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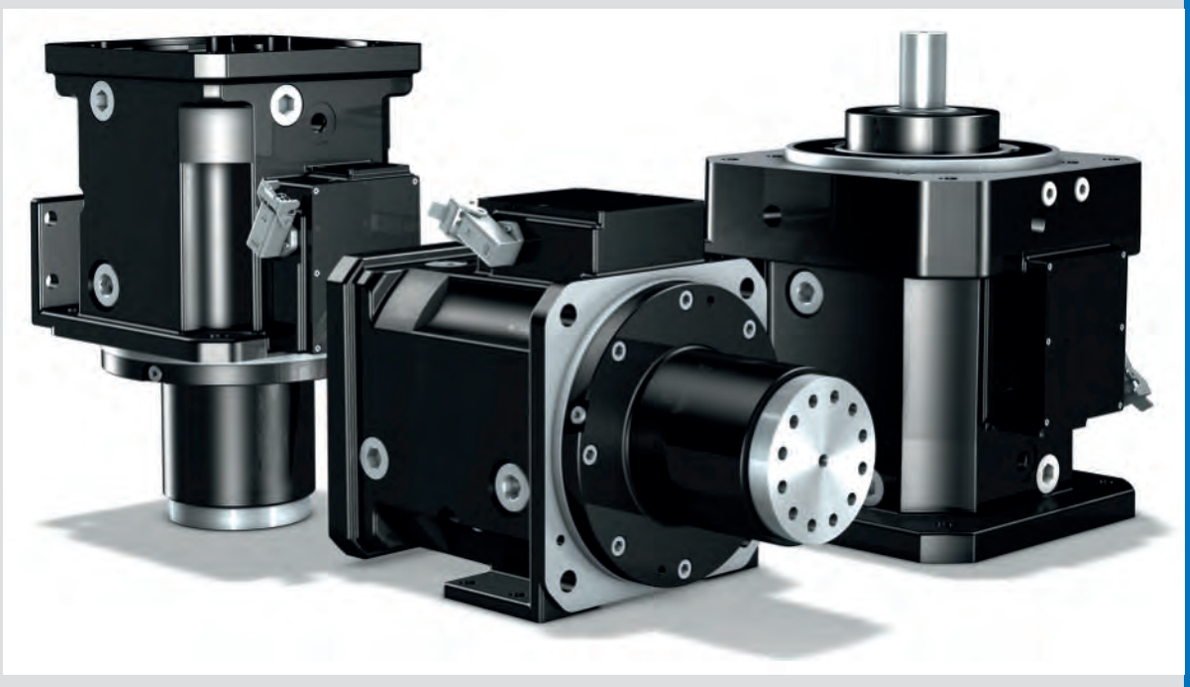
STÖBER

Two-speed gearboxes

PS



POWER 2 SPEED

Product catalog

PS two-speed gearboxes

STOBER, decades of innovative drive technology

STÖBER ANTRIEBSTECHNIK has a long drive-related tradition. The family-owned company was founded in Pforzheim, Germany in 1934.

As a service-oriented, worldwide system provider, STOBER is one of the innovators in digital drive technology.

STOBER IN MOTION

That very special spirit

A top-level production strategy gives rise to the highest level of product reliability

In demanding applications, you need to be able to depend on strength, smooth operation, repeatability and maximum stability.

This established level of product quality is ensured by the highly skilled employees at STOBER who have access to state-of-the-art machines and workstations.

STÖBER

1 PS two-speed gearboxes

Table of contents

1.1 Overview

PS two-speed gearboxes with loss-optimized direct drive

Technical data

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

Features

Designed for main feed drives on machine tools	✓
Fast changeover between high speed and high torque	✓
High-precision, helical planetary gear unit	✓
Direct drive or neutral gear position optimized to reduce loss (optional)	✓
Flange shaft or solid shaft	✓
Splash lubrication or circulating lubrication (optional)	✓
Integrated actuator control system with SensorShift (optional with electronic sensor)	✓
Oil sight glass or oil level gauge (optional)	✓
Easy and reliable attachment to any main feed motor	✓

1.2 Selection tables

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

Formula symbol	Unit	Explanation
ED	%	Duty cycle relative to 10 minutes
ED*	%	Actual duty cycle between 30% and 80%, relative to 10 minutes
EL	–	Installation position
i	–	Gear ratio
J_1	$10^{-4}kgm^2$	Mass moment of inertia relative to the gearbox input
m	kg	Weight
M_{1max}	Nm	Maximum torque at the gear unit input
M_{1N}	Nm	Nominal torque at the gear unit input
M_{2max}	Nm	Maximum torque at the gear unit output
M_{2N}	Nm	Nominal torque at the gear unit output (relative to n_{1N})
n_{1maxS1}	rpm	Maximum permitted input speed in S1 operation
$n_{1maxS1H}$	rpm	Maximum permitted input speed in S1 operation in a horizontal installation position
$n_{1maxS1V}$	rpm	Maximum permitted input speed in S1 operation in a vertical installation 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 installation positions
$n_{1maxS3V}$	rpm	Maximum permitted input speed in S3 operation (ED=30%) in vertical installation positions
n_{1maxV}	rpm	Maximum permitted input speed in vertical installation positions
n_{1N}	rpm	Nominal speed at the gear unit input
$P_{N,GB}$	kW	Nominal power of the two-speed gearbox
S1	–	Continuous operation at a constant load (ED=100%)
S3	–	Periodic intermittent duty (ED=30%)
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)
$\Delta\varphi_2$	arcmin	Backlash at the output shaft with a blocked input

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.

$$n_{1max\,S3*} = \frac{n_{1max\,S1} - n_{1max\,S3}}{50} \cdot (ED * -30) + n_{1max\,S3}$$

