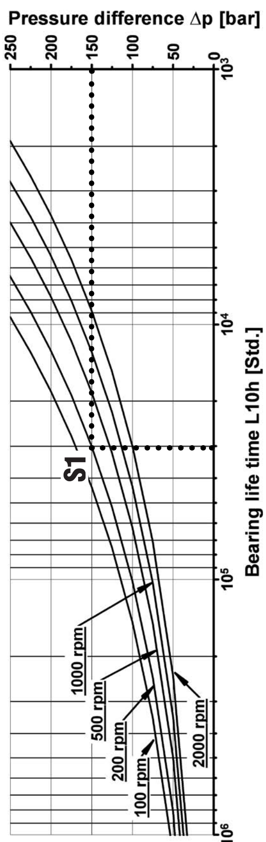
Radial load	F =	3,75	kN
Gap	X =	50	mm
Pressure difference	Δp =	150	bar
Speed	n =	200	rpm

Wanted: Service life radial bearing

Graph to determine service life of radial bearing:

To determine service life of bearing, use radial load **F_r = 3,75 kN** and gap **X = 50 mm** in order to find intercept point **S1**. By using **S1**, draw a vertical line to pressure curves **Δp = 150 bar**. From this, intercept point **S2** can be determined. By drawing a horizontal line to speed curve **n = 200 rpm**, intercept point **S3** can be found. By drawing a vertical line from **S3** to the x-axis, you can determine the service life of the bearing **Lh10** by approx. **40.000 hours**.

Life expectancy-nomogram of axial bearing



Given:

Radial load	F =	nonexistent	
Gap	X =	nonexistent	
Pressure difference	Δp =	150	bar
Speed	n =	200	rpm

Wanted: Service life radial bearing

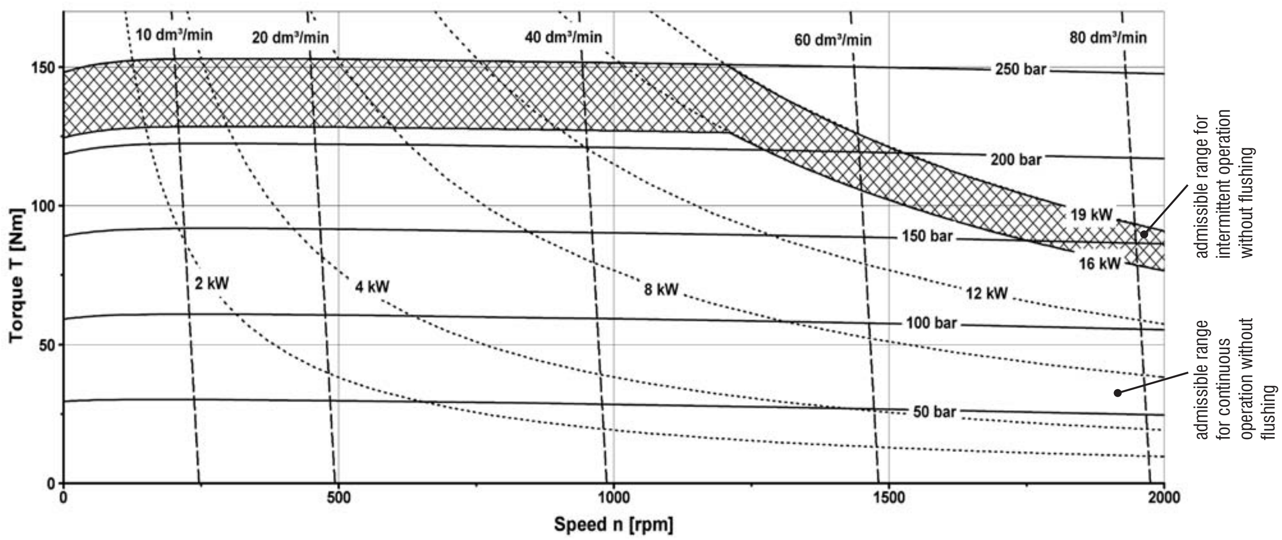
Graph to determine service life of axial bearing:

Axial bearings are not able to receive any radial force.

