# PS two-speed gearboxes

STÖBER

PS two-speed gearboxes

STOBER drive technology for perfectionists

Sooner or later, design engineers never satisfied with the second-best solution end up at STOBER. That is because they can find everything here, with the broadest range of all imaginable drive technology components. Available with the highest level of design granularity to satisfy any individualized requirements perfectly. And the result is a complete STOBER system, from the gear rack and geared motor to open-loop or closed-loop control to intuitive project configuration software. With open interfaces based on established industry standards and reliably functioning communication between the individual components. The STOBER system also includes a complete package of services and practical support. Find out more on the following pages.
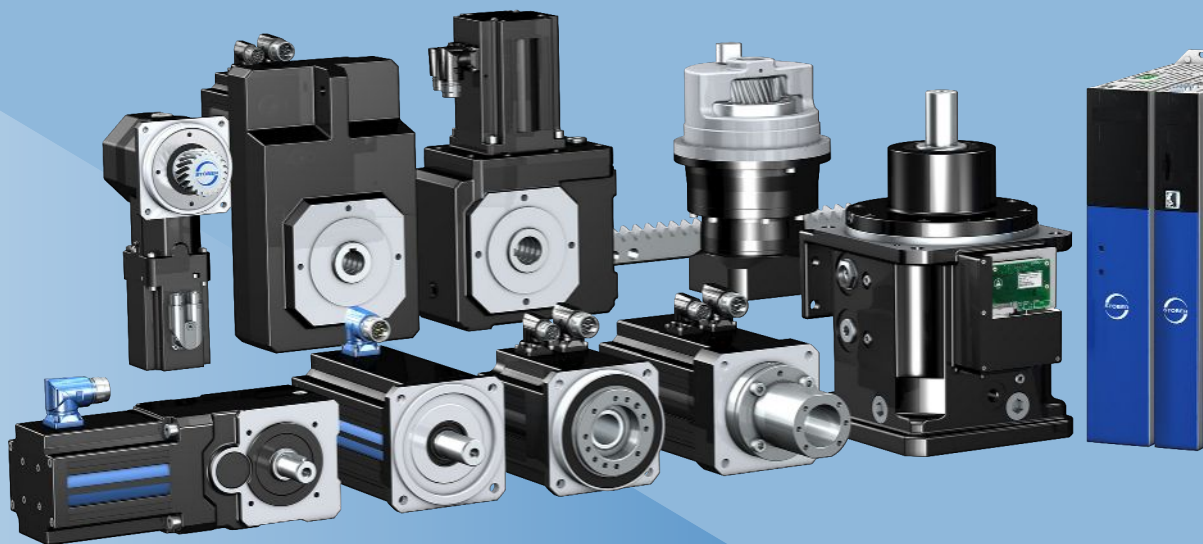
You can put your trust in STOBER

STOBER has been building excellent drive technology for more than 80 years. As a medium-sized, owner-operated company, STOBER understands the needs of its customers. Our company is down-to-earth, innovative, dynamic and focused on the customer. Our customers can find certified experts in every area, whether in research and development, production, technical consultation or design support. This goes beyond the technical qualifications. It also includes an equal measure of dedication, dependability and friendly, clear communication.

STOBER in motion

Despite our sense of tradition, we always enjoy something new. We continue to push ourselves forward and to refine our products further. We do this by implementing suggestions from real-world use, giving due consideration to customer requests and constantly seeking out even better solutions. This is all made possible by the competitive spirit with which we face every exciting challenge. The strong STOBER team spirit provides for productive collaboration. Both at work and outside the company doors. Our customers benefit from the extraordinary constancy of our employee base. This provides the astounding result where we can provide contacts familiar with a customer's industry and who can identify with a customer's needs.

The team that works well together wins

STOBER supplies the complete system: controller, automation, geared motors

STOBER has its roots in developing and building geared motors. We have also been developing and manufacturing drive controllers for decades. These STOBER components form drive systems with dependable functionality thanks to their plug-and-play design. Electronics and mechanical systems that speak the same language are critical for this. They understand each other without any adapters. All of the system components can recognize each other by their "electronic nameplate."

Systematic quality assurance

We check every single component and how it works together with others. Mass-producers are not able to do that. We assume responsibility for the complete system. This means certified operational reliability and the highest machine availability are guaranteed.

Technical system advantages

The STOBER system is flexible. One example is the freedom to choose between drive-based mode and controller-based mode. Or the feature allowing you to combine drive controllers in a multi-axis drive system and stand-alone controllers with special functions as you wish. This allows the modular design and free scalability of a drive system. This enables full utilization of capacity.

STOBER engineering software

Our AS6 engineering software based on Codesys plays a leading role in the STOBER system. The AS6 has a whole series of new and useful features integrated into it that make your work easier in every phase of the project. Comprehensive libraries provide direct access to STOBER products from every level of the drive system. You can find detailed technical information and have ready access to presets for standard functions.

STOBER is your partner

Our role does not end with the delivery of hardware and software. If you like, we will accompany and support you throughout your entire project. You can call on programming manpower at STOBER. Our experienced Codesys professionals will be happy to handle tricky special tasks or help you find the right template. This is even possible if components from other manufacturers are part of the bigger picture. You have direct, one-on-one contact with your project engineer. Your personal contact understands your needs and works with you to find the ideal solution.

You receive quick, professional feedback using the 24-hour hotline. You are not a number—you are our priority. We at STOBER do not have anything like a "service ticket."

Geographic proximity is also an intrinsic part of this personal contact. STOBER has four customer support centers throughout Germany. These support centers provide you with a high level of decision-making expertise. Your contacts have technical experience. And STOBER is international. We have 10 subsidiaries across 3 continents. This is also a valuable part of being near to our customers.
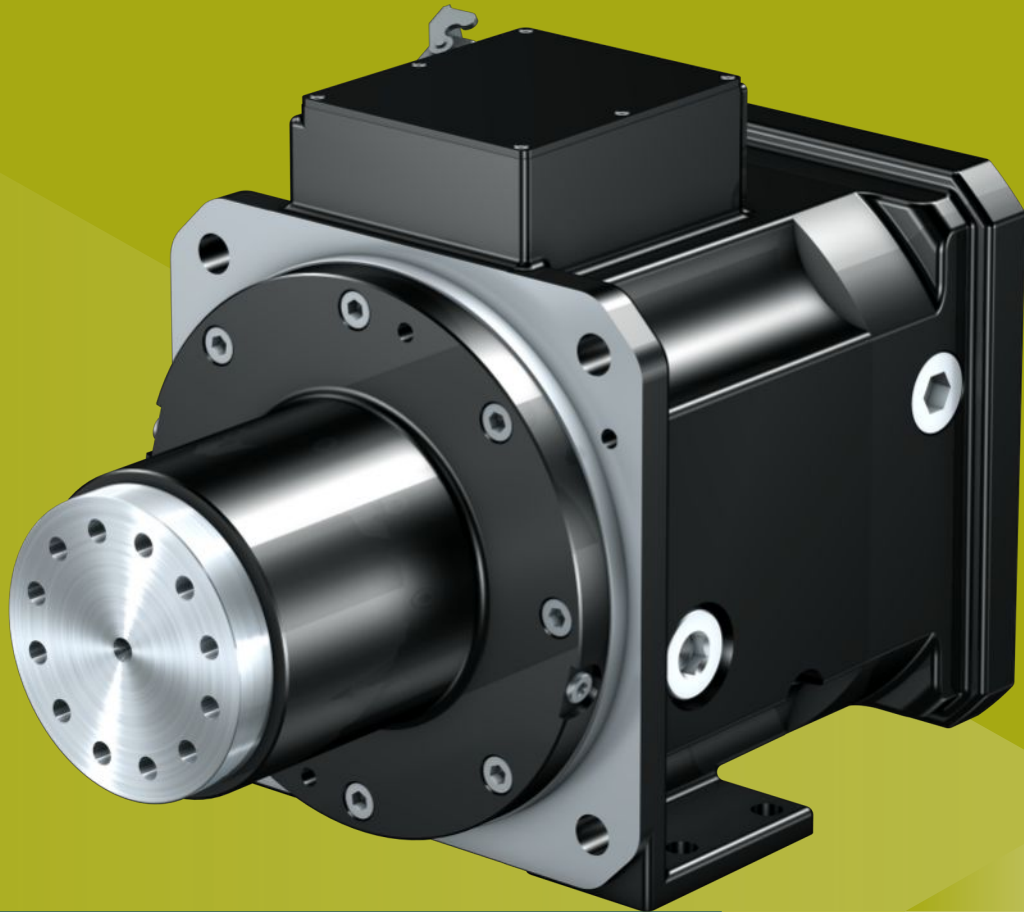
Dortmund