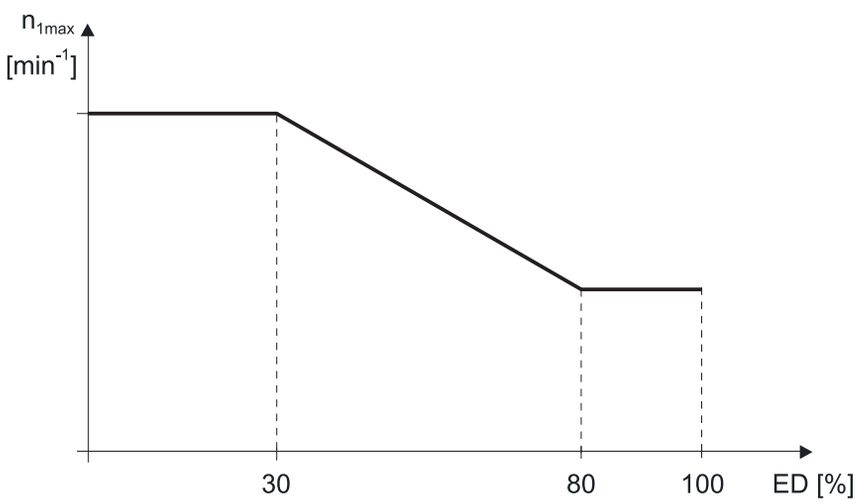


Fig. 1: Maximum speeds in S3 operation

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

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

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

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

Maximum speeds with circulating lubrication system

Type	i	$n_{1maxS1H}$ EL1, EL3, EL4 S1 [min⁻¹]	$n_{1maxS1V}$ EL5, EL6 S1 [min⁻¹]	$n_{1maxS3H}$ EL1, EL3, EL4 S6 [min⁻¹]	$n_{1maxS3V}$ EL5, EL6 S6 [min⁻¹]
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 [▷ 1.5.7.2].

1.2.2 Torques

Type	i	$P_{N,GB}$ [kW]	M_{1N} [Nm]	M_{2N} [Nm]	M_{1max} [Nm]	M_{2max} [Nm]
PS2501_0040 ME	4.0	47	300	1200	400	1600
–	1.0	47	300	300	400	400
PS2501_0055 ME	5.5	47	250	1375	400	2200
–	1.0	47	250	250	400	400
PS3001_0040 ME	4.0	47	300	1200	400	1600
–	1.0	47	300	300	400	400
PS3001_0055 ME	5.5	47	250	1375	400	2200
–	1.0	47	250	250	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 10^{-4} [kgm²]	m [kg]	$\Delta\varphi_2$ [arcmin]	v_{swS} [mm/s]	v_{swRZ} [mm/s]
PS25	82	86	30/20	1	1.4
PS30	82	95	30/20	1	1.4

P shaft design (solid shaft with two feather keys)

Type	J_1 10^{-4} [kgm²]	m [kg]	$\Delta\varphi_2$ [arcmin]	v_{swS} [mm/s]	v_{swRZ} [mm/s]
PS25	85	86	30/20	1	1.4
PS30	85	95	30/20	1	1.4

F shaft design (flange shaft)

Type	J_1 10^{-4} [kgm²]	m [kg]	$\Delta\varphi_2$ [arcmin]	v_{swS} [mm/s]	v_{swRZ} [mm/s]
PS25	120	86	30/20	1	1.4
PS30	120	95	30/20	1	1.4

The mass moment of inertia J_1 applies to both directly and indirectly driving the respective shaft design.

The vibration speed v_{sw} has been determined in accordance with DIN ISO 10816-1 under the following test conditions: n_1 = 5000 rpm, 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.

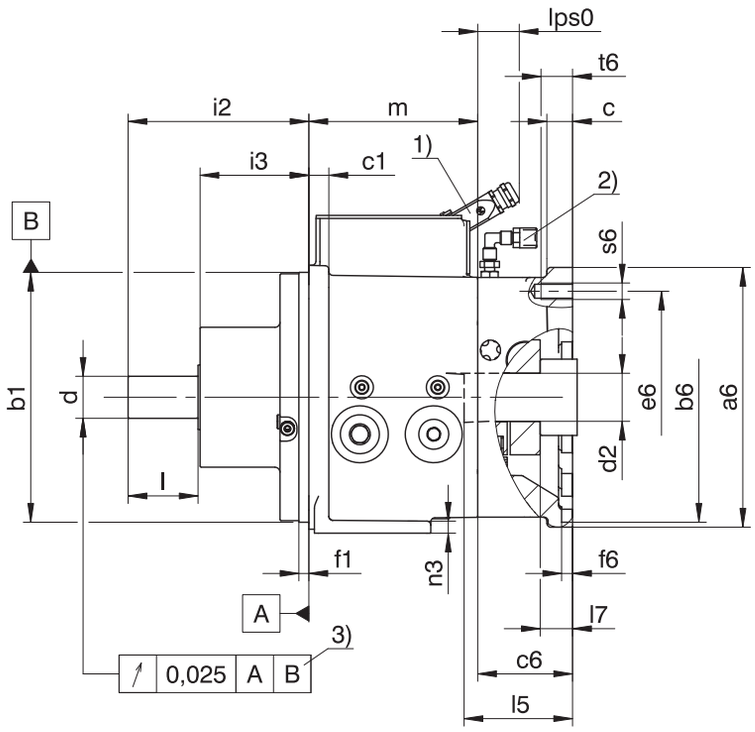
We reserve the right to make dimensional changes due to ongoing technical development.

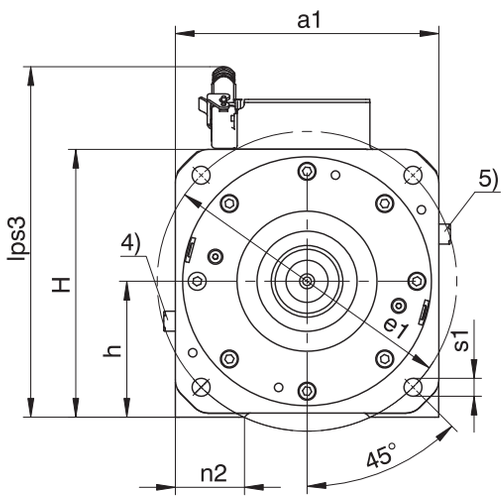
You can download CAD models of our standard drives at http://cad.stoeber.de.

