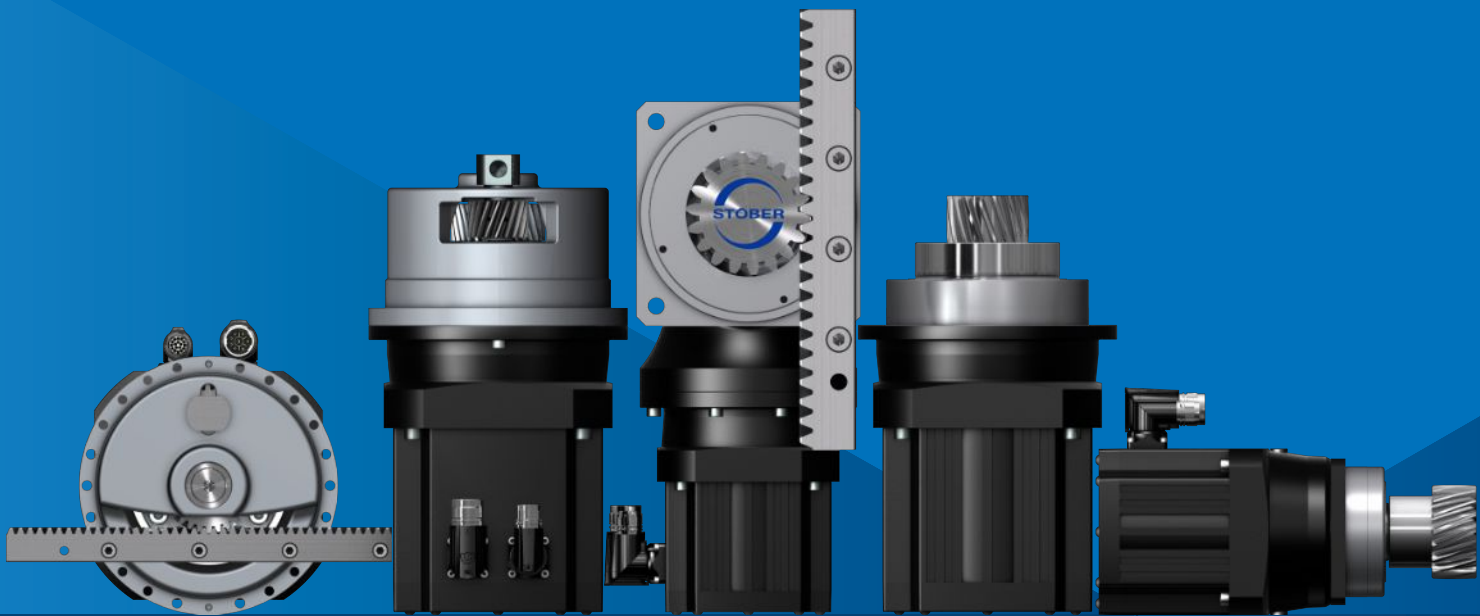


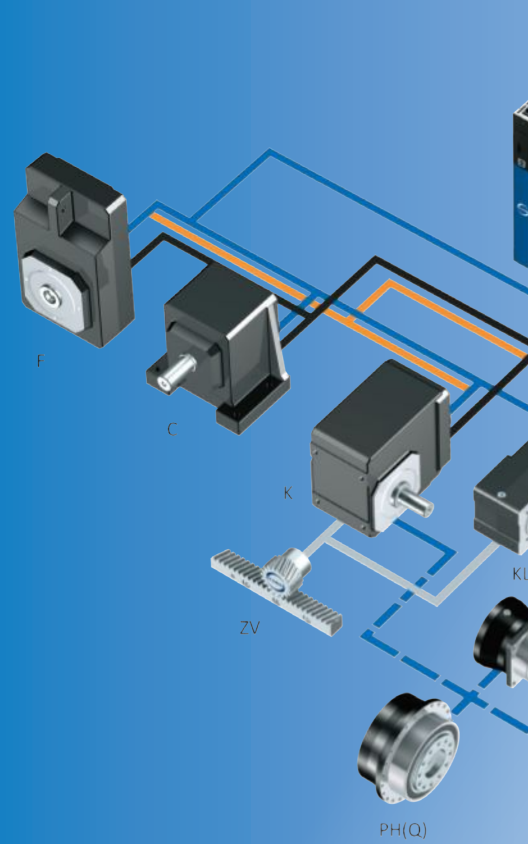
Rack and pinion drives with synchronous servo motors

STÖBER

Rack and pinion drives with synchronous servo motors

One partner. All the possibilities.

STOBER has developed and produced excellent drive technology since 1934 and is active internationally with around 1000 employees at 14 locations. STOBER impresses machine manufacturers in wide-ranging industries and markets around the world with tailor-made, highly efficient drive systems for demanding movements.



"Together with our customers, we achieve perfect motion in a wide variety of applications with our precisely coordinated system. Whenever precision, dynamics and quality are required, we are at your side as a reliable partner."

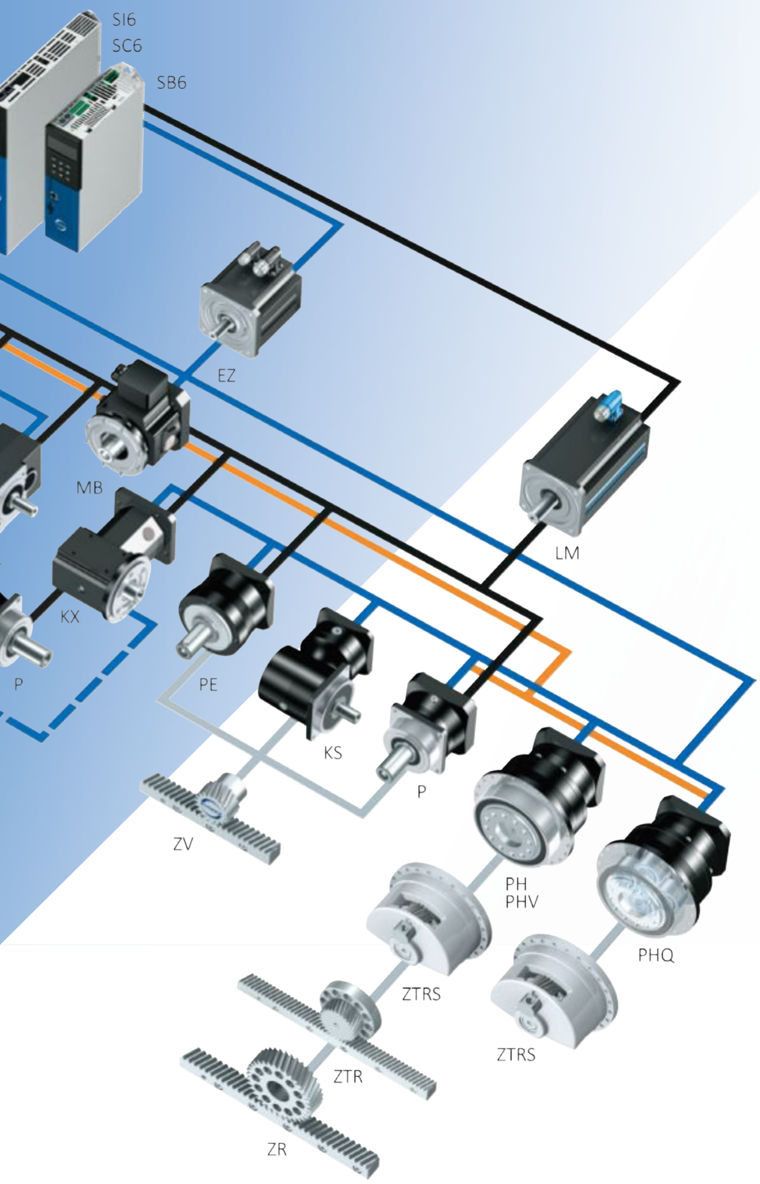
Rainer Wegener, Chief Executive Officer, STÖBER Antriebstechnik

Rack and pinion drives with synchronous servo motors – here's what you get!

From full rotation to linear motion: With its innovative system concept for rack and pinion drives, STOBER has developed a compact, reliable, and easy-to-use system that is precisely tailored to meet the demands of machine tool, automation, and robotics applications. By combining this with our planetary or helical bevel gearboxes and STOBER synchronous servo motors, you get the benefits of extremely compact, highly dynamic drive solutions. It's impossible to be more flexible!

At home in the world of demanding motion

Gearboxes
Geared motors
Motors
Cables and drive controllers



Everything from a single source.

The STOBER drive system consisting of gearboxes, motors, cables and drive controllers has a modular design and is freely scalable—for tailor-made, compact and powerful machine concepts. It can be adapted to your individual requirements and combined as needed in nearly all industries and applications areas.

We check every single component and how it works together with others, taking on the responsibility for the complete drive train. For you, this means that one contact partner, certified operating safety and maximum availability are guaranteed.

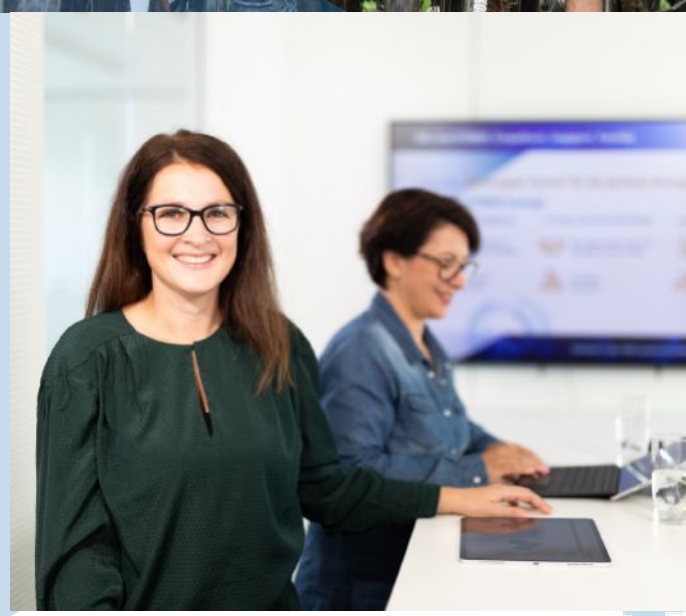
Need special solutions?

Numerous one-of-a-kind product highlights and project-related adjustments make it possible. With a holistic approach to your specific task, we work together on individualized solutions that are optimally co-ordinated to your requirements. Dedicated and solution-oriented in the support of your visions and projects.

STOBER moves integrally and precisely.

"Versatile products, countless possibilities. Your perfect motion is what drives us!"

Markus Graf, Chief Sales Officer, STÖBER Antriebstechnik



STOBER moves as a team and with personality.

As a family-owned company, it is very important to us to maintain close relationships and treat each other with trust. We put people first.

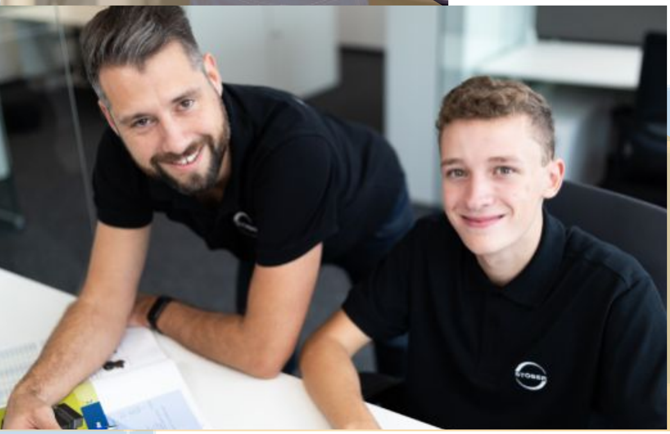
We are committed to the well-being of our employees, identify with the expectations of our customers, and show personal commitment to mutual success.

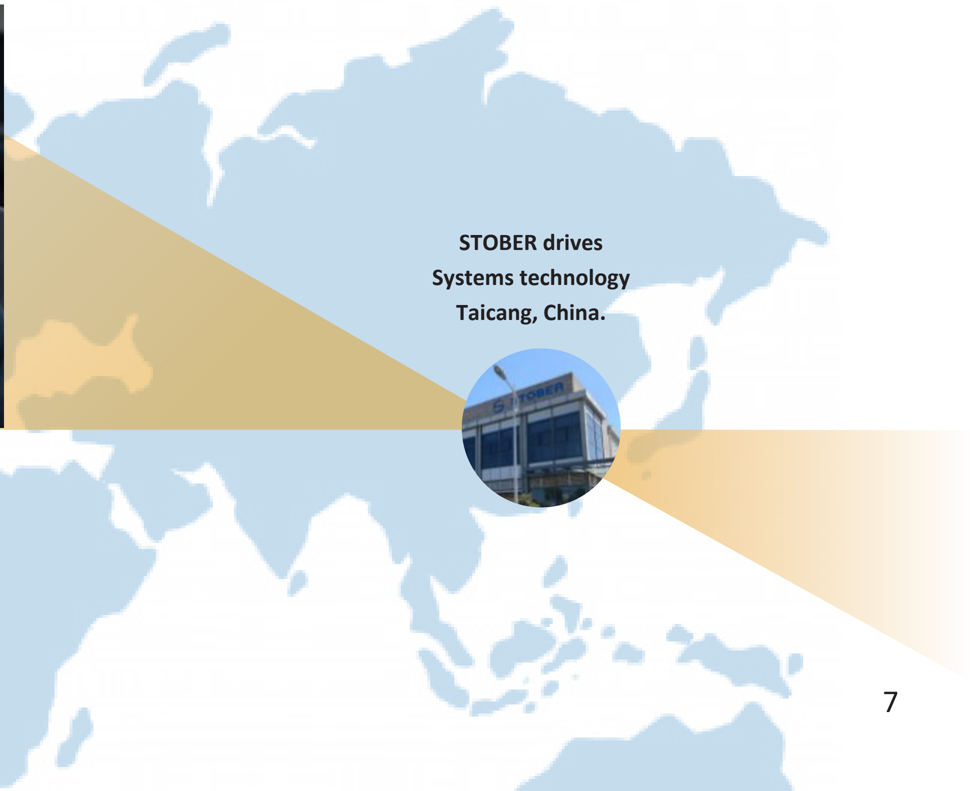
"We have installed gearboxes, motors and drive controllers from STOBER in nearly all our systems. STOBER supports us in new projects from the first stroke of a pencil in the design phase until commissioning. Our years of cooperation are shaped by openness and honesty and emanate a rather special spirit. The technical consulting, the support—that is real, experienced partnership"

Jürgen Leicht, Managing Partner of Leicht Stanzautomation

Working together. Worldwide. Successfully.

With an eye to the future, STOBER is facing the challenges of digitalization and investing in integrated solutions and a strong global presence in production, sales and service. STOBER China was founded at the end of 2019. As a result, we are present in more than 40 countries around in the world at 14 locations and with 80 service partners.





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1 Selection tool

1.1 Rack and pinion drives with synchronous servo motors

     

Product chapter	ZTRSPH	ZTRSPHQ	ZTRSPHV	ZTRPH	ZTRPHV	ZRPH
Chapter number	[▸ 2]	[▸ 3]	[▸ 4]	[▸ 5]	[▸ 6]	[▸ 7]

Technical data

m_n	3 – 8 mm	8 mm	5 – 8 mm	2 – 6 mm	5 – 6 mm	2 – 4 mm
z	15 – 32	19	15 – 20	12 – 32	16 – 19	30 – 40
F_{f2acc}	5 – 79 kN	124 kN	26 – 77 kN	1.9 – 67 kN	22 – 67 kN	0.9 – 16 kN
v_{f2}	0.12 – 3.6 m/s	0.11 – 0.23 m/s	0.14 – 0.49 m/s	0.11 – 4.3 m/s	0.13 – 0.39 m/s	0.16 – 6.7 m/s
Δs	8 – 56 µm	70 µm	15 – 56 µm	4 – 44 µm	15 – 44 µm	10 – 56 µm

An explanation of the formula symbols can be found in the chapter [▸ 17.1].

Features

Power density	★★★★★	★★★★★	★★★★★	★★★★☆	★★★★☆	★★★☆☆
Linear backlash	★★★★★	★★★★☆	★★★★☆	★★★★★	★★★★☆	★★★★★
Price category	€€€€€	€€€€€	€€€€€	€€€€	€€€€	€€€
Smooth operation	★★★★☆	★★★★☆	★★★★☆	★★★★☆	★★★★☆	★★★★☆
Linear rigidity	★★★★★	★★★★★	★★★★★	★★★★☆	★★★★☆	★★★☆☆
Mass moment of inertia	★★★★☆	★★★★☆	★★★★☆	★★★★☆	★★★★☆	★★★★☆
Key	★☆☆☆☆ good | ★★★★★ excellent € Economy | €€€€€ Premium					
Pinion gearing						
Helical gearing	✓	✓	✓	✓	✓	✓
Gearing quality	5	5	5	5	5	5
Bearing design						
Standard	✓	✓	✓	✓	✓	✓
Reinforced				✓ (PH3 – PH5)		✓ (PH3 – PH5)
Accessories						
Felt gear	✓	✓	✓			

In the chapter [▸ 13], you can find the matching precision gear racks for our rack and pinion drives.

1 Selection tool

1.1 Rack and pinion drives with synchronous servo motors


Product chapter	**ZVP**	**ZVPE**
Chapter number	[▹ 8]	[▹ 9]

Technical data

m_n	2 – 4 mm	2 – 3 mm
z	16 – 25	16 – 25
F_{f2acc}	0.5 – 11 kN	0.5 – 6.1 kN
v_{f2}	0.08 – 5.3 m/s	0.13 – 4.5 m/s
Δs	8 – 44 µm	40 – 83 µm

An explanation of the formula symbols can be found in the chapter [▹ 17.1].

Features

Power density	★★★☆☆	★★☆☆☆
Linear backlash	★★★★★	★★☆☆☆
Price category	€€	€
Smooth operation	★★★★☆	★★★☆☆
Linear rigidity	★★★☆☆	★★☆☆☆
Mass moment of inertia	★★★★☆	★★★★☆
Key	★☆☆☆☆ good | ★★★★★ excellent € Economy | €€€€€ Premium	
Pinion gearing		
Helical gearing	✓	✓
Gearing quality	6	6
Bearing design		
Standard	✓	✓
Axially reinforced	✓	

In the chapter [▹ 13], you can find the matching precision gear racks for our rack and pinion drives.

1 Selection tool

1.1 Rack and pinion drives with synchronous servo motors

			
Product chapter	**ZVKS**	**ZVKL**	**ZVK**
Chapter number	[▷ 10]	[▷ 11]	[▷ 12]

Technical data

m_n	2 – 4 mm	2 mm	2 – 4 mm
z	16 – 25	16 – 20	18 – 25
F_{f2acc}	0.6 – 11 kN	0.3 – 2.7 kN	0.9 – 16 kN
v_{f2}	0.08 – 6.8 m/s	0.21 – 3.3 m/s	0.04 – 3.4 m/s
Δs	30 – 44 µm	99 – 123 µm	12 – 111 µm

An explanation of the formula symbols can be found in the chapter [▷ 17.1].

Features

Power density	★★★☆☆	★★☆☆☆	★☆☆☆☆
Linear backlash	★★★☆☆	★☆☆☆☆	★★★☆☆
Price category	€€€	€	€
Smooth operation	★★★★☆	★★☆☆☆	★★★☆☆
Linear rigidity	★★★☆☆	★☆☆☆☆	★☆☆☆☆
Mass moment of inertia	★★★★☆	★★★★☆	★★★★☆
Key	★☆☆☆☆ good | ★★★★★ excellent € Economy | €€€€€ Premium		

Pinion gearing			
Helical gearing	✓	✓	✓
Gearing quality	6	6	6

In the chapter [▷ 13], you can find the matching precision gear racks for our rack and pinion drives.

1 Selection tool

1.1 Rack and pinion drives with synchronous servo motors

Product chapter	**ZS gear racks**
Chapter number	[▹ 13]

Technical data

m_n	2 – 6 mm
$F_{f,max}$	12.6 – 83.1 kN
F_{sv}	8 – 203 kN

An explanation of the formula symbols can be found in the chapter [▹ 17.1].

Features

Helical gearing	✓
Heat-treatable steel in accordance with STOBER specification	✓
Hardened and smoothed	✓
Gearing quality 6 in accordance with DIN 3962-1	✓
Length 500, 1000 and 2000 mm	✓

Product chapter	**EZ**
Chapter number	[14]

Technical data

M_N	0.4 – 91 Nm
M_0	0.44 – 100 Nm

An explanation of the formula symbols can be found in the chapter [17.1].

Shaft design	
Solid shaft without feather key	✓
Encoder	
EnDat 3 One Cable Solution (OCS)	✓
EnDat 2.2	✓
EnDat 2.1	✓
Resolvers	✓
Cooling	
Convection cooling	✓
Forced ventilation	✓
Brake	
Permanent magnet holding brake	✓
Marks and test symbols	
CE	✓
cURus	✓
UKCA	✓

2 ZTRSPH rack and pinion drives

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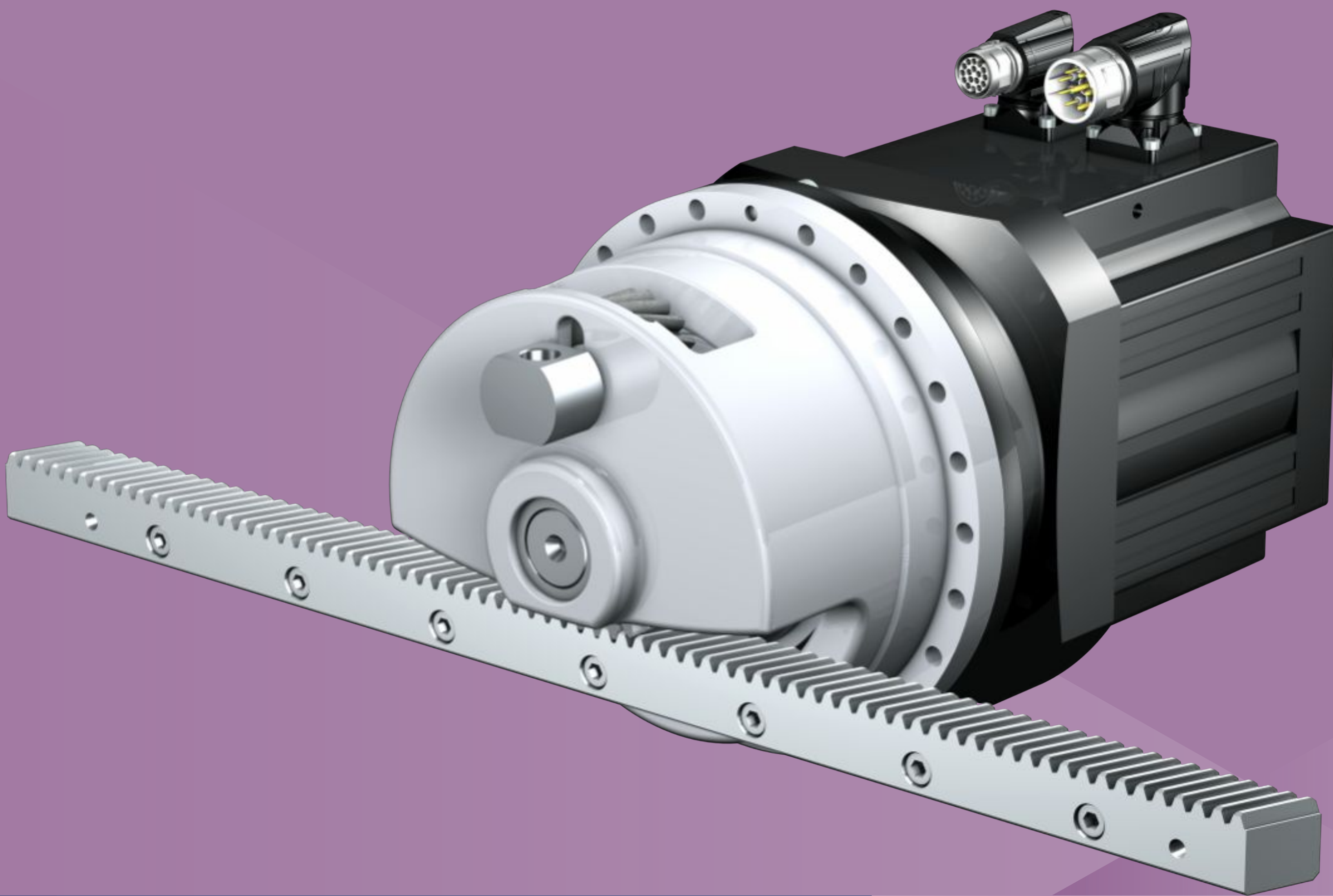


2 Rack and pinion drives

ZTRSPH

2.1 Overview

High Force precision planetary geared motors with supporting bearing holder

Features

Power density	★★★★★
Linear clearance	★★★★★
Price category	€€€€€
Smooth operation	★★★★☆
Linear rigidity	★★★★★
Mass moment of inertia	★★★★☆
Ready-to-install drive solution	✓
Pinion gearing quality 5 (DIN 3962)	✓
Helical gearing	✓
Case-hardened and smoothed	✓
Radial runout ≤ 10 µm (optional)	✓
Compact and highly dynamic due to direct motor attachment	✓

Key ★☆☆☆☆ good | ★★★★★ excellent
€ Economy | €€€€€ Premium

Technical data

m_n	3 – 8 mm
z	15 – 32
F_{f2acc}	5 – 79 kN
v_{f2}	0.12 – 3.6 m/s
Δs	8 – 56 µm

2.2 Selection tables

The technical data specified in the selection tables applies to:

- De-energized installation
- Permanent lubrication with the lubricants recommended in the chapter on gear racks [▷ 13.5.1]
- Case-hardened pinions, helical (left-hand 19° 31' 42"), gearing quality 5
- Installation altitudes up to 1000 m above sea level
- Surrounding temperatures from 0 °C to 40 °C
- Without consideration of the thermal limiting performance
- Drives with convection-cooled motors (e.g. EZ401**U**)

For the technical data on drives with forced ventilated motors (e.g. EZ401**B**), refer to https://configurator.stoeber.de/en-US/

Higher feed forces are possible for rack and pinion drives with reduced backlash. For this and all other technical data, refer to https://configurator.stoeber.de/en-US/.

An explanation of the formula symbols can be found in the chapter [▷ 17.1].

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTRS3PH7 (n_{1N} = 2000 min^{-1}, ($F_{f2acc,max}$ = 24 kN)																	
1.13	6.9	7.8	14	1.1	ZTRS317SPH731_0050 EZ813U	24	41	652	5.000	1.25	2.83	24	8	184	3	17	54.1
1.42	5.5	6.2	18	1.3	ZTRS317SPH731_0040 EZ813U	20	41	538	4.000	1.35	2.83	24	8	189	3	17	54.1
ZTRS3PH7 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 24 kN)																	
0.12	10	11	0.7	1.6	ZTRS317SPH732_0700 EZ501U	24	41	652	70.00	0.15	0.28	24	8	173	3	17	54.1
0.17	7.4	8.1	0.9	2.0	ZTRS317SPH732_0500 EZ501U	24	41	652	50.00	0.21	0.40	24	8	178	3	17	54.1
0.17	13	14	1.5	1.1	ZTRS317SPH732_0500 EZ502U	24	41	652	50.00	0.21	0.40	24	8	178	3	17	54.1
0.17	13	14	1.5	1.1	ZTRS317SPH732_0500 EZ701U	24	41	652	50.00	0.21	0.40	24	8	178	3	17	54.1
0.21	5.9	6.5	1.1	2.3	ZTRS317SPH732_0400 EZ501U	22	41	595	40.00	0.26	0.50	24	8	179	3	17	54.1
0.21	10	11	1.9	1.3	ZTRS317SPH732_0400 EZ502U	24	41	652	40.00	0.26	0.50	24	8	179	3	17	54.1
0.21	10	11	1.9	1.3	ZTRS317SPH732_0400 EZ701U	24	41	652	40.00	0.26	0.50	24	8	179	3	17	54.1
0.21	13	15	2.5	1.0	ZTRS317SPH732_0400 EZ503U	24	41	652	40.00	0.26	0.50	24	8	179	3	17	54.1
0.24	5.2	5.7	1.1	2.5	ZTRS317SPH732_0350 EZ501U	19	41	521	35.00	0.30	0.57	24	8	179	3	17	54.1
0.24	8.9	9.6	1.8	1.4	ZTRS317SPH732_0350 EZ502U	24	41	652	35.00	0.30	0.57	24	8	179	3	17	54.1
0.24	8.9	10	1.8	1.4	ZTRS317SPH732_0350 EZ701U	24	41	651	35.00	0.30	0.57	24	8	179	3	17	54.1
0.24	12	13	2.4	1.1	ZTRS317SPH732_0350 EZ503U	24	41	652	35.00	0.30	0.57	24	8	179	3	17	54.1
0.30	4.1	4.5	1.2	2.9	ZTRS317SPH732_0280 EZ501U	15	41	417	28.00	0.37	0.71	24	8	182	3	17	54.1
0.30	7.1	7.7	2.0	1.7	ZTRS317SPH732_0280 EZ502U	24	41	652	28.00	0.37	0.71	24	8	182	3	17	54.1
0.30	7.1	8.0	2.0	1.7	ZTRS317SPH732_0280 EZ701U	19	41	521	28.00	0.37	0.71	24	8	182	3	17	54.1
0.30	9.3	11	2.7	1.3	ZTRS317SPH732_0280 EZ503U	24	41	652	28.00	0.37	0.71	24	8	182	3	17	54.1
0.30	12	14	3.3	1.0	ZTRS317SPH732_0280 EZ702U	24	41	652	28.00	0.37	0.71	24	8	182	3	17	54.1
0.34	3.7	4.0	1.3	3.1	ZTRS317SPH732_0250 EZ501U	14	41	372	25.00	0.40	0.79	24	8	180	3	17	54.1
0.34	6.4	6.9	2.3	1.8	ZTRS317SPH732_0250 EZ502U	24	41	652	25.00	0.40	0.79	24	8	180	3	17	54.1
0.34	6.4	7.1	2.3	1.8	ZTRS317SPH732_0250 EZ701U	17	41	465	25.00	0.40	0.79	24	8	180	3	17	54.1
0.34	8.3	9.5	3.0	1.4	ZTRS317SPH732_0250 EZ503U	24	41	652	25.00	0.40	0.79	24	8	180	3	17	54.1
0.34	10	12	3.8	1.1	ZTRS317SPH732_0250 EZ702U	24	41	652	25.00	0.40	0.79	24	8	180	3	17	54.1
0.43	3.0	3.2	1.6	3.6	ZTRS317SPH732_0200 EZ501U	11	41	298	20.00	0.43	0.85	24	8	180	3	17	54.1
0.43	5.1	5.5	2.8	2.1	ZTRS317SPH732_0200 EZ502U	21	41	577	20.00	0.43	0.85	24	8	180	3	17	54.1
0.43	5.1	5.7	2.8	2.1	ZTRS317SPH732_0200 EZ701U	14	41	372	20.00	0.43	0.85	24	8	180	3	17	54.1
0.43	6.7	7.6	3.7	1.6	ZTRS317SPH732_0200 EZ503U	24	41	652	20.00	0.43	0.85	24	8	180	3	17	54.1
0.43	8.2	9.9	4.6	1.3	ZTRS317SPH732_0200 EZ702U	24	41	652	20.00	0.43	0.85	24	8	180	3	17	54.1
0.43	9.3	11	5.1	1.1	ZTRS317SPH732_0200 EZ505U	24	41	652	20.00	0.43	0.85	24	8	180	3	17	54.1
0.53	2.4	2.6	1.9	4.2	ZTRS317SPH732_0160 EZ501U	8.8	41	238	16.00	0.53	1.06	24	8	183	3	17	54.1
0.53	4.1	4.4	3.2	2.4	ZTRS317SPH732_0160 EZ502U	17	41	461	16.00	0.53	1.06	24	8	183	3	17	54.1
0.53	4.1	4.6	3.2	2.4	ZTRS317SPH732_0160 EZ701U	11	41	298	16.00	0.53	1.06	24	8	183	3	17	54.1
0.53	5.3	6.1	4.2	1.9	ZTRS317SPH732_0160 EZ503U	24	41	640	16.00	0.53	1.06	24	8	183	3	17	54.1
0.53	6.6	7.9	5.2	1.5	ZTRS317SPH732_0160 EZ702U	23	41	610	16.00	0.53	1.06	24	8	183	3	17	54.1
0.53	7.4	8.8	5.9	1.3	ZTRS317SPH732_0160 EZ505U	24	41	652	16.00	0.53	1.06	24	8	183	3	17	54.1
0.53	9.1	11	7.2	1.1	ZTRS317SPH732_0160 EZ703U	24	41	652	16.00	0.53	1.06	24	8	183	3	17	54.1
0.85	2.6	2.9	1.8	3.2	ZTRS317SPH731_0100 EZ701U	7.1	41	192	10.00	0.71	1.42	24	8	163	3	17	54.1
0.85	4.3	5.1	3.0	2.0	ZTRS317SPH731_0100 EZ702U	15	41	394	10.00	0.71	1.42	24	8	163	3	17	54.1
0.85	5.9	7.4	4.1	1.4	ZTRS317SPH731_0100 EZ703U	21	41	575	10.00	0.71	1.42	24	8	163	3	17	54.1
0.85	7.6	11	5.3	1.1	ZTRS317SPH731_0100 EZ705U	21	41	575	10.00	0.71	1.42	24	8	163	3	17	54.1
1.21	1.8	2.1	2.0	4.1	ZTRS317SPH731_0070 EZ701U	5.0	41	134	7.000	1.01	2.02	24	8	176	3	17	54.1
1.21	3.0	3.6	3.3	2.5	ZTRS317SPH731_0070 EZ702U	10	41	276	7.000	1.01	2.02	24	8	176	3	17	54.1
1.21	4.1	5.2	4.5	1.8	ZTRS317SPH731_0070 EZ703U	16	41	437	7.000	1.01	2.02	24	8	176	3	17	54.1

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTRS3PH7 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 24 kN)																	
1.21	5.3	7.5	5.9	1.4	ZTRS317SPH731_0070 EZ705U	24	41	652	7.000	1.01	2.02	24	8	176	3	17	54.1
1.70	2.1	2.6	5.0	3.2	ZTRS317SPH731_0050 EZ702U	7.3	41	197	5.000	1.25	2.83	24	8	184	3	17	54.1
1.70	2.9	3.7	6.8	2.3	ZTRS317SPH731_0050 EZ703U	12	41	312	5.000	1.25	2.83	24	8	184	3	17	54.1
1.70	3.8	5.4	8.8	1.8	ZTRS317SPH731_0050 EZ705U	18	41	499	5.000	1.25	2.83	24	8	184	3	17	54.1
2.13	1.7	2.0	6.5	3.7	ZTRS317SPH731_0040 EZ702U	5.8	33	157	4.000	1.35	2.83	24	8	189	3	17	54.1
2.13	2.3	3.0	8.9	2.7	ZTRS317SPH731_0040 EZ703U	9.2	33	250	4.000	1.35	2.83	24	8	189	3	17	54.1
2.13	3.0	4.3	11	2.1	ZTRS317SPH731_0040 EZ705U	15	33	399	4.000	1.35	2.83	24	8	189	3	17	54.1
ZTRS3PH7 (n_{1N} = 4000 min^{-1}, ($F_{f2acc,max}$ = 24 kN)																	
1.62	6.3	11	7.6	1.1	ZTRS317SPH731_0070 EZ813U	24	41	652	7.000	1.01	2.02	24	8	176	3	17	54.1
1.62	6.5	17	7.9	1.1	ZTRS317SPH731_0070 EZ815U	24	41	652	7.000	1.01	2.02	24	8	176	3	17	54.1
2.27	4.5	7.8	11	1.4	ZTRS317SPH731_0050 EZ813U	24	41	652	5.000	1.25	2.83	24	8	184	3	17	54.1
2.27	4.6	12	12	1.3	ZTRS317SPH731_0050 EZ815U	24	41	652	5.000	1.25	2.83	24	8	184	3	17	54.1
2.83	3.6	6.2	15	1.6	ZTRS317SPH731_0040 EZ813U	20	41	538	4.000	1.35	2.83	24	8	189	3	17	54.1
2.83	3.7	9.5	16	1.5	ZTRS317SPH731_0040 EZ815U	24	41	652	4.000	1.35	2.83	24	8	189	3	17	54.1
ZTRS3PH7 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 24 kN)																	
0.46	9.1	15	2.9	1.1	ZTRS317SPH732_0280 EZ505U	24	41	652	28.00	0.37	0.71	24	8	182	3	17	54.1
0.51	8.2	13	3.2	1.2	ZTRS317SPH732_0250 EZ505U	24	41	652	25.00	0.40	0.79	24	8	180	3	17	54.1
0.64	6.5	11	3.7	1.4	ZTRS317SPH732_0200 EZ505U	24	41	652	20.00	0.43	0.85	24	8	180	3	17	54.1
0.64	8.3	14	4.7	1.1	ZTRS317SPH732_0200 EZ703U	24	41	652	20.00	0.43	0.85	24	8	180	3	17	54.1
0.80	5.2	8.4	4.1	1.7	ZTRS317SPH732_0160 EZ505U	24	41	652	16.00	0.53	1.06	24	8	183	3	17	54.1
0.80	6.7	11	5.3	1.3	ZTRS317SPH732_0160 EZ703U	24	41	652	16.00	0.53	1.06	24	8	183	3	17	54.1
1.28	4.3	7.1	3.4	1.7	ZTRS317SPH731_0100 EZ703U	21	41	575	10.00	0.71	1.42	24	8	163	3	17	54.1
1.28	5.8	11	4.7	1.3	ZTRS317SPH731_0100 EZ705U	21	41	575	10.00	0.71	1.42	24	8	163	3	17	54.1
1.82	3.0	5.0	3.8	2.2	ZTRS317SPH731_0070 EZ703U	16	41	437	7.000	1.01	2.02	24	8	176	3	17	54.1
1.82	4.1	7.5	5.2	1.6	ZTRS317SPH731_0070 EZ705U	24	41	652	7.000	1.01	2.02	24	8	176	3	17	54.1
2.55	2.1	3.5	5.7	2.7	ZTRS317SPH731_0050 EZ703U	12	41	312	5.000	1.25	2.83	24	8	184	3	17	54.1
2.55	2.9	5.3	7.7	2.0	ZTRS317SPH731_0050 EZ705U	18	41	499	5.000	1.25	2.83	24	8	184	3	17	54.1
ZTRS3PH7 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 24 kN)																	
0.24	8.2	11	0.7	1.6	ZTRS317SPH732_0700 EZ501U	24	41	652	70.00	0.15	0.28	24	8	173	3	17	54.1
0.24	13	19	1.1	1.0	ZTRS317SPH732_0700 EZ502U	24	41	652	70.00	0.15	0.28	24	8	173	3	17	54.1
0.24	13	19	1.1	1.0	ZTRS317SPH732_0700 EZ701U	24	41	652	70.00	0.15	0.28	24	8	173	3	17	54.1
0.34	5.8	7.6	0.9	2.0	ZTRS317SPH732_0500 EZ501U	24	41	652	50.00	0.21	0.40	24	8	178	3	17	54.1
0.34	8.9	13	1.3	1.3	ZTRS317SPH732_0500 EZ502U	24	41	652	50.00	0.21	0.40	24	8	178	3	17	54.1
0.34	8.9	14	1.3	1.3	ZTRS317SPH732_0500 EZ701U	24	41	652	50.00	0.21	0.40	24	8	178	3	17	54.1
0.34	11	18	1.6	1.1	ZTRS317SPH732_0500 EZ503U	24	41	652	50.00	0.21	0.40	24	8	178	3	17	54.1
0.43	4.7	6.0	1.1	2.3	ZTRS317SPH732_0400 EZ501U	22	41	595	40.00	0.26	0.50	24	8	179	3	17	54.1
0.43	7.1	11	1.7	1.5	ZTRS317SPH732_0400 EZ502U	24	41	652	40.00	0.26	0.50	24	8	179	3	17	54.1
0.43	7.1	11	1.7	1.5	ZTRS317SPH732_0400 EZ701U	24	41	652	40.00	0.26	0.50	24	8	179	3	17	54.1
0.43	8.5	15	2.0	1.2	ZTRS317SPH732_0400 EZ503U	24	41	652	40.00	0.26	0.50	24	8	179	3	17	54.1
0.43	9.9	20	2.4	1.1	ZTRS317SPH732_0400 EZ702U	24	41	652	40.00	0.26	0.50	24	8	179	3	17	54.1
0.49	4.1	5.3	1.0	2.5	ZTRS317SPH732_0350 EZ501U	19	41	521	35.00	0.30	0.57	24	8	179	3	17	54.1
0.49	6.3	9.4	1.6	1.6	ZTRS317SPH732_0350 EZ502U	24	41	652	35.00	0.30	0.57	24	8	179	3	17	54.1
0.49	6.3	9.5	1.6	1.6	ZTRS317SPH732_0350 EZ701U	24	41	651	35.00	0.30	0.57	24	8	179	3	17	54.1
0.49	7.5	13	1.9	1.4	ZTRS317SPH732_0350 EZ503U	24	41	652	35.00	0.30	0.57	24	8	179	3	17	54.1
0.49	8.7	17	2.2	1.2	ZTRS317SPH732_0350 EZ702U	24	41	652	35.00	0.30	0.57	24	8	179	3	17	54.1
0.61	3.3	4.2	1.1	2.9	ZTRS317SPH732_0280 EZ501U	15	41	417	28.00	0.37	0.71	24	8	182	3	17	54.1
0.61	5.0	7.5	1.7	1.9	ZTRS317SPH732_0280 EZ502U	24	41	652	28.00	0.37	0.71	24	8	182	3	17	54.1
0.61	5.0	7.6	1.7	1.9	ZTRS317SPH732_0280 EZ701U	19	41	521	28.00	0.37	0.71	24	8	182	3	17	54.1
0.61	6.0	10	2.1	1.6	ZTRS317SPH732_0280 EZ503U	24	41	652	28.00	0.37	0.71	24	8	182	3	17	54.1
0.61	6.9	14	2.4	1.4	ZTRS317SPH732_0280 EZ702U	24	41	652	28.00	0.37	0.71	24	8	182	3	17	54.1
0.68	2.9	3.8	1.3	3.1	ZTRS317SPH732_0250 EZ501U	14	41	372	25.00	0.40	0.79	24	8	180	3	17	54.1
0.68	4.5	6.7	2.0	2.0	ZTRS317SPH732_0250 EZ502U	24	41	652	25.00	0.40	0.79	24	8	180	3	17	54.1
0.68	4.5	6.8	2.0	2.0	ZTRS317SPH732_0250 EZ701U	17	41	465	25.00	0.40	0.79	24	8	180	3	17	54.1
0.68	5.3	9.1	2.3	1.7	ZTRS317SPH732_0250 EZ503U	24	41	652	25.00	0.40	0.79	24	8	180	3	17	54.1
0.68	6.2	12	2.7	1.5	ZTRS317SPH732_0250 EZ702U	24	41	652	25.00	0.40	0.79	24	8	180	3	17	54.1
0.85	2.3	3.0	1.5	3.6	ZTRS317SPH732_0200 EZ501U	11	41	298	20.00	0.43	0.85	24	8	180	3	17	54.1
0.85	3.6	5.4	2.2	2.4	ZTRS317SPH732_0200 EZ502U	21	41	577	20.00	0.43	0.85	24	8	180	3	17	54.1
0.85	3.6	5.4	2.2	2.4	ZTRS317SPH732_0200 EZ701U	14	41	372	20.00	0.43	0.85	24	8	180	3	17	54.1
0.85	4.3	7.3	2.6	2.0	ZTRS317SPH732_0200 EZ503U	24	41	652	20.00	0.43	0.85	24	8	180	3	17	54.1
0.85	4.9	9.8	3.1	1.7	ZTRS317SPH732_0200 EZ702U	24	41	652	20.00	0.43	0.85	24	8	180	3	17	54.1
1.06	1.9	2.4	1.6	4.2	ZTRS317SPH732_0160 EZ501U	8.8	41	238	16.00	0.53	1.06	24	8	183	3	17	54.1
1.06	2.9	4.3	2.5	2.7	ZTRS317SPH732_0160 EZ502U	17	41	461	16.00	0.53	1.06	24	8	183	3	17	54.1
1.06	2.9	4.3	2.5	2.7	ZTRS317SPH732_0160 EZ701U	11	41	298	16.00	0.53	1.06	24	8	183	3	17	54.1
1.06	3.4	5.8	3.0	2.3	ZTRS317SPH732_0160 EZ503U	24	41	640	16.00	0.53	1.06	24	8	183	3	17	54.1
1.06	4.0	7.9	3.4	2.0	ZTRS317SPH732_0160 EZ702U	23	41	610	16.00	0.53	1.06	24	8	183	3	17	54.1

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTRS3PH8 (n_{1N} = 2000 min^{-1}, ($F_{f2acc,max}$ = 28 kN)																	
0.31	25	28	3.9	1.1	ZTRS332SPH832_0350 EZ813U	28	55	1426	35.00	0.46	0.91	44	15	229	3	32	101.9
0.38	20	22	5.7	1.1	ZTRS332SPH832_0280 EZ813U	28	55	1426	28.00	0.57	1.14	44	15	224	3	32	101.9
0.43	18	20	5.1	1.4	ZTRS332SPH832_0250 EZ813U	28	55	1426	25.00	0.58	1.17	44	15	230	3	32	101.9
0.53	14	16	5.9	1.7	ZTRS332SPH832_0200 EZ813U	28	55	1426	20.00	0.67	1.20	44	15	231	3	32	101.9
0.53	21	25	8.7	1.2	ZTRS332SPH832_0200 EZ815U	28	55	1426	20.00	0.67	1.20	44	15	231	3	32	101.9
0.67	11	13	7.5	1.9	ZTRS332SPH832_0160 EZ813U	28	55	1426	16.00	0.83	1.50	44	15	227	3	32	101.9
0.67	17	20	11	1.3	ZTRS332SPH832_0160 EZ815U	28	55	1426	16.00	0.83	1.50	44	15	227	3	32	101.9
1.07	7.3	8.2	3.8	2.1	ZTRS332SPH831_0100 EZ813U	26	55	1344	10.00	1.17	2.13	44	15	197	3	32	101.9
1.07	11	13	5.6	1.4	ZTRS332SPH831_0100 EZ815U	27	55	1392	10.00	1.17	2.13	44	15	197	3	32	101.9
1.52	5.1	5.8	4.5	3.8	ZTRS332SPH831_0070 EZ813U	18	55	941	7.000	1.52	3.05	44	15	221	3	32	101.9
1.52	7.6	9.1	6.6	2.6	ZTRS332SPH831_0070 EZ815U	26	55	1344	7.000	1.52	3.05	44	15	221	3	32	101.9
2.13	3.7	4.1	6.7	4.9	ZTRS332SPH831_0050 EZ813U	13	49	672	5.000	1.71	4.27	44	15	241	3	32	101.9
2.13	5.4	6.5	9.9	3.3	ZTRS332SPH831_0050 EZ815U	19	49	960	5.000	1.71	4.27	44	15	241	3	32	101.9
2.67	4.4	5.2	16	3.6	ZTRS332SPH831_0040 EZ815U	15	39	768	4.000	1.87	4.67	44	15	243	3	32	101.9
ZTRS3PH8 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 28 kN)																	
0.16	14	15	0.7	1.3	ZTRS332SPH832_1000 EZ701U	27	54	1380	100.0	0.16	0.32	44	15	194	3	32	101.9
0.23	9.5	11	0.6	2.6	ZTRS332SPH832_0700 EZ701U	26	55	1302	70.00	0.23	0.46	44	15	214	3	32	101.9
0.23	15	18	1.0	1.6	ZTRS332SPH832_0700 EZ702U	28	55	1426	70.00	0.23	0.46	44	15	214	3	32	101.9
0.23	21	27	1.3	1.2	ZTRS332SPH832_0700 EZ703U	28	55	1426	70.00	0.23	0.46	44	15	214	3	32	101.9
0.32	6.8	7.6	0.7	3.7	ZTRS332SPH832_0500 EZ701U	18	55	930	50.00	0.32	0.64	44	15	226	3	32	101.9
0.32	11	13	1.1	2.3	ZTRS332SPH832_0500 EZ702U	28	55	1426	50.00	0.32	0.64	44	15	226	3	32	101.9
0.32	15	19	1.6	1.7	ZTRS332SPH832_0500 EZ703U	28	55	1426	50.00	0.32	0.64	44	15	226	3	32	101.9
0.32	19	28	2.0	1.3	ZTRS332SPH832_0500 EZ705U	28	55	1426	50.00	0.32	0.64	44	15	226	3	32	101.9
0.40	5.4	6.1	1.0	3.7	ZTRS332SPH832_0400 EZ701U	15	55	744	40.00	0.40	0.80	44	15	219	3	32	101.9
0.40	8.8	11	1.6	2.3	ZTRS332SPH832_0400 EZ702U	28	55	1426	40.00	0.40	0.80	44	15	219	3	32	101.9
0.40	12	15	2.2	1.7	ZTRS332SPH832_0400 EZ703U	28	55	1426	40.00	0.40	0.80	44	15	219	3	32	101.9
0.40	16	22	2.8	1.3	ZTRS332SPH832_0400 EZ705U	28	55	1426	40.00	0.40	0.80	44	15	219	3	32	101.9
0.46	7.7	9.2	1.4	3.2	ZTRS332SPH832_0350 EZ702U	26	55	1335	35.00	0.46	0.91	44	15	229	3	32	101.9
0.46	11	13	1.9	2.3	ZTRS332SPH832_0350 EZ703U	28	55	1426	35.00	0.46	0.91	44	15	229	3	32	101.9
0.46	14	19	2.4	1.8	ZTRS332SPH832_0350 EZ705U	28	55	1426	35.00	0.46	0.91	44	15	229	3	32	101.9
0.57	6.1	7.4	1.9	3.2	ZTRS332SPH832_0280 EZ702U	21	55	1068	28.00	0.57	1.14	44	15	224	3	32	101.9
0.57	8.4	11	2.6	2.3	ZTRS332SPH832_0280 EZ703U	28	55	1426	28.00	0.57	1.14	44	15	224	3	32	101.9
0.57	11	15	3.4	1.8	ZTRS332SPH832_0280 EZ705U	28	55	1426	28.00	0.57	1.14	44	15	224	3	32	101.9
0.64	5.5	6.6	1.6	4.5	ZTRS332SPH832_0250 EZ702U	19	55	953	25.00	0.58	1.17	44	15	230	3	32	101.9
0.64	7.5	9.5	2.2	3.3	ZTRS332SPH832_0250 EZ703U	28	55	1426	25.00	0.58	1.17	44	15	230	3	32	101.9
0.64	9.7	14	2.9	2.5	ZTRS332SPH832_0250 EZ705U	28	55	1426	25.00	0.58	1.17	44	15	230	3	32	101.9
0.80	6.0	7.6	2.5	4.1	ZTRS332SPH832_0200 EZ703U	24	55	1209	20.00	0.67	1.20	44	15	231	3	32	101.9
0.80	7.8	11	3.2	3.2	ZTRS332SPH832_0200 EZ705U	28	55	1426	20.00	0.67	1.20	44	15	231	3	32	101.9
1.00	4.8	6.1	3.5	4.1	ZTRS332SPH832_0160 EZ703U	19	55	967	16.00	0.83	1.50	44	15	227	3	32	101.9
1.00	6.2	8.8	4.5	3.2	ZTRS332SPH832_0160 EZ705U	28	55	1426	16.00	0.83	1.50	44	15	227	3	32	101.9
ZTRS3PH8 (n_{1N} = 4000 min^{-1}, ($F_{f2acc,max}$ = 28 kN)																	
0.61	16	28	3.2	1.4	ZTRS332SPH832_0350 EZ813U	28	55	1426	35.00	0.46	0.91	44	15	229	3	32	101.9
0.61	17	43	3.3	1.3	ZTRS332SPH832_0350 EZ815U	28	55	1426	35.00	0.46	0.91	44	15	229	3	32	101.9
0.76	13	22	4.4	1.4	ZTRS332SPH832_0280 EZ813U	28	55	1426	28.00	0.57	1.14	44	15	224	3	32	101.9
0.76	13	34	4.6	1.3	ZTRS332SPH832_0280 EZ815U	28	55	1426	28.00	0.57	1.14	44	15	224	3	32	101.9
0.85	12	20	3.7	2.0	ZTRS332SPH832_0250 EZ813U	28	55	1426	25.00	0.58	1.17	44	15	230	3	32	101.9
0.85	12	31	3.9	1.9	ZTRS332SPH832_0250 EZ815U	28	55	1426	25.00	0.58	1.17	44	15	230	3	32	101.9
1.07	9.2	16	4.2	2.4	ZTRS332SPH832_0200 EZ813U	28	55	1426	20.00	0.67	1.20	44	15	231	3	32	101.9
1.07	9.5	25	4.3	2.4	ZTRS332SPH832_0200 EZ815U	28	55	1426	20.00	0.67	1.20	44	15	231	3	32	101.9
1.33	7.4	13	5.8	2.4	ZTRS332SPH832_0160 EZ813U	28	55	1426	16.00	0.83	1.50	44	15	227	3	32	101.9
1.33	7.6	20	6.0	2.4	ZTRS332SPH832_0160 EZ815U	28	55	1426	16.00	0.83	1.50	44	15	227	3	32	101.9
2.13	4.8	8.2	3.1	2.5	ZTRS332SPH831_0100 EZ813U	26	55	1344	10.00	1.17	2.13	44	15	197	3	32	101.9
2.13	4.9	13	3.2	2.4	ZTRS332SPH831_0100 EZ815U	27	55	1392	10.00	1.17	2.13	44	15	197	3	32	101.9
3.05	3.3	5.8	3.6	4.7	ZTRS332SPH831_0070 EZ813U	18	55	941	7.000	1.52	3.05	44	15	221	3	32	101.9
3.05	3.4	8.9	3.8	4.5	ZTRS332SPH831_0070 EZ815U	26	55	1344	7.000	1.52	3.05	44	15	221	3	32	101.9
ZTRS3PH8 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 28 kN)																	
0.34	15	26	1.1	1.4	ZTRS332SPH832_0700 EZ703U	28	55	1426	70.00	0.23	0.46	44	15	214	3	32	101.9
0.34	21	38	1.5	1.0	ZTRS332SPH832_0700 EZ705U	28	55	1426	70.00	0.23	0.46	44	15	214	3	32	101.9
0.48	11	18	1.3	2.0	ZTRS332SPH832_0500 EZ703U	28	55	1426	50.00	0.32	0.64	44	15	226	3	32	101.9
0.48	15	27	1.8	1.5	ZTRS332SPH832_0500 EZ705U	28	55	1426	50.00	0.32	0.64	44	15	226	3	32	101.9
0.60	8.8	15	1.8	2.0	ZTRS332SPH832_0400 EZ703U	28	55	1426	40.00	0.40	0.80	44	15	219	3	32	101.9
0.60	12	22	2.5	1.5	ZTRS332SPH832_0400 EZ705U	28	55	1426	40.00	0.40	0.80	44	15	219	3	32	101.9
0.69	7.7	13	1.6	2.8	ZTRS332SPH832_0350 EZ703U	28	55	1426	35.00	0.46	0.91	44	15	229	3	32	101.9
0.69	10	19	2.1	2.1	ZTRS332SPH832_0350 EZ705U	28	55	1426	35.00	0.46	0.91	44	15	229	3	32	101.9
0.86	6.2	10	2.2	2.8	ZTRS332SPH832_0280 EZ703U	28	55	1426	28.00	0.57	1.14	44	15	224	3	32	101.9
0.86	8.4	15	3.0	2.1	ZTRS332SPH832_0280 EZ705U	28	55	1426	28.00	0.57	1.14	44	15	224	3	32	101.9

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTRS3PH8 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 28 kN)																	
0.96	5.5	9.1	1.9	3.9	ZTRS332SPH832_0250 EZ703U	28	55	1426	25.00	0.58	1.17	44	15	230	3	32	101.9
0.96	7.5	14	2.5	2.9	ZTRS332SPH832_0250 EZ705U	28	55	1426	25.00	0.58	1.17	44	15	230	3	32	101.9
1.20	4.4	7.3	2.1	4.9	ZTRS332SPH832_0200 EZ703U	24	55	1209	20.00	0.67	1.20	44	15	231	3	32	101.9
1.20	6.0	11	2.8	3.6	ZTRS332SPH832_0200 EZ705U	28	55	1426	20.00	0.67	1.20	44	15	231	3	32	101.9
1.50	3.5	5.8	2.9	4.9	ZTRS332SPH832_0160 EZ703U	19	55	967	16.00	0.83	1.50	44	15	227	3	32	101.9
1.50	4.8	8.8	3.9	3.6	ZTRS332SPH832_0160 EZ705U	28	55	1426	16.00	0.83	1.50	44	15	227	3	32	101.9
ZTRS3PH8 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 28 kN)																	
0.32	9.5	14	0.6	1.4	ZTRS332SPH832_1000 EZ701U	27	54	1380	100.0	0.16	0.32	44	15	194	3	32	101.9
0.32	13	26	0.9	1.0	ZTRS332SPH832_1000 EZ702U	27	54	1380	100.0	0.16	0.32	44	15	194	3	32	101.9
0.46	6.6	10	0.5	3.0	ZTRS332SPH832_0700 EZ701U	26	55	1302	70.00	0.23	0.46	44	15	214	3	32	101.9
0.46	9.2	18	0.7	2.1	ZTRS332SPH832_0700 EZ702U	28	55	1426	70.00	0.23	0.46	44	15	214	3	32	101.9
0.64	4.7	7.2	0.6	4.2	ZTRS332SPH832_0500 EZ701U	18	55	930	50.00	0.32	0.64	44	15	226	3	32	101.9
0.64	6.6	13	0.9	3.0	ZTRS332SPH832_0500 EZ702U	28	55	1426	50.00	0.32	0.64	44	15	226	3	32	101.9
0.80	3.8	5.8	0.9	4.2	ZTRS332SPH832_0400 EZ701U	15	55	744	40.00	0.40	0.80	44	15	219	3	32	101.9
0.80	5.3	10	1.2	3.0	ZTRS332SPH832_0400 EZ702U	28	55	1426	40.00	0.40	0.80	44	15	219	3	32	101.9
0.91	4.6	9.1	1.0	4.3	ZTRS332SPH832_0350 EZ702U	26	55	1335	35.00	0.46	0.91	44	15	229	3	32	101.9
1.14	3.7	7.3	1.4	4.3	ZTRS332SPH832_0280 EZ702U	21	55	1068	28.00	0.57	1.14	44	15	224	3	32	101.9
ZTRS4PH8 (n_{1N} = 2000 min^{-1}, ($F_{f2acc,max}$ = 45 kN)																	
0.25	30	34	3.9	1.1	ZTRS420SPH832_0350 EZ813U	45	70	1929	35.00	0.38	0.76	37	12	281	4	20	84.9
0.32	24	27	5.7	1.1	ZTRS420SPH832_0280 EZ813U	45	70	1929	28.00	0.48	0.95	37	12	276	4	20	84.9
0.36	21	24	5.1	1.4	ZTRS420SPH832_0250 EZ813U	45	70	1929	25.00	0.48	0.98	37	12	283	4	20	84.9
0.44	17	19	5.9	1.7	ZTRS420SPH832_0200 EZ813U	45	70	1929	20.00	0.56	1.00	37	12	284	4	20	84.9
0.44	25	30	8.7	1.1	ZTRS420SPH832_0200 EZ815U	45	70	1929	20.00	0.56	1.00	37	12	284	4	20	84.9
0.56	14	15	7.5	1.9	ZTRS420SPH832_0160 EZ813U	45	70	1929	16.00	0.69	1.25	37	12	280	4	20	84.9
0.56	20	24	11	1.3	ZTRS420SPH832_0160 EZ815U	45	70	1929	16.00	0.69	1.25	37	12	280	4	20	84.9
0.89	8.8	9.9	3.8	2.1	ZTRS420SPH831_0100 EZ813U	32	66	1344	10.00	0.98	1.78	37	12	247	4	20	84.9
0.89	13	16	5.6	1.4	ZTRS420SPH831_0100 EZ815U	33	66	1392	10.00	0.98	1.78	37	12	247	4	20	84.9
1.27	6.2	6.9	4.5	3.2	ZTRS420SPH831_0070 EZ813U	22	70	941	7.000	1.27	2.54	37	12	273	4	20	84.9
1.27	9.1	11	6.6	2.2	ZTRS420SPH831_0070 EZ815U	32	70	1344	7.000	1.27	2.54	37	12	273	4	20	84.9
1.78	4.4	4.9	6.7	4.1	ZTRS420SPH831_0050 EZ813U	16	59	672	5.000	1.42	3.56	37	12	294	4	20	84.9
1.78	6.5	7.8	9.9	2.7	ZTRS420SPH831_0050 EZ815U	23	59	960	5.000	1.42	3.56	37	12	294	4	20	84.9
2.22	3.5	4.0	11	4.7	ZTRS420SPH831_0040 EZ813U	13	47	538	4.000	1.56	3.89	37	12	296	4	20	84.9
2.22	5.2	6.2	16	3.2	ZTRS420SPH831_0040 EZ815U	18	47	768	4.000	1.56	3.89	37	12	296	4	20	84.9
ZTRS4PH8 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 45 kN)																	
0.13	16	18	0.7	1.3	ZTRS420SPH832_1000 EZ701U	33	65	1380	100.0	0.13	0.27	37	12	244	4	20	84.9
0.19	11	13	0.6	2.6	ZTRS420SPH832_0700 EZ701U	31	70	1302	70.00	0.19	0.38	37	12	266	4	20	84.9
0.19	18	22	1.0	1.6	ZTRS420SPH832_0700 EZ702U	44	70	1848	70.00	0.19	0.38	37	12	266	4	20	84.9
0.19	25	32	1.3	1.2	ZTRS420SPH832_0700 EZ703U	44	70	1848	70.00	0.19	0.38	37	12	266	4	20	84.9
0.27	8.1	9.1	0.7	3.7	ZTRS420SPH832_0500 EZ701U	22	70	930	50.00	0.27	0.53	37	12	278	4	20	84.9
0.27	13	16	1.1	2.3	ZTRS420SPH832_0500 EZ702U	45	70	1907	50.00	0.27	0.53	37	12	278	4	20	84.9
0.27	18	23	1.6	1.7	ZTRS420SPH832_0500 EZ703U	45	70	1929	50.00	0.27	0.53	37	12	278	4	20	84.9
0.27	23	33	2.0	1.3	ZTRS420SPH832_0500 EZ705U	45	70	1929	50.00	0.27	0.53	37	12	278	4	20	84.9
0.33	6.5	7.3	1.0	3.7	ZTRS420SPH832_0400 EZ701U	18	70	744	40.00	0.33	0.67	37	12	271	4	20	84.9
0.33	11	13	1.6	2.3	ZTRS420SPH832_0400 EZ702U	36	70	1525	40.00	0.33	0.67	37	12	271	4	20	84.9
0.33	14	18	2.2	1.7	ZTRS420SPH832_0400 EZ703U	45	70	1920	40.00	0.33	0.67	37	12	271	4	20	84.9
0.33	19	26	2.8	1.3	ZTRS420SPH832_0400 EZ705U	45	70	1920	40.00	0.33	0.67	37	12	271	4	20	84.9
0.38	9.2	11	1.4	3.2	ZTRS420SPH832_0350 EZ702U	31	70	1335	35.00	0.38	0.76	37	12	281	4	20	84.9
0.38	13	16	1.9	2.3	ZTRS420SPH832_0350 EZ703U	45	70	1929	35.00	0.38	0.76	37	12	281	4	20	84.9
0.38	16	23	2.4	1.8	ZTRS420SPH832_0350 EZ705U	45	70	1929	35.00	0.38	0.76	37	12	281	4	20	84.9
0.48	7.4	8.8	1.9	3.2	ZTRS420SPH832_0280 EZ702U	25	70	1068	28.00	0.48	0.95	37	12	276	4	20	84.9
0.48	10	13	2.6	2.3	ZTRS420SPH832_0280 EZ703U	40	70	1693	28.00	0.48	0.95	37	12	276	4	20	84.9
0.48	13	19	3.4	1.8	ZTRS420SPH832_0280 EZ705U	45	70	1929	28.00	0.48	0.95	37	12	276	4	20	84.9
0.53	6.6	7.9	1.6	4.1	ZTRS420SPH832_0250 EZ702U	22	70	953	25.00	0.48	0.98	37	12	283	4	20	84.9
0.53	9.0	11	2.2	3.0	ZTRS420SPH832_0250 EZ703U	36	70	1511	25.00	0.48	0.98	37	12	283	4	20	84.9
0.53	12	17	2.9	2.3	ZTRS420SPH832_0250 EZ705U	45	70	1929	25.00	0.48	0.98	37	12	283	4	20	84.9
0.67	5.3	6.3	1.8	4.7	ZTRS420SPH832_0200 EZ702U	18	70	763	20.00	0.56	1.00	37	12	284	4	20	84.9
0.67	7.2	9.1	2.5	3.4	ZTRS420SPH832_0200 EZ703U	28	70	1209	20.00	0.56	1.00	37	12	284	4	20	84.9
0.67	9.3	13	3.2	2.7	ZTRS420SPH832_0200 EZ705U	45	70	1929	20.00	0.56	1.00	37	12	284	4	20	84.9
0.83	5.8	7.3	3.5	4.0	ZTRS420SPH832_0160 EZ703U	23	70	967	16.00	0.69	1.25	37	12	280	4	20	84.9
0.83	7.5	11	4.5	3.1	ZTRS420SPH832_0160 EZ705U	36	70	1548	16.00	0.69	1.25	37	12	280	4	20	84.9
ZTRS4PH8 (n_{1N} = 4000 min^{-1}, ($F_{f2acc,max}$ = 45 kN)																	
0.51	19	34	3.2	1.4	ZTRS420SPH832_0350 EZ813U	45	70	1929	35.00	0.38	0.76	37	12	281	4	20	84.9
0.51	20	51	3.3	1.3	ZTRS420SPH832_0350 EZ815U	45	70	1929	35.00	0.38	0.76	37	12	281	4	20	84.9
0.64	15	27	4.4	1.4	ZTRS420SPH832_0280 EZ813U	45	70	1929	28.00	0.48	0.95	37	12	276	4	20	84.9
0.64	16	41	4.6	1.3	ZTRS420SPH832_0280 EZ815U	45	70	1929	28.00	0.48	0.95	37	12	276	4	20	84.9
0.71	14	24	3.7	1.8	ZTRS420SPH832_0250 EZ813U	45	70	1929	25.00	0.48	0.98	37	12	283	4	20	84.9

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTRS4PH8 (n_{1N} = 4000 min^{-1}, ($F_{f2acc,max}$ = 45 kN)																	
0.71	14	37	3.9	1.7	ZTRS420SPH832_0250 EZ815U	45	70	1929	25.00	0.48	0.98	37	12	283	4	20	84.9
0.89	11	19	4.2	2.0	ZTRS420SPH832_0200 EZ813U	45	70	1929	20.00	0.56	1.00	37	12	284	4	20	84.9
0.89	11	29	4.3	2.0	ZTRS420SPH832_0200 EZ815U	45	70	1929	20.00	0.56	1.00	37	12	284	4	20	84.9
1.11	8.8	15	5.8	2.4	ZTRS420SPH832_0160 EZ813U	45	70	1929	16.00	0.69	1.25	37	12	280	4	20	84.9
1.11	9.2	24	6.0	2.3	ZTRS420SPH832_0160 EZ815U	45	70	1929	16.00	0.69	1.25	37	12	280	4	20	84.9
1.78	5.7	9.9	3.1	2.5	ZTRS420SPH831_0100 EZ813U	32	66	1344	10.00	0.98	1.78	37	12	247	4	20	84.9
1.78	5.9	15	3.2	2.4	ZTRS420SPH831_0100 EZ815U	33	66	1392	10.00	0.98	1.78	37	12	247	4	20	84.9
2.54	4.0	6.9	3.6	4.0	ZTRS420SPH831_0070 EZ813U	22	70	941	7.000	1.27	2.54	37	12	273	4	20	84.9
2.54	4.1	11	3.8	3.8	ZTRS420SPH831_0070 EZ815U	32	70	1344	7.000	1.27	2.54	37	12	273	4	20	84.9
3.56	2.9	4.9	5.5	5.0	ZTRS420SPH831_0050 EZ813U	16	59	672	5.000	1.42	3.56	37	12	294	4	20	84.9
3.56	3.0	7.6	5.7	4.8	ZTRS420SPH831_0050 EZ815U	23	59	960	5.000	1.42	3.56	37	12	294	4	20	84.9
ZTRS4PH8 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 45 kN)																	
0.29	19	31	1.1	1.4	ZTRS420SPH832_0700 EZ703U	44	70	1848	70.00	0.19	0.38	37	12	266	4	20	84.9
0.29	25	46	1.5	1.0	ZTRS420SPH832_0700 EZ705U	44	70	1848	70.00	0.19	0.38	37	12	266	4	20	84.9
0.40	13	22	1.3	2.0	ZTRS420SPH832_0500 EZ703U	45	70	1929	50.00	0.27	0.53	37	12	278	4	20	84.9
0.40	18	33	1.8	1.5	ZTRS420SPH832_0500 EZ705U	45	70	1929	50.00	0.27	0.53	37	12	278	4	20	84.9
0.50	11	18	1.8	2.0	ZTRS420SPH832_0400 EZ703U	45	70	1920	40.00	0.33	0.67	37	12	271	4	20	84.9
0.50	14	26	2.5	1.5	ZTRS420SPH832_0400 EZ705U	45	70	1920	40.00	0.33	0.67	37	12	271	4	20	84.9
0.57	9.3	15	1.6	2.8	ZTRS420SPH832_0350 EZ703U	45	70	1929	35.00	0.38	0.76	37	12	281	4	20	84.9
0.57	13	23	2.1	2.1	ZTRS420SPH832_0350 EZ705U	45	70	1929	35.00	0.38	0.76	37	12	281	4	20	84.9
0.71	7.4	12	2.2	2.8	ZTRS420SPH832_0280 EZ703U	40	70	1693	28.00	0.48	0.95	37	12	276	4	20	84.9
0.71	10	18	3.0	2.1	ZTRS420SPH832_0280 EZ705U	45	70	1929	28.00	0.48	0.95	37	12	276	4	20	84.9
0.80	6.6	11	1.9	3.5	ZTRS420SPH832_0250 EZ703U	36	70	1511	25.00	0.48	0.98	37	12	283	4	20	84.9
0.80	9.0	16	2.5	2.6	ZTRS420SPH832_0250 EZ705U	45	70	1929	25.00	0.48	0.98	37	12	283	4	20	84.9
1.00	5.3	8.8	2.1	4.1	ZTRS420SPH832_0200 EZ703U	28	70	1209	20.00	0.56	1.00	37	12	284	4	20	84.9
1.00	7.2	13	2.8	3.0	ZTRS420SPH832_0200 EZ705U	45	70	1929	20.00	0.56	1.00	37	12	284	4	20	84.9
1.25	4.2	7.0	2.9	4.7	ZTRS420SPH832_0160 EZ703U	23	70	967	16.00	0.69	1.25	37	12	280	4	20	84.9
1.25	5.7	11	3.9	3.5	ZTRS420SPH832_0160 EZ705U	36	70	1548	16.00	0.69	1.25	37	12	280	4	20	84.9
ZTRS4PH8 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 45 kN)																	
0.27	11	17	0.6	1.4	ZTRS420SPH832_1000 EZ701U	33	65	1380	100.0	0.13	0.27	37	12	244	4	20	84.9
0.27	16	31	0.9	1.0	ZTRS420SPH832_1000 EZ702U	33	65	1380	100.0	0.13	0.27	37	12	244	4	20	84.9
0.38	8.0	12	0.5	3.0	ZTRS420SPH832_0700 EZ701U	31	70	1302	70.00	0.19	0.38	37	12	266	4	20	84.9
0.38	11	22	0.7	2.1	ZTRS420SPH832_0700 EZ702U	44	70	1848	70.00	0.19	0.38	37	12	266	4	20	84.9
0.53	5.7	8.7	0.6	4.2	ZTRS420SPH832_0500 EZ701U	22	70	930	50.00	0.27	0.53	37	12	278	4	20	84.9
0.53	7.9	16	0.9	3.0	ZTRS420SPH832_0500 EZ702U	45	70	1907	50.00	0.27	0.53	37	12	278	4	20	84.9
0.67	4.6	6.9	0.9	4.2	ZTRS420SPH832_0400 EZ701U	18	70	744	40.00	0.33	0.67	37	12	271	4	20	84.9
0.67	6.3	13	1.2	3.0	ZTRS420SPH832_0400 EZ702U	36	70	1525	40.00	0.33	0.67	37	12	271	4	20	84.9
0.76	5.5	11	1.0	4.3	ZTRS420SPH832_0350 EZ702U	31	70	1335	35.00	0.38	0.76	37	12	281	4	20	84.9
0.95	4.4	8.8	1.4	4.3	ZTRS420SPH832_0280 EZ702U	25	70	1068	28.00	0.48	0.95	37	12	276	4	20	84.9
ZTRS5PH8 (n_{1N} = 2000 min^{-1}, ($F_{f2acc,max}$ = 49 kN)																	
0.25	30	34	3.9	1.1	ZTRS516SPH832_0350 EZ813U	49	70	2100	35.00	0.38	0.76	37	12	292	5	16	84.9
0.32	24	27	5.7	1.1	ZTRS516SPH832_0280 EZ813U	47	70	2000	28.00	0.48	0.95	37	12	287	5	16	84.9
0.36	21	24	5.1	1.4	ZTRS516SPH832_0250 EZ813U	49	70	2100	25.00	0.48	0.98	37	12	294	5	16	84.9
0.44	17	19	5.9	1.6	ZTRS516SPH832_0200 EZ813U	49	70	2100	20.00	0.56	1.00	37	12	295	5	16	84.9
0.44	25	30	8.7	1.1	ZTRS516SPH832_0200 EZ815U	49	70	2100	20.00	0.56	1.00	37	12	295	5	16	84.9
0.56	14	15	7.5	1.9	ZTRS516SPH832_0160 EZ813U	47	70	2000	16.00	0.69	1.25	37	12	290	5	16	84.9
0.56	20	24	11	1.3	ZTRS516SPH832_0160 EZ815U	47	70	2000	16.00	0.69	1.25	37	12	290	5	16	84.9
0.89	8.8	9.9	3.8	2.1	ZTRS516SPH831_0100 EZ813U	32	66	1344	10.00	0.98	1.78	37	12	255	5	16	84.9
0.89	13	16	5.6	1.4	ZTRS516SPH831_0100 EZ815U	33	66	1392	10.00	0.98	1.78	37	12	255	5	16	84.9
1.27	6.2	6.9	4.5	3.2	ZTRS516SPH831_0070 EZ813U	22	70	941	7.000	1.27	2.54	37	12	283	5	16	84.9
1.27	9.1	11	6.6	2.2	ZTRS516SPH831_0070 EZ815U	32	70	1344	7.000	1.27	2.54	37	12	283	5	16	84.9
1.78	4.4	4.9	6.7	4.0	ZTRS516SPH831_0050 EZ813U	16	59	672	5.000	1.42	3.56	37	12	306	5	16	84.9
1.78	6.5	7.8	9.9	2.7	ZTRS516SPH831_0050 EZ815U	23	59	960	5.000	1.42	3.56	37	12	306	5	16	84.9
2.22	3.5	4.0	11	4.6	ZTRS516SPH831_0040 EZ813U	13	47	538	4.000	1.56	3.89	37	12	308	5	16	84.9
2.22	5.2	6.2	16	3.1	ZTRS516SPH831_0040 EZ815U	18	47	768	4.000	1.56	3.89	37	12	308	5	16	84.9
ZTRS5PH8 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 49 kN)																	
0.13	16	18	0.7	1.3	ZTRS516SPH832_1000 EZ701U	33	65	1380	100.0	0.13	0.27	37	12	252	5	16	84.9
0.19	11	13	0.6	2.6	ZTRS516SPH832_0700 EZ701U	31	70	1302	70.00	0.19	0.38	37	12	276	5	16	84.9
0.19	18	22	1.0	1.6	ZTRS516SPH832_0700 EZ702U	44	70	1848	70.00	0.19	0.38	37	12	276	5	16	84.9
0.19	25	32	1.3	1.2	ZTRS516SPH832_0700 EZ703U	44	70	1848	70.00	0.19	0.38	37	12	276	5	16	84.9
0.27	8.1	9.1	0.7	3.7	ZTRS516SPH832_0500 EZ701U	22	70	930	50.00	0.27	0.53	37	12	289	5	16	84.9
0.27	13	16	1.1	2.3	ZTRS516SPH832_0500 EZ702U	45	70	1907	50.00	0.27	0.53	37	12	289	5	16	84.9
0.27	18	23	1.6	1.7	ZTRS516SPH832_0500 EZ703U	49	70	2100	50.00	0.27	0.53	37	12	289	5	16	84.9
0.27	23	33	2.0	1.3	ZTRS516SPH832_0500 EZ705U	49	70	2100	50.00	0.27	0.53	37	12	289	5	16	84.9
0.33	6.5	7.3	1.0	3.7	ZTRS516SPH832_0400 EZ701U	18	70	744	40.00	0.33	0.67	37	12	281	5	16	84.9
0.33	11	13	1.6	2.3	ZTRS516SPH832_0400 EZ702U	36	70	1525	40.00	0.33	0.67	37	12	281	5	16	84.9