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Pforzheim

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1 Two-speed gearboxes

PS

1.1   Overview

PS two-speed gearboxes with loss-optimized direct drive

Features

Designed for main feed drives on machine tools	✓
Fast changeover between high speed and high torque	✓
High-precision, helical planetary gear unit	✓
Loss-optimized direct gear	✓
Neutral gear position	✓
Flange shaft or solid shaft	✓
Default backlash or reduced backlash (optional)	✓
Splash lubrication or circulating lubrication (optional)	✓
Integrated actuator control system with Sensor-Shift PCB	✓
Oil sight glass or oil level gauge (optional)	✓
Motor adapter for simple and safe attachment of different main feed motors	✓

Technical data

i	1 – 5.5
n_{1max}	2500 – 10000 rpm
$P_{N,GB}$	39 – 47 kW
M_{2max}	400 – 2200 Nm

1.2   Selection tables

The technical data listed in the selection tables is valid for the ambient conditions outlined in Chapter [▷ 1.5.2].

An explanation of the formula symbols can be found in the chapter [▷ 3.1].

1.2.1   Maximum speeds

Note that the maximum values in the following tables may have to be reduced depending on the specific application. You can find more details in Chapter [▷ 1.6.1].

The table values for speeds in S3 operation apply in the case of a duty cycle ≤ 30%. The table values for S1 operation apply in the case of a duty cycle ≥ 80%. For a duty cycle between 30% and 80%, the maximum speeds can be calculated as follows.

$$n_{1maxS3^*} = \frac{n_{1maxS1} - n_{1maxS3}}{50} \cdot (ED^* - 30) + n_{1maxS3}$$
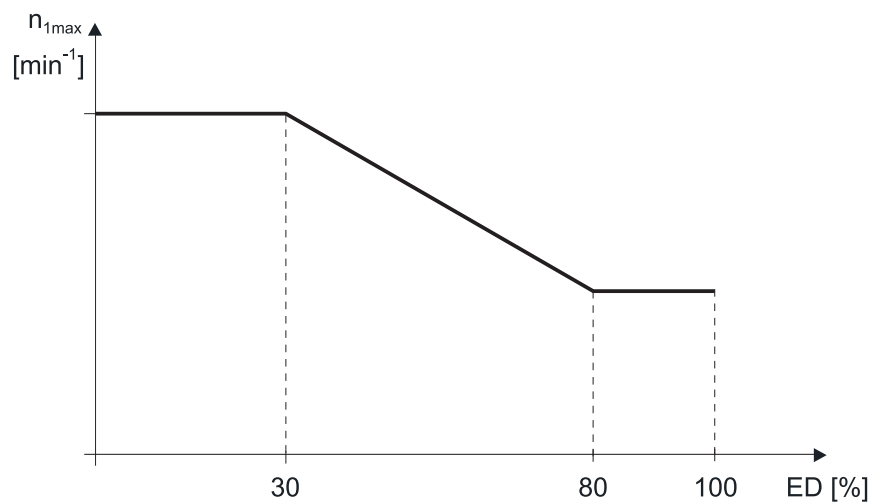
Fig. 1: Maximum speeds in S3 operation

Maximum speeds with splash lubrication in R (deep-groove ball bearing) or Z (cylindrical roller bearing) design

Type	i	$n_{1maxS1H}$	$n_{1maxS1V}$	$n_{1maxS3H}$	$n_{1maxS3V}$
		EL1, EL3, EL4	EL5	EL1, EL3, EL4	EL5
		S1	S1	S3	S3
		[rpm]	[rpm]	[rpm]	[rpm]
PS2501_0040 ME	4.0	3000	2500	6300	5300
–	1.0	5000	4500	6300	5300
PS2501_0055 ME	5.5	3000	2500	6300	6300
–	1.0	5000	4500	6300	5300
PS3001_0040 ME	4.0	3000	2500	6300	5300
–	1.0	5000	4500	6300	5300
PS3001_0055 ME	5.5	3000	2500	6300	6300
–	1.0	5000	4500	6300	5300

Maximum speeds with splash lubrication in S (angular contact ball bearing) design

Type	i	$n_{1maxS1H}$	$n_{1maxS1V}$	$n_{1maxS3H}$	$n_{1maxS3V}$
		EL1, EL3, EL4	EL5	EL1, EL3, EL4	EL5
		S1	S1	S3	S3
		[rpm]	[rpm]	[rpm]	[rpm]
PS2501_0040 ME	4.0	3000	2500	6300	5300
–	1.0	3000	2700	5500	5000
PS2501_0055 ME	5.5	3000	2500	6300	6300
–	1.0	3000	2700	5500	5000
PS3001_0040 ME	4.0	3000	2500	6300	5300
–	1.0	3000	2700	5500	5000
PS3001_0055 ME	5.5	3000	2500	6300	6300
–	1.0	3000	2700	5500	5000

Maximum speeds with circulating lubrication system

Type	i	$n_{1maxS1H}$	$n_{1maxS1V}$	$n_{1maxS3H}$	$n_{1maxS3V}$
		EL1, EL3, EL4	EL5	EL1, EL3, EL4	EL5
		S1	S1	S3	S3
		[rpm]	[rpm]	[rpm]	[rpm]
PS2501_0040	4.0	6500	6500	7000	7000
–	1.0	8000	8000	10000	10000
PS2501_0055	5.5	6500	6500	7000	7000
–	1.0	8000	8000	10000	10000
PS3001_0040	4.0	6500	6500	7000	7000
–	1.0	8000	8000	10000	10000
PS3001_0055	5.5	6500	6500	7000	7000
–	1.0	8000	8000	10000	10000

You can find the specifications for the circulating lubrication system in Chapter

1.2.2   Torques

Type	i	$P_{N,GB}$	M_{1N}	M_{2N}	M_{1max}	M_{2max}
		[kW]	[Nm]	[Nm]	[Nm]	[Nm]
PS2501_0040 ME	4.0	47	300	1200	400	1600
–	1.0	47	300	300	400	400
PS2501_0055 ME	5.5	39	250	1375	400	2200
–	1.0	47	300	300	400	400
PS3001_0040 ME	4.0	47	300	1200	400	1600
–	1.0	47	300	300	400	400
PS3001_0055 ME	5.5	39	250	1375	400	2200
–	1.0	47	300	300	400	400

The nominal torque for the output M_{2N} is based on the input speed n_{1N} = 1500 rpm.

1.2.3   Additional technical data

G shaft design (solid shaft without feather key)

Type	J_1	m	$\Delta\phi_2$	v_{swS}	v_{swRZ}
	[kgcm²]	[kg]	[arcmin]	[mm/s]	[mm/s]
PS2501	82	86	30/20	1.0	1.4
PS3001	82	95	30/20	1.0	1.4

P shaft design (solid shaft with two feather keys)

Type	J_1 [kgcm²]	m [kg]	$\Delta\phi_2$ [arcmin]	v_{swS} [mm/s]	v_{swRZ} [mm/s]
PS2501	85	86	30/20	1.0	1.4
PS3001	85	95	30/20	1.0	1.4

F shaft design (flange shaft)

Type	J_1 [kgcm²]	m [kg]	$\Delta\phi_2$ [arcmin]	v_{swS} [mm/s]	v_{swRZ} [mm/s]
PS2501	120	86	30/20	1.0	1.4
PS3001	120	95	30/20	1.0	1.4

The mass moment of inertia J_1 applies to both transmitted and direct gear of the respective shaft design.

The oscillation speed v_{sw} has been determined in accordance with DIN ISO 10816-1 under the following test conditions: n_1 = 5000 rpm, on the housing of the two-speed gearbox, without load, soft mounting.

1.3   Dimensional drawings

This chapter contains dimensional drawings for each shaft design, each of which includes tables for different bearing designs and motor connection dimensions.

You can removed the eyebolts used to transport the two-speed gearbox after installation and replace them with a screw plug. The eyebolts are not shown in the dimensional drawings for this reason.