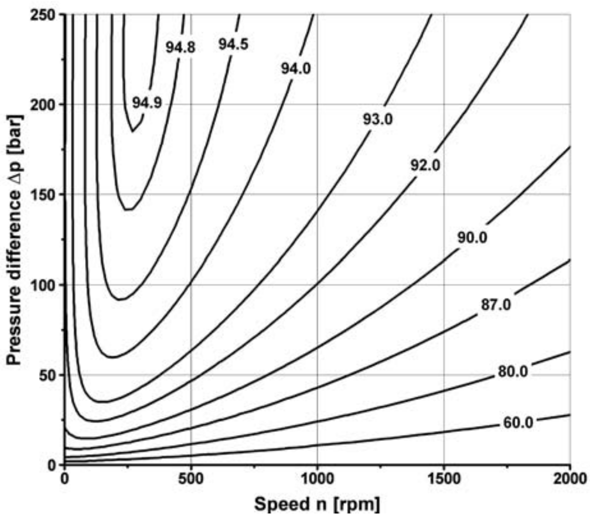
In order to determine service life of bearing, draft a horizontal line from the Y-axis **Δp =150 bar** to speed curve **n = 200 rpm**. By drawing a vertical line from **intercept point S1** to the X-axis, you can determine the service life of the bearing **Lh10** by approx. **30.000 hours.**

All parameters at $\nu = 32$ mm2/s; $\Theta = 40°C$; p_{outlet} = pressureless

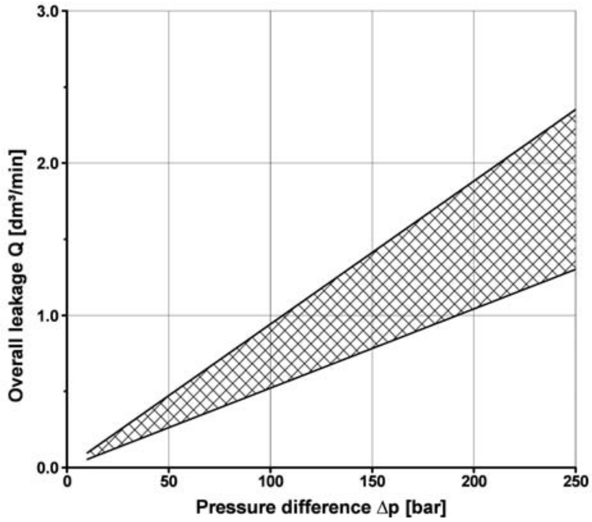
Torque curve



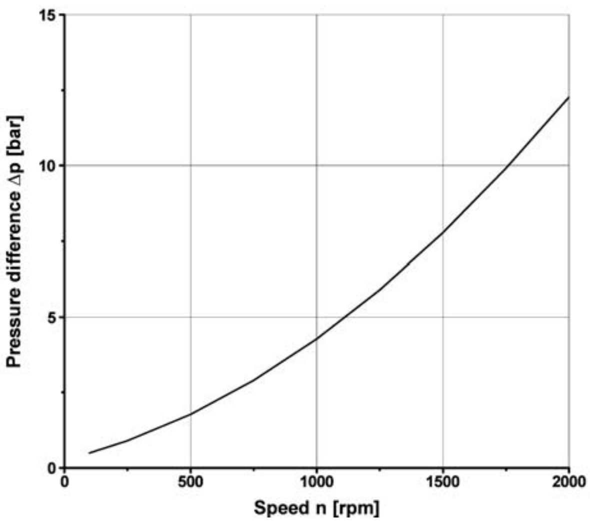
hydraulic and mechanical efficiency by %



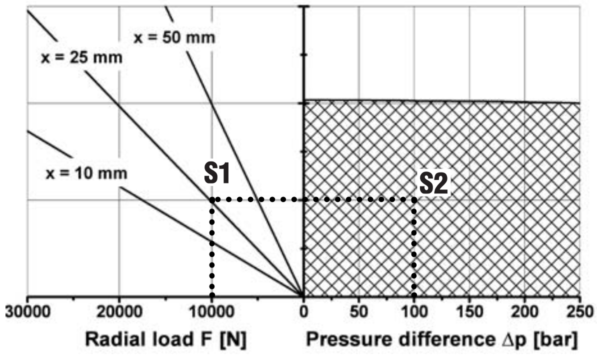
Overall leakage

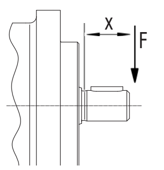


No-load characteristic



Shaft strength calculation





Example:
Given: F = 10000 N; x = 25 mm; Δp = 100 bar
Wanted: Shaft strength
Generate intercept point S1 by using radial load F and shaft gap X. Now, S2 will be determined by using S1 and the pressure difference Δp. In case, S2 is located within the hachure's sector, shaft will be fatigue endurable.