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTRS5PH8 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 49 kN)																	
0.33	14	18	2.2	1.7	ZTRS516SPH832_0400 EZ703U	45	70	1920	40.00	0.33	0.67	37	12	281	5	16	84.9
0.33	19	26	2.8	1.3	ZTRS516SPH832_0400 EZ705U	45	70	1920	40.00	0.33	0.67	37	12	281	5	16	84.9
0.38	9.2	11	1.4	3.2	ZTRS516SPH832_0350 EZ702U	31	70	1335	35.00	0.38	0.76	37	12	292	5	16	84.9
0.38	13	16	1.9	2.3	ZTRS516SPH832_0350 EZ703U	49	70	2100	35.00	0.38	0.76	37	12	292	5	16	84.9
0.38	16	23	2.4	1.8	ZTRS516SPH832_0350 EZ705U	49	70	2100	35.00	0.38	0.76	37	12	292	5	16	84.9
0.48	7.4	8.8	1.9	3.2	ZTRS516SPH832_0280 EZ702U	25	70	1068	28.00	0.48	0.95	37	12	287	5	16	84.9
0.48	10	13	2.6	2.3	ZTRS516SPH832_0280 EZ703U	40	70	1693	28.00	0.48	0.95	37	12	287	5	16	84.9
0.48	13	19	3.4	1.8	ZTRS516SPH832_0280 EZ705U	47	70	2000	28.00	0.48	0.95	37	12	287	5	16	84.9
0.53	6.6	7.9	1.6	4.0	ZTRS516SPH832_0250 EZ702U	22	70	953	25.00	0.48	0.98	37	12	294	5	16	84.9
0.53	9.0	11	2.2	2.9	ZTRS516SPH832_0250 EZ703U	36	70	1511	25.00	0.48	0.98	37	12	294	5	16	84.9
0.53	12	17	2.9	2.3	ZTRS516SPH832_0250 EZ705U	49	70	2100	25.00	0.48	0.98	37	12	294	5	16	84.9
0.67	5.3	6.3	1.8	4.7	ZTRS516SPH832_0200 EZ702U	18	70	763	20.00	0.56	1.00	37	12	295	5	16	84.9
0.67	7.2	9.1	2.5	3.4	ZTRS516SPH832_0200 EZ703U	28	70	1209	20.00	0.56	1.00	37	12	295	5	16	84.9
0.67	9.3	13	3.2	2.6	ZTRS516SPH832_0200 EZ705U	46	70	1934	20.00	0.56	1.00	37	12	295	5	16	84.9
0.83	5.8	7.3	3.5	3.9	ZTRS516SPH832_0160 EZ703U	23	70	967	16.00	0.69	1.25	37	12	290	5	16	84.9
0.83	7.5	11	4.5	3.0	ZTRS516SPH832_0160 EZ705U	36	70	1548	16.00	0.69	1.25	37	12	290	5	16	84.9
ZTRS5PH8 (n_{1N} = 4000 min^{-1}, ($F_{f2acc,max}$ = 49 kN)																	
0.51	19	34	3.2	1.4	ZTRS516SPH832_0350 EZ813U	49	70	2100	35.00	0.38	0.76	37	12	292	5	16	84.9
0.51	20	51	3.3	1.3	ZTRS516SPH832_0350 EZ815U	49	70	2100	35.00	0.38	0.76	37	12	292	5	16	84.9
0.64	15	27	4.4	1.4	ZTRS516SPH832_0280 EZ813U	47	70	2000	28.00	0.48	0.95	37	12	287	5	16	84.9
0.64	16	41	4.6	1.3	ZTRS516SPH832_0280 EZ815U	47	70	2000	28.00	0.48	0.95	37	12	287	5	16	84.9
0.71	14	24	3.7	1.7	ZTRS516SPH832_0250 EZ813U	49	70	2100	25.00	0.48	0.98	37	12	294	5	16	84.9
0.71	14	37	3.9	1.7	ZTRS516SPH832_0250 EZ815U	49	70	2100	25.00	0.48	0.98	37	12	294	5	16	84.9
0.89	11	19	4.2	2.0	ZTRS516SPH832_0200 EZ813U	49	70	2100	20.00	0.56	1.00	37	12	295	5	16	84.9
0.89	11	29	4.3	1.9	ZTRS516SPH832_0200 EZ815U	49	70	2100	20.00	0.56	1.00	37	12	295	5	16	84.9
1.11	8.8	15	5.8	2.3	ZTRS516SPH832_0160 EZ813U	47	70	2000	16.00	0.69	1.25	37	12	290	5	16	84.9
1.11	9.2	24	6.0	2.3	ZTRS516SPH832_0160 EZ815U	47	70	2000	16.00	0.69	1.25	37	12	290	5	16	84.9
1.78	5.7	9.9	3.1	2.5	ZTRS516SPH831_0100 EZ813U	32	66	1344	10.00	0.98	1.78	37	12	255	5	16	84.9
1.78	5.9	15	3.2	2.4	ZTRS516SPH831_0100 EZ815U	33	66	1392	10.00	0.98	1.78	37	12	255	5	16	84.9
2.54	4.0	6.9	3.6	3.9	ZTRS516SPH831_0070 EZ813U	22	70	941	7.000	1.27	2.54	37	12	283	5	16	84.9
2.54	4.1	11	3.8	3.8	ZTRS516SPH831_0070 EZ815U	32	70	1344	7.000	1.27	2.54	37	12	283	5	16	84.9
3.56	2.9	4.9	5.5	4.9	ZTRS516SPH831_0050 EZ813U	16	59	672	5.000	1.42	3.56	37	12	306	5	16	84.9
3.56	3.0	7.6	5.7	4.7	ZTRS516SPH831_0050 EZ815U	23	59	960	5.000	1.42	3.56	37	12	306	5	16	84.9
ZTRS5PH8 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 49 kN)																	
0.29	19	31	1.1	1.4	ZTRS516SPH832_0700 EZ703U	44	70	1848	70.00	0.19	0.38	37	12	276	5	16	84.9
0.29	25	46	1.5	1.0	ZTRS516SPH832_0700 EZ705U	44	70	1848	70.00	0.19	0.38	37	12	276	5	16	84.9
0.40	13	22	1.3	2.0	ZTRS516SPH832_0500 EZ703U	49	70	2100	50.00	0.27	0.53	37	12	289	5	16	84.9
0.40	18	33	1.8	1.5	ZTRS516SPH832_0500 EZ705U	49	70	2100	50.00	0.27	0.53	37	12	289	5	16	84.9
0.50	11	18	1.8	2.0	ZTRS516SPH832_0400 EZ703U	45	70	1920	40.00	0.33	0.67	37	12	281	5	16	84.9
0.50	14	26	2.5	1.5	ZTRS516SPH832_0400 EZ705U	45	70	1920	40.00	0.33	0.67	37	12	281	5	16	84.9
0.57	9.3	15	1.6	2.8	ZTRS516SPH832_0350 EZ703U	49	70	2100	35.00	0.38	0.76	37	12	292	5	16	84.9
0.57	13	23	2.1	2.1	ZTRS516SPH832_0350 EZ705U	49	70	2100	35.00	0.38	0.76	37	12	292	5	16	84.9
0.71	7.4	12	2.2	2.8	ZTRS516SPH832_0280 EZ703U	40	70	1693	28.00	0.48	0.95	37	12	287	5	16	84.9
0.71	10	18	3.0	2.1	ZTRS516SPH832_0280 EZ705U	47	70	2000	28.00	0.48	0.95	37	12	287	5	16	84.9
0.80	6.6	11	1.9	3.5	ZTRS516SPH832_0250 EZ703U	36	70	1511	25.00	0.48	0.98	37	12	294	5	16	84.9
0.80	9.0	16	2.5	2.6	ZTRS516SPH832_0250 EZ705U	49	70	2100	25.00	0.48	0.98	37	12	294	5	16	84.9
1.00	5.3	8.8	2.1	4.0	ZTRS516SPH832_0200 EZ703U	28	70	1209	20.00	0.56	1.00	37	12	295	5	16	84.9
1.00	7.2	13	2.8	3.0	ZTRS516SPH832_0200 EZ705U	46	70	1934	20.00	0.56	1.00	37	12	295	5	16	84.9
1.25	4.2	7.0	2.9	4.7	ZTRS516SPH832_0160 EZ703U	23	70	967	16.00	0.69	1.25	37	12	290	5	16	84.9
1.25	5.7	11	3.9	3.5	ZTRS516SPH832_0160 EZ705U	36	70	1548	16.00	0.69	1.25	37	12	290	5	16	84.9
ZTRS5PH8 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 45 kN)																	
0.27	11	17	0.6	1.4	ZTRS516SPH832_1000 EZ701U	33	65	1380	100.0	0.13	0.27	37	12	252	5	16	84.9
0.27	16	31	0.9	1.0	ZTRS516SPH832_1000 EZ702U	33	65	1380	100.0	0.13	0.27	37	12	252	5	16	84.9
0.38	8.0	12	0.5	3.0	ZTRS516SPH832_0700 EZ701U	31	70	1302	70.00	0.19	0.38	37	12	276	5	16	84.9
0.38	11	22	0.7	2.1	ZTRS516SPH832_0700 EZ702U	44	70	1848	70.00	0.19	0.38	37	12	276	5	16	84.9
0.53	5.7	8.7	0.6	4.2	ZTRS516SPH832_0500 EZ701U	22	70	930	50.00	0.27	0.53	37	12	289	5	16	84.9
0.53	7.9	16	0.9	3.0	ZTRS516SPH832_0500 EZ702U	45	70	1907	50.00	0.27	0.53	37	12	289	5	16	84.9
0.67	4.6	6.9	0.9	4.2	ZTRS516SPH832_0400 EZ701U	18	70	744	40.00	0.33	0.67	37	12	281	5	16	84.9
0.67	6.3	13	1.2	3.0	ZTRS516SPH832_0400 EZ702U	36	70	1525	40.00	0.33	0.67	37	12	281	5	16	84.9
0.76	5.5	11	1.0	4.2	ZTRS516SPH832_0350 EZ702U	31	70	1335	35.00	0.38	0.76	37	12	292	5	16	84.9
0.95	4.4	8.8	1.4	4.3	ZTRS516SPH832_0280 EZ702U	25	70	1068	28.00	0.48	0.95	37	12	287	5	16	84.9
ZTRS5PH9 (n_{1N} = 2000 min^{-1}, ($F_{f2acc,max}$ = 77 kN)																	
0.19	41	46	1.3	1.5	ZTRS520SPH942_0600 EZ813U	77	154	4075	60.00	0.26	0.42	46	15	383	5	20	106.1
0.23	33	37	1.5	1.7	ZTRS520SPH942_0480 EZ813U	77	154	4075	48.00	0.32	0.52	46	15	385	5	20	106.1
0.23	49	58	2.2	1.2	ZTRS520SPH942_0480 EZ815U	77	154	4075	48.00	0.32	0.52	46	15	385	5	20	106.1
0.27	29	32	1.6	1.9	ZTRS520SPH942_0420 EZ813U	77	154	4075	42.00	0.37	0.60	46	15	387	5	20	106.1

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTRS5PH9 (n_{1N} = 2000 min^{-1}, ($F_{f2acc,max}$ = 77 kN)																	
0.27	43	51	2.3	1.3	ZTRS520SPH942_0420 EZ815U	77	154	4075	42.00	0.37	0.60	46	15	387	5	20	106.1
0.28	27	31	1.9	1.9	ZTRS520SPH942_0400 EZ813U	77	154	4075	40.00	0.39	0.63	46	15	383	5	20	106.1
0.28	40	48	2.9	1.3	ZTRS520SPH942_0400 EZ815U	77	154	4075	40.00	0.39	0.63	46	15	383	5	20	106.1
0.35	22	25	2.0	2.2	ZTRS520SPH942_0320 EZ813U	77	154	4075	32.00	0.49	0.78	46	15	388	5	20	106.1
0.35	32	39	3.0	1.5	ZTRS520SPH942_0320 EZ815U	77	154	4075	32.00	0.49	0.78	46	15	388	5	20	106.1
0.37	21	23	2.0	2.3	ZTRS520SPH942_0300 EZ813U	74	154	3906	30.00	0.46	0.74	46	15	388	5	20	106.1
0.37	30	36	2.9	1.6	ZTRS520SPH942_0300 EZ815U	77	154	4075	30.00	0.46	0.74	46	15	388	5	20	106.1
0.40	19	21	1.9	2.4	ZTRS520SPH942_0280 EZ813U	69	154	3646	28.00	0.56	0.89	46	15	392	5	20	106.1
0.40	28	34	2.8	1.7	ZTRS520SPH942_0280 EZ815U	77	154	4075	28.00	0.56	0.89	46	15	392	5	20	106.1
0.46	16	18	2.4	2.7	ZTRS520SPH942_0240 EZ813U	59	154	3125	24.00	0.46	0.81	46	15	389	5	20	106.1
0.46	24	29	3.6	1.8	ZTRS520SPH942_0240 EZ815U	77	154	4075	24.00	0.46	0.81	46	15	389	5	20	106.1
0.56	14	15	2.6	3.1	ZTRS520SPH942_0200 EZ813U	49	154	2604	20.00	0.69	1.11	46	15	396	5	20	106.1
0.56	20	24	3.9	2.1	ZTRS520SPH942_0200 EZ815U	70	154	3720	20.00	0.69	1.11	46	15	396	5	20	106.1
0.62	12	14	2.8	3.3	ZTRS520SPH942_0180 EZ813U	44	154	2344	18.00	0.56	0.93	46	15	391	5	20	106.1
0.62	18	22	4.1	2.2	ZTRS520SPH942_0180 EZ815U	63	154	3348	18.00	0.56	0.93	46	15	391	5	20	106.1
0.69	11	12	3.0	3.6	ZTRS520SPH942_0160 EZ813U	39	145	2083	16.00	0.69	1.22	46	15	397	5	20	106.1
0.69	16	19	4.4	2.4	ZTRS520SPH942_0160 EZ815U	56	145	2976	16.00	0.69	1.22	46	15	397	5	20	106.1
0.93	8.2	9.2	3.4	4.3	ZTRS520SPH942_0120 EZ813U	29	109	1562	12.00	0.83	1.39	46	15	401	5	20	106.1
0.93	12	14	5.1	2.9	ZTRS520SPH942_0120 EZ815U	42	109	2232	12.00	0.83	1.39	46	15	401	5	20	106.1
ZTRS5PH9 (n_{1N} = 4000 min^{-1}, ($F_{f2acc,max}$ = 77 kN)																	
0.37	27	46	0.9	1.8	ZTRS520SPH942_0600 EZ813U	77	154	4075	60.00	0.26	0.42	46	15	383	5	20	106.1
0.37	27	71	1.0	1.7	ZTRS520SPH942_0600 EZ815U	77	154	4075	60.00	0.26	0.42	46	15	383	5	20	106.1
0.46	21	37	0.9	2.1	ZTRS520SPH942_0480 EZ813U	77	154	4075	48.00	0.32	0.52	46	15	385	5	20	106.1
0.46	22	56	1.0	2.0	ZTRS520SPH942_0480 EZ815U	77	154	4075	48.00	0.32	0.52	46	15	385	5	20	106.1
0.53	19	32	1.0	2.3	ZTRS520SPH942_0420 EZ813U	77	154	4075	42.00	0.37	0.60	46	15	387	5	20	106.1
0.53	19	49	1.0	2.2	ZTRS520SPH942_0420 EZ815U	77	154	4075	42.00	0.37	0.60	46	15	387	5	20	106.1
0.56	18	31	1.6	2.4	ZTRS520SPH942_0400 EZ813U	77	154	4075	40.00	0.39	0.63	46	15	383	5	20	106.1
0.56	18	47	1.6	2.3	ZTRS520SPH942_0400 EZ815U	77	154	4075	40.00	0.39	0.63	46	15	383	5	20	106.1
0.69	14	25	1.7	2.7	ZTRS520SPH942_0320 EZ813U	77	154	4075	32.00	0.49	0.78	46	15	388	5	20	106.1
0.69	15	38	1.7	2.7	ZTRS520SPH942_0320 EZ815U	77	154	4075	32.00	0.49	0.78	46	15	388	5	20	106.1
0.74	13	23	1.3	2.9	ZTRS520SPH942_0300 EZ813U	74	154	3906	30.00	0.46	0.74	46	15	388	5	20	106.1
0.74	14	35	1.3	2.8	ZTRS520SPH942_0300 EZ815U	77	154	4075	30.00	0.46	0.74	46	15	388	5	20	106.1
0.79	12	21	1.4	3.0	ZTRS520SPH942_0280 EZ813U	69	154	3646	28.00	0.56	0.89	46	15	392	5	20	106.1
0.79	13	33	1.5	2.9	ZTRS520SPH942_0280 EZ815U	77	154	4075	28.00	0.56	0.89	46	15	392	5	20	106.1
1.11	8.8	15	1.7	3.8	ZTRS520SPH942_0200 EZ813U	49	154	2604	20.00	0.69	1.11	46	15	396	5	20	106.1
1.11	9.2	24	1.8	3.6	ZTRS520SPH942_0200 EZ815U	70	154	3720	20.00	0.69	1.11	46	15	396	5	20	106.1
ZTRS6PH9 (n_{1N} = 2000 min^{-1}, ($F_{f2acc,max}$ = 77 kN)																	
0.22	34	38	1.3	1.6	ZTRS620SPH942_0600 EZ813U	77	150	4919	60.00	0.31	0.50	56	19	354	6	20	127.3
0.22	51	60	1.9	1.1	ZTRS620SPH942_0600 EZ815U	77	150	4919	60.00	0.31	0.50	56	19	354	6	20	127.3
0.28	27	31	1.5	2.0	ZTRS620SPH942_0480 EZ813U	77	150	4919	48.00	0.39	0.63	56	19	357	6	20	127.3
0.28	40	48	2.2	1.4	ZTRS620SPH942_0480 EZ815U	77	150	4919	48.00	0.39	0.63	56	19	357	6	20	127.3
0.32	24	27	1.6	2.2	ZTRS620SPH942_0420 EZ813U	77	150	4919	42.00	0.44	0.71	56	19	359	6	20	127.3
0.32	35	42	2.3	1.5	ZTRS620SPH942_0420 EZ815U	77	150	4919	42.00	0.44	0.71	56	19	359	6	20	127.3
0.33	23	26	1.9	2.0	ZTRS620SPH942_0400 EZ813U	72	145	4600	40.00	0.47	0.75	56	19	355	6	20	127.3
0.33	34	40	2.9	1.4	ZTRS620SPH942_0400 EZ815U	72	145	4600	40.00	0.47	0.75	56	19	355	6	20	127.3
0.42	18	20	2.0	2.6	ZTRS620SPH942_0320 EZ813U	65	145	4166	32.00	0.58	0.94	56	19	360	6	20	127.3
0.42	27	32	3.0	1.8	ZTRS620SPH942_0320 EZ815U	72	145	4600	32.00	0.58	0.94	56	19	360	6	20	127.3
0.44	17	19	2.0	2.8	ZTRS620SPH942_0300 EZ813U	61	150	3906	30.00	0.56	0.89	56	19	361	6	20	127.3
0.44	25	30	2.9	1.9	ZTRS620SPH942_0300 EZ815U	77	150	4919	30.00	0.56	0.89	56	19	361	6	20	127.3
0.48	16	18	1.9	2.9	ZTRS620SPH942_0280 EZ813U	57	150	3646	28.00	0.67	1.07	56	19	366	6	20	127.3
0.48	24	28	2.8	2.0	ZTRS620SPH942_0280 EZ815U	77	150	4919	28.00	0.67	1.07	56	19	366	6	20	127.3
0.56	14	15	2.4	3.2	ZTRS620SPH942_0240 EZ813U	49	150	3125	24.00	0.56	0.97	56	19	362	6	20	127.3
0.56	20	24	3.6	2.2	ZTRS620SPH942_0240 EZ815U	70	150	4464	24.00	0.56	0.97	56	19	362	6	20	127.3
0.67	11	13	2.6	3.6	ZTRS620SPH942_0200 EZ813U	41	150	2604	20.00	0.83	1.33	56	19	370	6	20	127.3
0.67	17	20	3.9	2.5	ZTRS620SPH942_0200 EZ815U	58	150	3720	20.00	0.83	1.33	56	19	370	6	20	127.3
0.74	10	11	2.8	3.9	ZTRS620SPH942_0180 EZ813U	37	136	2344	18.00	0.67	1.11	56	19	364	6	20	127.3
0.74	15	18	4.1	2.6	ZTRS620SPH942_0180 EZ815U	53	136	3348	18.00	0.67	1.11	56	19	364	6	20	127.3
0.83	9.1	10	3.0	4.2	ZTRS620SPH942_0160 EZ813U	33	120	2083	16.00	0.83	1.46	56	19	372	6	20	127.3
0.83	13	16	4.4	2.9	ZTRS620SPH942_0160 EZ815U	47	120	2976	16.00	0.83	1.46	56	19	372	6	20	127.3
1.11	10	12	5.1	3.5	ZTRS620SPH942_0120 EZ815U	35	91	2232	12.00	1.00	1.67	56	19	377	6	20	127.3
ZTRS6PH9 (n_{1N} = 4000 min^{-1}, ($F_{f2acc,max}$ = 77 kN)																	
0.44	22	38	0.9	2.2	ZTRS620SPH942_0600 EZ813U	77	150	4919	60.00	0.31	0.50	56	19	354	6	20	127.3
0.44	23	59	1.0	2.1	ZTRS620SPH942_0600 EZ815U	77	150	4919	60.00	0.31	0.50	56	19	354	6	20	127.3
0.56	18	31	0.9	2.5	ZTRS620SPH942_0480 EZ813U	77	150	4919	48.00	0.39	0.63	56	19	357	6	20	127.3
0.56	18	47	1.0	2.4	ZTRS620SPH942_0480 EZ815U	77	150	4919	48.00	0.39	0.63	56	19	357	6	20	127.3
0.64	15	27	1.0	2.7	ZTRS620SPH942_0420 EZ813U	77	150	4919	42.00	0.44	0.71	56	19	359	6	20	127.3

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTRS6PH9 (n_{1N} = 4000 min^{-1}, ($F_{f2acc,max}$ = 77 kN)																	
0.64	16	41	1.0	2.6	ZTRS620SPH942_0420 EZ815U	77	150	4919	42.00	0.44	0.71	56	19	359	6	20	127.3
0.67	15	26	1.6	2.5	ZTRS620SPH942_0400 EZ813U	72	145	4600	40.00	0.47	0.75	56	19	355	6	20	127.3
0.67	15	39	1.6	2.4	ZTRS620SPH942_0400 EZ815U	72	145	4600	40.00	0.47	0.75	56	19	355	6	20	127.3
0.83	12	20	1.7	3.3	ZTRS620SPH942_0320 EZ813U	65	145	4166	32.00	0.58	0.94	56	19	360	6	20	127.3
0.83	12	31	1.7	3.1	ZTRS620SPH942_0320 EZ815U	72	145	4600	32.00	0.58	0.94	56	19	360	6	20	127.3
0.89	11	19	1.3	3.4	ZTRS620SPH942_0300 EZ813U	61	150	3906	30.00	0.56	0.89	56	19	361	6	20	127.3
0.89	11	29	1.3	3.3	ZTRS620SPH942_0300 EZ815U	77	150	4919	30.00	0.56	0.89	56	19	361	6	20	127.3
0.95	10	18	1.4	3.6	ZTRS620SPH942_0280 EZ813U	57	150	3646	28.00	0.67	1.07	56	19	366	6	20	127.3
0.95	11	27	1.5	3.5	ZTRS620SPH942_0280 EZ815U	77	150	4919	28.00	0.67	1.07	56	19	366	6	20	127.3
1.33	7.4	13	1.7	4.5	ZTRS620SPH942_0200 EZ813U	41	150	2604	20.00	0.83	1.33	56	19	370	6	20	127.3
1.33	7.6	20	1.8	4.3	ZTRS620SPH942_0200 EZ815U	58	150	3720	20.00	0.83	1.33	56	19	370	6	20	127.3
ZTRS8PH9 (n_{1N} = 2000 min^{-1}, ($F_{f2acc,max}$ = 79 kN)																	
0.22	34	38	1.3	1.6	ZTRS815SPH942_0600 EZ813U	79	150	5000	60.00	0.31	0.50	56	19	371	8	15	127.3
0.22	51	60	1.9	1.1	ZTRS815SPH942_0600 EZ815U	79	150	5000	60.00	0.31	0.50	56	19	371	8	15	127.3
0.28	27	31	1.5	2.0	ZTRS815SPH942_0480 EZ813U	79	150	5000	48.00	0.39	0.63	56	19	373	8	15	127.3
0.28	40	48	2.2	1.4	ZTRS815SPH942_0480 EZ815U	79	150	5000	48.00	0.39	0.63	56	19	373	8	15	127.3
0.32	24	27	1.6	2.2	ZTRS815SPH942_0420 EZ813U	79	150	5000	42.00	0.44	0.71	56	19	376	8	15	127.3
0.32	35	42	2.3	1.5	ZTRS815SPH942_0420 EZ815U	79	150	5000	42.00	0.44	0.71	56	19	376	8	15	127.3
0.33	23	26	1.9	2.0	ZTRS815SPH942_0400 EZ813U	72	145	4600	40.00	0.47	0.75	56	19	371	8	15	127.3
0.33	34	40	2.9	1.4	ZTRS815SPH942_0400 EZ815U	72	145	4600	40.00	0.47	0.75	56	19	371	8	15	127.3
0.42	18	20	2.0	2.6	ZTRS815SPH942_0320 EZ813U	65	145	4166	32.00	0.58	0.94	56	19	377	8	15	127.3
0.42	27	32	3.0	1.8	ZTRS815SPH942_0320 EZ815U	72	145	4600	32.00	0.58	0.94	56	19	377	8	15	127.3
0.44	17	19	2.0	2.8	ZTRS815SPH942_0300 EZ813U	61	150	3906	30.00	0.56	0.89	56	19	378	8	15	127.3
0.44	25	30	2.9	1.9	ZTRS815SPH942_0300 EZ815U	79	150	5000	30.00	0.56	0.89	56	19	378	8	15	127.3
0.48	16	18	1.9	2.9	ZTRS815SPH942_0280 EZ813U	57	150	3646	28.00	0.67	1.07	56	19	383	8	15	127.3
0.48	24	28	2.8	2.0	ZTRS815SPH942_0280 EZ815U	79	150	5000	28.00	0.67	1.07	56	19	383	8	15	127.3
0.56	14	15	2.4	3.2	ZTRS815SPH942_0240 EZ813U	49	150	3125	24.00	0.56	0.97	56	19	379	8	15	127.3
0.56	20	24	3.6	2.2	ZTRS815SPH942_0240 EZ815U	70	150	4464	24.00	0.56	0.97	56	19	379	8	15	127.3
0.67	11	13	2.6	3.6	ZTRS815SPH942_0200 EZ813U	41	150	2604	20.00	0.83	1.33	56	19	388	8	15	127.3
0.67	17	20	3.9	2.5	ZTRS815SPH942_0200 EZ815U	58	150	3720	20.00	0.83	1.33	56	19	388	8	15	127.3
0.74	10	11	2.8	3.9	ZTRS815SPH942_0180 EZ813U	37	136	2344	18.00	0.67	1.11	56	19	381	8	15	127.3
0.74	15	18	4.1	2.6	ZTRS815SPH942_0180 EZ815U	53	136	3348	18.00	0.67	1.11	56	19	381	8	15	127.3
0.83	9.1	10	3.0	4.2	ZTRS815SPH942_0160 EZ813U	33	120	2083	16.00	0.83	1.46	56	19	390	8	15	127.3
0.83	13	16	4.4	2.9	ZTRS815SPH942_0160 EZ815U	47	120	2976	16.00	0.83	1.46	56	19	390	8	15	127.3
1.11	10	12	5.1	3.5	ZTRS815SPH942_0120 EZ815U	35	91	2232	12.00	1.00	1.67	56	19	395	8	15	127.3
ZTRS8PH9 (n_{1N} = 4000 min^{-1}, ($F_{f2acc,max}$ = 79 kN)																	
0.44	22	38	0.9	2.2	ZTRS815SPH942_0600 EZ813U	79	150	5000	60.00	0.31	0.50	56	19	371	8	15	127.3
0.44	23	59	1.0	2.1	ZTRS815SPH942_0600 EZ815U	79	150	5000	60.00	0.31	0.50	56	19	371	8	15	127.3
0.56	18	31	0.9	2.5	ZTRS815SPH942_0480 EZ813U	79	150	5000	48.00	0.39	0.63	56	19	373	8	15	127.3
0.56	18	47	1.0	2.4	ZTRS815SPH942_0480 EZ815U	79	150	5000	48.00	0.39	0.63	56	19	373	8	15	127.3
0.64	15	27	1.0	2.7	ZTRS815SPH942_0420 EZ813U	79	150	5000	42.00	0.44	0.71	56	19	376	8	15	127.3
0.64	16	41	1.0	2.6	ZTRS815SPH942_0420 EZ815U	79	150	5000	42.00	0.44	0.71	56	19	376	8	15	127.3
0.67	15	26	1.6	2.5	ZTRS815SPH942_0400 EZ813U	72	145	4600	40.00	0.47	0.75	56	19	371	8	15	127.3
0.67	15	39	1.6	2.4	ZTRS815SPH942_0400 EZ815U	72	145	4600	40.00	0.47	0.75	56	19	371	8	15	127.3
0.83	12	20	1.7	3.3	ZTRS815SPH942_0320 EZ813U	65	145	4166	32.00	0.58	0.94	56	19	377	8	15	127.3
0.83	12	31	1.7	3.1	ZTRS815SPH942_0320 EZ815U	72	145	4600	32.00	0.58	0.94	56	19	377	8	15	127.3
0.89	11	19	1.3	3.4	ZTRS815SPH942_0300 EZ813U	61	150	3906	30.00	0.56	0.89	56	19	378	8	15	127.3
0.89	11	29	1.3	3.3	ZTRS815SPH942_0300 EZ815U	79	150	5000	30.00	0.56	0.89	56	19	378	8	15	127.3
0.95	10	18	1.4	3.6	ZTRS815SPH942_0280 EZ813U	57	150	3646	28.00	0.67	1.07	56	19	383	8	15	127.3
0.95	11	27	1.5	3.5	ZTRS815SPH942_0280 EZ815U	79	150	5000	28.00	0.67	1.07	56	19	383	8	15	127.3
1.33	7.4	13	1.7	4.5	ZTRS815SPH942_0200 EZ813U	41	150	2604	20.00	0.83	1.33	56	19	388	8	15	127.3
1.33	7.6	20	1.8	4.3	ZTRS815SPH942_0200 EZ815U	58	150	3720	20.00	0.83	1.33	56	19	388	8	15	127.3

2.3 Dimensional drawings

This chapter shows you the dimensions of rack and pinion drives with EZ synchronous servo motors.

Dimension az in the tables of dimensions applies to STOBER gear racks. In general: az = ½ d0 + h0 + x*mn

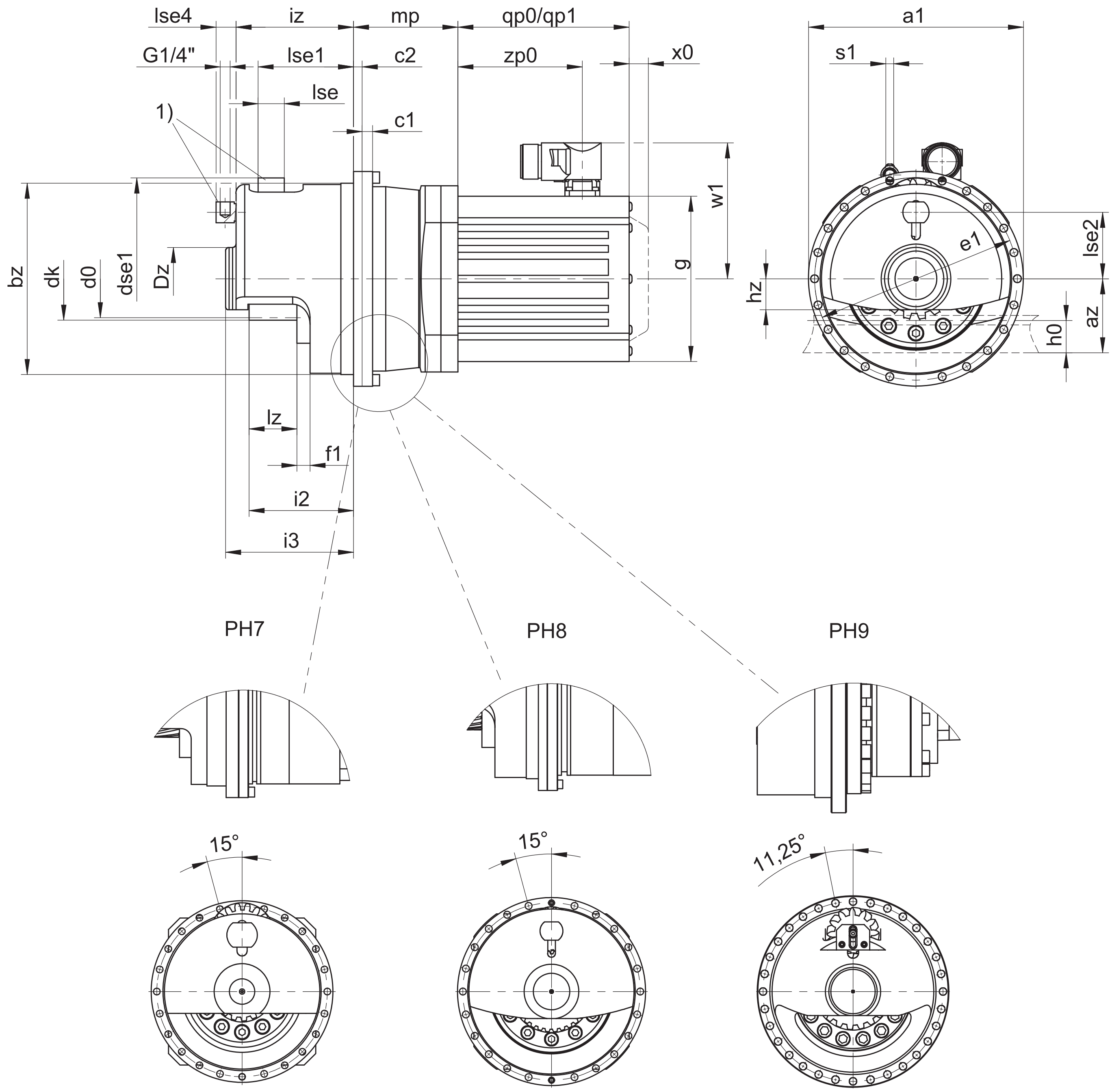
The pinion is helical (left-hand 19° 31' 42"). The pinion gearing quality is 5.

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 https://configurator.stoeber.de/en-US/.

Combination options and the dimensions of forced ventilated geared motors can also be found at https://configurator.stoeber.de/en-US/.



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x0	Applies to encoders using an optical measuring method.	w1	Different for the One Cable Solution (OCS), see the chapter [▷ 14.4]

1) Felt gear for lubrication (option)

Dimensions of gearboxes

Type	mn	∅a1	az	∅bz	c1	c2	∅d0	∅dk	∅dse1	∅Dz	∅e1	f1	i2	i3	iz	h0	hz	lz	lse	lse1	lse2	lse4	∅s1	x
ZTRS317SPH7_	3	179	53.06	156_{h7}	10	12	54.11	60.1	63.6	55	168	19.0	78.5	99.5	89.5	26	21.5	32.5	25	75.2	55.7	23.0	6.6	0.00
ZTRS332SPH8_	3	247	76.93	220_{h7}	12	10	101.86	107.9	63.6	72	233	14.0	107.0	137.0	125.0	26	35.5	42.0	30	102.6	79.5	23.0	9.0	0.00
ZTRS420SPH8_	4	247	77.44	220_{h7}	12	10	84.88	92.8	62.8	72	233	14.0	110.0	137.0	125.0	35	35.5	45.0	30	98.6	68.9	23.0	9.0	0.00
ZTRS516SPH8_	5	247	76.44	220_{h7}	12	10	84.88	94.8	78.6	72	233	14.5	120.0	147.0	135.0	34	35.5	55.0	30	109.6	76.5	23.0	9.0	0.00
ZTRS520SPH9_	5	346	87.05	300_{h7}	18	18	106.10	116.1	78.6	100	325	21.5	137.0	179.0	171.0	34	45.0	55.0	30	131.1	87.1	–	13.5	0.00
ZTRS620SPH9_	6	346	106.66	300_{h7}	18	18	127.32	139.3	94.2	100	325	21.5	147.0	189.0	181.0	43	43.5	65.0	30	131.1	104.8	–	13.5	0.00
ZTRS815SPH9_	8	346	136.66	300_{h7}	18	18	127.32	147.3	160.0	110	325	21.5	162.0	204.7	196.5	71	55.0	80.0	65	162.0	137.7	5.5	13.5	0.25

Dimensions of motors

Type	□g	qp0	qp1	w1	x0	zp0
EZ501U	115	93	147.5	100.0	22	58.5
EZ502U	115	118	172.5	100.0	22	83.5
EZ503U	115	143	197.5	100.0	22	108.5
EZ505U	115	193	247.5	100.0	22	158.5
EZ701U	145	102	161.0	115.0	22	64.0
EZ702U	145	127	186.0	115.0	22	89.0
EZ703U	145	152	211.0	115.0	22	114.0
EZ705U	145	207	266.0	134.0	22	165.0
EZ813U	190	238	315.0	156.5	22	184.0
EZ815U	190	320	397.0	156.5	22	266.0

Dimensions of geared motors

Type	EZ5	EZ7	EZ8
	mp	mp	mp
ZTRS_PH731_	–	83.0	93.0
ZTRS_PH732_	131.0	134.0	–
ZTRS_PH831_	–	–	120.0
ZTRS_PH832_	–	171.0	181.0
ZTRS_PH942_	–	–	228.5

2.4 Type designation

This chapter shows you an explanation of the type designation with the associated options.

Additional ordering information not included in the type designation can be found at the end of the chapter.

Example code

Z	TRS	3	17	S	PH	7	3	1	S	F	S	S	0050	EZ703U

Explanation

Code	Designation	Design
Z	Type	Rack and pinion gearbox
TRS	Design	Screwed flange pinion with supporting bearing holder
3	Normal module	m_n = 3 mm (example)
17	Number of teeth	z = 17 (example)
S SF	Helix angle	Left-hand 19° 31' 42" Left-hand 19° 31' 42" with felt gear for lubrication
PH	Type	Planetary gearbox
7	Size	7 (example)
3 4	Generation	Generation 3 Generation 4
1 2	Stages	Single-stage Two-stage
S	Housing	Standard
F	Shaft	Flange shaft
S V	Bearing	Standard bearing Reinforced bearing (PH3 – PH5)
S R	Backlash	Standard Reduced (PH3 – PH9)
0050	Transmission ratio (i x 10)	i = 5 (example)
EZ703U	Motor	EZ synchronous servo motor

To complete the type designation, also specify the following in your order:

- A detailed type designation of the motor, see the chapter [▸ 14.5]
- Position of the plug connectors, see the chapter [▸ 2.5.5]
- Radial shaft seal rings at the output made of NBR or FKM (option), see the chapter [▸ 2.6.2]
- Radial runout ≤ 10 µm (optional)
- Reverse operation of the output shaft from ±20° to ±90° for horizontal installation on request

This catalog shows you all the information on rack and pinion drives with EZ synchronous servo motors. All input options available on request are shown in the chapter [▸ 2.5.1].

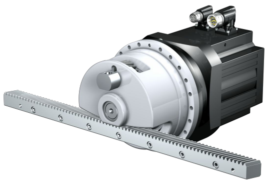
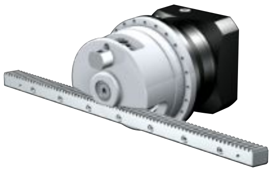
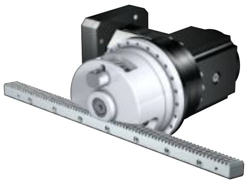
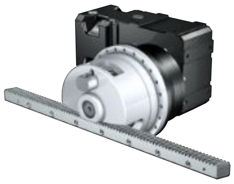
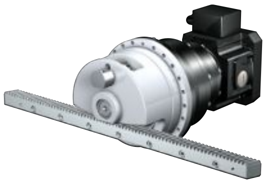
To make selecting your rack and pinion drive easy, use our STOBER Configurator at https://configurator.stoeber.de/en-US/.

A detailed description of the nameplate, see the chapter [▸ 14.5.1].

2.5 Product description

2.5.1 Input options

This chapter shows you all available input options:

Synchronous servo motors	Motor adapter	KX right-angle input with MF motor adapter	K right-angle input with ME motor adapter	MB motor adapter
				
Catalog ID 443286_en	Catalog ID 443137_en	On request	On request	On request

The corresponding catalogs can be found at http://www.stoeber.de/en/downloads/

Enter the ID of the catalog in the Search term field.

2.5.2 Gear rack

The gear rack used must have a right-hand design (19° 31' 42"); the load capacity must not be exceeded.

2.5.3 Installation conditions

The torque and force values listed in this catalog are valid under the following conditions:

- When the gear housing is fastened on the machine side using screws of strength class 12.9
- When the gear housings are adjusted at pilot øbz. The machine-side fit must be H7.

2.5.4 Lubricants

STOBER fills the gearboxes with the amount and type of lubricant specified on the nameplate.

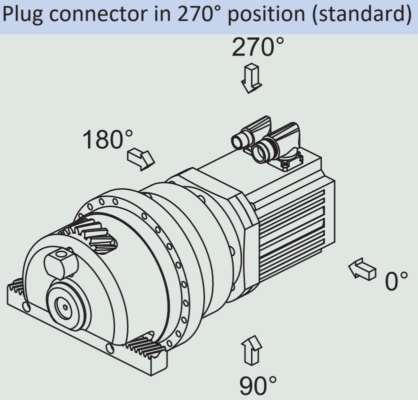
You will receive lubricants for use in the food industry upon request.

2.5.4.1 Lubrication of rack and pinion gearbox

Ensure permanent lubrication with the lubricants recommended in the chapter [▸ 13.5.1].

2.5.5 Position of the plug connectors

Plug connector in 270° position (standard)



The plug connectors are in the 270° position as standard. Indicate variations for your rack and pinion drive in the order.

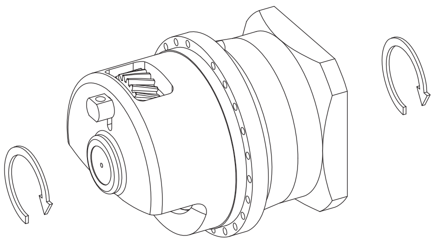
Note that the plug connectors also rotate when the gear rack is rotated to a different position.

2.5.6 Other product features

Feature	Value
Max. permitted gearbox temperature (on the surface of the gearbox)	≤ 90 °C
Paint	Black RAL 9005
(ATEX) Directive 2014/34/EU (Option)	Not suitable.
Protection class: [1]	
Planetary gearboxes	IP65
Motor	IP56, optionally IP66
Pinion/gear rack	IPXX

2.5.7 Direction of rotation

The input and output rotate in the same direction.



2.6 Project configuration

Project your drives using our SERVOsoft designing software. Download SERVOsoft free of charge after registration at https://www.stoeber.de/en/services/info-servosoft/.

It is the most convenient and reliable method of drive selection, as the entire torque/speed curve of the application is displayed and evaluated here in the curve of the geared motor.

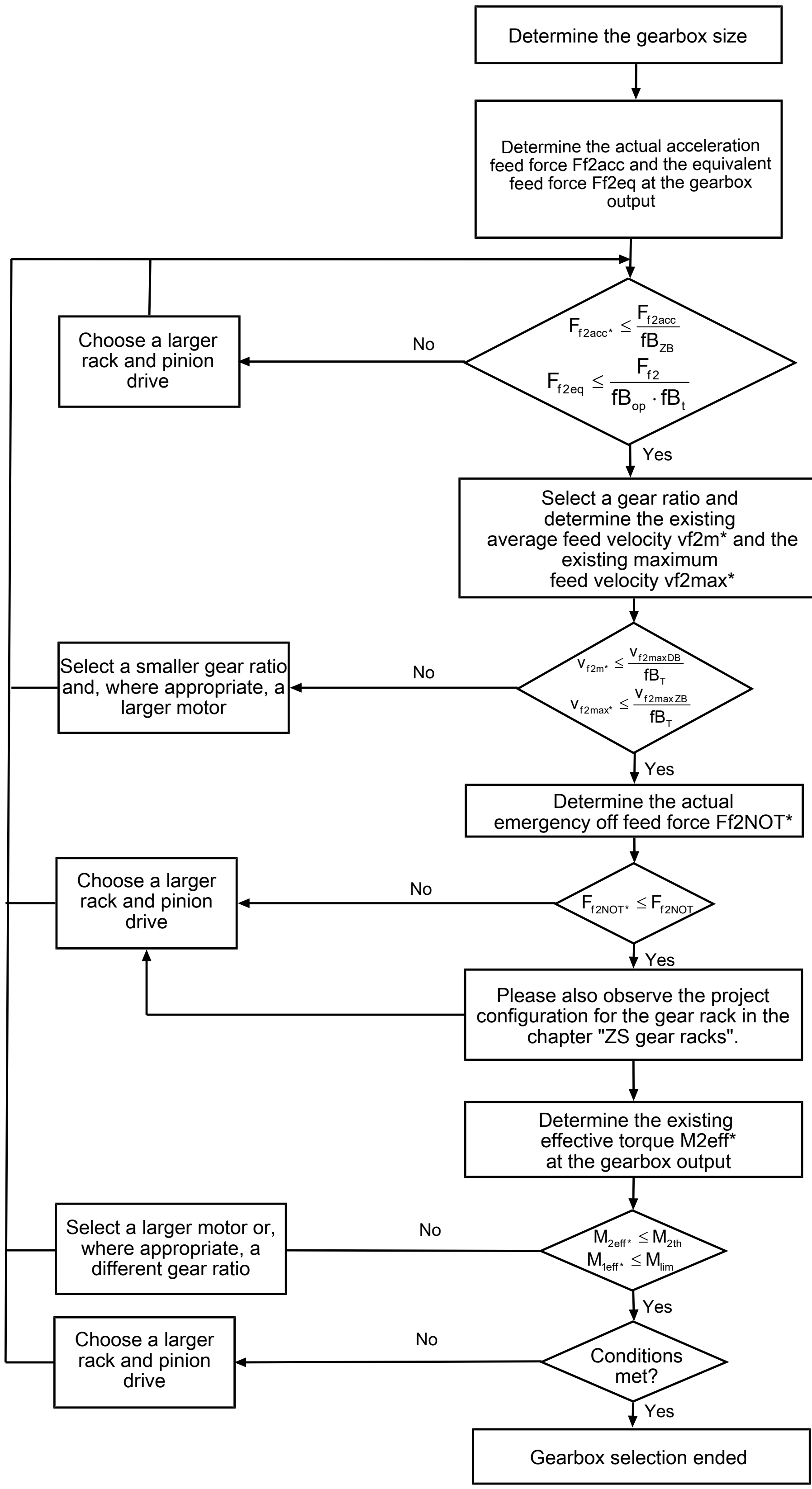
In this chapter, only limit values for specific operating points can be taken into consideration for manual drive selection.

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

An explanation of the formula symbols can be found in the chapter [▷ 17.1].

[1] Observe the protection class of all the components.

2.6.1 Drive selection

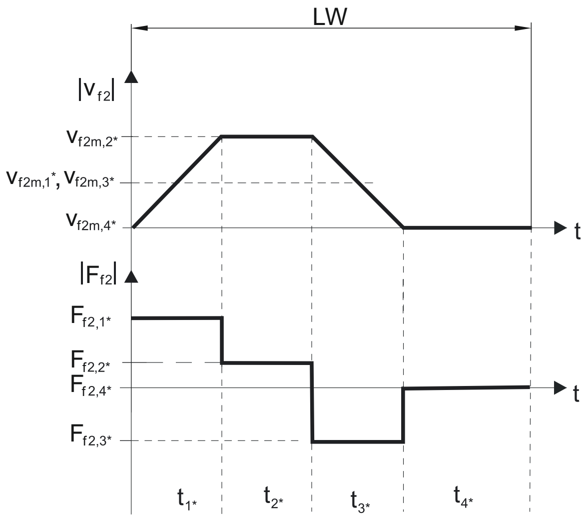


Refer to the selection tables for the values of i, $v_{f2maxDB}$, $v_{f2maxZB}$, F_{f2acc}, F_{f2N} and F_{f2NOT}.

The values for fB_T, fB_{op}, fB_t and fB_{ZB} can be found in the corresponding tables in this chapter.

Example of cyclic operation

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



Calculation of the actual maximum acceleration feed force

$$F_{f2acc^*} = m^* \cdot a^* + F_{L^*}$$

Calculation of the actual average input speed

$$n_{1m^*} = \frac{v_{f2m^*} \cdot i}{d_0 \cdot \pi}$$

$$v_{f2m^*} = \frac{|v_{f2m,1^*}| \cdot t_{1^*} + \ldots + |v_{f2m,n^*}| \cdot t_{n^*}}{t_{1^*} + \ldots + t_{n^*}}$$

If $t_{1^*} + \ldots + t_{3^*} \geq 6$ min, determine v_{2m^*} without the rest phase t_{4^*}.

The values for the ratio i can be found in the selection tables.

Calculation of the actual emergency off feed force

$$F_{f2NOT^*} = m^* \cdot a_{NOT^*} + F_{L^*}$$

Calculation of the actual equivalent feed force

$$F_{f2eq^*} = \sqrt[3]{\frac{|v_{f2m,1^*}| \cdot t_{1^*} \cdot |F_{f2,1^*}{}^3| + \ldots + |v_{f2m,n^*}| \cdot t_{n^*} \cdot |F_{f2,n^*}{}^3|}{|v_{f2m,1^*}| \cdot t_{1^*} + \ldots + |v_{f2m,n^*}| \cdot t_{n^*}}}$$

Calculation of the thermal limit torque

Calculate the thermal limit torque M_{2th} for a duty cycle ED_{10} > 50% and the actual average input speed n_{1m^*}. (At $K_{mot,th} \leq 0$ you must reduce the average input speed n_{1m^*} accordingly or select another geared motor size.)

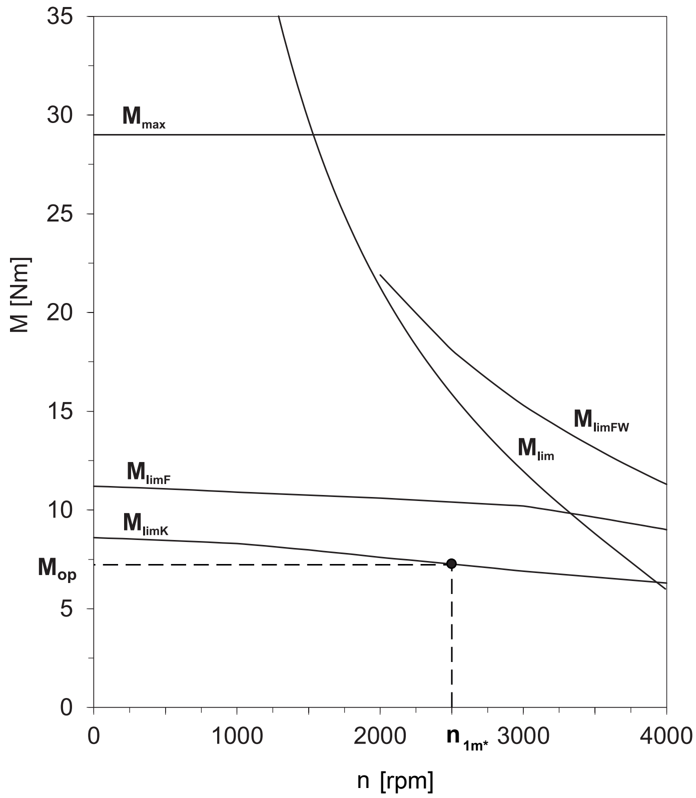
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

$$K_{mot,th} = 0{,}93 - \frac{a_{th}}{1000} \cdot fB_T \cdot \left(\frac{n_{1m^*}}{1000}\right)^3$$

Refer to the selection tables for the values of i and a_{th}.

The values for fB_T can be found in the corresponding table in this chapter.

The value for the torque of the motor at operating point M_{op} with the determined average input speed n_{1m^*} can be found in the motor characteristic curve in the chapter Torque/speed curves. Note the size, nominal speed n_N and cooling type of the motor. The figure below shows an example of reading the torque M_{op} of a motor with convection cooling at the operating point.



Calculation of the actual effective torque

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

$$M_{2,n^*} = \frac{F_{f2,n^*} \cdot d_0}{2}$$

$$M_{1eff^*} = \frac{M_{2eff^*}}{i \cdot \eta}$$

Operating factors

Operating mode	**fB_{op}**
Uniform continuous operation	1.00
Cyclic operation	1.00
Reversing load cyclic operation	1.00

Run time	**fB_t**
Daily runtime ≤ 8 h	1.00
Daily runtime ≤ 16 h	1.15
Daily runtime ≤ 24 h	1.20

Cyclic operation	**fB_{ZB}**
≤ 1000 load changes/hour (LW/h)	1.00
> 1000 load changes/hour (LW/h)	1.15

Temperature		fB_T
Motor cooling	**Surrounding temperature**	
Motor with forced ventilation	≤ 20 °C	0.9
	≤ 30 °C	1.0
	≤ 40 °C	1.15
Motor with convection cooling	≤ 20 °C	1.0
	≤ 30 °C	1.1
	≤ 40 °C	1.25

Notes

- The maximum permitted gearbox temperature (see the "Other product features" chapter) must not be exceeded, as that could result in damage.
- For braking from full speed (for example, when the power fails or when setting up the machine), note the permitted gearbox feed forces (F_{f2acc}, F_{f2NOT}) in the selection tables.

2.6.2 Recommendation for radial shaft seal rings

For a duty cycle > 60% and higher surrounding temperatures, we recommend radial shaft seal rings made of FKM at the output.

Properties:

- Excellent temperature resistance
- High chemical stability
- Very good resistance to aging
- Excellent resistance in oils and greases
- For use in the food, beverage and pharmaceutical industries

Leak-proofness

Our gearboxes are equipped with high-quality radial shaft seal rings and checked for leaks. However, a leak cannot be fully ruled out over the length of use of a gearbox. If you use a gearbox with goods incompatible with the lubricant, you must take measures to prevent direct contact with the gearbox lubricant in case of a leak.

2.7 Additional documentation

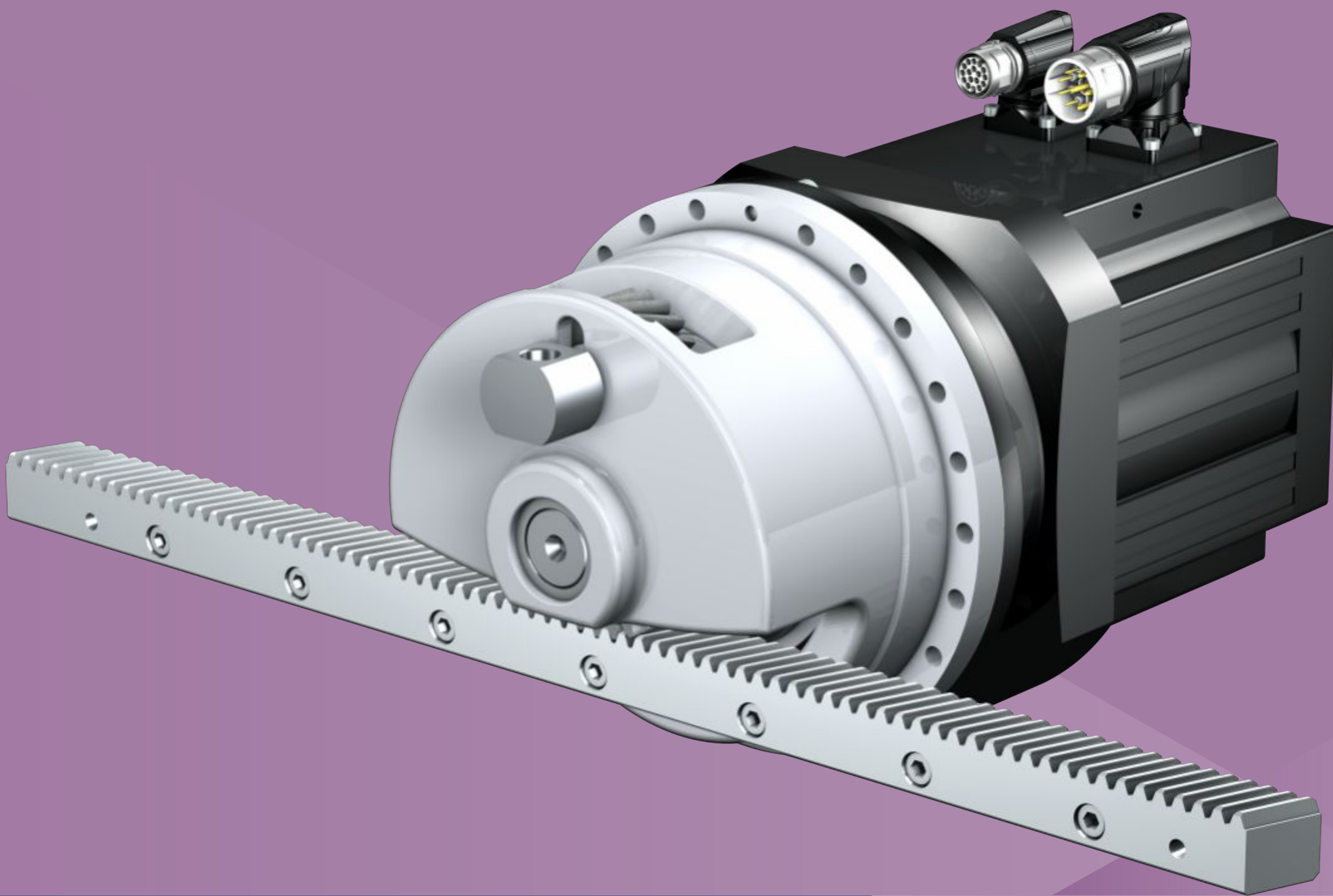
Additional documentation related to the product can be found at http://www.stoeber.de/en/downloads/

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

Documentation	ID
Operating manual gearboxes, geared motors PH33 – PH83, PH94 – PH104	443354_en
Operating manual for EZ synchronous servo motors	443032_en
Operating manual gear racks	443392_en

3 ZTRSPHQ rack and pinion drives

Table of contents



3 Rack and pinion drives

ZTRSPHQ

3.1 Overview

High Force Quattro-Power precision planetary geared motors with supporting bearing holder

Features

Power density	★★★★★
Linear clearance	★★★★☆
Price category	€€€€€
Smooth operation	★★★★☆
Linear rigidity	★★★★★
Mass moment of inertia	★★★★☆
Ready-to-install drive solution	✓
Pinion gearing quality 5 (DIN 3962)	✓
Helical gearing	✓
Case-hardened and smoothed	✓
Radial runout ≤ 10 µm (optional)	✓
Compact and highly dynamic due to direct motor attachment	✓

Key ★☆☆☆☆ good | ★★★★★ excellent
€ Economy | €€€€€ Premium

Technical data

m_n	8 mm
z	19
F_{f2acc}	124 kN
v_{f2}	0.11 – 0.23 m/s
Δs	70 µm

3.2 Selection tables

The technical data specified in the selection tables applies to:

- De-energized installation
- Permanent lubrication with the lubricants recommended in the chapter on gear racks [▶ 13.5.1]
- Case-hardened pinions, helical (left-hand 19° 31' 42"), gearing quality 5
- Installation altitudes up to 1000 m above sea level
- Surrounding temperatures from 0 °C to 40 °C
- Without consideration of the thermal limiting performance
- Drives with convection-cooled motors (e.g. EZ401**U**)

For the technical data on drives with forced ventilated motors (e.g. EZ401**B**), refer to https://configurator.stoeber.de/en-US/

For all other technical data, refer to https://configurator.stoeber.de/en-US/.

An explanation of the formula symbols can be found in the chapter [▶ 17.1].

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTRS8PHQ10 (n_{1N} = 2000 min^{-1}, ($F_{f2acc,max}$ = 124 kN)																	
0.11	65	73	0.5	1.0	ZTRS819SPHQ1043_1500 EZ813U	124	240	10000	150.0	0.14	0.23	70	–	340	8	19	161.3
0.14	52	59	0.5	1.3	ZTRS819SPHQ1043_1200 EZ813U	124	240	10000	120.0	0.14	0.25	70	–	340	8	19	161.3
0.18	42	47	0.6	1.6	ZTRS819SPHQ1043_0960 EZ813U	124	240	10000	96.00	0.18	0.31	70	–	340	8	19	161.3
0.18	62	74	0.9	1.1	ZTRS819SPHQ1043_0960 EZ815U	124	240	10000	96.00	0.18	0.31	70	–	340	8	19	161.3
ZTRS8PHQ10 (n_{1N} = 4000 min^{-1}, ($F_{f2acc,max}$ = 124 kN)																	
0.16	59	102	0.3	1.1	ZTRS819SPHQ1043_2100 EZ813U	124	240	10000	210.0	0.11	0.18	70	–	340	8	19	161.3
0.16	61	157	0.3	1.1	ZTRS819SPHQ1043_2100 EZ815U	124	240	10000	210.0	0.11	0.18	70	–	340	8	19	161.3
0.20	47	82	0.3	1.3	ZTRS819SPHQ1043_1680 EZ813U	124	240	10000	168.0	0.14	0.23	70	–	340	8	19	161.3
0.20	49	126	0.3	1.3	ZTRS819SPHQ1043_1680 EZ815U	124	240	10000	168.0	0.14	0.23	70	–	340	8	19	161.3
0.23	42	73	0.3	1.4	ZTRS819SPHQ1043_1500 EZ813U	124	240	10000	150.0	0.14	0.23	70	–	340	8	19	161.3
0.23	44	112	0.3	1.4	ZTRS819SPHQ1043_1500 EZ815U	124	240	10000	150.0	0.14	0.23	70	–	340	8	19	161.3

3.3 Dimensional drawings

This chapter shows you the dimensions of rack and pinion drives with EZ synchronous servo motors.

Dimension az in the tables of dimensions applies to STOBER gear racks. In general: az = ½ d0 + h0 + x*mn

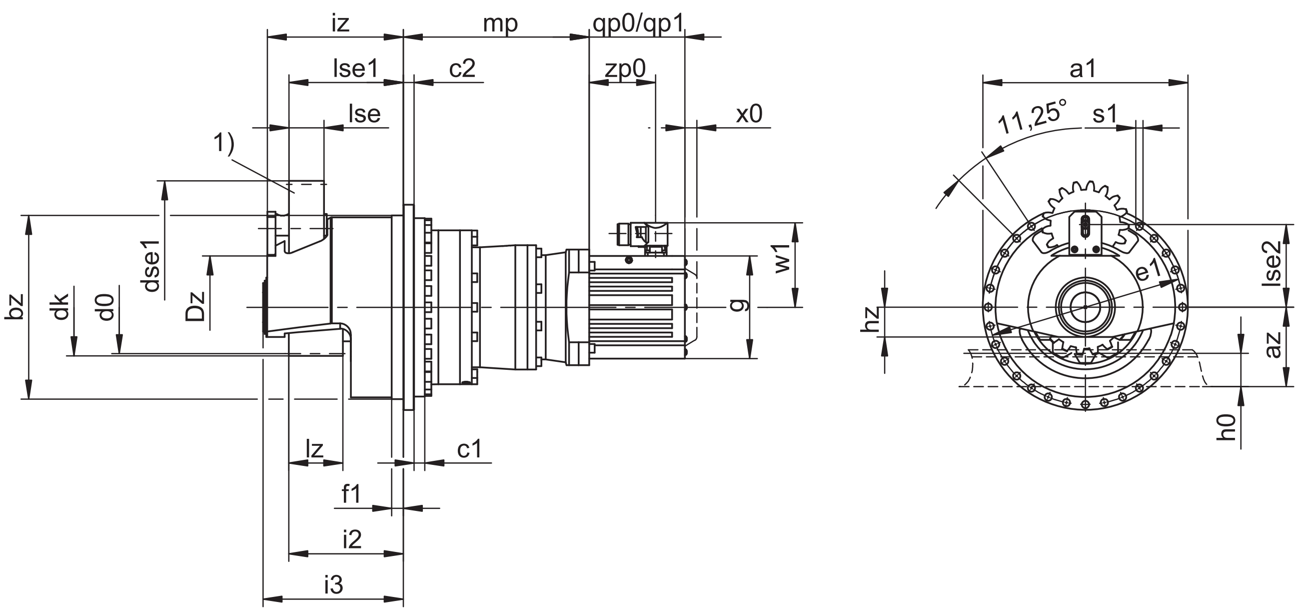
The pinion is helical (left-hand 19° 31' 42"). The pinion gearing quality is 5.

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 https://configurator.stoeber.de/en-US/.

Combination options and the dimensions of forced ventilated geared motors can also be found at https://configurator.stoeber.de/en-US/.



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x0	Applies to encoders using an optical measuring method.	w1	Different for the One Cable Solution (OCS), see the chapter [▹ 14.4]

1) Felt gear for lubrication (option)

Dimensions of gearboxes

Type	mn	∅a1	az	∅bz	c1	c2	∅d0	∅dk	∅dse1	∅Dz	∅e1	f1	i2	i3	iz	h0	hz	lz	lse	lse1	lse2	∅s1	x
ZTRS819SPHQ10_	8	380	151.64	340_{h7}	20	20	161.28	177.3	160	110	360	21.5	212	260	251.9	71	55	100	65	211.7	152.8	13.5	0.00

Dimensions of motors

Type	□g	qp0	qp1	w1	x0	zp0
EZ813U	190	238	315	156.5	22	184
EZ815U	190	320	397	156.5	22	266

Dimensions of geared motors

Type	EZ8 mp
ZTRS_PHQ1043_	344.5

3.4 Type designation

In this chapter, you will find an explanation of the type designation with the associated options.

Additional ordering information not included in the type designation can be found at the end of the chapter.

Example code

Z	TRS	8	19	S	PHQ	10	4	3	F	1680	EZ813U

Explanation

Code	Designation	Design
Z	Type	Rack and pinion gearbox
TRS	Design	Screwed flange pinion with supporting bearing holder
8	Normal module	m_n = 8 mm (example)
19	Number of teeth	z = 19 (example)
S SF	Helix angle	Left-hand 19° 31' 42" Left-hand 19° 31' 42" with felt gear for lubrication
PHQ	Type	Planetary gearbox
10	Size	10 (example)
4	Generation	Generation 4
3	Stages	Three-stage
F	Shaft	Flange shaft
1680	Transmission ratio (i x 10)	i = 168 (example)
EZ813U	Motor	EZ synchronous servo motor

To complete the type designation, also specify the following in your order:

- A detailed type designation of the motor, see the chapter [▷ 14.5]
- Mounting position (for three-stage gearboxes), see the chapter [▷ 3.5.5]
- Position of the plug connectors, see the chapter [▷ 3.5.6]
- Radial shaft seal rings at the output made of NBR or FKM (option), see the chapter [▷ 3.6.2]
- Radial runout ≤ 10 µm (optional)
- Reverse operation of the output shaft from ±20° to ±90° for horizontal installation on request

This catalog shows you all the information on rack and pinion drives with EZ synchronous servo motors. All input options available on request are shown in the chapter [▷ 3.5.1].

To make selecting your rack and pinion drive easy, use our STOBER Configurator at https://configurator.stoeber.de/en-US/.

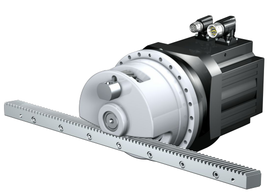
A detailed description of the nameplate, see the chapter [▷ 14.5.1].

3.5 Product description

3.5.1 Input options

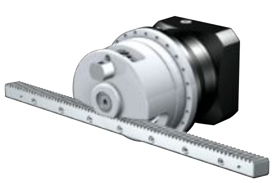
This chapter shows you all available input options:

EZ synchronous servo motor



Catalog ID 443286_en

Motor adapter



Catalog ID 443137_en

K right-angle input with ME motor adapter

On request

MB motor adapter

On request

The corresponding catalogs can be found at http://www.stoeber.de/en/downloads/

Enter the ID of the catalog in the Search term field.

3.5.2 Gear rack

The gear rack used must have a right-hand design (19° 31' 42"); the load capacity must not be exceeded.

3.5.3 Installation conditions

The torque and force values listed in this catalog are valid under the following conditions:

- When the gear housing is fastened on the machine side using screws of strength class 12.9
- When the gear housings are adjusted at pilot øbz. The machine-side fit must be H7.

3.5.4 Lubricants

STOBER fills the gearboxes with the amount and type of lubricant specified on the nameplate. The filling volume and the structure of the gearboxes depend on the mounting position.

Only install the gearboxes in the intended mounting position! Reposition the gearboxes only after consulting STOBER. Otherwise, STOBER assumes no liability for the gearboxes.

You will receive lubricants for use in the food industry upon request.

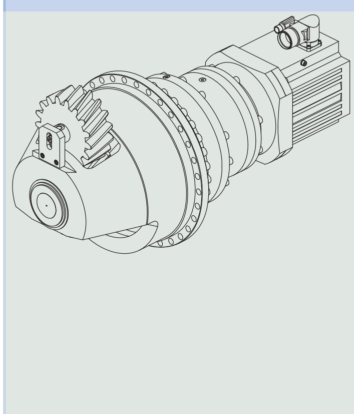
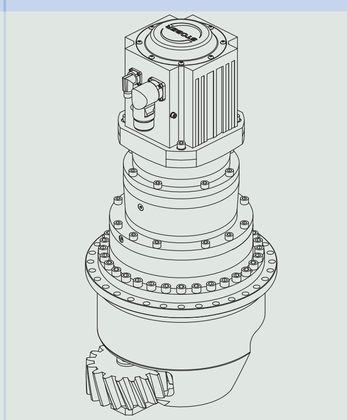
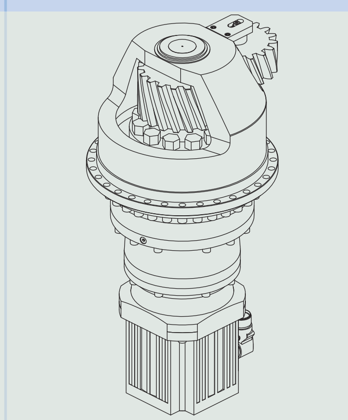
3.5.4.1 Lubrication of rack and pinion gearbox

Ensure permanent lubrication with the lubricants recommended in the chapter [▸ 13.5.1].

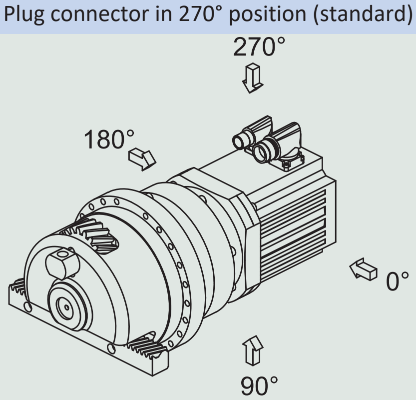
3.5.5 Mounting positions

The following table shows the standard mounting positions.

Please indicate the mounting position when ordering three-stage geared motors.

EL1	EL5	EL6
		
Horizontal output	Vertical downward output	Vertical upward output

3.5.6 Position of the plug connectors

Plug connector in 270° position (standard)


The plug connectors are in the 270° position as standard. Indicate variations for your rack and pinion drive in the order.

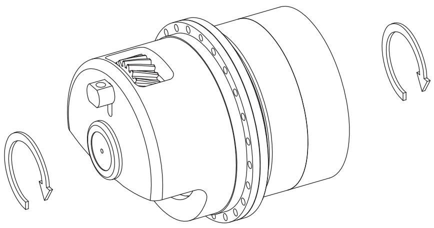
Note that the plug connectors also rotate when the gear rack is rotated to a different position.

3.5.7 Other product features

Feature	Value
Max. permitted gearbox temperature (on the surface of the gearbox)	≤ 90 °C
Paint	Black RAL 9005
(ATEX) Directive 2014/34/EU (Option)	Not suitable.
Protection class: [1]	
Planetary gearboxes	IP65
Motor	IP56, optionally IP66
Pinion/gear rack	IPXX

3.5.8 Direction of rotation

The input and output rotate in the same direction.



3.6 Project configuration

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It is the most convenient and reliable method of drive selection, as the entire torque/speed curve of the application is displayed and evaluated here in the curve of the geared motor.

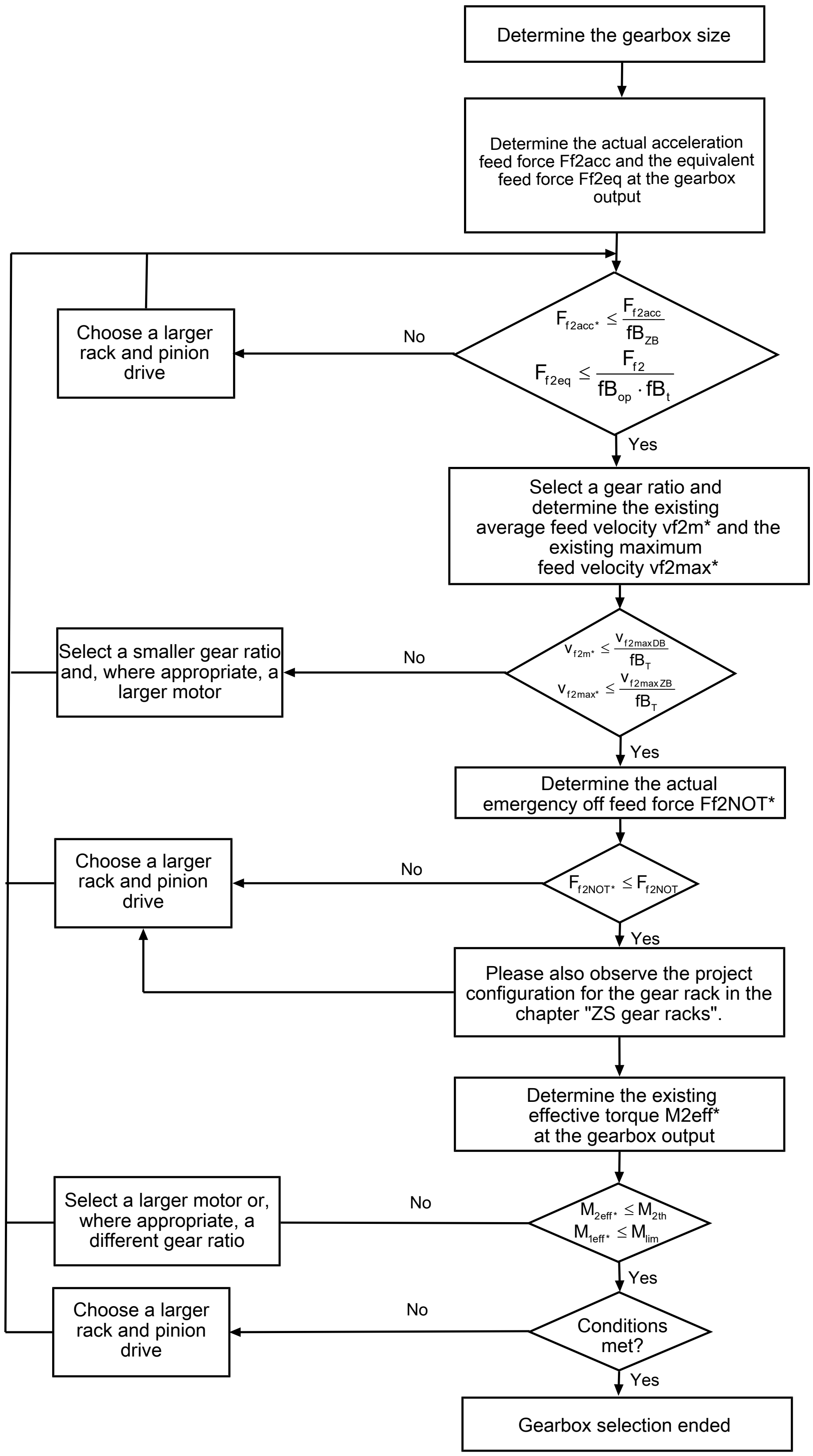
In this chapter, only limit values for specific operating points can be taken into consideration for manual drive selection.

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

An explanation of the formula symbols can be found in the chapter [▹ 17.1].

[1] Observe the protection class of all the components.

3.6.1 Drive selection

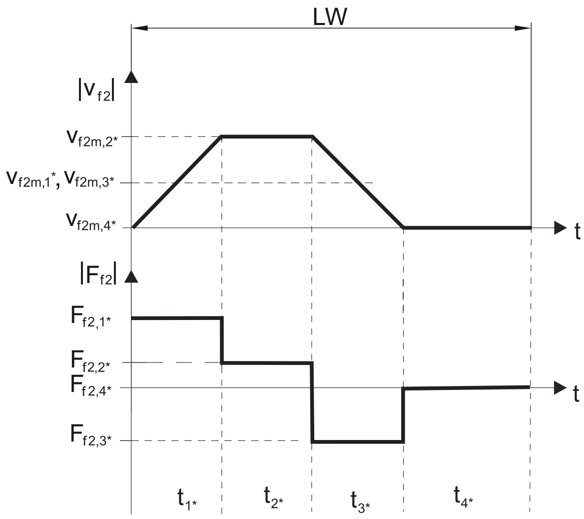


Refer to the selection tables for the values of i, $v_{f2maxDB}$, $v_{f2maxZB}$, F_{f2acc}, F_{f2N} and F_{f2NOT}.

The values for fB_T, fB_{op}, fB_t and fB_{ZB} can be found in the corresponding tables in this chapter.

Example of cyclic operation

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



Calculation of the actual maximum acceleration feed force

$$F_{f2acc^*} = m^* \cdot a^* + F_{L^*}$$

Calculation of the actual average input speed

$$n_{1m^*} = \frac{v_{f2m^*} \cdot i}{d_0 \cdot \pi}$$

$$v_{f2m^*} = \frac{\left|v_{f2m,1^*}\right| \cdot t_{1^*} + \ldots + \left|v_{f2m,n^*}\right| \cdot t_{n^*}}{t_{1^*} + \ldots + t_{n^*}}$$

If $t_{1^*} + \ldots + t_{3^*} \geq 6$ min, determine v_{2m^*} without the rest phase t_{4^*}.

The values for the ratio i can be found in the selection tables.

Calculation of the actual emergency off feed force

$$F_{f2NOT^*} = m^* \cdot a_{NOT^*} + F_{L^*}$$

Calculation of the actual equivalent feed force

$$F_{f2eq^*} = \sqrt[3]{\frac{\left|v_{f2m,1^*}\right| \cdot t_{1^*} \cdot \left|F_{f2,1^*}{}^3\right| + \ldots + \left|v_{f2m,n^*}\right| \cdot t_{n^*} \cdot \left|F_{f2,n^*}{}^3\right|}{\left|v_{f2m,1^*}\right| \cdot t_{1^*} + \ldots + \left|v_{f2m,n^*}\right| \cdot t_{n^*}}}$$

Calculation of the thermal limit torque

Calculate the thermal limit torque M_{2th} for a duty cycle $ED_{10} > 50\%$ and the actual average input speed n_{1m^*}. (At $K_{mot,th} \leq 0$ you must reduce the average input speed n_{1m^*} accordingly or select another geared motor size.)

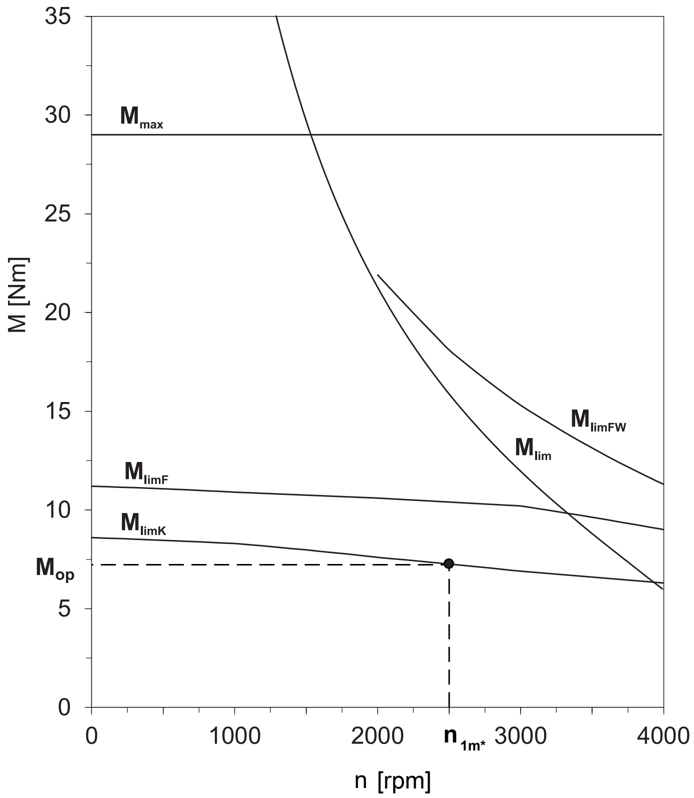
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

$$K_{mot,th} = 0{,}93 - \frac{a_{th}}{1000} \cdot fB_T \cdot \left(\frac{n_{1m^*}}{1000}\right)^3$$

Refer to the selection tables for the values of i and a_{th}.

The values for fB_T can be found in the corresponding table in this chapter.

The value for the torque of the motor at operating point M_{op} with the determined average input speed n_{1m*} can be found in the motor characteristic curve in the chapter Torque/speed curves. Note the size, nominal speed n_N and cooling type of the motor. The figure below shows an example of reading the torque M_{op} of a motor with convection cooling at the operating point.



Calculation of the actual effective torque

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

$$M_{2,n*} = \frac{F_{f2,n*} \cdot d_0}{2}$$

$$M_{1eff*} = \frac{M_{2eff*}}{i \cdot \eta}$$

Operating factors

Operating mode	fB_{op}
Uniform continuous operation	1.00
Cyclic operation	1.00
Reversing load cyclic operation	1.00

Run time	fB_t
Daily runtime ≤ 8 h	1.00
Daily runtime ≤ 16 h	1.15
Daily runtime ≤ 24 h	1.20

Cyclic operation	fB_{ZB}
≤ 1000 load changes/hour (LW/h)	1.00
> 1000 load changes/hour (LW/h)	1.15

Temperature		fB_T
Motor cooling	**Surrounding temperature**	
Motor with forced ventilation	≤ 20 °C	0.9
	≤ 30 °C	1.0
	≤ 40 °C	1.15
Motor with convection cooling	≤ 20 °C	1.0
	≤ 30 °C	1.1
	≤ 40 °C	1.25

Notes

- The maximum permitted gearbox temperature (see the "Other product features" chapter) must not be exceeded, as that could result in damage.
- For braking from full speed (for example, when the power fails or when setting up the machine), note the permitted gearbox feed forces (F_{f2acc}, F_{f2NOT}) in the selection tables.

3.6.2 Recommendation for radial shaft seal rings

For a duty cycle > 60% and higher surrounding temperatures, we recommend radial shaft seal rings made of FKM at the output.

Properties:

- Excellent temperature resistance
- High chemical stability
- Very good resistance to aging
- Excellent resistance in oils and greases
- For use in the food, beverage and pharmaceutical industries

Leak-proofness

Our gearboxes are equipped with high-quality radial shaft seal rings and checked for leaks. However, a leak cannot be fully ruled out over the length of use of a gearbox. If you use a gearbox with goods incompatible with the lubricant, you must take measures to prevent direct contact with the gearbox lubricant in case of a leak.

3.7 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 term field.