Dimensions can exceed the specifications of ISO 2768-mK due to casting tolerances or accumulation of individual tolerances.

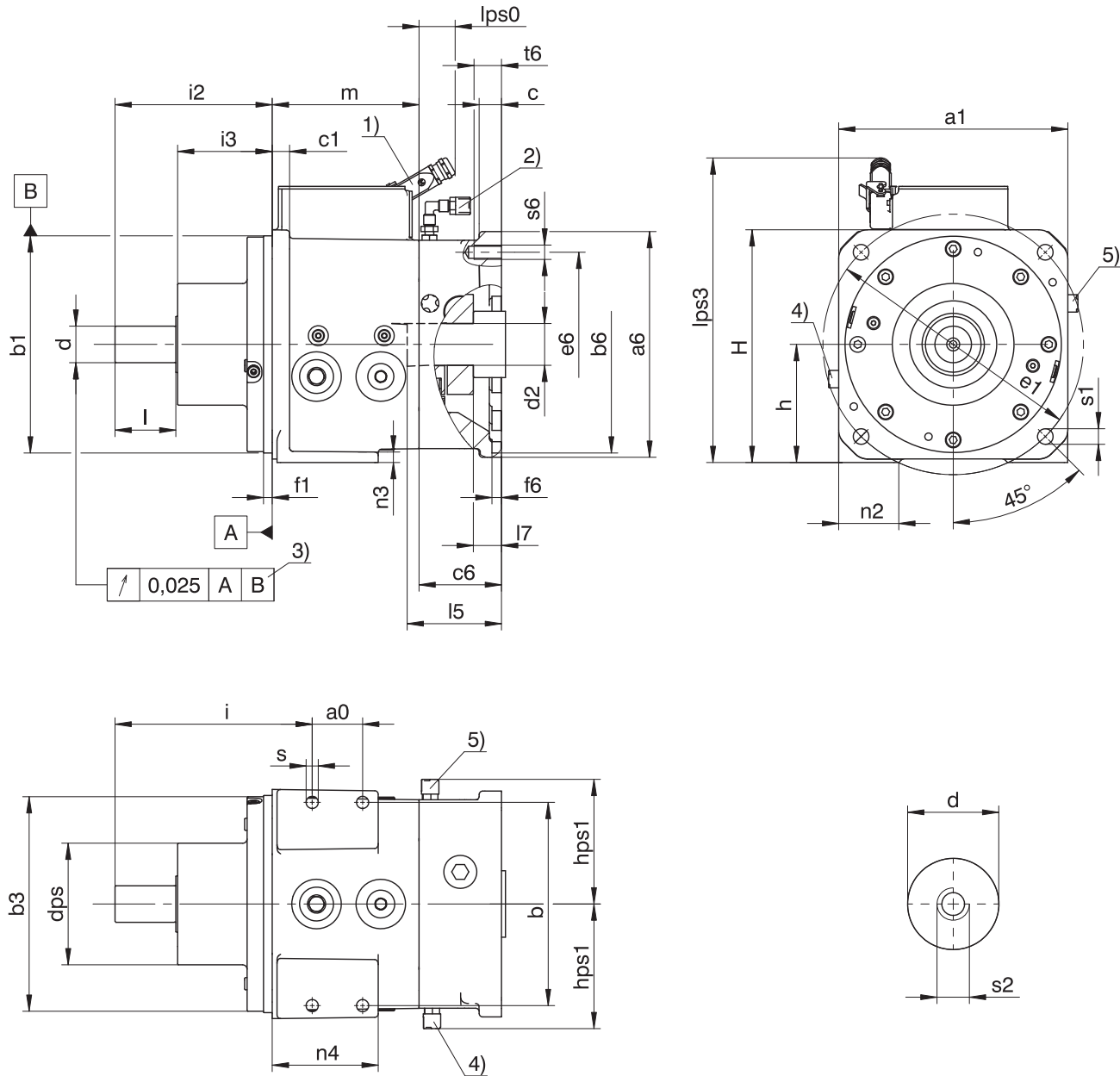We reserve the right to make dimensional changes due to ongoing technical development.

You can download 3D models of our standard drives at http://configurator.stoeber.de.

Centering holes in solid shafts in accordance with DIN 332-2, DR shape

Thread size	M4	M5	M6	M8	M10	M12	M16	M20	M24
Thread depth [mm]	10	12.5	16	19	22	28	36	42	50

1.3.1   G shaft design (solid shaft without feather key)

1	Mating connector for the switching unit electrical connection (optional). For designs where the dimension of a6 ≤ 250 mm, you can also install the connector housing in a horizontal position if this is more useful for laying the cables.	2	Air release valve, only for circulating lubrication; angled in mounting position EL5, not angled in mounting position EL1
3	Only applies to an S bearing design	4	Air release valve only for circulating lubrication and mounting position EL4
5	Air release valve only for circulating lubrication and mounting position EL3		

S housing design (short bearing distance)

Type	Ød	a0	□a1	b	Øb1	Øb3	c1	Ødps	Øe1	f1	h	H	i	i2	i3	l	lps0	lps3	m	n2	n3	n4	s	Øs1	s2
PS25	42$_{k6}$	58	264	234	250$_{h6}$	247	20	140	300	10	136	268	227	181	109	70	41	350	169	69	12.0	122	14	18	M10
PS30	42$_{k6}$	58	320	290	250$_{h6}$	247	20	140	350	10	164	324	227	181	109	70	41	380	169	62	17.5	122	14	18	M10

M housing design (medium bearing distance)

Type	Ød	a0	□a1	b	Øb1	Øb3	c1	Ødps	Øe1	f1	h	H	i	i2	i3	l	lps0	lps3	m	n2	n3	n4	s	Øs1	s2
PS25	42$_{k6}$	58	264	234	250$_{h6}$	247	20	140	300	10	136	268	267	221	149	70	41	350	169	69	12.0	122	14	18	M10
PS25	55$_{m6}$	58	264	234	250$_{h6}$	247	20	140	300	10	136	268	307	261	149	110	41	350	169	69	12.0	122	14	18	M12
PS30	42$_{k6}$	58	320	290	250$_{h6}$	247	20	140	350	10	164	324	267	221	149	70	41	380	169	62	17.5	122	14	18	M10
PS30	55$_{m6}$	58	320	290	250$_{h6}$	247	20	140	350	10	164	324	307	261	149	110	41	380	169	62	17.5	122	14	18	M12

Motor connection dimensions

Type	Øb6	Ød2	□e6	l5$_{max}$	□a6	c	c6	f6	hps1	l7	Øs6	t6
PS25	230^{H7}	42/48/55	265	112	250	24.5	95	11	141.5	31	M12	32.0
PS30	230^{H7}	42/48/55	265	112	250	24.5	95	11	141.5	31	M12	32.0
PS25	250^{H7}	42/48/55	300	112	260	24.5	95	11	141.5	31	M16	32.0
PS30	250^{H7}	42/48/55	300	112	260	24.5	95	11	141.5	31	M16	32.0
PS25	300^{H7}	42/48/55	350	112	314	26.3	95	11	141.5	31	M16	26.3
PS30	300^{H7}	42/48/55	350	112	314	26.3	95	11	141.5	31	M16	26.3
PS25	300^{H7}	60	350	142	314	26.3	125	11	141.5	61	M16	26.3
PS30	300^{H7}	60	350	142	314	26.3	125	11	141.5	61	M16	26.3

Motor connections with a dimension of ∅b6 = 300 mm are available as an option

1.3.2   P shaft design (solid shaft with two feather keys)

1   Mating connector for the switching unit electrical connection (optional). For designs where the dimension of a6 ≤ 250 mm, you can also install the connector housing in a horizontal position if this is more useful for laying the cables.