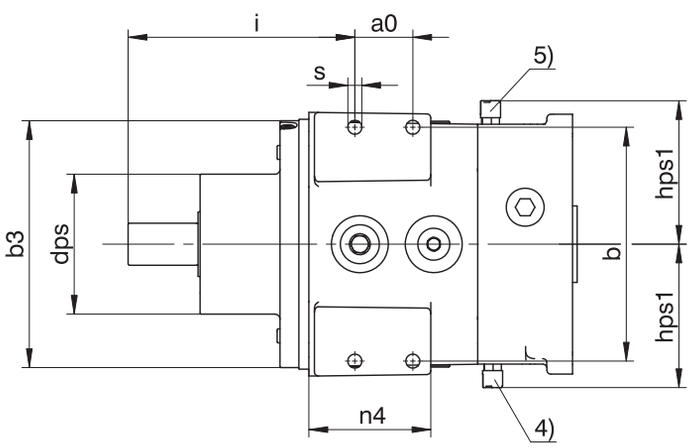
Centering holes in solid shafts in accordance with DIN 332-2, shape DR

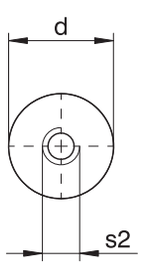
Thread size	M4	M5	M6	M8	M10	M12	M16	M20	M24
Thread depth	10	12.5	16	19	22	28	36	42	50

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 installation position EL5, not angled in installation position EL1
3	Only applies to an S bearing design	4	Air release valve only for circulating lubrication and installation position EL4
5	Air release valve only for circulating lubrication and installation position EL3		

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S bearing 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

S bearing design (long bearing distance)

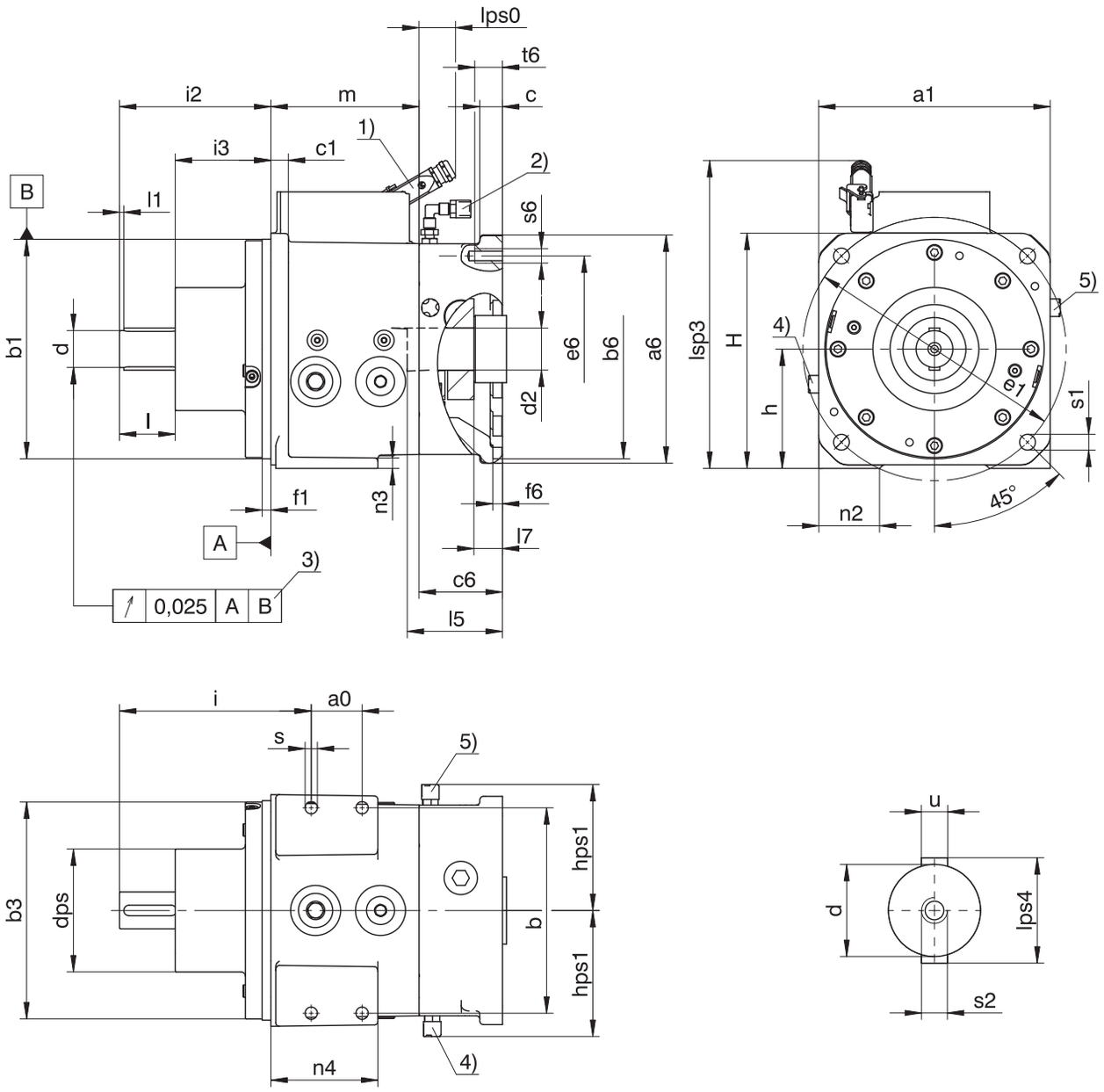
Type	Ød	a0	□a1	b	Øb1	Øb3	c1	Ødps	Øe1	f1	h	H	i	i2	i3	l	lps0	lps3	m	n2	n3	n4	s	Øs1	s2
PS25	42_{k6}	58	264	234	250_{h6}	247	20	140	300	10	136	268	267	221	149	70	41	350	169	69	12.0	122	14	18	M10
PS25	55_{m6}	58	264	234	250_{h6}	247	20	140	300	10	136	268	307	261	149	110	41	350	169	69	12.0	122	14	18	M12
PS30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

Typ	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 installation position EL5, not angled in installation position EL1
3	Only applies to an S bearing design	4	Air release valve only for circulating lubrication and installation position EL4
5	Air release valve only for circulating lubrication and installation position EL3		

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S bearing 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

S bearing design (long bearing distance)