Documentation	ID
Operating manual gearboxes, geared motors PHQ43 – PHQ83, PHQ94 – PHQ124	443353_en
Operating manual for EZ synchronous servo motors	443032_en
Operating manual gear racks	443392_en

4 ZTRSPHV rack and pinion drives

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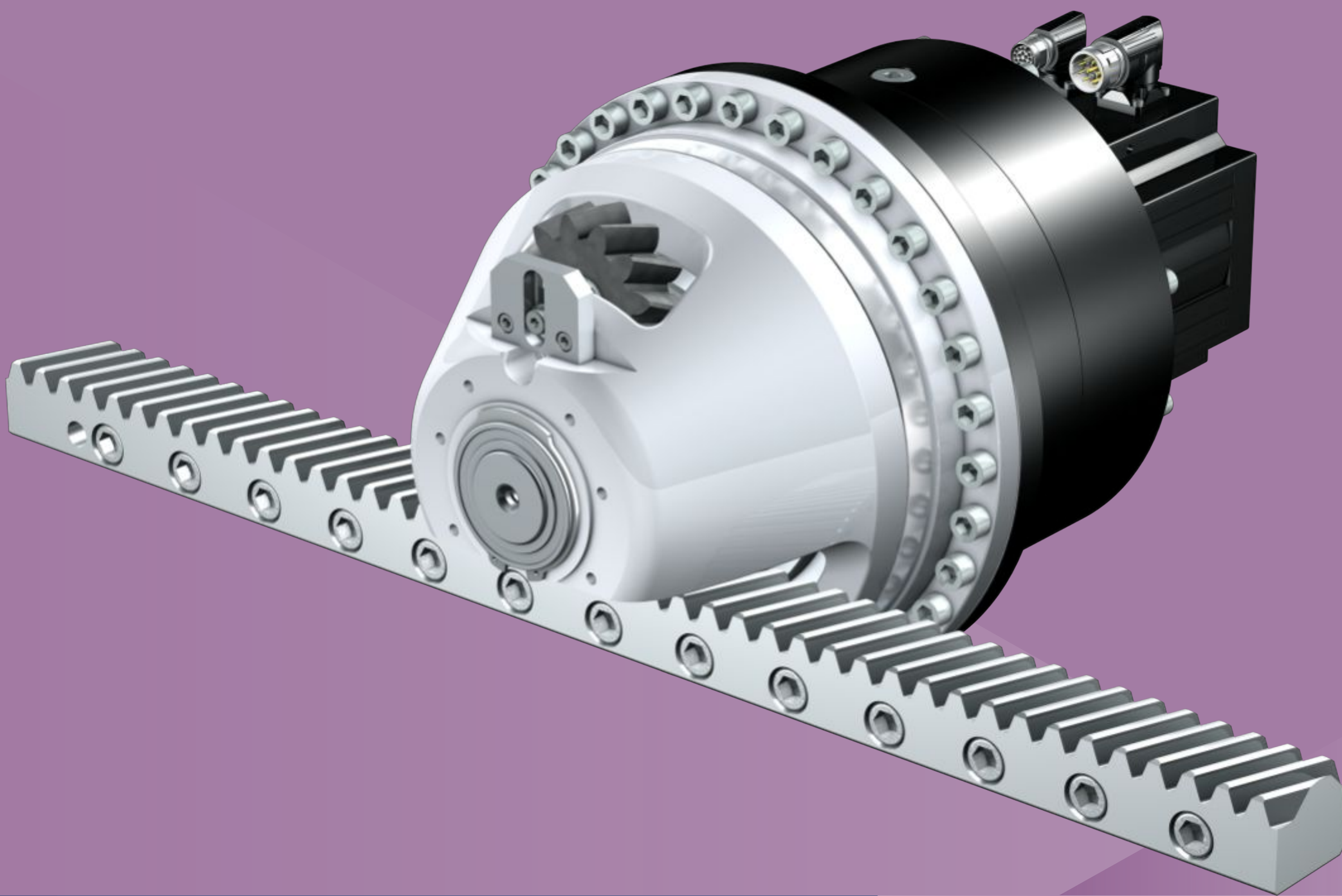


4 Rack and pinion drives

ZTRSPHV

4.1 Overview

High Force precision planetary geared motors with supporting bearing holder

Features

Power density	★★★★★
Linear clearance	★★★★☆
Price category	€€€€€
Smooth operation	★★★★☆
Linear rigidity	★★★★★
Mass moment of inertia	★★★★☆
Ready-to-install drive solution	✓
Pinion gearing quality 5 (DIN 3962)	✓
Helical gearing	✓
Case-hardened and smoothed	✓
Radial runout ≤ 10 µm (optional)	✓
Compact and highly dynamic due to direct motor attachment	✓

Key ★☆☆☆☆ good | ★★★★★ excellent
€ Economy | €€€€€ Premium

Technical data

m_n	5 – 8 mm
z	15 – 20
F_{f2acc}	26 – 77 kN
v_{f2}	0.14 – 0.49 m/s
Δs	15 – 56 µm

4.2 Selection tables

The technical data specified in the selection tables applies to:

- De-energized installation
- Permanent lubrication with the lubricants recommended in the chapter on gear racks [▷ 13.5.1]
- Case-hardened pinions, helical (left-hand 19° 31' 42"), gearing quality 5
- Installation altitudes up to 1000 m above sea level
- Surrounding temperatures from 0 °C to 40 °C
- Without consideration of the thermal limiting performance
- Drives with convection-cooled motors (e.g. EZ401**U**)

For the technical data on drives with forced ventilated motors (e.g. EZ401**B**), refer to https://configurator.stoeber.de/en-US/

For all other technical data, refer to https://configurator.stoeber.de/en-US/.

An explanation of the formula symbols can be found in the chapter [▷ 17.1].

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTRS5PHV9 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 77 kN)																	
0.14	15	17	0.2	3.1	ZTRS520SPHV943_1210 EZ701U	41	154	2178	121.0	0.12	0.21	46	15	350	5	20	106.1
0.14	25	30	0.4	1.9	ZTRS520SPHV943_1210 EZ702U	77	154	4075	121.0	0.12	0.21	46	15	350	5	20	106.1
0.14	34	43	0.5	1.4	ZTRS520SPHV943_1210 EZ703U	77	154	4075	121.0	0.12	0.21	46	15	350	5	20	106.1
0.14	44	62	0.7	1.1	ZTRS520SPHV943_1210 EZ705U	77	154	4075	121.0	0.12	0.21	46	15	350	5	20	106.1
0.18	11	13	0.3	4.1	ZTRS520SPHV943_0910 EZ701U	31	154	1638	91.00	0.15	0.28	46	15	355	5	20	106.1
0.18	19	22	0.4	2.5	ZTRS520SPHV943_0910 EZ702U	63	154	3358	91.00	0.15	0.28	46	15	355	5	20	106.1
0.18	25	32	0.6	1.9	ZTRS520SPHV943_0910 EZ703U	77	154	4075	91.00	0.15	0.28	46	15	355	5	20	106.1
0.18	33	47	0.8	1.4	ZTRS520SPHV943_0910 EZ705U	77	154	4075	91.00	0.15	0.28	46	15	355	5	20	106.1
0.27	12	15	0.5	3.8	ZTRS520SPHV943_0610 EZ702U	42	154	2251	61.00	0.23	0.41	46	15	357	5	20	106.1
0.27	17	22	0.7	2.8	ZTRS520SPHV943_0610 EZ703U	67	154	3569	61.00	0.23	0.41	46	15	357	5	20	106.1
0.27	22	31	1.0	2.1	ZTRS520SPHV943_0610 EZ705U	77	154	4075	61.00	0.23	0.41	46	15	357	5	20	106.1
ZTRS5PHV9 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 77 kN)																	
0.21	25	41	0.4	1.7	ZTRS520SPHV943_1210 EZ703U	77	154	4075	121.0	0.12	0.21	46	15	350	5	20	106.1
0.21	34	62	0.6	1.3	ZTRS520SPHV943_1210 EZ705U	77	154	4075	121.0	0.12	0.21	46	15	350	5	20	106.1
0.28	19	31	0.5	2.3	ZTRS520SPHV943_0910 EZ703U	77	154	4075	91.00	0.15	0.28	46	15	355	5	20	106.1
0.28	25	46	0.7	1.7	ZTRS520SPHV943_0910 EZ705U	77	154	4075	91.00	0.15	0.28	46	15	355	5	20	106.1
0.41	13	21	0.6	3.4	ZTRS520SPHV943_0610 EZ703U	67	154	3569	61.00	0.23	0.41	46	15	357	5	20	106.1
0.41	17	31	0.8	2.5	ZTRS520SPHV943_0610 EZ705U	77	154	4075	61.00	0.23	0.41	46	15	357	5	20	106.1
ZTRS6PHV9 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 67 kN)																	
0.17	13	14	0.2	3.1	ZTRS620SPHV943_1210 EZ701U	34	141	2178	121.0	0.14	0.25	56	19	314	6	20	127.3
0.17	21	25	0.4	1.9	ZTRS620SPHV943_1210 EZ702U	67	141	4250	121.0	0.14	0.25	56	19	314	6	20	127.3
0.17	28	36	0.5	1.4	ZTRS620SPHV943_1210 EZ703U	67	141	4250	121.0	0.14	0.25	56	19	314	6	20	127.3
0.17	36	52	0.7	1.1	ZTRS620SPHV943_1210 EZ705U	67	141	4250	121.0	0.14	0.25	56	19	314	6	20	127.3
0.22	9.5	11	0.3	4.1	ZTRS620SPHV943_0910 EZ701U	26	141	1638	91.00	0.18	0.33	56	19	320	6	20	127.3
0.22	15	19	0.4	2.5	ZTRS620SPHV943_0910 EZ702U	53	141	3358	91.00	0.18	0.33	56	19	320	6	20	127.3
0.22	21	27	0.6	1.9	ZTRS620SPHV943_0910 EZ703U	67	141	4250	91.00	0.18	0.33	56	19	320	6	20	127.3
0.22	27	39	0.8	1.4	ZTRS620SPHV943_0910 EZ705U	67	141	4250	91.00	0.18	0.33	56	19	320	6	20	127.3
0.33	10	12	0.5	3.8	ZTRS620SPHV943_0610 EZ702U	35	141	2251	61.00	0.27	0.49	56	19	322	6	20	127.3
0.33	14	18	0.7	2.8	ZTRS620SPHV943_0610 EZ703U	56	141	3569	61.00	0.27	0.49	56	19	322	6	20	127.3
0.33	18	26	1.0	2.1	ZTRS620SPHV943_0610 EZ705U	67	141	4250	61.00	0.27	0.49	56	19	322	6	20	127.3
ZTRS6PHV9 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 67 kN)																	
0.25	21	34	0.4	1.7	ZTRS620SPHV943_1210 EZ703U	67	141	4250	121.0	0.14	0.25	56	19	314	6	20	127.3
0.25	28	51	0.6	1.3	ZTRS620SPHV943_1210 EZ705U	67	141	4250	121.0	0.14	0.25	56	19	314	6	20	127.3
0.33	16	26	0.5	2.3	ZTRS620SPHV943_0910 EZ703U	67	141	4250	91.00	0.18	0.33	56	19	320	6	20	127.3
0.33	21	39	0.7	1.7	ZTRS620SPHV943_0910 EZ705U	67	141	4250	91.00	0.18	0.33	56	19	320	6	20	127.3
0.49	10	17	0.6	3.4	ZTRS620SPHV943_0610 EZ703U	56	141	3569	61.00	0.27	0.49	56	19	322	6	20	127.3
0.49	14	26	0.8	2.5	ZTRS620SPHV943_0610 EZ705U	67	141	4250	61.00	0.27	0.49	56	19	322	6	20	127.3
ZTRS8PHV9 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 67 kN)																	
0.17	13	14	0.2	3.1	ZTRS815SPHV943_1210 EZ701U	34	141	2178	121.0	0.14	0.25	56	19	327	8	15	127.3
0.17	21	25	0.4	1.9	ZTRS815SPHV943_1210 EZ702U	67	141	4250	121.0	0.14	0.25	56	19	327	8	15	127.3
0.17	28	36	0.5	1.4	ZTRS815SPHV943_1210 EZ703U	67	141	4250	121.0	0.14	0.25	56	19	327	8	15	127.3
0.17	36	52	0.7	1.1	ZTRS815SPHV943_1210 EZ705U	67	141	4250	121.0	0.14	0.25	56	19	327	8	15	127.3
0.22	9.5	11	0.3	4.1	ZTRS815SPHV943_0910 EZ701U	26	141	1638	91.00	0.18	0.33	56	19	334	8	15	127.3
0.22	15	19	0.4	2.5	ZTRS815SPHV943_0910 EZ702U	53	141	3358	91.00	0.18	0.33	56	19	334	8	15	127.3
0.22	21	27	0.6	1.9	ZTRS815SPHV943_0910 EZ703U	67	141	4250	91.00	0.18	0.33	56	19	334	8	15	127.3
0.22	27	39	0.8	1.4	ZTRS815SPHV943_0910 EZ705U	67	141	4250	91.00	0.18	0.33	56	19	334	8	15	127.3
0.33	10	12	0.5	3.8	ZTRS815SPHV943_0610 EZ702U	35	141	2251	61.00	0.27	0.49	56	19	336	8	15	127.3

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTRS8PHV9 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 67 kN)																	
0.33	14	18	0.7	2.8	ZTRS815SPHV943_0610 EZ703U	56	141	3569	61.00	0.27	0.49	56	19	336	8	15	127.3
0.33	18	26	1.0	2.1	ZTRS815SPHV943_0610 EZ705U	67	141	4250	61.00	0.27	0.49	56	19	336	8	15	127.3
ZTRS8PHV9 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 67 kN)																	
0.25	21	34	0.4	1.7	ZTRS815SPHV943_1210 EZ703U	67	141	4250	121.0	0.14	0.25	56	19	327	8	15	127.3
0.25	28	51	0.6	1.3	ZTRS815SPHV943_1210 EZ705U	67	141	4250	121.0	0.14	0.25	56	19	327	8	15	127.3
0.33	16	26	0.5	2.3	ZTRS815SPHV943_0910 EZ703U	67	141	4250	91.00	0.18	0.33	56	19	334	8	15	127.3
0.33	21	39	0.7	1.7	ZTRS815SPHV943_0910 EZ705U	67	141	4250	91.00	0.18	0.33	56	19	334	8	15	127.3
0.49	10	17	0.6	3.4	ZTRS815SPHV943_0610 EZ703U	56	141	3569	61.00	0.27	0.49	56	19	336	8	15	127.3
0.49	14	26	0.8	2.5	ZTRS815SPHV943_0610 EZ705U	67	141	4250	61.00	0.27	0.49	56	19	336	8	15	127.3

4.3 Dimensional drawings

This chapter shows you the dimensions of rack and pinion drives with EZ synchronous servo motors.

Dimension az in the tables of dimensions applies to STOBER gear racks. In general: az = ½ d0 + h0 + x*mn

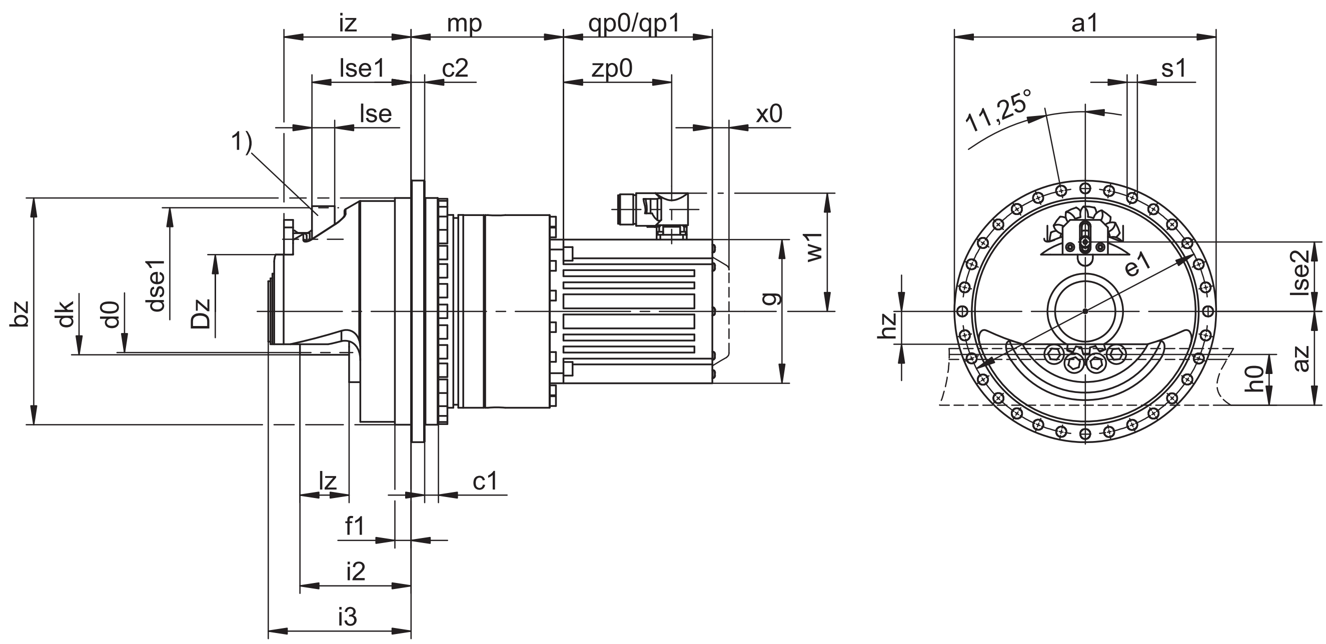
The pinion is helical (left-hand 19° 31' 42"). The pinion gearing quality is 5.

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 https://configurator.stoeber.de/en-US/.

Combination options and the dimensions of forced ventilated geared motors can also be found at https://configurator.stoeber.de/en-US/.



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x0	Applies to encoders using an optical measuring method.	w1	Different for the One Cable Solution (OCS), see the chapter [▶ 14.4]

1) Felt gear for lubrication (option)

Dimensions of gearboxes

Type	mn	Øa1	az	Øbz	c1	c2	Ød0	Ødk	Ødse1	ØDz	Øe1	f1	i2	i3	iz	h0	hz	lz	lse	lse1	lse2	Øs1	x
ZTRS520SPHV9_	5	346	87.05	300$_{h7}$	18	18	106.10	116.1	78.6	100	325	21.5	137	179.0	171.0	34	45.0	55	30	131.1	87.1	13.5	0.00
ZTRS620SPHV9_	6	346	106.66	300$_{h7}$	18	18	127.32	139.3	94.2	100	325	21.5	147	189.0	181.0	43	43.5	65	30	131.1	104.8	13.5	0.00
ZTRS815SPHV9_	8	346	136.66	300$_{h7}$	18	18	127.32	147.3	160.0	110	325	21.5	162	204.7	196.5	71	55.0	80	65	162.0	137.7	13.5	0.25

Dimensions of motors

Type	□g	qp0	qp1	w1	x0	zp0
EZ701U	145	102	161	115	22	64
EZ702U	145	127	186	115	22	89
EZ703U	145	152	211	115	22	114
EZ705U	145	207	266	134	22	165

Dimensions of geared motors

Type	EZ7
	mp
ZTRS_PHV943_	192

4.4 Type designation

In this chapter, you will find an explanation of the type designation with the associated options.

Additional ordering information not included in the type designation can be found at the end of the chapter.

Example code

Z	TRS	6	20	S	PHV	9	4	3	S	F	S	S	0910	EZ703U

Explanation

Code	Designation	Design
Z	Type	Rack and pinion gearbox
TRS	Design	Screwed flange pinion with supporting bearing holder
6	Normal module	m_n = 6 mm (example)
20	Number of teeth	z = 20 (example)
S SF	Helix angle	Left-hand 19° 31' 42" Left-hand 19° 31' 42" with felt gear for lubrication
PHV	Type	Planetary gearbox
9	Size	9 (example)
4	Generation	Generation 4
3	Stages	Three-stage
S	Housing	Standard
F	Shaft	Flange shaft
S V	Bearing	Standard bearing Reinforced bearing (PH3 – PH5)
S R	Backlash	Standard Reduced (PHV9)
0910	Transmission ratio (i x 10)	i = 91 (example)
EZ703U	Motor	EZ synchronous servo motor

To complete the type designation, also specify the following in your order:

- A detailed type designation of the motor, see the chapter [▹ 14.5]
- Position of the plug connectors, see the chapter [▹ 4.5.5]
- Radial shaft seal rings at the output made of NBR or FKM (option), see the chapter [▹ 4.6.2]
- Radial runout ≤ 10 µm (optional)
- Reverse operation of the output shaft from ±20° to ±90° for horizontal installation on request

This catalog shows you all the information on rack and pinion drives with EZ synchronous servo motors. All input options available on request are shown in the chapter [▹ 4.5.1].

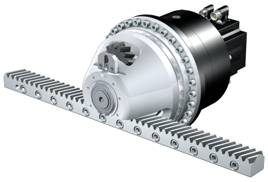
To make selecting your rack and pinion drive easy, use our STOBER Configurator at https://configurator.stoeber.de/en-US/.

A detailed description of the nameplate, see the chapter [▹ 14.5.1].

4.5 Product description

4.5.1 Input options

This chapter shows you all available input options:

EZ synchronous servo motor	Motor adapter
	
Catalog ID 443286_en	Catalog ID 443137_en

The corresponding catalogs can be found at http://www.stoeber.de/en/downloads/

Enter the ID of the catalog in the Search term field.

4.5.2 Gear rack

The gear rack used must have a right-hand design (19° 31' 42"); the load capacity must not be exceeded.

4.5.3 Installation conditions

The torque and force values listed in this catalog are valid under the following conditions:

- When the gear housing is fastened on the machine side using screws of strength class 12.9
- When the gear housings are adjusted at pilot øbz. The machine-side fit must be H7.

4.5.4 Lubricants

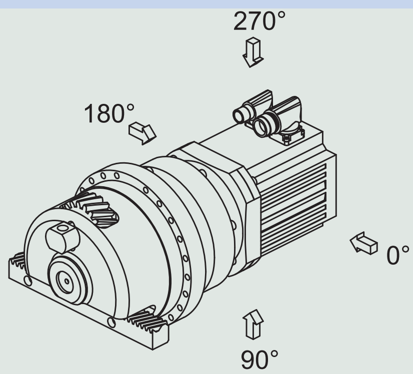
STOBER fills the gearboxes with the amount and type of lubricant specified on the nameplate.

You will receive lubricants for use in the food industry upon request.

4.5.4.1 Lubrication of rack and pinion gearbox

Ensure permanent lubrication with the lubricants recommended in the chapter [▶ 13.5.1].

4.5.5 Position of the plug connectors

Plug connector in 270° position (standard)


The plug connectors are in the 270° position as standard. Indicate variations for your rack and pinion drive in the order.

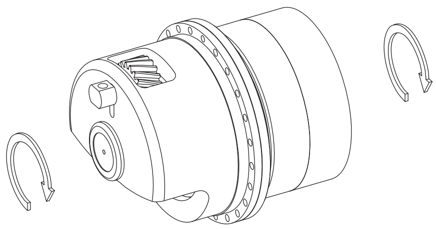
Note that the plug connectors also rotate when the gear rack is rotated to a different position.

4.5.6 Other product features

Feature	Value
Max. permitted gearbox temperature (on the surface of the gearbox)	≤ 90 °C
Paint	Black RAL 9005
(ATEX) Directive 2014/34/EU (Option)	Not suitable.
Protection class: [1]	
Planetary gearboxes	IP65
Motor	IP56, optionally IP66
Pinion/gear rack	IPXX

4.5.7 Direction of rotation

The input and output rotate in the same direction.



4.6 Project configuration

Project your drives using our SERVOsoft designing software. Download SERVOsoft free of charge after registration at https://www.stoeber.de/en/services/info-servosoft/.

It is the most convenient and reliable method of drive selection, as the entire torque/speed curve of the application is displayed and evaluated here in the curve of the geared motor.

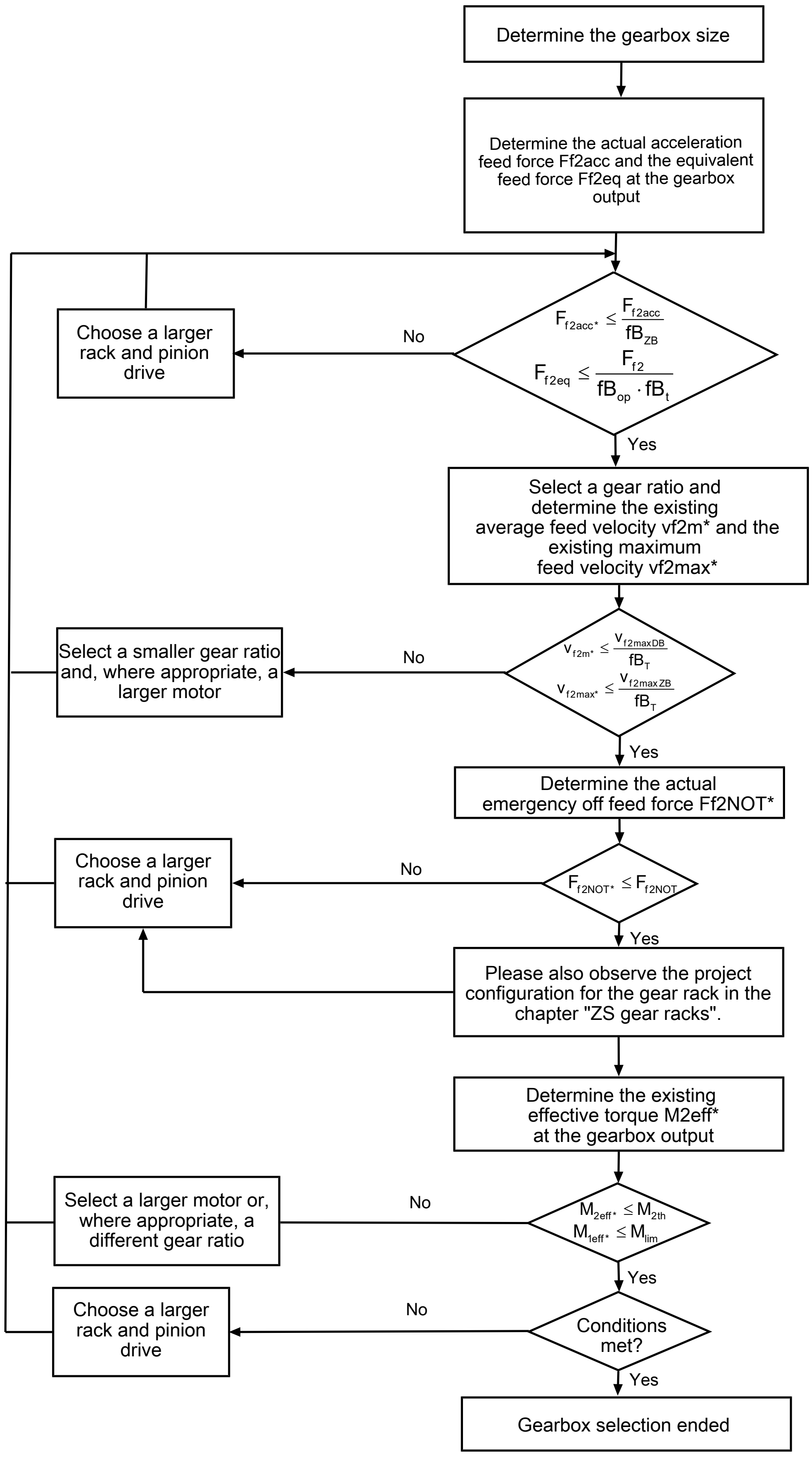
In this chapter, only limit values for specific operating points can be taken into consideration for manual drive selection.

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

An explanation of the formula symbols can be found in the chapter [▸ 17.1].

[1] Observe the protection class of all the components.

4.6.1 Drive selection

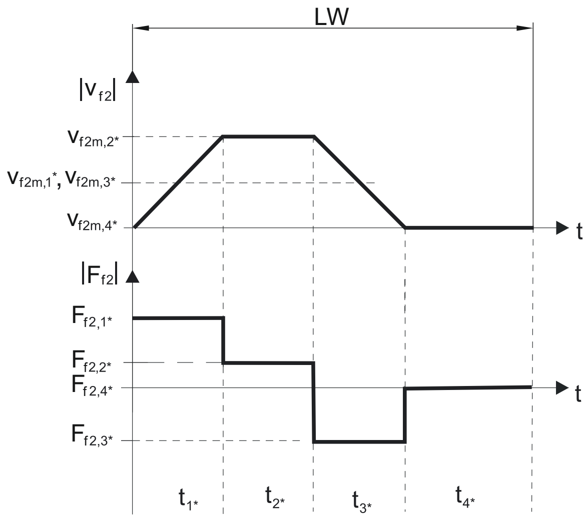


Refer to the selection tables for the values of i, $v_{f2maxDB}$, $v_{f2maxZB}$, F_{f2acc}, F_{f2N} and F_{f2NOT}.

The values for fB_T, fB_{op}, fB_t and fB_{ZB} can be found in the corresponding tables in this chapter.

Example of cyclic operation

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



Calculation of the actual maximum acceleration feed force

$$F_{f2acc^*} = m^* \cdot a^* + F_{L^*}$$

Calculation of the actual average input speed

$$n_{1m^*} = \frac{v_{f2m^*} \cdot i}{d_0 \cdot \pi}$$

$$v_{f2m^*} = \frac{|v_{f2m,1^*}| \cdot t_{1^*} + \ldots + |v_{f2m,n^*}| \cdot t_{n^*}}{t_{1^*} + \ldots + t_{n^*}}$$

If $t_{1^*} + \ldots + t_{3^*} \geq 6$ min, determine v_{2m^*} without the rest phase t_{4^*}.

The values for the ratio i can be found in the selection tables.

Calculation of the actual emergency off feed force

$$F_{f2NOT^*} = m^* \cdot a_{NOT^*} + F_{L^*}$$

Calculation of the actual equivalent feed force

$$F_{f2eq^*} = \sqrt[3]{\frac{|v_{f2m,1^*}| \cdot t_{1^*} \cdot |F_{f2,1^*}{}^3| + \ldots + |v_{f2m,n^*}| \cdot t_{n^*} \cdot |F_{f2,n^*}{}^3|}{|v_{f2m,1^*}| \cdot t_{1^*} + \ldots + |v_{f2m,n^*}| \cdot t_{n^*}}}$$

Calculation of the thermal limit torque

Calculate the thermal limit torque M_{2th} for a duty cycle $ED_{10} > 50\%$ and the actual average input speed n_{1m^*}. (At $K_{mot,th} \leq 0$ you must reduce the average input speed n_{1m^*} accordingly or select another geared motor size.)

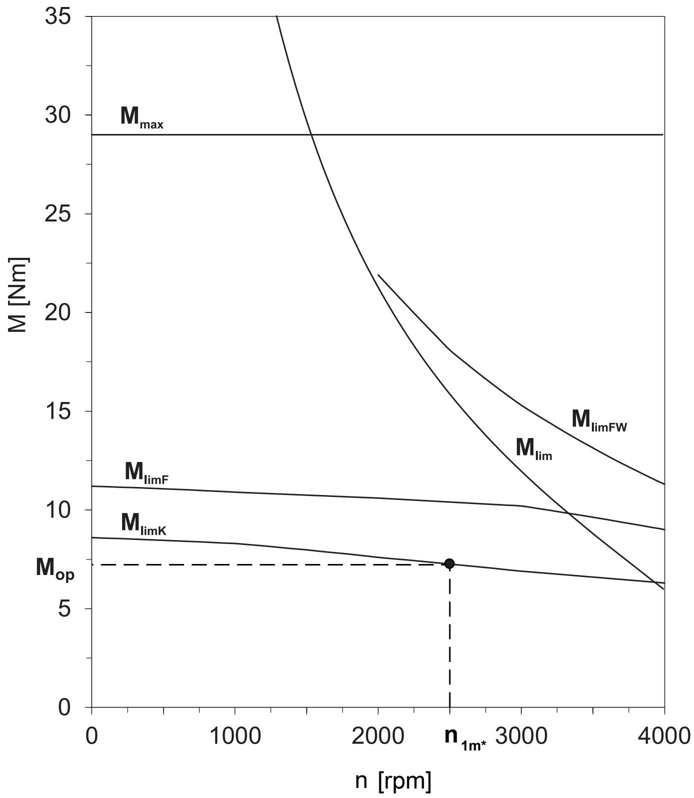
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

$$K_{mot,th} = 0{,}93 - \frac{a_{th}}{1000} \cdot fB_T \cdot \left(\frac{n_{1m^*}}{1000}\right)^3$$

Refer to the selection tables for the values of i and a_{th}.

The values for fB_T can be found in the corresponding table in this chapter.

The value for the torque of the motor at operating point M_{op} with the determined average input speed n_{1m*} can be found in the motor characteristic curve in the chapter Torque/speed curves. Note the size, nominal speed n_N and cooling type of the motor. The figure below shows an example of reading the torque M_{op} of a motor with convection cooling at the operating point.



Calculation of the actual effective torque

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

$$M_{2,n*} = \frac{F_{f2,n*} \cdot d_0}{2}$$

$$M_{1eff*} = \frac{M_{2eff*}}{i \cdot \eta}$$

Operating factors

Operating mode	fB_{op}
Uniform continuous operation	1.00
Cyclic operation	1.00
Reversing load cyclic operation	1.00

Run time	fB_t
Daily runtime ≤ 8 h	1.00
Daily runtime ≤ 16 h	1.15
Daily runtime ≤ 24 h	1.20

Cyclic operation	fB_{ZB}
≤ 1000 load changes/hour (LW/h)	1.00
> 1000 load changes/hour (LW/h)	1.15

Temperature		fB_T
Motor cooling	**Surrounding temperature**	
Motor with forced ventilation	≤ 20 °C	0.9
	≤ 30 °C	1.0
	≤ 40 °C	1.15
Motor with convection cooling	≤ 20 °C	1.0
	≤ 30 °C	1.1
	≤ 40 °C	1.25

Notes

- The maximum permitted gearbox temperature (see the "Other product features" chapter) must not be exceeded, as that could result in damage.
- For braking from full speed (for example, when the power fails or when setting up the machine), note the permitted gearbox feed forces (F_{f2acc}, F_{f2NOT}) in the selection tables.

4.6.2 Recommendation for radial shaft seal rings

For a duty cycle > 60% and higher surrounding temperatures, we recommend radial shaft seal rings made of FKM at the output.

Properties:

- Excellent temperature resistance
- High chemical stability
- Very good resistance to aging
- Excellent resistance in oils and greases
- For use in the food, beverage and pharmaceutical industries

Leak-proofness

Our gearboxes are equipped with high-quality radial shaft seal rings and checked for leaks. However, a leak cannot be fully ruled out over the length of use of a gearbox. If you use a gearbox with goods incompatible with the lubricant, you must take measures to prevent direct contact with the gearbox lubricant in case of a leak.

4.7 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 term field.

Documentation	ID
Operating manual gearboxes, geared motors PHV94 – PHV104	443355_en
Operating manual for EZ synchronous servo motors	443032_en
Operating manual gear racks	443392_en

5 ZTRPH rack and pinion drives

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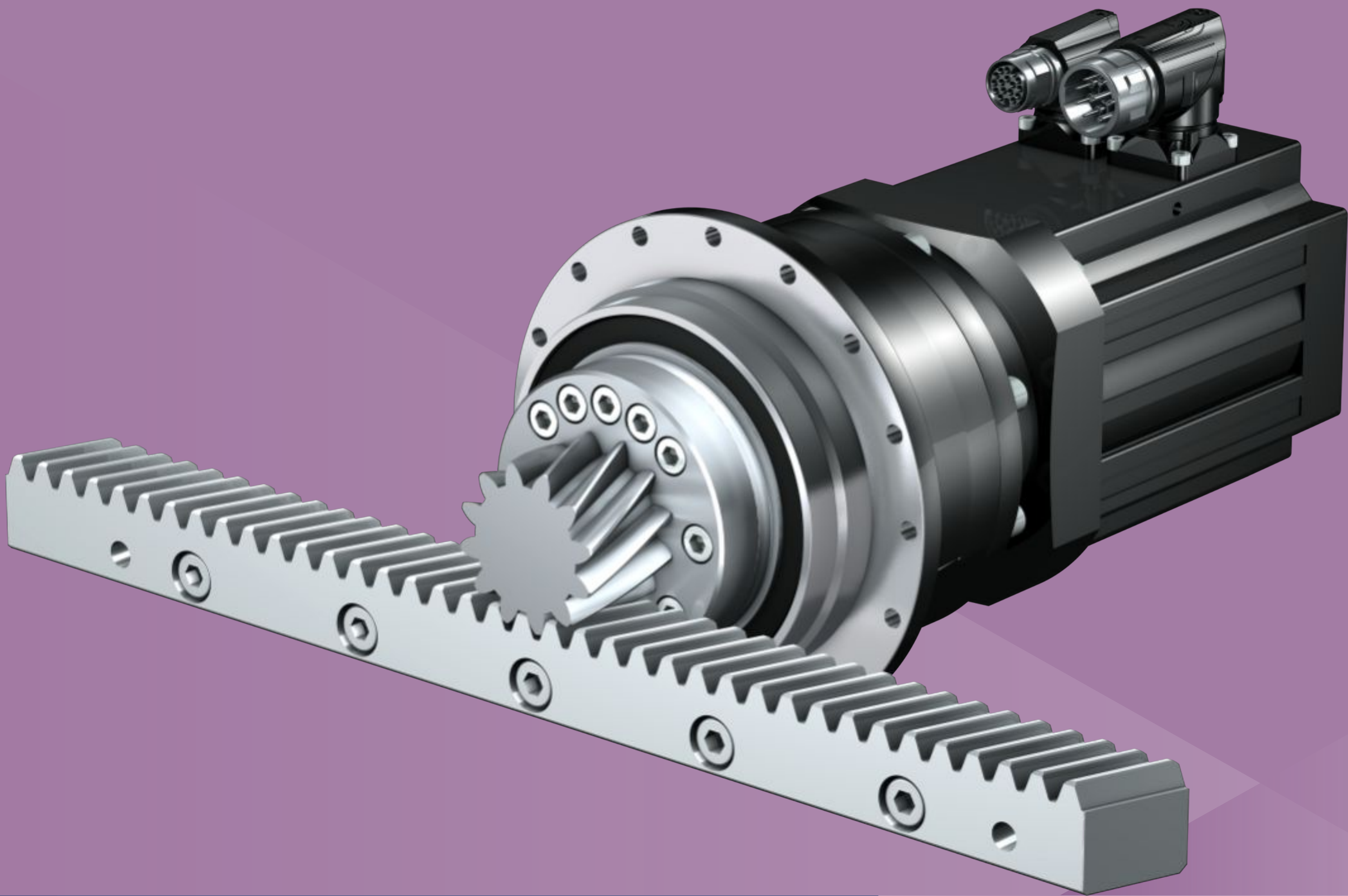


5 Rack and pinion drives

ZTRPH

5.1 Overview

High Performance precision planetary geared motors with screwed flange pinion

Features

Power density	★★★★☆
Linear clearance	★★★★★
Price category	€€€€
Smooth operation	★★★★☆
Linear rigidity	★★★★☆
Mass moment of inertia	★★★★☆
Ready-to-install drive solution	✓
Pinion gearing quality 5 (DIN 3962)	✓
Helical gearing	✓
Case-hardened and smoothed	✓
Radial runout ≤ 10 µm (optional)	✓
Reinforced output bearing (PH3 – PH5)	✓ (optional)
Compact and highly dynamic due to direct motor attachment	✓

Key ★☆☆☆☆ good | ★★★★★ excellent
€ Economy | €€€€€ Premium

Technical data

m_n	2 – 6 mm
z	12 – 32
F_{f2acc}	1.9 – 67 kN
v_{f2}	0.11 – 4.3 m/s
Δs	4 – 44 µm

5.2 Selection table

The technical data specified in the selection tables applies to:

- De-energized installation
- Permanent lubrication with the lubricants recommended in the chapter on gear racks [▶ 13.5.1]
- Case-hardened pinions, helical (left-hand 19° 31' 42"), gearing quality 5
- Installation altitudes up to 1000 m above sea level
- Surrounding temperatures from 0 °C to 40 °C
- Without consideration of the thermal limiting performance
- Drives with convection-cooled motors (e.g. EZ401**U**)

For the technical data on drives with forced ventilated motors (e.g. EZ401**B**), refer to https://configurator.stoeber.de/en-US/

Higher feed forces are possible for rack and pinion drives with reduced backlash or reinforced bearings (PH3 – PH5). For this and all other technical data, refer to https://configurator.stoeber.de/en-US/.

An explanation of the formula symbols can be found in the chapter [▶ 17.1].

v_{f2}	F_{f2}	$F_{f2,0}$	a_{th}	S	Type	F_{f2acc}	F_{f2NOT}	M_{2acc}	i	$v_{f2maxDB}$	$v_{f2maxZB}$	Δs	$Δs_{red}$	C_{lin}	m_n	z	d_0
[m/s]	[kN]	[kN]				[kN]	[kN]	[Nm]		[m/s]	[m/s]	[µm]	[µm]	[N/µm]	[mm]		[mm]
ZTR2PH4 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 6,7 kN)																	
0.11	2.5	2.6	0.7	1.1	ZTR216SPH432_0500 EZ301U	6.7	9.2	114	50.00	0.16	0.28	15	5	90	2	16	34.0
0.11	2.4	2.4	0.9	1.1	ZTR212SPH432_0350 EZ301U	6.7	11	85	35.00	0.17	0.31	11	4	97	2	12	25.5
0.13	2.0	2.1	0.8	1.3	ZTR216SPH432_0400 EZ301U	6.1	9.2	104	40.00	0.20	0.36	15	5	89	2	16	34.0
0.14	1.9	1.9	1.1	1.3	ZTR212SPH432_0280 EZ301U	5.7	11	73	28.00	0.21	0.38	11	4	97	2	12	25.5
0.15	1.8	1.8	0.9	1.4	ZTR216SPH432_0350 EZ301U	5.4	9.2	91	35.00	0.23	0.41	15	5	90	2	16	34.0
0.16	1.7	1.7	1.1	1.4	ZTR212SPH432_0250 EZ301U	5.1	11	65	25.00	0.24	0.43	11	4	97	2	12	25.5
0.19	1.4	1.5	1.1	1.7	ZTR216SPH432_0280 EZ301U	4.3	9.2	73	28.00	0.29	0.51	15	5	90	2	16	34.0
0.20	1.4	1.4	1.3	1.6	ZTR212SPH432_0200 EZ301U	4.1	11	52	20.00	0.27	0.53	11	4	97	2	12	25.5
0.21	1.3	1.3	1.1	1.8	ZTR216SPH432_0250 EZ301U	3.8	9.2	65	25.00	0.32	0.57	15	5	91	2	16	34.0
0.21	2.2	2.3	1.9	1.1	ZTR216SPH432_0250 EZ302U	6.7	9.2	114	25.00	0.32	0.57	15	5	91	2	16	34.0
0.25	1.1	1.1	1.5	1.8	ZTR212SPH432_0160 EZ301U	3.3	11	42	16.00	0.33	0.67	11	4	96	2	12	25.5
0.25	1.9	2.0	2.6	1.1	ZTR212SPH432_0160 EZ302U	5.8	11	74	16.00	0.33	0.67	11	4	96	2	12	25.5
0.27	1.0	1.0	1.3	2.1	ZTR216SPH432_0200 EZ301U	3.1	9.2	52	20.00	0.36	0.71	15	5	90	2	16	34.0
0.27	1.7	1.8	2.2	1.2	ZTR216SPH432_0200 EZ302U	5.5	9.2	93	20.00	0.36	0.71	15	5	90	2	16	34.0
0.33	0.8	0.8	1.5	2.4	ZTR216SPH432_0160 EZ301U	2.5	9.2	42	16.00	0.44	0.89	15	5	90	2	16	34.0
0.33	1.4	1.5	2.6	1.4	ZTR216SPH432_0160 EZ302U	4.4	9.2	74	16.00	0.44	0.89	15	5	90	2	16	34.0
0.33	1.8	1.9	3.4	1.1	ZTR216SPH432_0160 EZ303U	6.1	9.2	104	16.00	0.44	0.89	15	5	90	2	16	34.0
0.53	1.6	1.7	2.4	1.1	ZTR216SPH431_0100 EZ401U	4.8	9.2	82	10.00	0.62	1.24	15	5	81	2	16	34.0
0.57	1.5	1.6	3.0	1.0	ZTR212SPH431_0070 EZ401U	4.5	11	57	7.000	0.61	1.14	11	4	96	2	12	25.5
0.80	1.1	1.1	4.5	1.3	ZTR212SPH431_0050 EZ401U	3.2	11	41	5.000	0.80	1.60	11	4	99	2	12	25.5
1.00	0.8	0.9	5.9	1.5	ZTR212SPH431_0040 EZ401U	2.6	11	33	4.000	0.87	1.67	11	4	99	2	12	25.5
1.07	0.8	0.8	4.5	1.7	ZTR216SPH431_0050 EZ401U	2.4	9.2	41	5.000	1.07	2.13	15	5	93	2	16	34.0
1.07	1.2	1.3	6.9	1.1	ZTR216SPH431_0050 EZ501U	4.5	9.2	77	5.000	1.07	2.13	15	5	93	2	16	34.0
1.07	1.3	1.5	7.5	1.0	ZTR216SPH431_0050 EZ402U	4.5	9.2	77	5.000	1.07	2.13	15	5	93	2	16	34.0
1.33	0.6	0.7	5.9	2.0	ZTR216SPH431_0040 EZ401U	1.9	9.2	33	4.000	1.16	2.22	15	5	95	2	16	34.0
1.33	1.0	1.1	9.0	1.3	ZTR216SPH431_0040 EZ501U	3.6	9.2	61	4.000	1.16	2.22	15	5	95	2	16	34.0
1.33	1.1	1.2	9.8	1.2	ZTR216SPH431_0040 EZ402U	3.6	9.2	61	4.000	1.16	2.22	15	5	95	2	16	34.0
ZTR2PH4 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 6,1 kN)																	
0.27	2.0	2.1	1.0	1.1	ZTR216SPH432_0400 EZ301U	6.1	9.2	104	40.00	0.20	0.36	15	5	89	2	16	34.0
0.29	1.8	1.9	1.2	1.0	ZTR212SPH432_0280 EZ301U	5.7	11	73	28.00	0.21	0.38	11	4	97	2	12	25.5
0.31	1.7	1.8	1.0	1.2	ZTR216SPH432_0350 EZ301U	5.4	9.2	91	35.00	0.23	0.41	15	5	90	2	16	34.0
0.32	1.6	1.7	1.2	1.1	ZTR212SPH432_0250 EZ301U	5.1	11	65	25.00	0.24	0.43	11	4	97	2	12	25.5
0.38	1.4	1.5	1.2	1.4	ZTR216SPH432_0280 EZ301U	4.3	9.2	73	28.00	0.29	0.51	15	5	90	2	16	34.0
0.40	1.3	1.4	1.4	1.3	ZTR212SPH432_0200 EZ301U	4.1	11	52	20.00	0.27	0.53	11	4	97	2	12	25.5
0.43	1.2	1.3	1.2	1.5	ZTR216SPH432_0250 EZ301U	3.8	9.2	65	25.00	0.32	0.57	15	5	91	2	16	34.0
0.50	1.0	1.1	1.7	1.5	ZTR212SPH432_0160 EZ301U	3.3	11	42	16.00	0.33	0.67	11	4	96	2	12	25.5
0.53	1.0	1.0	1.4	1.7	ZTR216SPH432_0200 EZ301U	3.1	9.2	52	20.00	0.36	0.71	15	5	90	2	16	34.0
0.53	1.6	1.8	2.3	1.0	ZTR216SPH432_0200 EZ302U	5.5	9.2	93	20.00	0.36	0.71	15	5	90	2	16	34.0
0.67	0.8	0.8	1.7	2.0	ZTR216SPH432_0160 EZ301U	2.5	9.2	42	16.00	0.44	0.89	15	5	90	2	16	34.0
0.67	1.3	1.5	2.8	1.2	ZTR216SPH432_0160 EZ302U	4.4	9.2	74	16.00	0.44	0.89	15	5	90	2	16	34.0
1.07	1.3	1.6	2.5	1.0	ZTR216SPH431_0100 EZ401U	4.8	9.2	82	10.00	0.62	1.24	15	5	81	2	16	34.0
1.52	0.9	1.1	3.1	1.3	ZTR216SPH431_0070 EZ401U	3.4	9.2	57	7.000	0.81	1.52	15	5	89	2	16	34.0
1.60	0.9	1.1	4.6	1.2	ZTR212SPH431_0050 EZ401U	3.2	11	41	5.000	0.80	1.60	11	4	99	2	12	25.5
2.13	1.0	1.2	6.9	1.1	ZTR216SPH431_0050 EZ501U	4.5	9.2	77	5.000	1.07	2.13	15	5	93	2	16	34.0
2.13	1.0	1.4	7.1	1.1	ZTR216SPH431_0050 EZ402U	4.5	9.2	77	5.000	1.07	2.13	15	5	93	2	16	34.0

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTR2PH5 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 11 kN)																	
0.22	3.7	4.0	1.2	1.0	ZTR223SPH532_0350 EZ401U	11	14	264	35.00	0.29	0.58	21	7	89	2	23	48.8
0.25	3.2	3.5	1.4	1.0	ZTR219SPH532_0250 EZ401U	9.8	15	198	25.00	0.31	0.63	18	6	93	2	19	40.3
0.27	3.0	3.2	1.4	1.2	ZTR223SPH532_0280 EZ401U	9.1	14	221	28.00	0.37	0.73	21	7	88	2	23	48.8
0.31	2.7	2.9	1.4	1.3	ZTR223SPH532_0250 EZ401U	8.1	14	198	25.00	0.38	0.77	21	7	90	2	23	48.8
0.32	2.6	2.8	1.6	1.2	ZTR219SPH532_0200 EZ401U	7.8	15	158	20.00	0.37	0.74	18	6	93	2	19	40.3
0.40	2.1	2.2	2.0	1.4	ZTR219SPH532_0160 EZ401U	6.3	15	126	16.00	0.46	0.92	18	6	93	2	19	40.3
0.48	2.6	2.9	3.0	1.1	ZTR223SPH532_0160 EZ501U	9.8	14	238	16.00	0.56	1.12	21	7	89	2	23	48.8
0.48	2.9	3.2	3.3	1.0	ZTR223SPH532_0160 EZ402U	9.8	14	238	16.00	0.56	1.12	21	7	89	2	23	48.8
0.63	2.0	2.2	1.7	1.2	ZTR219SPH531_0100 EZ501U	7.6	15	154	10.00	0.70	1.37	18	6	87	2	19	40.3
0.91	1.4	1.6	2.1	1.5	ZTR219SPH531_0070 EZ501U	5.3	15	108	7.000	0.91	1.81	18	6	92	2	19	40.3
1.10	2.0	2.2	3.6	1.1	ZTR223SPH531_0070 EZ502U	8.5	14	208	7.000	1.10	2.19	21	7	88	2	23	48.8
1.10	2.0	2.3	3.6	1.1	ZTR223SPH531_0070 EZ701U	5.5	14	134	7.000	1.10	2.19	21	7	88	2	23	48.8
1.27	1.0	1.1	3.1	1.9	ZTR219SPH531_0050 EZ501U	3.8	15	77	5.000	1.06	2.32	18	6	95	2	19	40.3
1.27	1.8	1.9	5.3	1.1	ZTR219SPH531_0050 EZ502U	7.4	15	149	5.000	1.06	2.32	18	6	95	2	19	40.3
1.27	1.8	2.0	5.3	1.1	ZTR219SPH531_0050 EZ701U	4.8	15	96	5.000	1.06	2.32	18	6	95	2	19	40.3
1.53	0.8	0.9	3.1	2.3	ZTR223SPH531_0050 EZ501U	3.1	14	77	5.000	1.28	2.81	21	7	92	2	23	48.8
1.53	1.5	1.6	5.3	1.4	ZTR223SPH531_0050 EZ502U	6.1	14	149	5.000	1.28	2.81	21	7	92	2	23	48.8
1.53	1.5	1.6	5.3	1.4	ZTR223SPH531_0050 EZ701U	3.9	14	96	5.000	1.28	2.81	21	7	92	2	23	48.8
1.53	1.9	2.2	7.0	1.0	ZTR223SPH531_0050 EZ503U	8.5	14	206	5.000	1.28	2.81	21	7	92	2	23	48.8
1.58	0.8	0.9	4.1	2.2	ZTR219SPH531_0040 EZ501U	3.0	15	61	4.000	1.16	2.64	18	6	95	2	19	40.3
1.58	1.4	1.5	7.0	1.3	ZTR219SPH531_0040 EZ502U	5.9	15	119	4.000	1.16	2.64	18	6	95	2	19	40.3
1.58	1.4	1.6	7.0	1.3	ZTR219SPH531_0040 EZ701U	3.8	15	77	4.000	1.16	2.64	18	6	95	2	19	40.3
1.92	0.7	0.7	4.1	2.7	ZTR223SPH531_0040 EZ501U	2.5	14	61	4.000	1.41	3.19	21	7	92	2	23	48.8
1.92	1.2	1.3	7.0	1.6	ZTR223SPH531_0040 EZ502U	4.9	14	119	4.000	1.41	3.19	21	7	92	2	23	48.8
1.92	1.2	1.3	7.0	1.6	ZTR223SPH531_0040 EZ701U	3.1	14	77	4.000	1.41	3.19	21	7	92	2	23	48.8
1.92	1.5	1.7	9.1	1.2	ZTR223SPH531_0040 EZ503U	6.8	14	165	4.000	1.41	3.19	21	7	92	2	23	48.8
ZTR2PH5 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 11 kN)																	
2.88	1.5	2.4	10	1.1	ZTR223SPH531_0040 EZ505U	11	14	257	4.000	1.41	3.19	21	7	92	2	23	48.8
ZTR2PH5 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 11 kN)																	
0.51	2.7	3.2	1.4	1.0	ZTR219SPH532_0250 EZ401U	9.8	15	198	25.00	0.31	0.63	18	6	93	2	19	40.3
0.55	2.5	3.0	1.4	1.1	ZTR223SPH532_0280 EZ401U	9.1	14	221	28.00	0.37	0.73	21	7	88	2	23	48.8
0.61	2.2	2.7	1.4	1.2	ZTR223SPH532_0250 EZ401U	8.1	14	198	25.00	0.38	0.77	21	7	90	2	23	48.8
0.63	2.1	2.6	1.6	1.2	ZTR219SPH532_0200 EZ401U	7.8	15	158	20.00	0.37	0.74	18	6	93	2	19	40.3
0.79	1.7	2.1	1.9	1.4	ZTR219SPH532_0160 EZ401U	6.3	15	126	16.00	0.46	0.92	18	6	93	2	19	40.3
0.96	2.1	2.7	2.8	1.1	ZTR223SPH532_0160 EZ501U	9.8	14	238	16.00	0.56	1.12	21	7	89	2	23	48.8
0.96	2.1	3.0	2.9	1.1	ZTR223SPH532_0160 EZ402U	9.8	14	238	16.00	0.56	1.12	21	7	89	2	23	48.8
1.27	1.6	2.1	1.7	1.2	ZTR219SPH531_0100 EZ501U	7.6	15	154	10.00	0.70	1.37	18	6	87	2	19	40.3
1.81	1.1	1.5	2.1	1.5	ZTR219SPH531_0070 EZ501U	5.3	15	108	7.000	0.91	1.81	18	6	92	2	19	40.3
1.81	1.7	2.6	3.2	1.0	ZTR219SPH531_0070 EZ502U	10	15	208	7.000	0.91	1.81	18	6	92	2	19	40.3
1.81	1.7	2.6	3.2	1.0	ZTR219SPH531_0070 EZ701U	6.7	15	134	7.000	0.91	1.81	18	6	92	2	19	40.3
2.19	0.9	1.2	2.1	1.9	ZTR223SPH531_0070 EZ501U	4.4	14	108	7.000	1.10	2.19	21	7	88	2	23	48.8
2.19	1.4	2.1	3.2	1.2	ZTR223SPH531_0070 EZ502U	8.5	14	208	7.000	1.10	2.19	21	7	88	2	23	48.8
2.19	1.4	2.2	3.2	1.2	ZTR223SPH531_0070 EZ701U	5.5	14	134	7.000	1.10	2.19	21	7	88	2	23	48.8
2.19	1.7	2.9	3.8	1.0	ZTR223SPH531_0070 EZ503U	11	14	264	7.000	1.10	2.19	21	7	88	2	23	48.8
ZTR3PH5 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 9,9 kN)																	
0.25	3.3	3.5	1.4	1.0	ZTR314SPH532_0280 EZ401U	9.9	14	221	28.00	0.33	0.67	19	6	86	3	14	44.6
0.28	2.9	3.1	1.4	1.1	ZTR314SPH532_0250 EZ401U	8.9	14	198	25.00	0.35	0.70	19	6	87	3	14	44.6
0.35	2.3	2.5	1.6	1.3	ZTR314SPH532_0200 EZ401U	7.1	14	158	20.00	0.41	0.82	19	6	87	3	14	44.6
0.44	1.9	2.0	2.0	1.5	ZTR314SPH532_0160 EZ401U	5.7	14	126	16.00	0.51	1.02	19	6	87	3	14	44.6
0.70	1.9	2.0	1.7	1.3	ZTR314SPH531_0100 EZ501U	6.9	14	154	10.00	0.77	1.52	19	6	80	3	14	44.6
1.00	1.3	1.4	2.1	1.7	ZTR314SPH531_0070 EZ501U	4.8	14	108	7.000	1.00	2.00	19	6	86	3	14	44.6
1.40	0.9	1.0	3.1	2.1	ZTR314SPH531_0050 EZ501U	3.4	14	77	5.000	1.17	2.57	19	6	89	3	14	44.6
1.40	1.6	1.7	5.3	1.2	ZTR314SPH531_0050 EZ502U	6.7	14	149	5.000	1.17	2.57	19	6	89	3	14	44.6
1.40	1.6	1.8	5.3	1.2	ZTR314SPH531_0050 EZ701U	4.3	14	96	5.000	1.17	2.57	19	6	89	3	14	44.6
1.75	0.7	0.8	4.1	2.4	ZTR314SPH531_0040 EZ501U	2.8	14	61	4.000	1.28	2.92	19	6	89	3	14	44.6
1.75	1.3	1.4	7.0	1.4	ZTR314SPH531_0040 EZ502U	5.3	14	119	4.000	1.28	2.92	19	6	89	3	14	44.6
1.75	1.3	1.4	7.0	1.4	ZTR314SPH531_0040 EZ701U	3.4	14	77	4.000	1.28	2.92	19	6	89	3	14	44.6
1.75	1.7	1.9	9.1	1.1	ZTR314SPH531_0040 EZ503U	7.4	14	165	4.000	1.28	2.92	19	6	89	3	14	44.6
ZTR3PH5 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 9,9 kN)																	
0.50	2.7	3.3	1.4	1.0	ZTR314SPH532_0280 EZ401U	9.9	14	221	28.00	0.33	0.67	19	6	86	3	14	44.6
0.56	2.4	2.9	1.4	1.1	ZTR314SPH532_0250 EZ401U	8.9	14	198	25.00	0.35	0.70	19	6	87	3	14	44.6
0.70	1.9	2.3	1.6	1.3	ZTR314SPH532_0200 EZ401U	7.1	14	158	20.00	0.41	0.82	19	6	87	3	14	44.6
0.88	1.5	1.9	1.9	1.5	ZTR314SPH532_0160 EZ401U	5.7	14	126	16.00	0.51	1.02	19	6	87	3	14	44.6
1.40	1.5	1.9	1.7	1.3	ZTR314SPH531_0100 EZ501U	6.9	14	154	10.00	0.77	1.52	19	6	80	3	14	44.6
2.00	1.0	1.3	2.1	1.7	ZTR314SPH531_0070 EZ501U	4.8	14	108	7.000	1.00	2.00	19	6	86	3	14	44.6

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTR3PH5 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 9,9 kN)																	
2.00	1.6	2.4	3.2	1.1	ZTR314SPH531_0070 EZ502U	9.3	14	208	7.000	1.00	2.00	19	6	86	3	14	44.6
2.00	1.6	2.4	3.2	1.1	ZTR314SPH531_0070 EZ701U	6.0	14	134	7.000	1.00	2.00	19	6	86	3	14	44.6
ZTR2PH7 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 15 kN)																	
0.11	11	13	0.7	1.1	ZTR223SPH732_0700 EZ501U	15	29	366	70.00	0.14	0.26	21	7	115	2	23	48.8
0.15	8.2	9.0	0.9	1.4	ZTR223SPH732_0500 EZ501U	15	29	366	50.00	0.19	0.36	21	7	117	2	23	48.8
0.19	6.6	7.2	1.1	1.6	ZTR223SPH732_0400 EZ501U	15	29	366	40.00	0.24	0.45	21	7	118	2	23	48.8
0.22	5.7	6.3	1.1	1.7	ZTR223SPH732_0350 EZ501U	15	29	366	35.00	0.27	0.51	21	7	118	2	23	48.8
0.22	9.9	11	1.8	1.0	ZTR223SPH732_0350 EZ502U	15	29	366	35.00	0.27	0.51	21	7	118	2	23	48.8
0.22	9.9	11	1.8	1.0	ZTR223SPH732_0350 EZ701U	15	29	366	35.00	0.27	0.51	21	7	118	2	23	48.8
0.27	4.6	5.0	1.2	2.0	ZTR223SPH732_0280 EZ501U	15	29	366	28.00	0.34	0.64	21	7	118	2	23	48.8
0.27	7.9	8.5	2.0	1.2	ZTR223SPH732_0280 EZ502U	15	29	366	28.00	0.34	0.64	21	7	118	2	23	48.8
0.27	7.9	8.9	2.0	1.2	ZTR223SPH732_0280 EZ701U	15	29	366	28.00	0.34	0.64	21	7	118	2	23	48.8
0.31	4.1	4.5	1.3	2.2	ZTR223SPH732_0250 EZ501U	15	29	366	25.00	0.36	0.72	21	7	118	2	23	48.8
0.31	7.1	7.6	2.3	1.3	ZTR223SPH732_0250 EZ502U	15	29	366	25.00	0.36	0.72	21	7	118	2	23	48.8
0.31	7.1	7.9	2.3	1.3	ZTR223SPH732_0250 EZ701U	15	29	366	25.00	0.36	0.72	21	7	118	2	23	48.8
0.38	3.3	3.6	1.6	2.5	ZTR223SPH732_0200 EZ501U	12	29	298	20.00	0.38	0.77	21	7	118	2	23	48.8
0.38	5.6	6.1	2.8	1.5	ZTR223SPH732_0200 EZ502U	15	29	366	20.00	0.38	0.77	21	7	118	2	23	48.8
0.38	5.6	6.3	2.8	1.5	ZTR223SPH732_0200 EZ701U	15	29	366	20.00	0.38	0.77	21	7	118	2	23	48.8
0.38	7.4	8.5	3.7	1.1	ZTR223SPH732_0200 EZ503U	15	29	366	20.00	0.38	0.77	21	7	118	2	23	48.8
0.48	2.6	2.9	1.9	2.9	ZTR223SPH732_0160 EZ501U	9.8	29	238	16.00	0.48	0.96	21	7	119	2	23	48.8
0.48	4.5	4.9	3.2	1.7	ZTR223SPH732_0160 EZ502U	15	29	366	16.00	0.48	0.96	21	7	119	2	23	48.8
0.48	4.5	5.1	3.2	1.7	ZTR223SPH732_0160 EZ701U	12	29	298	16.00	0.48	0.96	21	7	119	2	23	48.8
0.48	5.9	6.8	4.2	1.3	ZTR223SPH732_0160 EZ503U	15	29	366	16.00	0.48	0.96	21	7	119	2	23	48.8
0.48	7.3	8.8	5.2	1.0	ZTR223SPH732_0160 EZ702U	15	29	366	16.00	0.48	0.96	21	7	119	2	23	48.8
0.77	2.9	3.3	1.8	2.2	ZTR223SPH731_0100 EZ701U	7.9	29	192	10.00	0.64	1.28	21	7	112	2	23	48.8
0.77	4.7	5.7	3.0	1.4	ZTR223SPH731_0100 EZ702U	15	29	366	10.00	0.64	1.28	21	7	112	2	23	48.8
0.77	6.5	8.2	4.1	1.0	ZTR223SPH731_0100 EZ703U	15	29	366	10.00	0.64	1.28	21	7	112	2	23	48.8
1.10	2.0	2.3	2.0	2.8	ZTR223SPH731_0070 EZ701U	5.5	29	134	7.000	0.91	1.83	21	7	116	2	23	48.8
1.10	3.3	4.0	3.3	1.7	ZTR223SPH731_0070 EZ702U	11	29	276	7.000	0.91	1.83	21	7	116	2	23	48.8
1.10	4.5	5.7	4.5	1.3	ZTR223SPH731_0070 EZ703U	15	29	366	7.000	0.91	1.83	21	7	116	2	23	48.8
1.53	1.5	1.6	3.1	3.5	ZTR223SPH731_0050 EZ701U	3.9	29	96	5.000	1.12	2.56	21	7	119	2	23	48.8
1.53	2.4	2.8	5.0	2.2	ZTR223SPH731_0050 EZ702U	8.1	29	197	5.000	1.12	2.56	21	7	119	2	23	48.8
1.53	3.2	4.1	6.8	1.6	ZTR223SPH731_0050 EZ703U	13	29	312	5.000	1.12	2.56	21	7	119	2	23	48.8
1.53	4.2	5.9	8.8	1.2	ZTR223SPH731_0050 EZ705U	15	29	366	5.000	1.12	2.56	21	7	119	2	23	48.8
1.92	1.2	1.3	4.0	4.1	ZTR223SPH731_0040 EZ701U	3.1	29	77	4.000	1.21	2.56	21	7	121	2	23	48.8
1.92	1.9	2.3	6.5	2.5	ZTR223SPH731_0040 EZ702U	6.5	29	157	4.000	1.21	2.56	21	7	121	2	23	48.8
1.92	2.6	3.3	8.9	1.8	ZTR223SPH731_0040 EZ703U	10	29	250	4.000	1.21	2.56	21	7	121	2	23	48.8
1.92	3.4	4.8	11	1.4	ZTR223SPH731_0040 EZ705U	15	29	366	4.000	1.21	2.56	21	7	121	2	23	48.8
ZTR2PH7 (n_{1N} = 4000 min^{-1}, ($F_{f2acc,max}$ = 15 kN)																	
2.56	4.0	6.9	15	1.1	ZTR223SPH731_0040 EZ813U	15	29	366	4.000	1.21	2.56	21	7	121	2	23	48.8
2.56	4.1	11	16	1.1	ZTR223SPH731_0040 EZ815U	15	29	366	4.000	1.21	2.56	21	7	121	2	23	48.8
ZTR2PH7 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 15 kN)																	
0.72	5.8	9.3	4.1	1.1	ZTR223SPH732_0160 EZ505U	15	29	366	16.00	0.48	0.96	21	7	119	2	23	48.8
1.15	4.8	7.9	3.4	1.2	ZTR223SPH731_0100 EZ703U	15	29	366	10.00	0.64	1.28	21	7	112	2	23	48.8
1.64	3.3	5.5	3.8	1.5	ZTR223SPH731_0070 EZ703U	15	29	366	7.000	0.91	1.83	21	7	116	2	23	48.8
1.64	4.5	8.3	5.2	1.1	ZTR223SPH731_0070 EZ705U	15	29	366	7.000	0.91	1.83	21	7	116	2	23	48.8
2.30	2.4	3.9	5.7	1.9	ZTR223SPH731_0050 EZ703U	13	29	312	5.000	1.12	2.56	21	7	119	2	23	48.8
2.30	3.2	5.9	7.7	1.4	ZTR223SPH731_0050 EZ705U	15	29	366	5.000	1.12	2.56	21	7	119	2	23	48.8
ZTR2PH7 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 15 kN)																	
0.22	9.1	12	0.7	1.1	ZTR223SPH732_0700 EZ501U	15	29	366	70.00	0.14	0.26	21	7	115	2	23	48.8
0.31	6.5	8.4	0.9	1.4	ZTR223SPH732_0500 EZ501U	15	29	366	50.00	0.19	0.36	21	7	117	2	23	48.8
0.38	5.2	6.7	1.1	1.6	ZTR223SPH732_0400 EZ501U	15	29	366	40.00	0.24	0.45	21	7	118	2	23	48.8
0.38	7.9	12	1.7	1.0	ZTR223SPH732_0400 EZ502U	15	29	366	40.00	0.24	0.45	21	7	118	2	23	48.8
0.38	7.9	12	1.7	1.0	ZTR223SPH732_0400 EZ701U	15	29	366	40.00	0.24	0.45	21	7	118	2	23	48.8
0.44	4.5	5.9	1.0	1.7	ZTR223SPH732_0350 EZ501U	15	29	366	35.00	0.27	0.51	21	7	118	2	23	48.8
0.44	6.9	10	1.6	1.1	ZTR223SPH732_0350 EZ502U	15	29	366	35.00	0.27	0.51	21	7	118	2	23	48.8
0.44	6.9	11	1.6	1.1	ZTR223SPH732_0350 EZ701U	15	29	366	35.00	0.27	0.51	21	7	118	2	23	48.8
0.55	3.6	4.7	1.1	2.0	ZTR223SPH732_0280 EZ501U	15	29	366	28.00	0.34	0.64	21	7	118	2	23	48.8
0.55	5.5	8.3	1.7	1.3	ZTR223SPH732_0280 EZ502U	15	29	366	28.00	0.34	0.64	21	7	118	2	23	48.8
0.55	5.5	8.4	1.7	1.3	ZTR223SPH732_0280 EZ701U	15	29	366	28.00	0.34	0.64	21	7	118	2	23	48.8
0.55	6.6	11	2.1	1.1	ZTR223SPH732_0280 EZ503U	15	29	366	28.00	0.34	0.64	21	7	118	2	23	48.8
0.61	3.2	4.2	1.3	2.2	ZTR223SPH732_0250 EZ501U	15	29	366	25.00	0.36	0.72	21	7	118	2	23	48.8
0.61	5.0	7.4	2.0	1.4	ZTR223SPH732_0250 EZ502U	15	29	366	25.00	0.36	0.72	21	7	118	2	23	48.8
0.61	5.0	7.5	2.0	1.4	ZTR223SPH732_0250 EZ701U	15	29	366	25.00	0.36	0.72	21	7	118	2	23	48.8
0.61	5.9	10	2.3	1.2	ZTR223SPH732_0250 EZ503U	15	29	366	25.00	0.36	0.72	21	7	118	2	23	48.8
0.61	6.9	14	2.7	1.0	ZTR223SPH732_0250 EZ702U	15	29	366	25.00	0.36	0.72	21	7	118	2	23	48.8

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTR2PH7 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 15 kN)																	
0.77	2.6	3.4	1.5	2.5	ZTR223SPH732_0200 EZ501U	12	29	298	20.00	0.38	0.77	21	7	118	2	23	48.8
0.77	4.0	5.9	2.2	1.6	ZTR223SPH732_0200 EZ502U	15	29	366	20.00	0.38	0.77	21	7	118	2	23	48.8
0.77	4.0	6.0	2.2	1.6	ZTR223SPH732_0200 EZ701U	15	29	366	20.00	0.38	0.77	21	7	118	2	23	48.8
0.77	4.7	8.1	2.6	1.4	ZTR223SPH732_0200 EZ503U	15	29	366	20.00	0.38	0.77	21	7	118	2	23	48.8
0.77	5.5	11	3.1	1.2	ZTR223SPH732_0200 EZ702U	15	29	366	20.00	0.38	0.77	21	7	118	2	23	48.8
0.96	2.1	2.7	1.6	2.9	ZTR223SPH732_0160 EZ501U	9.8	29	238	16.00	0.48	0.96	21	7	119	2	23	48.8
0.96	3.2	4.8	2.5	1.9	ZTR223SPH732_0160 EZ502U	15	29	366	16.00	0.48	0.96	21	7	119	2	23	48.8
0.96	3.2	4.8	2.5	1.9	ZTR223SPH732_0160 EZ701U	12	29	298	16.00	0.48	0.96	21	7	119	2	23	48.8
0.96	3.8	6.5	3.0	1.6	ZTR223SPH732_0160 EZ503U	15	29	366	16.00	0.48	0.96	21	7	119	2	23	48.8
0.96	4.4	8.7	3.4	1.4	ZTR223SPH732_0160 EZ702U	15	29	366	16.00	0.48	0.96	21	7	119	2	23	48.8
ZTR3PH7 (n_{1N} = 2000 min^{-1}, ($F_{f2acc,max}$ = 18 kN)																	
1.58	5.0	5.6	18	1.1	ZTR319SPH731_0040 EZ813U	18	26	538	4.000	1.50	3.17	26	9	117	3	19	60.5
ZTR3PH7 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 20 kN)																	
0.11	11	12	0.7	1.1	ZTR316SPH732_0700 EZ501U	20	30	517	70.00	0.14	0.27	22	7	114	3	16	50.9
0.16	7.9	8.6	0.9	1.4	ZTR316SPH732_0500 EZ501U	20	30	517	50.00	0.20	0.37	22	7	116	3	16	50.9
0.20	6.3	6.9	1.1	1.6	ZTR316SPH732_0400 EZ501U	20	30	517	40.00	0.25	0.47	22	7	117	3	16	50.9
0.23	5.5	6.0	1.1	1.8	ZTR316SPH732_0350 EZ501U	20	30	517	35.00	0.28	0.53	22	7	117	3	16	50.9
0.23	9.5	10	1.8	1.0	ZTR316SPH732_0350 EZ502U	20	30	517	35.00	0.28	0.53	22	7	117	3	16	50.9
0.23	9.5	11	1.8	1.0	ZTR316SPH732_0350 EZ701U	20	30	517	35.00	0.28	0.53	22	7	117	3	16	50.9
0.24	5.3	5.8	1.1	1.9	ZTR319SPH732_0400 EZ501U	20	26	595	40.00	0.29	0.55	26	9	113	3	19	60.5
0.24	9.1	9.8	1.9	1.1	ZTR319SPH732_0400 EZ502U	20	26	615	40.00	0.29	0.55	26	9	113	3	19	60.5
0.24	9.1	10	1.9	1.1	ZTR319SPH732_0400 EZ701U	20	26	615	40.00	0.29	0.55	26	9	113	3	19	60.5
0.27	4.6	5.1	1.1	2.1	ZTR319SPH732_0350 EZ501U	17	26	521	35.00	0.34	0.63	26	9	113	3	19	60.5
0.27	8.0	8.6	1.8	1.2	ZTR319SPH732_0350 EZ502U	20	26	615	35.00	0.34	0.63	26	9	113	3	19	60.5
0.27	8.0	8.9	1.8	1.2	ZTR319SPH732_0350 EZ701U	20	26	615	35.00	0.34	0.63	26	9	113	3	19	60.5
0.29	4.4	4.8	1.2	2.0	ZTR316SPH732_0280 EZ501U	16	30	417	28.00	0.35	0.67	22	7	117	3	16	50.9
0.29	7.6	8.2	2.0	1.2	ZTR316SPH732_0280 EZ502U	20	30	517	28.00	0.35	0.67	22	7	117	3	16	50.9
0.29	7.6	8.5	2.0	1.2	ZTR316SPH732_0280 EZ701U	20	30	517	28.00	0.35	0.67	22	7	117	3	16	50.9
0.32	3.9	4.3	1.3	2.2	ZTR316SPH732_0250 EZ501U	15	30	372	25.00	0.37	0.75	22	7	117	3	16	50.9
0.32	6.8	7.3	2.3	1.3	ZTR316SPH732_0250 EZ502U	20	30	517	25.00	0.37	0.75	22	7	117	3	16	50.9
0.32	6.8	7.6	2.3	1.3	ZTR316SPH732_0250 EZ701U	18	30	465	25.00	0.37	0.75	22	7	117	3	16	50.9
0.34	3.7	4.0	1.2	2.4	ZTR319SPH732_0280 EZ501U	14	26	417	28.00	0.42	0.79	26	9	114	3	19	60.5
0.34	6.4	6.9	2.0	1.4	ZTR319SPH732_0280 EZ502U	20	26	615	28.00	0.42	0.79	26	9	114	3	19	60.5
0.34	6.4	7.1	2.0	1.4	ZTR319SPH732_0280 EZ701U	17	26	521	28.00	0.42	0.79	26	9	114	3	19	60.5
0.34	8.4	9.6	2.7	1.1	ZTR319SPH732_0280 EZ503U	20	26	615	28.00	0.42	0.79	26	9	114	3	19	60.5
0.38	3.3	3.6	1.3	2.6	ZTR319SPH732_0250 EZ501U	12	26	372	25.00	0.44	0.89	26	9	113	3	19	60.5
0.38	5.7	6.2	2.3	1.5	ZTR319SPH732_0250 EZ502U	20	26	615	25.00	0.44	0.89	26	9	113	3	19	60.5
0.38	5.7	6.4	2.3	1.5	ZTR319SPH732_0250 EZ701U	15	26	465	25.00	0.44	0.89	26	9	113	3	19	60.5
0.38	7.5	8.5	3.0	1.2	ZTR319SPH732_0250 EZ503U	20	26	615	25.00	0.44	0.89	26	9	113	3	19	60.5
0.40	3.1	3.4	1.6	2.6	ZTR316SPH732_0200 EZ501U	12	30	298	20.00	0.40	0.80	22	7	117	3	16	50.9
0.40	5.4	5.8	2.8	1.5	ZTR316SPH732_0200 EZ502U	20	30	517	20.00	0.40	0.80	22	7	117	3	16	50.9
0.40	5.4	6.1	2.8	1.5	ZTR316SPH732_0200 EZ701U	15	30	372	20.00	0.40	0.80	22	7	117	3	16	50.9
0.40	7.1	8.1	3.7	1.1	ZTR316SPH732_0200 EZ503U	20	30	517	20.00	0.40	0.80	22	7	117	3	16	50.9
0.48	2.6	2.9	1.6	3.0	ZTR319SPH732_0200 EZ501U	9.8	26	298	20.00	0.48	0.95	26	9	113	3	19	60.5
0.48	4.6	4.9	2.8	1.8	ZTR319SPH732_0200 EZ502U	19	26	577	20.00	0.48	0.95	26	9	113	3	19	60.5
0.48	4.6	5.1	2.8	1.8	ZTR319SPH732_0200 EZ701U	12	26	372	20.00	0.48	0.95	26	9	113	3	19	60.5
0.48	6.0	6.8	3.7	1.3	ZTR319SPH732_0200 EZ503U	20	26	615	20.00	0.48	0.95	26	9	113	3	19	60.5
0.48	7.4	8.9	4.6	1.1	ZTR319SPH732_0200 EZ702U	20	26	615	20.00	0.48	0.95	26	9	113	3	19	60.5
0.50	2.5	2.7	1.9	3.0	ZTR316SPH732_0160 EZ501U	9.3	30	238	16.00	0.50	1.00	22	7	118	3	16	50.9
0.50	4.3	4.7	3.2	1.7	ZTR316SPH732_0160 EZ502U	18	30	461	16.00	0.50	1.00	22	7	118	3	16	50.9
0.50	4.3	4.8	3.2	1.7	ZTR316SPH732_0160 EZ701U	12	30	298	16.00	0.50	1.00	22	7	118	3	16	50.9
0.50	5.7	6.5	4.2	1.3	ZTR316SPH732_0160 EZ503U	20	30	517	16.00	0.50	1.00	22	7	118	3	16	50.9
0.50	7.0	8.4	5.2	1.1	ZTR316SPH732_0160 EZ702U	20	30	517	16.00	0.50	1.00	22	7	118	3	16	50.9
0.59	2.1	2.3	1.9	3.5	ZTR319SPH732_0160 EZ501U	7.9	26	238	16.00	0.59	1.19	26	9	115	3	19	60.5
0.59	3.6	3.9	3.2	2.0	ZTR319SPH732_0160 EZ502U	15	26	461	16.00	0.59	1.19	26	9	115	3	19	60.5
0.59	3.6	4.1	3.2	2.0	ZTR319SPH732_0160 EZ701U	9.8	26	298	16.00	0.59	1.19	26	9	115	3	19	60.5
0.59	4.8	5.5	4.2	1.6	ZTR319SPH732_0160 EZ503U	20	26	615	16.00	0.59	1.19	26	9	115	3	19	60.5
0.59	5.9	7.1	5.2	1.3	ZTR319SPH732_0160 EZ702U	20	26	610	16.00	0.59	1.19	26	9	115	3	19	60.5
0.59	6.6	7.9	5.9	1.1	ZTR319SPH732_0160 EZ505U	20	26	615	16.00	0.59	1.19	26	9	115	3	19	60.5
0.80	2.8	3.1	1.8	2.3	ZTR316SPH731_0100 EZ701U	7.5	30	192	10.00	0.67	1.33	22	7	110	3	16	50.9
0.80	4.5	5.4	3.0	1.4	ZTR316SPH731_0100 EZ702U	15	30	394	10.00	0.67	1.33	22	7	110	3	16	50.9
0.80	6.2	7.8	4.1	1.0	ZTR316SPH731_0100 EZ703U	20	30	517	10.00	0.67	1.33	22	7	110	3	16	50.9
0.95	2.3	2.6	1.8	2.7	ZTR319SPH731_0100 EZ701U	6.3	26	192	10.00	0.79	1.58	26	9	105	3	19	60.5
0.95	3.8	4.6	3.0	1.7	ZTR319SPH731_0100 EZ702U	13	26	394	10.00	0.79	1.58	26	9	105	3	19	60.5
0.95	5.2	6.6	4.1	1.2	ZTR319SPH731_0100 EZ703U	19	26	575	10.00	0.79	1.58	26	9	105	3	19	60.5
1.14	2.0	2.2	2.0	2.9	ZTR316SPH731_0070 EZ701U	5.3	30	134	7.000	0.95	1.91	22	7	115	3	16	50.9