2   Air release valve, only for circulating lubrication; angled in mounting position EL5, not angled in mounting position EL1

3   Only applies to an S bearing design

4   Air release valve only for circulating lubrication and mounting position EL4

5   Air release valve only for circulating lubrication and mounting position EL3

S housing design (short bearing distance)

Type	Ød	a0	□a1	b	Øb1	Øb3	c1	Ødps	Øe1	f1	h	H	i	i2	i3	l	l1	lps0	lps3	lps4	m	n2	n3	n4	s	Øs1	s2	u
PS25	42_{k6}	58	264	234	250_{h6}	247	20	140	300	10	136	268	227	181	109	70	3	41	350	48	169	69	12.0	122	14	18	M10	A12x8x63
PS30	42_{k6}	58	320	290	250_{h6}	247	20	140	350	10	164	324	227	181	109	70	3	41	380	48	169	62	17.5	122	14	18	M10	A12x8x63

M housing design (medium bearing distance)

Type	Ød	a0	□a1	b	Øb1	Øb3	c1	Ødps	Øe1	f1	h	H	i	i2	i3	l	l1	lps0	lps3	lps4	m	n2	n3	n4	s	Øs1	s2	u
PS25	42_{k6}	58	264	234	250_{h6}	247	20	140	300	10	136	268	267	221	149	70	3	41	350	48	169	69	12.0	122	14	18	M10	A12x8x63
PS25	55_{m6}	58	264	234	250_{h6}	247	20	140	300	10	136	268	307	261	149	110	10	41	350	63	169	69	12.0	122	14	18	M12	A16x10x90
PS30	42_{k6}	58	320	290	250_{h6}	247	20	140	350	10	164	324	267	221	149	70	3	41	380	48	169	62	17.5	122	14	18	M10	A12x8x63
PS30	55_{m6}	58	320	290	250_{h6}	247	20	140	350	10	164	324	307	261	149	110	10	41	380	63	169	62	17.5	122	14	18	M12	A16x10x90

Motor connection dimensions

Type	Øb6	Ød2	□e6	$l5_{max}$	□a6	c	c6	f6	hps1	l7	Øs6	t6
PS25	230^{H7}	42/48/55	265	112	250	24.5	95	11	141.5	31	M12	32.0
PS30	230^{H7}	42/48/55	265	112	250	24.5	95	11	141.5	31	M12	32.0
PS25	250^{H7}	42/48/55	300	112	260	24.5	95	11	141.5	31	M16	32.0
PS30	250^{H7}	42/48/55	300	112	260	24.5	95	11	141.5	31	M16	32.0
PS25	300^{H7}	42/48/55	350	112	314	26.3	95	11	141.5	31	M16	26.3
PS30	300^{H7}	42/48/55	350	112	314	26.3	95	11	141.5	31	M16	26.3
PS25	300^{H7}	60	350	142	314	26.3	125	11	141.5	61	M16	26.3
PS30	300^{H7}	60	350	142	314	26.3	125	11	141.5	61	M16	26.3

Motor connections with a dimension of Øb6 = 300 mm are available as an option

1.3.3   F shaft design (flange shaft)

1   Mating connector for the switching unit electrical connec-
     tion (optional). For designs where the dimension of a6 ≤
     250 mm, you can also install the connector housing in a
     horizontal position if this is more useful for laying the ca-
     bles.

2   Air release valve, only for circulating lubrication; angled in
     mounting position EL5, not angled in mounting position
     EL1

3   Only applies to an S bearing design

4   Air release valve only for circulating lubrication and
     mounting position EL4

5   Air release valve only for circulating lubrication and
     mounting position EL3

M housing design (medium bearing distance)

Type	$\varnothing v$	a0	$\square$a1	b	$\varnothing b1$	$\varnothing b3$	c1	$\varnothing dps$	$\varnothing e$	$\varnothing e1$	f1	h	H	i	i2	lps	lps0	lps3	lps5	lps7	m	n2	n3	n4	s	$\varnothing s1$	s2	s4
PS25	118_{k6}	58	264	234	250_{h6}	247	20	116	100	300	10	136	268	217.5	171.5	142.5	41	350	22.5	20	169	69	12.0	122	14	18	M10	M12
PS25	118_{k6}	58	264	234	250_{h6}	247	20	140	100	300	10	136	268	217.5	171.5	142.5	41	350	22.5	20	169	69	12.0	122	14	18	M10	M12
PS25	130_{k6}	58	264	234	250_{h6}	247	20	140	100	300	10	136	268	217.5	171.5	142.5	41	350	22.5	20	169	69	12.0	122	14	18	M10	M12
PS30	118_{k6}	58	320	290	250_{h6}	247	20	116	100	350	10	164	324	217.5	171.5	142.5	41	380	22.5	20	169	62	17.5	122	14	18	M10	M12
PS30	118_{k6}	58	320	290	250_{h6}	247	20	140	100	350	10	164	324	217.5	171.5	142.5	41	380	22.5	20	169	62	17.5	122	14	18	M10	M12
PS30	130_{k6}	58	320	290	250_{h6}	247	20	140	100	350	10	164	324	217.5	171.5	142.5	41	380	22.5	20	169	62	17.5	122	14	18	M10	M12

L housing design (long bearing distance)

Type	$\varnothing v$	a0	$\square$a1	b	$\varnothing b1$	$\varnothing b3$	c1	$\varnothing dps$	$\varnothing e$	$\varnothing e1$	f1	h	H	i	i2	lps	lps0	lps3	lps5	lps7	m	n2	n3	n4	s	$\varnothing s1$	s2	s4
PS25	130_{k6}	58	264	234	250_{h6}	247	20	140	100	300	10	136	268	282	236	207	41	350	22.5	20	169	69	12.0	122	14	18	M10	M12
PS30	130_{k6}	58	320	290	250_{h6}	247	20	140	100	350	10	164	324	282	236	207	41	380	22.5	20	169	62	17.5	122	14	18	M10	M12

Motor connection dimensions

Type	$\varnothing b6$	$\varnothing d2$	$\square$e6	$l5_{max}$	$\square$a6	c	c6	f6	hps1	l7	$\varnothing s6$	t6
PS25	230^{H7}	42/48/55	265	112	250	24.5	95	11	141.5	31	M12	32.0
PS30	230^{H7}	42/48/55	265	112	250	24.5	95	11	141.5	31	M12	32.0
PS25	250^{H7}	42/48/55	300	112	260	24.5	95	11	141.5	31	M16	32.0
PS30	250^{H7}	42/48/55	300	112	260	24.5	95	11	141.5	31	M16	32.0
PS25	300^{H7}	42/48/55	350	112	314	26.3	95	11	141.5	31	M16	26.3
PS30	300^{H7}	42/48/55	350	112	314	26.3	95	11	141.5	31	M16	26.3
PS25	300^{H7}	60	350	142	314	26.3	125	11	141.5	61	M16	26.3
PS30	300^{H7}	60	350	142	314	26.3	125	11	141.5	61	M16	26.3

Motor connections with a dimension of $\varnothing$b6 = 300 mm are available as an option

1.3.4   Connection for lubrication
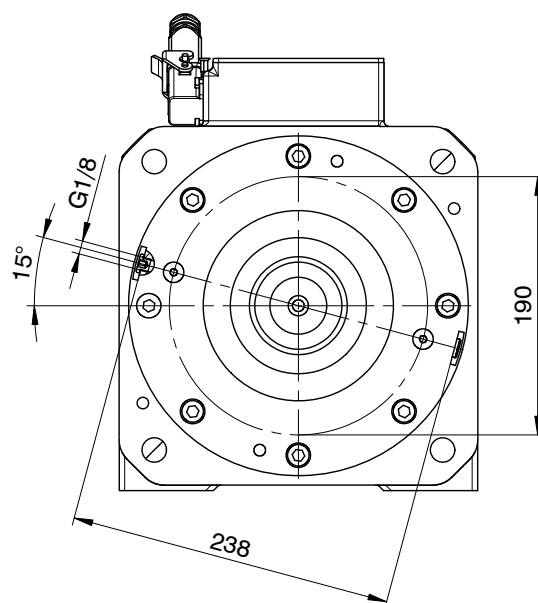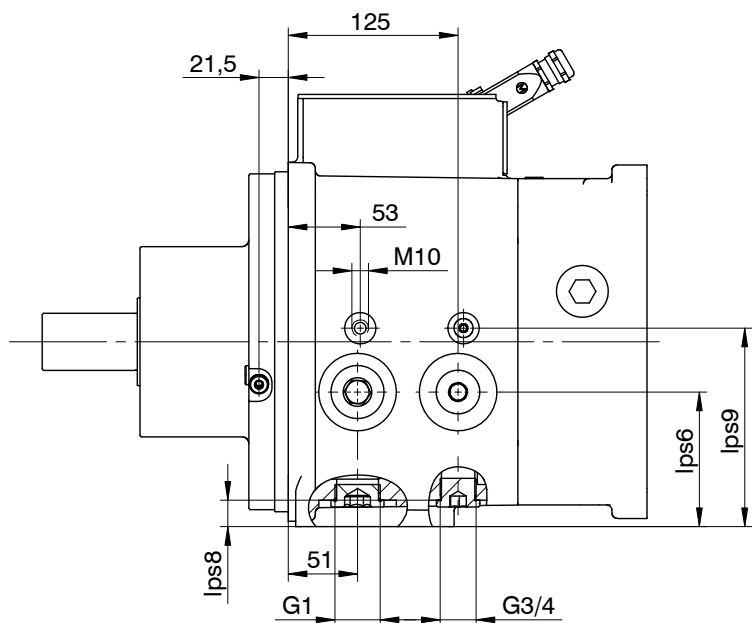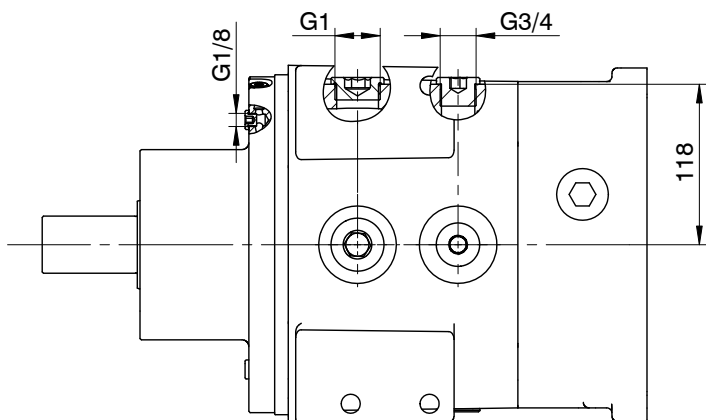
Type	lps6	lps8	lps9
PS25	99	19.5	146
PS30	127	46.0	174