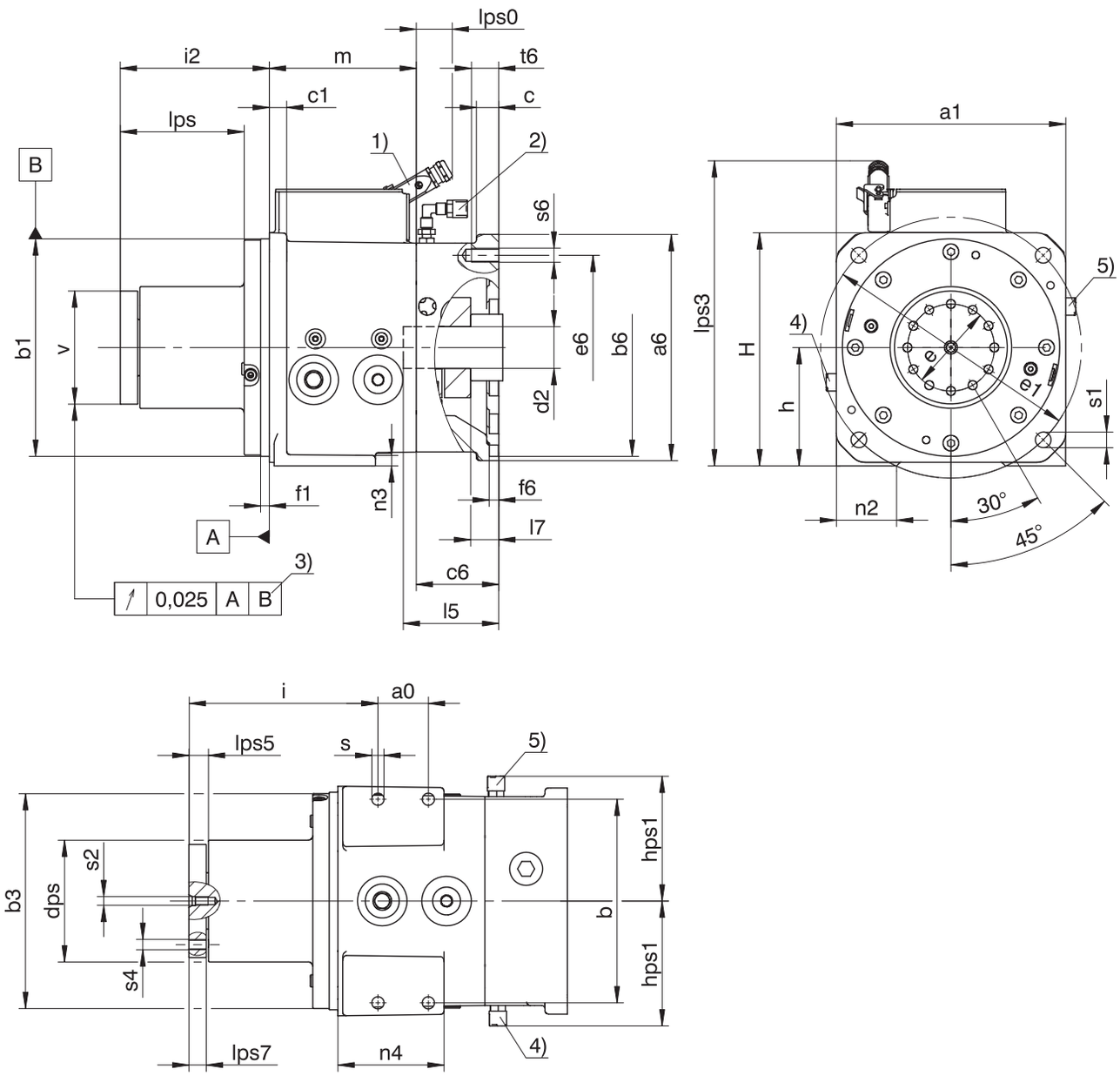
Type	Ød	a0	□a1	b	Øb1	Øb3	c1	Ødps	Øe1	f1	h	H	i	i2	i3	l	l1	lps0	lps3	lps4	m	n2	n3	n4	s	Øs1	s2	u
PS25	42_{k6}	58	264	234	250_{h6}	247	20	140	300	10	136	268	267	221	149	70	3	41	350	48	169	69	12.0	122	14	18	M10	A12x8x63
PS25	55_{m6}	58	264	234	250_{h6}	247	20	140	300	10	136	268	307	261	149	110	10	41	350	63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

Typ	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

1.3.3 F shaft design (flange shaft)



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 installation position EL5, not angled in installation position EL1
3	Only applies to an S bearing design	4	Air release valve only for circulating lubrication and installation position EL4
5	Air release valve only for circulating lubrication and installation position EL3		

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S bearing design (long bearing distance)

Type	Øv	a0	□a1	b	Øb1	Øb3	c1	Ødps	Øe	Øe1	f1	h	H	i	i2	lps	lps0	lps3	lps5	lps7	m	n2	n3	n4	s	Øs1	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 bearing design (long bearing distance)

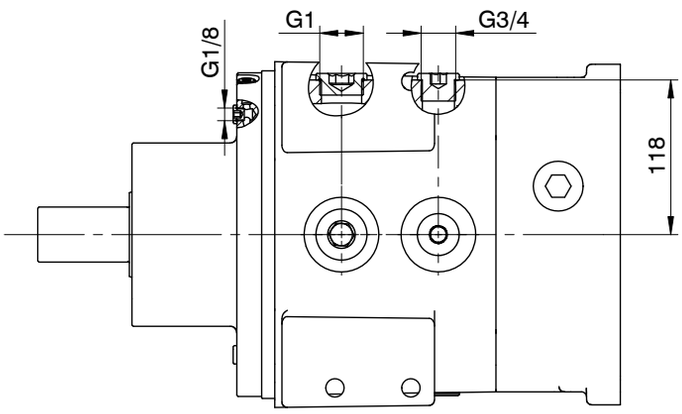
Type	Øv	a0	□a1	b	Øb1	Øb3	c1	Ødps	Øe	Øe1	f1	h	H	i	i2	lps	lps0	lps3	lps5	lps7	m	n2	n3	n4	s	Øs1	s2	s4
PS25	130_{k6}	58	264	234	250_{h6}	247	20	140	100	300	10	136	268	282	236	207	41	350	22.5	20	169	69	12.0	122	14	18	M10	M12
PS30	130_{k6}	58	320	290	250_{h6}	247	20	140	100	350	10	164	324	282	236	207	41	380	22.5	20	169	62	17.5	122	14	18	M10	M12