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTR3PH7 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 20 kN)																	
1.14	3.2	3.8	3.3	1.8	ZTR316SPH731_0070 EZ702U	11	30	276	7.000	0.95	1.91	22	7	115	3	16	50.9
1.14	4.4	5.5	4.5	1.3	ZTR316SPH731_0070 EZ703U	17	30	437	7.000	0.95	1.91	22	7	115	3	16	50.9
1.14	5.6	8.0	5.9	1.0	ZTR316SPH731_0070 EZ705U	20	30	517	7.000	0.95	1.91	22	7	115	3	16	50.9
1.36	1.6	1.8	2.0	3.4	ZTR319SPH731_0070 EZ701U	4.4	26	134	7.000	1.13	2.26	26	9	111	3	19	60.5
1.36	2.7	3.2	3.3	2.1	ZTR319SPH731_0070 EZ702U	9.1	26	276	7.000	1.13	2.26	26	9	111	3	19	60.5
1.36	3.7	4.6	4.5	1.5	ZTR319SPH731_0070 EZ703U	14	26	437	7.000	1.13	2.26	26	9	111	3	19	60.5
1.36	4.7	6.7	5.9	1.2	ZTR319SPH731_0070 EZ705U	20	26	615	7.000	1.13	2.26	26	9	111	3	19	60.5
1.60	1.4	1.6	3.1	3.6	ZTR316SPH731_0050 EZ701U	3.8	30	96	5.000	1.17	2.67	22	7	118	3	16	50.9
1.60	2.3	2.7	5.0	2.2	ZTR316SPH731_0050 EZ702U	7.7	30	197	5.000	1.17	2.67	22	7	118	3	16	50.9
1.60	3.1	3.9	6.8	1.6	ZTR316SPH731_0050 EZ703U	12	30	312	5.000	1.17	2.67	22	7	118	3	16	50.9
1.60	4.0	5.7	8.8	1.3	ZTR316SPH731_0050 EZ705U	20	30	499	5.000	1.17	2.67	22	7	118	3	16	50.9
1.90	1.2	1.3	3.1	4.3	ZTR319SPH731_0050 EZ701U	3.2	26	96	5.000	1.39	3.17	26	9	115	3	19	60.5
1.90	1.9	2.3	5.0	2.6	ZTR319SPH731_0050 EZ702U	6.5	26	197	5.000	1.39	3.17	26	9	115	3	19	60.5
1.90	2.6	3.3	6.8	1.9	ZTR319SPH731_0050 EZ703U	10	26	312	5.000	1.39	3.17	26	9	115	3	19	60.5
1.90	3.4	4.8	8.8	1.5	ZTR319SPH731_0050 EZ705U	17	26	499	5.000	1.39	3.17	26	9	115	3	19	60.5
2.00	1.1	1.3	4.0	4.2	ZTR316SPH731_0040 EZ701U	3.0	30	77	4.000	1.27	2.67	22	7	120	3	16	50.9
2.00	1.8	2.2	6.5	2.6	ZTR316SPH731_0040 EZ702U	6.2	30	157	4.000	1.27	2.67	22	7	120	3	16	50.9
2.00	2.5	3.1	8.9	1.9	ZTR316SPH731_0040 EZ703U	9.8	30	250	4.000	1.27	2.67	22	7	120	3	16	50.9
2.00	3.2	4.6	11	1.5	ZTR316SPH731_0040 EZ705U	16	30	399	4.000	1.27	2.67	22	7	120	3	16	50.9
2.38	0.9	1.1	4.0	5.0	ZTR319SPH731_0040 EZ701U	2.5	26	77	4.000	1.50	3.17	26	9	117	3	19	60.5
2.38	1.5	1.8	6.5	3.1	ZTR319SPH731_0040 EZ702U	5.2	26	157	4.000	1.50	3.17	26	9	117	3	19	60.5
2.38	2.1	2.6	8.9	2.2	ZTR319SPH731_0040 EZ703U	8.3	26	250	4.000	1.50	3.17	26	9	117	3	19	60.5
2.38	2.7	3.8	11	1.7	ZTR319SPH731_0040 EZ705U	13	26	399	4.000	1.50	3.17	26	9	117	3	19	60.5
ZTR3PH7 (n_{1N} = 4000 min^{-1}, ($F_{f2acc,max}$ = 20 kN)																	
2.53	4.0	6.9	11	1.1	ZTR319SPH731_0050 EZ813U	20	26	615	5.000	1.39	3.17	26	9	115	3	19	60.5
2.53	4.1	11	12	1.1	ZTR319SPH731_0050 EZ815U	20	26	615	5.000	1.39	3.17	26	9	115	3	19	60.5
2.67	3.8	6.6	15	1.1	ZTR316SPH731_0040 EZ813U	20	30	517	4.000	1.27	2.67	22	7	120	3	16	50.9
2.67	3.9	10	16	1.1	ZTR316SPH731_0040 EZ815U	20	30	517	4.000	1.27	2.67	22	7	120	3	16	50.9
3.17	3.2	5.5	15	1.3	ZTR319SPH731_0040 EZ813U	18	26	538	4.000	1.50	3.17	26	9	117	3	19	60.5
3.17	3.3	8.5	16	1.3	ZTR319SPH731_0040 EZ815U	20	26	615	4.000	1.50	3.17	26	9	117	3	19	60.5
ZTR3PH7 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 20 kN)																	
0.57	7.3	12	3.2	1.0	ZTR319SPH732_0250 EZ505U	20	26	615	25.00	0.44	0.89	26	9	113	3	19	60.5
0.60	6.9	11	3.7	1.0	ZTR316SPH732_0200 EZ505U	20	30	517	20.00	0.40	0.80	22	7	117	3	16	50.9
0.75	5.6	8.9	4.1	1.2	ZTR316SPH732_0160 EZ505U	20	30	517	16.00	0.50	1.00	22	7	118	3	16	50.9
0.89	6.0	9.8	5.3	1.1	ZTR319SPH732_0160 EZ703U	20	26	615	16.00	0.59	1.19	26	9	115	3	19	60.5
1.20	4.6	7.5	3.4	1.2	ZTR316SPH731_0100 EZ703U	20	30	517	10.00	0.67	1.33	22	7	110	3	16	50.9
1.43	5.2	9.5	4.7	1.1	ZTR319SPH731_0100 EZ705U	19	26	575	10.00	0.79	1.58	26	9	105	3	19	60.5
1.71	3.2	5.3	3.8	1.5	ZTR316SPH731_0070 EZ703U	17	30	437	7.000	0.95	1.91	22	7	115	3	16	50.9
1.71	4.3	7.9	5.2	1.1	ZTR316SPH731_0070 EZ705U	20	30	517	7.000	0.95	1.91	22	7	115	3	16	50.9
2.04	2.7	4.4	3.8	1.8	ZTR319SPH731_0070 EZ703U	14	26	437	7.000	1.13	2.26	26	9	111	3	19	60.5
2.04	3.6	6.7	5.2	1.4	ZTR319SPH731_0070 EZ705U	20	26	615	7.000	1.13	2.26	26	9	111	3	19	60.5
2.40	2.3	3.8	5.7	1.9	ZTR316SPH731_0050 EZ703U	12	30	312	5.000	1.17	2.67	22	7	118	3	16	50.9
2.40	3.1	5.7	7.7	1.4	ZTR316SPH731_0050 EZ705U	20	30	499	5.000	1.17	2.67	22	7	118	3	16	50.9
2.85	1.9	3.2	5.7	2.3	ZTR319SPH731_0050 EZ703U	10	26	312	5.000	1.39	3.17	26	9	115	3	19	60.5
2.85	2.6	4.8	7.7	1.7	ZTR319SPH731_0050 EZ705U	17	26	499	5.000	1.39	3.17	26	9	115	3	19	60.5
ZTR3PH7 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 20 kN)																	
0.23	8.7	11	0.7	1.1	ZTR316SPH732_0700 EZ501U	20	30	517	70.00	0.14	0.27	22	7	114	3	16	50.9
0.32	6.2	8.0	0.9	1.4	ZTR316SPH732_0500 EZ501U	20	30	517	50.00	0.20	0.37	22	7	116	3	16	50.9
0.38	8.0	12	1.3	1.1	ZTR319SPH732_0500 EZ502U	20	26	615	50.00	0.23	0.44	26	9	112	3	19	60.5
0.38	8.0	12	1.3	1.1	ZTR319SPH732_0500 EZ701U	20	26	615	50.00	0.23	0.44	26	9	112	3	19	60.5
0.40	5.0	6.4	1.1	1.6	ZTR316SPH732_0400 EZ501U	20	30	517	40.00	0.25	0.47	22	7	117	3	16	50.9
0.40	7.6	11	1.7	1.1	ZTR316SPH732_0400 EZ502U	20	30	517	40.00	0.25	0.47	22	7	117	3	16	50.9
0.40	7.6	12	1.7	1.1	ZTR316SPH732_0400 EZ701U	20	30	517	40.00	0.25	0.47	22	7	117	3	16	50.9
0.46	4.3	5.6	1.0	1.8	ZTR316SPH732_0350 EZ501U	20	30	517	35.00	0.28	0.53	22	7	117	3	16	50.9
0.46	6.6	10	1.6	1.2	ZTR316SPH732_0350 EZ502U	20	30	517	35.00	0.28	0.53	22	7	117	3	16	50.9
0.46	6.6	10	1.6	1.2	ZTR316SPH732_0350 EZ701U	20	30	517	35.00	0.28	0.53	22	7	117	3	16	50.9
0.48	4.2	5.4	1.1	1.9	ZTR319SPH732_0400 EZ501U	20	26	595	40.00	0.29	0.55	26	9	113	3	19	60.5
0.48	6.4	9.6	1.7	1.2	ZTR319SPH732_0400 EZ502U	20	26	615	40.00	0.29	0.55	26	9	113	3	19	60.5
0.48	6.4	9.7	1.7	1.2	ZTR319SPH732_0400 EZ701U	20	26	615	40.00	0.29	0.55	26	9	113	3	19	60.5
0.48	7.6	13	2.0	1.0	ZTR319SPH732_0400 EZ503U	20	26	615	40.00	0.29	0.55	26	9	113	3	19	60.5
0.54	3.7	4.7	1.0	2.1	ZTR319SPH732_0350 EZ501U	17	26	521	35.00	0.34	0.63	26	9	113	3	19	60.5
0.54	5.6	8.4	1.6	1.4	ZTR319SPH732_0350 EZ502U	20	26	615	35.00	0.34	0.63	26	9	113	3	19	60.5
0.54	5.6	8.5	1.6	1.4	ZTR319SPH732_0350 EZ701U	20	26	615	35.00	0.34	0.63	26	9	113	3	19	60.5
0.54	6.7	11	1.9	1.1	ZTR319SPH732_0350 EZ503U	20	26	615	35.00	0.34	0.63	26	9	113	3	19	60.5
0.57	3.5	4.5	1.1	2.1	ZTR316SPH732_0280 EZ501U	16	30	417	28.00	0.35	0.67	22	7	117	3	16	50.9
0.57	5.3	8.0	1.7	1.3	ZTR316SPH732_0280 EZ502U	20	30	517	28.00	0.35	0.67	22	7	117	3	16	50.9

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTR3PH7 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 20 kN)																	
0.57	5.3	8.1	1.7	1.3	ZTR316SPH732_0280 EZ701U	20	30	517	28.00	0.35	0.67	22	7	117	3	16	50.9
0.57	6.3	11	2.1	1.1	ZTR316SPH732_0280 EZ503U	20	30	517	28.00	0.35	0.67	22	7	117	3	16	50.9
0.64	3.1	4.0	1.3	2.2	ZTR316SPH732_0250 EZ501U	15	30	372	25.00	0.37	0.75	22	7	117	3	16	50.9
0.64	4.7	7.1	2.0	1.4	ZTR316SPH732_0250 EZ502U	20	30	517	25.00	0.37	0.75	22	7	117	3	16	50.9
0.64	4.7	7.2	2.0	1.4	ZTR316SPH732_0250 EZ701U	18	30	465	25.00	0.37	0.75	22	7	117	3	16	50.9
0.64	5.7	9.7	2.3	1.2	ZTR316SPH732_0250 EZ503U	20	30	517	25.00	0.37	0.75	22	7	117	3	16	50.9
0.64	6.6	13	2.7	1.0	ZTR316SPH732_0250 EZ702U	20	30	517	25.00	0.37	0.75	22	7	117	3	16	50.9
0.68	2.9	3.8	1.1	2.4	ZTR319SPH732_0280 EZ501U	14	26	417	28.00	0.42	0.79	26	9	114	3	19	60.5
0.68	4.5	6.7	1.7	1.6	ZTR319SPH732_0280 EZ502U	20	26	615	28.00	0.42	0.79	26	9	114	3	19	60.5
0.68	4.5	6.8	1.7	1.6	ZTR319SPH732_0280 EZ701U	17	26	521	28.00	0.42	0.79	26	9	114	3	19	60.5
0.68	5.3	9.1	2.1	1.3	ZTR319SPH732_0280 EZ503U	20	26	615	28.00	0.42	0.79	26	9	114	3	19	60.5
0.68	6.2	12	2.4	1.1	ZTR319SPH732_0280 EZ702U	20	26	615	28.00	0.42	0.79	26	9	114	3	19	60.5
0.76	2.6	3.4	1.3	2.6	ZTR319SPH732_0250 EZ501U	12	26	372	25.00	0.44	0.89	26	9	113	3	19	60.5
0.76	4.0	6.0	2.0	1.7	ZTR319SPH732_0250 EZ502U	20	26	615	25.00	0.44	0.89	26	9	113	3	19	60.5
0.76	4.0	6.1	2.0	1.7	ZTR319SPH732_0250 EZ701U	15	26	465	25.00	0.44	0.89	26	9	113	3	19	60.5
0.76	4.8	8.1	2.3	1.4	ZTR319SPH732_0250 EZ503U	20	26	615	25.00	0.44	0.89	26	9	113	3	19	60.5
0.76	5.5	11	2.7	1.2	ZTR319SPH732_0250 EZ702U	20	26	615	25.00	0.44	0.89	26	9	113	3	19	60.5
0.80	2.5	3.2	1.5	2.6	ZTR316SPH732_0200 EZ501U	12	30	298	20.00	0.40	0.80	22	7	117	3	16	50.9
0.80	3.8	5.7	2.2	1.7	ZTR316SPH732_0200 EZ502U	20	30	517	20.00	0.40	0.80	22	7	117	3	16	50.9
0.80	3.8	5.8	2.2	1.7	ZTR316SPH732_0200 EZ701U	15	30	372	20.00	0.40	0.80	22	7	117	3	16	50.9
0.80	4.5	7.7	2.6	1.4	ZTR316SPH732_0200 EZ503U	20	30	517	20.00	0.40	0.80	22	7	117	3	16	50.9
0.80	5.3	10	3.1	1.2	ZTR316SPH732_0200 EZ702U	20	30	517	20.00	0.40	0.80	22	7	117	3	16	50.9
0.95	2.1	2.7	1.5	3.0	ZTR319SPH732_0200 EZ501U	9.8	26	298	20.00	0.48	0.95	26	9	113	3	19	60.5
0.95	3.2	4.8	2.2	2.0	ZTR319SPH732_0200 EZ502U	19	26	577	20.00	0.48	0.95	26	9	113	3	19	60.5
0.95	3.2	4.9	2.2	2.0	ZTR319SPH732_0200 EZ701U	12	26	372	20.00	0.48	0.95	26	9	113	3	19	60.5
0.95	3.8	6.5	2.6	1.7	ZTR319SPH732_0200 EZ503U	20	26	615	20.00	0.48	0.95	26	9	113	3	19	60.5
0.95	4.4	8.8	3.1	1.4	ZTR319SPH732_0200 EZ702U	20	26	615	20.00	0.48	0.95	26	9	113	3	19	60.5
1.00	2.0	2.6	1.6	3.0	ZTR316SPH732_0160 EZ501U	9.3	30	238	16.00	0.50	1.00	22	7	118	3	16	50.9
1.00	3.0	4.6	2.5	1.9	ZTR316SPH732_0160 EZ502U	18	30	461	16.00	0.50	1.00	22	7	118	3	16	50.9
1.00	3.0	4.6	2.5	1.9	ZTR316SPH732_0160 EZ701U	12	30	298	16.00	0.50	1.00	22	7	118	3	16	50.9
1.00	3.6	6.2	3.0	1.6	ZTR316SPH732_0160 EZ503U	20	30	517	16.00	0.50	1.00	22	7	118	3	16	50.9
1.00	4.2	8.4	3.4	1.4	ZTR316SPH732_0160 EZ702U	20	30	517	16.00	0.50	1.00	22	7	118	3	16	50.9
1.19	1.7	2.2	1.6	3.5	ZTR319SPH732_0160 EZ501U	7.9	26	238	16.00	0.59	1.19	26	9	115	3	19	60.5
1.19	2.6	3.8	2.5	2.3	ZTR319SPH732_0160 EZ502U	15	26	461	16.00	0.59	1.19	26	9	115	3	19	60.5
1.19	2.6	3.9	2.5	2.3	ZTR319SPH732_0160 EZ701U	9.8	26	298	16.00	0.59	1.19	26	9	115	3	19	60.5
1.19	3.1	5.2	3.0	1.9	ZTR319SPH732_0160 EZ503U	20	26	615	16.00	0.59	1.19	26	9	115	3	19	60.5
1.19	3.5	7.0	3.4	1.7	ZTR319SPH732_0160 EZ702U	20	26	610	16.00	0.59	1.19	26	9	115	3	19	60.5
ZTR4PH7 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 19 kN)																	
0.11	11	12	0.7	1.1	ZTR412SPH732_0700 EZ501U	19	28	491	70.00	0.14	0.27	22	7	110	4	12	50.9
0.16	7.9	8.6	0.9	1.3	ZTR412SPH732_0500 EZ501U	19	28	491	50.00	0.20	0.37	22	7	112	4	12	50.9
0.20	6.3	6.9	1.1	1.5	ZTR412SPH732_0400 EZ501U	19	28	491	40.00	0.25	0.47	22	7	113	4	12	50.9
0.23	5.5	6.0	1.1	1.7	ZTR412SPH732_0350 EZ501U	19	28	491	35.00	0.28	0.53	22	7	113	4	12	50.9
0.29	4.4	4.8	1.2	2.0	ZTR412SPH732_0280 EZ501U	16	28	417	28.00	0.35	0.67	22	7	114	4	12	50.9
0.29	7.6	8.2	2.0	1.1	ZTR412SPH732_0280 EZ502U	19	28	491	28.00	0.35	0.67	22	7	114	4	12	50.9
0.29	7.6	8.5	2.0	1.1	ZTR412SPH732_0280 EZ701U	19	28	491	28.00	0.35	0.67	22	7	114	4	12	50.9
0.32	3.9	4.3	1.3	2.1	ZTR412SPH732_0250 EZ501U	15	28	372	25.00	0.37	0.75	22	7	113	4	12	50.9
0.32	6.8	7.3	2.3	1.2	ZTR412SPH732_0250 EZ502U	19	28	491	25.00	0.37	0.75	22	7	113	4	12	50.9
0.32	6.8	7.6	2.3	1.2	ZTR412SPH732_0250 EZ701U	18	28	465	25.00	0.37	0.75	22	7	113	4	12	50.9
0.40	3.1	3.4	1.6	2.5	ZTR412SPH732_0200 EZ501U	12	28	298	20.00	0.40	0.80	22	7	113	4	12	50.9
0.40	5.4	5.8	2.8	1.4	ZTR412SPH732_0200 EZ502U	19	28	491	20.00	0.40	0.80	22	7	113	4	12	50.9
0.40	5.4	6.1	2.8	1.4	ZTR412SPH732_0200 EZ701U	15	28	372	20.00	0.40	0.80	22	7	113	4	12	50.9
0.40	7.1	8.1	3.7	1.1	ZTR412SPH732_0200 EZ503U	19	28	491	20.00	0.40	0.80	22	7	113	4	12	50.9
0.50	2.5	2.7	1.9	2.9	ZTR412SPH732_0160 EZ501U	9.3	28	238	16.00	0.50	1.00	22	7	114	4	12	50.9
0.50	4.3	4.7	3.2	1.7	ZTR412SPH732_0160 EZ502U	18	28	461	16.00	0.50	1.00	22	7	114	4	12	50.9
0.50	4.3	4.8	3.2	1.7	ZTR412SPH732_0160 EZ701U	12	28	298	16.00	0.50	1.00	22	7	114	4	12	50.9
0.50	5.7	6.5	4.2	1.3	ZTR412SPH732_0160 EZ503U	19	28	491	16.00	0.50	1.00	22	7	114	4	12	50.9
0.50	7.0	8.4	5.2	1.0	ZTR412SPH732_0160 EZ702U	19	28	491	16.00	0.50	1.00	22	7	114	4	12	50.9
0.80	2.8	3.1	1.8	2.2	ZTR412SPH731_0100 EZ701U	7.5	28	192	10.00	0.67	1.33	22	7	107	4	12	50.9
0.80	4.5	5.4	3.0	1.4	ZTR412SPH731_0100 EZ702U	15	28	394	10.00	0.67	1.33	22	7	107	4	12	50.9
1.14	2.0	2.2	2.0	2.8	ZTR412SPH731_0070 EZ701U	5.3	28	134	7.000	0.95	1.91	22	7	112	4	12	50.9
1.14	3.2	3.8	3.3	1.7	ZTR412SPH731_0070 EZ702U	11	28	276	7.000	0.95	1.91	22	7	112	4	12	50.9
1.14	4.4	5.5	4.5	1.3	ZTR412SPH731_0070 EZ703U	17	28	437	7.000	0.95	1.91	22	7	112	4	12	50.9
1.60	1.4	1.6	3.1	3.5	ZTR412SPH731_0050 EZ701U	3.8	28	96	5.000	1.17	2.67	22	7	115	4	12	50.9
1.60	2.3	2.7	5.0	2.2	ZTR412SPH731_0050 EZ702U	7.7	28	197	5.000	1.17	2.67	22	7	115	4	12	50.9
1.60	3.1	3.9	6.8	1.6	ZTR412SPH731_0050 EZ703U	12	28	312	5.000	1.17	2.67	22	7	115	4	12	50.9
1.60	4.0	5.7	8.8	1.2	ZTR412SPH731_0050 EZ705U	19	28	491	5.000	1.17	2.67	22	7	115	4	12	50.9

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTR4PH7 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 19 kN)																	
2.00	1.1	1.3	4.0	4.0	ZTR412SPH731_0040 EZ701U	3.0	28	77	4.000	1.27	2.67	22	7	116	4	12	50.9
2.00	1.8	2.2	6.5	2.5	ZTR412SPH731_0040 EZ702U	6.2	28	157	4.000	1.27	2.67	22	7	116	4	12	50.9
2.00	2.5	3.1	8.9	1.8	ZTR412SPH731_0040 EZ703U	9.8	28	250	4.000	1.27	2.67	22	7	116	4	12	50.9
2.00	3.2	4.6	11	1.4	ZTR412SPH731_0040 EZ705U	16	28	399	4.000	1.27	2.67	22	7	116	4	12	50.9
ZTR4PH7 (n_{1N} = 4000 min^{-1}, ($F_{f2acc,max}$ = 19 kN)																	
2.67	3.8	6.6	15	1.1	ZTR412SPH731_0040 EZ813U	19	28	491	4.000	1.27	2.67	22	7	116	4	12	50.9
2.67	3.9	10	16	1.0	ZTR412SPH731_0040 EZ815U	19	28	491	4.000	1.27	2.67	22	7	116	4	12	50.9
ZTR4PH7 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 19 kN)																	
0.75	5.6	8.9	4.1	1.1	ZTR412SPH732_0160 EZ505U	19	28	491	16.00	0.50	1.00	22	7	114	4	12	50.9
1.20	4.6	7.5	3.4	1.2	ZTR412SPH731_0100 EZ703U	19	28	491	10.00	0.67	1.33	22	7	107	4	12	50.9
1.71	3.2	5.3	3.8	1.5	ZTR412SPH731_0070 EZ703U	17	28	437	7.000	0.95	1.91	22	7	112	4	12	50.9
1.71	4.3	7.9	5.2	1.1	ZTR412SPH731_0070 EZ705U	19	28	491	7.000	0.95	1.91	22	7	112	4	12	50.9
2.40	2.3	3.8	5.7	1.9	ZTR412SPH731_0050 EZ703U	12	28	312	5.000	1.17	2.67	22	7	115	4	12	50.9
2.40	3.1	5.7	7.7	1.4	ZTR412SPH731_0050 EZ705U	19	28	491	5.000	1.17	2.67	22	7	115	4	12	50.9
ZTR4PH7 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 19 kN)																	
0.23	8.7	11	0.7	1.1	ZTR412SPH732_0700 EZ501U	19	28	491	70.00	0.14	0.27	22	7	110	4	12	50.9
0.32	6.2	8.0	0.9	1.3	ZTR412SPH732_0500 EZ501U	19	28	491	50.00	0.20	0.37	22	7	112	4	12	50.9
0.40	5.0	6.4	1.1	1.6	ZTR412SPH732_0400 EZ501U	19	28	491	40.00	0.25	0.47	22	7	113	4	12	50.9
0.40	7.6	11	1.7	1.0	ZTR412SPH732_0400 EZ502U	19	28	491	40.00	0.25	0.47	22	7	113	4	12	50.9
0.40	7.6	12	1.7	1.0	ZTR412SPH732_0400 EZ701U	19	28	491	40.00	0.25	0.47	22	7	113	4	12	50.9
0.46	4.3	5.6	1.0	1.7	ZTR412SPH732_0350 EZ501U	19	28	491	35.00	0.28	0.53	22	7	113	4	12	50.9
0.46	6.6	10	1.6	1.1	ZTR412SPH732_0350 EZ502U	19	28	491	35.00	0.28	0.53	22	7	113	4	12	50.9
0.46	6.6	10	1.6	1.1	ZTR412SPH732_0350 EZ701U	19	28	491	35.00	0.28	0.53	22	7	113	4	12	50.9
0.57	3.5	4.5	1.1	2.0	ZTR412SPH732_0280 EZ501U	16	28	417	28.00	0.35	0.67	22	7	114	4	12	50.9
0.57	5.3	8.0	1.7	1.3	ZTR412SPH732_0280 EZ502U	19	28	491	28.00	0.35	0.67	22	7	114	4	12	50.9
0.57	5.3	8.1	1.7	1.3	ZTR412SPH732_0280 EZ701U	19	28	491	28.00	0.35	0.67	22	7	114	4	12	50.9
0.57	6.3	11	2.1	1.1	ZTR412SPH732_0280 EZ503U	19	28	491	28.00	0.35	0.67	22	7	114	4	12	50.9
0.64	3.1	4.0	1.3	2.1	ZTR412SPH732_0250 EZ501U	15	28	372	25.00	0.37	0.75	22	7	113	4	12	50.9
0.64	4.7	7.1	2.0	1.4	ZTR412SPH732_0250 EZ502U	19	28	491	25.00	0.37	0.75	22	7	113	4	12	50.9
0.64	4.7	7.2	2.0	1.4	ZTR412SPH732_0250 EZ701U	18	28	465	25.00	0.37	0.75	22	7	113	4	12	50.9
0.64	5.7	9.7	2.3	1.2	ZTR412SPH732_0250 EZ503U	19	28	491	25.00	0.37	0.75	22	7	113	4	12	50.9
0.64	6.6	13	2.7	1.0	ZTR412SPH732_0250 EZ702U	19	28	491	25.00	0.37	0.75	22	7	113	4	12	50.9
0.80	2.5	3.2	1.5	2.5	ZTR412SPH732_0200 EZ501U	12	28	298	20.00	0.40	0.80	22	7	113	4	12	50.9
0.80	3.8	5.7	2.2	1.6	ZTR412SPH732_0200 EZ502U	19	28	491	20.00	0.40	0.80	22	7	113	4	12	50.9
0.80	3.8	5.8	2.2	1.6	ZTR412SPH732_0200 EZ701U	15	28	372	20.00	0.40	0.80	22	7	113	4	12	50.9
0.80	4.5	7.7	2.6	1.4	ZTR412SPH732_0200 EZ503U	19	28	491	20.00	0.40	0.80	22	7	113	4	12	50.9
0.80	5.3	10	3.1	1.2	ZTR412SPH732_0200 EZ702U	19	28	491	20.00	0.40	0.80	22	7	113	4	12	50.9
1.00	2.0	2.6	1.6	2.9	ZTR412SPH732_0160 EZ501U	9.3	28	238	16.00	0.50	1.00	22	7	114	4	12	50.9
1.00	3.0	4.6	2.5	1.9	ZTR412SPH732_0160 EZ502U	18	28	461	16.00	0.50	1.00	22	7	114	4	12	50.9
1.00	3.0	4.6	2.5	1.9	ZTR412SPH732_0160 EZ701U	12	28	298	16.00	0.50	1.00	22	7	114	4	12	50.9
1.00	3.6	6.2	3.0	1.6	ZTR412SPH732_0160 EZ503U	19	28	491	16.00	0.50	1.00	22	7	114	4	12	50.9
1.00	4.2	8.4	3.4	1.4	ZTR412SPH732_0160 EZ702U	19	28	491	16.00	0.50	1.00	22	7	114	4	12	50.9
ZTR3PH8 (n_{1N} = 2000 min^{-1}, ($F_{f2acc,max}$ = 25 kN)																	
0.31	25	28	3.9	1.0	ZTR332SPH832_0350 EZ813U	25	44	1294	35.00	0.46	0.91	44	15	184	3	32	101.9
0.38	20	22	5.7	1.1	ZTR332SPH832_0280 EZ813U	25	44	1294	28.00	0.57	1.14	44	15	181	3	32	101.9
0.43	18	20	5.1	1.3	ZTR332SPH832_0250 EZ813U	25	44	1294	25.00	0.58	1.17	44	15	185	3	32	101.9
0.53	14	16	5.9	1.5	ZTR332SPH832_0200 EZ813U	25	44	1294	20.00	0.67	1.20	44	15	185	3	32	101.9
0.53	21	25	8.7	1.0	ZTR332SPH832_0200 EZ815U	25	44	1294	20.00	0.67	1.20	44	15	185	3	32	101.9
0.67	11	13	7.5	1.8	ZTR332SPH832_0160 EZ813U	25	44	1294	16.00	0.83	1.50	44	15	183	3	32	101.9
0.67	17	20	11	1.2	ZTR332SPH832_0160 EZ815U	25	44	1294	16.00	0.83	1.50	44	15	183	3	32	101.9
1.07	7.3	8.2	3.8	2.1	ZTR332SPH831_0100 EZ813U	25	44	1294	10.00	1.17	2.13	44	15	162	3	32	101.9
1.07	11	13	5.6	1.4	ZTR332SPH831_0100 EZ815U	25	44	1294	10.00	1.17	2.13	44	15	162	3	32	101.9
1.52	5.1	5.8	4.5	2.9	ZTR332SPH831_0070 EZ813U	18	44	941	7.000	1.52	3.05	44	15	179	3	32	101.9
1.52	7.6	9.1	6.6	2.0	ZTR332SPH831_0070 EZ815U	25	44	1294	7.000	1.52	3.05	44	15	179	3	32	101.9
2.13	3.7	4.1	6.7	3.7	ZTR332SPH831_0050 EZ813U	13	44	672	5.000	1.71	4.27	44	15	192	3	32	101.9
2.13	5.4	6.5	9.9	2.5	ZTR332SPH831_0050 EZ815U	19	44	960	5.000	1.71	4.27	44	15	192	3	32	101.9
2.67	2.9	3.3	11	4.3	ZTR332SPH831_0040 EZ813U	11	39	538	4.000	1.87	4.67	44	15	193	3	32	101.9
2.67	4.4	5.2	16	2.9	ZTR332SPH831_0040 EZ815U	15	39	768	4.000	1.87	4.67	44	15	193	3	32	101.9
ZTR3PH8 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 25 kN)																	
0.16	14	15	0.7	1.3	ZTR332SPH832_1000 EZ701U	25	44	1294	100.0	0.16	0.32	44	15	161	3	32	101.9
0.23	9.5	11	0.6	2.6	ZTR332SPH832_0700 EZ701U	25	44	1294	70.00	0.23	0.46	44	15	174	3	32	101.9
0.23	15	18	1.0	1.6	ZTR332SPH832_0700 EZ702U	25	44	1294	70.00	0.23	0.46	44	15	174	3	32	101.9
0.23	21	27	1.3	1.2	ZTR332SPH832_0700 EZ703U	25	44	1294	70.00	0.23	0.46	44	15	174	3	32	101.9
0.32	6.8	7.6	0.7	3.7	ZTR332SPH832_0500 EZ701U	18	44	930	50.00	0.32	0.64	44	15	182	3	32	101.9
0.32	11	13	1.1	2.3	ZTR332SPH832_0500 EZ702U	25	44	1294	50.00	0.32	0.64	44	15	182	3	32	101.9

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTR3PH8 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 25 kN)																	
0.32	15	19	1.6	1.7	ZTR332SPH832_0500 EZ703U	25	44	1294	50.00	0.32	0.64	44	15	182	3	32	101.9
0.32	19	28	2.0	1.3	ZTR332SPH832_0500 EZ705U	25	44	1294	50.00	0.32	0.64	44	15	182	3	32	101.9
0.40	5.4	6.1	1.0	3.7	ZTR332SPH832_0400 EZ701U	15	44	744	40.00	0.40	0.80	44	15	178	3	32	101.9
0.40	8.8	11	1.6	2.3	ZTR332SPH832_0400 EZ702U	25	44	1294	40.00	0.40	0.80	44	15	178	3	32	101.9
0.40	12	15	2.2	1.7	ZTR332SPH832_0400 EZ703U	25	44	1294	40.00	0.40	0.80	44	15	178	3	32	101.9
0.40	16	22	2.8	1.3	ZTR332SPH832_0400 EZ705U	25	44	1294	40.00	0.40	0.80	44	15	178	3	32	101.9
0.46	4.7	5.3	0.8	4.8	ZTR332SPH832_0350 EZ701U	13	44	651	35.00	0.46	0.91	44	15	184	3	32	101.9
0.46	7.7	9.2	1.4	2.9	ZTR332SPH832_0350 EZ702U	25	44	1294	35.00	0.46	0.91	44	15	184	3	32	101.9
0.46	11	13	1.9	2.1	ZTR332SPH832_0350 EZ703U	25	44	1294	35.00	0.46	0.91	44	15	184	3	32	101.9
0.46	14	19	2.4	1.7	ZTR332SPH832_0350 EZ705U	25	44	1294	35.00	0.46	0.91	44	15	184	3	32	101.9
0.57	6.1	7.4	1.9	3.2	ZTR332SPH832_0280 EZ702U	21	44	1068	28.00	0.57	1.14	44	15	181	3	32	101.9
0.57	8.4	11	2.6	2.3	ZTR332SPH832_0280 EZ703U	25	44	1294	28.00	0.57	1.14	44	15	181	3	32	101.9
0.57	11	15	3.4	1.8	ZTR332SPH832_0280 EZ705U	25	44	1294	28.00	0.57	1.14	44	15	181	3	32	101.9
0.64	5.5	6.6	1.6	3.7	ZTR332SPH832_0250 EZ702U	19	44	953	25.00	0.58	1.17	44	15	185	3	32	101.9
0.64	7.5	9.5	2.2	2.7	ZTR332SPH832_0250 EZ703U	25	44	1294	25.00	0.58	1.17	44	15	185	3	32	101.9
0.64	9.7	14	2.9	2.1	ZTR332SPH832_0250 EZ705U	25	44	1294	25.00	0.58	1.17	44	15	185	3	32	101.9
0.80	4.4	5.3	1.8	4.3	ZTR332SPH832_0200 EZ702U	15	44	763	20.00	0.67	1.20	44	15	185	3	32	101.9
0.80	6.0	7.6	2.5	3.1	ZTR332SPH832_0200 EZ703U	24	44	1209	20.00	0.67	1.20	44	15	185	3	32	101.9
0.80	7.8	11	3.2	2.4	ZTR332SPH832_0200 EZ705U	25	44	1294	20.00	0.67	1.20	44	15	185	3	32	101.9
1.00	3.5	4.2	2.5	5.0	ZTR332SPH832_0160 EZ702U	12	44	610	16.00	0.83	1.50	44	15	183	3	32	101.9
1.00	4.8	6.1	3.5	3.6	ZTR332SPH832_0160 EZ703U	19	44	967	16.00	0.83	1.50	44	15	183	3	32	101.9
1.00	6.2	8.8	4.5	2.8	ZTR332SPH832_0160 EZ705U	25	44	1294	16.00	0.83	1.50	44	15	183	3	32	101.9
ZTR3PH8 (n_{1N} = 4000 min^{-1}, ($F_{f2acc,max}$ = 25 kN)																	
0.61	16	28	3.2	1.3	ZTR332SPH832_0350 EZ813U	25	44	1294	35.00	0.46	0.91	44	15	184	3	32	101.9
0.61	17	43	3.3	1.2	ZTR332SPH832_0350 EZ815U	25	44	1294	35.00	0.46	0.91	44	15	184	3	32	101.9
0.76	13	22	4.4	1.4	ZTR332SPH832_0280 EZ813U	25	44	1294	28.00	0.57	1.14	44	15	181	3	32	101.9
0.76	13	34	4.6	1.3	ZTR332SPH832_0280 EZ815U	25	44	1294	28.00	0.57	1.14	44	15	181	3	32	101.9
0.85	12	20	3.7	1.6	ZTR332SPH832_0250 EZ813U	25	44	1294	25.00	0.58	1.17	44	15	185	3	32	101.9
0.85	12	31	3.9	1.5	ZTR332SPH832_0250 EZ815U	25	44	1294	25.00	0.58	1.17	44	15	185	3	32	101.9
1.07	9.2	16	4.2	1.9	ZTR332SPH832_0200 EZ813U	25	44	1294	20.00	0.67	1.20	44	15	185	3	32	101.9
1.07	9.5	25	4.3	1.8	ZTR332SPH832_0200 EZ815U	25	44	1294	20.00	0.67	1.20	44	15	185	3	32	101.9
1.33	7.4	13	5.8	2.2	ZTR332SPH832_0160 EZ813U	25	44	1294	16.00	0.83	1.50	44	15	183	3	32	101.9
1.33	7.6	20	6.0	2.1	ZTR332SPH832_0160 EZ815U	25	44	1294	16.00	0.83	1.50	44	15	183	3	32	101.9
2.13	4.8	8.2	3.1	2.5	ZTR332SPH831_0100 EZ813U	25	44	1294	10.00	1.17	2.13	44	15	162	3	32	101.9
2.13	4.9	13	3.2	2.4	ZTR332SPH831_0100 EZ815U	25	44	1294	10.00	1.17	2.13	44	15	162	3	32	101.9
3.05	3.3	5.8	3.6	3.6	ZTR332SPH831_0070 EZ813U	18	44	941	7.000	1.52	3.05	44	15	179	3	32	101.9
3.05	3.4	8.9	3.8	3.5	ZTR332SPH831_0070 EZ815U	25	44	1294	7.000	1.52	3.05	44	15	179	3	32	101.9
4.27	2.4	4.1	5.5	4.5	ZTR332SPH831_0050 EZ813U	13	44	672	5.000	1.71	4.27	44	15	192	3	32	101.9
4.27	2.5	6.3	5.7	4.4	ZTR332SPH831_0050 EZ815U	19	44	960	5.000	1.71	4.27	44	15	192	3	32	101.9
ZTR3PH8 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 25 kN)																	
0.34	15	26	1.1	1.4	ZTR332SPH832_0700 EZ703U	25	44	1294	70.00	0.23	0.46	44	15	174	3	32	101.9
0.34	21	38	1.5	1.0	ZTR332SPH832_0700 EZ705U	25	44	1294	70.00	0.23	0.46	44	15	174	3	32	101.9
0.48	11	18	1.3	2.0	ZTR332SPH832_0500 EZ703U	25	44	1294	50.00	0.32	0.64	44	15	182	3	32	101.9
0.48	15	27	1.8	1.5	ZTR332SPH832_0500 EZ705U	25	44	1294	50.00	0.32	0.64	44	15	182	3	32	101.9
0.60	8.8	15	1.8	2.0	ZTR332SPH832_0400 EZ703U	25	44	1294	40.00	0.40	0.80	44	15	178	3	32	101.9
0.60	12	22	2.5	1.5	ZTR332SPH832_0400 EZ705U	25	44	1294	40.00	0.40	0.80	44	15	178	3	32	101.9
0.69	7.7	13	1.6	2.6	ZTR332SPH832_0350 EZ703U	25	44	1294	35.00	0.46	0.91	44	15	184	3	32	101.9
0.69	10	19	2.1	1.9	ZTR332SPH832_0350 EZ705U	25	44	1294	35.00	0.46	0.91	44	15	184	3	32	101.9
0.86	6.2	10	2.2	2.8	ZTR332SPH832_0280 EZ703U	25	44	1294	28.00	0.57	1.14	44	15	181	3	32	101.9
0.86	8.4	15	3.0	2.1	ZTR332SPH832_0280 EZ705U	25	44	1294	28.00	0.57	1.14	44	15	181	3	32	101.9
0.96	5.5	9.1	1.9	3.2	ZTR332SPH832_0250 EZ703U	25	44	1294	25.00	0.58	1.17	44	15	185	3	32	101.9
0.96	7.5	14	2.5	2.4	ZTR332SPH832_0250 EZ705U	25	44	1294	25.00	0.58	1.17	44	15	185	3	32	101.9
1.20	4.4	7.3	2.1	3.7	ZTR332SPH832_0200 EZ703U	24	44	1209	20.00	0.67	1.20	44	15	185	3	32	101.9
1.20	6.0	11	2.8	2.7	ZTR332SPH832_0200 EZ705U	25	44	1294	20.00	0.67	1.20	44	15	185	3	32	101.9
1.50	3.5	5.8	2.9	4.3	ZTR332SPH832_0160 EZ703U	19	44	967	16.00	0.83	1.50	44	15	183	3	32	101.9
1.50	4.8	8.8	3.9	3.2	ZTR332SPH832_0160 EZ705U	25	44	1294	16.00	0.83	1.50	44	15	183	3	32	101.9
ZTR3PH8 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 25 kN)																	
0.32	9.5	14	0.6	1.4	ZTR332SPH832_1000 EZ701U	25	44	1294	100.0	0.16	0.32	44	15	161	3	32	101.9
0.32	13	26	0.9	1.0	ZTR332SPH832_1000 EZ702U	25	44	1294	100.0	0.16	0.32	44	15	161	3	32	101.9
0.46	6.6	10	0.5	3.0	ZTR332SPH832_0700 EZ701U	25	44	1294	70.00	0.23	0.46	44	15	174	3	32	101.9
0.46	9.2	18	0.7	2.1	ZTR332SPH832_0700 EZ702U	25	44	1294	70.00	0.23	0.46	44	15	174	3	32	101.9
0.64	4.7	7.2	0.6	4.2	ZTR332SPH832_0500 EZ701U	18	44	930	50.00	0.32	0.64	44	15	182	3	32	101.9
0.64	6.6	13	0.9	3.0	ZTR332SPH832_0500 EZ702U	25	44	1294	50.00	0.32	0.64	44	15	182	3	32	101.9
0.80	3.8	5.8	0.9	4.2	ZTR332SPH832_0400 EZ701U	15	44	744	40.00	0.40	0.80	44	15	178	3	32	101.9
0.80	5.3	10	1.2	3.0	ZTR332SPH832_0400 EZ702U	25	44	1294	40.00	0.40	0.80	44	15	178	3	32	101.9

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTR3PH8 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 25 kN)																	
0.91	4.6	9.1	1.0	3.9	ZTR332SPH832_0350 EZ702U	25	44	1294	35.00	0.46	0.91	44	15	184	3	32	101.9
1.14	3.7	7.3	1.4	4.3	ZTR332SPH832_0280 EZ702U	21	44	1068	28.00	0.57	1.14	44	15	181	3	32	101.9
ZTR4PH8 (n_{1N} = 2000 min^{-1}, ($F_{f2acc,max}$ = 36 kN)																	
0.36	21	24	5.1	1.1	ZTR420SPH832_0250 EZ813U	36	50	1532	25.00	0.48	0.98	37	12	208	4	20	84.9
0.38	20	23	5.9	1.1	ZTR417SPH832_0200 EZ813U	36	55	1302	20.00	0.47	0.85	31	10	218	4	17	72.2
0.47	16	18	7.5	1.2	ZTR417SPH832_0160 EZ813U	36	55	1302	16.00	0.59	1.06	31	10	216	4	17	72.2
0.76	10	12	3.8	1.6	ZTR417SPH831_0100 EZ813U	36	55	1302	10.00	0.83	1.51	31	10	201	4	17	72.2
0.76	15	18	5.6	1.1	ZTR417SPH831_0100 EZ815U	36	55	1302	10.00	0.83	1.51	31	10	201	4	17	72.2
0.89	8.8	9.9	3.8	1.9	ZTR420SPH831_0100 EZ813U	32	50	1344	10.00	0.98	1.78	37	12	188	4	20	84.9
0.89	13	16	5.6	1.3	ZTR420SPH831_0100 EZ815U	33	50	1392	10.00	0.98	1.78	37	12	188	4	20	84.9
1.08	7.3	8.1	4.5	2.1	ZTR417SPH831_0070 EZ813U	26	55	941	7.000	1.08	2.16	31	10	213	4	17	72.2
1.08	11	13	6.6	1.4	ZTR417SPH831_0070 EZ815U	36	55	1302	7.000	1.08	2.16	31	10	213	4	17	72.2
1.27	6.2	6.9	4.5	2.4	ZTR420SPH831_0070 EZ813U	22	50	941	7.000	1.27	2.54	37	12	203	4	20	84.9
1.27	9.1	11	6.6	1.6	ZTR420SPH831_0070 EZ815U	32	50	1344	7.000	1.27	2.54	37	12	203	4	20	84.9
1.51	5.2	5.8	6.7	2.6	ZTR417SPH831_0050 EZ813U	19	55	672	5.000	1.21	3.02	31	10	222	4	17	72.2
1.51	7.7	9.1	9.9	1.7	ZTR417SPH831_0050 EZ815U	27	55	960	5.000	1.21	3.02	31	10	222	4	17	72.2
1.78	4.4	4.9	6.7	3.0	ZTR420SPH831_0050 EZ813U	16	50	672	5.000	1.42	3.56	37	12	214	4	20	84.9
1.78	6.5	7.8	9.9	2.0	ZTR420SPH831_0050 EZ815U	23	50	960	5.000	1.42	3.56	37	12	214	4	20	84.9
1.89	4.2	4.7	11	3.0	ZTR417SPH831_0040 EZ813U	15	55	538	4.000	1.32	3.31	31	10	223	4	17	72.2
1.89	6.1	7.3	16	2.0	ZTR417SPH831_0040 EZ815U	21	55	768	4.000	1.32	3.31	31	10	223	4	17	72.2
2.22	3.5	4.0	11	3.5	ZTR420SPH831_0040 EZ813U	13	47	538	4.000	1.56	3.89	37	12	215	4	20	84.9
2.22	5.2	6.2	16	2.4	ZTR420SPH831_0040 EZ815U	18	47	768	4.000	1.56	3.89	37	12	215	4	20	84.9
ZTR4PH8 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 36 kN)																	
0.11	19	21	0.7	1.3	ZTR417SPH832_1000 EZ701U	36	55	1302	100.0	0.11	0.23	31	10	200	4	17	72.2
0.16	13	15	0.6	2.1	ZTR417SPH832_0700 EZ701U	36	55	1302	70.00	0.16	0.32	31	10	210	4	17	72.2
0.16	22	26	1.0	1.3	ZTR417SPH832_0700 EZ702U	36	55	1302	70.00	0.16	0.32	31	10	210	4	17	72.2
0.19	11	13	0.6	2.5	ZTR420SPH832_0700 EZ701U	31	50	1302	70.00	0.19	0.38	37	12	199	4	20	84.9
0.19	18	22	1.0	1.5	ZTR420SPH832_0700 EZ702U	36	50	1532	70.00	0.19	0.38	37	12	199	4	20	84.9
0.19	25	32	1.3	1.1	ZTR420SPH832_0700 EZ703U	36	50	1532	70.00	0.19	0.38	37	12	199	4	20	84.9
0.23	9.5	11	0.7	2.6	ZTR417SPH832_0500 EZ701U	26	55	930	50.00	0.23	0.45	31	10	216	4	17	72.2
0.23	15	19	1.1	1.6	ZTR417SPH832_0500 EZ702U	36	55	1302	50.00	0.23	0.45	31	10	216	4	17	72.2
0.23	21	27	1.6	1.2	ZTR417SPH832_0500 EZ703U	36	55	1302	50.00	0.23	0.45	31	10	216	4	17	72.2
0.27	8.1	9.1	0.7	3.1	ZTR420SPH832_0500 EZ701U	22	50	930	50.00	0.27	0.53	37	12	205	4	20	84.9
0.27	13	16	1.1	1.9	ZTR420SPH832_0500 EZ702U	36	50	1532	50.00	0.27	0.53	37	12	205	4	20	84.9
0.27	18	23	1.6	1.4	ZTR420SPH832_0500 EZ703U	36	50	1532	50.00	0.27	0.53	37	12	205	4	20	84.9
0.27	23	33	2.0	1.1	ZTR420SPH832_0500 EZ705U	36	50	1532	50.00	0.27	0.53	37	12	205	4	20	84.9
0.28	7.6	8.6	1.0	3.1	ZTR417SPH832_0400 EZ701U	21	55	744	40.00	0.28	0.57	31	10	213	4	17	72.2
0.28	12	15	1.6	1.9	ZTR417SPH832_0400 EZ702U	36	55	1302	40.00	0.28	0.57	31	10	213	4	17	72.2
0.28	17	21	2.2	1.4	ZTR417SPH832_0400 EZ703U	36	55	1302	40.00	0.28	0.57	31	10	213	4	17	72.2
0.28	22	31	2.8	1.1	ZTR417SPH832_0400 EZ705U	36	55	1302	40.00	0.28	0.57	31	10	213	4	17	72.2
0.32	6.7	7.5	0.8	3.3	ZTR417SPH832_0350 EZ701U	18	55	651	35.00	0.32	0.65	31	10	217	4	17	72.2
0.32	11	13	1.4	2.1	ZTR417SPH832_0350 EZ702U	36	55	1302	35.00	0.32	0.65	31	10	217	4	17	72.2
0.32	15	19	1.9	1.5	ZTR417SPH832_0350 EZ703U	36	55	1302	35.00	0.32	0.65	31	10	217	4	17	72.2
0.32	19	27	2.4	1.2	ZTR417SPH832_0350 EZ705U	36	55	1302	35.00	0.32	0.65	31	10	217	4	17	72.2
0.33	6.5	7.3	1.0	3.6	ZTR420SPH832_0400 EZ701U	18	50	744	40.00	0.33	0.67	37	12	202	4	20	84.9
0.33	11	13	1.6	2.2	ZTR420SPH832_0400 EZ702U	36	50	1525	40.00	0.33	0.67	37	12	202	4	20	84.9
0.33	14	18	2.2	1.6	ZTR420SPH832_0400 EZ703U	36	50	1532	40.00	0.33	0.67	37	12	202	4	20	84.9
0.33	19	26	2.8	1.2	ZTR420SPH832_0400 EZ705U	36	50	1532	40.00	0.33	0.67	37	12	202	4	20	84.9
0.38	5.7	6.4	0.8	3.9	ZTR420SPH832_0350 EZ701U	15	50	651	35.00	0.38	0.76	37	12	207	4	20	84.9
0.38	9.2	11	1.4	2.4	ZTR420SPH832_0350 EZ702U	31	50	1335	35.00	0.38	0.76	37	12	207	4	20	84.9
0.38	13	16	1.9	1.7	ZTR420SPH832_0350 EZ703U	36	50	1532	35.00	0.38	0.76	37	12	207	4	20	84.9
0.38	16	23	2.4	1.4	ZTR420SPH832_0350 EZ705U	36	50	1532	35.00	0.38	0.76	37	12	207	4	20	84.9
0.41	5.3	6.0	1.2	3.9	ZTR417SPH832_0280 EZ701U	14	55	521	28.00	0.41	0.81	31	10	215	4	17	72.2
0.41	8.7	10	1.9	2.4	ZTR417SPH832_0280 EZ702U	30	55	1068	28.00	0.41	0.81	31	10	215	4	17	72.2
0.41	12	15	2.6	1.7	ZTR417SPH832_0280 EZ703U	36	55	1302	28.00	0.41	0.81	31	10	215	4	17	72.2
0.41	15	22	3.4	1.3	ZTR417SPH832_0280 EZ705U	36	55	1302	28.00	0.41	0.81	31	10	215	4	17	72.2
0.45	4.8	5.3	1.0	4.2	ZTR417SPH832_0250 EZ701U	13	55	465	25.00	0.41	0.83	31	10	218	4	17	72.2
0.45	7.7	9.3	1.6	2.6	ZTR417SPH832_0250 EZ702U	26	55	953	25.00	0.41	0.83	31	10	218	4	17	72.2
0.45	11	13	2.2	1.9	ZTR417SPH832_0250 EZ703U	36	55	1302	25.00	0.41	0.83	31	10	218	4	17	72.2
0.45	14	19	2.9	1.4	ZTR417SPH832_0250 EZ705U	36	55	1302	25.00	0.41	0.83	31	10	218	4	17	72.2
0.48	4.5	5.1	1.2	4.5	ZTR420SPH832_0280 EZ701U	12	50	521	28.00	0.48	0.95	37	12	204	4	20	84.9
0.48	7.4	8.8	1.9	2.8	ZTR420SPH832_0280 EZ702U	25	50	1068	28.00	0.48	0.95	37	12	204	4	20	84.9
0.48	10	13	2.6	2.0	ZTR420SPH832_0280 EZ703U	36	50	1532	28.00	0.48	0.95	37	12	204	4	20	84.9
0.48	13	19	3.4	1.6	ZTR420SPH832_0280 EZ705U	36	50	1532	28.00	0.48	0.95	37	12	204	4	20	84.9
0.53	4.1	4.5	1.0	4.9	ZTR420SPH832_0250 EZ701U	11	50	465	25.00	0.48	0.98	37	12	208	4	20	84.9
0.53	6.6	7.9	1.6	3.0	ZTR420SPH832_0250 EZ702U	22	50	953	25.00	0.48	0.98	37	12	208	4	20	84.9

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTR4PH8 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 36 kN)																	
0.53	9.0	11	2.2	2.2	ZTR420SPH832_0250 EZ703U	36	50	1511	25.00	0.48	0.98	37	12	208	4	20	84.9
0.53	12	17	2.9	1.7	ZTR420SPH832_0250 EZ705U	36	50	1532	25.00	0.48	0.98	37	12	208	4	20	84.9
0.57	3.8	4.3	1.1	4.8	ZTR417SPH832_0200 EZ701U	10	55	372	20.00	0.47	0.85	31	10	218	4	17	72.2
0.57	6.2	7.4	1.8	3.0	ZTR417SPH832_0200 EZ702U	21	55	763	20.00	0.47	0.85	31	10	218	4	17	72.2
0.57	8.5	11	2.5	2.2	ZTR417SPH832_0200 EZ703U	34	55	1209	20.00	0.47	0.85	31	10	218	4	17	72.2
0.57	11	16	3.2	1.7	ZTR417SPH832_0200 EZ705U	36	55	1302	20.00	0.47	0.85	31	10	218	4	17	72.2
0.67	5.3	6.3	1.8	3.5	ZTR420SPH832_0200 EZ702U	18	50	763	20.00	0.56	1.00	37	12	208	4	20	84.9
0.67	7.2	9.1	2.5	2.5	ZTR420SPH832_0200 EZ703U	28	50	1209	20.00	0.56	1.00	37	12	208	4	20	84.9
0.67	9.3	13	3.2	2.0	ZTR420SPH832_0200 EZ705U	36	50	1532	20.00	0.56	1.00	37	12	208	4	20	84.9
0.71	4.9	5.9	2.5	3.5	ZTR417SPH832_0160 EZ702U	17	55	610	16.00	0.59	1.06	31	10	216	4	17	72.2
0.71	6.8	8.6	3.5	2.5	ZTR417SPH832_0160 EZ703U	27	55	967	16.00	0.59	1.06	31	10	216	4	17	72.2
0.71	8.8	12	4.5	2.0	ZTR417SPH832_0160 EZ705U	36	55	1302	16.00	0.59	1.06	31	10	216	4	17	72.2
0.83	4.2	5.0	2.5	4.1	ZTR420SPH832_0160 EZ702U	14	50	610	16.00	0.69	1.25	37	12	206	4	20	84.9
0.83	5.8	7.3	3.5	2.9	ZTR420SPH832_0160 EZ703U	23	50	967	16.00	0.69	1.25	37	12	206	4	20	84.9
0.83	7.5	11	4.5	2.3	ZTR420SPH832_0160 EZ705U	36	50	1532	16.00	0.69	1.25	37	12	206	4	20	84.9
ZTR4PH8 (n_{1N} = 4000 min^{-1}, ($F_{f2acc,max}$ = 36 kN)																	
0.51	19	34	3.2	1.0	ZTR420SPH832_0350 EZ813U	36	50	1532	35.00	0.38	0.76	37	12	207	4	20	84.9
0.51	20	51	3.3	1.0	ZTR420SPH832_0350 EZ815U	36	50	1532	35.00	0.38	0.76	37	12	207	4	20	84.9
0.54	18	32	4.4	1.0	ZTR417SPH832_0280 EZ813U	36	55	1302	28.00	0.41	0.81	31	10	215	4	17	72.2
0.60	16	28	3.7	1.1	ZTR417SPH832_0250 EZ813U	36	55	1302	25.00	0.41	0.83	31	10	218	4	17	72.2
0.60	17	43	3.9	1.1	ZTR417SPH832_0250 EZ815U	36	55	1302	25.00	0.41	0.83	31	10	218	4	17	72.2
0.64	15	27	4.4	1.2	ZTR420SPH832_0280 EZ813U	36	50	1532	28.00	0.48	0.95	37	12	204	4	20	84.9
0.64	16	41	4.6	1.2	ZTR420SPH832_0280 EZ815U	36	50	1532	28.00	0.48	0.95	37	12	204	4	20	84.9
0.71	14	24	3.7	1.3	ZTR420SPH832_0250 EZ813U	36	50	1532	25.00	0.48	0.98	37	12	208	4	20	84.9
0.71	14	37	3.9	1.3	ZTR420SPH832_0250 EZ815U	36	50	1532	25.00	0.48	0.98	37	12	208	4	20	84.9
0.76	13	23	4.2	1.3	ZTR417SPH832_0200 EZ813U	36	55	1302	20.00	0.47	0.85	31	10	218	4	17	72.2
0.76	13	35	4.3	1.2	ZTR417SPH832_0200 EZ815U	36	55	1302	20.00	0.47	0.85	31	10	218	4	17	72.2
0.89	11	19	4.2	1.5	ZTR420SPH832_0200 EZ813U	36	50	1532	20.00	0.56	1.00	37	12	208	4	20	84.9
0.89	11	29	4.3	1.5	ZTR420SPH832_0200 EZ815U	36	50	1532	20.00	0.56	1.00	37	12	208	4	20	84.9
0.94	10	18	5.8	1.5	ZTR417SPH832_0160 EZ813U	36	55	1302	16.00	0.59	1.06	31	10	216	4	17	72.2
0.94	11	28	6.0	1.4	ZTR417SPH832_0160 EZ815U	36	55	1302	16.00	0.59	1.06	31	10	216	4	17	72.2
1.11	8.8	15	5.8	1.8	ZTR420SPH832_0160 EZ813U	36	50	1532	16.00	0.69	1.25	37	12	206	4	20	84.9
1.11	9.2	24	6.0	1.7	ZTR420SPH832_0160 EZ815U	36	50	1532	16.00	0.69	1.25	37	12	206	4	20	84.9
1.51	6.7	12	3.1	2.0	ZTR417SPH831_0100 EZ813U	36	55	1302	10.00	0.83	1.51	31	10	201	4	17	72.2
1.51	6.9	18	3.2	1.9	ZTR417SPH831_0100 EZ815U	36	55	1302	10.00	0.83	1.51	31	10	201	4	17	72.2
1.78	5.7	9.9	3.1	2.3	ZTR420SPH831_0100 EZ813U	32	50	1344	10.00	0.98	1.78	37	12	188	4	20	84.9
1.78	5.9	15	3.2	2.2	ZTR420SPH831_0100 EZ815U	33	50	1392	10.00	0.98	1.78	37	12	188	4	20	84.9
2.16	4.7	8.1	3.6	2.5	ZTR417SPH831_0070 EZ813U	26	55	941	7.000	1.08	2.16	31	10	213	4	17	72.2
2.16	4.9	13	3.8	2.4	ZTR417SPH831_0070 EZ815U	36	55	1302	7.000	1.08	2.16	31	10	213	4	17	72.2
2.54	4.0	6.9	3.6	2.9	ZTR420SPH831_0070 EZ813U	22	50	941	7.000	1.27	2.54	37	12	203	4	20	84.9
2.54	4.1	11	3.8	2.8	ZTR420SPH831_0070 EZ815U	32	50	1344	7.000	1.27	2.54	37	12	203	4	20	84.9
3.02	3.4	5.8	5.5	3.2	ZTR417SPH831_0050 EZ813U	19	55	672	5.000	1.21	3.02	31	10	222	4	17	72.2
3.02	3.5	8.9	5.7	3.0	ZTR417SPH831_0050 EZ815U	27	55	960	5.000	1.21	3.02	31	10	222	4	17	72.2
3.56	2.9	4.9	5.5	3.7	ZTR420SPH831_0050 EZ813U	16	50	672	5.000	1.42	3.56	37	12	214	4	20	84.9
3.56	3.0	7.6	5.7	3.6	ZTR420SPH831_0050 EZ815U	23	50	960	5.000	1.42	3.56	37	12	214	4	20	84.9
ZTR4PH8 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 36 kN)																	
0.24	22	36	1.1	1.1	ZTR417SPH832_0700 EZ703U	36	55	1302	70.00	0.16	0.32	31	10	210	4	17	72.2
0.34	16	26	1.3	1.4	ZTR417SPH832_0500 EZ703U	36	55	1302	50.00	0.23	0.45	31	10	216	4	17	72.2
0.34	21	39	1.8	1.0	ZTR417SPH832_0500 EZ705U	36	55	1302	50.00	0.23	0.45	31	10	216	4	17	72.2
0.40	13	22	1.3	1.6	ZTR420SPH832_0500 EZ703U	36	50	1532	50.00	0.27	0.53	37	12	205	4	20	84.9
0.40	18	33	1.8	1.2	ZTR420SPH832_0500 EZ705U	36	50	1532	50.00	0.27	0.53	37	12	205	4	20	84.9
0.43	12	21	1.8	1.6	ZTR417SPH832_0400 EZ703U	36	55	1302	40.00	0.28	0.57	31	10	213	4	17	72.2
0.43	17	31	2.5	1.2	ZTR417SPH832_0400 EZ705U	36	55	1302	40.00	0.28	0.57	31	10	213	4	17	72.2
0.49	11	18	1.6	1.8	ZTR417SPH832_0350 EZ703U	36	55	1302	35.00	0.32	0.65	31	10	217	4	17	72.2
0.49	15	27	2.1	1.3	ZTR417SPH832_0350 EZ705U	36	55	1302	35.00	0.32	0.65	31	10	217	4	17	72.2
0.50	11	18	1.8	1.9	ZTR420SPH832_0400 EZ703U	36	50	1532	40.00	0.33	0.67	37	12	202	4	20	84.9
0.50	14	26	2.5	1.4	ZTR420SPH832_0400 EZ705U	36	50	1532	40.00	0.33	0.67	37	12	202	4	20	84.9
0.57	9.3	15	1.6	2.1	ZTR420SPH832_0350 EZ703U	36	50	1532	35.00	0.38	0.76	37	12	207	4	20	84.9
0.57	13	23	2.1	1.5	ZTR420SPH832_0350 EZ705U	36	50	1532	35.00	0.38	0.76	37	12	207	4	20	84.9
0.61	8.7	14	2.2	2.1	ZTR417SPH832_0280 EZ703U	36	55	1302	28.00	0.41	0.81	31	10	215	4	17	72.2
0.61	12	22	3.0	1.5	ZTR417SPH832_0280 EZ705U	36	55	1302	28.00	0.41	0.81	31	10	215	4	17	72.2
0.68	7.8	13	1.9	2.2	ZTR417SPH832_0250 EZ703U	36	55	1302	25.00	0.41	0.83	31	10	218	4	17	72.2
0.68	11	19	2.5	1.6	ZTR417SPH832_0250 EZ705U	36	55	1302	25.00	0.41	0.83	31	10	218	4	17	72.2
0.71	7.4	12	2.2	2.4	ZTR420SPH832_0280 EZ703U	36	50	1532	28.00	0.48	0.95	37	12	204	4	20	84.9
0.71	10	18	3.0	1.8	ZTR420SPH832_0280 EZ705U	36	50	1532	28.00	0.48	0.95	37	12	204	4	20	84.9
0.80	6.6	11	1.9	2.6	ZTR420SPH832_0250 EZ703U	36	50	1511	25.00	0.48	0.98	37	12	208	4	20	84.9

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTR4PH8 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 36 kN)																	
0.80	9.0	16	2.5	1.9	ZTR420SPH832_0250 EZ705U	36	50	1532	25.00	0.48	0.98	37	12	208	4	20	84.9
0.85	6.2	10	2.1	2.6	ZTR417SPH832_0200 EZ703U	34	55	1209	20.00	0.47	0.85	31	10	218	4	17	72.2
0.85	8.5	15	2.8	1.9	ZTR417SPH832_0200 EZ705U	36	55	1302	20.00	0.47	0.85	31	10	218	4	17	72.2
1.00	5.3	8.8	2.1	3.0	ZTR420SPH832_0200 EZ703U	28	50	1209	20.00	0.56	1.00	37	12	208	4	20	84.9
1.00	7.2	13	2.8	2.2	ZTR420SPH832_0200 EZ705U	36	50	1532	20.00	0.56	1.00	37	12	208	4	20	84.9
1.06	5.0	8.2	2.9	3.0	ZTR417SPH832_0160 EZ703U	27	55	967	16.00	0.59	1.06	31	10	216	4	17	72.2
1.06	6.8	12	3.9	2.2	ZTR417SPH832_0160 EZ705U	36	55	1302	16.00	0.59	1.06	31	10	216	4	17	72.2
1.25	4.2	7.0	2.9	3.5	ZTR420SPH832_0160 EZ703U	23	50	967	16.00	0.69	1.25	37	12	206	4	20	84.9
1.25	5.7	11	3.9	2.6	ZTR420SPH832_0160 EZ705U	36	50	1532	16.00	0.69	1.25	37	12	206	4	20	84.9
ZTR4PH8 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 36 kN)																	
0.23	13	20	0.6	1.4	ZTR417SPH832_1000 EZ701U	36	55	1302	100.0	0.11	0.23	31	10	200	4	17	72.2
0.23	19	37	0.9	1.0	ZTR417SPH832_1000 EZ702U	36	55	1302	100.0	0.11	0.23	31	10	200	4	17	72.2
0.27	11	17	0.6	1.4	ZTR420SPH832_1000 EZ701U	33	50	1380	100.0	0.13	0.27	37	12	186	4	20	84.9
0.27	16	31	0.9	1.0	ZTR420SPH832_1000 EZ702U	33	50	1380	100.0	0.13	0.27	37	12	186	4	20	84.9
0.32	9.4	14	0.5	2.4	ZTR417SPH832_0700 EZ701U	36	55	1302	70.00	0.16	0.32	31	10	210	4	17	72.2
0.32	13	26	0.7	1.7	ZTR417SPH832_0700 EZ702U	36	55	1302	70.00	0.16	0.32	31	10	210	4	17	72.2
0.38	8.0	12	0.5	2.8	ZTR420SPH832_0700 EZ701U	31	50	1302	70.00	0.19	0.38	37	12	199	4	20	84.9
0.38	11	22	0.7	2.0	ZTR420SPH832_0700 EZ702U	36	50	1532	70.00	0.19	0.38	37	12	199	4	20	84.9
0.45	6.7	10	0.6	3.0	ZTR417SPH832_0500 EZ701U	26	55	930	50.00	0.23	0.45	31	10	216	4	17	72.2
0.45	9.3	18	0.9	2.1	ZTR417SPH832_0500 EZ702U	36	55	1302	50.00	0.23	0.45	31	10	216	4	17	72.2
0.53	5.7	8.7	0.6	3.5	ZTR420SPH832_0500 EZ701U	22	50	930	50.00	0.27	0.53	37	12	205	4	20	84.9
0.53	7.9	16	0.9	2.5	ZTR420SPH832_0500 EZ702U	36	50	1532	50.00	0.27	0.53	37	12	205	4	20	84.9
0.57	5.4	8.1	0.9	3.4	ZTR417SPH832_0400 EZ701U	21	55	744	40.00	0.28	0.57	31	10	213	4	17	72.2
0.57	7.4	15	1.2	2.5	ZTR417SPH832_0400 EZ702U	36	55	1302	40.00	0.28	0.57	31	10	213	4	17	72.2
0.65	4.7	7.1	0.7	3.8	ZTR417SPH832_0350 EZ701U	18	55	651	35.00	0.32	0.65	31	10	217	4	17	72.2
0.65	6.5	13	1.0	2.7	ZTR417SPH832_0350 EZ702U	36	55	1302	35.00	0.32	0.65	31	10	217	4	17	72.2
0.67	4.6	6.9	0.9	4.0	ZTR420SPH832_0400 EZ701U	18	50	744	40.00	0.33	0.67	37	12	202	4	20	84.9
0.67	6.3	13	1.2	2.9	ZTR420SPH832_0400 EZ702U	36	50	1525	40.00	0.33	0.67	37	12	202	4	20	84.9
0.76	4.0	6.1	0.7	4.4	ZTR420SPH832_0350 EZ701U	15	50	651	35.00	0.38	0.76	37	12	207	4	20	84.9
0.76	5.5	11	1.0	3.2	ZTR420SPH832_0350 EZ702U	31	50	1335	35.00	0.38	0.76	37	12	207	4	20	84.9
0.81	3.8	5.7	1.0	4.4	ZTR417SPH832_0280 EZ701U	14	55	521	28.00	0.41	0.81	31	10	215	4	17	72.2
0.81	5.2	10	1.4	3.2	ZTR417SPH832_0280 EZ702U	30	55	1068	28.00	0.41	0.81	31	10	215	4	17	72.2
0.95	4.4	8.8	1.4	3.7	ZTR420SPH832_0280 EZ702U	25	50	1068	28.00	0.48	0.95	37	12	204	4	20	84.9
ZTR5PH8 (n_{1N} = 2000 min^{-1}, ($F_{f2acc,max}$ = 40 kN)																	
0.36	21	24	5.7	1.1	ZTR518SPH832_0280 EZ813U	40	50	1918	28.00	0.54	1.07	42	14	199	5	18	95.5
0.40	19	21	5.1	1.2	ZTR518SPH832_0250 EZ813U	40	50	1918	25.00	0.54	1.10	42	14	203	5	18	95.5
0.50	15	17	5.9	1.4	ZTR518SPH832_0200 EZ813U	40	50	1918	20.00	0.63	1.13	42	14	204	5	18	95.5
0.63	12	14	7.5	1.6	ZTR518SPH832_0160 EZ813U	40	50	1918	16.00	0.78	1.41	42	14	201	5	18	95.5
0.63	18	21	11	1.1	ZTR518SPH832_0160 EZ815U	40	50	1918	16.00	0.78	1.41	42	14	201	5	18	95.5
1.00	7.8	8.8	3.8	2.1	ZTR518SPH831_0100 EZ813U	28	50	1344	10.00	1.10	2.00	42	14	179	5	18	95.5
1.00	12	14	5.6	1.4	ZTR518SPH831_0100 EZ815U	29	50	1392	10.00	1.10	2.00	42	14	179	5	18	95.5
1.43	5.5	6.2	4.5	2.6	ZTR518SPH831_0070 EZ813U	20	50	941	7.000	1.43	2.86	42	14	197	5	18	95.5
1.43	8.1	9.7	6.6	1.8	ZTR518SPH831_0070 EZ815U	28	50	1344	7.000	1.43	2.86	42	14	197	5	18	95.5
2.00	3.9	4.4	6.7	3.3	ZTR518SPH831_0050 EZ813U	14	50	672	5.000	1.60	4.00	42	14	210	5	18	95.5
2.00	5.8	6.9	9.9	2.2	ZTR518SPH831_0050 EZ815U	20	50	960	5.000	1.60	4.00	42	14	210	5	18	95.5
2.50	3.1	3.5	11	3.8	ZTR518SPH831_0040 EZ813U	11	42	538	4.000	1.75	4.38	42	14	212	5	18	95.5
2.50	4.6	5.5	16	2.6	ZTR518SPH831_0040 EZ815U	16	42	768	4.000	1.75	4.38	42	14	212	5	18	95.5
ZTR5PH8 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 40 kN)																	
0.15	14	16	0.7	1.3	ZTR518SPH832_1000 EZ701U	29	50	1380	100.0	0.15	0.30	42	14	177	5	18	95.5
0.21	10	11	0.6	2.6	ZTR518SPH832_0700 EZ701U	27	50	1302	70.00	0.21	0.43	42	14	192	5	18	95.5
0.21	16	20	1.0	1.6	ZTR518SPH832_0700 EZ702U	39	50	1848	70.00	0.21	0.43	42	14	192	5	18	95.5
0.21	22	28	1.3	1.2	ZTR518SPH832_0700 EZ703U	39	50	1848	70.00	0.21	0.43	42	14	192	5	18	95.5
0.30	7.2	8.1	0.7	3.4	ZTR518SPH832_0500 EZ701U	19	50	930	50.00	0.30	0.60	42	14	200	5	18	95.5
0.30	12	14	1.1	2.1	ZTR518SPH832_0500 EZ702U	40	50	1907	50.00	0.30	0.60	42	14	200	5	18	95.5
0.30	16	20	1.6	1.5	ZTR518SPH832_0500 EZ703U	40	50	1918	50.00	0.30	0.60	42	14	200	5	18	95.5
0.30	21	29	2.0	1.2	ZTR518SPH832_0500 EZ705U	40	50	1918	50.00	0.30	0.60	42	14	200	5	18	95.5
0.38	5.8	6.5	1.0	3.7	ZTR518SPH832_0400 EZ701U	16	50	744	40.00	0.38	0.75	42	14	195	5	18	95.5
0.38	9.3	11	1.6	2.3	ZTR518SPH832_0400 EZ702U	32	50	1525	40.00	0.38	0.75	42	14	195	5	18	95.5
0.38	13	16	2.2	1.7	ZTR518SPH832_0400 EZ703U	40	50	1918	40.00	0.38	0.75	42	14	195	5	18	95.5
0.38	17	24	2.8	1.3	ZTR518SPH832_0400 EZ705U	40	50	1918	40.00	0.38	0.75	42	14	195	5	18	95.5
0.43	5.0	5.7	0.8	4.3	ZTR518SPH832_0350 EZ701U	14	50	651	35.00	0.43	0.86	42	14	202	5	18	95.5
0.43	8.2	9.8	1.4	2.6	ZTR518SPH832_0350 EZ702U	28	50	1335	35.00	0.43	0.86	42	14	202	5	18	95.5
0.43	11	14	1.9	1.9	ZTR518SPH832_0350 EZ703U	40	50	1918	35.00	0.43	0.86	42	14	202	5	18	95.5
0.43	15	21	2.4	1.5	ZTR518SPH832_0350 EZ705U	40	50	1918	35.00	0.43	0.86	42	14	202	5	18	95.5
0.54	4.0	4.5	1.2	5.0	ZTR518SPH832_0280 EZ701U	11	50	521	28.00	0.54	1.07	42	14	199	5	18	95.5
0.54	6.5	7.9	1.9	3.1	ZTR518SPH832_0280 EZ702U	22	50	1068	28.00	0.54	1.07	42	14	199	5	18	95.5

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTR5PH8 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 40 kN)																	
0.54	9.0	11	2.6	2.2	ZTR518SPH832_0280 EZ703U	35	50	1693	28.00	0.54	1.07	42	14	199	5	18	95.5
0.54	12	16	3.4	1.7	ZTR518SPH832_0280 EZ705U	40	50	1918	28.00	0.54	1.07	42	14	199	5	18	95.5
0.60	5.8	7.0	1.6	3.3	ZTR518SPH832_0250 EZ702U	20	50	953	25.00	0.54	1.10	42	14	203	5	18	95.5
0.60	8.0	10	2.2	2.4	ZTR518SPH832_0250 EZ703U	32	50	1511	25.00	0.54	1.10	42	14	203	5	18	95.5
0.60	10	15	2.9	1.9	ZTR518SPH832_0250 EZ705U	40	50	1918	25.00	0.54	1.10	42	14	203	5	18	95.5
0.75	4.7	5.6	1.8	3.8	ZTR518SPH832_0200 EZ702U	16	50	763	20.00	0.63	1.13	42	14	204	5	18	95.5
0.75	6.4	8.1	2.5	2.8	ZTR518SPH832_0200 EZ703U	25	50	1209	20.00	0.63	1.13	42	14	204	5	18	95.5
0.75	8.3	12	3.2	2.2	ZTR518SPH832_0200 EZ705U	40	50	1918	20.00	0.63	1.13	42	14	204	5	18	95.5
0.94	3.7	4.5	2.5	4.4	ZTR518SPH832_0160 EZ702U	13	50	610	16.00	0.78	1.41	42	14	201	5	18	95.5
0.94	5.1	6.5	3.5	3.2	ZTR518SPH832_0160 EZ703U	20	50	967	16.00	0.78	1.41	42	14	201	5	18	95.5
0.94	6.6	9.4	4.5	2.5	ZTR518SPH832_0160 EZ705U	32	50	1548	16.00	0.78	1.41	42	14	201	5	18	95.5
ZTR5PH8 (n_{1N} = 4000 min^{-1}, ($F_{f2acc,max}$ = 40 kN)																	
0.57	17	30	3.2	1.1	ZTR518SPH832_0350 EZ813U	40	50	1918	35.00	0.43	0.86	42	14	202	5	18	95.5
0.57	18	46	3.3	1.1	ZTR518SPH832_0350 EZ815U	40	50	1918	35.00	0.43	0.86	42	14	202	5	18	95.5
0.71	14	24	4.4	1.3	ZTR518SPH832_0280 EZ813U	40	50	1918	28.00	0.54	1.07	42	14	199	5	18	95.5
0.71	14	37	4.6	1.3	ZTR518SPH832_0280 EZ815U	40	50	1918	28.00	0.54	1.07	42	14	199	5	18	95.5
0.80	12	21	3.7	1.4	ZTR518SPH832_0250 EZ813U	40	50	1918	25.00	0.54	1.10	42	14	203	5	18	95.5
0.80	13	33	3.9	1.4	ZTR518SPH832_0250 EZ815U	40	50	1918	25.00	0.54	1.10	42	14	203	5	18	95.5
1.00	9.8	17	4.2	1.7	ZTR518SPH832_0200 EZ813U	40	50	1918	20.00	0.63	1.13	42	14	204	5	18	95.5
1.00	10	26	4.3	1.6	ZTR518SPH832_0200 EZ815U	40	50	1918	20.00	0.63	1.13	42	14	204	5	18	95.5
1.25	7.9	14	5.8	1.9	ZTR518SPH832_0160 EZ813U	40	50	1918	16.00	0.78	1.41	42	14	201	5	18	95.5
1.25	8.1	21	6.0	1.9	ZTR518SPH832_0160 EZ815U	40	50	1918	16.00	0.78	1.41	42	14	201	5	18	95.5
2.00	5.1	8.8	3.1	2.5	ZTR518SPH831_0100 EZ813U	28	50	1344	10.00	1.10	2.00	42	14	179	5	18	95.5
2.00	5.2	13	3.2	2.4	ZTR518SPH831_0100 EZ815U	29	50	1392	10.00	1.10	2.00	42	14	179	5	18	95.5
2.86	3.5	6.2	3.6	3.2	ZTR518SPH831_0070 EZ813U	20	50	941	7.000	1.43	2.86	42	14	197	5	18	95.5
2.86	3.7	9.4	3.8	3.1	ZTR518SPH831_0070 EZ815U	28	50	1344	7.000	1.43	2.86	42	14	197	5	18	95.5
4.00	2.5	4.4	5.5	4.0	ZTR518SPH831_0050 EZ813U	14	50	672	5.000	1.60	4.00	42	14	210	5	18	95.5
4.00	2.6	6.7	5.7	3.9	ZTR518SPH831_0050 EZ815U	20	50	960	5.000	1.60	4.00	42	14	210	5	18	95.5
ZTR5PH8 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 40 kN)																	
0.32	16	27	1.1	1.4	ZTR518SPH832_0700 EZ703U	39	50	1848	70.00	0.21	0.43	42	14	192	5	18	95.5
0.32	22	41	1.5	1.0	ZTR518SPH832_0700 EZ705U	39	50	1848	70.00	0.21	0.43	42	14	192	5	18	95.5
0.45	12	19	1.3	1.8	ZTR518SPH832_0500 EZ703U	40	50	1918	50.00	0.30	0.60	42	14	200	5	18	95.5
0.45	16	29	1.8	1.3	ZTR518SPH832_0500 EZ705U	40	50	1918	50.00	0.30	0.60	42	14	200	5	18	95.5
0.56	9.4	16	1.8	2.0	ZTR518SPH832_0400 EZ703U	40	50	1918	40.00	0.38	0.75	42	14	195	5	18	95.5
0.56	13	23	2.5	1.5	ZTR518SPH832_0400 EZ705U	40	50	1918	40.00	0.38	0.75	42	14	195	5	18	95.5
0.64	8.2	14	1.6	2.3	ZTR518SPH832_0350 EZ703U	40	50	1918	35.00	0.43	0.86	42	14	202	5	18	95.5
0.64	11	20	2.1	1.7	ZTR518SPH832_0350 EZ705U	40	50	1918	35.00	0.43	0.86	42	14	202	5	18	95.5
0.80	6.6	11	2.2	2.7	ZTR518SPH832_0280 EZ703U	35	50	1693	28.00	0.54	1.07	42	14	199	5	18	95.5
0.80	8.9	16	3.0	2.0	ZTR518SPH832_0280 EZ705U	40	50	1918	28.00	0.54	1.07	42	14	199	5	18	95.5
0.90	5.9	9.7	1.9	2.9	ZTR518SPH832_0250 EZ703U	32	50	1511	25.00	0.54	1.10	42	14	203	5	18	95.5
0.90	8.0	15	2.5	2.1	ZTR518SPH832_0250 EZ705U	40	50	1918	25.00	0.54	1.10	42	14	203	5	18	95.5
1.13	4.7	7.8	2.1	3.3	ZTR518SPH832_0200 EZ703U	25	50	1209	20.00	0.63	1.13	42	14	204	5	18	95.5
1.13	6.4	12	2.8	2.4	ZTR518SPH832_0200 EZ705U	40	50	1918	20.00	0.63	1.13	42	14	204	5	18	95.5
1.41	3.8	6.2	2.9	3.9	ZTR518SPH832_0160 EZ703U	20	50	967	16.00	0.78	1.41	42	14	201	5	18	95.5
1.41	5.1	9.3	3.9	2.8	ZTR518SPH832_0160 EZ705U	32	50	1548	16.00	0.78	1.41	42	14	201	5	18	95.5
ZTR5PH8 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 40 kN)																	
0.30	10	15	0.6	1.4	ZTR518SPH832_1000 EZ701U	29	50	1380	100.0	0.15	0.30	42	14	177	5	18	95.5
0.30	14	28	0.9	1.0	ZTR518SPH832_1000 EZ702U	29	50	1380	100.0	0.15	0.30	42	14	177	5	18	95.5
0.43	7.1	11	0.5	3.0	ZTR518SPH832_0700 EZ701U	27	50	1302	70.00	0.21	0.43	42	14	192	5	18	95.5
0.43	9.8	19	0.7	2.1	ZTR518SPH832_0700 EZ702U	39	50	1848	70.00	0.21	0.43	42	14	192	5	18	95.5
0.60	5.1	7.7	0.6	3.8	ZTR518SPH832_0500 EZ701U	19	50	930	50.00	0.30	0.60	42	14	200	5	18	95.5
0.60	7.0	14	0.9	2.8	ZTR518SPH832_0500 EZ702U	40	50	1907	50.00	0.30	0.60	42	14	200	5	18	95.5
0.75	4.1	6.2	0.9	4.2	ZTR518SPH832_0400 EZ701U	16	50	744	40.00	0.38	0.75	42	14	195	5	18	95.5
0.75	5.6	11	1.2	3.0	ZTR518SPH832_0400 EZ702U	32	50	1525	40.00	0.38	0.75	42	14	195	5	18	95.5
0.86	3.5	5.4	0.7	4.8	ZTR518SPH832_0350 EZ701U	14	50	651	35.00	0.43	0.86	42	14	202	5	18	95.5
0.86	4.9	9.7	1.0	3.5	ZTR518SPH832_0350 EZ702U	28	50	1335	35.00	0.43	0.86	42	14	202	5	18	95.5
1.07	3.9	7.8	1.4	4.0	ZTR518SPH832_0280 EZ702U	22	50	1068	28.00	0.54	1.07	42	14	199	5	18	95.5
ZTR6PH8 (n_{1N} = 2000 min^{-1}, ($F_{f2acc,max}$ = 39 kN)																	
0.36	21	24	5.7	1.1	ZTR615SPH832_0280 EZ813U	39	49	1874	28.00	0.54	1.07	42	14	199	6	15	95.5
0.40	19	21	5.1	1.1	ZTR615SPH832_0250 EZ813U	39	49	1874	25.00	0.54	1.10	42	14	204	6	15	95.5
0.50	15	17	5.9	1.3	ZTR615SPH832_0200 EZ813U	39	49	1874	20.00	0.63	1.13	42	14	204	6	15	95.5
0.63	12	14	7.5	1.5	ZTR615SPH832_0160 EZ813U	39	49	1874	16.00	0.78	1.41	42	14	202	6	15	95.5
0.63	18	21	11	1.0	ZTR615SPH832_0160 EZ815U	39	49	1874	16.00	0.78	1.41	42	14	202	6	15	95.5
1.00	7.8	8.8	3.8	2.0	ZTR615SPH831_0100 EZ813U	28	49	1344	10.00	1.10	2.00	42	14	180	6	15	95.5
1.00	12	14	5.6	1.4	ZTR615SPH831_0100 EZ815U	29	49	1392	10.00	1.10	2.00	42	14	180	6	15	95.5
1.43	5.5	6.2	4.5	2.6	ZTR615SPH831_0070 EZ813U	20	49	941	7.000	1.43	2.86	42	14	198	6	15	95.5