DÜSTERLOH Fluidtechnik

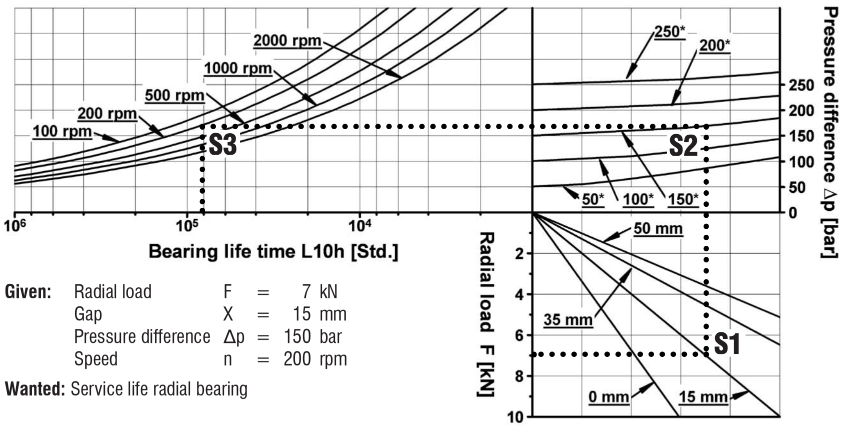
Axial piston motor

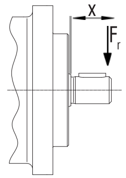
AE 40

Chracteristic curve

All parameters at ν = 32 mm2/s; Θ = 40°C; p_{outlet} = pressureless

Life expectancy-nomogram of control unit faceing radial bearing





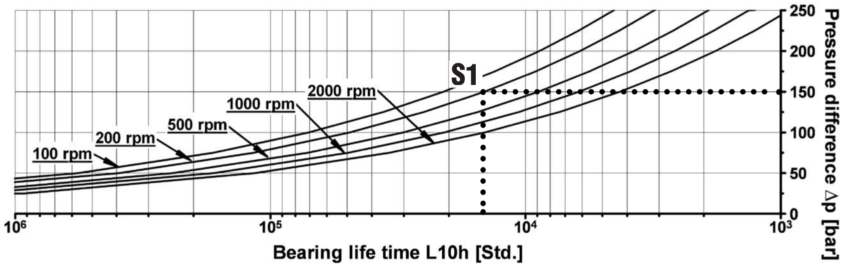
Given: Radial load F = 7 kN
Gap X = 15 mm
Pressure difference Δp = 150 bar
Speed n = 200 rpm

Wanted: Service life radial bearing

Graph to determine service life of radial bearing:

To determine service life of bearing, use radial load **F_r = 7 kN** and gap **X = 15 mm** in order to find intercept point **S1.** By using **S1**, draw a vertical line to pressure curves **Δp = 150 bar**. From this, intercept point **S2** can be determined. By drawing a horizontal line to speed curve **n = 200 rpm**, intercept point **S3** cam be found. By drawing a vertical line from **S3** to the x-axis, you can determine the service life of the bearing **Lh10** by approx. **84.000 hours**.

Life expectancy-nomogram of axial bearing



Given: Radial load F =nonexistent
Gap X =nonexistent
Pressure difference Δp = 150 bar
Speed n = 200 rpm