1.4   Type designation

Sample code

PS	25	0	1	M	F	Z	0040	ME

Explanation

Code	Designation	Design
PS	Type	Two-speed gearboxes
25	Size	25
30		30
0	Generation	Generation 0
1	Stages	Single-stage
S	Housing	Short bearing distance
M		Medium bearing distance
L		Long bearing distance
F	Shaft	Flange shaft
G		Solid shaft without feather key
P		Solid shaft with two feather keys
R	Bearing	Standard bearing (deep-groove ball bearing)
S		Axially reinforced bearing (angular contact ball bearing)
Z		Radially reinforced bearing (cylindrical roller bearing)
0040	Transmission ratio (i x 10)	i = 4 (example)
ME	Motor adapter	Motor adapter with EasyAdapt® coupling

In order to complete the type designation, also specify:

- The mounting position, see the chapter [▷ 1.5.4]
- Diameter of the solid shaft or flange shaft
- Diameter of the output flange for a flange shaft
- Splash lubrication (default) or circulating lubrication (optional)
- Oil level gauge for splash lubrication in EL5 (optional)?
- Motor connection dimensions: Pilot, hole pattern, shaft length, shaft diameter, see the chapter [▷ 1.3]
- Default backlash or reduced backlash (optional)
- With matching mating connector for the switching unit electrical connection (optional)?

Available designs

Housing design		S	M	S	M	M	L
Shaft design			G		P		F
Bearing design							
R		SGR	–	SPR	–	–	–
S		SGS	MGS	SPS	MPS	MFS	–
Z		–	MGZ	–	MPZ	MFZ	LFZ

1.5   Product description

1.5.1   General features

Feature	Description
Maximum permitted gear unit temperature (on the surface of the gear unit)	≤ 80 °C
Paint	Black RAL 9005
Explosion protection (in accordance with ATEX 2014/34/EU)	None
Protection class	IP65

1.5.2   Ambient conditions

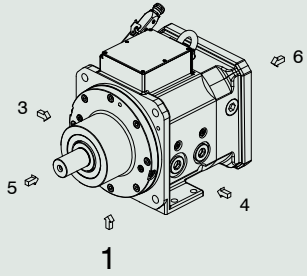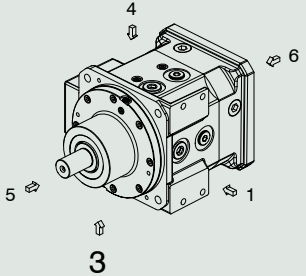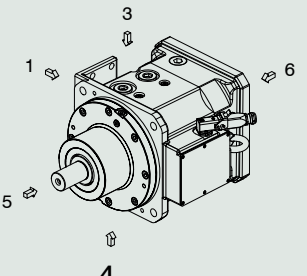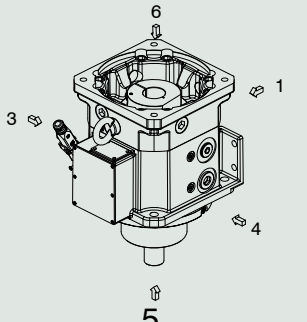| Feature	Description
Transport/storage surrounding temperature	−10 °C to +50 °C
Surrounding operating temperature	0 °C to +40 °C
Relative humidity	< 60%
Installation altitude	≤ 1000 m above sea level

1.5.3   Installation conditions

The torques and forces specified only apply for the attachment of the two-speed gearbox on the machine side using screws of quality 10.9. In addition, the two-speed gearbox housing must be adjusted at the pilot (H7).

If you are installing the two-speed gearbox only at the foot mount and not through the use of a flange, the attached motor must be installed on the foot mount of the motor.
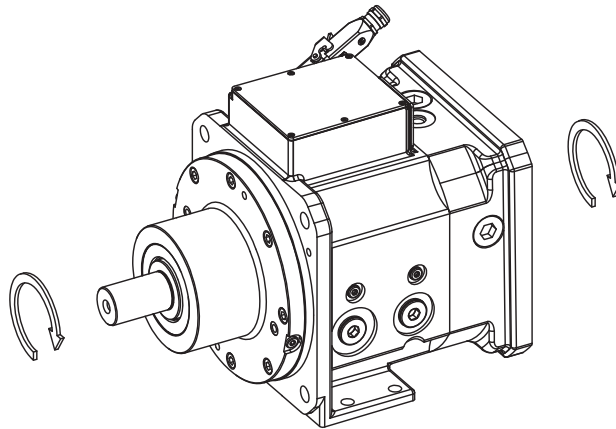
1.5.4   Mounting positions

The following table shows the standard mounting positions.

The numbers indicate the sides of the two-speed gearbox. The mounting position is defined by the side of the two-speed gearbox that is facing downward.

EL1	EL2	EL3
1	Not permitted	3

EL4	EL5	EL6
4	5	Not permitted

1.5.5   Direction of rotation

The input and output turn in the same direction.


1.5.6   Motor requirements

This chapter contains the requirements for the motor attached to the two-speed gearbox by the machine manufacturer. Select a motor with a smooth shaft; a keyway in the motor shaft has a negative effect on smooth operation.

1.5.6.1   Tolerances

The motor to be attached must be within the following tolerances for error-free operation.

An explanation of the formula symbols can be found in the chapter Formula symbols.

Tolerance for radial runout, axial runout and concentricity in accordance with IEC 60072-1 (precision class)
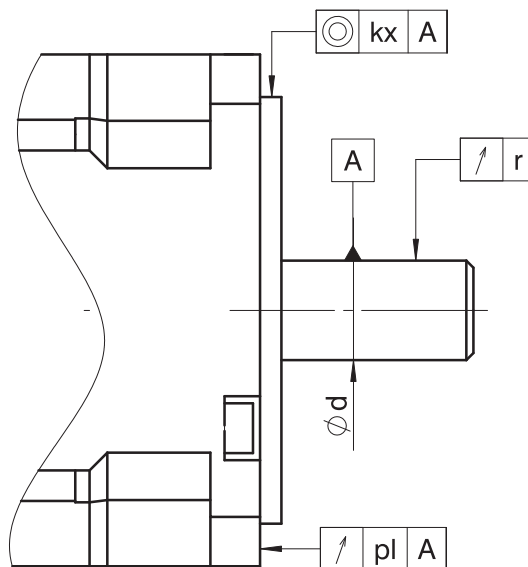
| Formula symbols	Tolerance
r	25 µm
kx	63 µm
pl	63 µm

Fit tolerances in accordance with EN ISO 286-1

Diameter [mm]	Tolerance
d < 55	ISO k6
d ≥ 55	ISO m6

1.5.6.2 Maximum permitted breakdown torque

This chapter contains information on calculating the maximum permitted breakdown torque on a gear unit input.