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZTR6PH8 (n_{1N} = 2000 min^{-1}, ($F_{f2acc,max}$ = 39 kN)																	
1.43	8.1	9.7	6.6	1.7	ZTR615SPH831_0070 EZ815U	28	49	1344	7.000	1.43	2.86	42	14	198	6	15	95.5
2.00	3.9	4.4	6.7	3.2	ZTR615SPH831_0050 EZ813U	14	49	672	5.000	1.60	4.00	42	14	211	6	15	95.5
2.00	5.8	6.9	9.9	2.2	ZTR615SPH831_0050 EZ815U	20	49	960	5.000	1.60	4.00	42	14	211	6	15	95.5
2.50	3.1	3.5	11	3.8	ZTR615SPH831_0040 EZ813U	11	42	538	4.000	1.75	4.38	42	14	213	6	15	95.5
2.50	4.6	5.5	16	2.5	ZTR615SPH831_0040 EZ815U	16	42	768	4.000	1.75	4.38	42	14	213	6	15	95.5
ZTR6PH8 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 39 kN)																	
0.15	14	16	0.7	1.3	ZTR615SPH832_1000 EZ701U	29	49	1380	100.0	0.15	0.30	42	14	178	6	15	95.5
0.21	10	11	0.6	2.6	ZTR615SPH832_0700 EZ701U	27	49	1302	70.00	0.21	0.43	42	14	193	6	15	95.5
0.21	16	20	1.0	1.6	ZTR615SPH832_0700 EZ702U	39	49	1848	70.00	0.21	0.43	42	14	193	6	15	95.5
0.21	22	28	1.3	1.2	ZTR615SPH832_0700 EZ703U	39	49	1848	70.00	0.21	0.43	42	14	193	6	15	95.5
0.30	7.2	8.1	0.7	3.3	ZTR615SPH832_0500 EZ701U	19	49	930	50.00	0.30	0.60	42	14	201	6	15	95.5
0.30	12	14	1.1	2.0	ZTR615SPH832_0500 EZ702U	39	49	1874	50.00	0.30	0.60	42	14	201	6	15	95.5
0.30	16	20	1.6	1.5	ZTR615SPH832_0500 EZ703U	39	49	1874	50.00	0.30	0.60	42	14	201	6	15	95.5
0.30	21	29	2.0	1.2	ZTR615SPH832_0500 EZ705U	39	49	1874	50.00	0.30	0.60	42	14	201	6	15	95.5
0.38	5.8	6.5	1.0	3.7	ZTR615SPH832_0400 EZ701U	16	49	744	40.00	0.38	0.75	42	14	196	6	15	95.5
0.38	9.3	11	1.6	2.3	ZTR615SPH832_0400 EZ702U	32	49	1525	40.00	0.38	0.75	42	14	196	6	15	95.5
0.38	13	16	2.2	1.7	ZTR615SPH832_0400 EZ703U	39	49	1874	40.00	0.38	0.75	42	14	196	6	15	95.5
0.38	17	24	2.8	1.3	ZTR615SPH832_0400 EZ705U	39	49	1874	40.00	0.38	0.75	42	14	196	6	15	95.5
0.43	5.0	5.7	0.8	4.2	ZTR615SPH832_0350 EZ701U	14	49	651	35.00	0.43	0.86	42	14	203	6	15	95.5
0.43	8.2	9.8	1.4	2.6	ZTR615SPH832_0350 EZ702U	28	49	1335	35.00	0.43	0.86	42	14	203	6	15	95.5
0.43	11	14	1.9	1.9	ZTR615SPH832_0350 EZ703U	39	49	1874	35.00	0.43	0.86	42	14	203	6	15	95.5
0.43	15	21	2.4	1.5	ZTR615SPH832_0350 EZ705U	39	49	1874	35.00	0.43	0.86	42	14	203	6	15	95.5
0.54	4.0	4.5	1.2	4.9	ZTR615SPH832_0280 EZ701U	11	49	521	28.00	0.54	1.07	42	14	199	6	15	95.5
0.54	6.5	7.9	1.9	3.0	ZTR615SPH832_0280 EZ702U	22	49	1068	28.00	0.54	1.07	42	14	199	6	15	95.5
0.54	9.0	11	2.6	2.2	ZTR615SPH832_0280 EZ703U	35	49	1693	28.00	0.54	1.07	42	14	199	6	15	95.5
0.54	12	16	3.4	1.7	ZTR615SPH832_0280 EZ705U	39	49	1874	28.00	0.54	1.07	42	14	199	6	15	95.5
0.60	5.8	7.0	1.6	3.2	ZTR615SPH832_0250 EZ702U	20	49	953	25.00	0.54	1.10	42	14	204	6	15	95.5
0.60	8.0	10	2.2	2.4	ZTR615SPH832_0250 EZ703U	32	49	1511	25.00	0.54	1.10	42	14	204	6	15	95.5
0.60	10	15	2.9	1.8	ZTR615SPH832_0250 EZ705U	39	49	1874	25.00	0.54	1.10	42	14	204	6	15	95.5
0.75	4.7	5.6	1.8	3.8	ZTR615SPH832_0200 EZ702U	16	49	763	20.00	0.63	1.13	42	14	204	6	15	95.5
0.75	6.4	8.1	2.5	2.7	ZTR615SPH832_0200 EZ703U	25	49	1209	20.00	0.63	1.13	42	14	204	6	15	95.5
0.75	8.3	12	3.2	2.1	ZTR615SPH832_0200 EZ705U	39	49	1874	20.00	0.63	1.13	42	14	204	6	15	95.5
0.94	3.7	4.5	2.5	4.4	ZTR615SPH832_0160 EZ702U	13	49	610	16.00	0.78	1.41	42	14	202	6	15	95.5
0.94	5.1	6.5	3.5	3.2	ZTR615SPH832_0160 EZ703U	20	49	967	16.00	0.78	1.41	42	14	202	6	15	95.5
0.94	6.6	9.4	4.5	2.5	ZTR615SPH832_0160 EZ705U	32	49	1548	16.00	0.78	1.41	42	14	202	6	15	95.5
ZTR6PH8 (n_{1N} = 4000 min^{-1}, ($F_{f2acc,max}$ = 39 kN)																	
0.57	17	30	3.2	1.1	ZTR615SPH832_0350 EZ813U	39	49	1874	35.00	0.43	0.86	42	14	203	6	15	95.5
0.57	18	46	3.3	1.1	ZTR615SPH832_0350 EZ815U	39	49	1874	35.00	0.43	0.86	42	14	203	6	15	95.5
0.71	14	24	4.4	1.3	ZTR615SPH832_0280 EZ813U	39	49	1874	28.00	0.54	1.07	42	14	199	6	15	95.5
0.71	14	37	4.6	1.3	ZTR615SPH832_0280 EZ815U	39	49	1874	28.00	0.54	1.07	42	14	199	6	15	95.5
0.80	12	21	3.7	1.4	ZTR615SPH832_0250 EZ813U	39	49	1874	25.00	0.54	1.10	42	14	204	6	15	95.5
0.80	13	33	3.9	1.4	ZTR615SPH832_0250 EZ815U	39	49	1874	25.00	0.54	1.10	42	14	204	6	15	95.5
1.00	9.8	17	4.2	1.6	ZTR615SPH832_0200 EZ813U	39	49	1874	20.00	0.63	1.13	42	14	204	6	15	95.5
1.00	10	26	4.3	1.6	ZTR615SPH832_0200 EZ815U	39	49	1874	20.00	0.63	1.13	42	14	204	6	15	95.5
1.25	7.9	14	5.8	1.9	ZTR615SPH832_0160 EZ813U	39	49	1874	16.00	0.78	1.41	42	14	202	6	15	95.5
1.25	8.1	21	6.0	1.8	ZTR615SPH832_0160 EZ815U	39	49	1874	16.00	0.78	1.41	42	14	202	6	15	95.5
2.00	5.1	8.8	3.1	2.5	ZTR615SPH831_0100 EZ813U	28	49	1344	10.00	1.10	2.00	42	14	180	6	15	95.5
2.00	5.2	13	3.2	2.4	ZTR615SPH831_0100 EZ815U	29	49	1392	10.00	1.10	2.00	42	14	180	6	15	95.5
2.86	3.5	6.2	3.6	3.2	ZTR615SPH831_0070 EZ813U	20	49	941	7.000	1.43	2.86	42	14	198	6	15	95.5
2.86	3.7	9.4	3.8	3.1	ZTR615SPH831_0070 EZ815U	28	49	1344	7.000	1.43	2.86	42	14	198	6	15	95.5
4.00	2.5	4.4	5.5	4.0	ZTR615SPH831_0050 EZ813U	14	49	672	5.000	1.60	4.00	42	14	211	6	15	95.5
4.00	2.6	6.7	5.7	3.8	ZTR615SPH831_0050 EZ815U	20	49	960	5.000	1.60	4.00	42	14	211	6	15	95.5
ZTR6PH8 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 39 kN)																	
0.32	16	27	1.1	1.4	ZTR615SPH832_0700 EZ703U	39	49	1848	70.00	0.21	0.43	42	14	193	6	15	95.5
0.32	22	41	1.5	1.0	ZTR615SPH832_0700 EZ705U	39	49	1848	70.00	0.21	0.43	42	14	193	6	15	95.5
0.45	12	19	1.3	1.8	ZTR615SPH832_0500 EZ703U	39	49	1874	50.00	0.30	0.60	42	14	201	6	15	95.5
0.45	16	29	1.8	1.3	ZTR615SPH832_0500 EZ705U	39	49	1874	50.00	0.30	0.60	42	14	201	6	15	95.5
0.56	9.4	16	1.8	2.0	ZTR615SPH832_0400 EZ703U	39	49	1874	40.00	0.38	0.75	42	14	196	6	15	95.5
0.56	13	23	2.5	1.5	ZTR615SPH832_0400 EZ705U	39	49	1874	40.00	0.38	0.75	42	14	196	6	15	95.5
0.64	8.2	14	1.6	2.2	ZTR615SPH832_0350 EZ703U	39	49	1874	35.00	0.43	0.86	42	14	203	6	15	95.5
0.64	11	20	2.1	1.7	ZTR615SPH832_0350 EZ705U	39	49	1874	35.00	0.43	0.86	42	14	203	6	15	95.5
0.80	6.6	11	2.2	2.6	ZTR615SPH832_0280 EZ703U	35	49	1693	28.00	0.54	1.07	42	14	199	6	15	95.5
0.80	8.9	16	3.0	1.9	ZTR615SPH832_0280 EZ705U	39	49	1874	28.00	0.54	1.07	42	14	199	6	15	95.5
0.90	5.9	9.7	1.9	2.8	ZTR615SPH832_0250 EZ703U	32	49	1511	25.00	0.54	1.10	42	14	204	6	15	95.5
0.90	8.0	15	2.5	2.1	ZTR615SPH832_0250 EZ705U	39	49	1874	25.00	0.54	1.10	42	14	204	6	15	95.5
1.13	4.7	7.8	2.1	3.3	ZTR615SPH832_0200 EZ703U	25	49	1209	20.00	0.63	1.13	42	14	204	6	15	95.5

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [μm]	$Δs_{red}$ [μm]	C_{lin} [N/μm]	m_n [mm]	z	d_0 [mm]
ZTR6PH8 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 39 kN)																	
1.13	6.4	12	2.8	2.4	ZTR615SPH832_0200 EZ705U	39	49	1874	20.00	0.63	1.13	42	14	204	6	15	95.5
1.41	3.8	6.2	2.9	3.8	ZTR615SPH832_0160 EZ703U	20	49	967	16.00	0.78	1.41	42	14	202	6	15	95.5
1.41	5.1	9.3	3.9	2.8	ZTR615SPH832_0160 EZ705U	32	49	1548	16.00	0.78	1.41	42	14	202	6	15	95.5
ZTR6PH8 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 39 kN)																	
0.30	10	15	0.6	1.4	ZTR615SPH832_1000 EZ701U	29	49	1380	100.0	0.15	0.30	42	14	178	6	15	95.5
0.30	14	28	0.9	1.0	ZTR615SPH832_1000 EZ702U	29	49	1380	100.0	0.15	0.30	42	14	178	6	15	95.5
0.43	7.1	11	0.5	3.0	ZTR615SPH832_0700 EZ701U	27	49	1302	70.00	0.21	0.43	42	14	193	6	15	95.5
0.43	9.8	19	0.7	2.1	ZTR615SPH832_0700 EZ702U	39	49	1848	70.00	0.21	0.43	42	14	193	6	15	95.5
0.60	5.1	7.7	0.6	3.7	ZTR615SPH832_0500 EZ701U	19	49	930	50.00	0.30	0.60	42	14	201	6	15	95.5
0.60	7.0	14	0.9	2.7	ZTR615SPH832_0500 EZ702U	39	49	1874	50.00	0.30	0.60	42	14	201	6	15	95.5
0.75	4.1	6.2	0.9	4.2	ZTR615SPH832_0400 EZ701U	16	49	744	40.00	0.38	0.75	42	14	196	6	15	95.5
0.75	5.6	11	1.2	3.0	ZTR615SPH832_0400 EZ702U	32	49	1525	40.00	0.38	0.75	42	14	196	6	15	95.5
0.86	3.5	5.4	0.7	4.7	ZTR615SPH832_0350 EZ701U	14	49	651	35.00	0.43	0.86	42	14	203	6	15	95.5
0.86	4.9	9.7	1.0	3.4	ZTR615SPH832_0350 EZ702U	28	49	1335	35.00	0.43	0.86	42	14	203	6	15	95.5
1.07	3.9	7.8	1.4	4.0	ZTR615SPH832_0280 EZ702U	22	49	1068	28.00	0.54	1.07	42	14	199	6	15	95.5
ZTR5PH9 (n_{1N} = 2000 min^{-1}, ($F_{f2acc,max}$ = 67 kN)																	
0.18	43	48	1.3	1.1	ZTR519SPH942_0600 EZ813U	67	133	3360	60.00	0.25	0.40	44	15	299	5	19	100.8
0.22	35	39	1.5	1.2	ZTR519SPH942_0480 EZ813U	67	133	3360	48.00	0.31	0.50	44	15	300	5	19	100.8
0.25	30	34	1.6	1.3	ZTR519SPH942_0420 EZ813U	67	133	3360	42.00	0.35	0.57	44	15	301	5	19	100.8
0.26	29	32	1.9	1.4	ZTR519SPH942_0400 EZ813U	67	133	3360	40.00	0.37	0.59	44	15	299	5	19	100.8
0.33	23	26	2.0	1.6	ZTR519SPH942_0320 EZ813U	67	133	3360	32.00	0.46	0.74	44	15	302	5	19	100.8
0.33	34	41	3.0	1.1	ZTR519SPH942_0320 EZ815U	67	133	3360	32.00	0.46	0.74	44	15	302	5	19	100.8
0.35	22	24	2.0	1.7	ZTR519SPH942_0300 EZ813U	67	133	3360	30.00	0.44	0.70	44	15	302	5	19	100.8
0.35	32	38	2.9	1.1	ZTR519SPH942_0300 EZ815U	67	133	3360	30.00	0.44	0.70	44	15	302	5	19	100.8
0.38	20	23	1.9	1.8	ZTR519SPH942_0280 EZ813U	67	133	3360	28.00	0.53	0.85	44	15	304	5	19	100.8
0.38	30	36	2.8	1.2	ZTR519SPH942_0280 EZ815U	67	133	3360	28.00	0.53	0.85	44	15	304	5	19	100.8
0.44	17	19	2.4	1.9	ZTR519SPH942_0240 EZ813U	62	133	3125	24.00	0.44	0.77	44	15	302	5	19	100.8
0.44	26	30	3.6	1.3	ZTR519SPH942_0240 EZ815U	67	133	3360	24.00	0.44	0.77	44	15	302	5	19	100.8
0.53	14	16	2.6	2.2	ZTR519SPH942_0200 EZ813U	52	133	2604	20.00	0.66	1.06	44	15	306	5	19	100.8
0.53	21	25	3.9	1.5	ZTR519SPH942_0200 EZ815U	67	133	3360	20.00	0.66	1.06	44	15	306	5	19	100.8
0.59	13	15	2.8	2.4	ZTR519SPH942_0180 EZ813U	47	133	2344	18.00	0.53	0.88	44	15	303	5	19	100.8
0.59	19	23	4.1	1.6	ZTR519SPH942_0180 EZ815U	66	133	3348	18.00	0.53	0.88	44	15	303	5	19	100.8
0.66	12	13	3.0	2.6	ZTR519SPH942_0160 EZ813U	41	133	2083	16.00	0.66	1.15	44	15	307	5	19	100.8
0.66	17	20	4.4	1.7	ZTR519SPH942_0160 EZ815U	59	133	2976	16.00	0.66	1.15	44	15	307	5	19	100.8
0.88	8.6	9.7	3.4	3.1	ZTR519SPH942_0120 EZ813U	31	114	1562	12.00	0.79	1.32	44	15	309	5	19	100.8
0.88	13	15	5.1	2.1	ZTR519SPH942_0120 EZ815U	44	114	2232	12.00	0.79	1.32	44	15	309	5	19	100.8
ZTR5PH9 (n_{1N} = 4000 min^{-1}, ($F_{f2acc,max}$ = 67 kN)																	
0.35	28	48	0.9	1.3	ZTR519SPH942_0600 EZ813U	67	133	3360	60.00	0.25	0.40	44	15	299	5	19	100.8
0.35	29	74	1.0	1.3	ZTR519SPH942_0600 EZ815U	67	133	3360	60.00	0.25	0.40	44	15	299	5	19	100.8
0.44	22	39	0.9	1.5	ZTR519SPH942_0480 EZ813U	67	133	3360	48.00	0.31	0.50	44	15	300	5	19	100.8
0.44	23	59	1.0	1.5	ZTR519SPH942_0480 EZ815U	67	133	3360	48.00	0.31	0.50	44	15	300	5	19	100.8
0.50	20	34	1.0	1.6	ZTR519SPH942_0420 EZ813U	67	133	3360	42.00	0.35	0.57	44	15	301	5	19	100.8
0.50	20	52	1.0	1.6	ZTR519SPH942_0420 EZ815U	67	133	3360	42.00	0.35	0.57	44	15	301	5	19	100.8
0.53	19	32	1.6	1.7	ZTR519SPH942_0400 EZ813U	67	133	3360	40.00	0.37	0.59	44	15	299	5	19	100.8
0.53	19	50	1.6	1.6	ZTR519SPH942_0400 EZ815U	67	133	3360	40.00	0.37	0.59	44	15	299	5	19	100.8
0.66	15	26	1.7	2.0	ZTR519SPH942_0320 EZ813U	67	133	3360	32.00	0.46	0.74	44	15	302	5	19	100.8
0.66	15	40	1.7	1.9	ZTR519SPH942_0320 EZ815U	67	133	3360	32.00	0.46	0.74	44	15	302	5	19	100.8
0.70	14	24	1.3	2.1	ZTR519SPH942_0300 EZ813U	67	133	3360	30.00	0.44	0.70	44	15	302	5	19	100.8
0.70	14	37	1.3	2.0	ZTR519SPH942_0300 EZ815U	67	133	3360	30.00	0.44	0.70	44	15	302	5	19	100.8
0.75	13	23	1.4	2.2	ZTR519SPH942_0280 EZ813U	67	133	3360	28.00	0.53	0.85	44	15	304	5	19	100.8
0.75	13	35	1.5	2.1	ZTR519SPH942_0280 EZ815U	67	133	3360	28.00	0.53	0.85	44	15	304	5	19	100.8
1.06	9.3	16	1.7	2.7	ZTR519SPH942_0200 EZ813U	52	133	2604	20.00	0.66	1.06	44	15	306	5	19	100.8
1.06	9.6	25	1.8	2.6	ZTR519SPH942_0200 EZ815U	67	133	3360	20.00	0.66	1.06	44	15	306	5	19	100.8
ZTR6PH9 (n_{1N} = 2000 min^{-1}, ($F_{f2acc,max}$ = 67 kN)																	
0.18	43	48	1.3	1.1	ZTR616SPH942_0600 EZ813U	67	112	3412	60.00	0.25	0.40	44	15	305	6	16	101.9
0.22	34	38	1.5	1.2	ZTR616SPH942_0480 EZ813U	67	112	3412	48.00	0.31	0.50	44	15	306	6	16	101.9
0.25	30	34	1.6	1.3	ZTR616SPH942_0420 EZ813U	67	112	3412	42.00	0.36	0.57	44	15	307	6	16	101.9
0.27	28	32	1.9	1.4	ZTR616SPH942_0400 EZ813U	67	112	3412	40.00	0.37	0.60	44	15	305	6	16	101.9
0.33	23	26	2.0	1.6	ZTR616SPH942_0320 EZ813U	67	112	3412	32.00	0.47	0.75	44	15	308	6	16	101.9
0.33	34	40	3.0	1.1	ZTR616SPH942_0320 EZ815U	67	112	3412	32.00	0.47	0.75	44	15	308	6	16	101.9
0.36	21	24	2.0	1.7	ZTR616SPH942_0300 EZ813U	67	112	3412	30.00	0.44	0.71	44	15	308	6	16	101.9
0.36	32	38	2.9	1.1	ZTR616SPH942_0300 EZ815U	67	112	3412	30.00	0.44	0.71	44	15	308	6	16	101.9
0.38	20	22	1.9	1.7	ZTR616SPH942_0280 EZ813U	67	112	3412	28.00	0.53	0.86	44	15	310	6	16	101.9
0.38	30	35	2.8	1.2	ZTR616SPH942_0280 EZ815U	67	112	3412	28.00	0.53	0.86	44	15	310	6	16	101.9
0.44	17	19	2.4	1.9	ZTR616SPH942_0240 EZ813U	61	112	3125	24.00	0.44	0.78	44	15	308	6	16	101.9
0.44	25	30	3.6	1.3	ZTR616SPH942_0240 EZ815U	67	112	3412	24.00	0.44	0.78	44	15	308	6	16	101.9

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [μm]	$Δs_{red}$ [μm]	C_{lin} [N/μm]	m_n [mm]	z	d_0 [mm]
ZTR6PH9 (n_{1N} = 2000 min^{-1}, ($F_{f2acc,max}$ = 67 kN)																	
0.53	14	16	2.6	2.2	ZTR616SPH942_0200 EZ813U	51	112	2604	20.00	0.67	1.07	44	15	312	6	16	101.9
0.53	21	25	3.9	1.5	ZTR616SPH942_0200 EZ815U	67	112	3412	20.00	0.67	1.07	44	15	312	6	16	101.9
0.59	13	14	2.8	2.3	ZTR616SPH942_0180 EZ813U	46	112	2344	18.00	0.53	0.89	44	15	309	6	16	101.9
0.59	19	23	4.1	1.6	ZTR616SPH942_0180 EZ815U	66	112	3348	18.00	0.53	0.89	44	15	309	6	16	101.9
0.67	11	13	3.0	2.5	ZTR616SPH942_0160 EZ813U	41	112	2083	16.00	0.67	1.17	44	15	313	6	16	101.9
0.67	17	20	4.4	1.7	ZTR616SPH942_0160 EZ815U	58	112	2976	16.00	0.67	1.17	44	15	313	6	16	101.9
0.89	8.5	9.6	3.4	3.1	ZTR616SPH942_0120 EZ813U	31	112	1562	12.00	0.80	1.33	44	15	315	6	16	101.9
0.89	13	15	5.1	2.1	ZTR616SPH942_0120 EZ815U	44	112	2232	12.00	0.80	1.33	44	15	315	6	16	101.9
ZTR6PH9 (n_{1N} = 4000 min^{-1}, ($F_{f2acc,max}$ = 67 kN)																	
0.36	28	48	0.9	1.3	ZTR616SPH942_0600 EZ813U	67	112	3412	60.00	0.25	0.40	44	15	305	6	16	101.9
0.36	29	74	1.0	1.2	ZTR616SPH942_0600 EZ815U	67	112	3412	60.00	0.25	0.40	44	15	305	6	16	101.9
0.44	22	38	0.9	1.5	ZTR616SPH942_0480 EZ813U	67	112	3412	48.00	0.31	0.50	44	15	306	6	16	101.9
0.44	23	59	1.0	1.4	ZTR616SPH942_0480 EZ815U	67	112	3412	48.00	0.31	0.50	44	15	306	6	16	101.9
0.51	19	34	1.0	1.6	ZTR616SPH942_0420 EZ813U	67	112	3412	42.00	0.36	0.57	44	15	307	6	16	101.9
0.51	20	51	1.0	1.6	ZTR616SPH942_0420 EZ815U	67	112	3412	42.00	0.36	0.57	44	15	307	6	16	101.9
0.53	18	32	1.6	1.7	ZTR616SPH942_0400 EZ813U	67	112	3412	40.00	0.37	0.60	44	15	305	6	16	101.9
0.53	19	49	1.6	1.6	ZTR616SPH942_0400 EZ815U	67	112	3412	40.00	0.37	0.60	44	15	305	6	16	101.9
0.67	15	26	1.7	2.0	ZTR616SPH942_0320 EZ813U	67	112	3412	32.00	0.47	0.75	44	15	308	6	16	101.9
0.67	15	39	1.7	1.9	ZTR616SPH942_0320 EZ815U	67	112	3412	32.00	0.47	0.75	44	15	308	6	16	101.9
0.71	14	24	1.3	2.0	ZTR616SPH942_0300 EZ813U	67	112	3412	30.00	0.44	0.71	44	15	308	6	16	101.9
0.71	14	37	1.3	2.0	ZTR616SPH942_0300 EZ815U	67	112	3412	30.00	0.44	0.71	44	15	308	6	16	101.9
0.76	13	22	1.4	2.1	ZTR616SPH942_0280 EZ813U	67	112	3412	28.00	0.53	0.86	44	15	310	6	16	101.9
0.76	13	34	1.5	2.1	ZTR616SPH942_0280 EZ815U	67	112	3412	28.00	0.53	0.86	44	15	310	6	16	101.9
1.07	9.2	16	1.7	2.7	ZTR616SPH942_0200 EZ813U	51	112	2604	20.00	0.67	1.07	44	15	312	6	16	101.9
1.07	9.5	25	1.8	2.6	ZTR616SPH942_0200 EZ815U	67	112	3412	20.00	0.67	1.07	44	15	312	6	16	101.9

5.3 Dimensional drawings

This chapter shows you the dimensions of rack and pinion drives with EZ synchronous servo motors.

Dimension az in the tables of dimensions applies to STOBER gear racks. In general: az = ½ d0 + h0 + x*mn

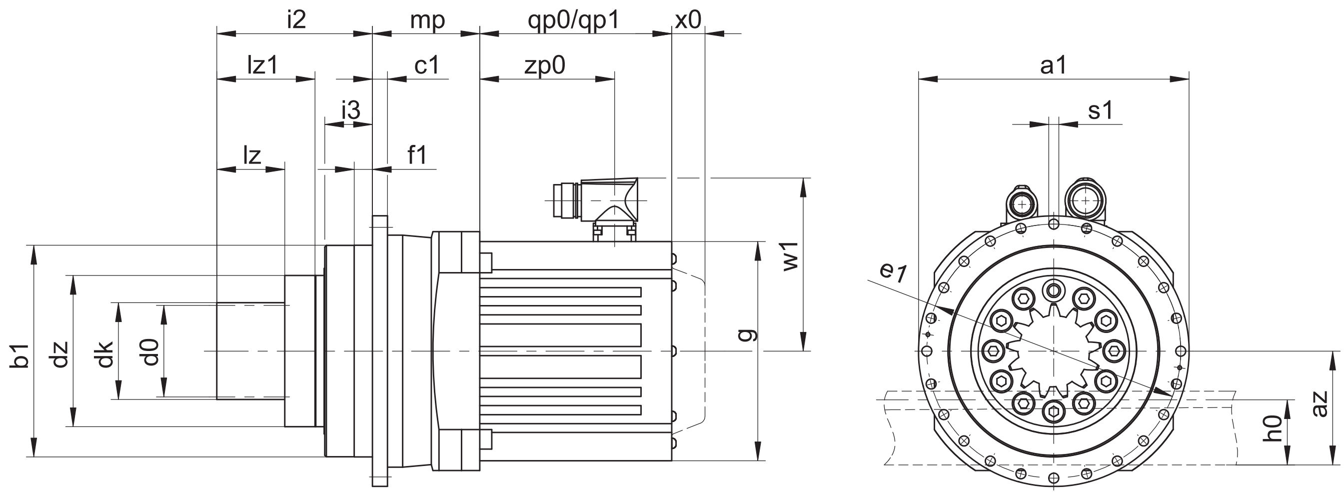
The pinion is helical (left-hand 19° 31' 42"). The pinion gearing quality is 5.

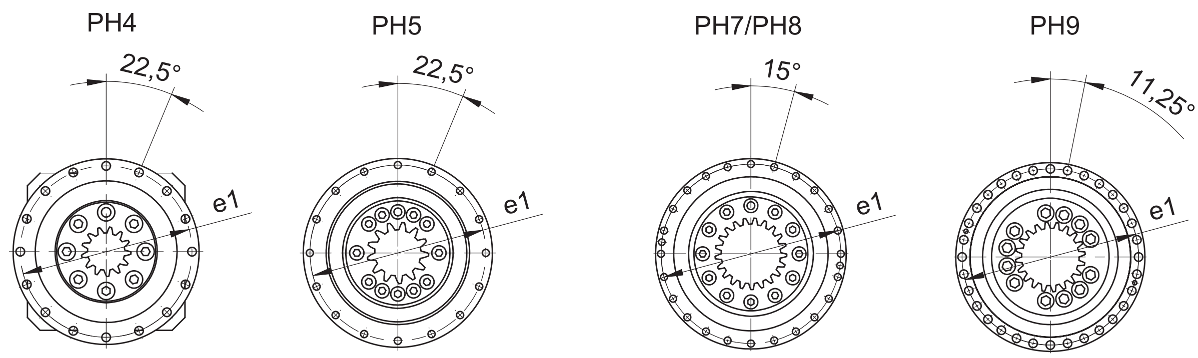
Dimensions can exceed the specifications of ISO 2768-mK due to casting tolerances or accumulation of individual tolerances.

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

You can download 3D models of our standard drives at https://configurator.stoeber.de/en-US/.

Combination options and the dimensions of forced ventilated geared motors can also be found at https://configurator.stoeber.de/en-US/.





qp0	Applies to motors without brake.
x0	Applies to encoders using an optical measuring method.
qp1	Applies to motors with brake.
w1	Different for the One Cable Solution (OCS), see the chapter [▸ 14.4]

Dimensions of gearboxes

Type	mn	∅a1	az	∅b1	c1	∅d0	∅dk	dz	∅e1	f1	h0	i2	i3	lz	lz1	∅s1	x
ZTR212SPH4_	2	118	35.73	90_{h7}	7	25.47	31.5	63	109	10	22	71.0	23.5	26.0	41.0	5.5	0.50
ZTR216SPH4_	2	118	38.98	90_{h7}	7	33.95	38.0	63	109	10	22	71.0	23.5	26.0	41.0	5.5	0.00
ZTR219SPH5_	2	145	42.16	110_{h7}	8	40.32	44.3	80	135	12	22	70.0	22.5	26.0	41.0	5.5	0.00
ZTR223SPH5_	2	145	46.40	110_{h7}	8	48.81	52.8	80	135	12	22	70.0	22.5	26.0	41.0	5.5	0.00
ZTR314SPH5_	3	145	49.18	110_{h7}	8	44.56	52.4	80	135	12	26	76.5	22.5	32.5	47.5	5.5	0.30
ZTR223SPH7_	2	179	46.40	140_{h7}	10	48.81	52.8	100	168	12	22	84.0	31.5	26.0	46.0	6.6	0.00
ZTR316SPH7_	3	179	51.46	140_{h7}	10	50.93	56.9	100	168	12	26	90.5	31.5	32.5	52.5	6.6	0.00
ZTR319SPH7_	3	179	56.24	140_{h7}	10	60.48	66.5	100	168	12	26	90.5	31.5	32.5	52.5	6.6	0.00
ZTR412SPH7_	4	179	62.46	140_{h7}	10	50.93	62.9	100	168	12	35	103.0	31.5	45.0	65.0	6.6	0.50
ZTR332SPH8_	3	247	76.93	200_{h7}	12	101.86	107.9	148	233	15	26	107.5	41.5	32.5	57.5	9.0	0.00
ZTR417SPH8_	4	247	71.08	200_{h7}	12	72.15	80.2	148	233	15	35	120.0	41.5	45.0	70.0	9.0	0.00
ZTR420SPH8_	4	247	77.44	200_{h7}	12	84.88	92.9	148	233	15	35	120.0	41.5	45.0	70.0	9.0	0.00
ZTR518SPH8_	5	247	81.75	200_{h7}	12	95.49	105.5	148	233	15	34	130.0	41.5	55.0	80.0	9.0	0.00
ZTR615SPH8_	6	247	90.75	200_{h7}	12	95.49	107.5	148	233	15	43	140.0	41.5	65.0	90.0	9.0	0.00
ZTR519SPH9_	5	300	84.40	255_{h7}	18	100.80	110.8	187	280	20	34	155.0	54.0	55.0	101.0	13.5	0.00
ZTR616SPH9_	6	300	93.93	255_{h7}	18	101.86	113.9	187	280	20	43	165.0	54.0	65.0	111.0	13.5	0.00

Dimensions of motors

Type	□g	qp0	qp1	w1	x0	zp0
EZ301U	72	90	130.0	55.5	21	54.5
EZ302U	72	112	152.0	55.5	21	76.5
EZ303U	72	134	174.0	55.5	21	98.5
EZ401U	98	98	146.5	91.0	22	56.0
EZ402U	98	123	171.5	91.0	22	81.0
EZ501U	115	93	147.5	100.0	22	58.5
EZ502U	115	118	172.5	100.0	22	83.5
EZ503U	115	143	197.5	100.0	22	108.5
EZ505U	115	193	247.5	100.0	22	158.5
EZ701U	145	102	161.0	115.0	22	64.0
EZ702U	145	127	186.0	115.0	22	89.0
EZ703U	145	152	211.0	115.0	22	114.0
EZ705U	145	207	266.0	134.0	22	165.0
EZ813U	190	238	315.0	156.5	22	184.0
EZ815U	190	320	397.0	156.5	22	266.0

Dimensions of geared motors

Type	EZ3	EZ4	EZ5	EZ7	EZ8
	mp	mp	mp	mp	mp
ZTR_PH431_	–	54.5	54.0	–	–
ZTR_PH432_	99.0	–	–	–	–
ZTR_PH531_	–	–	61.0	64.0	–
ZTR_PH532_	–	103.0	102.5	–	–
ZTR_PH731_	–	–	–	71.0	81.0
ZTR_PH732_	–	–	119.0	122.0	–
ZTR_PH831_	–	–	–	–	110.0
ZTR_PH832_	–	–	–	161.0	171.0
ZTR_PH942_	–	–	–	–	210.5

5.4 Type designation

This chapter shows you an explanation of the type designation with the associated options.

Additional ordering information not included in the type designation can be found at the end of the chapter.

Example code

Z	TR	3	19	S	PH	7	3	1	S	F	S	S	0050	EZ703U

Explanation

Code	Designation	Design
Z	Type	Rack and pinion gearbox
TR	Design	Screwed flange pinion
3	Normal module	m_n = 3 mm (example)
19	Number of teeth	z = 19 (example)
S	Helix angle	Left-hand 19° 31' 42"
PH	Type	Planetary gearbox
7	Size	7 (example)
3	Generation	Generation 3
4		Generation 4
1	Stages	Single-stage
2		Two-stage
S	Housing	Standard
F	Shaft	Flange shaft
S	Bearing	Standard bearing
V		Reinforced bearing (PH3 – PH5)
S	Backlash	Standard
R		Reduced (PH3 – PH9)
0050	Transmission ratio (i x 10)	i = 5 (example)
EZ703U	Motor	EZ synchronous servo motor

To complete the type designation, also specify the following in your order:

- A detailed type designation of the motor, see the chapter [14.5]
- Radial shaft seal rings at the output made of NBR or FKM (option), see the chapter [5.6.2]
- Radial runout ≤ 10 µm (optional)
- Reverse operation of the output shaft from ±20° to ±90° for horizontal installation on request

This catalog shows you all the information on rack and pinion drives with EZ synchronous servo motors. All input options available on request are shown in the chapter [5.5.1].

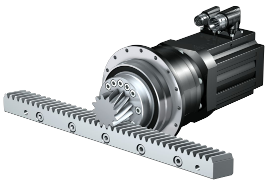
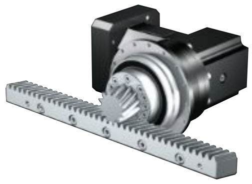
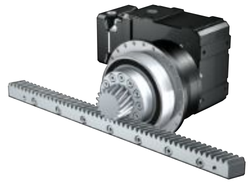
To make selecting your rack and pinion drive easy, use our STOBER Configurator at https://configurator.stoeber.de/en-US/.

A detailed description of the nameplate, see the chapter [14.5.1].

5.5 Product description

5.5.1 Input options

This chapter shows you all available input options:

EZ synchronous servo motor	Motor adapter	KX right-angle input with MF motor adapter	K right-angle input with ME motor adapter	MB motor adapter
				
Catalog ID 443286_en	Catalog ID 443137_en	On request	On request	On request

The corresponding catalogs can be found at http://www.stoeber.de/en/downloads/

Enter the ID of the catalog in the Search term field.

5.5.2 Gear rack

The gear rack used must have a right-hand design (19° 31' 42"); the load capacity must not be exceeded.

5.5.3 Installation conditions

The torque and force values listed in this catalog are valid under the following conditions:

- When the gear housing is fastened on the machine side using screws of strength class 12.9
- When the gear housings are adjusted at pilot øbz. The machine-side fit must be H7.

5.5.4 Lubricants

STOBER fills the gearboxes with the amount and type of lubricant specified on the nameplate.

You will receive lubricants for use in the food industry upon request.

5.5.4.1 Lubrication of rack and pinion gearbox

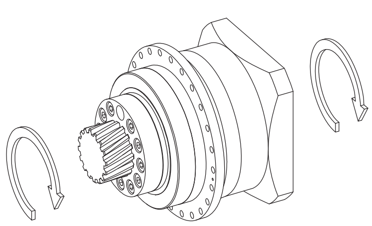
Ensure permanent lubrication with the lubricants recommended in the chapter [13.5.1].

5.5.5 Other product features

Feature	Value
Max. permitted gearbox temperature (on the surface of the gearbox)	≤ 90 °C
Paint	Black RAL 9005
(ATEX) Directive 2014/34/EU (Option)	Not suitable.
Protection class: [1]	
Planetary gearboxes	IP65
Motor	IP56, optionally IP66
Pinion/gear rack	IPXX

5.5.6 Direction of rotation

The input and output rotate in the same direction.



[1] Observe the protection class of all the components.

5.6 Project configuration

Project your drives using our SERVOsoft designing software. Download SERVOsoft free of charge after registration at https://www.stoeber.de/en/services/info-servosoft/.

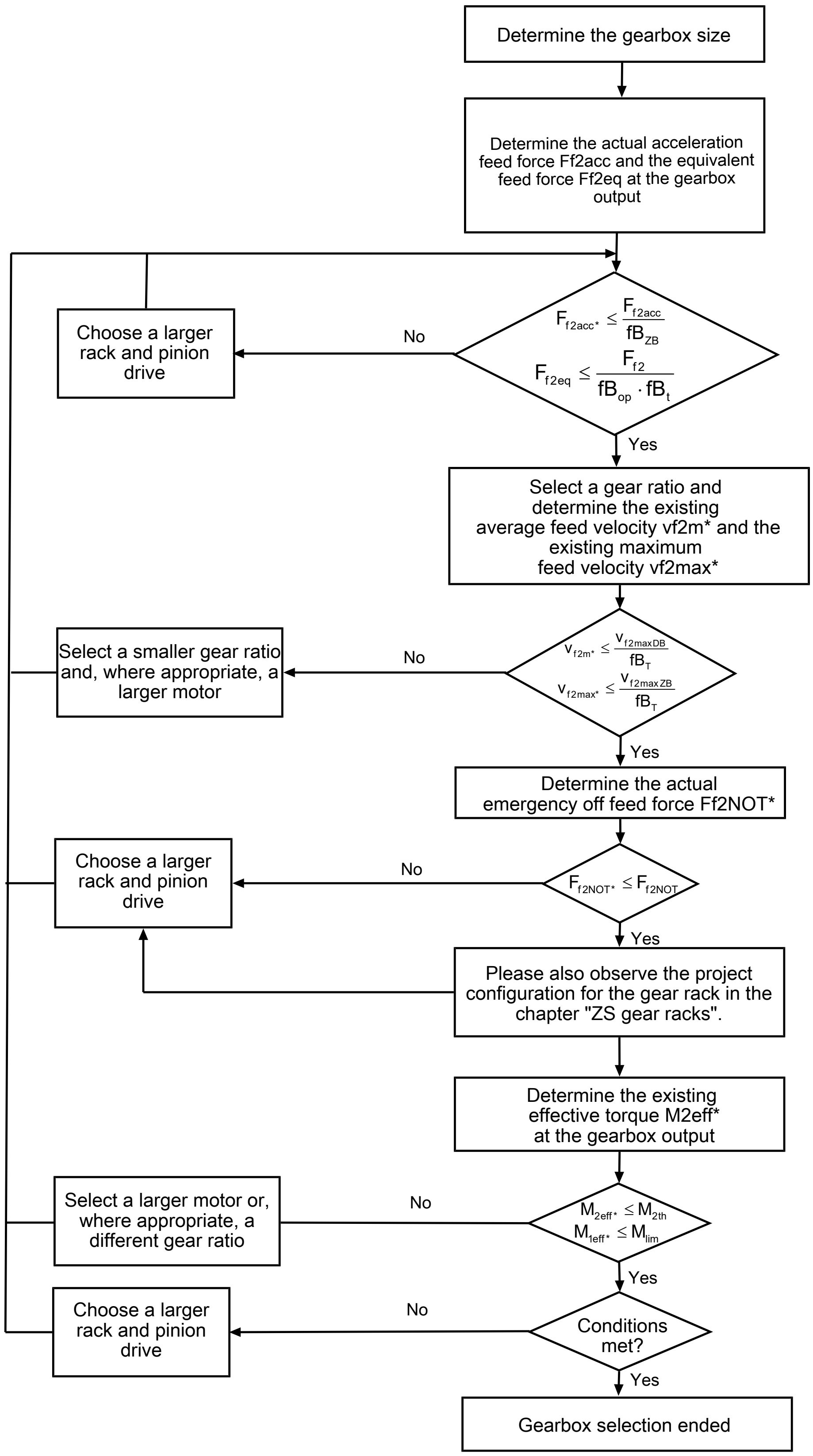
It is the most convenient and reliable method of drive selection, as the entire torque/speed curve of the application is displayed and evaluated here in the curve of the geared motor.

In this chapter, only limit values for specific operating points can be taken into consideration for manual drive selection.

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

An explanation of the formula symbols can be found in the chapter [▶ 17.1].

5.6.1 Drive selection

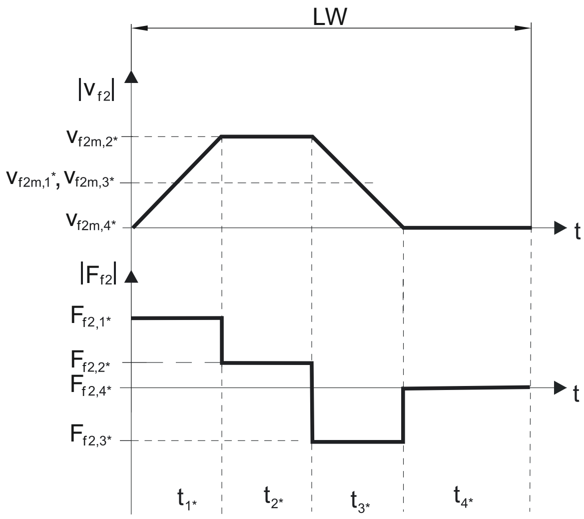


Refer to the selection tables for the values of i, $v_{f2maxDB}$, $v_{f2maxZB}$, F_{f2acc}, F_{f2N} and F_{f2NOT}.

The values for fB_T, fB_{op}, fB_t and fB_{ZB} can be found in the corresponding tables in this chapter.

Example of cyclic operation

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



Calculation of the actual maximum acceleration feed force

$$F_{f2acc^*} = m^* \cdot a^* + F_{L^*}$$

Calculation of the actual average input speed

$$n_{1m^*} = \frac{v_{f2m^*} \cdot i}{d_0 \cdot \pi}$$

$$v_{f2m^*} = \frac{|v_{f2m,1^*}| \cdot t_{1^*} + \ldots + |v_{f2m,n^*}| \cdot t_{n^*}}{t_{1^*} + \ldots + t_{n^*}}$$

If $t_{1^*} + \ldots + t_{3^*} \geq 6$ min, determine v_{2m^*} without the rest phase t_{4^*}.

The values for the ratio i can be found in the selection tables.

Calculation of the actual emergency off feed force

$$F_{f2NOT^*} = m^* \cdot a_{NOT^*} + F_{L^*}$$

Calculation of the actual equivalent feed force

$$F_{f2eq^*} = \sqrt[3]{\frac{|v_{f2m,1^*}| \cdot t_{1^*} \cdot |F_{f2,1^*}{}^3| + \ldots + |v_{f2m,n^*}| \cdot t_{n^*} \cdot |F_{f2,n^*}{}^3|}{|v_{f2m,1^*}| \cdot t_{1^*} + \ldots + |v_{f2m,n^*}| \cdot t_{n^*}}}$$

Calculation of the thermal limit torque

Calculate the thermal limit torque M_{2th} for a duty cycle ED_{10} > 50% and the actual average input speed n_{1m^*}. (At $K_{mot,th} \leq 0$ you must reduce the average input speed n_{1m^*} accordingly or select another geared motor size.)

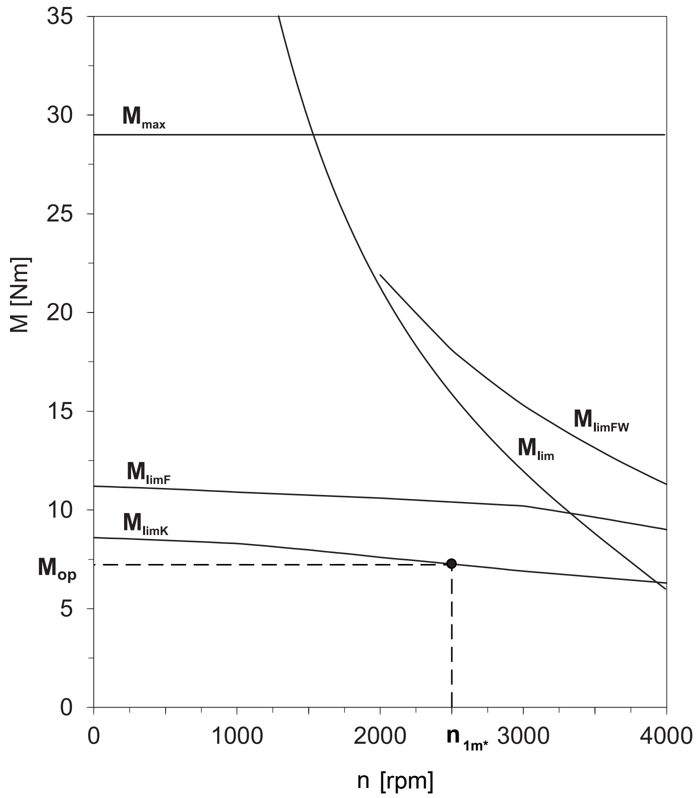
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

$$K_{mot,th} = 0{,}93 - \frac{a_{th}}{1000} \cdot fB_T \cdot \left(\frac{n_{1m^*}}{1000}\right)^3$$

Refer to the selection tables for the values of i and a_{th}.

The values for fB_T can be found in the corresponding table in this chapter.

The value for the torque of the motor at operating point M_{op} with the determined average input speed n_{1m*} can be found in the motor characteristic curve in the chapter Torque/speed curves. Note the size, nominal speed n_N and cooling type of the motor. The figure below shows an example of reading the torque M_{op} of a motor with convection cooling at the operating point.



Calculation of the actual effective torque

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

$$M_{2,n*} = \frac{F_{f2,n*} \cdot d_0}{2}$$

$$M_{1eff*} = \frac{M_{2eff*}}{i \cdot \eta}$$

Operating factors

Operating mode	fB_{op}
Uniform continuous operation	1.00
Cyclic operation	1.00
Reversing load cyclic operation	1.00

Run time	fB_t
Daily runtime ≤ 8 h	1.00
Daily runtime ≤ 16 h	1.15
Daily runtime ≤ 24 h	1.20

Cyclic operation	fB_{ZB}
≤ 1000 load changes/hour (LW/h)	1.00
> 1000 load changes/hour (LW/h)	1.15

Temperature		fB_T
Motor cooling	**Surrounding temperature**	
Motor with forced ventilation	≤ 20 °C	0.9
	≤ 30 °C	1.0
	≤ 40 °C	1.15
Motor with convection cooling	≤ 20 °C	1.0
	≤ 30 °C	1.1
	≤ 40 °C	1.25

Notes

- The maximum permitted gearbox temperature (see the "Other product features" chapter) must not be exceeded, as that could result in damage.
- For braking from full speed (for example, when the power fails or when setting up the machine), note the permitted gearbox feed forces (F_{f2acc}, F_{f2NOT}) in the selection tables.

5.6.2 Recommendation for radial shaft seal rings

For a duty cycle > 60% and higher surrounding temperatures, we recommend radial shaft seal rings made of FKM at the output.

Properties:

- Excellent temperature resistance
- High chemical stability
- Very good resistance to aging
- Excellent resistance in oils and greases
- For use in the food, beverage and pharmaceutical industries

Leak-proofness

Our gearboxes are equipped with high-quality radial shaft seal rings and checked for leaks. However, a leak cannot be fully ruled out over the length of use of a gearbox. If you use a gearbox with goods incompatible with the lubricant, you must take measures to prevent direct contact with the gearbox lubricant in case of a leak.

5.7 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 term field.

Documentation	ID
Operating manual gearboxes, geared motors PH33 – PH83, PH94 – PH104	443354_en
Operating manual for EZ synchronous servo motors	443032_en
Operating manual gear racks	443392_en

6 ZTRPHV rack and pinion drives

Table of contents

6 Rack and pinion drives

ZTRPHV

6.1 Overview

High Performance precision planetary geared motors with screwed flange pinion

Features

Power density	★★★★☆
Linear clearance	★★★★☆
Price category	€€€€
Smooth operation	★★★★☆
Linear rigidity	★★★★☆
Mass moment of inertia	★★★★☆
Ready-to-install drive solution	✓
Pinion gearing quality 5 (DIN 3962)	✓
Helical gearing	✓
Case-hardened and smoothed	✓
Radial runout ≤ 10 µm (optional)	✓
Compact and highly dynamic due to direct motor attachment	✓

Key ★☆☆☆☆ good | ★★★★★ excellent
€ Economy | €€€€€ Premium

Technical data

m_n	5 – 6 mm
z	16 – 19
F_{f2acc}	22 – 67 kN
v_{f2}	0.13 – 0.39 m/s
Δs	15 – 44 µm

6.2 Selection tables

The technical data specified in the selection tables applies to:

- De-energized installation
- Permanent lubrication with the lubricants recommended in the chapter on gear racks [13.5.1]
- Case-hardened pinions, helical (left-hand 19° 31' 42"), gearing quality 5
- Installation altitudes up to 1000 m above sea level
- Surrounding temperatures from 0 °C to 40 °C
- Without consideration of the thermal limiting performance
- Drives with convection-cooled motors (e.g. EZ401**U**)

For the technical data on drives with forced ventilated motors (e.g. EZ401**B**), refer to https://configurator.stoeber.de/en-US/

For all other technical data, refer to https://configurator.stoeber.de/en-US/.

An explanation of the formula symbols can be found in the chapter [17.1].

v_{f2}	F_{f2}	$F_{f2,0}$	a_{th}	S	Type	F_{f2acc}	F_{f2NOT}	M_{2acc}	i	$v_{f2maxDB}$	$v_{f2maxZB}$	Δs	$Δs_{red}$	C_{lin}	m_n	z	d_0
[m/s]	[kN]	[kN]				[kN]	[kN]	[Nm]		[m/s]	[m/s]	[µm]	[µm]	[N/µm]	[mm]		[mm]
ZTR5PHV9 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 67 kN)																	
0.13	16	18	0.2	3.1	ZTR519SPHV943_1210 EZ701U	43	133	2178	121.0	0.11	0.20	44	15	280	5	19	100.8
0.13	26	31	0.4	1.9	ZTR519SPHV943_1210 EZ702U	67	133	3360	121.0	0.11	0.20	44	15	280	5	19	100.8
0.13	36	45	0.5	1.4	ZTR519SPHV943_1210 EZ703U	67	133	3360	121.0	0.11	0.20	44	15	280	5	19	100.8
0.13	46	65	0.7	1.1	ZTR519SPHV943_1210 EZ705U	67	133	3360	121.0	0.11	0.20	44	15	280	5	19	100.8
0.17	12	13	0.3	3.8	ZTR519SPHV943_0910 EZ701U	33	133	1638	91.00	0.15	0.26	44	15	283	5	19	100.8
0.17	20	23	0.4	2.3	ZTR519SPHV943_0910 EZ702U	67	133	3358	91.00	0.15	0.26	44	15	283	5	19	100.8
0.17	27	34	0.6	1.7	ZTR519SPHV943_0910 EZ703U	67	133	3360	91.00	0.15	0.26	44	15	283	5	19	100.8
0.17	35	49	0.8	1.3	ZTR519SPHV943_0910 EZ705U	67	133	3360	91.00	0.15	0.26	44	15	283	5	19	100.8
0.26	8.1	9.0	0.3	5.0	ZTR519SPHV943_0610 EZ701U	22	133	1098	61.00	0.22	0.39	44	15	284	5	19	100.8
0.26	13	16	0.5	3.1	ZTR519SPHV943_0610 EZ702U	45	133	2251	61.00	0.22	0.39	44	15	284	5	19	100.8
0.26	18	23	0.7	2.2	ZTR519SPHV943_0610 EZ703U	67	133	3360	61.00	0.22	0.39	44	15	284	5	19	100.8
0.26	23	33	1.0	1.7	ZTR519SPHV943_0610 EZ705U	67	133	3360	61.00	0.22	0.39	44	15	284	5	19	100.8
ZTR5PHV9 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 67 kN)																	
0.20	26	43	0.4	1.7	ZTR519SPHV943_1210 EZ703U	67	133	3360	121.0	0.11	0.20	44	15	280	5	19	100.8
0.20	35	65	0.6	1.2	ZTR519SPHV943_1210 EZ705U	67	133	3360	121.0	0.11	0.20	44	15	280	5	19	100.8
0.26	20	33	0.5	2.0	ZTR519SPHV943_0910 EZ703U	67	133	3360	91.00	0.15	0.26	44	15	283	5	19	100.8
0.26	27	49	0.7	1.5	ZTR519SPHV943_0910 EZ705U	67	133	3360	91.00	0.15	0.26	44	15	283	5	19	100.8
0.39	13	22	0.6	2.6	ZTR519SPHV943_0610 EZ703U	67	133	3360	61.00	0.22	0.39	44	15	284	5	19	100.8
0.39	18	33	0.8	2.0	ZTR519SPHV943_0610 EZ705U	67	133	3360	61.00	0.22	0.39	44	15	284	5	19	100.8
ZTR6PHV9 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 67 kN)																	
0.13	16	18	0.2	3.1	ZTR616SPHV943_1210 EZ701U	43	112	2178	121.0	0.11	0.20	44	15	285	6	16	101.9
0.13	26	31	0.4	1.9	ZTR616SPHV943_1210 EZ702U	67	112	3412	121.0	0.11	0.20	44	15	285	6	16	101.9
0.13	35	44	0.5	1.4	ZTR616SPHV943_1210 EZ703U	67	112	3412	121.0	0.11	0.20	44	15	285	6	16	101.9
0.13	46	65	0.7	1.1	ZTR616SPHV943_1210 EZ705U	67	112	3412	121.0	0.11	0.20	44	15	285	6	16	101.9
0.18	12	13	0.3	3.8	ZTR616SPHV943_0910 EZ701U	32	112	1638	91.00	0.15	0.26	44	15	288	6	16	101.9
0.18	19	23	0.4	2.3	ZTR616SPHV943_0910 EZ702U	66	112	3358	91.00	0.15	0.26	44	15	288	6	16	101.9
0.18	27	33	0.6	1.7	ZTR616SPHV943_0910 EZ703U	67	112	3412	91.00	0.15	0.26	44	15	288	6	16	101.9
0.18	34	49	0.8	1.3	ZTR616SPHV943_0910 EZ705U	67	112	3412	91.00	0.15	0.26	44	15	288	6	16	101.9
0.26	8.0	8.9	0.3	4.9	ZTR616SPHV943_0610 EZ701U	22	112	1098	61.00	0.22	0.39	44	15	289	6	16	101.9
0.26	13	16	0.5	3.0	ZTR616SPHV943_0610 EZ702U	44	112	2251	61.00	0.22	0.39	44	15	289	6	16	101.9
0.26	18	22	0.7	2.2	ZTR616SPHV943_0610 EZ703U	67	112	3412	61.00	0.22	0.39	44	15	289	6	16	101.9
0.26	23	33	1.0	1.7	ZTR616SPHV943_0610 EZ705U	67	112	3412	61.00	0.22	0.39	44	15	289	6	16	101.9
ZTR6PHV9 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 67 kN)																	
0.20	26	43	0.4	1.7	ZTR616SPHV943_1210 EZ703U	67	112	3412	121.0	0.11	0.20	44	15	285	6	16	101.9
0.20	35	64	0.6	1.2	ZTR616SPHV943_1210 EZ705U	67	112	3412	121.0	0.11	0.20	44	15	285	6	16	101.9
0.26	19	32	0.5	2.0	ZTR616SPHV943_0910 EZ703U	67	112	3412	91.00	0.15	0.26	44	15	288	6	16	101.9
0.26	26	48	0.7	1.5	ZTR616SPHV943_0910 EZ705U	67	112	3412	91.00	0.15	0.26	44	15	288	6	16	101.9
0.39	13	22	0.6	2.6	ZTR616SPHV943_0610 EZ703U	67	112	3412	61.00	0.22	0.39	44	15	289	6	16	101.9
0.39	18	32	0.8	1.9	ZTR616SPHV943_0610 EZ705U	67	112	3412	61.00	0.22	0.39	44	15	289	6	16	101.9

6.3 Dimensional drawings

This chapter shows you the dimensions of rack and pinion drives with EZ synchronous servo motors.

Dimension az in the tables of dimensions applies to STOBER gear racks. In general: az = ½ d0 + h0 + x*mn

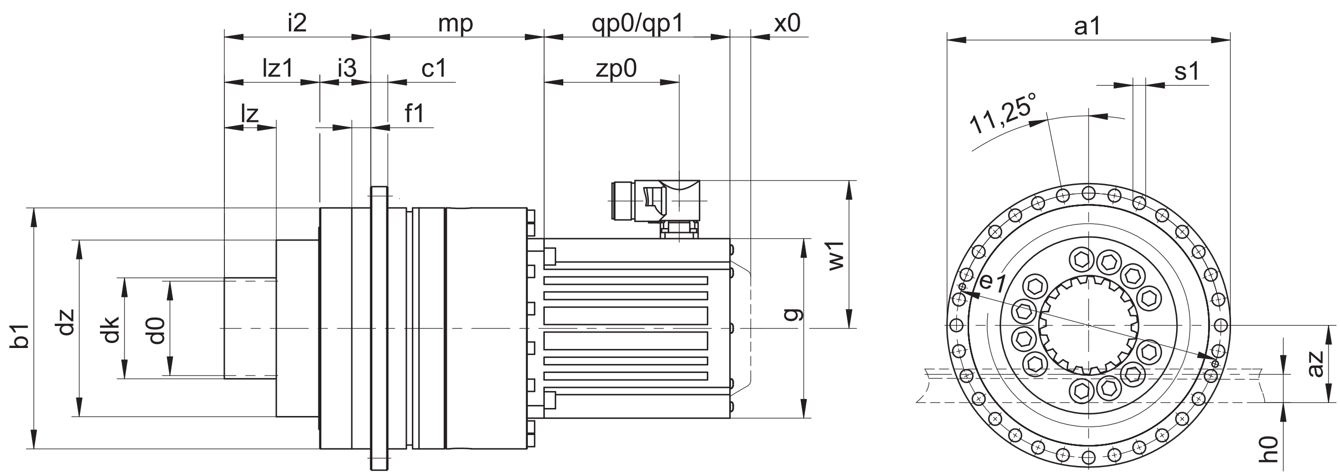
The pinion is helical (left-hand 19° 31' 42"). The pinion gearing quality is 5.

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 https://configurator.stoeber.de/en-US/.

Combination options and the dimensions of forced ventilated geared motors can also be found at https://configurator.stoeber.de/en-US/.



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x0	Applies to encoders using an optical measuring method.	w1	Different for the One Cable Solution (OCS), see the chapter [▸ 14.4]

Dimensions of gearboxes

Type	mn	∅a1	az	∅b1	c1	∅d0	∅dk	∅dz	∅e1	f1	h0	i2	i3	lz	lz1	∅s1	x
ZTR519SPHV9_	5	300	84.40	255_{h7}	18	100.80	110.8	187	280	20	34	155	54	55	101	13.5	0.00
ZTR616SPHV9_	6	300	93.93	255_{h7}	18	101.86	113.9	187	280	20	43	165	54	65	111	13.5	0.00

Dimensions of motors

Type	□g	qp0	qp1	w1	x0	zp0
EZ701U	145	102	161	115	22	64
EZ702U	145	127	186	115	22	89
EZ703U	145	152	211	115	22	114
EZ705U	145	207	266	134	22	165

Dimensions of geared motors

Type	EZ7 mp
ZTR_PHV943_	174

6.4 Type designation

In this chapter, you will find an explanation of the type designation with the associated options.

Additional ordering information not included in the type designation can be found at the end of the chapter.

Example code

Z	TR	6	16	S	PHV	9	4	3	S	F	S	S	0910	EZ703U

Explanation

Code	Designation	Design
Z	Type	Rack and pinion gearbox
TR	Design	Screwed flange pinion
6	Normal module	m_n = 6 mm (example)
16	Number of teeth	z = 16 (example)
S	Helix angle	Left-hand 19° 31' 42"
PHV	Type	Planetary gearbox
9	Size	9 (example)
4	Generation	Generation 4
3	Stages	Three-stage
S	Housing	Standard
F	Shaft	Flange shaft
S	Bearing	Standard bearing
V		Reinforced bearing (PH3 – PH5)
S	Backlash	Standard
R		Reduced (PHV9)
0910	Transmission ratio (i x 10)	i = 91 (example)
EZ703U	Motor	EZ synchronous servo motor

To complete the type designation, also specify the following in your order:

- A detailed type designation of the motor, see the chapter [▸ 14.5]
- Radial shaft seal rings at the output made of NBR or FKM (option), see the chapter [▸ 6.6.2]
- Radial runout ≤ 10 µm (optional)
- Reverse operation of the output shaft from ±20° to ±90° for horizontal installation on request

This catalog shows you all the information on rack and pinion drives with EZ synchronous servo motors. All input options available on request are shown in the chapter [▸ 6.5.1].

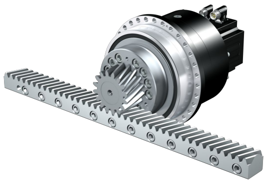
To make selecting your rack and pinion drive easy, use our STOBER Configurator at https://configurator.stoeber.de/en-US/.

A detailed description of the nameplate, see the chapter [▸ 14.5.1].

6.5 Product description

6.5.1 Input options

This chapter shows you all available input options:

EZ synchronous servo motor	Motor adapter
	
Catalog ID 443286_en	Catalog ID 443137_en

The corresponding catalogs can be found at http://www.stoeber.de/en/downloads/

Enter the ID of the catalog in the Search term field.

6.5.2 Gear rack

The gear rack used must have a right-hand design (19° 31' 42"); the load capacity must not be exceeded.

6.5.3 Installation conditions

The torque and force values listed in this catalog are valid under the following conditions:

- When the gear housing is fastened on the machine side using screws of strength class 12.9
- When the gear housings are adjusted at pilot øbz. The machine-side fit must be H7.

6.5.4 Lubricants

STOBER fills the gearboxes with the amount and type of lubricant specified on the nameplate.

You will receive lubricants for use in the food industry upon request.

6.5.4.1 Lubrication of rack and pinion gearbox

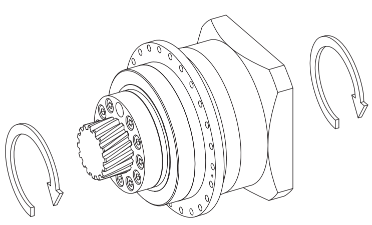
Ensure permanent lubrication with the lubricants recommended in the chapter [13.5.1].

6.5.5 Other product features

Feature	Value
Max. permitted gearbox temperature (on the surface of the gearbox)	≤ 90 °C
Paint	Black RAL 9005
(ATEX) Directive 2014/34/EU (Option)	Not suitable.
Protection class: [1]	
Planetary gearboxes	IP65
Motor	IP56, optionally IP66
Pinion/gear rack	IPXX

6.5.6 Direction of rotation

The input and output rotate in the same direction.



[1] Observe the protection class of all the components.

6.6 Project configuration

Project your drives using our SERVOsoft designing software. Download SERVOsoft free of charge after registration at https://www.stoeber.de/en/services/info-servosoft/.

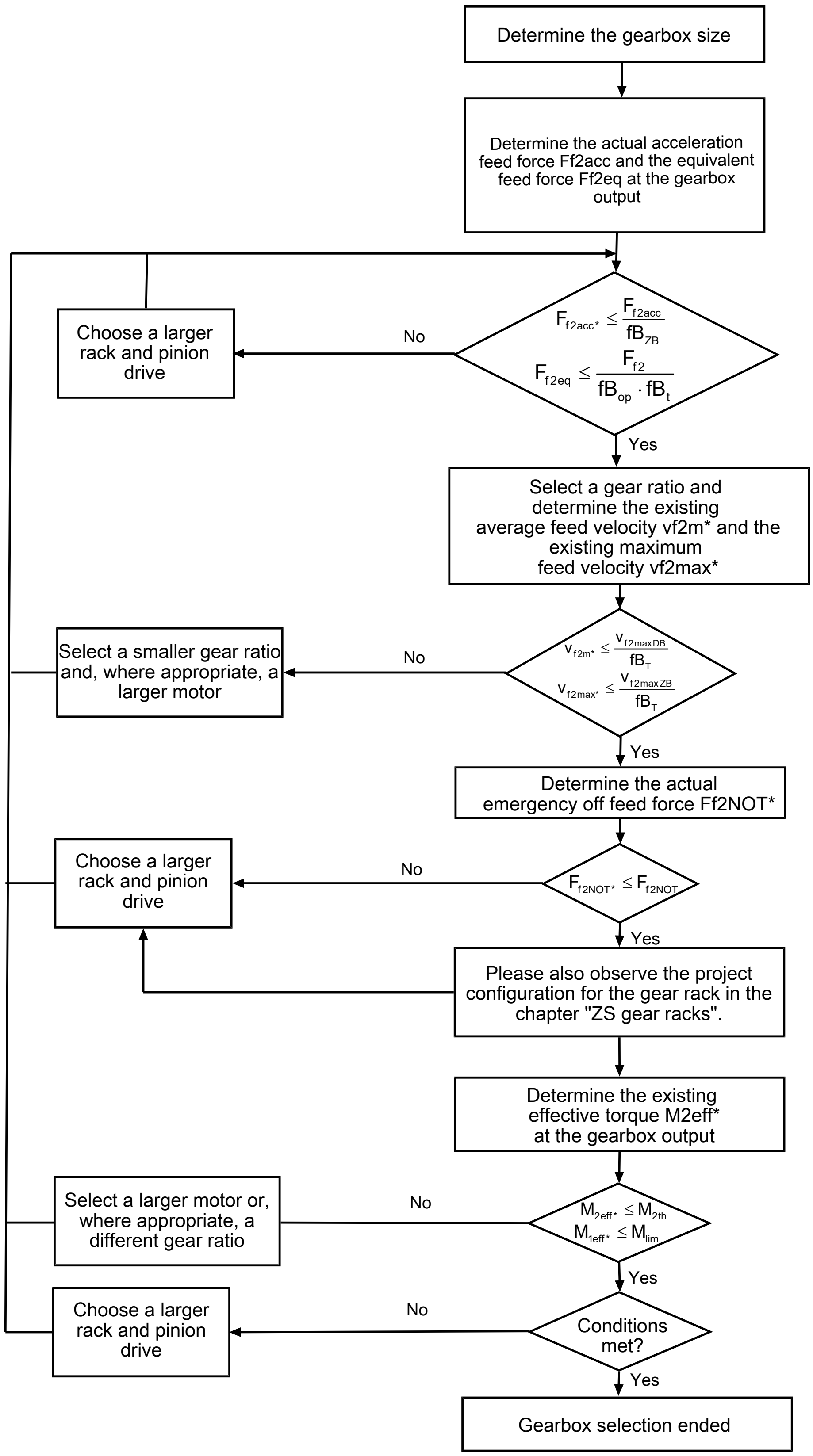
It is the most convenient and reliable method of drive selection, as the entire torque/speed curve of the application is displayed and evaluated here in the curve of the geared motor.

In this chapter, only limit values for specific operating points can be taken into consideration for manual drive selection.

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

An explanation of the formula symbols can be found in the chapter [▸ 17.1].

6.6.1 Drive selection

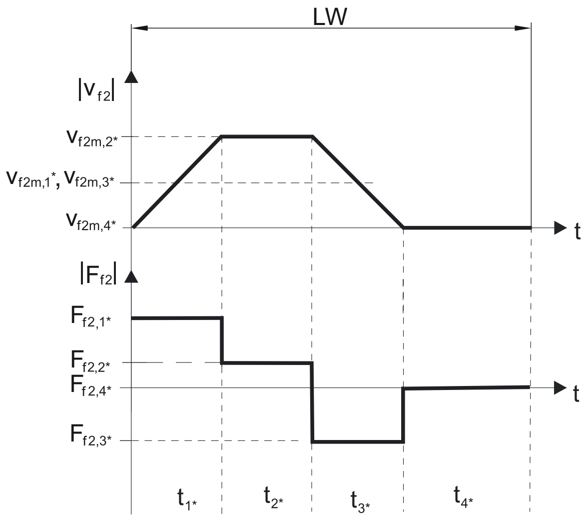


Refer to the selection tables for the values of i, $v_{f2maxDB}$, $v_{f2maxZB}$, F_{f2acc}, F_{f2N} and F_{f2NOT}.

The values for fB_T, fB_{op}, fB_t and fB_{ZB} can be found in the corresponding tables in this chapter.

Example of cyclic operation

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



Calculation of the actual maximum acceleration feed force

$$F_{f2acc^*} = m^* \cdot a^* + F_{L^*}$$

Calculation of the actual average input speed

$$n_{1m^*} = \frac{v_{f2m^*} \cdot i}{d_0 \cdot \pi}$$

$$v_{f2m^*} = \frac{\left|v_{f2m,1^*}\right| \cdot t_{1^*} + \ldots + \left|v_{f2m,n^*}\right| \cdot t_{n^*}}{t_{1^*} + \ldots + t_{n^*}}$$

If $t_{1^*} + \ldots + t_{3^*} \geq 6$ min, determine v_{2m^*} without the rest phase t_{4^*}.

The values for the ratio i can be found in the selection tables.

Calculation of the actual emergency off feed force

$$F_{f2NOT^*} = m^* \cdot a_{NOT^*} + F_{L^*}$$

Calculation of the actual equivalent feed force

$$F_{f2eq^*} = \sqrt[3]{\frac{\left|v_{f2m,1^*}\right| \cdot t_{1^*} \cdot \left|F_{f2,1^*}{}^3\right| + \ldots + \left|v_{f2m,n^*}\right| \cdot t_{n^*} \cdot \left|F_{f2,n^*}{}^3\right|}{\left|v_{f2m,1^*}\right| \cdot t_{1^*} + \ldots + \left|v_{f2m,n^*}\right| \cdot t_{n^*}}}$$

Calculation of the thermal limit torque

Calculate the thermal limit torque M_{2th} for a duty cycle $ED_{10} > 50\%$ and the actual average input speed n_{1m^*}. (At $K_{mot,th} \leq 0$ you must reduce the average input speed n_{1m^*} accordingly or select another geared motor size.)

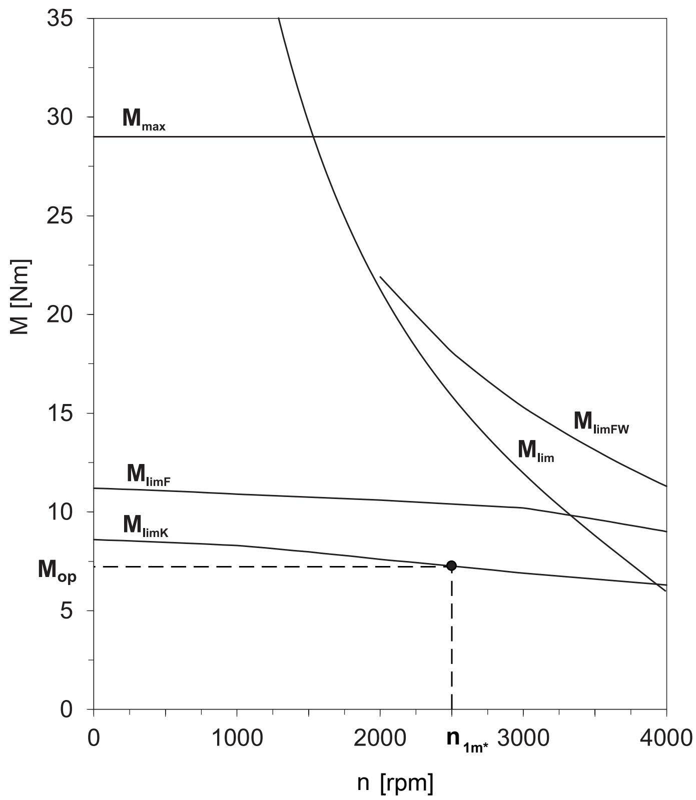
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

$$K_{mot,th} = 0{,}93 - \frac{a_{th}}{1000} \cdot fB_T \cdot \left(\frac{n_{1m^*}}{1000}\right)^3$$

Refer to the selection tables for the values of i and a_{th}.

The values for fB_T can be found in the corresponding table in this chapter.

The value for the torque of the motor at operating point M_{op} with the determined average input speed n_{1m*} can be found in the motor characteristic curve in the chapter Torque/speed curves. Note the size, nominal speed n_N and cooling type of the motor. The figure below shows an example of reading the torque M_{op} of a motor with convection cooling at the operating point.



Calculation of the actual effective torque

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

$$M_{2,n*} = \frac{F_{f2,n*} \cdot d_0}{2}$$

$$M_{1eff*} = \frac{M_{2eff*}}{i \cdot \eta}$$

Operating factors

Operating mode	fB_{op}
Uniform continuous operation	1.00
Cyclic operation	1.00
Reversing load cyclic operation	1.00

Run time	fB_t
Daily runtime ≤ 8 h	1.00
Daily runtime ≤ 16 h	1.15
Daily runtime ≤ 24 h	1.20

Cyclic operation	fB_{ZB}
≤ 1000 load changes/hour (LW/h)	1.00
> 1000 load changes/hour (LW/h)	1.15

Temperature		fB_T
Motor cooling	**Surrounding temperature**	
Motor with forced ventilation	≤ 20 °C	0.9
	≤ 30 °C	1.0
	≤ 40 °C	1.15
Motor with convection cooling	≤ 20 °C	1.0
	≤ 30 °C	1.1
	≤ 40 °C	1.25

Notes

- The maximum permitted gearbox temperature (see the "Other product features" chapter) must not be exceeded, as that could result in damage.
- For braking from full speed (for example, when the power fails or when setting up the machine), note the permitted gearbox feed forces (F_{f2acc}, F_{f2NOT}) in the selection tables.

6.6.2 Recommendation for radial shaft seal rings

For a duty cycle > 60% and higher surrounding temperatures, we recommend radial shaft seal rings made of FKM at the output.

Properties:

- Excellent temperature resistance
- High chemical stability
- Very good resistance to aging
- Excellent resistance in oils and greases
- For use in the food, beverage and pharmaceutical industries

Leak-proofness

Our gearboxes are equipped with high-quality radial shaft seal rings and checked for leaks. However, a leak cannot be fully ruled out over the length of use of a gearbox. If you use a gearbox with goods incompatible with the lubricant, you must take measures to prevent direct contact with the gearbox lubricant in case of a leak.

6.7 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 term field.