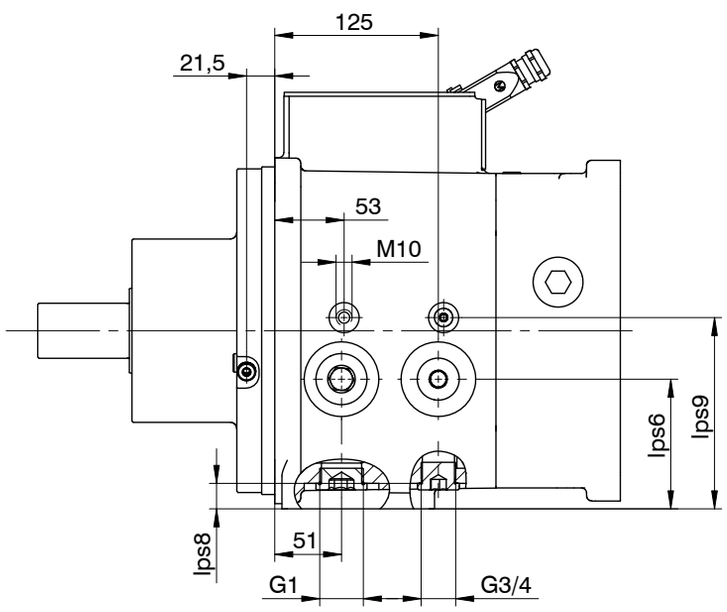
Motor connection dimensions

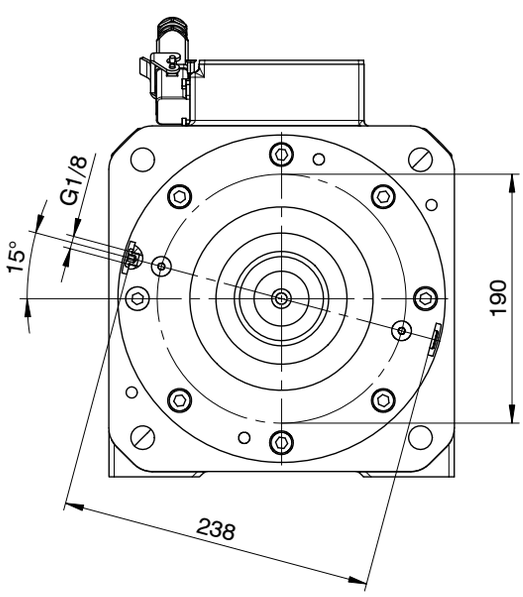
Typ	Øb6	Ød2	□e6	$l5_{max}$	□a6	c	c6	f6	hps1	l7	Øs6	t6
PS25	230^{H7}	42/48/55	265	112	250	24.5	95	11	141.5	31	M12	32.0
PS30	230^{H7}	42/48/55	265	112	250	24.5	95	11	141.5	31	M12	32.0
PS25	250^{H7}	42/48/55	300	112	260	24.5	95	11	141.5	31	M16	32.0
PS30	250^{H7}	42/48/55	300	112	260	24.5	95	11	141.5	31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

1.3.4 Connection for lubrication







Type	lps6	lps8	lps9
PS25	99	19.5	146
PS30	127	46.0	174

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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 30	Size	25 30
0	Generation	Generation 0
1	Stages	1-stage
S **M** L	Housing	Short bearing distance Medium bearing distance Long bearing distance
F G P	Shaft	Flange shaft Solid shaft without feather key Solid shaft with two feather keys
R S **Z**	Bearing	Deep-groove ball bearing Angular contact ball bearing Cylindrical roller bearing
0400	Transmission ratio (i x 10)	i = 4 (example)
ME	Attachment groups	Motor adapter with EASY-Adapt coupling

In order to complete the type designation, also specify:

- Installation position, see 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 Chapter [▷ 1.3]
- Default backlash or reduced backlash (optional)
- Switching unit with microswitches or SensorShift (optional with electronic sensor), see Chapter [▷ 1.5.8.2]
- Switching unit with neutral position (optional)?
- Switching unit with built-in varistor (optional for switching unit with microswitches)?
- 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
Shock load	≤ 5 g

1.5.3 Installation conditions

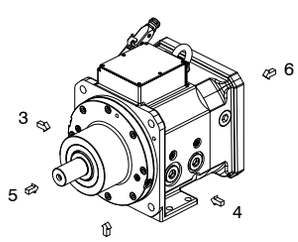
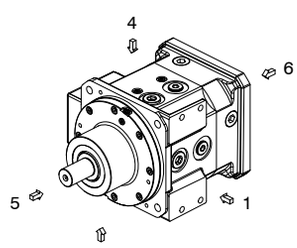
The torques and forces specified only apply for the attachment of the two-speed gearbox on the machine side using screws of quality 10.9. In addition, the two-speed gearbox housing must be adjusted at the pilot (H7).

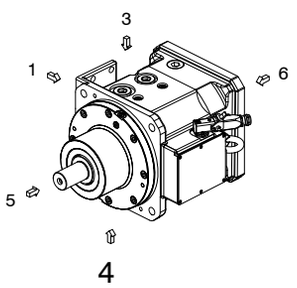
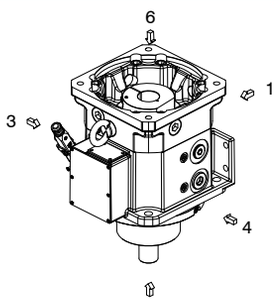
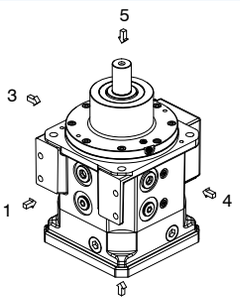
If you are installing the two-speed gearbox only at the base mount and not through the use of a flange, the attached motor must be installed on the base mount of the motor.

1.5.4 Installation positions

The following table shows the standard installation positions.

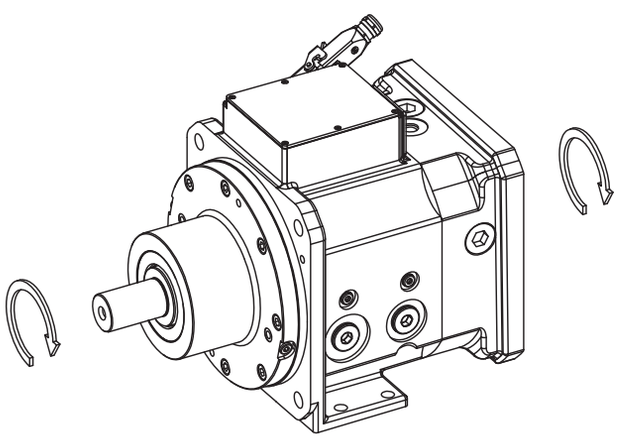
The numbers indicate the sides of the two-speed gearbox. The installation position is defined by the side of the two-speed gearbox that is facing downward.