An explanation of the formula symbols can be found in the chapter Formula symbols.
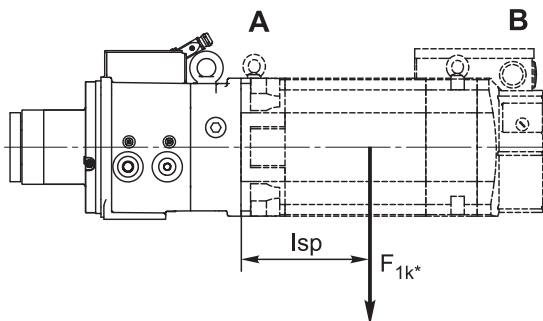
| A | Attachment or output side of the motor | B | Rear of the motor |

Calculate the existing breakdown torque at the gear unit input as follows:

$M_{1k*} = F_{1k*} \cdot lsp.$

If the calculated breakdown torque is > 1000 Nm, also install the motor at its foot mount (IMB35 design) or use a tension-free means of supporting it on the B side. The motor must also be installed on its foot mount if you do not use a flange to install the two-speed gearbox and instead only install it at the foot mount.

1.5.7 Lubrication

The two-speed gearbox is lubricated by default using splash lubrication and, optionally, using circulating lubrication. This chapter covers both methods of lubrication. The following formula symbols are used for this.

The forward slash (/) is used to mean "or" for specifying several alternative options.

1.5.7.1 Splash lubrication

For splash lubrication, use gear oil with a specification of CLP HC ISO VG 68. The oil fill volume depends on the mounting position. You can find the oil fill volume on the nameplate for your two-speed gearbox and in the document with ID 441871 (see the chapter [▷ 1.7]).

The oil has to be changed every 10000 operating hours. The following table lists the filling and draining connections that must be accessible based on the mounting position of the two-speed gearbox in the machine. You can find the position of the filling and draining connections in the next chapter.

Mounting position	Filling connections	Draining connections
EL1	L/O	I
EL3	A/B	C/D
EL4	C/D	A/B
EL5	B/D	E/F/G/H[1]
EL6	Mounting position not permitted	

Tab. 1: Filling and draining connections

1.5.7.2 Circulating lubrication

Since high speeds also create more heat that needs to be dissipated, it is possible to connect the two-speed gearbox to a circulating lubrication system with a cooling unit for such applications (optional).

For circulating lubrication, use gear oil with a specification of CLP HC ISO VG 46. Gear oil with a specification of CLP HC ISO VG 32 can be used if the maximum gear oil temperature of 50 °C is not exceeded in the application. Other gear oil specifications are available on request.

In the case of circulating lubrication, the two-speed gearbox is outfitted with an air release valve. The location of the valve depends on the mounting position of the two-speed gearbox. You can find more details in Chapter [▷ 1.3].

[1] The gear oil must be sucked out at Connection H

The illustrations below show our recommendations for connecting the two-speed gearbox to the circulating lubrication system for optimal temperature conditions based on the mounting position.
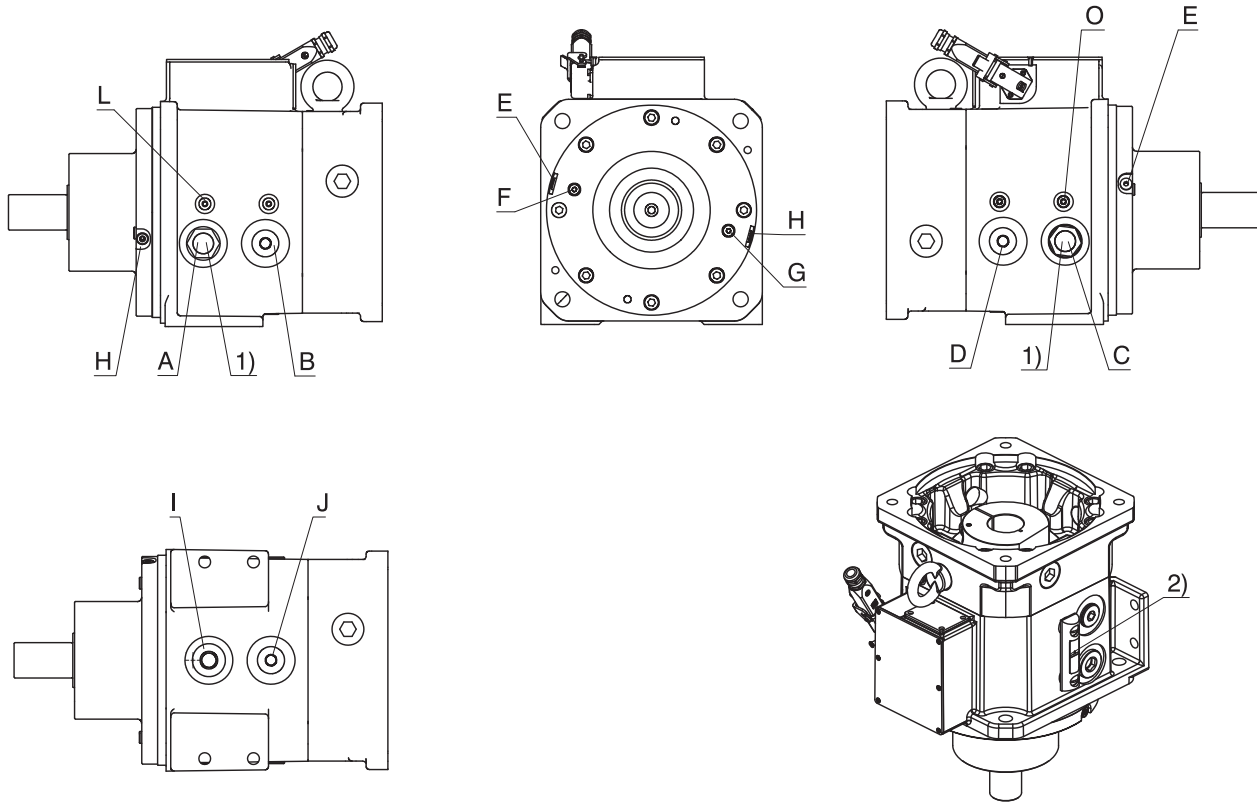

Fig. 2: Position of the connections

| 1 | Oil sight glass for splash lubrication and EL1 | 2 | Oil level gauge for splash lubrication and EL5 (optional) |

In the following table, note that:

- Two supply connections and one return connection are used in some mounting positions.
- The flow rate for the return must always be slightly higher than the total flow rate for the supply.

Mounting position, main direction of rotation	Supply connection 1		Supply connection 2		Return connection	
	Designation	$q_{v,lub}$ [l/min]	Designation	$q_{v,lub}$ [l/min]	Designation	$q_{v,lub}$ [l/min]
EL1, cw	B	≥ 2	E/F/G/H	≥ 1	C	> 3
EL1, ccw	D	≥ 2	E/F/G/H	≥ 1	A	> 3
EL3, cw and ccw	D	≥ 2	E/F/G/H	≥ 1	I	> 3
EL4, cw and ccw	B	≥ 2	E/F/G/H	≥ 1	I	> 3
EL5, cw and ccw	E/F/G/H	≥ 3	–	–	B/D	> 3
EL6, cw and ccw	Not permitted					

Tab. 2: Flow rates and connections for circulating lubrication

Requirements for the circulating lubrication system

Feature	Description
Specific cooling performance	≥ 0.07 kW/K
Absolute cooling performance	≥ 1.4 kW at $\Delta\vartheta = \vartheta_1 - \vartheta_2 = 60\ °C - 40\ °C = 20\ K$ and $\vartheta_{amb} = 30\ °C$
Flow rate $q_{v,lub}$	Refer to the table above
Filter on the two-speed gearbox supply connection	60 µm filter mesh
Inner diameter of threaded fitting on return[2]	≥ 21 mm for G1" thread ≥ 19 mm for G3/4" thread

---

[2] Threaded fittings should not limit the line cross-sections specified by threaded connections

1.5.8   Switching unit with SensorShift PCB

The switching unit shifts between two-speed gearbox gears. The switching unit is connected to the machine control system by the built-in connector. The operating manual contains notes on switching logic to be programmed for gear shifting.