Documentation	ID
Operating manual gearboxes, geared motors PHV94 – PHV104	443355_en
Operating manual for EZ synchronous servo motors	443032_en
Operating manual gear racks	443392_en

7 ZRPH rack and pinion drives

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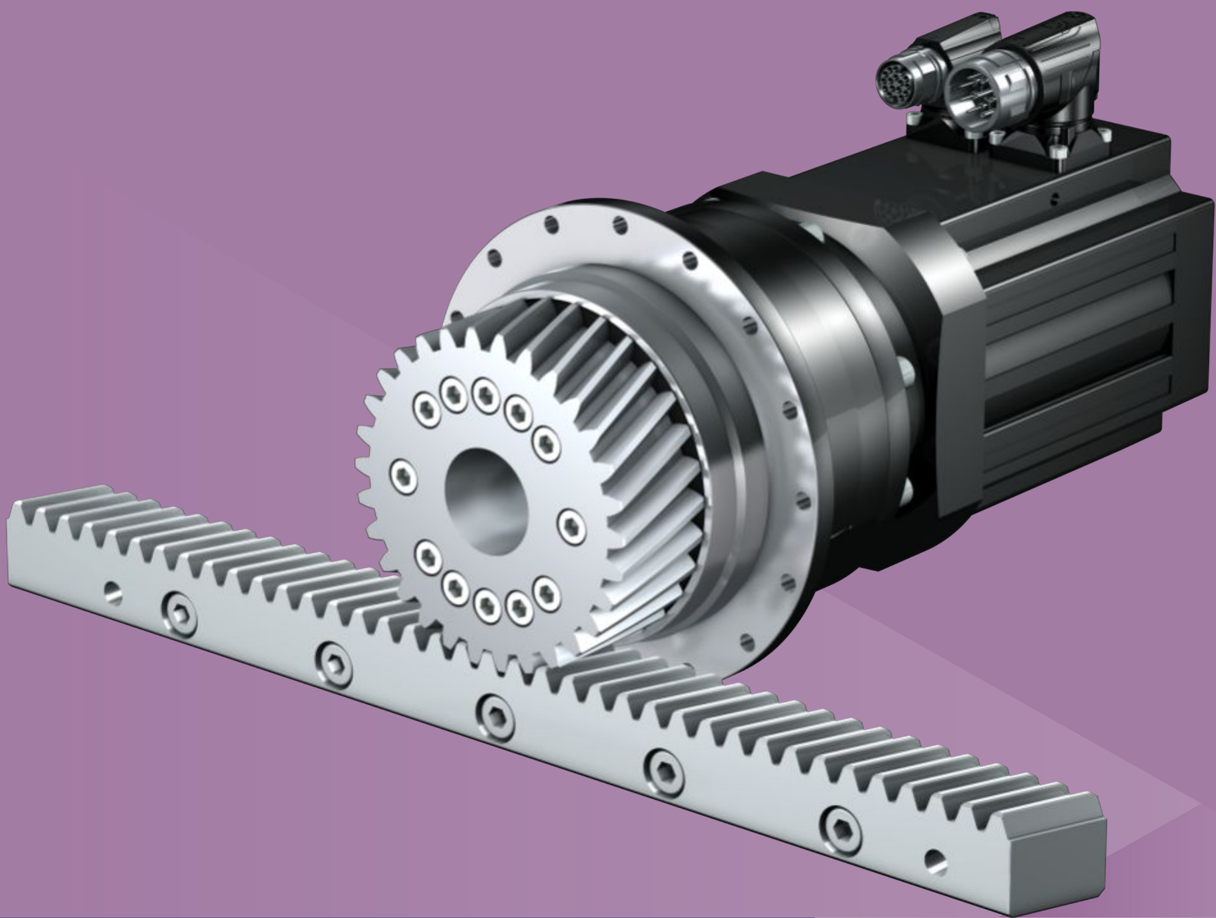


7 Rack and pinion drives

ZRPH

7.1 Overview

High Speed precision planetary geared motors with screwed pinion

Features

Power density	★★★☆☆
Linear clearance	★★★★★
Price category	€€€
Smooth operation	★★★★☆
Linear rigidity	★★★☆☆
Mass moment of inertia	★★★★☆
Ready-to-install drive solution	✓
Pinion gearing quality 5 (DIN 3962)	✓
Helical gearing	✓
Case-hardened and smoothed	✓
Reinforced output bearing (PH3 – PH5)	✓ (optional)
Compact and highly dynamic due to direct motor attachment	✓

Key ★☆☆☆☆ good | ★★★★★ excellent
€ Economy | €€€€€ Premium

Technical data

m_n	2 – 4 mm
z	30 – 40
F_{f2acc}	0.9 – 16 kN
v_{f2}	0.16 – 6.7 m/s
Δs	10 – 56 µm

7.2 Selection table

The technical data specified in the selection tables applies to:

- De-energized installation
- Permanent lubrication with the lubricants recommended in the chapter on gear racks [▶ 13.5.1]
- Case-hardened pinions, helical (left-hand 19° 31' 42"), gearing quality 5
- Installation altitudes up to 1000 m above sea level
- Surrounding temperatures from 0 °C to 40 °C
- Without consideration of the thermal limiting performance
- Drives with convection-cooled motors (e.g. EZ401**U**)

For the technical data on drives with forced ventilated motors (e.g. EZ401**B**), refer to https://configurator.stoeber.de/en-US/

For rack and pinion gearboxes with reduced backlash or reinforced bearings (PH3 – PH5), higher feed forces are possible. For this and all other technical data, refer to https://configurator.stoeber.de/en-US/.

An explanation of the formula symbols can be found in the chapter [▶ 17.1].

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZR2PH4 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 4,9 kN)																	
0.16	1.7	1.8	0.6	1.8	ZR233SPH432_0700 EZ301U	4.5	6.4	158	70.00	0.24	0.42	31	10	42	2	33	70.0
0.16	3.0	3.1	1.0	1.0	ZR233SPH432_0700 EZ302U	4.5	6.4	158	70.00	0.24	0.42	31	10	42	2	33	70.0
0.22	1.2	1.3	0.7	2.5	ZR233SPH432_0500 EZ301U	3.7	6.4	130	50.00	0.33	0.59	31	10	44	2	33	70.0
0.22	2.1	2.2	1.2	1.4	ZR233SPH432_0500 EZ302U	4.5	6.4	159	50.00	0.33	0.59	31	10	44	2	33	70.0
0.22	2.7	2.9	1.6	1.1	ZR233SPH432_0500 EZ303U	4.5	6.4	159	50.00	0.33	0.59	31	10	44	2	33	70.0
0.28	1.0	1.0	0.8	2.9	ZR233SPH432_0400 EZ301U	3.0	6.4	104	40.00	0.41	0.73	31	10	44	2	33	70.0
0.28	1.7	1.8	1.4	1.7	ZR233SPH432_0400 EZ302U	4.4	6.4	155	40.00	0.41	0.73	31	10	44	2	33	70.0
0.28	2.2	2.3	1.9	1.3	ZR233SPH432_0400 EZ303U	4.4	6.4	155	40.00	0.41	0.73	31	10	44	2	33	70.0
0.31	0.9	0.9	0.9	3.3	ZR233SPH432_0350 EZ301U	2.6	6.4	91	35.00	0.47	0.84	31	10	45	2	33	70.0
0.31	1.5	1.6	1.5	1.9	ZR233SPH432_0350 EZ302U	4.6	6.4	160	35.00	0.47	0.84	31	10	45	2	33	70.0
0.31	1.9	2.0	1.9	1.5	ZR233SPH432_0350 EZ303U	4.6	6.4	160	35.00	0.47	0.84	31	10	45	2	33	70.0
0.31	2.6	2.8	2.6	1.1	ZR233SPH432_0350 EZ401U	4.6	6.4	160	35.00	0.47	0.84	31	10	45	2	33	70.0
0.39	0.7	0.7	1.1	3.9	ZR233SPH432_0280 EZ301U	2.1	6.4	73	28.00	0.59	1.05	31	10	45	2	33	70.0
0.39	1.2	1.2	1.9	2.3	ZR233SPH432_0280 EZ302U	3.7	6.4	130	28.00	0.59	1.05	31	10	45	2	33	70.0
0.39	1.5	1.6	2.4	1.7	ZR233SPH432_0280 EZ303U	4.6	6.4	160	28.00	0.59	1.05	31	10	45	2	33	70.0
0.39	2.1	2.2	3.3	1.3	ZR233SPH432_0280 EZ401U	4.6	6.4	160	28.00	0.59	1.05	31	10	45	2	33	70.0
0.44	0.6	0.6	1.1	4.2	ZR233SPH432_0250 EZ301U	1.9	6.4	65	25.00	0.66	1.17	31	10	46	2	33	70.0
0.44	1.1	1.1	1.9	2.4	ZR233SPH432_0250 EZ302U	3.3	6.4	116	25.00	0.66	1.17	31	10	46	2	33	70.0
0.44	1.4	1.5	2.4	1.9	ZR233SPH432_0250 EZ303U	4.6	6.4	161	25.00	0.66	1.17	31	10	46	2	33	70.0
0.44	1.9	2.0	3.3	1.4	ZR233SPH432_0250 EZ401U	4.6	6.4	161	25.00	0.66	1.17	31	10	46	2	33	70.0
0.55	0.5	0.5	1.3	4.8	ZR233SPH432_0200 EZ301U	1.5	6.4	52	20.00	0.73	1.47	31	10	45	2	33	70.0
0.55	0.8	0.9	2.2	2.8	ZR233SPH432_0200 EZ302U	2.7	6.4	93	20.00	0.73	1.47	31	10	45	2	33	70.0
0.55	1.1	1.2	2.9	2.2	ZR233SPH432_0200 EZ303U	3.7	6.4	130	20.00	0.73	1.47	31	10	45	2	33	70.0
0.55	1.5	1.6	3.9	1.6	ZR233SPH432_0200 EZ401U	4.3	6.4	150	20.00	0.73	1.47	31	10	45	2	33	70.0
0.69	0.7	0.7	2.6	3.3	ZR233SPH432_0160 EZ302U	2.1	6.4	74	16.00	0.92	1.83	31	10	44	2	33	70.0
0.69	0.9	0.9	3.4	2.5	ZR233SPH432_0160 EZ303U	3.0	6.4	104	16.00	0.92	1.83	31	10	44	2	33	70.0
0.69	1.2	1.3	4.6	1.9	ZR233SPH432_0160 EZ401U	3.6	6.4	126	16.00	0.92	1.83	31	10	44	2	33	70.0
0.69	2.0	2.2	7.6	1.1	ZR233SPH432_0160 EZ402U	4.6	6.4	160	16.00	0.92	1.83	31	10	44	2	33	70.0
1.10	0.8	0.8	2.4	2.2	ZR233SPH431_0100 EZ401U	2.3	6.4	82	10.00	1.28	2.57	31	10	36	2	33	70.0
1.10	1.2	1.3	3.7	1.4	ZR233SPH431_0100 EZ501U	3.3	6.4	115	10.00	1.28	2.57	31	10	36	2	33	70.0
1.10	1.3	1.4	4.1	1.3	ZR233SPH431_0100 EZ402U	3.3	6.4	115	10.00	1.28	2.57	31	10	36	2	33	70.0
1.57	0.5	0.6	3.0	3.1	ZR233SPH431_0070 EZ401U	1.6	6.4	57	7.000	1.68	3.14	31	10	44	2	33	70.0
1.57	0.8	0.9	4.6	2.0	ZR233SPH431_0070 EZ501U	3.1	6.4	108	7.000	1.68	3.14	31	10	44	2	33	70.0
1.57	0.9	1.0	5.0	1.9	ZR233SPH431_0070 EZ402U	3.1	6.4	108	7.000	1.68	3.14	31	10	44	2	33	70.0
1.57	1.3	1.7	7.4	1.3	ZR233SPH431_0070 EZ404U	4.6	6.4	160	7.000	1.68	3.14	31	10	44	2	33	70.0
1.57	1.4	1.5	7.9	1.2	ZR233SPH431_0070 EZ502U	4.6	6.4	160	7.000	1.68	3.14	31	10	44	2	33	70.0
2.20	0.4	0.4	4.5	3.9	ZR233SPH431_0050 EZ401U	1.2	6.4	41	5.000	2.20	4.40	31	10	48	2	33	70.0
2.20	0.6	0.6	6.9	2.6	ZR233SPH431_0050 EZ501U	2.2	6.4	77	5.000	2.20	4.40	31	10	48	2	33	70.0
2.20	0.6	0.7	7.5	2.3	ZR233SPH431_0050 EZ402U	2.2	6.4	77	5.000	2.20	4.40	31	10	48	2	33	70.0
2.20	0.9	1.2	11	1.6	ZR233SPH431_0050 EZ404U	4.0	6.4	139	5.000	2.20	4.40	31	10	48	2	33	70.0
2.20	1.0	1.1	12	1.5	ZR233SPH431_0050 EZ502U	4.2	6.4	149	5.000	2.20	4.40	31	10	48	2	33	70.0
2.20	1.3	1.5	16	1.1	ZR233SPH431_0050 EZ503U	4.9	6.4	172	5.000	2.20	4.40	31	10	48	2	33	70.0
2.75	0.3	0.3	5.9	4.5	ZR233SPH431_0040 EZ401U	0.9	6.4	33	4.000	2.38	4.58	31	10	50	2	33	70.0
2.75	0.5	0.5	9.0	3.0	ZR233SPH431_0040 EZ501U	1.8	6.4	61	4.000	2.38	4.58	31	10	50	2	33	70.0
2.75	0.5	0.6	9.8	2.7	ZR233SPH431_0040 EZ402U	1.8	6.4	61	4.000	2.38	4.58	31	10	50	2	33	70.0
2.75	0.8	0.9	14	1.8	ZR233SPH431_0040 EZ404U	3.2	6.4	111	4.000	2.38	4.58	31	10	50	2	33	70.0

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZR2PH4 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 4,9 kN)																	
2.75	0.8	0.9	15	1.7	ZR233SPH431_0040 EZ502U	3.4	6.4	119	4.000	2.38	4.58	31	10	50	2	33	70.0
2.75	1.1	1.2	20	1.3	ZR233SPH431_0040 EZ503U	3.9	6.4	136	4.000	2.38	4.58	31	10	50	2	33	70.0
ZR2PH4 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 4,9 kN)																	
3.30	1.3	2.1	17	1.0	ZR233SPH431_0050 EZ505U	4.9	6.4	172	5.000	2.20	4.40	31	10	48	2	33	70.0
4.13	1.0	1.7	23	1.2	ZR233SPH431_0040 EZ505U	3.9	6.4	136	4.000	2.38	4.58	31	10	50	2	33	70.0
ZR2PH4 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 4,9 kN)																	
0.31	1.7	1.8	0.7	1.5	ZR233SPH432_0700 EZ301U	4.5	6.4	158	70.00	0.24	0.42	31	10	42	2	33	70.0
0.44	1.2	1.3	0.9	2.1	ZR233SPH432_0500 EZ301U	3.7	6.4	130	50.00	0.33	0.59	31	10	44	2	33	70.0
0.44	2.0	2.2	1.5	1.2	ZR233SPH432_0500 EZ302U	4.5	6.4	159	50.00	0.33	0.59	31	10	44	2	33	70.0
0.55	0.9	1.0	1.0	2.4	ZR233SPH432_0400 EZ301U	3.0	6.4	104	40.00	0.41	0.73	31	10	44	2	33	70.0
0.55	1.6	1.8	1.7	1.4	ZR233SPH432_0400 EZ302U	4.4	6.4	155	40.00	0.41	0.73	31	10	44	2	33	70.0
0.55	2.1	2.4	2.2	1.1	ZR233SPH432_0400 EZ303U	4.4	6.4	155	40.00	0.41	0.73	31	10	44	2	33	70.0
0.63	0.8	0.9	1.0	2.8	ZR233SPH432_0350 EZ301U	2.6	6.4	91	35.00	0.47	0.84	31	10	45	2	33	70.0
0.63	1.4	1.6	1.7	1.6	ZR233SPH432_0350 EZ302U	4.6	6.4	160	35.00	0.47	0.84	31	10	45	2	33	70.0
0.63	1.8	2.1	2.3	1.3	ZR233SPH432_0350 EZ303U	4.6	6.4	160	35.00	0.47	0.84	31	10	45	2	33	70.0
0.63	2.1	2.6	2.7	1.1	ZR233SPH432_0350 EZ401U	4.6	6.4	160	35.00	0.47	0.84	31	10	45	2	33	70.0
0.79	0.7	0.7	1.2	3.2	ZR233SPH432_0280 EZ301U	2.1	6.4	73	28.00	0.59	1.05	31	10	45	2	33	70.0
0.79	1.1	1.2	2.0	1.9	ZR233SPH432_0280 EZ302U	3.7	6.4	130	28.00	0.59	1.05	31	10	45	2	33	70.0
0.79	1.5	1.7	2.6	1.5	ZR233SPH432_0280 EZ303U	4.6	6.4	160	28.00	0.59	1.05	31	10	45	2	33	70.0
0.79	1.7	2.1	3.0	1.2	ZR233SPH432_0280 EZ401U	4.6	6.4	160	28.00	0.59	1.05	31	10	45	2	33	70.0
0.88	0.6	0.6	1.2	3.5	ZR233SPH432_0250 EZ301U	1.9	6.4	65	25.00	0.66	1.17	31	10	46	2	33	70.0
0.88	1.0	1.1	2.1	2.0	ZR233SPH432_0250 EZ302U	3.3	6.4	116	25.00	0.66	1.17	31	10	46	2	33	70.0
0.88	1.3	1.5	2.7	1.6	ZR233SPH432_0250 EZ303U	4.6	6.4	161	25.00	0.66	1.17	31	10	46	2	33	70.0
0.88	1.5	1.9	3.2	1.3	ZR233SPH432_0250 EZ401U	4.6	6.4	161	25.00	0.66	1.17	31	10	46	2	33	70.0
1.10	0.5	0.5	1.4	4.0	ZR233SPH432_0200 EZ301U	1.5	6.4	52	20.00	0.73	1.47	31	10	45	2	33	70.0
1.10	0.8	0.9	2.3	2.4	ZR233SPH432_0200 EZ302U	2.7	6.4	93	20.00	0.73	1.47	31	10	45	2	33	70.0
1.10	1.0	1.2	3.0	1.8	ZR233SPH432_0200 EZ303U	3.7	6.4	130	20.00	0.73	1.47	31	10	45	2	33	70.0
1.10	1.2	1.5	3.5	1.6	ZR233SPH432_0200 EZ401U	4.3	6.4	150	20.00	0.73	1.47	31	10	45	2	33	70.0
1.10	1.9	2.6	5.4	1.0	ZR233SPH432_0200 EZ402U	4.3	6.4	150	20.00	0.73	1.47	31	10	45	2	33	70.0
1.38	0.4	0.4	1.7	4.6	ZR233SPH432_0160 EZ301U	1.2	6.4	42	16.00	0.92	1.83	31	10	44	2	33	70.0
1.38	0.6	0.7	2.8	2.8	ZR233SPH432_0160 EZ302U	2.1	6.4	74	16.00	0.92	1.83	31	10	44	2	33	70.0
1.38	0.8	1.0	3.6	2.1	ZR233SPH432_0160 EZ303U	3.0	6.4	104	16.00	0.92	1.83	31	10	44	2	33	70.0
1.38	1.0	1.2	4.3	1.8	ZR233SPH432_0160 EZ401U	3.6	6.4	126	16.00	0.92	1.83	31	10	44	2	33	70.0
1.38	1.5	2.1	6.5	1.2	ZR233SPH432_0160 EZ402U	4.6	6.4	160	16.00	0.92	1.83	31	10	44	2	33	70.0
2.20	0.6	0.8	2.5	2.1	ZR233SPH431_0100 EZ401U	2.3	6.4	82	10.00	1.28	2.57	31	10	36	2	33	70.0
2.20	0.9	1.2	3.7	1.4	ZR233SPH431_0100 EZ501U	3.3	6.4	115	10.00	1.28	2.57	31	10	36	2	33	70.0
2.20	1.0	1.3	3.8	1.4	ZR233SPH431_0100 EZ402U	3.3	6.4	115	10.00	1.28	2.57	31	10	36	2	33	70.0
3.14	0.4	0.5	3.1	3.0	ZR233SPH431_0070 EZ401U	1.6	6.4	57	7.000	1.68	3.14	31	10	44	2	33	70.0
3.14	0.7	0.8	4.6	2.0	ZR233SPH431_0070 EZ501U	3.1	6.4	108	7.000	1.68	3.14	31	10	44	2	33	70.0
3.14	0.7	0.9	4.7	2.0	ZR233SPH431_0070 EZ402U	3.1	6.4	108	7.000	1.68	3.14	31	10	44	2	33	70.0
3.14	1.0	1.5	7.0	1.3	ZR233SPH431_0070 EZ502U	4.6	6.4	160	7.000	1.68	3.14	31	10	44	2	33	70.0
3.14	1.1	1.6	7.8	1.2	ZR233SPH431_0070 EZ404U	4.6	6.4	160	7.000	1.68	3.14	31	10	44	2	33	70.0
3.14	1.2	2.0	8.4	1.1	ZR233SPH431_0070 EZ503U	4.6	6.4	160	7.000	1.68	3.14	31	10	44	2	33	70.0
4.40	0.3	0.4	4.6	3.8	ZR233SPH431_0050 EZ401U	1.2	6.4	41	5.000	2.20	4.40	31	10	48	2	33	70.0
4.40	0.5	0.6	6.9	2.6	ZR233SPH431_0050 EZ501U	2.2	6.4	77	5.000	2.20	4.40	31	10	48	2	33	70.0
4.40	0.5	0.7	7.1	2.5	ZR233SPH431_0050 EZ402U	2.2	6.4	77	5.000	2.20	4.40	31	10	48	2	33	70.0
4.40	0.7	1.1	10	1.7	ZR233SPH431_0050 EZ502U	4.2	6.4	149	5.000	2.20	4.40	31	10	48	2	33	70.0
4.40	0.8	1.2	12	1.5	ZR233SPH431_0050 EZ404U	4.0	6.4	139	5.000	2.20	4.40	31	10	48	2	33	70.0
4.40	0.8	1.5	13	1.4	ZR233SPH431_0050 EZ503U	4.9	6.4	172	5.000	2.20	4.40	31	10	48	2	33	70.0
ZR2PH5 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 8,1 kN)																	
0.19	4.3	4.6	0.8	1.2	ZR240SPH532_0700 EZ401U	8.1	10	345	70.00	0.25	0.51	37	12	69	2	40	84.9
0.27	3.1	3.3	1.0	1.5	ZR240SPH532_0500 EZ401U	8.1	10	345	50.00	0.36	0.71	37	12	73	2	40	84.9
0.33	2.5	2.6	1.4	1.8	ZR240SPH532_0400 EZ401U	7.5	10	316	40.00	0.44	0.89	37	12	70	2	40	84.9
0.33	3.8	4.1	2.1	1.1	ZR240SPH532_0400 EZ501U	8.1	10	345	40.00	0.44	0.89	37	12	70	2	40	84.9
0.33	4.1	4.6	2.3	1.0	ZR240SPH532_0400 EZ402U	8.1	10	345	40.00	0.44	0.89	37	12	70	2	40	84.9
0.38	2.1	2.3	1.2	1.9	ZR240SPH532_0350 EZ401U	6.5	10	277	35.00	0.51	1.02	37	12	75	2	40	84.9
0.38	3.3	3.6	1.8	1.2	ZR240SPH532_0350 EZ501U	8.1	10	345	35.00	0.51	1.02	37	12	75	2	40	84.9
0.38	3.6	4.0	2.0	1.1	ZR240SPH532_0350 EZ402U	8.1	10	345	35.00	0.51	1.02	37	12	75	2	40	84.9
0.48	1.7	1.8	1.4	2.2	ZR240SPH532_0280 EZ401U	5.2	10	221	28.00	0.64	1.27	37	12	73	2	40	84.9
0.48	2.6	2.9	2.2	1.4	ZR240SPH532_0280 EZ501U	8.1	10	345	28.00	0.64	1.27	37	12	73	2	40	84.9
0.48	2.9	3.2	2.4	1.3	ZR240SPH532_0280 EZ402U	8.1	10	345	28.00	0.64	1.27	37	12	73	2	40	84.9
0.53	1.5	1.6	1.4	2.4	ZR240SPH532_0250 EZ401U	4.7	10	198	25.00	0.66	1.33	37	12	75	2	40	84.9
0.53	2.4	2.6	2.2	1.6	ZR240SPH532_0250 EZ501U	8.1	10	345	25.00	0.66	1.33	37	12	75	2	40	84.9
0.53	2.6	2.8	2.4	1.4	ZR240SPH532_0250 EZ402U	8.1	10	345	25.00	0.66	1.33	37	12	75	2	40	84.9
0.67	1.2	1.3	1.6	2.8	ZR240SPH532_0200 EZ401U	3.7	10	158	20.00	0.78	1.56	37	12	75	2	40	84.9
0.67	1.9	2.1	2.5	1.8	ZR240SPH532_0200 EZ501U	7.0	10	298	20.00	0.78	1.56	37	12	75	2	40	84.9

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZR2PH5 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 8,1 kN)																	
0.67	2.1	2.3	2.7	1.7	ZR240SPH532_0200 EZ402U	7.0	10	298	20.00	0.78	1.56	37	12	75	2	40	84.9
0.67	3.0	3.8	4.0	1.1	ZR240SPH532_0200 EZ404U	8.1	10	345	20.00	0.78	1.56	37	12	75	2	40	84.9
0.67	3.2	3.5	4.3	1.1	ZR240SPH532_0200 EZ502U	8.1	10	345	20.00	0.78	1.56	37	12	75	2	40	84.9
0.83	1.0	1.1	2.0	3.2	ZR240SPH532_0160 EZ401U	3.0	10	126	16.00	0.97	1.94	37	12	74	2	40	84.9
0.83	1.5	1.6	3.0	2.1	ZR240SPH532_0160 EZ501U	5.6	10	238	16.00	0.97	1.94	37	12	74	2	40	84.9
0.83	1.6	1.8	3.3	1.9	ZR240SPH532_0160 EZ402U	5.6	10	238	16.00	0.97	1.94	37	12	74	2	40	84.9
0.83	2.4	3.0	4.9	1.3	ZR240SPH532_0160 EZ404U	8.1	10	345	16.00	0.97	1.94	37	12	74	2	40	84.9
0.83	2.6	2.8	5.2	1.2	ZR240SPH532_0160 EZ502U	8.1	10	345	16.00	0.97	1.94	37	12	74	2	40	84.9
1.33	1.0	1.1	1.7	2.8	ZR240SPH531_0100 EZ501U	3.6	10	154	10.00	1.47	2.89	37	12	59	2	40	84.9
1.33	1.7	1.8	3.0	1.6	ZR240SPH531_0100 EZ502U	6.8	10	288	10.00	1.47	2.89	37	12	59	2	40	84.9
1.33	1.7	1.9	3.0	1.6	ZR240SPH531_0100 EZ701U	4.5	10	192	10.00	1.47	2.89	37	12	59	2	40	84.9
1.33	2.2	2.5	3.9	1.2	ZR240SPH531_0100 EZ503U	6.8	10	288	10.00	1.47	2.89	37	12	59	2	40	84.9
1.91	0.7	0.7	2.1	3.5	ZR240SPH531_0070 EZ501U	2.5	10	108	7.000	1.91	3.81	37	12	71	2	40	84.9
1.91	1.2	1.3	3.6	2.1	ZR240SPH531_0070 EZ502U	4.9	10	208	7.000	1.91	3.81	37	12	71	2	40	84.9
1.91	1.2	1.3	3.6	2.1	ZR240SPH531_0070 EZ701U	3.2	10	134	7.000	1.91	3.81	37	12	71	2	40	84.9
1.91	1.5	1.8	4.7	1.6	ZR240SPH531_0070 EZ503U	6.8	10	289	7.000	1.91	3.81	37	12	71	2	40	84.9
1.91	1.9	2.3	5.8	1.3	ZR240SPH531_0070 EZ702U	6.5	10	276	7.000	1.91	3.81	37	12	71	2	40	84.9
1.91	2.1	2.5	6.5	1.1	ZR240SPH531_0070 EZ505U	8.1	10	345	7.000	1.91	3.81	37	12	71	2	40	84.9
2.67	0.5	0.5	3.1	4.4	ZR240SPH531_0050 EZ501U	1.8	10	77	5.000	2.22	4.89	37	12	80	2	40	84.9
2.67	0.8	0.9	5.3	2.6	ZR240SPH531_0050 EZ502U	3.5	10	149	5.000	2.22	4.89	37	12	80	2	40	84.9
2.67	0.8	0.9	5.3	2.6	ZR240SPH531_0050 EZ701U	2.3	10	96	5.000	2.22	4.89	37	12	80	2	40	84.9
2.67	1.1	1.3	7.0	2.0	ZR240SPH531_0050 EZ503U	4.9	10	206	5.000	2.22	4.89	37	12	80	2	40	84.9
2.67	1.4	1.6	8.6	1.6	ZR240SPH531_0050 EZ702U	4.6	10	197	5.000	2.22	4.89	37	12	80	2	40	84.9
2.67	1.5	1.8	9.7	1.4	ZR240SPH531_0050 EZ505U	7.6	10	322	5.000	2.22	4.89	37	12	80	2	40	84.9
2.67	1.9	2.4	12	1.2	ZR240SPH531_0050 EZ703U	7.4	10	312	5.000	2.22	4.89	37	12	80	2	40	84.9
3.33	0.7	0.7	7.0	3.0	ZR240SPH531_0040 EZ502U	2.8	10	119	4.000	2.44	5.56	37	12	81	2	40	84.9
3.33	0.7	0.8	7.0	3.0	ZR240SPH531_0040 EZ701U	1.8	10	77	4.000	2.44	5.56	37	12	81	2	40	84.9
3.33	0.9	1.0	9.1	2.3	ZR240SPH531_0040 EZ503U	3.9	10	165	4.000	2.44	5.56	37	12	81	2	40	84.9
3.33	1.1	1.3	11	1.8	ZR240SPH531_0040 EZ702U	3.7	10	157	4.000	2.44	5.56	37	12	81	2	40	84.9
3.33	1.2	1.4	13	1.6	ZR240SPH531_0040 EZ505U	6.1	10	257	4.000	2.44	5.56	37	12	81	2	40	84.9
3.33	1.5	1.9	16	1.3	ZR240SPH531_0040 EZ703U	5.9	10	250	4.000	2.44	5.56	37	12	81	2	40	84.9
3.33	1.9	2.7	20	1.0	ZR240SPH531_0040 EZ705U	8.1	10	345	4.000	2.44	5.56	37	12	81	2	40	84.9
ZR2PH5 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 8,1 kN)																	
2.00	2.1	3.5	4.4	1.1	ZR240SPH531_0100 EZ505U	6.8	10	288	10.00	1.47	2.89	37	12	59	2	40	84.9
2.86	1.5	2.4	5.2	1.4	ZR240SPH531_0070 EZ505U	8.1	10	345	7.000	1.91	3.81	37	12	71	2	40	84.9
2.86	1.9	3.2	6.7	1.1	ZR240SPH531_0070 EZ703U	8.1	10	345	7.000	1.91	3.81	37	12	71	2	40	84.9
4.00	1.1	1.7	7.8	1.8	ZR240SPH531_0050 EZ505U	7.6	10	322	5.000	2.22	4.89	37	12	80	2	40	84.9
4.00	1.4	2.3	10	1.4	ZR240SPH531_0050 EZ703U	7.4	10	312	5.000	2.22	4.89	37	12	80	2	40	84.9
4.00	1.9	3.4	14	1.0	ZR240SPH531_0050 EZ705U	8.1	10	345	5.000	2.22	4.89	37	12	80	2	40	84.9
5.00	0.9	1.4	10	2.0	ZR240SPH531_0040 EZ505U	6.1	10	257	4.000	2.44	5.56	37	12	81	2	40	84.9
5.00	1.1	1.8	13	1.6	ZR240SPH531_0040 EZ703U	5.9	10	250	4.000	2.44	5.56	37	12	81	2	40	84.9
5.00	1.5	2.7	18	1.2	ZR240SPH531_0040 EZ705U	8.1	10	345	4.000	2.44	5.56	37	12	81	2	40	84.9
ZR2PH5 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 8,1 kN)																	
0.38	3.5	4.3	0.9	1.2	ZR240SPH532_0700 EZ401U	8.1	10	345	70.00	0.25	0.51	37	12	69	2	40	84.9
0.53	2.5	3.1	1.0	1.5	ZR240SPH532_0500 EZ401U	8.1	10	345	50.00	0.36	0.71	37	12	73	2	40	84.9
0.67	2.0	2.5	1.4	1.7	ZR240SPH532_0400 EZ401U	7.5	10	316	40.00	0.44	0.89	37	12	70	2	40	84.9
0.67	3.0	3.9	2.1	1.1	ZR240SPH532_0400 EZ501U	8.1	10	345	40.00	0.44	0.89	37	12	70	2	40	84.9
0.67	3.1	4.3	2.2	1.1	ZR240SPH532_0400 EZ402U	8.1	10	345	40.00	0.44	0.89	37	12	70	2	40	84.9
0.76	1.8	2.1	1.2	1.9	ZR240SPH532_0350 EZ401U	6.5	10	277	35.00	0.51	1.02	37	12	75	2	40	84.9
0.76	2.6	3.4	1.8	1.3	ZR240SPH532_0350 EZ501U	8.1	10	345	35.00	0.51	1.02	37	12	75	2	40	84.9
0.76	2.7	3.8	1.8	1.2	ZR240SPH532_0350 EZ402U	8.1	10	345	35.00	0.51	1.02	37	12	75	2	40	84.9
0.95	1.4	1.7	1.4	2.2	ZR240SPH532_0280 EZ401U	5.2	10	221	28.00	0.64	1.27	37	12	73	2	40	84.9
0.95	2.1	2.7	2.1	1.5	ZR240SPH532_0280 EZ501U	8.1	10	345	28.00	0.64	1.27	37	12	73	2	40	84.9
0.95	2.1	3.0	2.1	1.4	ZR240SPH532_0280 EZ402U	8.1	10	345	28.00	0.64	1.27	37	12	73	2	40	84.9
1.07	1.3	1.5	1.4	2.3	ZR240SPH532_0250 EZ401U	4.7	10	198	25.00	0.66	1.33	37	12	75	2	40	84.9
1.07	1.9	2.4	2.1	1.6	ZR240SPH532_0250 EZ501U	8.1	10	345	25.00	0.66	1.33	37	12	75	2	40	84.9
1.07	1.9	2.7	2.2	1.5	ZR240SPH532_0250 EZ402U	8.1	10	345	25.00	0.66	1.33	37	12	75	2	40	84.9
1.07	2.8	4.3	3.2	1.0	ZR240SPH532_0250 EZ502U	8.1	10	345	25.00	0.66	1.33	37	12	75	2	40	84.9
1.33	1.0	1.2	1.6	2.7	ZR240SPH532_0200 EZ401U	3.7	10	158	20.00	0.78	1.56	37	12	75	2	40	84.9
1.33	1.5	1.9	2.4	1.8	ZR240SPH532_0200 EZ501U	7.0	10	298	20.00	0.78	1.56	37	12	75	2	40	84.9
1.33	1.5	2.1	2.4	1.8	ZR240SPH532_0200 EZ402U	7.0	10	298	20.00	0.78	1.56	37	12	75	2	40	84.9
1.33	2.3	3.4	3.6	1.2	ZR240SPH532_0200 EZ502U	8.1	10	345	20.00	0.78	1.56	37	12	75	2	40	84.9
1.33	2.5	3.7	4.0	1.1	ZR240SPH532_0200 EZ404U	8.1	10	345	20.00	0.78	1.56	37	12	75	2	40	84.9
1.67	0.8	1.0	1.9	3.1	ZR240SPH532_0160 EZ401U	3.0	10	126	16.00	0.97	1.94	37	12	74	2	40	84.9
1.67	1.2	1.5	2.8	2.1	ZR240SPH532_0160 EZ501U	5.6	10	238	16.00	0.97	1.94	37	12	74	2	40	84.9
1.67	1.2	1.7	2.9	2.1	ZR240SPH532_0160 EZ402U	5.6	10	238	16.00	0.97	1.94	37	12	74	2	40	84.9

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZR2PH5 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 8,1 kN)																	
1.67	1.8	2.7	4.3	1.4	ZR240SPH532_0160 EZ502U	8.1	10	345	16.00	0.97	1.94	37	12	74	2	40	84.9
1.67	2.0	2.9	4.8	1.2	ZR240SPH532_0160 EZ404U	8.1	10	345	16.00	0.97	1.94	37	12	74	2	40	84.9
1.67	2.2	3.7	5.2	1.2	ZR240SPH532_0160 EZ503U	8.1	10	345	16.00	0.97	1.94	37	12	74	2	40	84.9
2.67	0.8	1.0	1.7	2.8	ZR240SPH531_0100 EZ501U	3.6	10	154	10.00	1.47	2.89	37	12	59	2	40	84.9
2.67	1.2	1.8	2.6	1.8	ZR240SPH531_0100 EZ502U	6.8	10	288	10.00	1.47	2.89	37	12	59	2	40	84.9
2.67	1.2	1.8	2.6	1.8	ZR240SPH531_0100 EZ701U	4.5	10	192	10.00	1.47	2.89	37	12	59	2	40	84.9
2.67	1.4	2.4	3.1	1.5	ZR240SPH531_0100 EZ503U	6.8	10	288	10.00	1.47	2.89	37	12	59	2	40	84.9
2.67	1.6	3.2	3.7	1.3	ZR240SPH531_0100 EZ702U	6.8	10	288	10.00	1.47	2.89	37	12	59	2	40	84.9
3.81	0.5	0.7	2.1	3.6	ZR240SPH531_0070 EZ501U	2.5	10	108	7.000	1.91	3.81	37	12	71	2	40	84.9
3.81	0.8	1.2	3.2	2.3	ZR240SPH531_0070 EZ502U	4.9	10	208	7.000	1.91	3.81	37	12	71	2	40	84.9
3.81	0.8	1.3	3.2	2.3	ZR240SPH531_0070 EZ701U	3.2	10	134	7.000	1.91	3.81	37	12	71	2	40	84.9
3.81	1.0	1.7	3.8	1.9	ZR240SPH531_0070 EZ503U	6.8	10	289	7.000	1.91	3.81	37	12	71	2	40	84.9
3.81	1.1	2.3	4.4	1.7	ZR240SPH531_0070 EZ702U	6.5	10	276	7.000	1.91	3.81	37	12	71	2	40	84.9
ZR3PH5 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 7,7 kN)																	
0.21	3.8	4.1	0.8	1.3	ZR330SPH532_0700 EZ401U	7.7	9.6	368	70.00	0.29	0.57	42	14	55	3	30	95.5
0.30	2.7	2.9	1.0	1.7	ZR330SPH532_0500 EZ401U	7.7	9.6	368	50.00	0.40	0.80	42	14	58	3	30	95.5
0.30	4.2	4.6	1.6	1.1	ZR330SPH532_0500 EZ501U	7.7	9.6	368	50.00	0.40	0.80	42	14	58	3	30	95.5
0.38	2.2	2.3	1.4	1.9	ZR330SPH532_0400 EZ401U	6.6	9.6	316	40.00	0.50	1.00	42	14	56	3	30	95.5
0.38	3.4	3.7	2.1	1.3	ZR330SPH532_0400 EZ501U	7.4	9.6	355	40.00	0.50	1.00	42	14	56	3	30	95.5
0.38	3.7	4.1	2.3	1.2	ZR330SPH532_0400 EZ402U	7.4	9.6	355	40.00	0.50	1.00	42	14	56	3	30	95.5
0.43	1.9	2.0	1.2	2.1	ZR330SPH532_0350 EZ401U	5.8	9.6	277	35.00	0.57	1.14	42	14	60	3	30	95.5
0.43	2.9	3.2	1.8	1.4	ZR330SPH532_0350 EZ501U	7.7	9.6	368	35.00	0.57	1.14	42	14	60	3	30	95.5
0.43	3.2	3.5	2.0	1.3	ZR330SPH532_0350 EZ402U	7.7	9.6	368	35.00	0.57	1.14	42	14	60	3	30	95.5
0.54	1.5	1.6	1.4	2.5	ZR330SPH532_0280 EZ401U	4.6	9.6	221	28.00	0.71	1.43	42	14	58	3	30	95.5
0.54	2.3	2.6	2.2	1.6	ZR330SPH532_0280 EZ501U	7.4	9.6	355	28.00	0.71	1.43	42	14	58	3	30	95.5
0.54	2.6	2.8	2.4	1.5	ZR330SPH532_0280 EZ402U	7.4	9.6	355	28.00	0.71	1.43	42	14	58	3	30	95.5
0.60	1.4	1.5	1.4	2.6	ZR330SPH532_0250 EZ401U	4.1	9.6	198	25.00	0.74	1.50	42	14	60	3	30	95.5
0.60	2.1	2.3	2.2	1.7	ZR330SPH532_0250 EZ501U	7.7	9.6	368	25.00	0.74	1.50	42	14	60	3	30	95.5
0.60	2.3	2.5	2.4	1.6	ZR330SPH532_0250 EZ402U	7.7	9.6	368	25.00	0.74	1.50	42	14	60	3	30	95.5
0.60	3.4	4.2	3.5	1.1	ZR330SPH532_0250 EZ404U	7.7	9.6	368	25.00	0.74	1.50	42	14	60	3	30	95.5
0.60	3.6	3.9	3.7	1.0	ZR330SPH532_0250 EZ502U	7.7	9.6	368	25.00	0.74	1.50	42	14	60	3	30	95.5
0.75	1.1	1.2	1.6	3.1	ZR330SPH532_0200 EZ401U	3.3	9.6	158	20.00	0.88	1.75	42	14	60	3	30	95.5
0.75	1.7	1.8	2.5	2.0	ZR330SPH532_0200 EZ501U	6.2	9.6	298	20.00	0.88	1.75	42	14	60	3	30	95.5
0.75	1.8	2.0	2.7	1.8	ZR330SPH532_0200 EZ402U	6.2	9.6	298	20.00	0.88	1.75	42	14	60	3	30	95.5
0.75	2.7	3.4	4.0	1.2	ZR330SPH532_0200 EZ404U	7.7	9.6	368	20.00	0.88	1.75	42	14	60	3	30	95.5
0.75	2.9	3.1	4.3	1.2	ZR330SPH532_0200 EZ502U	7.7	9.6	368	20.00	0.88	1.75	42	14	60	3	30	95.5
0.94	0.9	0.9	2.0	3.6	ZR330SPH532_0160 EZ401U	2.6	9.6	126	16.00	1.09	2.19	42	14	59	3	30	95.5
0.94	1.3	1.5	3.0	2.3	ZR330SPH532_0160 EZ501U	5.0	9.6	238	16.00	1.09	2.19	42	14	59	3	30	95.5
0.94	1.5	1.6	3.3	2.1	ZR330SPH532_0160 EZ402U	5.0	9.6	238	16.00	1.09	2.19	42	14	59	3	30	95.5
0.94	2.2	2.7	4.9	1.4	ZR330SPH532_0160 EZ404U	7.4	9.6	355	16.00	1.09	2.19	42	14	59	3	30	95.5
0.94	2.3	2.5	5.2	1.3	ZR330SPH532_0160 EZ502U	7.4	9.6	355	16.00	1.09	2.19	42	14	59	3	30	95.5
0.94	3.0	3.5	6.9	1.0	ZR330SPH532_0160 EZ503U	7.4	9.6	355	16.00	1.09	2.19	42	14	59	3	30	95.5
1.50	0.9	0.9	1.7	3.1	ZR330SPH531_0100 EZ501U	3.2	9.6	154	10.00	1.65	3.25	42	14	47	3	30	95.5
1.50	1.5	1.6	3.0	1.8	ZR330SPH531_0100 EZ502U	6.0	9.6	288	10.00	1.65	3.25	42	14	47	3	30	95.5
1.50	1.5	1.7	3.0	1.8	ZR330SPH531_0100 EZ701U	4.0	9.6	192	10.00	1.65	3.25	42	14	47	3	30	95.5
1.50	2.0	2.2	3.9	1.4	ZR330SPH531_0100 EZ503U	6.0	9.6	288	10.00	1.65	3.25	42	14	47	3	30	95.5
1.50	2.4	2.9	4.8	1.1	ZR330SPH531_0100 EZ702U	6.0	9.6	288	10.00	1.65	3.25	42	14	47	3	30	95.5
2.14	0.6	0.7	2.1	3.9	ZR330SPH531_0070 EZ501U	2.3	9.6	108	7.000	2.14	4.29	42	14	57	3	30	95.5
2.14	1.0	1.1	3.6	2.3	ZR330SPH531_0070 EZ502U	4.4	9.6	208	7.000	2.14	4.29	42	14	57	3	30	95.5
2.14	1.0	1.2	3.6	2.3	ZR330SPH531_0070 EZ701U	2.8	9.6	134	7.000	2.14	4.29	42	14	57	3	30	95.5
2.14	1.4	1.6	4.7	1.7	ZR330SPH531_0070 EZ503U	6.1	9.6	289	7.000	2.14	4.29	42	14	57	3	30	95.5
2.14	1.7	2.0	5.8	1.4	ZR330SPH531_0070 EZ702U	5.8	9.6	276	7.000	2.14	4.29	42	14	57	3	30	95.5
2.14	1.9	2.3	6.5	1.2	ZR330SPH531_0070 EZ505U	7.7	9.6	368	7.000	2.14	4.29	42	14	57	3	30	95.5
2.14	2.3	2.9	7.9	1.0	ZR330SPH531_0070 EZ703U	7.7	9.6	368	7.000	2.14	4.29	42	14	57	3	30	95.5
3.00	0.4	0.5	3.1	4.9	ZR330SPH531_0050 EZ501U	1.6	9.6	77	5.000	2.50	5.50	42	14	64	3	30	95.5
3.00	0.7	0.8	5.3	2.8	ZR330SPH531_0050 EZ502U	3.1	9.6	149	5.000	2.50	5.50	42	14	64	3	30	95.5
3.00	0.7	0.8	5.3	2.8	ZR330SPH531_0050 EZ701U	2.0	9.6	96	5.000	2.50	5.50	42	14	64	3	30	95.5
3.00	1.0	1.1	7.0	2.2	ZR330SPH531_0050 EZ503U	4.3	9.6	206	5.000	2.50	5.50	42	14	64	3	30	95.5
3.00	1.2	1.4	8.6	1.7	ZR330SPH531_0050 EZ702U	4.1	9.6	197	5.000	2.50	5.50	42	14	64	3	30	95.5
3.00	1.4	1.6	9.7	1.6	ZR330SPH531_0050 EZ505U	6.7	9.6	322	5.000	2.50	5.50	42	14	64	3	30	95.5
3.00	1.7	2.1	12	1.3	ZR330SPH531_0050 EZ703U	6.5	9.6	312	5.000	2.50	5.50	42	14	64	3	30	95.5
3.75	0.6	0.6	7.0	3.3	ZR330SPH531_0040 EZ502U	2.5	9.5	119	4.000	2.75	6.25	42	14	65	3	30	95.5
3.75	0.6	0.7	7.0	3.3	ZR330SPH531_0040 EZ701U	1.6	9.6	77	4.000	2.75	6.25	42	14	65	3	30	95.5
3.75	0.8	0.9	9.1	2.5	ZR330SPH531_0040 EZ503U	3.5	9.5	165	4.000	2.75	6.25	42	14	65	3	30	95.5
3.75	1.0	1.2	11	2.0	ZR330SPH531_0040 EZ702U	3.3	9.6	157	4.000	2.75	6.25	42	14	65	3	30	95.5
3.75	1.1	1.3	13	1.8	ZR330SPH531_0040 EZ505U	5.4	9.5	257	4.000	2.75	6.25	42	14	65	3	30	95.5

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZR3PH5 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 7,7 kN)																	
3.75	1.3	1.7	16	1.5	ZR330SPH531_0040 EZ703U	5.2	9.6	250	4.000	2.75	6.25	42	14	65	3	30	95.5
3.75	1.7	2.4	20	1.1	ZR330SPH531_0040 EZ705U	7.4	9.6	355	4.000	2.75	6.25	42	14	65	3	30	95.5
ZR3PH5 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 7,7 kN)																	
2.25	1.9	3.1	4.4	1.2	ZR330SPH531_0100 EZ505U	6.0	9.6	288	10.00	1.65	3.25	42	14	47	3	30	95.5
3.21	1.3	2.2	5.2	1.5	ZR330SPH531_0070 EZ505U	7.7	9.6	368	7.000	2.14	4.29	42	14	57	3	30	95.5
3.21	1.7	2.8	6.7	1.2	ZR330SPH531_0070 EZ703U	7.7	9.6	368	7.000	2.14	4.29	42	14	57	3	30	95.5
4.50	1.0	1.5	7.8	1.9	ZR330SPH531_0050 EZ505U	6.7	9.6	322	5.000	2.50	5.50	42	14	64	3	30	95.5
4.50	1.2	2.0	10	1.5	ZR330SPH531_0050 EZ703U	6.5	9.6	312	5.000	2.50	5.50	42	14	64	3	30	95.5
4.50	1.6	3.0	14	1.1	ZR330SPH531_0050 EZ705U	7.7	9.6	368	5.000	2.50	5.50	42	14	64	3	30	95.5
5.63	0.8	1.2	10	2.2	ZR330SPH531_0040 EZ505U	5.4	9.5	257	4.000	2.75	6.25	42	14	65	3	30	95.5
5.63	1.0	1.6	13	1.8	ZR330SPH531_0040 EZ703U	5.2	9.6	250	4.000	2.75	6.25	42	14	65	3	30	95.5
5.63	1.3	2.4	18	1.3	ZR330SPH531_0040 EZ705U	7.4	9.6	355	4.000	2.75	6.25	42	14	65	3	30	95.5
ZR3PH5 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 7,7 kN)																	
0.43	3.1	3.8	0.9	1.3	ZR330SPH532_0700 EZ401U	7.7	9.6	368	70.00	0.29	0.57	42	14	55	3	30	95.5
0.60	2.2	2.7	1.0	1.6	ZR330SPH532_0500 EZ401U	7.7	9.6	368	50.00	0.40	0.80	42	14	58	3	30	95.5
0.60	3.3	4.3	1.6	1.1	ZR330SPH532_0500 EZ501U	7.7	9.6	368	50.00	0.40	0.80	42	14	58	3	30	95.5
0.60	3.4	4.8	1.6	1.1	ZR330SPH532_0500 EZ402U	7.7	9.6	368	50.00	0.40	0.80	42	14	58	3	30	95.5
0.75	1.8	2.2	1.4	1.9	ZR330SPH532_0400 EZ401U	6.6	9.6	316	40.00	0.50	1.00	42	14	56	3	30	95.5
0.75	2.6	3.4	2.1	1.3	ZR330SPH532_0400 EZ501U	7.4	9.6	355	40.00	0.50	1.00	42	14	56	3	30	95.5
0.75	2.7	3.8	2.2	1.2	ZR330SPH532_0400 EZ402U	7.4	9.6	355	40.00	0.50	1.00	42	14	56	3	30	95.5
0.86	1.6	1.9	1.2	2.0	ZR330SPH532_0350 EZ401U	5.8	9.6	277	35.00	0.57	1.14	42	14	60	3	30	95.5
0.86	2.3	3.0	1.8	1.4	ZR330SPH532_0350 EZ501U	7.7	9.6	368	35.00	0.57	1.14	42	14	60	3	30	95.5
0.86	2.4	3.3	1.8	1.3	ZR330SPH532_0350 EZ402U	7.7	9.6	368	35.00	0.57	1.14	42	14	60	3	30	95.5
1.07	1.3	1.5	1.4	2.4	ZR330SPH532_0280 EZ401U	4.6	9.6	221	28.00	0.71	1.43	42	14	58	3	30	95.5
1.07	1.9	2.4	2.1	1.6	ZR330SPH532_0280 EZ501U	7.4	9.6	355	28.00	0.71	1.43	42	14	58	3	30	95.5
1.07	1.9	2.7	2.1	1.6	ZR330SPH532_0280 EZ402U	7.4	9.6	355	28.00	0.71	1.43	42	14	58	3	30	95.5
1.07	2.8	4.3	3.2	1.0	ZR330SPH532_0280 EZ502U	7.4	9.6	355	28.00	0.71	1.43	42	14	58	3	30	95.5
1.20	1.1	1.4	1.4	2.6	ZR330SPH532_0250 EZ401U	4.1	9.6	198	25.00	0.74	1.50	42	14	60	3	30	95.5
1.20	1.7	2.1	2.1	1.7	ZR330SPH532_0250 EZ501U	7.7	9.6	368	25.00	0.74	1.50	42	14	60	3	30	95.5
1.20	1.7	2.4	2.2	1.7	ZR330SPH532_0250 EZ402U	7.7	9.6	368	25.00	0.74	1.50	42	14	60	3	30	95.5
1.20	2.5	3.8	3.2	1.1	ZR330SPH532_0250 EZ502U	7.7	9.6	368	25.00	0.74	1.50	42	14	60	3	30	95.5
1.20	2.8	4.1	3.6	1.0	ZR330SPH532_0250 EZ404U	7.7	9.6	368	25.00	0.74	1.50	42	14	60	3	30	95.5
1.50	0.9	1.1	1.6	3.0	ZR330SPH532_0200 EZ401U	3.3	9.6	158	20.00	0.88	1.75	42	14	60	3	30	95.5
1.50	1.3	1.7	2.4	2.0	ZR330SPH532_0200 EZ501U	6.2	9.6	298	20.00	0.88	1.75	42	14	60	3	30	95.5
1.50	1.4	1.9	2.4	1.9	ZR330SPH532_0200 EZ402U	6.2	9.6	298	20.00	0.88	1.75	42	14	60	3	30	95.5
1.50	2.0	3.0	3.6	1.3	ZR330SPH532_0200 EZ502U	7.7	9.6	368	20.00	0.88	1.75	42	14	60	3	30	95.5
1.50	2.3	3.3	4.0	1.2	ZR330SPH532_0200 EZ404U	7.7	9.6	368	20.00	0.88	1.75	42	14	60	3	30	95.5
1.50	2.4	4.1	4.3	1.1	ZR330SPH532_0200 EZ503U	7.7	9.6	368	20.00	0.88	1.75	42	14	60	3	30	95.5
1.88	0.7	0.9	1.9	3.4	ZR330SPH532_0160 EZ401U	2.6	9.6	126	16.00	1.09	2.19	42	14	59	3	30	95.5
1.88	1.1	1.4	2.8	2.3	ZR330SPH532_0160 EZ501U	5.0	9.6	238	16.00	1.09	2.19	42	14	59	3	30	95.5
1.88	1.1	1.5	2.9	2.3	ZR330SPH532_0160 EZ402U	5.0	9.6	238	16.00	1.09	2.19	42	14	59	3	30	95.5
1.88	1.6	2.4	4.3	1.5	ZR330SPH532_0160 EZ502U	7.4	9.6	355	16.00	1.09	2.19	42	14	59	3	30	95.5
1.88	1.8	2.6	4.8	1.4	ZR330SPH532_0160 EZ404U	7.4	9.6	355	16.00	1.09	2.19	42	14	59	3	30	95.5
1.88	1.9	3.3	5.2	1.3	ZR330SPH532_0160 EZ503U	7.4	9.6	355	16.00	1.09	2.19	42	14	59	3	30	95.5
3.00	0.7	0.9	1.7	3.1	ZR330SPH531_0100 EZ501U	3.2	9.6	154	10.00	1.65	3.25	42	14	47	3	30	95.5
3.00	1.0	1.6	2.6	2.0	ZR330SPH531_0100 EZ502U	6.0	9.6	288	10.00	1.65	3.25	42	14	47	3	30	95.5
3.00	1.0	1.6	2.6	2.0	ZR330SPH531_0100 EZ701U	4.0	9.6	192	10.00	1.65	3.25	42	14	47	3	30	95.5
3.00	1.2	2.1	3.1	1.7	ZR330SPH531_0100 EZ503U	6.0	9.6	288	10.00	1.65	3.25	42	14	47	3	30	95.5
3.00	1.4	2.9	3.7	1.5	ZR330SPH531_0100 EZ702U	6.0	9.6	288	10.00	1.65	3.25	42	14	47	3	30	95.5
4.29	0.5	0.6	2.1	3.9	ZR330SPH531_0070 EZ501U	2.3	9.6	108	7.000	2.14	4.29	42	14	57	3	30	95.5
4.29	0.7	1.1	3.2	2.6	ZR330SPH531_0070 EZ502U	4.4	9.6	208	7.000	2.14	4.29	42	14	57	3	30	95.5
4.29	0.7	1.1	3.2	2.6	ZR330SPH531_0070 EZ701U	2.8	9.6	134	7.000	2.14	4.29	42	14	57	3	30	95.5
4.29	0.9	1.5	3.8	2.1	ZR330SPH531_0070 EZ503U	6.1	9.6	289	7.000	2.14	4.29	42	14	57	3	30	95.5
4.29	1.0	2.0	4.4	1.8	ZR330SPH531_0070 EZ702U	5.8	9.6	276	7.000	2.14	4.29	42	14	57	3	30	95.5
ZR3PH7 (n_{1N} = 2000 min^{-1}, ($F_{f2acc,max}$ = 16 kN)																	
1.67	4.7	5.3	9.4	1.5	ZR335SPH731_0070 EZ813U	16	19	869	7.000	2.08	4.17	49	16	94	3	35	111.4
1.67	7.0	8.3	14	1.0	ZR335SPH731_0070 EZ815U	16	19	869	7.000	2.08	4.17	49	16	94	3	35	111.4
1.91	4.1	4.6	9.4	1.7	ZR340SPH731_0070 EZ813U	14	17	869	7.000	2.38	4.76	56	19	82	3	40	127.3
1.91	6.1	7.3	14	1.1	ZR340SPH731_0070 EZ815U	14	17	869	7.000	2.38	4.76	56	19	82	3	40	127.3
2.33	3.4	3.8	14	1.9	ZR335SPH731_0050 EZ813U	12	19	672	5.000	2.57	5.83	49	16	106	3	35	111.4
2.33	5.0	5.9	21	1.3	ZR335SPH731_0050 EZ815U	16	19	869	5.000	2.57	5.83	49	16	106	3	35	111.4
2.67	2.9	3.3	14	2.2	ZR340SPH731_0050 EZ813U	11	17	672	5.000	2.93	6.67	56	19	93	3	40	127.3
2.67	4.4	5.2	21	1.5	ZR340SPH731_0050 EZ815U	14	17	879	5.000	2.93	6.67	56	19	93	3	40	127.3
2.92	2.7	3.0	18	2.2	ZR335SPH731_0040 EZ813U	9.7	19	538	4.000	2.77	5.83	49	16	113	3	35	111.4
2.92	4.0	4.7	27	1.5	ZR335SPH731_0040 EZ815U	14	19	768	4.000	2.77	5.83	49	16	113	3	35	111.4

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZR3PH7 (n_{1N} = 2000 min^{-1}, ($F_{f2acc,max}$ = 16 kN)																	
3.33	2.4	2.6	18	2.5	ZR340SPH731_0040 EZ813U	8.4	17	538	4.000	3.17	6.67	56	19	100	3	40	127.3
3.33	3.5	4.1	27	1.7	ZR340SPH731_0040 EZ815U	12	17	768	4.000	3.17	6.67	56	19	100	3	40	127.3
ZR3PH7 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 16 kN)																	
0.25	5.0	5.5	0.7	2.0	ZR335SPH732_0700 EZ501U	15	19	809	70.00	0.31	0.58	49	16	91	3	35	111.4
0.25	8.6	9.3	1.2	1.2	ZR335SPH732_0700 EZ502U	15	19	809	70.00	0.31	0.58	49	16	91	3	35	111.4
0.25	8.6	9.7	1.2	1.2	ZR335SPH732_0700 EZ701U	15	19	809	70.00	0.31	0.58	49	16	91	3	35	111.4
0.29	4.4	4.8	0.7	2.0	ZR340SPH732_0700 EZ501U	13	17	809	70.00	0.35	0.67	56	19	78	3	40	127.3
0.29	7.6	8.2	1.2	1.2	ZR340SPH732_0700 EZ502U	13	17	809	70.00	0.35	0.67	56	19	78	3	40	127.3
0.29	7.6	8.5	1.2	1.2	ZR340SPH732_0700 EZ701U	13	17	809	70.00	0.35	0.67	56	19	78	3	40	127.3
0.35	3.6	3.9	0.9	2.8	ZR335SPH732_0500 EZ501U	13	19	744	50.00	0.43	0.82	49	16	97	3	35	111.4
0.35	6.2	6.7	1.5	1.6	ZR335SPH732_0500 EZ502U	15	19	830	50.00	0.43	0.82	49	16	97	3	35	111.4
0.35	6.2	6.9	1.5	1.6	ZR335SPH732_0500 EZ701U	15	19	830	50.00	0.43	0.82	49	16	97	3	35	111.4
0.35	8.1	9.3	1.9	1.2	ZR335SPH732_0500 EZ503U	15	19	830	50.00	0.43	0.82	49	16	97	3	35	111.4
0.40	3.1	3.4	0.9	2.8	ZR340SPH732_0500 EZ501U	12	17	744	50.00	0.49	0.93	56	19	85	3	40	127.3
0.40	5.4	5.8	1.5	1.6	ZR340SPH732_0500 EZ502U	13	17	830	50.00	0.49	0.93	56	19	85	3	40	127.3
0.40	5.4	6.1	1.5	1.6	ZR340SPH732_0500 EZ701U	13	17	830	50.00	0.49	0.93	56	19	85	3	40	127.3
0.40	7.1	8.1	1.9	1.2	ZR340SPH732_0500 EZ503U	13	17	830	50.00	0.49	0.93	56	19	85	3	40	127.3
0.44	2.9	3.1	1.1	3.0	ZR335SPH732_0400 EZ501U	11	19	595	40.00	0.54	1.02	49	16	99	3	35	111.4
0.44	4.9	5.3	1.9	1.7	ZR335SPH732_0400 EZ502U	14	19	770	40.00	0.54	1.02	49	16	99	3	35	111.4
0.44	4.9	5.5	1.9	1.7	ZR335SPH732_0400 EZ701U	13	19	744	40.00	0.54	1.02	49	16	99	3	35	111.4
0.44	6.5	7.4	2.5	1.3	ZR335SPH732_0400 EZ503U	14	19	770	40.00	0.54	1.02	49	16	99	3	35	111.4
0.44	8.0	9.6	3.1	1.1	ZR335SPH732_0400 EZ702U	14	19	770	40.00	0.54	1.02	49	16	99	3	35	111.4
0.50	2.5	2.7	1.1	3.9	ZR335SPH732_0350 EZ501U	9.3	19	521	35.00	0.62	1.17	49	16	99	3	35	111.4
0.50	2.5	2.7	1.1	3.0	ZR340SPH732_0400 EZ501U	9.3	17	595	40.00	0.62	1.17	56	19	86	3	40	127.3
0.50	4.3	4.7	1.8	2.2	ZR335SPH732_0350 EZ502U	16	19	866	35.00	0.62	1.17	49	16	99	3	35	111.4
0.50	4.3	4.7	1.9	1.7	ZR340SPH732_0400 EZ502U	12	17	770	40.00	0.62	1.17	56	19	86	3	40	127.3
0.50	4.3	4.8	1.8	2.2	ZR335SPH732_0350 EZ701U	12	19	651	35.00	0.62	1.17	49	16	99	3	35	111.4
0.50	4.3	4.8	1.9	1.7	ZR340SPH732_0400 EZ701U	12	17	744	40.00	0.62	1.17	56	19	86	3	40	127.3
0.50	4.3	4.8	1.8	2.2	ZR335SPH732_0350 EZ701U	12	19	651	35.00	0.62	1.17	49	16	99	3	35	111.4
0.50	4.3	4.8	1.9	1.7	ZR340SPH732_0400 EZ701U	12	17	744	40.00	0.62	1.17	56	19	86	3	40	127.3
0.50	5.7	6.5	2.4	1.7	ZR335SPH732_0350 EZ503U	16	19	866	35.00	0.62	1.17	49	16	99	3	35	111.4
0.50	5.7	6.5	2.5	1.3	ZR340SPH732_0400 EZ503U	12	17	770	40.00	0.62	1.17	56	19	86	3	40	127.3
0.50	7.0	8.4	2.9	1.4	ZR335SPH732_0350 EZ702U	16	19	866	35.00	0.62	1.17	49	16	99	3	35	111.4
0.50	7.0	8.4	3.1	1.1	ZR340SPH732_0400 EZ702U	12	17	770	40.00	0.62	1.17	56	19	86	3	40	127.3
0.50	7.0	8.4	2.9	1.4	ZR335SPH732_0350 EZ702U	16	19	866	35.00	0.62	1.17	49	16	99	3	35	111.4
0.50	7.0	8.4	3.1	1.1	ZR340SPH732_0400 EZ702U	12	17	770	40.00	0.62	1.17	56	19	86	3	40	127.3
0.50	7.9	9.3	3.3	1.2	ZR335SPH732_0350 EZ505U	16	19	866	35.00	0.62	1.17	49	16	99	3	35	111.4
0.50	9.6	12	4.0	1.0	ZR335SPH732_0350 EZ703U	16	19	866	35.00	0.62	1.17	49	16	99	3	35	111.4
0.57	2.2	2.4	1.1	3.9	ZR340SPH732_0350 EZ501U	8.2	17	521	35.00	0.71	1.33	56	19	87	3	40	127.3
0.57	3.8	4.1	1.8	2.2	ZR340SPH732_0350 EZ502U	14	17	866	35.00	0.71	1.33	56	19	87	3	40	127.3
0.57	3.8	4.2	1.8	2.2	ZR340SPH732_0350 EZ701U	10	17	651	35.00	0.71	1.33	56	19	87	3	40	127.3
0.57	5.0	5.7	2.4	1.7	ZR340SPH732_0350 EZ503U	14	17	866	35.00	0.71	1.33	56	19	87	3	40	127.3
0.57	6.1	7.4	2.9	1.4	ZR340SPH732_0350 EZ702U	14	17	866	35.00	0.71	1.33	56	19	87	3	40	127.3
0.57	6.9	8.2	3.3	1.2	ZR340SPH732_0350 EZ505U	14	17	866	35.00	0.71	1.33	56	19	87	3	40	127.3
0.57	8.4	11	4.0	1.0	ZR340SPH732_0350 EZ703U	14	17	866	35.00	0.71	1.33	56	19	87	3	40	127.3
0.63	2.0	2.2	1.2	4.8	ZR335SPH732_0280 EZ501U	7.5	19	417	28.00	0.77	1.46	49	16	102	3	35	111.4
0.63	3.5	3.7	2.0	2.8	ZR335SPH732_0280 EZ502U	14	19	770	28.00	0.77	1.46	49	16	102	3	35	111.4
0.63	3.5	3.9	2.0	2.8	ZR335SPH732_0280 EZ701U	9.3	19	521	28.00	0.77	1.46	49	16	102	3	35	111.4
0.63	4.5	5.2	2.7	2.1	ZR335SPH732_0280 EZ503U	14	19	770	28.00	0.77	1.46	49	16	102	3	35	111.4
0.63	5.6	6.7	3.3	1.7	ZR335SPH732_0280 EZ702U	14	19	770	28.00	0.77	1.46	49	16	102	3	35	111.4
0.63	6.3	7.5	3.7	1.5	ZR335SPH732_0280 EZ505U	14	19	770	28.00	0.77	1.46	49	16	102	3	35	111.4
0.63	7.7	9.7	4.5	1.3	ZR335SPH732_0280 EZ703U	14	19	770	28.00	0.77	1.46	49	16	102	3	35	111.4
0.70	3.1	3.3	2.3	2.9	ZR335SPH732_0250 EZ502U	13	19	721	25.00	0.82	1.63	49	16	100	3	35	111.4
0.70	3.1	3.5	2.3	2.9	ZR335SPH732_0250 EZ701U	8.3	19	465	25.00	0.82	1.63	49	16	100	3	35	111.4
0.70	4.0	4.6	3.0	2.2	ZR335SPH732_0250 EZ503U	16	19	866	25.00	0.82	1.63	49	16	100	3	35	111.4
0.70	5.0	6.0	3.8	1.8	ZR335SPH732_0250 EZ702U	16	19	866	25.00	0.82	1.63	49	16	100	3	35	111.4
0.70	5.6	6.7	4.2	1.6	ZR335SPH732_0250 EZ505U	16	19	866	25.00	0.82	1.63	49	16	100	3	35	111.4
0.70	6.9	8.7	5.2	1.3	ZR335SPH732_0250 EZ703U	16	19	866	25.00	0.82	1.63	49	16	100	3	35	111.4
0.70	8.9	13	6.7	1.0	ZR335SPH732_0250 EZ705U	16	19	866	25.00	0.82	1.63	49	16	100	3	35	111.4
0.71	1.8	1.9	1.2	4.8	ZR340SPH732_0280 EZ501U	6.5	17	417	28.00	0.88	1.67	56	19	90	3	40	127.3
0.71	3.0	3.3	2.0	2.8	ZR340SPH732_0280 EZ502U	12	17	770	28.00	0.88	1.67	56	19	90	3	40	127.3
0.71	3.0	3.4	2.0	2.8	ZR340SPH732_0280 EZ701U	8.2	17	521	28.00	0.88	1.67	56	19	90	3	40	127.3
0.71	4.0	4.5	2.7	2.1	ZR340SPH732_0280 EZ503U	12	17	770	28.00	0.88	1.67	56	19	90	3	40	127.3
0.71	4.9	5.9	3.3	1.7	ZR340SPH732_0280 EZ702U	12	17	770	28.00	0.88	1.67	56	19	90	3	40	127.3
0.71	5.5	6.5	3.7	1.5	ZR340SPH732_0280 EZ505U	12	17	770	28.00	0.88	1.67	56	19	90	3	40	127.3
0.71	6.7	8.5	4.5	1.3	ZR340SPH732_0280 EZ703U	12	17	770	28.00	0.88	1.67	56	19	90	3	40	127.3

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZR3PH7 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 16 kN)																	
0.80	2.7	2.9	2.3	2.9	ZR340SPH732_0250 EZ502U	11	17	721	25.00	0.93	1.87	56	19	87	3	40	127.3
0.80	2.7	3.0	2.3	2.9	ZR340SPH732_0250 EZ701U	7.3	17	465	25.00	0.93	1.87	56	19	87	3	40	127.3
0.80	3.5	4.1	3.0	2.2	ZR340SPH732_0250 EZ503U	14	17	866	25.00	0.93	1.87	56	19	87	3	40	127.3
0.80	4.4	5.3	3.8	1.8	ZR340SPH732_0250 EZ702U	14	17	866	25.00	0.93	1.87	56	19	87	3	40	127.3
0.80	4.9	5.8	4.2	1.6	ZR340SPH732_0250 EZ505U	14	17	866	25.00	0.93	1.87	56	19	87	3	40	127.3
0.80	6.0	7.6	5.2	1.3	ZR340SPH732_0250 EZ703U	14	17	866	25.00	0.93	1.87	56	19	87	3	40	127.3
0.80	7.8	11	6.7	1.0	ZR340SPH732_0250 EZ705U	14	17	866	25.00	0.93	1.87	56	19	87	3	40	127.3
0.88	2.5	2.7	2.8	3.3	ZR335SPH732_0200 EZ502U	10	19	577	20.00	0.88	1.75	49	16	101	3	35	111.4
0.88	2.5	2.8	2.8	3.3	ZR335SPH732_0200 EZ701U	6.7	19	372	20.00	0.88	1.75	49	16	101	3	35	111.4
0.88	3.2	3.7	3.7	2.6	ZR335SPH732_0200 EZ503U	14	19	800	20.00	0.88	1.75	49	16	101	3	35	111.4
0.88	4.0	4.8	4.6	2.1	ZR335SPH732_0200 EZ702U	14	19	763	20.00	0.88	1.75	49	16	101	3	35	111.4
0.88	4.5	5.3	5.1	1.8	ZR335SPH732_0200 EZ505U	14	19	805	20.00	0.88	1.75	49	16	101	3	35	111.4
0.88	5.5	6.9	6.3	1.5	ZR335SPH732_0200 EZ703U	14	19	805	20.00	0.88	1.75	49	16	101	3	35	111.4
0.88	7.1	10	8.1	1.2	ZR335SPH732_0200 EZ705U	14	19	805	20.00	0.88	1.75	49	16	101	3	35	111.4
1.00	2.2	2.3	2.8	3.3	ZR340SPH732_0200 EZ502U	9.1	17	577	20.00	1.00	2.00	56	19	88	3	40	127.3
1.00	2.2	2.4	2.8	3.3	ZR340SPH732_0200 EZ701U	5.8	17	372	20.00	1.00	2.00	56	19	88	3	40	127.3
1.00	2.8	3.2	3.7	2.6	ZR340SPH732_0200 EZ503U	13	17	800	20.00	1.00	2.00	56	19	88	3	40	127.3
1.00	3.5	4.2	4.6	2.1	ZR340SPH732_0200 EZ702U	12	17	763	20.00	1.00	2.00	56	19	88	3	40	127.3
1.00	3.9	4.7	5.1	1.8	ZR340SPH732_0200 EZ505U	13	17	805	20.00	1.00	2.00	56	19	88	3	40	127.3
1.00	4.8	6.1	6.3	1.5	ZR340SPH732_0200 EZ703U	13	17	805	20.00	1.00	2.00	56	19	88	3	40	127.3
1.00	6.2	8.8	8.1	1.2	ZR340SPH732_0200 EZ705U	13	17	805	20.00	1.00	2.00	56	19	88	3	40	127.3
1.09	2.0	2.1	3.2	4.1	ZR335SPH732_0160 EZ502U	8.3	19	461	16.00	1.09	2.19	49	16	104	3	35	111.4
1.09	2.0	2.2	3.2	4.1	ZR335SPH732_0160 EZ701U	5.3	19	298	16.00	1.09	2.19	49	16	104	3	35	111.4
1.09	2.6	3.0	4.2	3.1	ZR335SPH732_0160 EZ503U	11	19	640	16.00	1.09	2.19	49	16	104	3	35	111.4
1.09	3.2	3.8	5.2	2.5	ZR335SPH732_0160 EZ702U	11	19	610	16.00	1.09	2.19	49	16	104	3	35	111.4
1.09	3.6	4.3	5.9	2.2	ZR335SPH732_0160 EZ505U	13	19	740	16.00	1.09	2.19	49	16	104	3	35	111.4
1.09	4.4	5.6	7.2	1.8	ZR335SPH732_0160 EZ703U	13	19	740	16.00	1.09	2.19	49	16	104	3	35	111.4
1.09	5.7	8.1	9.2	1.4	ZR335SPH732_0160 EZ705U	13	19	740	16.00	1.09	2.19	49	16	104	3	35	111.4
1.25	1.7	1.9	3.2	4.1	ZR340SPH732_0160 EZ502U	7.2	17	461	16.00	1.25	2.50	56	19	92	3	40	127.3
1.25	1.7	1.9	3.2	4.1	ZR340SPH732_0160 EZ701U	4.7	17	298	16.00	1.25	2.50	56	19	92	3	40	127.3
1.25	2.3	2.6	4.2	3.1	ZR340SPH732_0160 EZ503U	10	17	640	16.00	1.25	2.50	56	19	92	3	40	127.3
1.25	2.8	3.4	5.2	2.5	ZR340SPH732_0160 EZ702U	9.6	17	610	16.00	1.25	2.50	56	19	92	3	40	127.3
1.25	3.2	3.7	5.9	2.2	ZR340SPH732_0160 EZ505U	12	17	740	16.00	1.25	2.50	56	19	92	3	40	127.3
1.25	3.9	4.9	7.2	1.8	ZR340SPH732_0160 EZ703U	12	17	740	16.00	1.25	2.50	56	19	92	3	40	127.3
1.25	5.0	7.1	9.2	1.4	ZR340SPH732_0160 EZ705U	12	17	740	16.00	1.25	2.50	56	19	92	3	40	127.3
1.75	1.3	1.4	1.8	3.9	ZR335SPH731_0100 EZ701U	3.4	19	192	10.00	1.46	2.92	49	16	81	3	35	111.4
1.75	2.1	2.5	3.0	2.4	ZR335SPH731_0100 EZ702U	7.1	19	394	10.00	1.46	2.92	49	16	81	3	35	111.4
1.75	2.8	3.6	4.1	1.8	ZR335SPH731_0100 EZ703U	10	19	575	10.00	1.46	2.92	49	16	81	3	35	111.4
1.75	3.7	5.2	5.3	1.4	ZR335SPH731_0100 EZ705U	10	19	575	10.00	1.46	2.92	49	16	81	3	35	111.4
2.00	1.1	1.3	1.8	3.9	ZR340SPH731_0100 EZ701U	3.0	17	192	10.00	1.67	3.33	56	19	69	3	40	127.3
2.00	1.8	2.2	3.0	2.4	ZR340SPH731_0100 EZ702U	6.2	17	394	10.00	1.67	3.33	56	19	69	3	40	127.3
2.00	2.5	3.1	4.1	1.8	ZR340SPH731_0100 EZ703U	9.0	17	575	10.00	1.67	3.33	56	19	69	3	40	127.3
2.00	3.2	4.6	5.3	1.4	ZR340SPH731_0100 EZ705U	9.0	17	575	10.00	1.67	3.33	56	19	69	3	40	127.3
2.50	1.4	1.7	3.3	4.4	ZR335SPH731_0070 EZ702U	4.9	19	276	7.000	2.08	4.17	49	16	94	3	35	111.4
2.50	2.0	2.5	4.5	3.2	ZR335SPH731_0070 EZ703U	7.8	19	437	7.000	2.08	4.17	49	16	94	3	35	111.4
2.50	2.6	3.6	5.9	2.5	ZR335SPH731_0070 EZ705U	13	19	699	7.000	2.08	4.17	49	16	94	3	35	111.4
2.86	1.3	1.5	3.3	4.8	ZR340SPH731_0070 EZ702U	4.3	17	276	7.000	2.38	4.76	56	19	82	3	40	127.3
2.86	1.7	2.2	4.5	3.5	ZR340SPH731_0070 EZ703U	6.9	17	437	7.000	2.38	4.76	56	19	82	3	40	127.3
2.86	2.2	3.2	5.9	2.7	ZR340SPH731_0070 EZ705U	11	17	699	7.000	2.38	4.76	56	19	82	3	40	127.3
3.50	1.4	1.8	6.8	4.0	ZR335SPH731_0050 EZ703U	5.6	19	312	5.000	2.57	5.83	49	16	106	3	35	111.4
3.50	1.8	2.6	8.8	3.1	ZR335SPH731_0050 EZ705U	9.0	19	499	5.000	2.57	5.83	49	16	106	3	35	111.4
4.00	1.2	1.6	6.8	4.5	ZR340SPH731_0050 EZ703U	4.9	17	312	5.000	2.93	6.67	56	19	93	3	40	127.3
4.00	1.6	2.3	8.8	3.5	ZR340SPH731_0050 EZ705U	7.8	17	499	5.000	2.93	6.67	56	19	93	3	40	127.3
4.38	1.1	1.4	8.9	4.6	ZR335SPH731_0040 EZ703U	4.5	16	250	4.000	2.77	5.83	49	16	113	3	35	111.4
4.38	1.5	2.1	11	3.6	ZR335SPH731_0040 EZ705U	7.2	16	399	4.000	2.77	5.83	49	16	113	3	35	111.4
5.00	1.3	1.8	11	4.1	ZR340SPH731_0040 EZ705U	6.3	14	399	4.000	3.17	6.67	56	19	100	3	40	127.3
ZR3PH7 (n_{1N} = 4000 min^{-1}, ($F_{f2acc,max}$ = 16 kN)																	
2.33	4.3	7.5	6.9	1.0	ZR335SPH731_0100 EZ813U	10	19	575	10.00	1.46	2.92	49	16	81	3	35	111.4
2.33	4.5	12	7.1	1.0	ZR335SPH731_0100 EZ815U	10	19	575	10.00	1.46	2.92	49	16	81	3	35	111.4
2.67	3.8	6.6	6.9	1.0	ZR340SPH731_0100 EZ813U	9.0	17	575	10.00	1.67	3.33	56	19	69	3	40	127.3
2.67	3.9	10	7.1	1.0	ZR340SPH731_0100 EZ815U	9.0	17	575	10.00	1.67	3.33	56	19	69	3	40	127.3
3.33	3.0	5.3	7.6	1.9	ZR335SPH731_0070 EZ813U	16	19	869	7.000	2.08	4.17	49	16	94	3	35	111.4
3.33	3.1	8.1	7.9	1.8	ZR335SPH731_0070 EZ815U	16	19	869	7.000	2.08	4.17	49	16	94	3	35	111.4
3.81	2.7	4.6	7.6	2.1	ZR340SPH731_0070 EZ813U	14	17	869	7.000	2.38	4.76	56	19	82	3	40	127.3
3.81	2.8	7.1	7.9	2.0	ZR340SPH731_0070 EZ815U	14	17	869	7.000	2.38	4.76	56	19	82	3	40	127.3
4.67	2.2	3.8	11	2.4	ZR335SPH731_0050 EZ813U	12	19	672	5.000	2.57	5.83	49	16	106	3	35	111.4