EL1	EL2	EL3
 1	Not permitted	 3

EL4	EL5	EL6
		

1.5.5 Direction of rotation

The input and output turn in the same direction.



1.5.6 Motor requirements

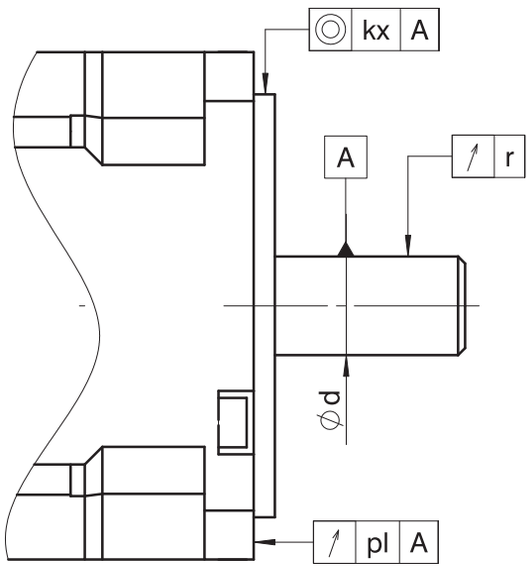
This chapter contains the requirements for the motor attached to the two-speed gearbox by the machine manufacturer. Select a motor with a smooth shaft; a feather key groove in the motor shaft has a negative effect on smooth operation.

1.5.6.1 Tolerances

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

Tolerance for radial runout, axial runout and concentricity in accordance with IEC 60072-1 (precision class)

Formula symbol	Unit	Explanation
kx	µm	Concentricity of the flange centering in relation to the shaft
pl	µm	Axial runout of the flange mounting surface in relation to the shaft
r	µm	Radial runout of the shaft end



Formula symbols	Tolerance
r	25 µm
kx	63 µm
pl	63 µm

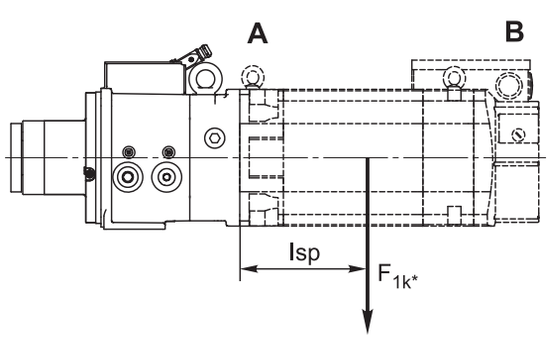
Fit tolerances in accordance with EN ISO 286-1

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.

Formula symbol	Unit	Explanation
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
lsp	m	Distance between the motor's center of mass and the gear unit input's center of mass
M_{1k*}	Nm	Existing breakdown torque on the gear unit input



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 base mount (IMB35 design) or use a tension-free means of supporting it on the B side. The motor must also be installed on its base mount if you do not use a flange to install the two-speed gearbox and instead only install it at the base 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.

Formula 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
$\Delta\vartheta$	K	Temperature difference
$q_{v,lub}$	l/min	Flow rate in the case of circulating lubrication
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

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 installation position. You can find the oil fill volume on the nameplate for your two-speed gearbox and in the document with ID 441871 (see 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 installation position of the two-speed gearbox in the machine. You can find the position of the filling and draining connections in the next chapter.

Installation 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	Not permitted for splash lubrication	

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). In addition, this enables operation of the two-speed gearbox in installation position EL6.

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.

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

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 installation position of the two-speed gearbox. You can find more details in Chapter [▶ 1.3].

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

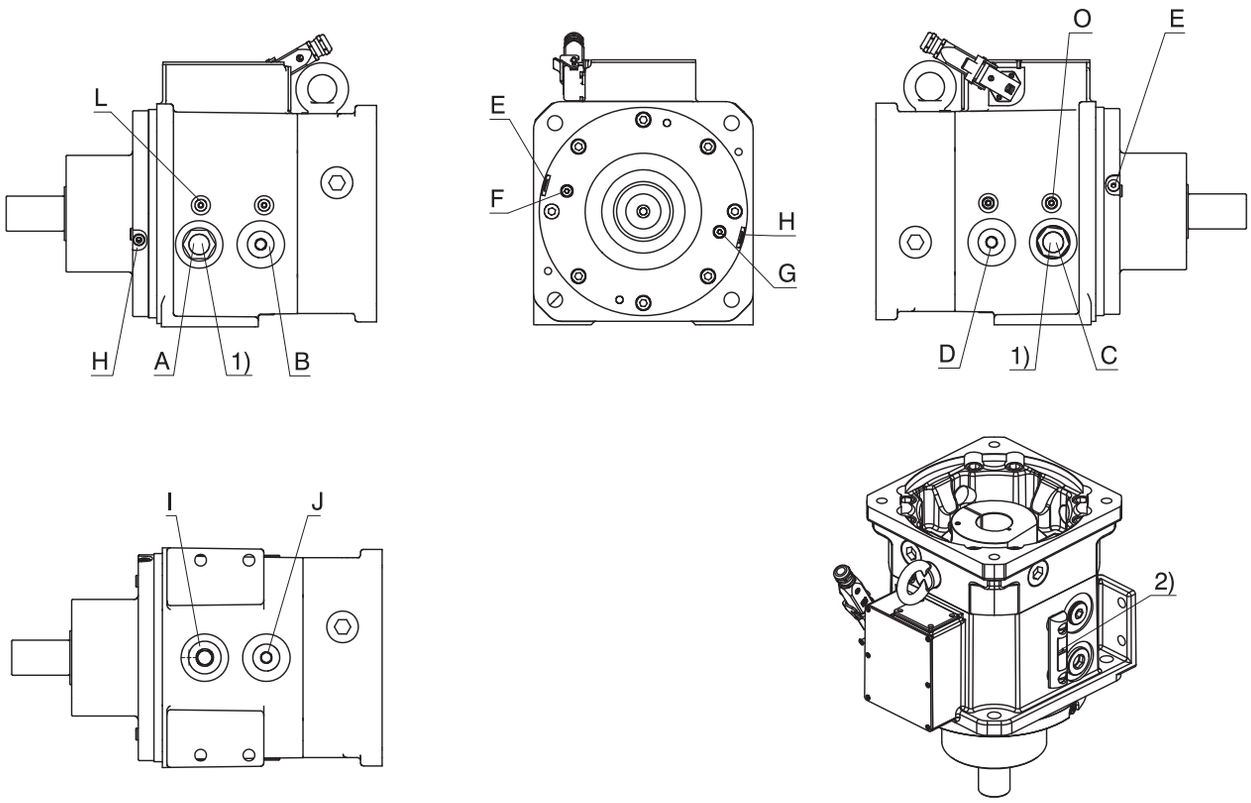


Fig. 2: Position of the connections

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 installation positions.
- The flow rate for the return must always be slightly higher than the total flow rate for the supply.