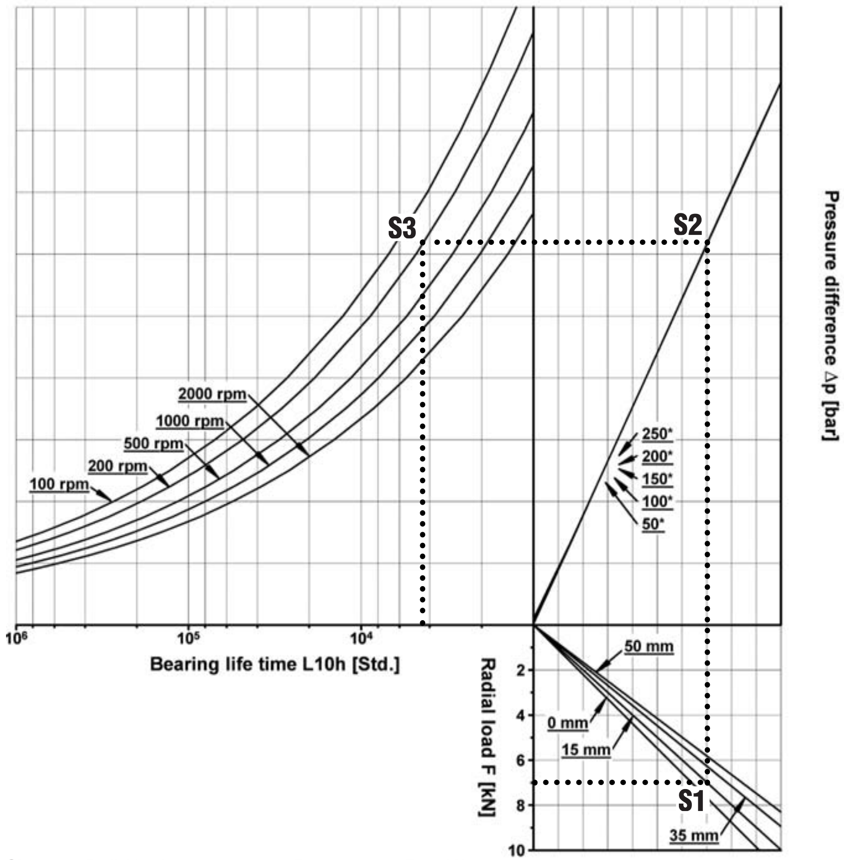
Wanted: Service life radial bearing

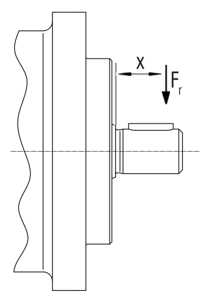
Graph to determine service life of axial bearing:

Axial bearings are not able to receive any radial force.

In order to determine service life of bearing, draft a horizontal line from the Y-axis **Δp =150 bar** to speed curve **n = 200 rpm**. By drawing a vertical line from **intercept point S1** to the X-axis, you can determine the service life of the bearing **Lh10** by approx. **14.500 hours**.

Life expectancy-nomogram of drive shaft faceing radial bearing





Given: Radial load Fr = 7 kN
Gap X = 15 mm
Pressure difference Δp = 250 bar
Speed n = 200 rpm

Wanted: Service life radial bearing

Graph to determine service life of radial bearing:

To determine service life of bearing, use radial load **F_r = 7 kN** and gap **X = 15 mm** in order to find intercept point **S1.** By using **S1**, draw a vertical line to pressure curves **Δp = 250 bar**. From this, intercept point **S2** can be determined. By drawing a horizontal line to speed curve **n = 200 rpm**, intercept point **S3** can be found. By drawing a vertical line from **S3** to the x-axis, you can determine the service life of the bearing **Lh10** by approx. **4.400 hours**.