The position of the actuator is determined using an electronic sensor. An actuator control system integrated into the switching unit analyzes the position signals and precisely activates the switching motor.

The switching unit with SensorShift PCB has the following advantages:

- No need for a customer-side relay or wiring in the control cabinet
- Low programming complexity for the shifting process
- The shifting process is not time-sensitive for the machine control system and can run in the background
- Automatic repetition of the shifting process in the event of a shifting error
- Wear-free, non-contact position detection
- Integrated soft start protects mechanical parts
- Possible to shift into neutral from any gear

The version with SensorShift PCB has compatible connections with the previous design with microswitches. In this case, however, be aware that some of the listed advantages of the SensorShift PCB may not be available.

The operating manual contains details on connection and gear shifting. You can find the electrical connection values in the following table.

Feature	Value
Nominal voltage	24 V DC −10%, +20%
Nominal current at gear shift	0.6 A
Starting current at gear shift	5 A
Low-level digital inputs	0 – 8 V DC
High-level digital inputs	12 – 30 V DC
Input current for digital inputs	< 10 mA
Debounce time for digital inputs	100 ms
Shock resistance	20 g (10 Hz ≤ f ≤ 500 Hz)

1.6   Project configuration

This chapter contains project configuration notes regarding permitted speeds and shaft loads.

An explanation of the formula symbols can be found in the chapter [▶ 3.1].

1.6.1   Permitted speeds and torques

The maximum speeds and torques specified in the chapter [▶ 1.2] must be adjusted as follows based on the application.

S1 operation

Adjust the maximum permitted input speeds as follows according to the surrounding temperature in your application:

For mounting position EL1, EL3 or EL4:

$$n_{1\max S1H^*} = \frac{n_{1\max S1H}}{fB_T}$$

For mounting position EL5:

$$n_{1\max S1V^*} = \frac{n_{1\max S1V}}{fB_T}$$

ϑ_{amb}	fB_T
≤ 20 °C	1.0
≤ 30 °C	1.15
≤ 40 °C	1.3

Tab. 3: Surrounding temperature operating factor

S3 operation

Check whether the following condition is met in S3 operation for the actual average input speed n_{1m*}.

For mounting position EL1, EL3 or EL4: $n_{1m*} < n_{1maxS3H}$

For mounting position EL5: $n_{1m*} < n_{1maxS3V}$.

You can calculate n_{1m*} as follows:

$$n_{1m*} = n_{2m*} \cdot i$$

$$n_{2m*} = \frac{\left|n_{2m,1*}\right| \cdot t_{1*} + ... + \left|n_{2m,n*}\right| \cdot t_{n*}}{t_{1*} + ... + t_{n*}}$$

Also check whether the following condition is met for the actual effective torque M_{2eff*}: $M_{2eff*} \leq M_{2max}$

You can calculate M_{2eff*} as follows:

$$M_{2eff*} = \sqrt{\frac{t_{1*} \cdot M_{2,1*}^2 + ... + t_{n*} \cdot M_{2,n*}^2}{t_{1*} + ... + t_{n*}}}$$

The calculations are based on a representation of the power taken from the output in accordance with the following figure.
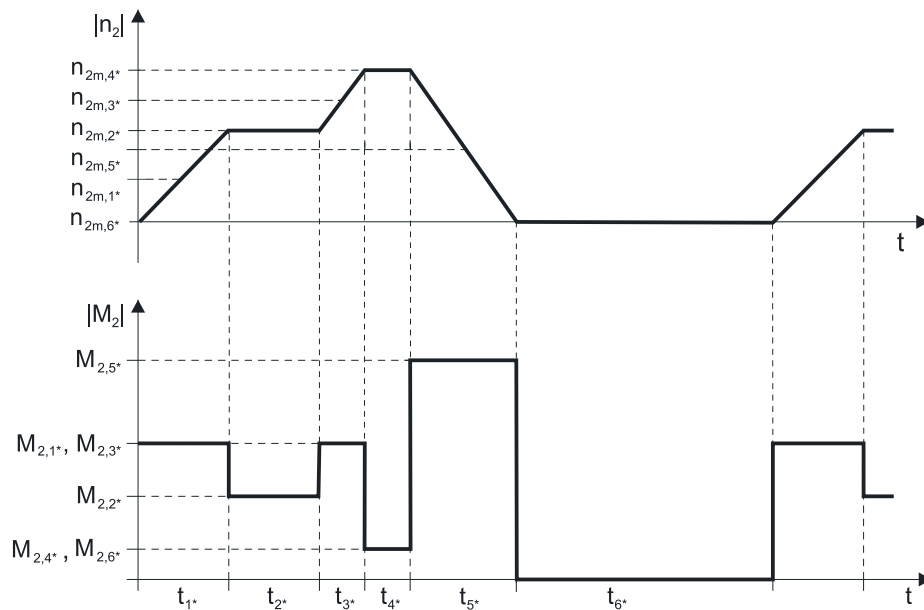
Fig. 3: Example of a cycle in S3 operation

1.6.2   Permitted shaft loads

The values for permitted shaft loads specified in the following tables apply:

- For shaft dimensions in accordance with the catalog
- For output speeds $n_{2m*} \leq 300$ rpm ($F_{2axN} = F_{2ax300}$; $F_{2radN} = F_{2rad300}$; $M_{2kN} = M_{2k300}$)
- For the optimal force application point $x_2 = x_{2min}$
- Only if radial forces on the two-speed gearbox are stabilized using the pilot of the gear unit housing

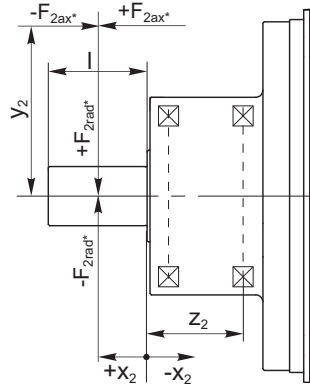## 1.6.2.1   G/P shaft design (solid shaft)

Fig. 4: Force application points for solid shaft

SR design (short bearing distance, deep-groove ball bearing)

Type	z_2	x_{2min}	x_{2max}	F_{2ax300}	$F_{2rad300}$	M_{2k300}
	[mm]	[mm]	[mm]	[N]	[N]	[Nm]
PS25	61.0	-43.0	110.0	1100	1900	182
PS30	61.0	-43.0	110.0	1100	1900	182

SS design (short bearing distance, angular contact ball bearing)

Type	z_2	x_{2min}	x_{2max}	F_{2ax300}	$F_{2rad300}$	M_{2k300}
	[mm]	[mm]	[mm]	[N]	[N]	[Nm]
PS25	94.0	-43.0	110.0	2150	4300	552
PS30	94.0	-43.0	110.0	2150	4300	552

MS design (medium bearing distance, angular contact ball bearing)

Type	z_2	x_{2min}	x_{2max}	F_{2ax300}	$F_{2rad300}$	M_{2k300}
	[mm]	[mm]	[mm]	[N]	[N]	[Nm]
PS25	133.0	-63.0	110.0	2300	4600	770
PS30	133.0	-63.0	110.0	2300	4600	770

MZ design (medium bearing distance, cylindrical roller bearing)

Type	z_2	x_{2min}	x_{2max}	F_{2ax300}	$F_{2rad300}$	M_{2k300}
	[mm]	[mm]	[mm]	[N]	[N]	[Nm]
PS25	101.0	-38.0	110.0	1750	8750	1185
PS30	101.0	-38.0	110.0	1750	8750	1185

For output speeds > 300 rpm, the permitted shaft loads can be calculated based on the following formulas:

$$F_{2axN} = \frac{F_{2ax300}}{\sqrt[3]{\dfrac{n_{2m^*}}{300\,\text{min}^{-1}}}} \qquad F_{2radN} = \frac{F_{2rad300}}{\sqrt[3]{\dfrac{n_{2m^*}}{300\,\text{min}^{-1}}}} \qquad M_{2kN} = \frac{M_{2k300}}{\sqrt[3]{\dfrac{n_{2m^*}}{300\,\text{min}^{-1}}}}$$