Installation 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	E/F/G/H	≥ 3	–	–	A/C/I	> 3

Tab. 2: Volume flows 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 ϑ_{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

1.5.8 Switching unit

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 switching unit is available in two versions which are described below.

1.5.8.1 Version with microswitches

In the standard version, the position of the actuator is determined using microswitches. The machine control system has to analyze these signals in realtime and activate the switching motor accordingly.

For the version with microswitches, we recommend also ordering an optional (built-in) varistor. The varistor is used to reduce inductive voltage peaks when switching off the switching motor. This increases the service life of the relay switching contacts and reduces interference with the electronic components that are present. Alternatively, you can connect a S14K35 type varistor (or similar) in parallel with the connections of the switching motor.

You can find the electrical connection values of the switching unit in the following table. Keep the following information in mind:

- The specified nominal switching motor voltage has to be applied directly at the switching motor connections. Therefore, in setting up the power supply, take into account the voltage losses in the lines, the contact resistance values and the increased resistance over time as a result of corrosion.
- The microswitches must be energized only by the control current and not by current from the switching motor.

Feature	Value
Switching motor nominal voltage	24 V DC ± 10%
Switching motor nominal current	0.6 A
Switching motor starting current	2.76 A
Microswitch nominal voltage	24 V DC
Microswitch nominal current	1 A

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

1.5.8.2 Version with SensorShift (electronic sensor)

Optionally, the position of the actuator can be determined with SensorShift (an electronic sensor). An actuator control system integrated into the switching unit analyzes the position signals and precisely activates the switching motor.

The version with SensorShift and integrated actuator control system has the following advantages compared to the version with microswitches:

- No need for a customer-side relay or wiring in the control cabinet
- Significant reduction in 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
- Ability to shift into neutral (optional) from any gear

The version with SensorShift has connections that make it compatible with the standard version with microswitches. 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 binary inputs	0 – 8 V DC
High-level binary inputs	12 – 30 V DC
Input current for binary inputs	< 10 mA
Debounce time for binary 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. The following formula symbols are used for this.

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

Formula symbol	Unit	Explanation
F_{2ax*}	N	Actual axial force on the gear unit output
F_{2ax300}	N	Permitted axial force on the gear unit output for $n_{2m*} \leq 300$ rpm
F_{2axN}	N	Permitted nominal axial force on 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 $n_{2m*} \leq 300$ rpm
F_{2radN}	N	Permitted nominal radial force on the gear unit output
fB_T	–	Temperature service factor
M_{2eff*}	Nm	Actual effective torque on the gear unit output
M_{2max}	Nm	Maximum torque at the gear unit output
$M_{2,n*}$	Nm	Actual torque in the n-th time segment
M_{2k*}	Nm	Actual breakdown torque on the gear unit output
M_{2k300}	Nm	Permitted breakdown torque on the gear unit output for $n_{2m*} \leq 300$ rpm

Formula symbol	Unit	Explanation
M_{2kN}	Nm	Permitted nominal breakdown torque on the gear unit output
n_{1m*}	rpm	Actual average input speed
$n_{1maxS1H}$	rpm	Maximum permitted input speed in S1 operation in a horizontal installation position
$n_{1maxS1V}$	rpm	Maximum permitted input speed in S1 operation in a vertical installation position
n_{2m*}	rpm	Actual average output speed
$n_{2m,n*}$	rpm	Actual average output speed in the n-th time segment
$t_{1*} - t_{n*}$	s	Duration of the respective time segment

1.6.1 Permitted speeds and torques

Maximum speeds and torques specified in Chapter [▷ 1.2] have to 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 installation position EL1, EL3 or EL4:

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

For installation position EL5 or EL6:

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

ϑ_{amb}	fB_T
≤ 20 °C	1.0
≤ 30 °C	1.1
≤ 40 °C	1.2

Tab. 3: Surrounding temperature service factor

S3 operation

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

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

For installation position EL5 or EL6: $n_{1m*} < n_{1maxS3V}$.

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

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

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

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.

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

The calculations are based on a representation of the power taken from the output in accordance with the following figure.

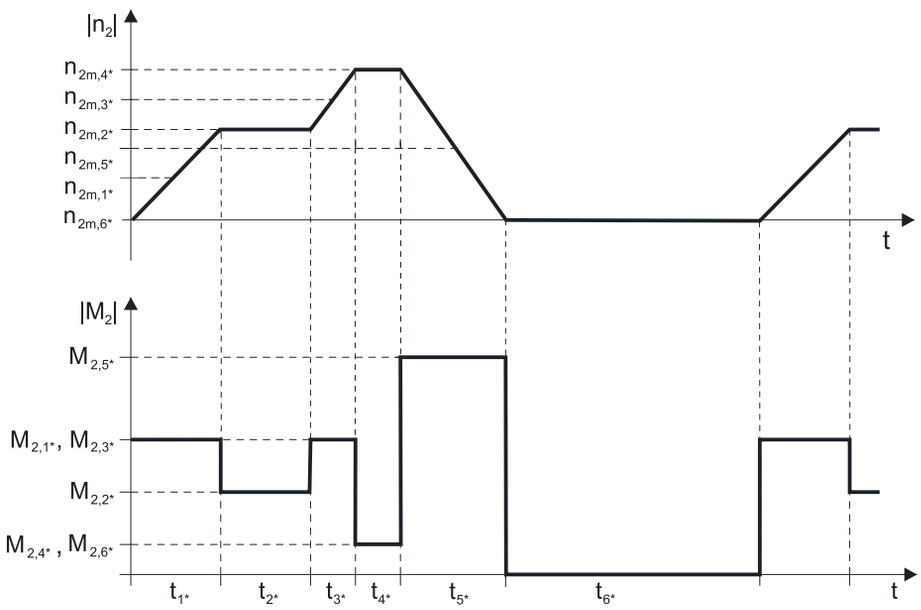


Fig. 3: Example of a cycle sequence in S3 operation

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 shear 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)