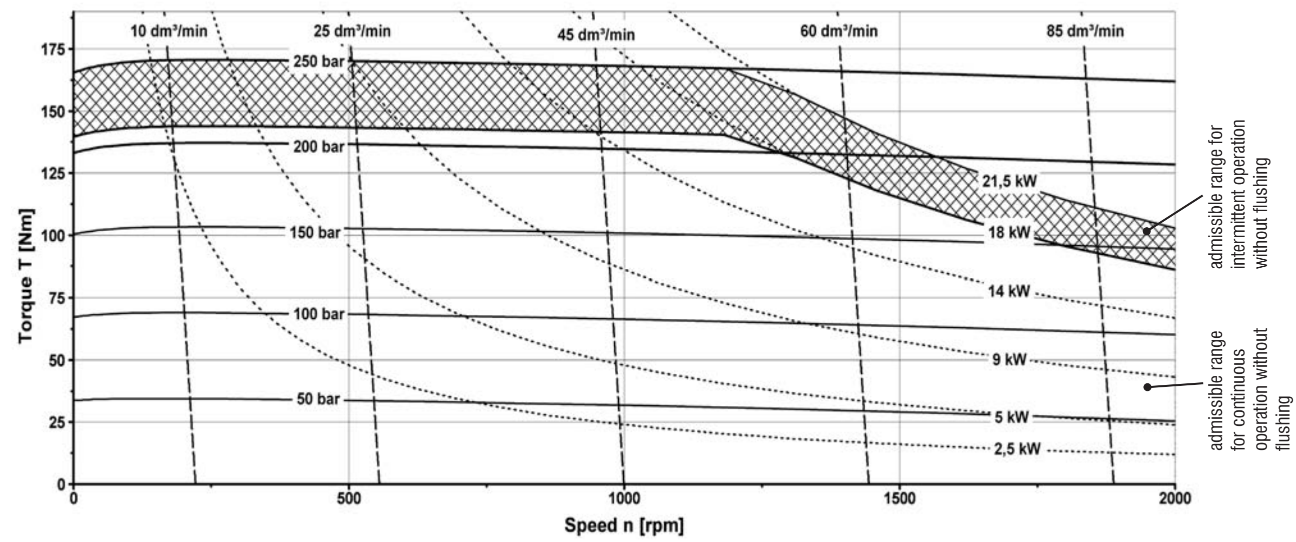
Axial piston motor

AE 45

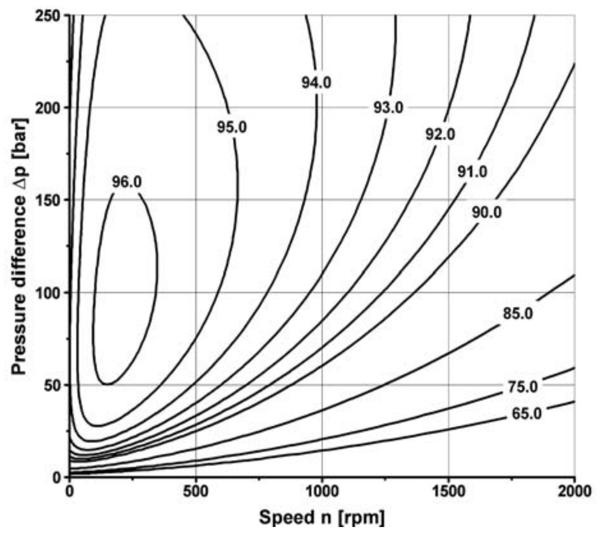
Chracteristic curve

All parameters at $\nu = 32$ mm2/s; $\Theta = 40°C$; p_{outlet} = pressureless

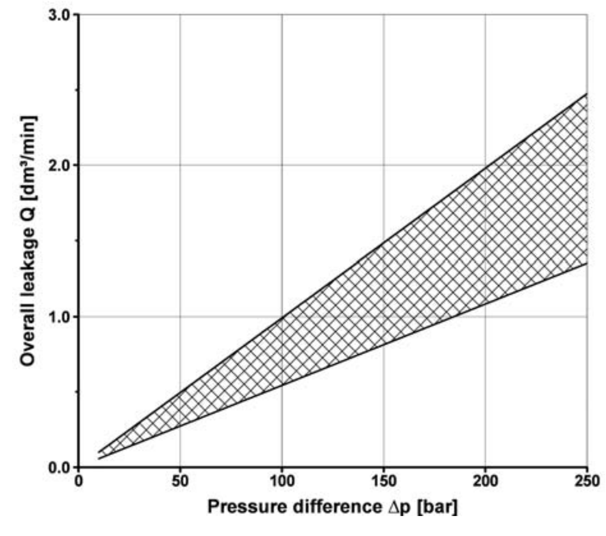
Torque curve



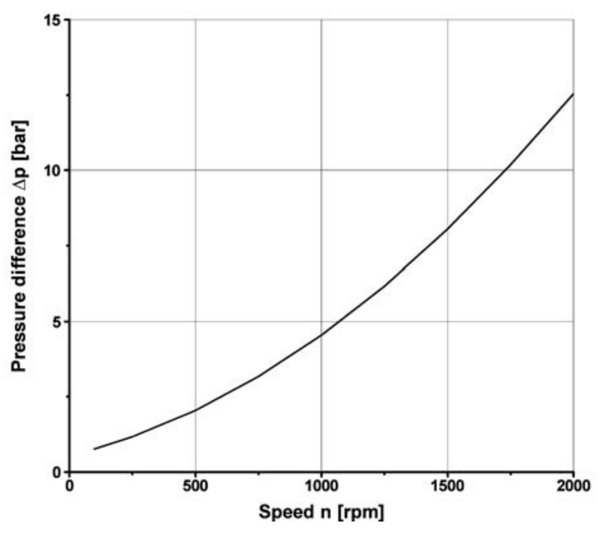
hydraulic and mechanical efficiency by %



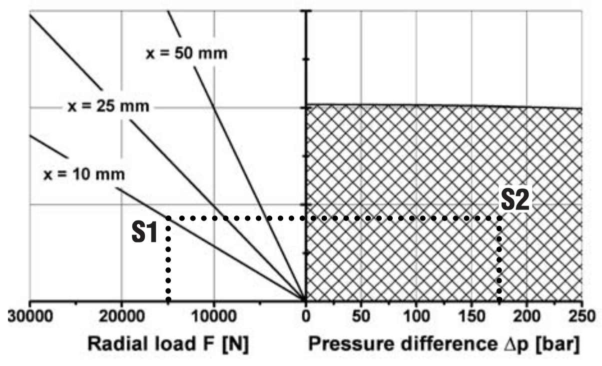
Overall leakage

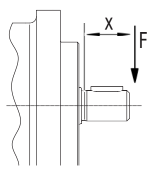


No-load characteristic



Shaft strength calculation





Example:
Given: F = 150000 N; x = 10 mm; Δp = 175 bar
Wanted: Shaft strength
Generate intercept point S1 by using radial load F and shaft gap X. Now, S2 will be determined by using S1 and the pressure difference Δp. In case, S2 is located within the hachure's sector, shaft will be fatigue endurable.