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZR3PH7 (n_{1N} = 4000 min^{-1}, ($F_{f2acc,max}$ = 16 kN)																	
4.67	2.2	5.8	12	2.3	ZR335SPH731_0050 EZ815U	16	19	869	5.000	2.57	5.83	49	16	106	3	35	111.4
5.33	1.9	3.3	11	2.7	ZR340SPH731_0050 EZ813U	11	17	672	5.000	2.93	6.67	56	19	93	3	40	127.3
5.33	2.0	5.1	12	2.6	ZR340SPH731_0050 EZ815U	14	17	879	5.000	2.93	6.67	56	19	93	3	40	127.3
5.83	1.7	3.0	15	2.8	ZR335SPH731_0040 EZ813U	9.7	19	538	4.000	2.77	5.83	49	16	113	3	35	111.4
5.83	1.8	4.6	16	2.7	ZR335SPH731_0040 EZ815U	14	19	768	4.000	2.77	5.83	49	16	113	3	35	111.4
6.67	1.5	2.6	15	3.1	ZR340SPH731_0040 EZ813U	8.4	17	538	4.000	3.17	6.67	56	19	100	3	40	127.3
6.67	1.6	4.0	16	3.0	ZR340SPH731_0040 EZ815U	12	17	768	4.000	3.17	6.67	56	19	100	3	40	127.3
ZR3PH7 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 16 kN)																	
0.53	7.9	13	2.2	1.1	ZR335SPH732_0500 EZ505U	15	19	830	50.00	0.43	0.82	49	16	97	3	35	111.4
0.66	6.3	10	2.8	1.2	ZR335SPH732_0400 EZ505U	14	19	770	40.00	0.54	1.02	49	16	99	3	35	111.4
0.75	5.6	8.9	2.6	1.6	ZR335SPH732_0350 EZ505U	16	19	866	35.00	0.62	1.17	49	16	99	3	35	111.4
0.75	7.1	12	3.3	1.2	ZR335SPH732_0350 EZ703U	16	19	866	35.00	0.62	1.17	49	16	99	3	35	111.4
0.86	4.9	7.8	2.6	1.6	ZR340SPH732_0350 EZ505U	14	17	866	35.00	0.71	1.33	56	19	87	3	40	127.3
0.86	6.2	10	3.3	1.2	ZR340SPH732_0350 EZ703U	14	17	866	35.00	0.71	1.33	56	19	87	3	40	127.3
0.94	4.4	7.2	2.9	2.0	ZR335SPH732_0280 EZ505U	14	19	770	28.00	0.77	1.46	49	16	102	3	35	111.4
0.94	5.7	9.3	3.7	1.5	ZR335SPH732_0280 EZ703U	14	19	770	28.00	0.77	1.46	49	16	102	3	35	111.4
0.94	7.7	14	5.0	1.1	ZR335SPH732_0280 EZ705U	14	19	770	28.00	0.77	1.46	49	16	102	3	35	111.4
1.05	4.0	6.4	3.2	2.1	ZR335SPH732_0250 EZ505U	16	19	866	25.00	0.82	1.63	49	16	100	3	35	111.4
1.05	5.1	8.3	4.1	1.6	ZR335SPH732_0250 EZ703U	16	19	866	25.00	0.82	1.63	49	16	100	3	35	111.4
1.05	6.8	13	5.6	1.2	ZR335SPH732_0250 EZ705U	16	19	866	25.00	0.82	1.63	49	16	100	3	35	111.4
1.07	3.9	6.3	2.9	2.0	ZR340SPH732_0280 EZ505U	12	17	770	28.00	0.88	1.67	56	19	90	3	40	127.3
1.07	4.9	8.2	3.7	1.5	ZR340SPH732_0280 EZ703U	12	17	770	28.00	0.88	1.67	56	19	90	3	40	127.3
1.07	6.7	12	5.0	1.1	ZR340SPH732_0280 EZ705U	12	17	770	28.00	0.88	1.67	56	19	90	3	40	127.3
1.20	3.5	5.6	3.2	2.1	ZR340SPH732_0250 EZ505U	14	17	866	25.00	0.93	1.87	56	19	87	3	40	127.3
1.20	4.4	7.3	4.1	1.6	ZR340SPH732_0250 EZ703U	14	17	866	25.00	0.93	1.87	56	19	87	3	40	127.3
1.20	6.0	11	5.6	1.2	ZR340SPH732_0250 EZ705U	14	17	866	25.00	0.93	1.87	56	19	87	3	40	127.3
1.31	3.2	5.1	3.7	2.5	ZR335SPH732_0200 EZ505U	14	19	805	20.00	0.88	1.75	49	16	101	3	35	111.4
1.31	4.0	6.7	4.7	2.0	ZR335SPH732_0200 EZ703U	14	19	805	20.00	0.88	1.75	49	16	101	3	35	111.4
1.31	5.5	10	6.4	1.4	ZR335SPH732_0200 EZ705U	14	19	805	20.00	0.88	1.75	49	16	101	3	35	111.4
1.50	2.8	4.5	3.7	2.6	ZR340SPH732_0200 EZ505U	13	17	805	20.00	1.00	2.00	56	19	88	3	40	127.3
1.50	3.5	5.8	4.7	2.0	ZR340SPH732_0200 EZ703U	13	17	805	20.00	1.00	2.00	56	19	88	3	40	127.3
1.50	4.8	8.8	6.4	1.5	ZR340SPH732_0200 EZ705U	13	17	805	20.00	1.00	2.00	56	19	88	3	40	127.3
1.64	2.5	4.1	4.1	2.9	ZR335SPH732_0160 EZ505U	13	19	740	16.00	1.09	2.19	49	16	104	3	35	111.4
1.64	3.2	5.3	5.3	2.3	ZR335SPH732_0160 EZ703U	13	19	740	16.00	1.09	2.19	49	16	104	3	35	111.4
1.64	4.4	8.0	7.1	1.7	ZR335SPH732_0160 EZ705U	13	19	740	16.00	1.09	2.19	49	16	104	3	35	111.4
1.88	2.2	3.6	4.1	3.2	ZR340SPH732_0160 EZ505U	12	17	740	16.00	1.25	2.50	56	19	92	3	40	127.3
1.88	2.8	4.7	5.3	2.5	ZR340SPH732_0160 EZ703U	12	17	740	16.00	1.25	2.50	56	19	92	3	40	127.3
1.88	3.8	7.0	7.1	1.8	ZR340SPH732_0160 EZ705U	12	17	740	16.00	1.25	2.50	56	19	92	3	40	127.3
2.63	2.1	3.4	3.4	2.1	ZR335SPH731_0100 EZ703U	10	19	575	10.00	1.46	2.92	49	16	81	3	35	111.4
2.63	2.8	5.2	4.7	1.5	ZR335SPH731_0100 EZ705U	10	19	575	10.00	1.46	2.92	49	16	81	3	35	111.4
3.00	1.8	3.0	3.4	2.1	ZR340SPH731_0100 EZ703U	9.0	17	575	10.00	1.67	3.33	56	19	69	3	40	127.3
3.00	2.5	4.5	4.7	1.5	ZR340SPH731_0100 EZ705U	9.0	17	575	10.00	1.67	3.33	56	19	69	3	40	127.3
3.75	1.5	2.4	3.8	3.8	ZR335SPH731_0070 EZ703U	7.8	19	437	7.000	2.08	4.17	49	16	94	3	35	111.4
3.75	2.0	3.6	5.2	2.8	ZR335SPH731_0070 EZ705U	13	19	699	7.000	2.08	4.17	49	16	94	3	35	111.4
4.29	1.3	2.1	3.8	4.1	ZR340SPH731_0070 EZ703U	6.9	17	437	7.000	2.38	4.76	56	19	82	3	40	127.3
4.29	1.7	3.2	5.2	3.0	ZR340SPH731_0070 EZ705U	11	17	699	7.000	2.38	4.76	56	19	82	3	40	127.3
5.25	1.0	1.7	5.7	4.8	ZR335SPH731_0050 EZ703U	5.6	19	312	5.000	2.57	5.83	49	16	106	3	35	111.4
5.25	1.4	2.6	7.7	3.5	ZR335SPH731_0050 EZ705U	9.0	19	499	5.000	2.57	5.83	49	16	106	3	35	111.4
6.00	1.2	2.3	7.7	4.0	ZR340SPH731_0050 EZ705U	7.8	17	499	5.000	2.93	6.67	56	19	93	3	40	127.3
ZR3PH7 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 16 kN)																	
0.50	4.0	5.1	0.7	2.0	ZR335SPH732_0700 EZ501U	15	19	809	70.00	0.31	0.58	49	16	91	3	35	111.4
0.50	6.1	9.1	1.1	1.3	ZR335SPH732_0700 EZ502U	15	19	809	70.00	0.31	0.58	49	16	91	3	35	111.4
0.50	6.1	9.2	1.1	1.3	ZR335SPH732_0700 EZ701U	15	19	809	70.00	0.31	0.58	49	16	91	3	35	111.4
0.50	7.2	12	1.3	1.1	ZR335SPH732_0700 EZ503U	15	19	809	70.00	0.31	0.58	49	16	91	3	35	111.4
0.57	3.5	4.5	0.7	2.0	ZR340SPH732_0700 EZ501U	13	17	809	70.00	0.35	0.67	56	19	78	3	40	127.3
0.57	5.3	8.0	1.1	1.3	ZR340SPH732_0700 EZ502U	13	17	809	70.00	0.35	0.67	56	19	78	3	40	127.3
0.57	5.3	8.1	1.1	1.3	ZR340SPH732_0700 EZ701U	13	17	809	70.00	0.35	0.67	56	19	78	3	40	127.3
0.57	6.3	11	1.3	1.1	ZR340SPH732_0700 EZ503U	13	17	809	70.00	0.35	0.67	56	19	78	3	40	127.3
0.70	2.8	3.7	0.9	2.8	ZR335SPH732_0500 EZ501U	13	19	744	50.00	0.43	0.82	49	16	97	3	35	111.4
0.70	4.3	6.5	1.3	1.8	ZR335SPH732_0500 EZ502U	15	19	830	50.00	0.43	0.82	49	16	97	3	35	111.4
0.70	4.3	6.6	1.3	1.8	ZR335SPH732_0500 EZ701U	15	19	830	50.00	0.43	0.82	49	16	97	3	35	111.4
0.70	5.2	8.8	1.6	1.5	ZR335SPH732_0500 EZ503U	15	19	830	50.00	0.43	0.82	49	16	97	3	35	111.4
0.70	6.0	12	1.8	1.3	ZR335SPH732_0500 EZ702U	15	19	830	50.00	0.43	0.82	49	16	97	3	35	111.4
0.80	2.5	3.2	0.9	2.8	ZR340SPH732_0500 EZ501U	12	17	744	50.00	0.49	0.93	56	19	85	3	40	127.3
0.80	3.8	5.7	1.3	1.8	ZR340SPH732_0500 EZ502U	13	17	830	50.00	0.49	0.93	56	19	85	3	40	127.3
0.80	3.8	5.8	1.3	1.8	ZR340SPH732_0500 EZ701U	13	17	830	50.00	0.49	0.93	56	19	85	3	40	127.3

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZR3PH7 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 16 kN)																	
0.80	4.5	7.7	1.6	1.5	ZR340SPH732_0500 EZ503U	13	17	830	50.00	0.49	0.93	56	19	85	3	40	127.3
0.80	5.3	10	1.8	1.3	ZR340SPH732_0500 EZ702U	13	17	830	50.00	0.49	0.93	56	19	85	3	40	127.3
0.88	2.3	2.9	1.1	3.0	ZR335SPH732_0400 EZ501U	11	19	595	40.00	0.54	1.02	49	16	99	3	35	111.4
0.88	3.5	5.2	1.7	1.9	ZR335SPH732_0400 EZ502U	14	19	770	40.00	0.54	1.02	49	16	99	3	35	111.4
0.88	3.5	5.3	1.7	1.9	ZR335SPH732_0400 EZ701U	13	19	744	40.00	0.54	1.02	49	16	99	3	35	111.4
0.88	4.1	7.1	2.0	1.6	ZR335SPH732_0400 EZ503U	14	19	770	40.00	0.54	1.02	49	16	99	3	35	111.4
0.88	4.8	9.5	2.4	1.4	ZR335SPH732_0400 EZ702U	14	19	770	40.00	0.54	1.02	49	16	99	3	35	111.4
1.00	2.0	2.6	1.0	4.0	ZR335SPH732_0350 EZ501U	9.3	19	521	35.00	0.62	1.17	49	16	99	3	35	111.4
1.00	2.0	2.6	1.1	3.0	ZR340SPH732_0400 EZ501U	9.3	17	595	40.00	0.62	1.17	56	19	86	3	40	127.3
1.00	3.0	4.6	1.6	2.6	ZR335SPH732_0350 EZ502U	16	19	866	35.00	0.62	1.17	49	16	99	3	35	111.4
1.00	3.0	4.6	1.7	1.9	ZR340SPH732_0400 EZ502U	12	17	770	40.00	0.62	1.17	56	19	86	3	40	127.3
1.00	3.0	4.6	1.6	2.6	ZR335SPH732_0350 EZ701U	12	19	651	35.00	0.62	1.17	49	16	99	3	35	111.4
1.00	3.0	4.6	1.7	1.9	ZR340SPH732_0400 EZ701U	12	17	744	40.00	0.62	1.17	56	19	86	3	40	127.3
1.00	3.0	4.6	1.6	2.6	ZR335SPH732_0350 EZ701U	12	19	651	35.00	0.62	1.17	49	16	99	3	35	111.4
1.00	3.6	6.2	1.9	2.2	ZR335SPH732_0350 EZ503U	16	19	866	35.00	0.62	1.17	49	16	99	3	35	111.4
1.00	3.6	6.2	2.0	1.6	ZR340SPH732_0400 EZ503U	12	17	770	40.00	0.62	1.17	56	19	86	3	40	127.3
1.00	4.2	8.4	2.4	1.4	ZR340SPH732_0400 EZ702U	12	17	770	40.00	0.62	1.17	56	19	86	3	40	127.3
1.00	4.2	8.4	2.2	1.9	ZR335SPH732_0350 EZ702U	16	19	866	35.00	0.62	1.17	49	16	99	3	35	111.4
1.00	4.2	8.4	2.4	1.4	ZR340SPH732_0400 EZ702U	12	17	770	40.00	0.62	1.17	56	19	86	3	40	127.3
1.14	1.7	2.2	1.0	4.0	ZR340SPH732_0350 EZ501U	8.2	17	521	35.00	0.71	1.33	56	19	87	3	40	127.3
1.14	2.7	4.0	1.6	2.6	ZR340SPH732_0350 EZ502U	14	17	866	35.00	0.71	1.33	56	19	87	3	40	127.3
1.14	2.7	4.0	1.6	2.6	ZR340SPH732_0350 EZ701U	10	17	651	35.00	0.71	1.33	56	19	87	3	40	127.3
1.14	3.2	5.4	1.9	2.2	ZR340SPH732_0350 EZ503U	14	17	866	35.00	0.71	1.33	56	19	87	3	40	127.3
1.14	3.7	7.3	2.2	1.9	ZR340SPH732_0350 EZ702U	14	17	866	35.00	0.71	1.33	56	19	87	3	40	127.3
1.25	1.6	2.1	1.1	5.0	ZR335SPH732_0280 EZ501U	7.5	19	417	28.00	0.77	1.46	49	16	102	3	35	111.4
1.25	2.4	3.6	1.7	3.2	ZR335SPH732_0280 EZ502U	14	19	770	28.00	0.77	1.46	49	16	102	3	35	111.4
1.25	2.4	3.7	1.7	3.2	ZR335SPH732_0280 EZ701U	9.3	19	521	28.00	0.77	1.46	49	16	102	3	35	111.4
1.25	2.9	5.0	2.1	2.7	ZR335SPH732_0280 EZ503U	14	19	770	28.00	0.77	1.46	49	16	102	3	35	111.4
1.25	3.4	6.7	2.4	2.3	ZR335SPH732_0280 EZ702U	14	19	770	28.00	0.77	1.46	49	16	102	3	35	111.4
1.40	2.2	3.3	2.0	3.4	ZR335SPH732_0250 EZ502U	13	19	721	25.00	0.82	1.63	49	16	100	3	35	111.4
1.40	2.2	3.3	2.0	3.4	ZR335SPH732_0250 EZ701U	8.3	19	465	25.00	0.82	1.63	49	16	100	3	35	111.4
1.40	2.6	4.4	2.3	2.9	ZR335SPH732_0250 EZ503U	16	19	866	25.00	0.82	1.63	49	16	100	3	35	111.4
1.40	3.0	6.0	2.7	2.5	ZR335SPH732_0250 EZ702U	16	19	866	25.00	0.82	1.63	49	16	100	3	35	111.4
1.43	1.4	1.8	1.1	5.0	ZR340SPH732_0280 EZ501U	6.5	17	417	28.00	0.88	1.67	56	19	90	3	40	127.3
1.43	2.1	3.2	1.7	3.2	ZR340SPH732_0280 EZ502U	12	17	770	28.00	0.88	1.67	56	19	90	3	40	127.3
1.43	2.1	3.2	1.7	3.2	ZR340SPH732_0280 EZ701U	8.2	17	521	28.00	0.88	1.67	56	19	90	3	40	127.3
1.43	2.5	4.3	2.1	2.7	ZR340SPH732_0280 EZ503U	12	17	770	28.00	0.88	1.67	56	19	90	3	40	127.3
1.43	2.9	5.8	2.4	2.3	ZR340SPH732_0280 EZ702U	12	17	770	28.00	0.88	1.67	56	19	90	3	40	127.3
1.60	1.9	2.8	2.0	3.4	ZR340SPH732_0250 EZ502U	11	17	721	25.00	0.93	1.87	56	19	87	3	40	127.3
1.60	1.9	2.9	2.0	3.4	ZR340SPH732_0250 EZ701U	7.3	17	465	25.00	0.93	1.87	56	19	87	3	40	127.3
1.60	2.3	3.9	2.3	2.9	ZR340SPH732_0250 EZ503U	14	17	866	25.00	0.93	1.87	56	19	87	3	40	127.3
1.60	2.6	5.2	2.7	2.5	ZR340SPH732_0250 EZ702U	14	17	866	25.00	0.93	1.87	56	19	87	3	40	127.3
1.75	1.7	2.6	2.2	4.1	ZR335SPH732_0200 EZ502U	10	19	577	20.00	0.88	1.75	49	16	101	3	35	111.4
1.75	1.7	2.6	2.2	4.1	ZR335SPH732_0200 EZ701U	6.7	19	372	20.00	0.88	1.75	49	16	101	3	35	111.4
1.75	2.1	3.5	2.6	3.5	ZR335SPH732_0200 EZ503U	14	19	800	20.00	0.88	1.75	49	16	101	3	35	111.4
1.75	2.4	4.8	3.1	3.0	ZR335SPH732_0200 EZ702U	14	19	763	20.00	0.88	1.75	49	16	101	3	35	111.4
2.00	1.5	2.3	2.2	4.2	ZR340SPH732_0200 EZ502U	9.1	17	577	20.00	1.00	2.00	56	19	88	3	40	127.3
2.00	1.5	2.3	2.2	4.2	ZR340SPH732_0200 EZ701U	5.8	17	372	20.00	1.00	2.00	56	19	88	3	40	127.3
2.00	1.8	3.1	2.6	3.6	ZR340SPH732_0200 EZ503U	13	17	800	20.00	1.00	2.00	56	19	88	3	40	127.3
2.00	2.1	4.2	3.1	3.1	ZR340SPH732_0200 EZ702U	12	17	763	20.00	1.00	2.00	56	19	88	3	40	127.3
2.19	1.4	2.1	2.5	4.8	ZR335SPH732_0160 EZ502U	8.3	19	461	16.00	1.09	2.19	49	16	104	3	35	111.4
2.19	1.4	2.1	2.5	4.8	ZR335SPH732_0160 EZ701U	5.3	19	298	16.00	1.09	2.19	49	16	104	3	35	111.4
2.19	1.7	2.8	3.0	4.0	ZR335SPH732_0160 EZ503U	11	19	640	16.00	1.09	2.19	49	16	104	3	35	111.4
2.19	1.9	3.8	3.4	3.5	ZR335SPH732_0160 EZ702U	11	19	610	16.00	1.09	2.19	49	16	104	3	35	111.4
2.50	1.4	2.5	3.0	4.4	ZR340SPH732_0160 EZ503U	10	17	640	16.00	1.25	2.50	56	19	92	3	40	127.3
2.50	1.7	3.3	3.4	3.8	ZR340SPH732_0160 EZ702U	9.6	17	610	16.00	1.25	2.50	56	19	92	3	40	127.3
ZR4PH7 (n_{1N} = 2000 min^{-1}, ($F_{f2acc,max}$ = 14 kN)																	
1.91	4.1	4.6	9.4	1.7	ZR430SPH731_0070 EZ813U	14	17	869	7.000	2.38	4.76	56	19	80	4	30	127.3
1.91	6.1	7.3	14	1.1	ZR430SPH731_0070 EZ815U	14	17	869	7.000	2.38	4.76	56	19	80	4	30	127.3
2.67	2.9	3.3	14	2.1	ZR430SPH731_0050 EZ813U	11	17	672	5.000	2.93	6.67	56	19	91	4	30	127.3
2.67	4.4	5.2	21	1.4	ZR430SPH731_0050 EZ815U	14	17	882	5.000	2.93	6.67	56	19	91	4	30	127.3
3.33	2.4	2.6	18	2.5	ZR430SPH731_0040 EZ813U	8.4	17	538	4.000	3.17	6.67	56	19	98	4	30	127.3
3.33	3.5	4.1	27	1.7	ZR430SPH731_0040 EZ815U	12	17	768	4.000	3.17	6.67	56	19	98	4	30	127.3
ZR4PH7 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 14 kN)																	
0.29	4.4	4.8	0.7	2.0	ZR430SPH732_0700 EZ501U	13	17	809	70.00	0.35	0.67	56	19	77	4	30	127.3
0.29	7.6	8.2	1.2	1.2	ZR430SPH732_0700 EZ502U	13	17	809	70.00	0.35	0.67	56	19	77	4	30	127.3

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZR4PH7 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 14 kN)																	
0.29	7.6	8.5	1.2	1.2	ZR430SPH732_0700 EZ701U	13	17	809	70.00	0.35	0.67	56	19	77	4	30	127.3
0.40	3.1	3.4	0.9	2.8	ZR430SPH732_0500 EZ501U	12	17	744	50.00	0.49	0.93	56	19	83	4	30	127.3
0.40	5.4	5.8	1.5	1.6	ZR430SPH732_0500 EZ502U	13	17	830	50.00	0.49	0.93	56	19	83	4	30	127.3
0.40	5.4	6.1	1.5	1.6	ZR430SPH732_0500 EZ701U	13	17	830	50.00	0.49	0.93	56	19	83	4	30	127.3
0.40	7.1	8.1	1.9	1.2	ZR430SPH732_0500 EZ503U	13	17	830	50.00	0.49	0.93	56	19	83	4	30	127.3
0.50	2.5	2.7	1.1	3.0	ZR430SPH732_0400 EZ501U	9.3	17	595	40.00	0.62	1.17	56	19	85	4	30	127.3
0.50	4.3	4.7	1.9	1.7	ZR430SPH732_0400 EZ502U	12	17	770	40.00	0.62	1.17	56	19	85	4	30	127.3
0.50	4.3	4.8	1.9	1.7	ZR430SPH732_0400 EZ701U	12	17	744	40.00	0.62	1.17	56	19	85	4	30	127.3
0.50	5.7	6.5	2.5	1.3	ZR430SPH732_0400 EZ503U	12	17	770	40.00	0.62	1.17	56	19	85	4	30	127.3
0.50	7.0	8.4	3.1	1.1	ZR430SPH732_0400 EZ702U	12	17	770	40.00	0.62	1.17	56	19	85	4	30	127.3
0.57	2.2	2.4	1.1	3.9	ZR430SPH732_0350 EZ501U	8.2	17	521	35.00	0.71	1.33	56	19	85	4	30	127.3
0.57	3.8	4.1	1.8	2.2	ZR430SPH732_0350 EZ502U	14	17	866	35.00	0.71	1.33	56	19	85	4	30	127.3
0.57	3.8	4.2	1.8	2.2	ZR430SPH732_0350 EZ701U	10	17	651	35.00	0.71	1.33	56	19	85	4	30	127.3
0.57	5.0	5.7	2.4	1.7	ZR430SPH732_0350 EZ503U	14	17	866	35.00	0.71	1.33	56	19	85	4	30	127.3
0.57	6.1	7.4	2.9	1.4	ZR430SPH732_0350 EZ702U	14	17	866	35.00	0.71	1.33	56	19	85	4	30	127.3
0.57	6.9	8.2	3.3	1.2	ZR430SPH732_0350 EZ505U	14	17	866	35.00	0.71	1.33	56	19	85	4	30	127.3
0.57	8.4	11	4.0	1.0	ZR430SPH732_0350 EZ703U	14	17	866	35.00	0.71	1.33	56	19	85	4	30	127.3
0.71	1.8	1.9	1.2	4.8	ZR430SPH732_0280 EZ501U	6.5	17	417	28.00	0.88	1.67	56	19	88	4	30	127.3
0.71	3.0	3.3	2.0	2.8	ZR430SPH732_0280 EZ502U	12	17	770	28.00	0.88	1.67	56	19	88	4	30	127.3
0.71	3.0	3.4	2.0	2.8	ZR430SPH732_0280 EZ701U	8.2	17	521	28.00	0.88	1.67	56	19	88	4	30	127.3
0.71	4.0	4.5	2.7	2.1	ZR430SPH732_0280 EZ503U	12	17	770	28.00	0.88	1.67	56	19	88	4	30	127.3
0.71	4.9	5.9	3.3	1.7	ZR430SPH732_0280 EZ702U	12	17	770	28.00	0.88	1.67	56	19	88	4	30	127.3
0.71	5.5	6.5	3.7	1.5	ZR430SPH732_0280 EZ505U	12	17	770	28.00	0.88	1.67	56	19	88	4	30	127.3
0.71	6.7	8.5	4.5	1.3	ZR430SPH732_0280 EZ703U	12	17	770	28.00	0.88	1.67	56	19	88	4	30	127.3
0.80	2.7	2.9	2.3	2.9	ZR430SPH732_0250 EZ502U	11	17	721	25.00	0.93	1.87	56	19	86	4	30	127.3
0.80	2.7	3.0	2.3	2.9	ZR430SPH732_0250 EZ701U	7.3	17	465	25.00	0.93	1.87	56	19	86	4	30	127.3
0.80	3.5	4.1	3.0	2.2	ZR430SPH732_0250 EZ503U	14	17	866	25.00	0.93	1.87	56	19	86	4	30	127.3
0.80	4.4	5.3	3.8	1.8	ZR430SPH732_0250 EZ702U	14	17	866	25.00	0.93	1.87	56	19	86	4	30	127.3
0.80	4.9	5.8	4.2	1.6	ZR430SPH732_0250 EZ505U	14	17	866	25.00	0.93	1.87	56	19	86	4	30	127.3
0.80	6.0	7.6	5.2	1.3	ZR430SPH732_0250 EZ703U	14	17	866	25.00	0.93	1.87	56	19	86	4	30	127.3
0.80	7.8	11	6.7	1.0	ZR430SPH732_0250 EZ705U	14	17	866	25.00	0.93	1.87	56	19	86	4	30	127.3
1.00	2.2	2.3	2.8	3.3	ZR430SPH732_0200 EZ502U	9.1	17	577	20.00	1.00	2.00	56	19	86	4	30	127.3
1.00	2.2	2.4	2.8	3.3	ZR430SPH732_0200 EZ701U	5.8	17	372	20.00	1.00	2.00	56	19	86	4	30	127.3
1.00	2.8	3.2	3.7	2.6	ZR430SPH732_0200 EZ503U	13	17	800	20.00	1.00	2.00	56	19	86	4	30	127.3
1.00	3.5	4.2	4.6	2.1	ZR430SPH732_0200 EZ702U	12	17	763	20.00	1.00	2.00	56	19	86	4	30	127.3
1.00	3.9	4.7	5.1	1.8	ZR430SPH732_0200 EZ505U	13	17	805	20.00	1.00	2.00	56	19	86	4	30	127.3
1.00	4.8	6.1	6.3	1.5	ZR430SPH732_0200 EZ703U	13	17	805	20.00	1.00	2.00	56	19	86	4	30	127.3
1.00	6.2	8.8	8.1	1.2	ZR430SPH732_0200 EZ705U	13	17	805	20.00	1.00	2.00	56	19	86	4	30	127.3
1.25	1.7	1.9	3.2	4.1	ZR430SPH732_0160 EZ502U	7.2	17	461	16.00	1.25	2.50	56	19	90	4	30	127.3
1.25	1.7	1.9	3.2	4.1	ZR430SPH732_0160 EZ701U	4.7	17	298	16.00	1.25	2.50	56	19	90	4	30	127.3
1.25	2.3	2.6	4.2	3.1	ZR430SPH732_0160 EZ503U	10	17	640	16.00	1.25	2.50	56	19	90	4	30	127.3
1.25	2.8	3.4	5.2	2.5	ZR430SPH732_0160 EZ702U	9.6	17	610	16.00	1.25	2.50	56	19	90	4	30	127.3
1.25	3.2	3.7	5.9	2.2	ZR430SPH732_0160 EZ505U	12	17	740	16.00	1.25	2.50	56	19	90	4	30	127.3
1.25	3.9	4.9	7.2	1.8	ZR430SPH732_0160 EZ703U	12	17	740	16.00	1.25	2.50	56	19	90	4	30	127.3
1.25	5.0	7.1	9.2	1.4	ZR430SPH732_0160 EZ705U	12	17	740	16.00	1.25	2.50	56	19	90	4	30	127.3
2.00	1.1	1.3	1.8	3.9	ZR430SPH731_0100 EZ701U	3.0	17	192	10.00	1.67	3.33	56	19	68	4	30	127.3
2.00	1.8	2.2	3.0	2.4	ZR430SPH731_0100 EZ702U	6.2	17	394	10.00	1.67	3.33	56	19	68	4	30	127.3
2.00	2.5	3.1	4.1	1.8	ZR430SPH731_0100 EZ703U	9.0	17	575	10.00	1.67	3.33	56	19	68	4	30	127.3
2.00	3.2	4.6	5.3	1.4	ZR430SPH731_0100 EZ705U	9.0	17	575	10.00	1.67	3.33	56	19	68	4	30	127.3
2.86	1.3	1.5	3.3	4.8	ZR430SPH731_0070 EZ702U	4.3	17	276	7.000	2.38	4.76	56	19	80	4	30	127.3
2.86	1.7	2.2	4.5	3.5	ZR430SPH731_0070 EZ703U	6.9	17	437	7.000	2.38	4.76	56	19	80	4	30	127.3
2.86	2.2	3.2	5.9	2.7	ZR430SPH731_0070 EZ705U	11	17	699	7.000	2.38	4.76	56	19	80	4	30	127.3
4.00	1.2	1.6	6.8	4.4	ZR430SPH731_0050 EZ703U	4.9	17	312	5.000	2.93	6.67	56	19	91	4	30	127.3
4.00	1.6	2.3	8.8	3.4	ZR430SPH731_0050 EZ705U	7.8	17	499	5.000	2.93	6.67	56	19	91	4	30	127.3
5.00	1.3	1.8	11	4.0	ZR430SPH731_0040 EZ705U	6.3	14	399	4.000	3.17	6.67	56	19	98	4	30	127.3
ZR4PH7 (n_{1N} = 4000 min^{-1}, ($F_{f2acc,max}$ = 14 kN)																	
2.67	3.8	6.6	6.9	1.0	ZR430SPH731_0100 EZ813U	9.0	17	575	10.00	1.67	3.33	56	19	68	4	30	127.3
2.67	3.9	10	7.1	1.0	ZR430SPH731_0100 EZ815U	9.0	17	575	10.00	1.67	3.33	56	19	68	4	30	127.3
3.81	2.7	4.6	7.6	2.1	ZR430SPH731_0070 EZ813U	14	17	869	7.000	2.38	4.76	56	19	80	4	30	127.3
3.81	2.8	7.1	7.9	2.0	ZR430SPH731_0070 EZ815U	14	17	869	7.000	2.38	4.76	56	19	80	4	30	127.3
5.33	1.9	3.3	11	2.6	ZR430SPH731_0050 EZ813U	11	17	672	5.000	2.93	6.67	56	19	91	4	30	127.3
5.33	2.0	5.1	12	2.5	ZR430SPH731_0050 EZ815U	14	17	882	5.000	2.93	6.67	56	19	91	4	30	127.3
6.67	1.5	2.6	15	3.0	ZR430SPH731_0040 EZ813U	8.4	17	538	4.000	3.17	6.67	56	19	98	4	30	127.3
6.67	1.6	4.0	16	2.9	ZR430SPH731_0040 EZ815U	12	17	768	4.000	3.17	6.67	56	19	98	4	30	127.3

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2acc} [kN]	F_{f2NOT} [kN]	M_{2acc} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{lin} [N/µm]	m_n [mm]	z	d_0 [mm]
ZR4PH7 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 14 kN)																	
0.60	6.9	11	2.2	1.1	ZR430SPH732_0500 EZ505U	13	17	830	50.00	0.49	0.93	56	19	83	4	30	127.3
0.75	5.6	8.9	2.8	1.2	ZR430SPH732_0400 EZ505U	12	17	770	40.00	0.62	1.17	56	19	85	4	30	127.3
0.86	4.9	7.8	2.6	1.6	ZR430SPH732_0350 EZ505U	14	17	866	35.00	0.71	1.33	56	19	85	4	30	127.3
0.86	6.2	10	3.3	1.2	ZR430SPH732_0350 EZ703U	14	17	866	35.00	0.71	1.33	56	19	85	4	30	127.3
1.07	3.9	6.3	2.9	2.0	ZR430SPH732_0280 EZ505U	12	17	770	28.00	0.88	1.67	56	19	88	4	30	127.3
1.07	4.9	8.2	3.7	1.5	ZR430SPH732_0280 EZ703U	12	17	770	28.00	0.88	1.67	56	19	88	4	30	127.3
1.07	6.7	12	5.0	1.1	ZR430SPH732_0280 EZ705U	12	17	770	28.00	0.88	1.67	56	19	88	4	30	127.3
1.20	3.5	5.6	3.2	2.1	ZR430SPH732_0250 EZ505U	14	17	866	25.00	0.93	1.87	56	19	86	4	30	127.3
1.20	4.4	7.3	4.1	1.6	ZR430SPH732_0250 EZ703U	14	17	866	25.00	0.93	1.87	56	19	86	4	30	127.3
1.20	6.0	11	5.6	1.2	ZR430SPH732_0250 EZ705U	14	17	866	25.00	0.93	1.87	56	19	86	4	30	127.3
1.50	2.8	4.5	3.7	2.6	ZR430SPH732_0200 EZ505U	13	17	805	20.00	1.00	2.00	56	19	86	4	30	127.3
1.50	3.5	5.8	4.7	2.0	ZR430SPH732_0200 EZ703U	13	17	805	20.00	1.00	2.00	56	19	86	4	30	127.3
1.50	4.8	8.8	6.4	1.5	ZR430SPH732_0200 EZ705U	13	17	805	20.00	1.00	2.00	56	19	86	4	30	127.3
1.88	2.2	3.6	4.1	3.2	ZR430SPH732_0160 EZ505U	12	17	740	16.00	1.25	2.50	56	19	90	4	30	127.3
1.88	2.8	4.7	5.3	2.5	ZR430SPH732_0160 EZ703U	12	17	740	16.00	1.25	2.50	56	19	90	4	30	127.3
1.88	3.8	7.0	7.1	1.8	ZR430SPH732_0160 EZ705U	12	17	740	16.00	1.25	2.50	56	19	90	4	30	127.3
3.00	1.8	3.0	3.4	2.1	ZR430SPH731_0100 EZ703U	9.0	17	575	10.00	1.67	3.33	56	19	68	4	30	127.3
3.00	2.5	4.5	4.7	1.5	ZR430SPH731_0100 EZ705U	9.0	17	575	10.00	1.67	3.33	56	19	68	4	30	127.3
4.29	1.3	2.1	3.8	4.1	ZR430SPH731_0070 EZ703U	6.9	17	437	7.000	2.38	4.76	56	19	80	4	30	127.3
4.29	1.7	3.2	5.2	3.0	ZR430SPH731_0070 EZ705U	11	17	699	7.000	2.38	4.76	56	19	80	4	30	127.3
6.00	1.2	2.3	7.7	3.9	ZR430SPH731_0050 EZ705U	7.8	17	499	5.000	2.93	6.67	56	19	91	4	30	127.3
ZR4PH7 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 14 kN)																	
0.57	3.5	4.5	0.7	2.0	ZR430SPH732_0700 EZ501U	13	17	809	70.00	0.35	0.67	56	19	77	4	30	127.3
0.57	5.3	8.0	1.1	1.3	ZR430SPH732_0700 EZ502U	13	17	809	70.00	0.35	0.67	56	19	77	4	30	127.3
0.57	5.3	8.1	1.1	1.3	ZR430SPH732_0700 EZ701U	13	17	809	70.00	0.35	0.67	56	19	77	4	30	127.3
0.57	6.3	11	1.3	1.1	ZR430SPH732_0700 EZ503U	13	17	809	70.00	0.35	0.67	56	19	77	4	30	127.3
0.80	2.5	3.2	0.9	2.8	ZR430SPH732_0500 EZ501U	12	17	744	50.00	0.49	0.93	56	19	83	4	30	127.3
0.80	3.8	5.7	1.3	1.8	ZR430SPH732_0500 EZ502U	13	17	830	50.00	0.49	0.93	56	19	83	4	30	127.3
0.80	3.8	5.8	1.3	1.8	ZR430SPH732_0500 EZ701U	13	17	830	50.00	0.49	0.93	56	19	83	4	30	127.3
0.80	4.5	7.7	1.6	1.5	ZR430SPH732_0500 EZ503U	13	17	830	50.00	0.49	0.93	56	19	83	4	30	127.3
0.80	5.3	10	1.8	1.3	ZR430SPH732_0500 EZ702U	13	17	830	50.00	0.49	0.93	56	19	83	4	30	127.3
1.00	2.0	2.6	1.1	3.0	ZR430SPH732_0400 EZ501U	9.3	17	595	40.00	0.62	1.17	56	19	85	4	30	127.3
1.00	3.0	4.6	1.7	1.9	ZR430SPH732_0400 EZ502U	12	17	770	40.00	0.62	1.17	56	19	85	4	30	127.3
1.00	3.0	4.6	1.7	1.9	ZR430SPH732_0400 EZ701U	12	17	744	40.00	0.62	1.17	56	19	85	4	30	127.3
1.00	3.6	6.2	2.0	1.6	ZR430SPH732_0400 EZ503U	12	17	770	40.00	0.62	1.17	56	19	85	4	30	127.3
1.00	4.2	8.4	2.4	1.4	ZR430SPH732_0400 EZ702U	12	17	770	40.00	0.62	1.17	56	19	85	4	30	127.3
1.14	1.7	2.2	1.0	4.0	ZR430SPH732_0350 EZ501U	8.2	17	521	35.00	0.71	1.33	56	19	85	4	30	127.3
1.14	2.7	4.0	1.6	2.6	ZR430SPH732_0350 EZ502U	14	17	866	35.00	0.71	1.33	56	19	85	4	30	127.3
1.14	2.7	4.0	1.6	2.6	ZR430SPH732_0350 EZ701U	10	17	651	35.00	0.71	1.33	56	19	85	4	30	127.3
1.14	3.2	5.4	1.9	2.2	ZR430SPH732_0350 EZ503U	14	17	866	35.00	0.71	1.33	56	19	85	4	30	127.3
1.14	3.7	7.3	2.2	1.9	ZR430SPH732_0350 EZ702U	14	17	866	35.00	0.71	1.33	56	19	85	4	30	127.3
1.43	1.4	1.8	1.1	5.0	ZR430SPH732_0280 EZ501U	6.5	17	417	28.00	0.88	1.67	56	19	88	4	30	127.3
1.43	2.1	3.2	1.7	3.2	ZR430SPH732_0280 EZ502U	12	17	770	28.00	0.88	1.67	56	19	88	4	30	127.3
1.43	2.1	3.2	1.7	3.2	ZR430SPH732_0280 EZ701U	8.2	17	521	28.00	0.88	1.67	56	19	88	4	30	127.3
1.43	2.5	4.3	2.1	2.7	ZR430SPH732_0280 EZ503U	12	17	770	28.00	0.88	1.67	56	19	88	4	30	127.3
1.43	2.9	5.8	2.4	2.3	ZR430SPH732_0280 EZ702U	12	17	770	28.00	0.88	1.67	56	19	88	4	30	127.3
1.60	1.9	2.8	2.0	3.4	ZR430SPH732_0250 EZ502U	11	17	721	25.00	0.93	1.87	56	19	86	4	30	127.3
1.60	1.9	2.9	2.0	3.4	ZR430SPH732_0250 EZ701U	7.3	17	465	25.00	0.93	1.87	56	19	86	4	30	127.3
1.60	2.3	3.9	2.3	2.9	ZR430SPH732_0250 EZ503U	14	17	866	25.00	0.93	1.87	56	19	86	4	30	127.3
1.60	2.6	5.2	2.7	2.5	ZR430SPH732_0250 EZ702U	14	17	866	25.00	0.93	1.87	56	19	86	4	30	127.3
2.00	1.5	2.3	2.2	4.2	ZR430SPH732_0200 EZ502U	9.1	17	577	20.00	1.00	2.00	56	19	86	4	30	127.3
2.00	1.5	2.3	2.2	4.2	ZR430SPH732_0200 EZ701U	5.8	17	372	20.00	1.00	2.00	56	19	86	4	30	127.3
2.00	1.8	3.1	2.6	3.6	ZR430SPH732_0200 EZ503U	13	17	800	20.00	1.00	2.00	56	19	86	4	30	127.3
2.00	2.1	4.2	3.1	3.1	ZR430SPH732_0200 EZ702U	12	17	763	20.00	1.00	2.00	56	19	86	4	30	127.3
2.50	1.4	2.5	3.0	4.4	ZR430SPH732_0160 EZ503U	10	17	640	16.00	1.25	2.50	56	19	90	4	30	127.3
2.50	1.7	3.3	3.4	3.8	ZR430SPH732_0160 EZ702U	9.6	17	610	16.00	1.25	2.50	56	19	90	4	30	127.3

7.3 Dimensional drawings

This chapter shows you the dimensions of rack and pinion drives with EZ synchronous servo motors.

Dimension az in the tables of dimensions applies to STOBER gear racks. In general: az = ½ d0 + h0 + x*mn

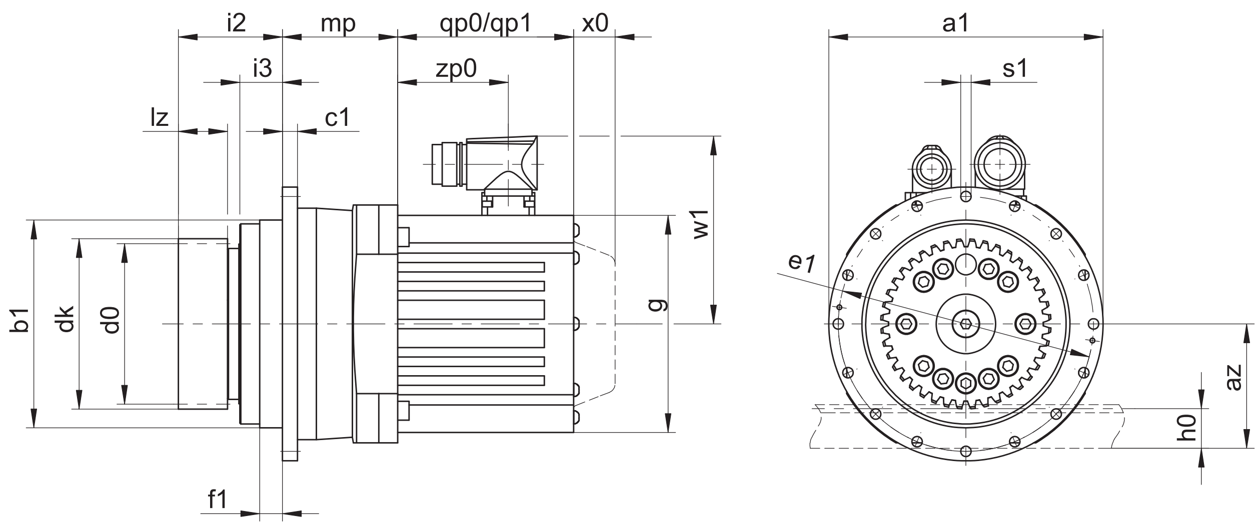
The pinion is helical (left-hand 19° 31' 42"). The pinion gearing quality is 5.

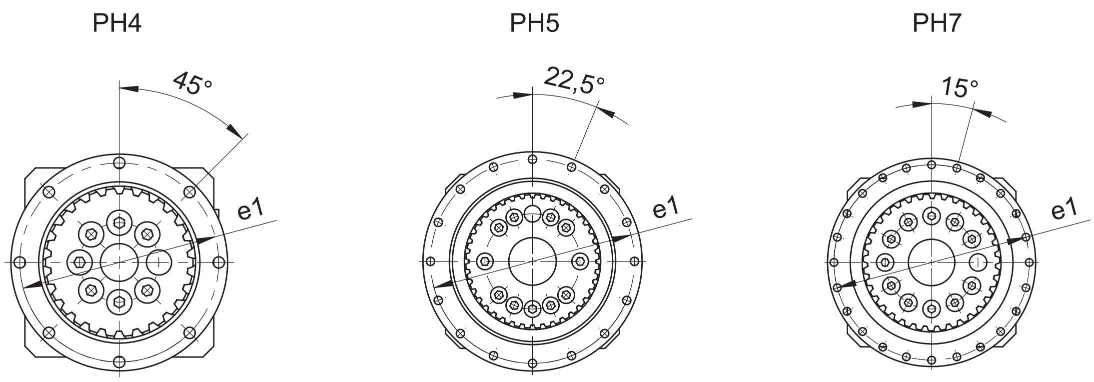
Dimensions can exceed the specifications of ISO 2768-mK due to casting tolerances or accumulation of individual tolerances.

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

You can download 3D models of our standard drives at https://configurator.stoeber.de/en-US/.

Combination options and the dimensions of forced ventilated geared motors can also be found at https://configurator.stoeber.de/en-US/.





qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x0	Applies to encoders using an optical measuring method.	w1	Different for the One Cable Solution (OCS), see the chapter [▸ 14.4]

Dimensions of gearboxes

Type	mn	∅a1	az	∅b1	c1	∅d0	∅dk	∅e1	f1	h0	i2	i3	lz	∅s1	x
ZR233SPH4_	2	118	57.80	90_{h7}	7	70.03	75.0	109	10	22	56.0	23.5	26	5.5	0.39
ZR240SPH5_	2	145	65.20	110_{h7}	8	84.88	90.0	135	12	22	55.0	22.5	26	5.5	0.38
ZR330SPH5_	3	145	73.75	110_{h7}	8	95.49	101.5	135	12	26	64.0	22.5	35	5.5	0.00
ZR335SPH7_	3	179	82.80	140_{h7}	10	111.41	119.0	168	12	26	69.0	31.5	31	6.6	0.37
ZR340SPH7_	3	179	90.80	140_{h7}	10	127.32	135.0	168	12	26	69.0	31.5	31	6.6	0.38
ZR430SPH7_	4	179	98.66	140_{h7}	10	127.32	135.3	168	12	35	83.0	31.5	45	6.6	0.00

Dimensions of motors

Type	□g	qp0	qp1	w1	x0	zp0
EZ301U	72	90	130.0	55.5	21	54.5
EZ302U	72	112	152.0	55.5	21	76.5
EZ303U	72	134	174.0	55.5	21	98.5
EZ401U	98	98	146.5	91.0	22	56.0
EZ402U	98	123	171.5	91.0	22	81.0
EZ501U	115	93	147.5	100.0	22	58.5
EZ502U	115	118	172.5	100.0	22	83.5
EZ503U	115	143	197.5	100.0	22	108.5
EZ505U	115	193	247.5	100.0	22	158.5
EZ701U	145	102	161.0	115.0	22	64.0
EZ702U	145	127	186.0	115.0	22	89.0
EZ703U	145	152	211.0	115.0	22	114.0
EZ705U	145	207	266.0	134.0	22	165.0
EZ813U	190	238	315.0	156.5	22	184.0
EZ815U	190	320	397.0	156.5	22	266.0

Dimensions of geared motors

Type	EZ3	EZ4	EZ5	EZ7	EZ8
	mp	mp	mp	mp	mp
ZR_PH431_	–	54.5	54.0	–	–
ZR_PH432_	99.0	95.5	–	–	–
ZR_PH531_	–	–	61.0	64.0	–
ZR_PH532_	–	103.0	102.5	–	–
ZR_PH731_	–	–	–	71.0	81.0
ZR_PH732_	–	–	119.0	122.0	–

7.4 Type designation

This chapter shows you an explanation of the type designation with the associated options.

Additional ordering information not included in the type designation can be found at the end of the chapter.

Example code

Z	R	3	30	S	PH	5	3	2	S	F	S	S	0280	EZ501U

Explanation

Code	Designation	Design
Z	Type	Rack and pinion gearbox
R	Design	Screwed pinion
3	Normal module	m_n = 3 mm (example)
30	Number of teeth	z = 30 (example)
S	Helix angle	Left-hand 19° 31' 42"
PH	Type	Planetary gearbox
5	Size	5 (example)
3	Generation	Generation 3
1	Stages	Single-stage
2		Two-stage
S	Housing	Standard
F	Shaft	Flange shaft
S	Bearing	Standard bearing
V		Reinforced bearing (PH3 – PH5)
S	Backlash	Standard
R		Reduced
0280	Transmission ratio (i x 10)	i = 28 (example)
EZ501U	Motor	EZ synchronous servo motor

To complete the type designation, also specify the following in your order:

- A detailed type designation of the motor, see the chapter [▷ 14.5]
- Radial shaft seal rings at the output made of NBR or FKM (option), see the chapter [▷ 7.6.2]
- Reverse operation of the output shaft from ±20° to ±90° for horizontal installation on request

This catalog shows you all the information on rack and pinion drives with EZ synchronous servo motors. All input options available on request are shown in the chapter [▷ 7.5.1].

To make selecting your rack and pinion drive easy, use our STOBER Configurator at https://configurator.stoeber.de/en-US/.

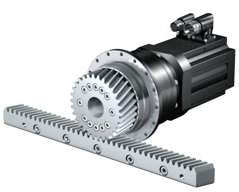
A detailed description of the nameplate, see the chapter [▷ 14.5.1].

7.5 Product description

7.5.1 Input options

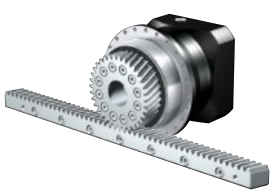
This chapter shows you all available input options:

EZ synchronous servo motor



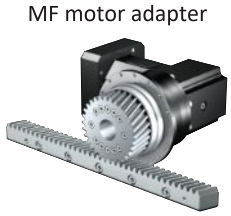
Catalog ID 443286_en

Motor adapter



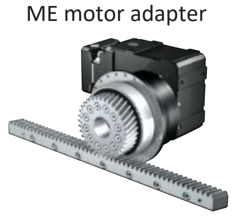
Catalog ID 443137_en

KX right-angle input with MF motor adapter



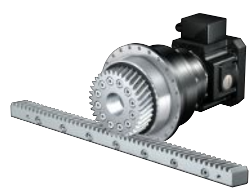
On request

K right-angle input with ME motor adapter



On request

MB motor adapter



On request

The corresponding catalogs can be found at http://www.stoeber.de/en/downloads/

Enter the ID of the catalog in the Search term field.

7.5.2 Gear rack

The gear rack used must have a right-hand design (19° 31' 42"); the load capacity must not be exceeded.

7.5.3 Installation conditions

The torque and force values listed in this catalog are valid under the following conditions:

- When the gear housing is fastened on the machine side using screws of strength class 12.9
- When the gear housings are adjusted at pilot øbz. The machine-side fit must be H7.

7.5.4 Lubricants

STOBER fills the gearboxes with the amount and type of lubricant specified on the nameplate.

You will receive lubricants for use in the food industry upon request.

7.5.4.1 Lubrication of rack and pinion gearbox

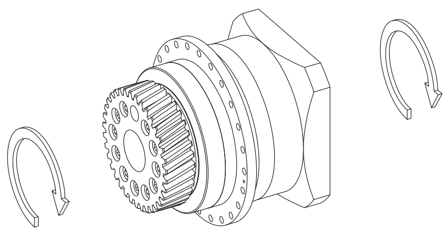
Ensure permanent lubrication with the lubricants recommended in the chapter [13.5.1].

7.5.5 Other product features

Feature	Value
Max. permitted gearbox temperature (on the surface of the gearbox)	≤ 90 °C
Paint	Black RAL 9005
(ATEX) Directive 2014/34/EU (Option)	Not suitable.
Protection class: [1]	
Planetary gearboxes	IP65
Motor	IP56, optionally IP66
Pinion/gear rack	IPXX

7.5.6 Direction of rotation

The input and output rotate in the same direction.



[1] Observe the protection class of all the components.

7.6 Project configuration

Project your drives using our SERVOsoft designing software. Download SERVOsoft free of charge after registration at https://www.stoeber.de/en/services/info-servosoft/.

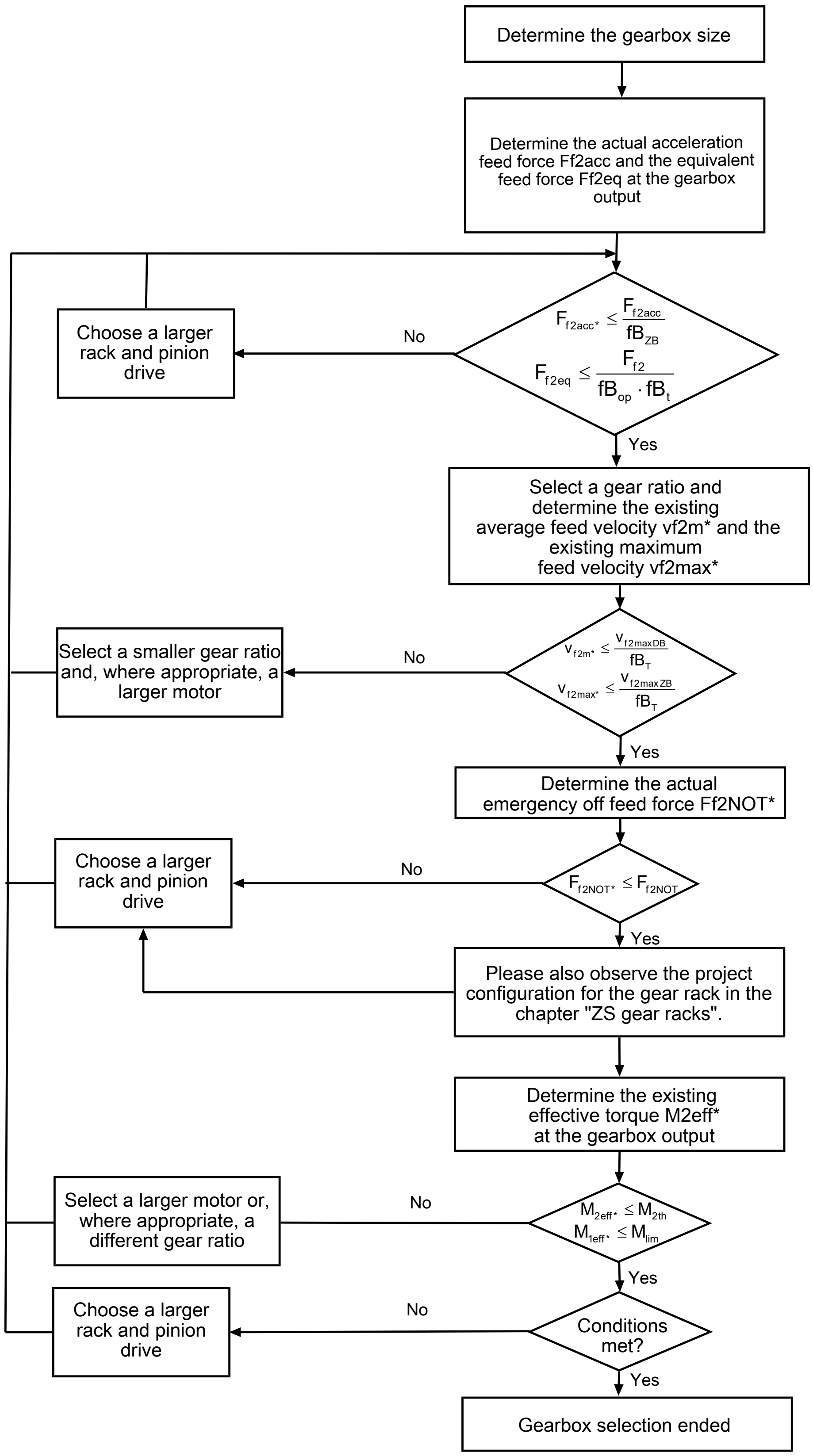
It is the most convenient and reliable method of drive selection, as the entire torque/speed curve of the application is displayed and evaluated here in the curve of the geared motor.

In this chapter, only limit values for specific operating points can be taken into consideration for manual drive selection.

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

An explanation of the formula symbols can be found in the chapter [▶ 17.1].

7.6.1 Drive selection

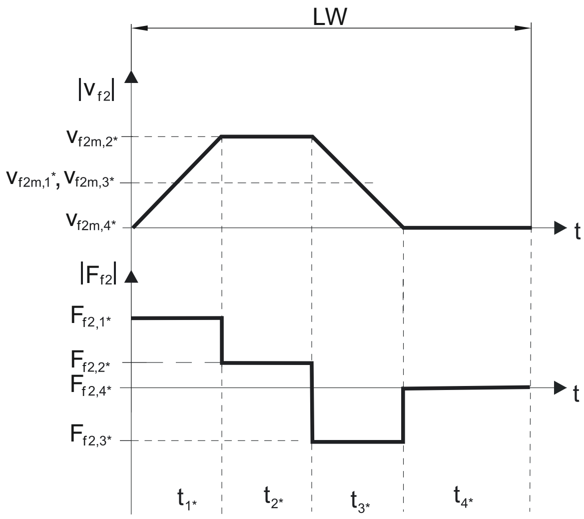


Refer to the selection tables for the values of i, $v_{f2maxDB}$, $v_{f2maxZB}$, F_{f2acc}, F_{f2N} and F_{f2NOT}.

The values for fB_T, fB_{op}, fB_t and fB_{ZB} can be found in the corresponding tables in this chapter.

Example of cyclic operation

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



Calculation of the actual maximum acceleration feed force

$$F_{f2acc*} = m^* \cdot a^* + F_{L*}$$

Calculation of the actual average input speed

$$n_{1m*} = \frac{v_{f2m*} \cdot i}{d_0 \cdot \pi}$$

$$v_{f2m*} = \frac{|v_{f2m,1*}| \cdot t_{1*} + \ldots + |v_{f2m,n*}| \cdot t_{n*}}{t_{1*} + \ldots + t_{n*}}$$

If $t_{1*} + \ldots + t_{3*} \geq 6$ min, determine v_{2m*} without the rest phase t_{4*}.

The values for the ratio i can be found in the selection tables.

Calculation of the actual emergency off feed force

$$F_{f2NOT*} = m^* \cdot a_{NOT*} + F_{L*}$$

Calculation of the actual equivalent feed force

$$F_{f2eq*} = \sqrt[3]{\frac{|v_{f2m,1*}| \cdot t_{1*} \cdot |F_{f2,1*}{}^3| + \ldots + |v_{f2m,n*}| \cdot t_{n*} \cdot |F_{f2,n*}{}^3|}{|v_{f2m,1*}| \cdot t_{1*} + \ldots + |v_{f2m,n*}| \cdot t_{n*}}}$$

Calculation of the thermal limit torque

Calculate the thermal limit torque M_{2th} for a duty cycle ED_{10} > 50% and the actual average input speed n_{1m*}. (At $K_{mot,th} \leq 0$ you must reduce the average input speed n_{1m*} accordingly or select another geared motor size.)

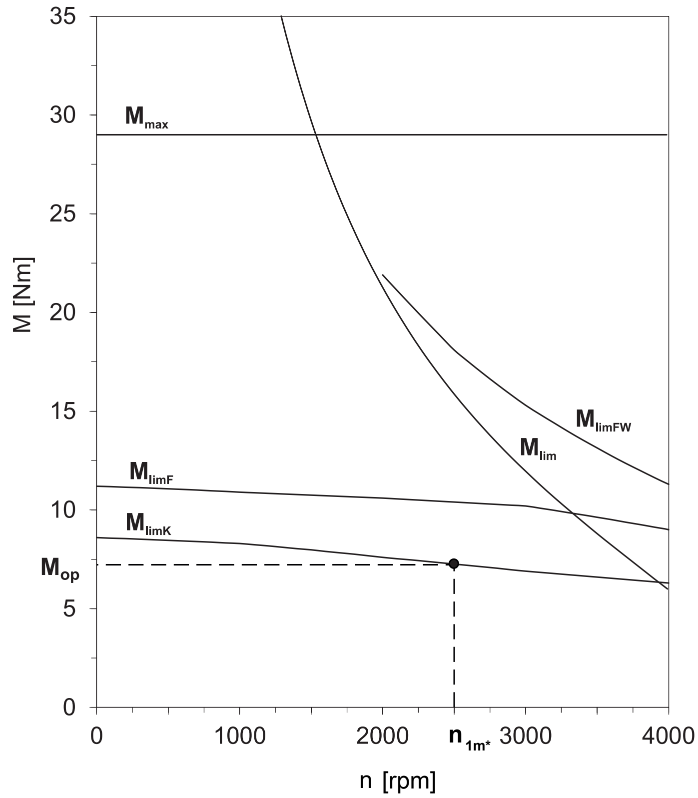
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

$$K_{mot,th} = 0{,}93 - \frac{a_{th}}{1000} \cdot fB_T \cdot \left(\frac{n_{1m*}}{1000}\right)^3$$

Refer to the selection tables for the values of i and a_{th}.

The values for fB_T can be found in the corresponding table in this chapter.

The value for the torque of the motor at operating point M_{op} with the determined average input speed n_{1m*} can be found in the motor characteristic curve in the chapter Torque/speed curves. Note the size, nominal speed n_N and cooling type of the motor. The figure below shows an example of reading the torque M_{op} of a motor with convection cooling at the operating point.



Calculation of the actual effective torque

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

$$M_{2,n*} = \frac{F_{f2,n*} \cdot d_0}{2}$$

$$M_{1eff*} = \frac{M_{2eff*}}{i \cdot \eta}$$

Operating factors

Operating mode	fB_{op}
Uniform continuous operation	1.00
Cyclic operation	1.00
Reversing load cyclic operation	1.00

Run time	fB_t
Daily runtime ≤ 8 h	1.00
Daily runtime ≤ 16 h	1.15
Daily runtime ≤ 24 h	1.20

Cyclic operation	fB_{ZB}
≤ 1000 load changes/hour (LW/h)	1.00
> 1000 load changes/hour (LW/h)	1.15

Temperature		fB_T
Motor cooling	**Surrounding temperature**	
Motor with forced ventilation	≤ 20 °C	0.9
	≤ 30 °C	1.0
	≤ 40 °C	1.15
Motor with convection cooling	≤ 20 °C	1.0
	≤ 30 °C	1.1
	≤ 40 °C	1.25

Notes

- The maximum permitted gearbox temperature (see the "Other product features" chapter) must not be exceeded, as that could result in damage.
- For braking from full speed (for example, when the power fails or when setting up the machine), note the permitted gearbox feed forces (F_{f2acc}, F_{f2NOT}) in the selection tables.

7.6.2 Recommendation for radial shaft seal rings

For a duty cycle > 60% and higher surrounding temperatures, we recommend radial shaft seal rings made of FKM at the output.

Properties:

- Excellent temperature resistance
- High chemical stability
- Very good resistance to aging
- Excellent resistance in oils and greases
- For use in the food, beverage and pharmaceutical industries

Leak-proofness

Our gearboxes are equipped with high-quality radial shaft seal rings and checked for leaks. However, a leak cannot be fully ruled out over the length of use of a gearbox. If you use a gearbox with goods incompatible with the lubricant, you must take measures to prevent direct contact with the gearbox lubricant in case of a leak.

7.7 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 term field.

Documentation	ID
Operating manual gearboxes, geared motors PH33 – PH83, PH94 – PH104	443354_en
Operating manual for EZ synchronous servo motors	443032_en
Operating manual gear racks	443392_en

8 ZVP rack and pinion drives

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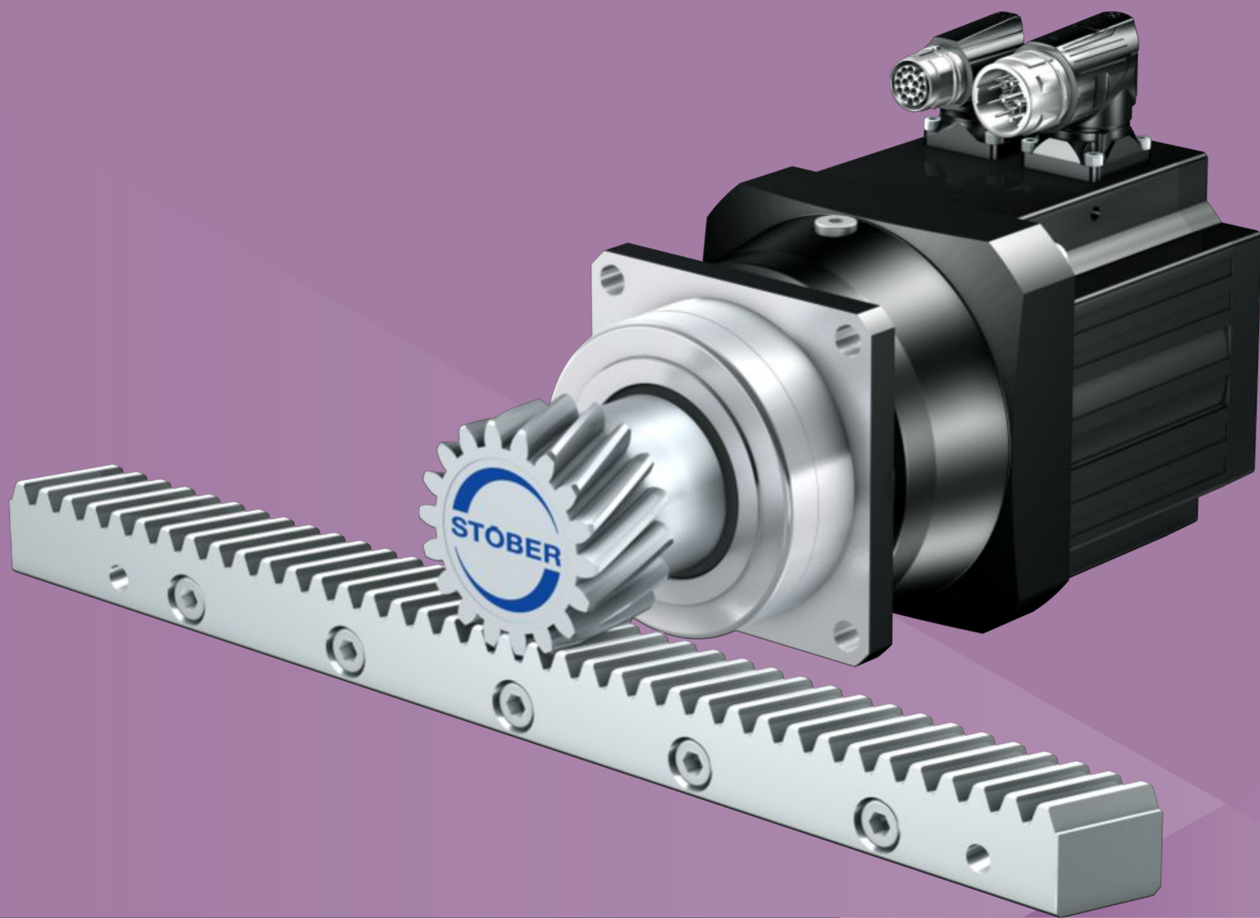


8 Rack and pinion drives

ZVP

8.1 Overview

High Flexibility precision planetary geared motors with plug-on pinion

Features

Power density	★★★☆☆
Linear clearance	★★★★★
Price category	€€
Smooth operation	★★★★☆
Linear rigidity	★★★☆☆
Mass moment of inertia	★★★★☆
Ready-to-install drive solution	✓
Pinion gearing quality 6 (DIN 3962)	✓
Helical gearing	✓
Case-hardened and smoothed	✓
Compact and highly dynamic due to direct motor attachment	✓

Key ★☆☆☆☆ good | ★★★★★ excellent
€ Economy | €€€€€ Premium

Technical data

m_n	2 – 4 mm
z	16 – 25
F_{f2acc}	0.5 – 11 kN
v_{f2}	0.08 – 5.3 m/s
Δs	8 – 44 µm

8.2 Selection table

The technical data specified in the selection tables applies to:

- Pinion position E with bearing design S (standard)
- De-energized installation
- Permanent lubrication with the lubricants recommended in the chapter on gear racks [▸ 13.5.1]
- Case-hardened pinions, helical (left-hand 19° 31' 42"), gearing quality 5
- Installation altitudes up to 1000 m above sea level
- Surrounding temperatures from 0 °C to 40 °C
- Without consideration of the thermal limiting performance
- Drives with convection-cooled motors (e.g. EZ401**U**)

For the technical data on drives with forced ventilated motors (e.g. EZ401**B**), refer to https://configurator.stoeber.de/en-US/

Higher feed forces are possible for rack and pinion drives with reduced backlash, reinforced bearing D (axially reinforced) or pinion position S. You can find this and all other technical data, as well as other combinations of the pinion position and bearing design, at https://configurator.stoeber.de/en-US/.

An explanation of the formula symbols can be found in the chapter [▸ 17.1].