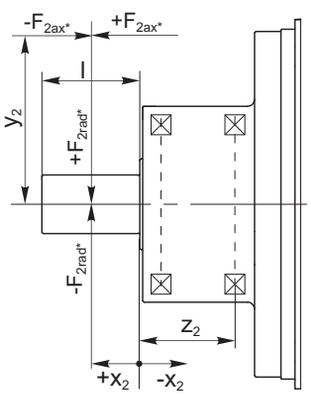


Fig. 4: Force application points for the solid shaft

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

Type	z_2 [mm]	x_{2min} [mm]	x_{2max} [mm]	F_{2ax300} [N]	$F_{2rad300}$ [N]	M_{2k300} [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 [mm]	x_{2min} [mm]	x_{2max} [mm]	F_{2ax300} [N]	$F_{2rad300}$ [N]	M_{2k300} [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 [mm]	x_{2min} [mm]	x_{2max} [mm]	F_{2ax300} [N]	$F_{2rad300}$ [N]	M_{2k300} [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 [mm]	x_{2min} [mm]	x_{2max} [mm]	F_{2ax300} [N]	$F_{2rad300}$ [N]	M_{2k300} [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:

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

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 breakdown torque M_{2k^*} in accordance with the following formula (limit values for x_2 are specified in the table above):

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

1.6.2.2 F shaft design (flange shaft)

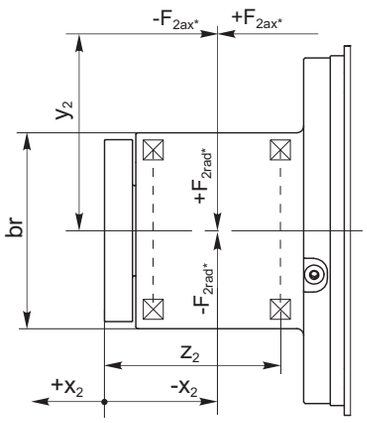


Fig. 5: Application of force points for the flange shaft

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

Type	z_2 [mm]	x_{2min} [mm]	x_{2max} [mm]	F_{2ax300} [N]	$F_{2rad300}$ [N]	M_{2k300} [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 [mm]	z_2 [mm]	x_{2min} [mm]	x_{2max} [mm]	F_{2ax300} [N]	$F_{2rad300}$ [N]	M_{2k300} [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 [mm]	x_{2min} [mm]	x_{2max} [mm]	F_{2ax300} [N]	$F_{2rad300}$ [N]	M_{2k300} [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:

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

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):

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

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1.7 More documentation

More documentation concerning the product can be found at http://www.stoeber.de/en/download

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

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

1.8 Service

1.8.1 Sales terms and delivery conditions

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

1.8.2 Close to customers around the world

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1.8.3 Publication details

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STOBER PRODUCT RANGE

Geared motors	**EZ synchronous servo geared motors (ID 442437_de)**
	Planetary geared motors
	Right-angle planetary geared motors
	Helical geared motors
	Offset helical geared motors
	Helical bevel geared motors
	Helical worm geared motors
	ED/EK synchronous servo geared motors (ID 441712)
	Planetary geared motors
	Right-angle planetary geared motors
	Helical geared motors
	Offset helical geared motors
	Helical bevel geared motors
	Helical worm geared motors
	IE2D asynchronous geared motors (ID 442356)
	Helical geared motors
	Offset helical geared motors
	Helical bevel geared motors
	Helical worm geared motors
	D asynchronous geared motors (ID 441809)
	Helical geared motors
	Offset helical geared motors
	Helical bevel geared motors
	Helical worm geared motors
Electronics	**Drive controllers/control system**
	MC6 motion controllers (ID 442711_de)
	SI6 drive controllers (ID 442711_de)
	SD6 drive controllers (ID 442711_de)
	SDS 5000 servo inverters (ID 442711_de)
	MDS 5000 servo inverters (ID 442711_de)
	MDS 5000 frequency inverters (ID 442356)
	FDS 5000 frequency inverters (ID 442356)
Gear units	**Servo gear units (ID 442257)**
	Planetary gear units
	Right-angle planetary gear units
	Helical gear units
	Offset helical gear units
	Helical bevel gear units
	Helical worm gear units
	Power transmission gear units (ID 441834)
	Helical gear units
	Offset helical gear units
	Helical bevel gear units
	Helical worm gear units
	Two-speed gearboxes (ID 442712_de)
	Two-speed gearboxes
Motors	
	EZ synchronous servo motors (ID 442437_de/442711_de)
	EZHD synchronous servo motors with hollow shaft (ID 442437_de/442711_de)
	EZHP synchronous servo geared motors with hollow shaft (ID 442437_de/442711_de)
	EZS/EZM synchronous servo motors for screw drives (ID 442437_de/442711_de)
	ED/EK synchronous servo motors (ID 441712)
	IE2D asynchronous motors (ID 442356)
	D asynchronous motors (ID 441809)
Rack and pinion drives	
	ZTRS/ZTR/ZR rack and pinion drives (ID 442225)
	ZV rack and pinion drives (ID 442506)

ID 442712_en.03

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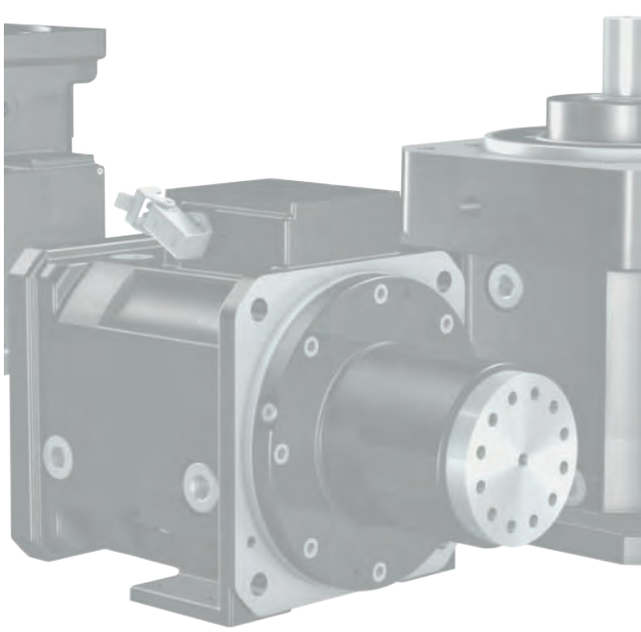

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