DÜSTERLOH Fluidtechnik

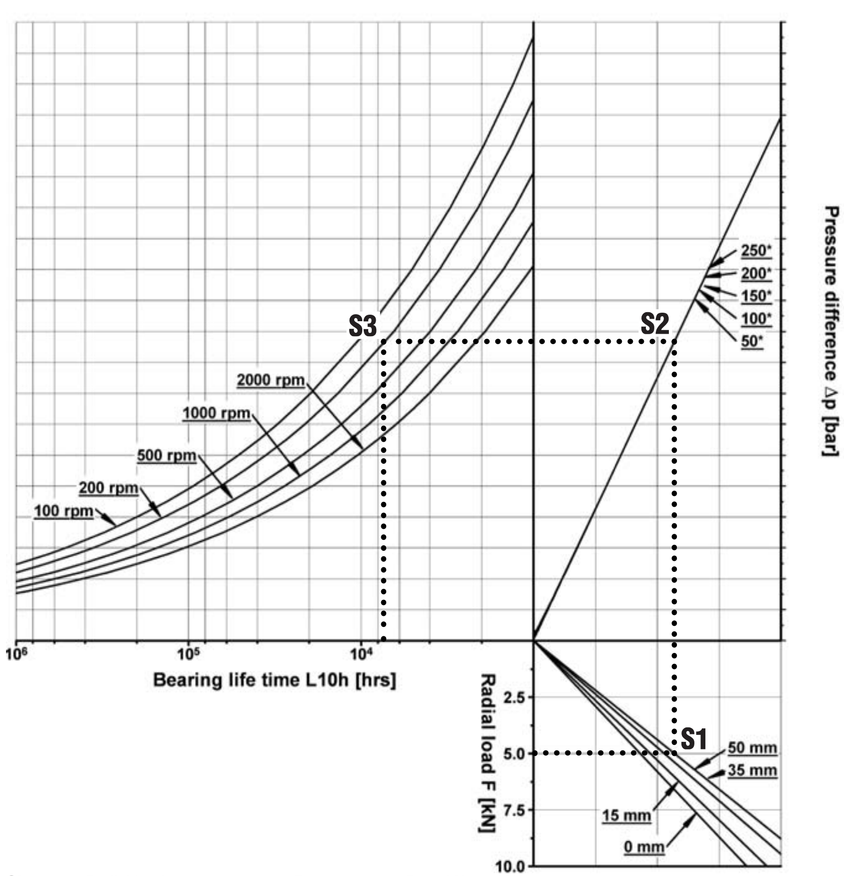
Axial piston motor

AE 45

Chracteristic curve

All parameters at ν = 32 mm2/s; Θ = 40°C; p_{outlet} = pressureless

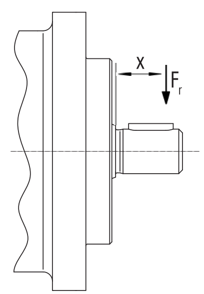
Life expectancy-nomogram of drive shaft faceing radial bearing



Given:

Radial load	Fr	=	5	kN
Gap	X	=	50	mm
Pressure difference	Δp	=	150	bar
Speed	n	=	200	rpm

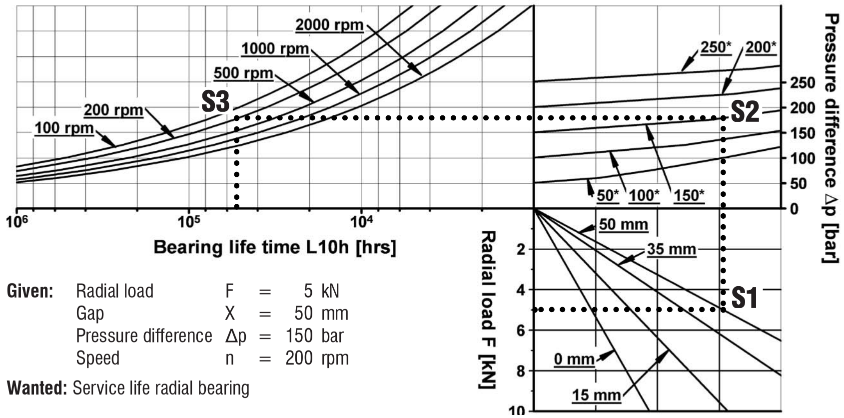
Wanted: Service life radial bearing



Graph to determine service life of radial bearing:

To determine service life of bearing, use radial load F_r **= 5 kN** and gap **X = 50 mm** in order to find intercept point **S1.** By using **S1**, draw a vertical line to pressure curves **Δp = 150 bar**. From this, intercept point **S2** can be determined. By drawing a horizontal line to speed curve **n = 200 rpm**, intercept point **S3** can be found. By drawing a vertical line from **S3** to the x-axis, you can determine the service life of the bearing **Lh10** by approx. **7.500 hours**.

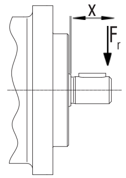
Life expectancy-nomogram of control unit faceing radial bearing



Given:

Radial load	F	=	5	kN
Gap	X	=	50	mm
Pressure difference	Δp	=	150	bar
Speed	n	=	200	rpm

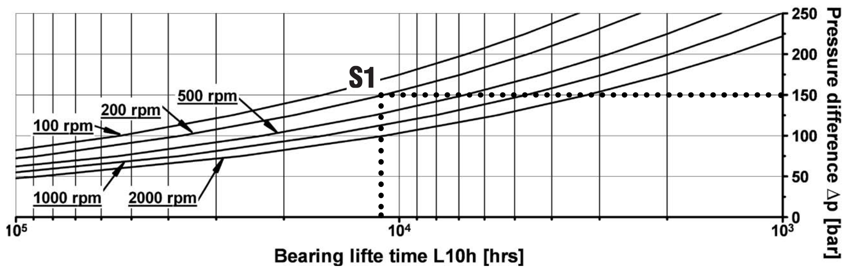
Wanted: Service life radial bearing



Graph to determine service life of radial bearing:

To determine service life of bearing, use radial load F_r **= 5 kN** and gap **X = 50 mm** in order to find intercept point **S1.** By using **S1**, draw a vertical line to pressure curves **Δp = 150 bar**. From this, intercept point **S2** can be determined. By drawing a horizontal line to speed curve **n = 200 rpm**, intercept point **S3** can be found. By drawing a vertical line from **S3** to the x-axis, you can determine the service life of the bearing **Lh10** by approx. **52.000 hours**.

Life expectancy-nomogram of axial bearing



Given:

Radial load	F	=	nonexistent	
Gap	X	=	nonexistent	
Pressure difference	Δp	=	150	bar
Speed	n	=	200	rpm

Wanted: Service life radial bearing

Graph to determine service life of radial bearing:

Axial bearings are not able to receive any axial force.

In order to determine service life of bearing, draft a horizontal line from the Y-axis **Δp =150 bar** to speed curve **n = 200 rpm**. By drawing a vertical line from **intercept point S1** to the X-axis, you can determine the service life of the bearing **Lh10** by approx. **11.000 hours**.

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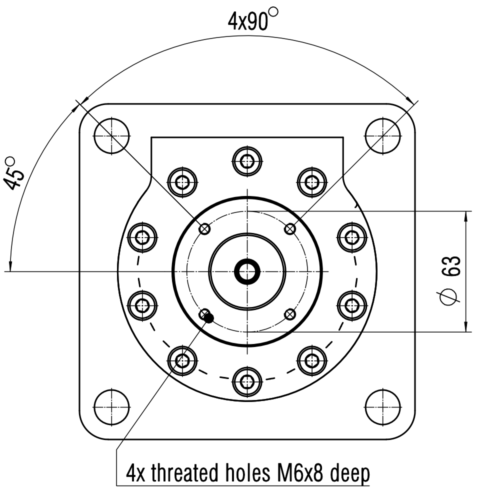
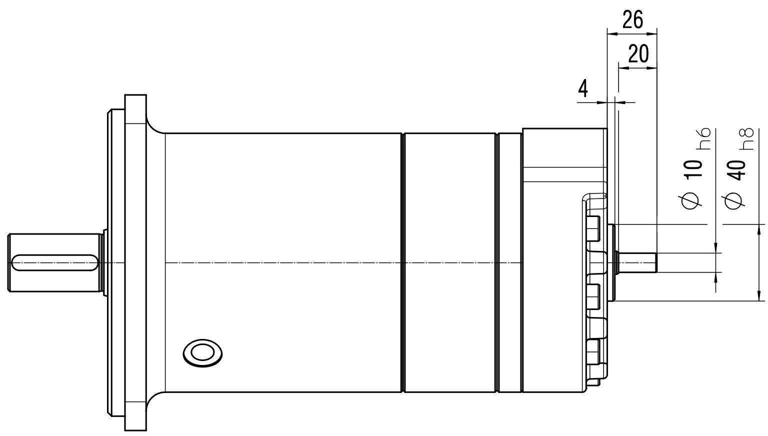
Measuring shaft: M