The specified values for radial forces are based on a central application of force ($x_2 = l/2$). In the event of an off-center application of force, the permitted radial forces can be determined from the permitted break-down torque M_{2k^*} in accordance with the following formula (limit values for x_2 are specified in the table above):

$$M_{2k^*} = \frac{2 \cdot F_{2ax^*} \cdot y_2 + F_{2rad^*} \cdot (x_2 + z_2)}{1000} \leq M_{2k\,300}$$
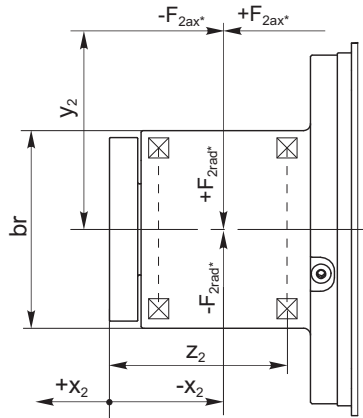
1.6.2.2　F shaft design (flange shaft)

Fig. 5: Application of force points for the flange shaft

MS design (medium bearing distance, angular contact ball bearing)

Type	z_2	x_{2min}	x_{2max}	F_{2ax300}	$F_{2rad300}$	M_{2k300}
	[mm]	[mm]	[mm]	[N]	[N]	[Nm]
PS25	154.0	-83.0	83.0	2300	11000	770
PS30	154.0	-83.0	83.0	2300	11000	770

MZ design (medium bearing distance, cylindrical roller bearing)

Type	br	z_2	x_{2min}	x_{2max}	F_{2ax300}	$F_{2rad300}$	M_{2k300}
	[mm]	[mm]	[mm]	[mm]	[N]	[N]	[Nm]
PS25	116.0	122.0	-80.0	80.0	1750	23000	943
PS25	140.0	121.0	-81.0	81.0	1750	30000	1185
PS30	116.0	122.0	-80.0	80.0	1750	23000	943
PS30	140.0	121.0	-81.0	81.0	1750	30000	1185

LZ design (longer bearing spacing, cylindrical roller bearing)

Type	z_2	x_{2min}	x_{2max}	F_{2ax300}	$F_{2rad300}$	M_{2k300}
	[mm]	[mm]	[mm]	[N]	[N]	[Nm]
PS25	186.0	-111.0	111.0	1750	30000	2235
PS30	186.0	-111.0	111.0	1750	30000	2235

For output speeds > 300 rpm, the permitted shaft loads can be calculated based on the following formulas:

$$F_{2axN} = \frac{F_{2ax300}}{\sqrt[3]{\dfrac{n_{2m^*}}{300\,min^{-1}}}}$$
$$F_{2radN} = \frac{F_{2rad300}}{\sqrt[3]{\dfrac{n_{2m^*}}{300\,min^{-1}}}}$$
$$M_{2kN} = \frac{M_{2k300}}{\sqrt[3]{\dfrac{n_{2m^*}}{300\,min^{-1}}}}$$

The specified values for radial forces are based on x_{2min} in the tables above. In the event of any other application of force, the permitted radial forces can be determined from the permitted breakdown torque M_{2k^*} in accordance with the following formula (limit values for x_2 are specified in the table above):

$$M_{2k^*} = \frac{2 \cdot F_{2ax^*} \cdot y_2 + F_{2rad^*} \cdot (x_2 + z_2)}{1000} \leq M_{2k300}$$

1.7　Additional documentation

Additional documentation related to the product can be found at
http://www.stoeber.de/en/downloads/

Enter the ID of the documentation in the Search... field.

Documentation	ID
Operating manual for PS two-speed gearboxes	442639_en
Lubricant filling quantities for gear units	441871

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3   Appendix

Table of contents

3.1   Formula symbols

The formula symbols for values actually present in the application are marked with *.

Symbol	Unit	Explanation
ccw	–	Counterclockwise direction of rotation when looking at the output shaft
cw	–	Clockwise direction of rotation when looking at the output shaft
$\Delta\phi_2$	arcmin	Backlash at the output shaft with a blocked input
$\Delta\vartheta$	K	Temperature difference
ED_{10}	%	Duty cycle based on 10 minutes
ED*	%	Actual duty cycle between 30% and 80%, relative to 10 minutes
EL	–	Mounting position
fB_T	–	Temperature operating factor
F_{1k*}	N	Static and dynamic loads present in the application from the weight of the motor, mass acceleration and vibrations at the gear unit input
F_{2ax*}	N	Actual axial force at the gear unit output
F_{2ax300}	N	Permitted axial force on the gear unit output for $n_{2m*} \le 300$ rpm
F_{2axN}	N	Permitted nominal axial force at the gear unit output
F_{2rad*}	N	Actual radial force on the gear unit output
$F_{2rad300}$	N	Permitted radial force on the gear unit output for $n_{2m*} \le 300$ rpm
F_{2radN}	N	Permitted nominal radial force at the gear unit output
i	–	Gear ratio
J_1	kgcm^2	Mass moment of inertia relative to the gear unit input
kx	µm	Concentricity of the flange centering in relation to the shaft
l_{sp}	m	Distance between the motor's center of mass and the gear unit input's center of mass
m	kg	Weight (for gear units without lubricant)
M_{1k*}	Nm	Existing breakdown torque on the gear unit input
M_{1max}	Nm	Maximum torque at the gear unit input
M_{1N}	Nm	Nominal torque at the gear unit input
M_{2eff*}	Nm	Actual effective torque on the gear unit output
M_{2k*}	Nm	Actual breakdown torque on the gear unit output
M_{2k300}	Nm	Permitted breakdown torque on the gear unit output for $n_{2m*} \le 300$ rpm
M_{2max}	Nm	Maximum torque at the gear unit output
$M_{2,n*}$	Nm	Actual torque in the n-th time segment
M_{2kN}	Nm	Permitted nominal breakdown torque at the gear unit output
M_{2N}	Nm	Nominal torque on the gear unit output (relative to n_{1N})
n_{1m*}	rpm	Actual average input speed
n_{1maxS1}	rpm	Maximum permitted input speed in S1 operation
$n_{1maxS1H}$	rpm	Maximum permitted input speed in S1 operation in a horizontal mounting position
$n_{1maxS1V}$	rpm	Maximum permitted input speed in S1 operation in a vertical mounting position
$n_{1maxS3*}$	rpm	Maximum permitted input speed in S3 operation for ED between 30% and 80%
$n_{1maxS3H}$	rpm	Maximum permitted input speed in S3 operation (ED=30%) in horizontal mounting positions
$n_{1maxS3V}$	rpm	Maximum permitted input speed in S3 operation (ED=30%) in vertical mounting positions
n_{1maxV}	rpm	Maximum permitted input speed in vertical mounting positions
n_{1N}	rpm	Nominal speed at the gear unit input
n_{2m*}	rpm	Actual average output speed
$n_{2m,n*}$	rpm	Actual average output speed in the n-th time segment
pl	µm	Axial runout of the flange mounting surface in relation to the shaft
$P_{N,GB}$	kW	Nominal power of the two-speed gearbox
$q_{v,lub}$	l/min	Flow rate in the case of circulating lubrication
r	µm	Radial runout of the shaft end
S1	–	Continuous operation at a constant load (ED=100%)
S3	–	Periodic cyclic operation (ED=30%)

Symbol	Unit	Explanation
$t_{1*} - t_{n*}$	s	Duration of the respective time segment
ϑ_{amb}	°C	Surrounding temperature
ϑ_{lub1}	°C	Temperature at the supply connection of the cooling unit
ϑ_{lub2}	°C	Temperature at the return connection of the cooling unit
v_{swS}	mm/s	Oscillation speed in an angular contact ball bearing design (RMS value)
v_{swRZ}	mm/s	Oscillation speed in a cylindrical roller bearing design (RMS value)

3.2   Sales terms and delivery conditions

You can find our current sales terms and delivery conditions at http://www.stoeber.de/en/gtc.

3.3   Publication details

Catalog Two-speed gearboxes, ID 442712_en.

You can find current versions of PDF files online at http://www.stoeber.de/en/downloads/.

Symbol	Unit	Explanation
$t_{1*} - t_{n*}$	s	Duration of the respective time segment
ϑ_{amb}	°C	Surrounding temperature
ϑ_{lub1}	°C	Temperature at the supply connection of the cooling unit
ϑ_{lub2}	°C	Temperature at the return connection of the cooling unit
v_{swS}	mm/s	Oscillation speed in an angular contact ball bearing design (RMS value)
v_{swRZ}	mm/s	Oscillation speed in a cylindrical roller bearing design (RMS value)