Axial piston motors of model range AE 10 till AE 45 including denomination "M" are additional featured by a measuring shaft in order to determine the motors speed. The special design gives the advantage to use several different encoders to suit for many different applications. All measuring shafts are rigid mounted to the drive shaft. Due to this point, we achieve a minimum measuring errors caused by clearance. Besides this, it is even possible to load the measuring shaft with torque up to 5 Nm or even higher.

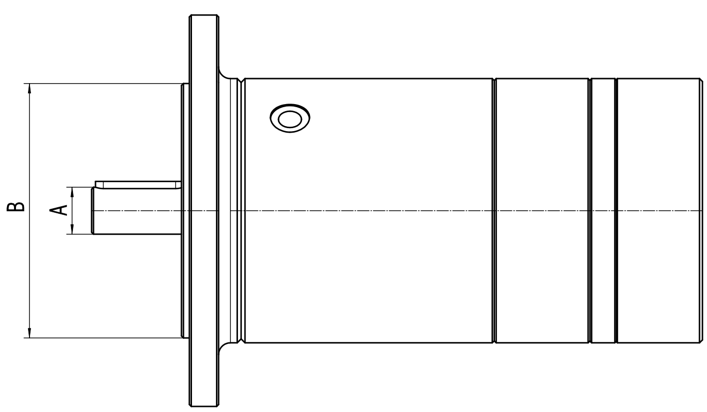
Should you need a special or unique design of measuring shafts, do not hesitate to contact us. We like to consult you based on our experience as a manufacturer from the coal mining as well as a supplier for test facilities. Finally, we design costumer solutions on your specifications.

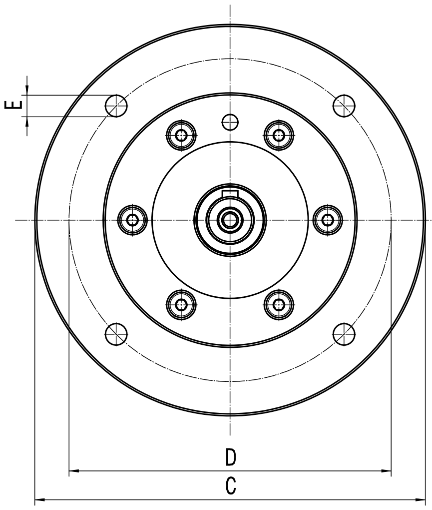




IEC - adapter flanges according to IEC 72-2 / B5:

	A	B	C	D	E
IEC 80 AE (10 till 21) Z76...F15...	ø19_{j6}	ø130_{h8}	ø200	ø165	11,5
IEC 90S / 90L AE (22 till 45) Z68...F15...	ø24_{j6}	ø130_{h8}	ø200	ø165	11,5
IEC 100/112M AE (22 till 45) Z8...F16...	ø28_{k6}	ø180_{h8}	ø250	ø215	13,5





NOTE

DUESTERLOH has been developing fluid technology products for more than 100 years.
The drives, controls and hydraulic power units from Hattingen are appreciated throughout the world for their complete reliability; including under extreme conditions. The owner-managed company´s own development and construction department and the wide range of products cater for distinctive flexibility and customer-orientation.

Products

- Hydraulic radial piston motors
- Hydraulic axial piston motors
- Hydraulic high precision motors
- Pneumatic motors
- Pneumatic starters
- Hydraulic and pneumatic controls
- Hydraulic power units

Designing controls and hydraulic power units specific to the customer is our company´s major strength. Vast product diversity is also available for standardized products.

Industrial areas of application

- Machine tools
- Smelting and rolling mill equipment
- Foundry machines
- Testing machines
- Shipbuilding (diesel engines)
- Offshore technology
- Printing and paper technology
- Vehicle construction
- Manipulators
- Environmental technology
- Mining equipment
- Materials handling equipment

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Certified acc. to ISO 9001