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV2P3 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 1,7 kN)																	
0.17	1.7	1.7	1.5	1.0	ZV216S_P332_0320 EZ301U	1.7	3.3	28	32.00	0.31	0.44	25	15	13	2	16	34.0
0.19	1.5	1.5	1.8	1.1	ZV216S_P332_0280 EZ301U	1.7	3.3	28	28.00	0.38	0.51	25	15	13	2	16	34.0
0.21	1.3	1.3	1.7	1.3	ZV216S_P332_0250 EZ301U	1.7	3.3	28	25.00	0.43	0.57	25	15	13	2	16	34.0
0.27	1.0	1.1	1.9	1.6	ZV216S_P332_0200 EZ301U	1.7	3.3	28	20.00	0.49	0.71	25	15	13	2	16	34.0
0.33	0.8	0.9	2.4	2.0	ZV216S_P332_0160 EZ301U	1.7	3.3	28	16.00	0.61	0.89	25	15	13	2	16	34.0
0.33	1.4	1.5	4.0	1.2	ZV216S_P332_0160 EZ302U	1.7	3.3	28	16.00	0.61	0.89	25	15	13	2	16	34.0
0.44	0.6	0.6	4.1	2.7	ZV216S_P332_0120 EZ301U	1.7	3.3	28	12.00	0.82	1.19	25	15	13	2	16	34.0
0.44	1.1	1.1	7.0	1.6	ZV216S_P332_0120 EZ302U	1.7	3.3	28	12.00	0.82	1.19	25	15	13	2	16	34.0
0.44	1.4	1.5	9.1	1.2	ZV216S_P332_0120 EZ303U	1.7	3.3	28	12.00	0.82	1.19	25	15	13	2	16	34.0
0.53	0.5	0.5	0.5	3.1	ZV216S_P331_0100 EZ301U	1.6	3.3	27	10.00	0.98	1.42	20	10	13	2	16	34.0
0.53	0.9	1.0	0.9	1.8	ZV216S_P331_0100 EZ302U	1.7	3.3	28	10.00	0.98	1.42	20	10	13	2	16	34.0
0.53	1.2	1.3	1.1	1.4	ZV216S_P331_0100 EZ303U	1.7	3.3	28	10.00	0.98	1.42	20	10	13	2	16	34.0
0.53	1.6	1.7	1.5	1.0	ZV216S_P331_0100 EZ401U	1.7	3.3	28	10.00	0.98	1.42	20	10	13	2	16	34.0
0.67	0.4	0.4	0.5	3.9	ZV216S_P331_0080 EZ301U	1.3	3.3	22	8.000	1.11	1.78	20	10	13	2	16	34.0
0.67	0.7	0.8	0.9	2.3	ZV216S_P331_0080 EZ302U	1.7	3.3	28	8.000	1.11	1.78	20	10	13	2	16	34.0
0.67	0.9	1.0	1.2	1.8	ZV216S_P331_0080 EZ303U	1.7	3.3	28	8.000	1.11	1.78	20	10	13	2	16	34.0
0.67	1.3	1.4	1.6	1.3	ZV216S_P331_0080 EZ401U	1.7	3.3	28	8.000	1.11	1.78	20	10	13	2	16	34.0
0.76	0.4	0.4	0.6	4.4	ZV216S_P331_0070 EZ301U	1.1	3.3	19	7.000	1.27	2.03	20	10	13	2	16	34.0
0.76	0.6	0.7	1.0	2.6	ZV216S_P331_0070 EZ302U	1.7	3.3	28	7.000	1.27	2.03	20	10	13	2	16	34.0
0.76	0.8	0.9	1.3	2.0	ZV216S_P331_0070 EZ303U	1.7	3.3	28	7.000	1.27	2.03	20	10	13	2	16	34.0
0.76	1.1	1.2	1.7	1.5	ZV216S_P331_0070 EZ401U	1.7	3.3	28	7.000	1.27	2.03	20	10	13	2	16	34.0
1.07	0.5	0.5	1.5	3.2	ZV216S_P331_0050 EZ302U	1.4	3.3	24	5.000	1.60	2.84	20	10	13	2	16	34.0
1.07	0.6	0.6	1.9	2.5	ZV216S_P331_0050 EZ303U	1.7	3.3	28	5.000	1.60	2.84	20	10	13	2	16	34.0
1.07	0.8	0.9	2.6	1.8	ZV216S_P331_0050 EZ401U	1.7	3.3	28	5.000	1.60	2.84	20	10	13	2	16	34.0
1.07	1.3	1.5	4.3	1.1	ZV216S_P331_0050 EZ402U	1.7	3.3	28	5.000	1.60	2.84	20	10	13	2	16	34.0
1.33	0.4	0.4	1.9	3.7	ZV216S_P331_0040 EZ302U	1.1	3.3	19	4.000	1.78	3.56	20	10	13	2	16	34.0
1.33	0.5	0.5	2.5	2.9	ZV216S_P331_0040 EZ303U	1.6	3.3	27	4.000	1.78	3.56	20	10	13	2	16	34.0
1.33	0.6	0.7	3.3	2.1	ZV216S_P331_0040 EZ401U	1.7	3.3	28	4.000	1.78	3.56	20	10	13	2	16	34.0
1.33	1.1	1.2	5.6	1.3	ZV216S_P331_0040 EZ402U	1.7	3.3	28	4.000	1.78	3.56	20	10	13	2	16	34.0
1.78	0.3	0.3	4.0	4.5	ZV216S_P331_0030 EZ302U	0.9	3.3	15	3.000	2.07	4.15	20	10	13	2	16	34.0
1.78	0.4	0.4	5.2	3.5	ZV216S_P331_0030 EZ303U	1.2	3.3	20	3.000	2.07	4.15	20	10	13	2	16	34.0
1.78	0.5	0.5	7.1	2.6	ZV216S_P331_0030 EZ401U	1.5	3.3	25	3.000	2.07	4.15	20	10	13	2	16	34.0
1.78	0.8	0.9	12	1.5	ZV216S_P331_0030 EZ402U	1.7	3.3	28	3.000	2.07	4.15	20	10	13	2	16	34.0
ZV2P3 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 1,7 kN)																	
0.15	1.6	1.7	0.5	1.1	ZV216S_P332_0700 EZ202U	1.7	3.3	28	70.00	0.15	0.20	25	15	13	2	16	34.0
0.19	1.3	1.4	0.6	1.3	ZV216S_P332_0560 EZ202U	1.7	3.3	28	56.00	0.19	0.25	25	15	13	2	16	34.0
0.21	1.1	1.2	0.6	1.5	ZV216S_P332_0500 EZ202U	1.7	3.3	28	50.00	0.21	0.28	25	15	13	2	16	34.0
0.27	0.9	1.0	0.9	1.9	ZV216S_P332_0400 EZ202U	1.7	3.3	28	40.00	0.27	0.36	25	15	13	2	16	34.0
0.27	1.4	1.5	1.4	1.2	ZV216S_P332_0400 EZ203U	1.7	3.3	28	40.00	0.27	0.36	25	15	13	2	16	34.0
0.31	0.8	0.9	0.7	2.1	ZV216S_P332_0350 EZ202U	1.7	3.3	28	35.00	0.31	0.41	25	15	13	2	16	34.0
0.31	1.2	1.4	1.0	1.4	ZV216S_P332_0350 EZ203U	1.7	3.3	28	35.00	0.31	0.41	25	15	13	2	16	34.0
0.33	0.7	0.8	0.8	2.3	ZV216S_P332_0320 EZ202U	1.7	3.3	28	32.00	0.31	0.44	25	15	13	2	16	34.0
0.33	1.1	1.2	1.2	1.5	ZV216S_P332_0320 EZ203U	1.7	3.3	28	32.00	0.31	0.44	25	15	13	2	16	34.0
0.33	1.6	1.7	1.8	1.0	ZV216S_P332_0320 EZ301U	1.7	3.3	28	32.00	0.31	0.44	25	15	13	2	16	34.0

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV2P3 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 1,7 kN)																	
0.38	0.6	0.7	0.9	2.7	ZV216S_P332_0280 EZ202U	1.7	3.3	28	28.00	0.38	0.51	25	15	13	2	16	34.0
0.38	1.0	1.1	1.4	1.7	ZV216S_P332_0280 EZ203U	1.7	3.3	28	28.00	0.38	0.51	25	15	13	2	16	34.0
0.38	1.4	1.5	2.0	1.2	ZV216S_P332_0280 EZ301U	1.7	3.3	28	28.00	0.38	0.51	25	15	13	2	16	34.0
0.43	0.6	0.6	0.8	3.0	ZV216S_P332_0250 EZ202U	1.7	3.3	28	25.00	0.43	0.57	25	15	13	2	16	34.0
0.43	0.9	1.0	1.2	2.0	ZV216S_P332_0250 EZ203U	1.7	3.3	28	25.00	0.43	0.57	25	15	13	2	16	34.0
0.43	1.2	1.3	1.8	1.3	ZV216S_P332_0250 EZ301U	1.7	3.3	28	25.00	0.43	0.57	25	15	13	2	16	34.0
0.53	0.4	0.5	0.9	3.7	ZV216S_P332_0200 EZ202U	1.7	3.3	28	20.00	0.49	0.71	25	15	13	2	16	34.0
0.53	0.7	0.8	1.4	2.4	ZV216S_P332_0200 EZ203U	1.7	3.3	28	20.00	0.49	0.71	25	15	13	2	16	34.0
0.53	1.0	1.1	2.0	1.7	ZV216S_P332_0200 EZ301U	1.7	3.3	28	20.00	0.49	0.71	25	15	13	2	16	34.0
0.67	0.4	0.4	1.2	4.7	ZV216S_P332_0160 EZ202U	1.3	3.3	22	16.00	0.61	0.89	25	15	13	2	16	34.0
0.67	0.5	0.6	1.8	3.1	ZV216S_P332_0160 EZ203U	1.7	3.3	28	16.00	0.61	0.89	25	15	13	2	16	34.0
0.67	0.8	0.9	2.6	2.1	ZV216S_P332_0160 EZ301U	1.7	3.3	28	16.00	0.61	0.89	25	15	13	2	16	34.0
0.67	1.3	1.5	4.5	1.2	ZV216S_P332_0160 EZ302U	1.7	3.3	28	16.00	0.61	0.89	25	15	13	2	16	34.0
0.89	0.4	0.5	3.0	3.8	ZV216S_P332_0120 EZ203U	1.7	3.3	28	12.00	0.82	1.19	25	15	13	2	16	34.0
0.89	0.6	0.6	4.3	2.6	ZV216S_P332_0120 EZ301U	1.7	3.3	28	12.00	0.82	1.19	25	15	13	2	16	34.0
0.89	1.0	1.1	7.3	1.5	ZV216S_P332_0120 EZ302U	1.7	3.3	28	12.00	0.82	1.19	25	15	13	2	16	34.0
0.89	1.3	1.5	9.5	1.2	ZV216S_P332_0120 EZ303U	1.7	3.3	28	12.00	0.82	1.19	25	15	13	2	16	34.0
1.07	0.5	0.5	0.6	2.6	ZV216S_P331_0100 EZ301U	1.6	3.3	27	10.00	0.98	1.42	20	10	13	2	16	34.0
1.07	0.9	1.0	1.0	1.6	ZV216S_P331_0100 EZ302U	1.7	3.3	28	10.00	0.98	1.42	20	10	13	2	16	34.0
1.07	1.1	1.3	1.4	1.2	ZV216S_P331_0100 EZ303U	1.7	3.3	28	10.00	0.98	1.42	20	10	13	2	16	34.0
1.07	1.3	1.6	1.6	1.0	ZV216S_P331_0100 EZ401U	1.7	3.3	28	10.00	0.98	1.42	20	10	13	2	16	34.0
1.33	0.4	0.4	0.7	3.3	ZV216S_P331_0080 EZ301U	1.3	3.3	22	8.000	1.11	1.78	20	10	13	2	16	34.0
1.33	0.7	0.8	1.1	2.0	ZV216S_P331_0080 EZ302U	1.7	3.3	28	8.000	1.11	1.78	20	10	13	2	16	34.0
1.33	0.9	1.0	1.4	1.5	ZV216S_P331_0080 EZ303U	1.7	3.3	28	8.000	1.11	1.78	20	10	13	2	16	34.0
1.33	1.1	1.3	1.7	1.3	ZV216S_P331_0080 EZ401U	1.7	3.3	28	8.000	1.11	1.78	20	10	13	2	16	34.0
1.52	0.4	0.4	0.7	3.6	ZV216S_P331_0070 EZ301U	1.1	3.3	19	7.000	1.27	2.03	20	10	13	2	16	34.0
1.52	0.6	0.7	1.2	2.2	ZV216S_P331_0070 EZ302U	1.7	3.3	28	7.000	1.27	2.03	20	10	13	2	16	34.0
1.52	0.8	0.9	1.5	1.7	ZV216S_P331_0070 EZ303U	1.7	3.3	28	7.000	1.27	2.03	20	10	13	2	16	34.0
1.52	0.9	1.1	1.8	1.4	ZV216S_P331_0070 EZ401U	1.7	3.3	28	7.000	1.27	2.03	20	10	13	2	16	34.0
2.13	0.3	0.3	1.0	4.5	ZV216S_P331_0050 EZ301U	0.8	3.3	14	5.000	1.60	2.84	20	10	13	2	16	34.0
2.13	0.4	0.5	1.7	2.7	ZV216S_P331_0050 EZ302U	1.4	3.3	24	5.000	1.60	2.84	20	10	13	2	16	34.0
2.13	0.6	0.6	2.3	2.1	ZV216S_P331_0050 EZ303U	1.7	3.3	28	5.000	1.60	2.84	20	10	13	2	16	34.0
2.13	0.7	0.8	2.6	1.8	ZV216S_P331_0050 EZ401U	1.7	3.3	28	5.000	1.60	2.84	20	10	13	2	16	34.0
2.13	1.0	1.4	4.0	1.2	ZV216S_P331_0050 EZ402U	1.7	3.3	28	5.000	1.60	2.84	20	10	13	2	16	34.0
2.67	0.3	0.4	2.3	3.1	ZV216S_P331_0040 EZ302U	1.1	3.3	19	4.000	1.78	3.56	20	10	13	2	16	34.0
2.67	0.4	0.5	3.0	2.4	ZV216S_P331_0040 EZ303U	1.6	3.3	27	4.000	1.78	3.56	20	10	13	2	16	34.0
2.67	0.5	0.6	3.5	2.0	ZV216S_P331_0040 EZ401U	1.7	3.3	28	4.000	1.78	3.56	20	10	13	2	16	34.0
2.67	0.8	1.1	5.3	1.3	ZV216S_P331_0040 EZ402U	1.7	3.3	28	4.000	1.78	3.56	20	10	13	2	16	34.0
3.56	0.3	0.3	4.8	3.8	ZV216S_P331_0030 EZ302U	0.9	3.3	15	3.000	2.07	4.15	20	10	13	2	16	34.0
3.56	0.3	0.4	6.2	2.9	ZV216S_P331_0030 EZ303U	1.2	3.3	20	3.000	2.07	4.15	20	10	13	2	16	34.0
3.56	0.4	0.5	7.3	2.5	ZV216S_P331_0030 EZ401U	1.5	3.3	25	3.000	2.07	4.15	20	10	13	2	16	34.0
3.56	0.6	0.8	11	1.6	ZV216S_P331_0030 EZ402U	1.7	3.3	28	3.000	2.07	4.15	20	10	13	2	16	34.0
ZV2P4 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 3,2 kN)																	
0.10	2.9	3.0	0.6	1.1	ZV220S_P432_0700 EZ301U	3.2	6.3	67	70.00	0.16	0.25	31	19	18	2	20	42.4
0.12	2.3	2.4	0.7	1.4	ZV220S_P432_0560 EZ301U	3.2	6.3	67	56.00	0.20	0.32	31	19	17	2	20	42.4
0.13	2.1	2.1	0.7	1.5	ZV220S_P432_0500 EZ301U	3.2	6.3	67	50.00	0.22	0.36	31	19	18	2	20	42.4
0.17	1.7	1.7	0.9	1.9	ZV220S_P432_0400 EZ301U	3.2	6.3	67	40.00	0.28	0.44	31	19	18	2	20	42.4
0.17	2.8	3.0	1.5	1.1	ZV220S_P432_0400 EZ302U	3.2	6.3	67	40.00	0.28	0.44	31	19	18	2	20	42.4
0.19	1.5	1.5	0.8	2.2	ZV220S_P432_0350 EZ301U	3.2	6.3	67	35.00	0.29	0.51	31	19	18	2	20	42.4
0.19	2.5	2.6	1.3	1.3	ZV220S_P432_0350 EZ302U	3.2	6.3	67	35.00	0.29	0.51	31	19	18	2	20	42.4
0.21	1.3	1.4	0.9	2.4	ZV220S_P432_0320 EZ301U	3.2	6.3	67	32.00	0.28	0.56	31	19	17	2	20	42.4
0.21	2.3	2.4	1.6	1.4	ZV220S_P432_0320 EZ302U	3.2	6.3	67	32.00	0.28	0.56	31	19	17	2	20	42.4
0.21	3.0	3.1	2.1	1.1	ZV220S_P432_0320 EZ303U	3.2	6.3	67	32.00	0.28	0.56	31	19	17	2	20	42.4
0.24	1.2	1.2	0.9	2.7	ZV220S_P432_0280 EZ301U	3.2	6.3	67	28.00	0.36	0.64	31	19	18	2	20	42.4
0.24	2.0	2.1	1.6	1.6	ZV220S_P432_0280 EZ302U	3.2	6.3	67	28.00	0.36	0.64	31	19	18	2	20	42.4
0.24	2.6	2.7	2.1	1.2	ZV220S_P432_0280 EZ303U	3.2	6.3	67	28.00	0.36	0.64	31	19	18	2	20	42.4
0.27	1.0	1.1	1.0	3.0	ZV220S_P432_0250 EZ301U	3.1	6.3	67	25.00	0.40	0.71	31	19	18	2	20	42.4
0.27	1.8	1.9	1.6	1.8	ZV220S_P432_0250 EZ302U	3.2	6.3	67	25.00	0.40	0.71	31	19	18	2	20	42.4
0.27	2.3	2.5	2.1	1.4	ZV220S_P432_0250 EZ303U	3.2	6.3	67	25.00	0.40	0.71	31	19	18	2	20	42.4
0.27	3.1	3.4	2.9	1.0	ZV220S_P432_0250 EZ401U	3.2	6.3	67	25.00	0.40	0.71	31	19	18	2	20	42.4
0.33	0.8	0.9	1.1	3.8	ZV220S_P432_0200 EZ301U	2.5	6.3	53	20.00	0.44	0.89	31	19	18	2	20	42.4
0.33	1.4	1.5	1.9	2.2	ZV220S_P432_0200 EZ302U	3.2	6.3	67	20.00	0.44	0.89	31	19	18	2	20	42.4
0.33	1.9	2.0	2.5	1.7	ZV220S_P432_0200 EZ303U	3.2	6.3	67	20.00	0.44	0.89	31	19	18	2	20	42.4
0.33	2.5	2.7	3.4	1.3	ZV220S_P432_0200 EZ401U	3.2	6.3	67	20.00	0.44	0.89	31	19	18	2	20	42.4
0.42	0.7	0.7	1.3	4.6	ZV220S_P432_0160 EZ301U	2.0	6.3	43	16.00	0.56	1.11	31	19	18	2	20	42.4
0.42	1.1	1.2	2.3	2.7	ZV220S_P432_0160 EZ302U	3.2	6.3	67	16.00	0.56	1.11	31	19	18	2	20	42.4

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{red} [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV2P4 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 3,2 kN)																	
0.42	1.5	1.6	3.0	2.1	ZV220S_P432_0160 EZ303U	3.2	6.3	67	16.00	0.56	1.11	31	19	18	2	20	42.4
0.42	2.0	2.1	4.0	1.5	ZV220S_P432_0160 EZ401U	3.2	6.3	67	16.00	0.56	1.11	31	19	18	2	20	42.4
0.56	0.9	0.9	3.9	3.2	ZV220S_P432_0120 EZ302U	2.7	6.3	57	12.00	0.65	1.30	31	19	18	2	20	42.4
0.56	1.1	1.2	5.1	2.5	ZV220S_P432_0120 EZ303U	3.2	6.3	67	12.00	0.65	1.30	31	19	18	2	20	42.4
0.56	1.5	1.6	6.9	1.8	ZV220S_P432_0120 EZ401U	3.2	6.3	67	12.00	0.65	1.30	31	19	18	2	20	42.4
0.56	2.5	2.8	12	1.1	ZV220S_P432_0120 EZ402U	3.2	6.3	67	12.00	0.65	1.30	31	19	18	2	20	42.4
0.67	1.3	1.4	0.9	2.0	ZV220S_P431_0100 EZ401U	3.2	6.3	67	10.00	0.89	1.78	25	12	17	2	20	42.4
0.67	2.0	2.1	1.4	1.3	ZV220S_P431_0100 EZ501U	3.2	6.3	67	10.00	0.89	1.78	25	12	17	2	20	42.4
0.67	2.1	2.4	1.5	1.2	ZV220S_P431_0100 EZ402U	3.2	6.3	67	10.00	0.89	1.78	25	12	17	2	20	42.4
0.83	1.0	1.1	1.0	2.4	ZV220S_P431_0080 EZ401U	3.1	6.3	66	8.000	1.11	2.22	25	12	17	2	20	42.4
0.83	1.6	1.7	1.5	1.5	ZV220S_P431_0080 EZ501U	3.2	6.3	67	8.000	1.11	2.22	25	12	17	2	20	42.4
0.83	1.7	1.9	1.7	1.4	ZV220S_P431_0080 EZ402U	3.2	6.3	67	8.000	1.11	2.22	25	12	17	2	20	42.4
0.95	0.9	1.0	1.1	2.6	ZV220S_P431_0070 EZ401U	2.7	6.3	58	7.000	1.27	2.54	25	12	18	2	20	42.4
0.95	1.4	1.5	1.7	1.7	ZV220S_P431_0070 EZ501U	3.2	6.3	67	7.000	1.27	2.54	25	12	18	2	20	42.4
0.95	1.5	1.7	1.9	1.5	ZV220S_P431_0070 EZ402U	3.2	6.3	67	7.000	1.27	2.54	25	12	18	2	20	42.4
0.95	2.2	2.8	2.7	1.0	ZV220S_P431_0070 EZ404U	3.2	6.3	67	7.000	1.27	2.54	25	12	18	2	20	42.4
1.33	0.6	0.7	1.7	3.2	ZV220S_P431_0050 EZ401U	1.9	6.3	41	5.000	1.64	3.11	25	12	18	2	20	42.4
1.33	1.0	1.1	2.5	2.1	ZV220S_P431_0050 EZ501U	3.2	6.3	67	5.000	1.64	3.11	25	12	18	2	20	42.4
1.33	1.1	1.2	2.8	1.9	ZV220S_P431_0050 EZ402U	3.2	6.3	67	5.000	1.64	3.11	25	12	18	2	20	42.4
1.33	1.6	2.0	4.1	1.3	ZV220S_P431_0050 EZ404U	3.2	6.3	67	5.000	1.64	3.11	25	12	18	2	20	42.4
1.33	1.7	1.8	4.4	1.2	ZV220S_P431_0050 EZ502U	3.2	6.3	67	5.000	1.64	3.11	25	12	18	2	20	42.4
1.67	0.5	0.5	2.2	3.7	ZV220S_P431_0040 EZ401U	1.6	6.3	33	4.000	1.83	3.61	25	12	18	2	20	42.4
1.67	0.8	0.9	3.3	2.4	ZV220S_P431_0040 EZ501U	2.9	6.3	62	4.000	1.83	3.61	25	12	18	2	20	42.4
1.67	0.9	1.0	3.6	2.2	ZV220S_P431_0040 EZ402U	2.9	6.3	62	4.000	1.83	3.61	25	12	18	2	20	42.4
1.67	1.3	1.6	5.3	1.5	ZV220S_P431_0040 EZ404U	3.2	6.3	67	4.000	1.83	3.61	25	12	18	2	20	42.4
1.67	1.4	1.5	5.7	1.4	ZV220S_P431_0040 EZ502U	3.2	6.3	67	4.000	1.83	3.61	25	12	18	2	20	42.4
1.67	1.8	2.0	7.5	1.1	ZV220S_P431_0040 EZ503U	3.2	6.3	67	4.000	1.83	3.61	25	12	18	2	20	42.4
2.22	0.4	0.4	5.2	4.5	ZV220S_P431_0030 EZ401U	1.2	6.3	25	3.000	2.22	4.44	25	12	18	2	20	42.4
2.22	0.6	0.6	8.0	3.0	ZV220S_P431_0030 EZ501U	2.2	6.3	47	3.000	2.22	4.44	25	12	18	2	20	42.4
2.22	0.6	0.7	8.7	2.7	ZV220S_P431_0030 EZ402U	2.2	6.3	47	3.000	2.22	4.44	25	12	18	2	20	42.4
2.22	0.9	1.2	13	1.8	ZV220S_P431_0030 EZ404U	3.2	6.3	67	3.000	2.22	4.44	25	12	18	2	20	42.4
2.22	1.0	1.1	14	1.7	ZV220S_P431_0030 EZ502U	3.2	6.3	67	3.000	2.22	4.44	25	12	18	2	20	42.4
2.22	1.3	1.5	18	1.3	ZV220S_P431_0030 EZ503U	3.2	6.3	67	3.000	2.22	4.44	25	12	18	2	20	42.4
ZV2P4 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 3,2 kN)																	
3.33	1.3	2.1	20	1.2	ZV220S_P431_0030 EZ505U	3.2	6.3	67	3.000	2.22	4.44	25	12	18	2	20	42.4
ZV2P4 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 3,2 kN)																	
0.19	2.8	3.0	0.6	1.1	ZV220S_P432_0700 EZ301U	3.2	6.3	67	70.00	0.16	0.25	31	19	18	2	20	42.4
0.24	2.2	2.4	0.8	1.4	ZV220S_P432_0560 EZ301U	3.2	6.3	67	56.00	0.20	0.32	31	19	17	2	20	42.4
0.27	2.0	2.1	0.8	1.6	ZV220S_P432_0500 EZ301U	3.2	6.3	67	50.00	0.22	0.36	31	19	18	2	20	42.4
0.33	1.6	1.7	0.9	2.0	ZV220S_P432_0400 EZ301U	3.2	6.3	67	40.00	0.28	0.44	31	19	18	2	20	42.4
0.33	2.7	3.0	1.5	1.2	ZV220S_P432_0400 EZ302U	3.2	6.3	67	40.00	0.28	0.44	31	19	18	2	20	42.4
0.38	1.4	1.5	0.9	2.2	ZV220S_P432_0350 EZ301U	3.2	6.3	67	35.00	0.29	0.51	31	19	18	2	20	42.4
0.38	2.4	2.6	1.5	1.3	ZV220S_P432_0350 EZ302U	3.2	6.3	67	35.00	0.29	0.51	31	19	18	2	20	42.4
0.38	3.1	3.5	2.0	1.0	ZV220S_P432_0350 EZ303U	3.2	6.3	67	35.00	0.29	0.51	31	19	18	2	20	42.4
0.42	1.3	1.4	1.0	2.4	ZV220S_P432_0320 EZ301U	3.2	6.3	67	32.00	0.28	0.56	31	19	17	2	20	42.4
0.42	2.1	2.4	1.7	1.4	ZV220S_P432_0320 EZ302U	3.2	6.3	67	32.00	0.28	0.56	31	19	17	2	20	42.4
0.42	2.8	3.2	2.2	1.1	ZV220S_P432_0320 EZ303U	3.2	6.3	67	32.00	0.28	0.56	31	19	17	2	20	42.4
0.48	1.1	1.2	1.0	2.6	ZV220S_P432_0280 EZ301U	3.2	6.3	67	28.00	0.36	0.64	31	19	18	2	20	42.4
0.48	1.9	2.1	1.7	1.5	ZV220S_P432_0280 EZ302U	3.2	6.3	67	28.00	0.36	0.64	31	19	18	2	20	42.4
0.48	2.5	2.8	2.2	1.2	ZV220S_P432_0280 EZ303U	3.2	6.3	67	28.00	0.36	0.64	31	19	18	2	20	42.4
0.48	2.9	3.5	2.6	1.0	ZV220S_P432_0280 EZ401U	3.2	6.3	67	28.00	0.36	0.64	31	19	18	2	20	42.4
0.53	1.0	1.1	1.1	2.8	ZV220S_P432_0250 EZ301U	3.1	6.3	67	25.00	0.40	0.71	31	19	18	2	20	42.4
0.53	1.7	1.9	1.8	1.7	ZV220S_P432_0250 EZ302U	3.2	6.3	67	25.00	0.40	0.71	31	19	18	2	20	42.4
0.53	2.2	2.5	2.4	1.3	ZV220S_P432_0250 EZ303U	3.2	6.3	67	25.00	0.40	0.71	31	19	18	2	20	42.4
0.53	2.6	3.1	2.8	1.1	ZV220S_P432_0250 EZ401U	3.2	6.3	67	25.00	0.40	0.71	31	19	18	2	20	42.4
0.67	0.8	0.9	1.2	3.3	ZV220S_P432_0200 EZ301U	2.5	6.3	53	20.00	0.44	0.89	31	19	18	2	20	42.4
0.67	1.3	1.5	2.0	1.9	ZV220S_P432_0200 EZ302U	3.2	6.3	67	20.00	0.44	0.89	31	19	18	2	20	42.4
0.67	1.8	2.0	2.6	1.5	ZV220S_P432_0200 EZ303U	3.2	6.3	67	20.00	0.44	0.89	31	19	18	2	20	42.4
0.67	2.1	2.5	3.1	1.3	ZV220S_P432_0200 EZ401U	3.2	6.3	67	20.00	0.44	0.89	31	19	18	2	20	42.4
0.83	0.6	0.7	1.5	3.8	ZV220S_P432_0160 EZ301U	2.0	6.3	43	16.00	0.56	1.11	31	19	18	2	20	42.4
0.83	1.1	1.2	2.4	2.2	ZV220S_P432_0160 EZ302U	3.2	6.3	67	16.00	0.56	1.11	31	19	18	2	20	42.4
0.83	1.4	1.6	3.2	1.7	ZV220S_P432_0160 EZ303U	3.2	6.3	67	16.00	0.56	1.11	31	19	18	2	20	42.4
0.83	1.6	2.0	3.7	1.5	ZV220S_P432_0160 EZ401U	3.2	6.3	67	16.00	0.56	1.11	31	19	18	2	20	42.4
1.11	0.5	0.5	2.6	4.6	ZV220S_P432_0120 EZ301U	1.5	6.3	32	12.00	0.65	1.30	31	19	18	2	20	42.4
1.11	0.8	0.9	4.4	2.7	ZV220S_P432_0120 EZ302U	2.7	6.3	57	12.00	0.65	1.30	31	19	18	2	20	42.4
1.11	1.1	1.2	5.8	2.1	ZV220S_P432_0120 EZ303U	3.2	6.3	67	12.00	0.65	1.30	31	19	18	2	20	42.4

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV2P4 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 3,2 kN)																	
1.11	1.2	1.5	6.8	1.8	ZV220S_P432_0120 EZ401U	3.2	6.3	67	12.00	0.65	1.30	31	19	18	2	20	42.4
1.11	1.9	2.6	10	1.2	ZV220S_P432_0120 EZ402U	3.2	6.3	67	12.00	0.65	1.30	31	19	18	2	20	42.4
1.33	1.1	1.3	0.9	2.0	ZV220S_P431_0100 EZ401U	3.2	6.3	67	10.00	0.89	1.78	25	12	17	2	20	42.4
1.33	1.6	2.0	1.4	1.3	ZV220S_P431_0100 EZ501U	3.2	6.3	67	10.00	0.89	1.78	25	12	17	2	20	42.4
1.33	1.6	2.2	1.4	1.3	ZV220S_P431_0100 EZ402U	3.2	6.3	67	10.00	0.89	1.78	25	12	17	2	20	42.4
1.67	0.8	1.0	1.0	2.3	ZV220S_P431_0080 EZ401U	3.1	6.3	66	8.000	1.11	2.22	25	12	17	2	20	42.4
1.67	1.2	1.6	1.5	1.5	ZV220S_P431_0080 EZ501U	3.2	6.3	67	8.000	1.11	2.22	25	12	17	2	20	42.4
1.67	1.3	1.8	1.6	1.5	ZV220S_P431_0080 EZ402U	3.2	6.3	67	8.000	1.11	2.22	25	12	17	2	20	42.4
1.67	1.9	2.9	2.3	1.0	ZV220S_P431_0080 EZ502U	3.2	6.3	67	8.000	1.11	2.22	25	12	17	2	20	42.4
1.91	0.7	0.9	1.1	2.5	ZV220S_P431_0070 EZ401U	2.7	6.3	58	7.000	1.27	2.54	25	12	18	2	20	42.4
1.91	1.1	1.4	1.7	1.7	ZV220S_P431_0070 EZ501U	3.2	6.3	67	7.000	1.27	2.54	25	12	18	2	20	42.4
1.91	1.1	1.6	1.7	1.6	ZV220S_P431_0070 EZ402U	3.2	6.3	67	7.000	1.27	2.54	25	12	18	2	20	42.4
1.91	1.7	2.5	2.6	1.1	ZV220S_P431_0070 EZ502U	3.2	6.3	67	7.000	1.27	2.54	25	12	18	2	20	42.4
2.67	0.5	0.6	1.7	3.1	ZV220S_P431_0050 EZ401U	1.9	6.3	41	5.000	1.64	3.11	25	12	18	2	20	42.4
2.67	0.8	1.0	2.5	2.1	ZV220S_P431_0050 EZ501U	3.2	6.3	67	5.000	1.64	3.11	25	12	18	2	20	42.4
2.67	0.8	1.1	2.6	2.0	ZV220S_P431_0050 EZ402U	3.2	6.3	67	5.000	1.64	3.11	25	12	18	2	20	42.4
2.67	1.2	1.8	3.9	1.4	ZV220S_P431_0050 EZ502U	3.2	6.3	67	5.000	1.64	3.11	25	12	18	2	20	42.4
2.67	1.3	1.9	4.3	1.2	ZV220S_P431_0050 EZ404U	3.2	6.3	67	5.000	1.64	3.11	25	12	18	2	20	42.4
2.67	1.4	2.4	4.6	1.2	ZV220S_P431_0050 EZ503U	3.2	6.3	67	5.000	1.64	3.11	25	12	18	2	20	42.4
3.33	0.4	0.5	2.2	3.6	ZV220S_P431_0040 EZ401U	1.6	6.3	33	4.000	1.83	3.61	25	12	18	2	20	42.4
3.33	0.6	0.8	3.3	2.4	ZV220S_P431_0040 EZ501U	2.9	6.3	62	4.000	1.83	3.61	25	12	18	2	20	42.4
3.33	0.6	0.9	3.4	2.4	ZV220S_P431_0040 EZ402U	2.9	6.3	62	4.000	1.83	3.61	25	12	18	2	20	42.4
3.33	1.0	1.4	5.1	1.6	ZV220S_P431_0040 EZ502U	3.2	6.3	67	4.000	1.83	3.61	25	12	18	2	20	42.4
3.33	1.1	1.5	5.6	1.4	ZV220S_P431_0040 EZ404U	3.2	6.3	67	4.000	1.83	3.61	25	12	18	2	20	42.4
3.33	1.1	1.9	6.0	1.3	ZV220S_P431_0040 EZ503U	3.2	6.3	67	4.000	1.83	3.61	25	12	18	2	20	42.4
4.44	0.3	0.4	5.4	4.4	ZV220S_P431_0030 EZ401U	1.2	6.3	25	3.000	2.22	4.44	25	12	18	2	20	42.4
4.44	0.5	0.6	7.9	3.0	ZV220S_P431_0030 EZ501U	2.2	6.3	47	3.000	2.22	4.44	25	12	18	2	20	42.4
4.44	0.5	0.7	8.2	2.9	ZV220S_P431_0030 EZ402U	2.2	6.3	47	3.000	2.22	4.44	25	12	18	2	20	42.4
4.44	0.7	1.1	12	1.9	ZV220S_P431_0030 EZ502U	3.2	6.3	67	3.000	2.22	4.44	25	12	18	2	20	42.4
4.44	0.8	1.2	14	1.7	ZV220S_P431_0030 EZ404U	3.2	6.3	67	3.000	2.22	4.44	25	12	18	2	20	42.4
4.44	0.9	1.5	14	1.6	ZV220S_P431_0030 EZ503U	3.2	6.3	67	3.000	2.22	4.44	25	12	18	2	20	42.4
ZV2P5 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 5,1 kN)																	
0.17	5.0	5.4	0.9	1.0	ZV225S_P532_0500 EZ401U	5.1	10	135	50.00	0.22	0.44	31	15	21	2	25	53.1
0.21	4.0	4.3	1.2	1.3	ZV225S_P532_0400 EZ401U	5.1	10	135	40.00	0.28	0.56	31	15	21	2	25	53.1
0.24	3.5	3.8	1.0	1.4	ZV225S_P532_0350 EZ401U	5.1	10	135	35.00	0.32	0.64	31	15	21	2	25	53.1
0.26	3.2	3.4	1.2	1.6	ZV225S_P532_0320 EZ401U	5.1	10	135	32.00	0.30	0.61	31	15	20	2	25	53.1
0.26	4.9	5.4	1.8	1.0	ZV225S_P532_0320 EZ501U	5.1	10	135	32.00	0.30	0.61	31	15	20	2	25	53.1
0.30	2.8	3.0	1.3	1.8	ZV225S_P532_0280 EZ401U	5.1	10	135	28.00	0.40	0.79	31	15	21	2	25	53.1
0.30	4.3	4.7	2.0	1.2	ZV225S_P532_0280 EZ501U	5.1	10	135	28.00	0.40	0.79	31	15	21	2	25	53.1
0.30	4.7	5.2	2.2	1.1	ZV225S_P532_0280 EZ402U	5.1	10	135	28.00	0.40	0.79	31	15	21	2	25	53.1
0.33	2.5	2.7	1.2	2.0	ZV225S_P532_0250 EZ401U	5.1	10	135	25.00	0.41	0.78	31	15	21	2	25	53.1
0.33	3.8	4.2	1.9	1.3	ZV225S_P532_0250 EZ501U	5.1	10	135	25.00	0.41	0.78	31	15	21	2	25	53.1
0.33	4.2	4.7	2.1	1.2	ZV225S_P532_0250 EZ402U	5.1	10	135	25.00	0.41	0.78	31	15	21	2	25	53.1
0.42	2.0	2.1	1.4	2.3	ZV225S_P532_0200 EZ401U	5.1	10	135	20.00	0.49	0.97	31	15	21	2	25	53.1
0.42	3.1	3.4	2.2	1.5	ZV225S_P532_0200 EZ501U	5.1	10	135	20.00	0.49	0.97	31	15	21	2	25	53.1
0.42	3.4	3.7	2.4	1.4	ZV225S_P532_0200 EZ402U	5.1	10	135	20.00	0.49	0.97	31	15	21	2	25	53.1
0.52	1.6	1.7	1.8	2.7	ZV225S_P532_0160 EZ401U	4.9	10	129	16.00	0.61	1.22	31	15	21	2	25	53.1
0.52	2.5	2.7	2.8	1.7	ZV225S_P532_0160 EZ501U	5.1	10	135	16.00	0.61	1.22	31	15	21	2	25	53.1
0.52	2.7	3.0	3.0	1.6	ZV225S_P532_0160 EZ402U	5.1	10	135	16.00	0.61	1.22	31	15	21	2	25	53.1
0.52	4.0	4.9	4.5	1.1	ZV225S_P532_0160 EZ404U	5.1	10	135	16.00	0.61	1.22	31	15	21	2	25	53.1
0.52	4.2	4.6	4.8	1.0	ZV225S_P532_0160 EZ502U	5.1	10	135	16.00	0.61	1.22	31	15	21	2	25	53.1
0.69	1.2	1.3	3.8	3.2	ZV225S_P532_0120 EZ401U	3.7	10	97	12.00	0.69	1.39	31	15	21	2	25	53.1
0.69	1.8	2.0	5.9	2.1	ZV225S_P532_0120 EZ501U	5.1	10	135	12.00	0.69	1.39	31	15	21	2	25	53.1
0.69	2.0	2.2	6.4	1.9	ZV225S_P532_0120 EZ402U	5.1	10	135	12.00	0.69	1.39	31	15	21	2	25	53.1
0.69	3.0	3.7	9.5	1.3	ZV225S_P532_0120 EZ404U	5.1	10	135	12.00	0.69	1.39	31	15	21	2	25	53.1
0.69	3.2	3.4	10	1.2	ZV225S_P532_0120 EZ502U	5.1	10	135	12.00	0.69	1.39	31	15	21	2	25	53.1
0.83	1.6	1.7	1.6	2.3	ZV225S_P531_0100 EZ501U	5.1	10	135	10.00	1.03	1.94	23	8	20	2	25	53.1
0.83	2.7	2.9	2.7	1.4	ZV225S_P531_0100 EZ502U	5.1	10	135	10.00	1.03	1.94	23	8	20	2	25	53.1
0.83	2.7	3.0	2.7	1.4	ZV225S_P531_0100 EZ701U	5.1	10	135	10.00	1.03	1.94	23	8	20	2	25	53.1
0.83	3.5	4.1	3.5	1.0	ZV225S_P531_0100 EZ503U	5.1	10	135	10.00	1.03	1.94	23	8	20	2	25	53.1
1.04	1.3	1.4	1.7	2.7	ZV225S_P531_0080 EZ501U	4.7	10	124	8.000	1.29	2.43	23	8	20	2	25	53.1
1.04	2.2	2.3	2.9	1.6	ZV225S_P531_0080 EZ502U	5.1	10	135	8.000	1.29	2.43	23	8	20	2	25	53.1
1.04	2.2	2.4	2.9	1.6	ZV225S_P531_0080 EZ701U	5.1	10	135	8.000	1.29	2.43	23	8	20	2	25	53.1
1.04	2.8	3.2	3.8	1.2	ZV225S_P531_0080 EZ503U	5.1	10	135	8.000	1.29	2.43	23	8	20	2	25	53.1
1.19	1.1	1.2	1.9	2.9	ZV225S_P531_0070 EZ501U	4.1	10	109	7.000	1.47	2.78	23	8	21	2	25	53.1
1.19	1.9	2.0	3.2	1.7	ZV225S_P531_0070 EZ502U	5.1	10	135	7.000	1.47	2.78	23	8	21	2	25	53.1

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV2P5 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 5,1 kN)																	
1.19	1.9	2.1	3.2	1.7	ZV225S_P531_0070 EZ701U	5.1	10	135	7.000	1.47	2.78	23	8	21	2	25	53.1
1.19	2.5	2.8	4.2	1.3	ZV225S_P531_0070 EZ503U	5.1	10	135	7.000	1.47	2.78	23	8	21	2	25	53.1
1.19	3.1	3.7	5.2	1.1	ZV225S_P531_0070 EZ702U	5.1	10	135	7.000	1.47	2.78	23	8	21	2	25	53.1
1.67	0.8	0.9	2.8	3.7	ZV225S_P531_0050 EZ501U	2.9	10	78	5.000	1.94	3.89	23	8	21	2	25	53.1
1.67	1.4	1.5	4.8	2.1	ZV225S_P531_0050 EZ502U	5.1	10	135	5.000	1.94	3.89	23	8	21	2	25	53.1
1.67	1.4	1.5	4.8	2.1	ZV225S_P531_0050 EZ701U	3.7	10	97	5.000	1.94	3.89	23	8	21	2	25	53.1
1.67	1.8	2.0	6.3	1.6	ZV225S_P531_0050 EZ503U	5.1	10	135	5.000	1.94	3.89	23	8	21	2	25	53.1
1.67	2.2	2.6	7.8	1.3	ZV225S_P531_0050 EZ702U	5.1	10	135	5.000	1.94	3.89	23	8	21	2	25	53.1
1.67	2.5	2.9	8.8	1.2	ZV225S_P531_0050 EZ505U	5.1	10	135	5.000	1.94	3.89	23	8	21	2	25	53.1
2.08	0.6	0.7	3.7	4.3	ZV225S_P531_0040 EZ501U	2.3	10	62	4.000	2.08	4.17	23	8	21	2	25	53.1
2.08	1.1	1.2	6.3	2.5	ZV225S_P531_0040 EZ502U	4.5	10	120	4.000	2.08	4.17	23	8	21	2	25	53.1
2.08	1.1	1.2	6.3	2.5	ZV225S_P531_0040 EZ701U	2.9	10	78	4.000	2.08	4.17	23	8	21	2	25	53.1
2.08	1.4	1.6	8.3	1.9	ZV225S_P531_0040 EZ503U	5.1	10	135	4.000	2.08	4.17	23	8	21	2	25	53.1
2.08	1.8	2.1	10	1.5	ZV225S_P531_0040 EZ702U	5.1	10	135	4.000	2.08	4.17	23	8	21	2	25	53.1
2.08	2.0	2.3	11	1.4	ZV225S_P531_0040 EZ505U	5.1	10	135	4.000	2.08	4.17	23	8	21	2	25	53.1
2.08	2.4	3.0	14	1.1	ZV225S_P531_0040 EZ703U	5.1	10	135	4.000	2.08	4.17	23	8	21	2	25	53.1
2.78	0.8	0.9	16	3.0	ZV225S_P531_0030 EZ502U	3.4	10	90	3.000	2.32	4.63	23	8	21	2	25	53.1
2.78	0.8	0.9	16	3.0	ZV225S_P531_0030 EZ701U	2.2	10	58	3.000	2.32	4.63	23	8	21	2	25	53.1
2.78	1.1	1.2	20	2.3	ZV225S_P531_0030 EZ503U	4.7	10	125	3.000	2.32	4.63	23	8	21	2	25	53.1
2.78	1.3	1.6	25	1.9	ZV225S_P531_0030 EZ702U	4.5	10	119	3.000	2.32	4.63	23	8	21	2	25	53.1
2.78	1.5	1.8	28	1.7	ZV225S_P531_0030 EZ505U	5.1	10	135	3.000	2.32	4.63	23	8	21	2	25	53.1
2.78	1.8	2.3	35	1.4	ZV225S_P531_0030 EZ703U	5.1	10	135	3.000	2.32	4.63	23	8	21	2	25	53.1
2.78	2.3	3.3	45	1.0	ZV225S_P531_0030 EZ705U	5.1	10	135	3.000	2.32	4.63	23	8	21	2	25	53.1
ZV2P5 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 5,1 kN)																	
1.56	2.8	4.5	4.2	1.1	ZV225S_P531_0080 EZ505U	5.1	10	135	8.000	1.29	2.43	23	8	20	2	25	53.1
1.79	2.4	3.9	4.7	1.2	ZV225S_P531_0070 EZ505U	5.1	10	135	7.000	1.47	2.78	23	8	21	2	25	53.1
2.50	1.7	2.8	7.1	1.5	ZV225S_P531_0050 EZ505U	5.1	10	135	5.000	1.94	3.89	23	8	21	2	25	53.1
2.50	2.2	3.7	9.0	1.1	ZV225S_P531_0050 EZ703U	5.1	10	135	5.000	1.94	3.89	23	8	21	2	25	53.1
3.13	1.4	2.2	9.3	1.7	ZV225S_P531_0040 EZ505U	5.1	10	135	4.000	2.08	4.17	23	8	21	2	25	53.1
3.13	1.8	2.9	12	1.3	ZV225S_P531_0040 EZ703U	5.1	10	135	4.000	2.08	4.17	23	8	21	2	25	53.1
4.17	1.0	1.7	23	2.1	ZV225S_P531_0030 EZ505U	5.1	10	135	3.000	2.32	4.63	23	8	21	2	25	53.1
4.17	1.3	2.2	29	1.6	ZV225S_P531_0030 EZ703U	5.1	10	135	3.000	2.32	4.63	23	8	21	2	25	53.1
4.17	1.8	3.3	40	1.2	ZV225S_P531_0030 EZ705U	5.1	10	135	3.000	2.32	4.63	23	8	21	2	25	53.1
ZV2P5 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 5,1 kN)																	
0.30	4.6	5.6	0.9	1.1	ZV225S_P532_0560 EZ401U	5.1	10	135	56.00	0.20	0.40	31	15	20	2	25	53.1
0.33	4.1	5.0	0.9	1.2	ZV225S_P532_0500 EZ401U	5.1	10	135	50.00	0.22	0.44	31	15	21	2	25	53.1
0.42	3.3	4.0	1.3	1.4	ZV225S_P532_0400 EZ401U	5.1	10	135	40.00	0.28	0.56	31	15	21	2	25	53.1
0.48	2.9	3.5	1.1	1.5	ZV225S_P532_0350 EZ401U	5.1	10	135	35.00	0.32	0.64	31	15	21	2	25	53.1
0.48	4.3	5.5	1.6	1.0	ZV225S_P532_0350 EZ501U	5.1	10	135	35.00	0.32	0.64	31	15	21	2	25	53.1
0.48	4.4	6.1	1.6	1.0	ZV225S_P532_0350 EZ402U	5.1	10	135	35.00	0.32	0.64	31	15	21	2	25	53.1
0.52	2.6	3.2	1.2	1.6	ZV225S_P532_0320 EZ401U	5.1	10	135	32.00	0.30	0.61	31	15	20	2	25	53.1
0.52	3.9	5.0	1.7	1.1	ZV225S_P532_0320 EZ501U	5.1	10	135	32.00	0.30	0.61	31	15	20	2	25	53.1
0.52	4.0	5.6	1.8	1.1	ZV225S_P532_0320 EZ402U	5.1	10	135	32.00	0.30	0.61	31	15	20	2	25	53.1
0.60	2.3	2.8	1.2	1.8	ZV225S_P532_0280 EZ401U	5.1	10	135	28.00	0.40	0.79	31	15	21	2	25	53.1
0.60	3.4	4.4	1.8	1.2	ZV225S_P532_0280 EZ501U	5.1	10	135	28.00	0.40	0.79	31	15	21	2	25	53.1
0.60	3.5	4.9	1.9	1.2	ZV225S_P532_0280 EZ402U	5.1	10	135	28.00	0.40	0.79	31	15	21	2	25	53.1
0.67	2.1	2.5	1.2	1.9	ZV225S_P532_0250 EZ401U	5.1	10	135	25.00	0.41	0.78	31	15	21	2	25	53.1
0.67	3.0	3.9	1.8	1.3	ZV225S_P532_0250 EZ501U	5.1	10	135	25.00	0.41	0.78	31	15	21	2	25	53.1
0.67	3.1	4.4	1.9	1.3	ZV225S_P532_0250 EZ402U	5.1	10	135	25.00	0.41	0.78	31	15	21	2	25	53.1
0.83	1.6	2.0	1.4	2.2	ZV225S_P532_0200 EZ401U	5.1	10	135	20.00	0.49	0.97	31	15	21	2	25	53.1
0.83	2.4	3.2	2.1	1.5	ZV225S_P532_0200 EZ501U	5.1	10	135	20.00	0.49	0.97	31	15	21	2	25	53.1
0.83	2.5	3.5	2.1	1.5	ZV225S_P532_0200 EZ402U	5.1	10	135	20.00	0.49	0.97	31	15	21	2	25	53.1
1.04	1.3	1.6	1.7	2.6	ZV225S_P532_0160 EZ401U	4.9	10	129	16.00	0.61	1.22	31	15	21	2	25	53.1
1.04	1.9	2.5	2.5	1.7	ZV225S_P532_0160 EZ501U	5.1	10	135	16.00	0.61	1.22	31	15	21	2	25	53.1
1.04	2.0	2.8	2.6	1.7	ZV225S_P532_0160 EZ402U	5.1	10	135	16.00	0.61	1.22	31	15	21	2	25	53.1
1.04	3.0	4.5	3.8	1.1	ZV225S_P532_0160 EZ502U	5.1	10	135	16.00	0.61	1.22	31	15	21	2	25	53.1
1.04	3.3	4.8	4.2	1.0	ZV225S_P532_0160 EZ404U	5.1	10	135	16.00	0.61	1.22	31	15	21	2	25	53.1
1.39	1.0	1.2	3.5	3.1	ZV225S_P532_0120 EZ401U	3.7	10	97	12.00	0.69	1.39	31	15	21	2	25	53.1
1.39	1.5	1.9	5.2	2.1	ZV225S_P532_0120 EZ501U	5.1	10	135	12.00	0.69	1.39	31	15	21	2	25	53.1
1.39	1.5	2.1	5.4	2.0	ZV225S_P532_0120 EZ402U	5.1	10	135	12.00	0.69	1.39	31	15	21	2	25	53.1
1.39	2.2	3.4	8.0	1.4	ZV225S_P532_0120 EZ502U	5.1	10	135	12.00	0.69	1.39	31	15	21	2	25	53.1
1.39	2.5	3.6	8.9	1.2	ZV225S_P532_0120 EZ404U	5.1	10	135	12.00	0.69	1.39	31	15	21	2	25	53.1
1.39	2.7	4.6	9.5	1.2	ZV225S_P532_0120 EZ503U	5.1	10	135	12.00	0.69	1.39	31	15	21	2	25	53.1
1.67	1.2	1.6	1.6	2.3	ZV225S_P531_0100 EZ501U	5.1	10	135	10.00	1.03	1.94	23	8	20	2	25	53.1
1.67	1.9	2.9	2.4	1.5	ZV225S_P531_0100 EZ502U	5.1	10	135	10.00	1.03	1.94	23	8	20	2	25	53.1
1.67	1.9	2.9	2.4	1.5	ZV225S_P531_0100 EZ701U	5.1	10	135	10.00	1.03	1.94	23	8	20	2	25	53.1

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV2P5 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 5,1 kN)																	
1.67	2.3	3.9	2.8	1.3	ZV225S_P531_0100 EZ503U	5.1	10	135	10.00	1.03	1.94	23	8	20	2	25	53.1
1.67	2.6	5.2	3.3	1.1	ZV225S_P531_0100 EZ702U	5.1	10	135	10.00	1.03	1.94	23	8	20	2	25	53.1
2.08	1.0	1.3	1.7	2.7	ZV225S_P531_0080 EZ501U	4.7	10	124	8.000	1.29	2.43	23	8	20	2	25	53.1
2.08	1.5	2.3	2.5	1.8	ZV225S_P531_0080 EZ502U	5.1	10	135	8.000	1.29	2.43	23	8	20	2	25	53.1
2.08	1.5	2.3	2.5	1.8	ZV225S_P531_0080 EZ701U	5.1	10	135	8.000	1.29	2.43	23	8	20	2	25	53.1
2.08	1.8	3.1	3.0	1.5	ZV225S_P531_0080 EZ503U	5.1	10	135	8.000	1.29	2.43	23	8	20	2	25	53.1
2.08	2.1	4.2	3.5	1.3	ZV225S_P531_0080 EZ702U	5.1	10	135	8.000	1.29	2.43	23	8	20	2	25	53.1
2.38	0.9	1.1	1.9	3.0	ZV225S_P531_0070 EZ501U	4.1	10	109	7.000	1.47	2.78	23	8	21	2	25	53.1
2.38	1.3	2.0	2.9	1.9	ZV225S_P531_0070 EZ502U	5.1	10	135	7.000	1.47	2.78	23	8	21	2	25	53.1
2.38	1.3	2.0	2.9	1.9	ZV225S_P531_0070 EZ701U	5.1	10	135	7.000	1.47	2.78	23	8	21	2	25	53.1
2.38	1.6	2.7	3.4	1.6	ZV225S_P531_0070 EZ503U	5.1	10	135	7.000	1.47	2.78	23	8	21	2	25	53.1
2.38	1.8	3.7	3.9	1.4	ZV225S_P531_0070 EZ702U	5.1	10	135	7.000	1.47	2.78	23	8	21	2	25	53.1
3.33	0.6	0.8	2.8	3.7	ZV225S_P531_0050 EZ501U	2.9	10	78	5.000	1.94	3.89	23	8	21	2	25	53.1
3.33	1.0	1.4	4.3	2.4	ZV225S_P531_0050 EZ502U	5.1	10	135	5.000	1.94	3.89	23	8	21	2	25	53.1
3.33	1.0	1.4	4.3	2.4	ZV225S_P531_0050 EZ701U	3.7	10	97	5.000	1.94	3.89	23	8	21	2	25	53.1
3.33	1.1	1.9	5.1	2.0	ZV225S_P531_0050 EZ503U	5.1	10	135	5.000	1.94	3.89	23	8	21	2	25	53.1
3.33	1.3	2.6	5.9	1.7	ZV225S_P531_0050 EZ702U	5.1	10	135	5.000	1.94	3.89	23	8	21	2	25	53.1
4.17	0.5	0.6	3.6	4.3	ZV225S_P531_0040 EZ501U	2.3	10	62	4.000	2.08	4.17	23	8	21	2	25	53.1
4.17	0.8	1.1	5.6	2.8	ZV225S_P531_0040 EZ502U	4.5	10	120	4.000	2.08	4.17	23	8	21	2	25	53.1
4.17	0.8	1.2	5.6	2.8	ZV225S_P531_0040 EZ701U	2.9	10	78	4.000	2.08	4.17	23	8	21	2	25	53.1
4.17	0.9	1.6	6.7	2.4	ZV225S_P531_0040 EZ503U	5.1	10	135	4.000	2.08	4.17	23	8	21	2	25	53.1
4.17	1.1	2.1	7.7	2.0	ZV225S_P531_0040 EZ702U	5.1	10	135	4.000	2.08	4.17	23	8	21	2	25	53.1
ZV3P5 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 5,2 kN)																	
0.16	5.2	5.6	1.0	1.0	ZV318S_P532_0560 EZ401U	5.2	10	150	56.00	0.21	0.43	33	17	21	3	18	57.3
0.18	4.6	5.0	0.9	1.1	ZV318S_P532_0500 EZ401U	5.2	10	150	50.00	0.24	0.48	33	17	22	3	18	57.3
0.23	3.7	4.0	1.2	1.4	ZV318S_P532_0400 EZ401U	5.2	10	150	40.00	0.30	0.60	33	17	22	3	18	57.3
0.26	3.2	3.5	1.0	1.6	ZV318S_P532_0350 EZ401U	5.2	10	150	35.00	0.34	0.69	33	17	22	3	18	57.3
0.26	5.0	5.5	1.6	1.0	ZV318S_P532_0350 EZ501U	5.2	10	150	35.00	0.34	0.69	33	17	22	3	18	57.3
0.28	3.0	3.2	1.2	1.8	ZV318S_P532_0320 EZ401U	5.2	10	150	32.00	0.33	0.66	33	17	21	3	18	57.3
0.28	4.6	5.0	1.8	1.1	ZV318S_P532_0320 EZ501U	5.2	10	150	32.00	0.33	0.66	33	17	21	3	18	57.3
0.28	5.0	5.5	2.0	1.0	ZV318S_P532_0320 EZ402U	5.2	10	150	32.00	0.33	0.66	33	17	21	3	18	57.3
0.32	2.6	2.8	1.3	2.0	ZV318S_P532_0280 EZ401U	5.2	10	150	28.00	0.43	0.86	33	17	22	3	18	57.3
0.32	4.0	4.4	2.0	1.3	ZV318S_P532_0280 EZ501U	5.2	10	150	28.00	0.43	0.86	33	17	22	3	18	57.3
0.32	4.4	4.8	2.2	1.2	ZV318S_P532_0280 EZ402U	5.2	10	150	28.00	0.43	0.86	33	17	22	3	18	57.3
0.36	2.3	2.5	1.2	2.2	ZV318S_P532_0250 EZ401U	5.2	10	150	25.00	0.44	0.84	33	17	22	3	18	57.3
0.36	3.6	3.9	1.9	1.4	ZV318S_P532_0250 EZ501U	5.2	10	150	25.00	0.44	0.84	33	17	22	3	18	57.3
0.36	3.9	4.3	2.1	1.3	ZV318S_P532_0250 EZ402U	5.2	10	150	25.00	0.44	0.84	33	17	22	3	18	57.3
0.45	1.9	2.0	1.4	2.5	ZV318S_P532_0200 EZ401U	5.2	10	150	20.00	0.53	1.05	33	17	22	3	18	57.3
0.45	2.9	3.1	2.2	1.6	ZV318S_P532_0200 EZ501U	5.2	10	150	20.00	0.53	1.05	33	17	22	3	18	57.3
0.45	3.1	3.4	2.4	1.5	ZV318S_P532_0200 EZ402U	5.2	10	150	20.00	0.53	1.05	33	17	22	3	18	57.3
0.45	4.6	5.7	3.5	1.0	ZV318S_P532_0200 EZ404U	5.2	10	150	20.00	0.53	1.05	33	17	22	3	18	57.3
0.56	1.5	1.6	1.8	2.9	ZV318S_P532_0160 EZ401U	4.5	10	129	16.00	0.66	1.31	33	17	22	3	18	57.3
0.56	2.3	2.5	2.8	1.9	ZV318S_P532_0160 EZ501U	5.2	10	150	16.00	0.66	1.31	33	17	22	3	18	57.3
0.56	2.5	2.8	3.0	1.7	ZV318S_P532_0160 EZ402U	5.2	10	150	16.00	0.66	1.31	33	17	22	3	18	57.3
0.56	3.7	4.6	4.5	1.2	ZV318S_P532_0160 EZ404U	5.2	10	150	16.00	0.66	1.31	33	17	22	3	18	57.3
0.56	3.9	4.2	4.8	1.1	ZV318S_P532_0160 EZ502U	5.2	10	150	16.00	0.66	1.31	33	17	22	3	18	57.3
0.75	1.1	1.2	3.8	3.5	ZV318S_P532_0120 EZ401U	3.4	10	97	12.00	0.75	1.50	33	17	22	3	18	57.3
0.75	1.7	1.9	5.9	2.3	ZV318S_P532_0120 EZ501U	5.2	10	150	12.00	0.75	1.50	33	17	22	3	18	57.3
0.75	1.9	2.1	6.4	2.1	ZV318S_P532_0120 EZ402U	5.2	10	150	12.00	0.75	1.50	33	17	22	3	18	57.3
0.75	2.7	3.4	9.5	1.4	ZV318S_P532_0120 EZ404U	5.2	10	150	12.00	0.75	1.50	33	17	22	3	18	57.3
0.75	2.9	3.2	10	1.3	ZV318S_P532_0120 EZ502U	5.2	10	150	12.00	0.75	1.50	33	17	22	3	18	57.3
0.75	3.9	4.4	13	1.0	ZV318S_P532_0120 EZ503U	5.2	10	150	12.00	0.75	1.50	33	17	22	3	18	57.3
0.90	1.5	1.6	1.6	2.5	ZV318S_P531_0100 EZ501U	5.2	10	150	10.00	1.11	2.10	25	8	21	3	18	57.3
0.90	2.5	2.7	2.7	1.5	ZV318S_P531_0100 EZ502U	5.2	10	150	10.00	1.11	2.10	25	8	21	3	18	57.3
0.90	2.5	2.8	2.7	1.5	ZV318S_P531_0100 EZ701U	5.2	10	150	10.00	1.11	2.10	25	8	21	3	18	57.3
0.90	3.3	3.8	3.5	1.1	ZV318S_P531_0100 EZ503U	5.2	10	150	10.00	1.11	2.10	25	8	21	3	18	57.3
1.13	1.2	1.3	1.7	2.9	ZV318S_P531_0080 EZ501U	4.3	10	124	8.000	1.39	2.63	25	8	21	3	18	57.3
1.13	2.0	2.2	2.9	1.7	ZV318S_P531_0080 EZ502U	5.2	10	150	8.000	1.39	2.63	25	8	21	3	18	57.3
1.13	2.0	2.2	2.9	1.7	ZV318S_P531_0080 EZ701U	5.2	10	150	8.000	1.39	2.63	25	8	21	3	18	57.3
1.13	2.6	3.0	3.8	1.3	ZV318S_P531_0080 EZ503U	5.2	10	150	8.000	1.39	2.63	25	8	21	3	18	57.3
1.13	3.3	3.9	4.7	1.1	ZV318S_P531_0080 EZ702U	5.2	10	150	8.000	1.39	2.63	25	8	21	3	18	57.3
1.29	1.0	1.1	1.9	3.2	ZV318S_P531_0070 EZ501U	3.8	10	109	7.000	1.59	3.00	25	8	22	3	18	57.3
1.29	1.8	1.9	3.2	1.9	ZV318S_P531_0070 EZ502U	5.2	10	150	7.000	1.59	3.00	25	8	22	3	18	57.3
1.29	1.8	2.0	3.2	1.9	ZV318S_P531_0070 EZ701U	4.7	10	136	7.000	1.59	3.00	25	8	22	3	18	57.3
1.29	2.3	2.6	4.2	1.4	ZV318S_P531_0070 EZ503U	5.2	10	150	7.000	1.59	3.00	25	8	22	3	18	57.3
1.29	2.8	3.4	5.2	1.2	ZV318S_P531_0070 EZ702U	5.2	10	150	7.000	1.59	3.00	25	8	22	3	18	57.3

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV3P5 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 5,2 kN)																	
1.29	3.2	3.8	5.9	1.0	ZV318S_P531_0070 EZ505U	5.2	10	150	7.000	1.59	3.00	25	8	22	3	18	57.3
1.80	0.7	0.8	2.8	4.0	ZV318S_P531_0050 EZ501U	2.7	10	78	5.000	2.10	4.20	25	8	22	3	18	57.3
1.80	1.3	1.4	4.8	2.3	ZV318S_P531_0050 EZ502U	5.2	10	150	5.000	2.10	4.20	25	8	22	3	18	57.3
1.80	1.3	1.4	4.8	2.3	ZV318S_P531_0050 EZ701U	3.4	10	97	5.000	2.10	4.20	25	8	22	3	18	57.3
1.80	1.6	1.9	6.3	1.8	ZV318S_P531_0050 EZ503U	5.2	10	150	5.000	2.10	4.20	25	8	22	3	18	57.3
1.80	2.0	2.4	7.8	1.4	ZV318S_P531_0050 EZ702U	5.2	10	150	5.000	2.10	4.20	25	8	22	3	18	57.3
1.80	2.3	2.7	8.8	1.3	ZV318S_P531_0050 EZ505U	5.2	10	150	5.000	2.10	4.20	25	8	22	3	18	57.3
1.80	2.8	3.5	11	1.1	ZV318S_P531_0050 EZ703U	5.2	10	150	5.000	2.10	4.20	25	8	22	3	18	57.3
2.25	0.6	0.6	3.7	4.7	ZV318S_P531_0040 EZ501U	2.2	10	62	4.000	2.25	4.50	25	8	22	3	18	57.3
2.25	1.0	1.1	6.3	2.7	ZV318S_P531_0040 EZ502U	4.2	10	120	4.000	2.25	4.50	25	8	22	3	18	57.3
2.25	1.0	1.1	6.3	2.7	ZV318S_P531_0040 EZ701U	2.7	10	78	4.000	2.25	4.50	25	8	22	3	18	57.3
2.25	1.3	1.5	8.3	2.1	ZV318S_P531_0040 EZ503U	5.2	10	150	4.000	2.25	4.50	25	8	22	3	18	57.3
2.25	1.6	2.0	10	1.7	ZV318S_P531_0040 EZ702U	5.2	10	150	4.000	2.25	4.50	25	8	22	3	18	57.3
2.25	1.8	2.2	11	1.5	ZV318S_P531_0040 EZ505U	5.2	10	150	4.000	2.25	4.50	25	8	22	3	18	57.3
2.25	2.2	2.8	14	1.2	ZV318S_P531_0040 EZ703U	5.2	10	150	4.000	2.25	4.50	25	8	22	3	18	57.3
3.00	0.8	0.8	16	3.3	ZV318S_P531_0030 EZ502U	3.1	10	90	3.000	2.50	5.00	25	8	22	3	18	57.3
3.00	0.8	0.8	16	3.3	ZV318S_P531_0030 EZ701U	2.0	10	58	3.000	2.50	5.00	25	8	22	3	18	57.3
3.00	1.0	1.1	20	2.5	ZV318S_P531_0030 EZ503U	4.4	10	125	3.000	2.50	5.00	25	8	22	3	18	57.3
3.00	1.2	1.5	25	2.0	ZV318S_P531_0030 EZ702U	4.2	10	119	3.000	2.50	5.00	25	8	22	3	18	57.3
3.00	1.4	1.6	28	1.8	ZV318S_P531_0030 EZ505U	5.2	10	150	3.000	2.50	5.00	25	8	22	3	18	57.3
3.00	1.7	2.1	35	1.5	ZV318S_P531_0030 EZ703U	5.2	10	150	3.000	2.50	5.00	25	8	22	3	18	57.3
3.00	2.2	3.1	45	1.1	ZV318S_P531_0030 EZ705U	5.2	10	150	3.000	2.50	5.00	25	8	22	3	18	57.3
ZV3P5 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 5,2 kN)																	
1.35	3.2	5.2	4.0	1.0	ZV318S_P531_0100 EZ505U	5.2	10	150	10.00	1.11	2.10	25	8	21	3	18	57.3
1.69	2.6	4.1	4.2	1.2	ZV318S_P531_0080 EZ505U	5.2	10	150	8.000	1.39	2.63	25	8	21	3	18	57.3
1.93	2.3	3.6	4.7	1.3	ZV318S_P531_0070 EZ505U	5.2	10	150	7.000	1.59	3.00	25	8	22	3	18	57.3
2.70	1.6	2.6	7.1	1.6	ZV318S_P531_0050 EZ505U	5.2	10	150	5.000	2.10	4.20	25	8	22	3	18	57.3
2.70	2.0	3.4	9.0	1.3	ZV318S_P531_0050 EZ703U	5.2	10	150	5.000	2.10	4.20	25	8	22	3	18	57.3
3.38	1.3	2.1	9.3	1.8	ZV318S_P531_0040 EZ505U	5.2	10	150	4.000	2.25	4.50	25	8	22	3	18	57.3
3.38	1.6	2.7	12	1.5	ZV318S_P531_0040 EZ703U	5.2	10	150	4.000	2.25	4.50	25	8	22	3	18	57.3
3.38	2.2	4.1	16	1.1	ZV318S_P531_0040 EZ705U	5.2	10	150	4.000	2.25	4.50	25	8	22	3	18	57.3
4.50	1.0	1.6	23	2.2	ZV318S_P531_0030 EZ505U	5.2	10	150	3.000	2.50	5.00	25	8	22	3	18	57.3
4.50	1.2	2.0	29	1.8	ZV318S_P531_0030 EZ703U	5.2	10	150	3.000	2.50	5.00	25	8	22	3	18	57.3
4.50	1.7	3.0	40	1.3	ZV318S_P531_0030 EZ705U	5.2	10	150	3.000	2.50	5.00	25	8	22	3	18	57.3
ZV3P5 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 5,2 kN)																	
0.32	4.3	5.2	0.9	1.2	ZV318S_P532_0560 EZ401U	5.2	10	150	56.00	0.21	0.43	33	17	21	3	18	57.3
0.36	3.8	4.6	0.9	1.3	ZV318S_P532_0500 EZ401U	5.2	10	150	50.00	0.24	0.48	33	17	22	3	18	57.3
0.45	3.1	3.7	1.3	1.5	ZV318S_P532_0400 EZ401U	5.2	10	150	40.00	0.30	0.60	33	17	22	3	18	57.3
0.45	4.5	5.8	1.9	1.0	ZV318S_P532_0400 EZ501U	5.2	10	150	40.00	0.30	0.60	33	17	22	3	18	57.3
0.45	4.6	6.5	2.0	1.0	ZV318S_P532_0400 EZ402U	5.2	10	150	40.00	0.30	0.60	33	17	22	3	18	57.3
0.51	2.7	3.2	1.1	1.7	ZV318S_P532_0350 EZ401U	5.2	10	150	35.00	0.34	0.69	33	17	22	3	18	57.3
0.51	3.9	5.1	1.6	1.1	ZV318S_P532_0350 EZ501U	5.2	10	150	35.00	0.34	0.69	33	17	22	3	18	57.3
0.51	4.1	5.7	1.6	1.1	ZV318S_P532_0350 EZ402U	5.2	10	150	35.00	0.34	0.69	33	17	22	3	18	57.3
0.56	2.4	3.0	1.2	1.8	ZV318S_P532_0320 EZ401U	5.2	10	150	32.00	0.33	0.66	33	17	21	3	18	57.3
0.56	3.6	4.7	1.7	1.2	ZV318S_P532_0320 EZ501U	5.2	10	150	32.00	0.33	0.66	33	17	21	3	18	57.3
0.56	3.7	5.2	1.8	1.2	ZV318S_P532_0320 EZ402U	5.2	10	150	32.00	0.33	0.66	33	17	21	3	18	57.3
0.64	2.1	2.6	1.2	1.9	ZV318S_P532_0280 EZ401U	5.2	10	150	28.00	0.43	0.86	33	17	22	3	18	57.3
0.64	3.2	4.1	1.8	1.3	ZV318S_P532_0280 EZ501U	5.2	10	150	28.00	0.43	0.86	33	17	22	3	18	57.3
0.64	3.2	4.5	1.9	1.3	ZV318S_P532_0280 EZ402U	5.2	10	150	28.00	0.43	0.86	33	17	22	3	18	57.3
0.72	1.9	2.3	1.2	2.1	ZV318S_P532_0250 EZ401U	5.2	10	150	25.00	0.44	0.84	33	17	22	3	18	57.3
0.72	2.8	3.6	1.8	1.4	ZV318S_P532_0250 EZ501U	5.2	10	150	25.00	0.44	0.84	33	17	22	3	18	57.3
0.72	2.9	4.1	1.9	1.4	ZV318S_P532_0250 EZ402U	5.2	10	150	25.00	0.44	0.84	33	17	22	3	18	57.3
0.90	1.5	1.9	1.4	2.4	ZV318S_P532_0200 EZ401U	5.2	10	150	20.00	0.53	1.05	33	17	22	3	18	57.3
0.90	2.3	2.9	2.1	1.6	ZV318S_P532_0200 EZ501U	5.2	10	150	20.00	0.53	1.05	33	17	22	3	18	57.3
0.90	2.3	3.2	2.1	1.6	ZV318S_P532_0200 EZ402U	5.2	10	150	20.00	0.53	1.05	33	17	22	3	18	57.3
0.90	3.4	5.2	3.2	1.1	ZV318S_P532_0200 EZ502U	5.2	10	150	20.00	0.53	1.05	33	17	22	3	18	57.3
1.13	1.2	1.5	1.7	2.8	ZV318S_P532_0160 EZ401U	4.5	10	129	16.00	0.66	1.31	33	17	22	3	18	57.3
1.13	1.8	2.3	2.5	1.9	ZV318S_P532_0160 EZ501U	5.2	10	150	16.00	0.66	1.31	33	17	22	3	18	57.3
1.13	1.9	2.6	2.6	1.8	ZV318S_P532_0160 EZ402U	5.2	10	150	16.00	0.66	1.31	33	17	22	3	18	57.3
1.13	2.8	4.1	3.8	1.2	ZV318S_P532_0160 EZ502U	5.2	10	150	16.00	0.66	1.31	33	17	22	3	18	57.3
1.13	3.1	4.5	4.2	1.1	ZV318S_P532_0160 EZ404U	5.2	10	150	16.00	0.66	1.31	33	17	22	3	18	57.3
1.13	3.3	5.6	4.5	1.0	ZV318S_P532_0160 EZ503U	5.2	10	150	16.00	0.66	1.31	33	17	22	3	18	57.3
1.50	0.9	1.1	3.5	3.4	ZV318S_P532_0120 EZ401U	3.4	10	97	12.00	0.75	1.50	33	17	22	3	18	57.3
1.50	1.4	1.8	5.2	2.3	ZV318S_P532_0120 EZ501U	5.2	10	150	12.00	0.75	1.50	33	17	22	3	18	57.3
1.50	1.4	1.9	5.4	2.2	ZV318S_P532_0120 EZ402U	5.2	10	150	12.00	0.75	1.50	33	17	22	3	18	57.3
1.50	2.1	3.1	8.0	1.5	ZV318S_P532_0120 EZ502U	5.2	10	150	12.00	0.75	1.50	33	17	22	3	18	57.3

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV3P5 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 5,2 kN)																	
1.50	2.3	3.3	8.9	1.4	ZV318S_P532_0120 EZ404U	5.2	10	150	12.00	0.75	1.50	33	17	22	3	18	57.3
1.50	2.5	4.2	9.5	1.3	ZV318S_P532_0120 EZ503U	5.2	10	150	12.00	0.75	1.50	33	17	22	3	18	57.3
1.80	1.2	1.5	1.6	2.5	ZV318S_P531_0100 EZ501U	5.2	10	150	10.00	1.11	2.10	25	8	21	3	18	57.3
1.80	1.8	2.6	2.4	1.7	ZV318S_P531_0100 EZ502U	5.2	10	150	10.00	1.11	2.10	25	8	21	3	18	57.3
1.80	1.8	2.7	2.4	1.7	ZV318S_P531_0100 EZ701U	5.2	10	150	10.00	1.11	2.10	25	8	21	3	18	57.3
1.80	2.1	3.6	2.8	1.4	ZV318S_P531_0100 EZ503U	5.2	10	150	10.00	1.11	2.10	25	8	21	3	18	57.3
1.80	2.4	4.8	3.3	1.2	ZV318S_P531_0100 EZ702U	5.2	10	150	10.00	1.11	2.10	25	8	21	3	18	57.3
2.25	0.9	1.2	1.7	3.0	ZV318S_P531_0080 EZ501U	4.3	10	124	8.000	1.39	2.63	25	8	21	3	18	57.3
2.25	1.4	2.1	2.5	1.9	ZV318S_P531_0080 EZ502U	5.2	10	150	8.000	1.39	2.63	25	8	21	3	18	57.3
2.25	1.4	2.1	2.5	1.9	ZV318S_P531_0080 EZ701U	5.2	10	150	8.000	1.39	2.63	25	8	21	3	18	57.3
2.25	1.7	2.9	3.0	1.6	ZV318S_P531_0080 EZ503U	5.2	10	150	8.000	1.39	2.63	25	8	21	3	18	57.3
2.25	2.0	3.9	3.5	1.4	ZV318S_P531_0080 EZ702U	5.2	10	150	8.000	1.39	2.63	25	8	21	3	18	57.3
2.57	0.8	1.0	1.9	3.2	ZV318S_P531_0070 EZ501U	3.8	10	109	7.000	1.59	3.00	25	8	22	3	18	57.3
2.57	1.2	1.8	2.9	2.1	ZV318S_P531_0070 EZ502U	5.2	10	150	7.000	1.59	3.00	25	8	22	3	18	57.3
2.57	1.2	1.9	2.9	2.1	ZV318S_P531_0070 EZ701U	4.7	10	136	7.000	1.59	3.00	25	8	22	3	18	57.3
2.57	1.5	2.5	3.4	1.8	ZV318S_P531_0070 EZ503U	5.2	10	150	7.000	1.59	3.00	25	8	22	3	18	57.3
2.57	1.7	3.4	3.9	1.5	ZV318S_P531_0070 EZ702U	5.2	10	150	7.000	1.59	3.00	25	8	22	3	18	57.3
3.60	0.6	0.7	2.8	4.0	ZV318S_P531_0050 EZ501U	2.7	10	78	5.000	2.10	4.20	25	8	22	3	18	57.3
3.60	0.9	1.3	4.3	2.6	ZV318S_P531_0050 EZ502U	5.2	10	150	5.000	2.10	4.20	25	8	22	3	18	57.3
3.60	0.9	1.3	4.3	2.6	ZV318S_P531_0050 EZ701U	3.4	10	97	5.000	2.10	4.20	25	8	22	3	18	57.3
3.60	1.0	1.8	5.1	2.2	ZV318S_P531_0050 EZ503U	5.2	10	150	5.000	2.10	4.20	25	8	22	3	18	57.3
3.60	1.2	2.4	5.9	1.9	ZV318S_P531_0050 EZ702U	5.2	10	150	5.000	2.10	4.20	25	8	22	3	18	57.3
4.50	0.5	0.6	3.6	4.7	ZV318S_P531_0040 EZ501U	2.2	10	62	4.000	2.25	4.50	25	8	22	3	18	57.3
4.50	0.7	1.1	5.6	3.1	ZV318S_P531_0040 EZ502U	4.2	10	120	4.000	2.25	4.50	25	8	22	3	18	57.3
4.50	0.7	1.1	5.6	3.1	ZV318S_P531_0040 EZ701U	2.7	10	78	4.000	2.25	4.50	25	8	22	3	18	57.3
4.50	0.8	1.4	6.7	2.6	ZV318S_P531_0040 EZ503U	5.2	10	150	4.000	2.25	4.50	25	8	22	3	18	57.3
4.50	1.0	1.9	7.7	2.2	ZV318S_P531_0040 EZ702U	5.2	10	150	4.000	2.25	4.50	25	8	22	3	18	57.3
ZV3P7 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 7,0 kN)																	
0.20	6.5	7.1	0.8	1.1	ZV322S_P732_0560 EZ501U	7.0	14	245	56.00	0.24	0.46	41	20	23	3	22	70.0
0.22	5.8	6.4	0.8	1.2	ZV322S_P732_0500 EZ501U	7.0	14	245	50.00	0.27	0.51	41	20	24	3	22	70.0
0.28	4.7	5.1	1.0	1.3	ZV322S_P732_0400 EZ501U	7.0	14	245	40.00	0.34	0.64	41	20	24	3	22	70.0
0.31	4.1	4.5	0.9	1.5	ZV322S_P732_0350 EZ501U	7.0	14	245	35.00	0.39	0.73	41	20	24	3	22	70.0
0.34	3.7	4.1	1.1	1.6	ZV322S_P732_0320 EZ501U	7.0	14	245	32.00	0.34	0.69	41	20	23	3	22	70.0
0.39	3.3	3.6	1.0	1.7	ZV322S_P732_0280 EZ501U	7.0	14	245	28.00	0.49	0.92	41	20	24	3	22	70.0
0.44	2.9	3.2	1.2	1.8	ZV322S_P732_0250 EZ501U	7.0	14	245	25.00	0.51	1.03	41	20	24	3	22	70.0
0.44	5.0	5.4	2.0	1.1	ZV322S_P732_0250 EZ502U	7.0	14	245	25.00	0.51	1.03	41	20	24	3	22	70.0
0.44	5.0	5.6	2.0	1.1	ZV322S_P732_0250 EZ701U	7.0	14	245	25.00	0.51	1.03	41	20	24	3	22	70.0
0.55	2.3	2.6	1.4	2.1	ZV322S_P732_0200 EZ501U	7.0	14	245	20.00	0.55	1.10	41	20	24	3	22	70.0
0.55	4.0	4.3	2.5	1.2	ZV322S_P732_0200 EZ502U	7.0	14	245	20.00	0.55	1.10	41	20	24	3	22	70.0
0.55	4.0	4.5	2.5	1.2	ZV322S_P732_0200 EZ701U	7.0	14	245	20.00	0.55	1.10	41	20	24	3	22	70.0
0.69	1.9	2.0	1.6	2.5	ZV322S_P732_0160 EZ501U	6.9	14	243	16.00	0.69	1.38	41	20	24	3	22	70.0
0.69	3.2	3.5	2.8	1.4	ZV322S_P732_0160 EZ502U	7.0	14	245	16.00	0.69	1.38	41	20	24	3	22	70.0
0.69	3.2	3.6	2.8	1.4	ZV322S_P732_0160 EZ701U	7.0	14	245	16.00	0.69	1.38	41	20	24	3	22	70.0
0.69	4.2	4.8	3.7	1.1	ZV322S_P732_0160 EZ503U	7.0	14	245	16.00	0.69	1.38	41	20	24	3	22	70.0
0.92	1.4	1.5	2.9	3.0	ZV322S_P732_0120 EZ501U	5.2	14	182	12.00	0.76	1.53	41	20	23	3	22	70.0
0.92	2.4	2.6	5.0	1.7	ZV322S_P732_0120 EZ502U	7.0	14	245	12.00	0.76	1.53	41	20	23	3	22	70.0
0.92	2.4	2.7	5.0	1.7	ZV322S_P732_0120 EZ701U	6.5	14	228	12.00	0.76	1.53	41	20	23	3	22	70.0
0.92	3.2	3.6	6.5	1.3	ZV322S_P732_0120 EZ503U	7.0	14	245	12.00	0.76	1.53	41	20	23	3	22	70.0
0.92	3.9	4.7	8.0	1.1	ZV322S_P732_0120 EZ702U	7.0	14	245	12.00	0.76	1.53	41	20	23	3	22	70.0
1.10	2.1	2.3	1.7	1.9	ZV322S_P731_0100 EZ701U	5.5	14	194	10.00	1.10	2.20	31	10	23	3	22	70.0
1.10	3.3	4.0	2.7	1.2	ZV322S_P731_0100 EZ702U	7.0	14	245	10.00	1.10	2.20	31	10	23	3	22	70.0
1.38	1.6	1.8	1.7	2.2	ZV322S_P731_0080 EZ701U	4.4	14	155	8.000	1.38	2.75	31	10	23	3	22	70.0
1.38	2.7	3.2	2.8	1.4	ZV322S_P731_0080 EZ702U	7.0	14	245	8.000	1.38	2.75	31	10	23	3	22	70.0
1.38	3.7	4.6	3.9	1.0	ZV322S_P731_0080 EZ703U	7.0	14	245	8.000	1.38	2.75	31	10	23	3	22	70.0
1.57	1.4	1.6	1.8	2.4	ZV322S_P731_0070 EZ701U	3.9	14	136	7.000	1.57	3.14	31	10	23	3	22	70.0
1.57	2.3	2.8	3.0	1.5	ZV322S_P731_0070 EZ702U	7.0	14	245	7.000	1.57	3.14	31	10	23	3	22	70.0
1.57	3.2	4.0	4.1	1.1	ZV322S_P731_0070 EZ703U	7.0	14	245	7.000	1.57	3.14	31	10	23	3	22	70.0
2.20	1.0	1.1	2.8	3.1	ZV322S_P731_0050 EZ701U	2.8	14	97	5.000	1.98	4.03	31	10	24	3	22	70.0
2.20	1.7	2.0	4.5	1.9	ZV322S_P731_0050 EZ702U	5.7	14	199	5.000	1.98	4.03	31	10	24	3	22	70.0
2.20	2.3	2.9	6.2	1.4	ZV322S_P731_0050 EZ703U	7.0	14	245	5.000	1.98	4.03	31	10	24	3	22	70.0
2.20	3.0	4.2	7.9	1.1	ZV322S_P731_0050 EZ705U	7.0	14	245	5.000	1.98	4.03	31	10	24	3	22	70.0
2.75	0.8	0.9	3.6	3.5	ZV322S_P731_0040 EZ701U	2.2	14	78	4.000	2.29	4.58	31	10	24	3	22	70.0
2.75	1.3	1.6	5.9	2.2	ZV322S_P731_0040 EZ702U	4.5	14	159	4.000	2.29	4.58	31	10	24	3	22	70.0
2.75	1.8	2.3	8.0	1.6	ZV322S_P731_0040 EZ703U	7.0	14	245	4.000	2.29	4.58	31	10	24	3	22	70.0
2.75	2.4	3.3	10	1.2	ZV322S_P731_0040 EZ705U	7.0	14	245	4.000	2.29	4.58	31	10	24	3	22	70.0
3.67	0.6	0.7	8.0	4.3	ZV322S_P731_0030 EZ701U	1.7	14	58	3.000	2.69	4.89	31	10	24	3	22	70.0

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV3P7 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 7,0 kN)																	
3.67	1.0	1.2	13	2.6	ZV322S_P731_0030 EZ702U	3.4	14	119	3.000	2.69	4.89	31	10	24	3	22	70.0
3.67	1.4	1.7	18	1.9	ZV322S_P731_0030 EZ703U	5.4	14	189	3.000	2.69	4.89	31	10	24	3	22	70.0
3.67	1.8	2.5	23	1.5	ZV322S_P731_0030 EZ705U	7.0	14	245	3.000	2.69	4.89	31	10	24	3	22	70.0
ZV3P7 (n_{1N} = 4000 min^{-1}, ($F_{f2acc,max}$ = 7,0 kN)																	
4.89	2.1	3.6	30	1.1	ZV322S_P731_0030 EZ813U	7.0	14	245	3.000	2.69	4.89	31	10	24	3	22	70.0
4.89	2.2	5.6	31	1.1	ZV322S_P731_0030 EZ815U	7.0	14	245	3.000	2.69	4.89	31	10	24	3	22	70.0
ZV3P7 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 7,0 kN)																	
1.38	3.1	5.0	6.6	1.2	ZV322S_P732_0120 EZ505U	7.0	14	245	12.00	0.76	1.53	41	20	23	3	22	70.0
1.65	3.4	5.5	3.1	1.0	ZV322S_P731_0100 EZ703U	7.0	14	245	10.00	1.10	2.20	31	10	23	3	22	70.0
2.06	2.7	4.4	3.2	1.2	ZV322S_P731_0080 EZ703U	7.0	14	245	8.000	1.38	2.75	31	10	23	3	22	70.0
2.36	2.3	3.9	3.5	1.3	ZV322S_P731_0070 EZ703U	7.0	14	245	7.000	1.57	3.14	31	10	23	3	22	70.0
3.30	1.7	2.8	5.2	1.6	ZV322S_P731_0050 EZ703U	7.0	14	245	5.000	1.98	4.03	31	10	24	3	22	70.0
3.30	2.3	4.2	7.0	1.2	ZV322S_P731_0050 EZ705U	7.0	14	245	5.000	1.98	4.03	31	10	24	3	22	70.0
4.13	1.3	2.2	6.8	1.9	ZV322S_P731_0040 EZ703U	7.0	14	245	4.000	2.29	4.58	31	10	24	3	22	70.0
4.13	1.8	3.3	9.2	1.4	ZV322S_P731_0040 EZ705U	7.0	14	245	4.000	2.29	4.58	31	10	24	3	22	70.0
ZV3P7 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 7,0 kN)																	
0.39	5.2	6.7	0.8	1.1	ZV322S_P732_0560 EZ501U	7.0	14	245	56.00	0.24	0.46	41	20	23	3	22	70.0
0.44	4.6	6.0	0.7	1.2	ZV322S_P732_0500 EZ501U	7.0	14	245	50.00	0.27	0.51	41	20	24	3	22	70.0
0.55	3.7	4.8	1.0	1.3	ZV322S_P732_0400 EZ501U	7.0	14	245	40.00	0.34	0.64	41	20	24	3	22	70.0
0.63	3.2	4.2	0.9	1.5	ZV322S_P732_0350 EZ501U	7.0	14	245	35.00	0.39	0.73	41	20	24	3	22	70.0
0.69	3.0	3.8	1.1	1.6	ZV322S_P732_0320 EZ501U	7.0	14	245	32.00	0.34	0.69	41	20	23	3	22	70.0
0.69	4.5	6.8	1.6	1.0	ZV322S_P732_0320 EZ502U	7.0	14	245	32.00	0.34	0.69	41	20	23	3	22	70.0
0.69	4.5	6.9	1.6	1.0	ZV322S_P732_0320 EZ701U	7.0	14	245	32.00	0.34	0.69	41	20	23	3	22	70.0
0.79	2.6	3.3	1.0	1.7	ZV322S_P732_0280 EZ501U	7.0	14	245	28.00	0.49	0.92	41	20	24	3	22	70.0
0.79	4.0	5.9	1.5	1.1	ZV322S_P732_0280 EZ502U	7.0	14	245	28.00	0.49	0.92	41	20	24	3	22	70.0
0.79	4.0	6.0	1.5	1.1	ZV322S_P732_0280 EZ701U	7.0	14	245	28.00	0.49	0.92	41	20	24	3	22	70.0
0.88	2.3	3.0	1.1	1.8	ZV322S_P732_0250 EZ501U	7.0	14	245	25.00	0.51	1.03	41	20	24	3	22	70.0
0.88	3.5	5.3	1.7	1.2	ZV322S_P732_0250 EZ502U	7.0	14	245	25.00	0.51	1.03	41	20	24	3	22	70.0
0.88	3.5	5.4	1.7	1.2	ZV322S_P732_0250 EZ701U	7.0	14	245	25.00	0.51	1.03	41	20	24	3	22	70.0
0.88	4.2	7.2	2.0	1.0	ZV322S_P732_0250 EZ503U	7.0	14	245	25.00	0.51	1.03	41	20	24	3	22	70.0
1.10	1.8	2.4	1.3	2.1	ZV322S_P732_0200 EZ501U	7.0	14	245	20.00	0.55	1.10	41	20	24	3	22	70.0
1.10	2.8	4.2	1.9	1.4	ZV322S_P732_0200 EZ502U	7.0	14	245	20.00	0.55	1.10	41	20	24	3	22	70.0
1.10	2.8	4.3	1.9	1.4	ZV322S_P732_0200 EZ701U	7.0	14	245	20.00	0.55	1.10	41	20	24	3	22	70.0
1.10	3.4	5.8	2.3	1.2	ZV322S_P732_0200 EZ503U	7.0	14	245	20.00	0.55	1.10	41	20	24	3	22	70.0
1.10	3.9	7.8	2.7	1.0	ZV322S_P732_0200 EZ702U	7.0	14	245	20.00	0.55	1.10	41	20	24	3	22	70.0
1.38	1.5	1.9	1.4	2.5	ZV322S_P732_0160 EZ501U	6.9	14	243	16.00	0.69	1.38	41	20	24	3	22	70.0
1.38	2.3	3.4	2.2	1.6	ZV322S_P732_0160 EZ502U	7.0	14	245	16.00	0.69	1.38	41	20	24	3	22	70.0
1.38	2.3	3.4	2.2	1.6	ZV322S_P732_0160 EZ701U	7.0	14	245	16.00	0.69	1.38	41	20	24	3	22	70.0
1.38	2.7	4.6	2.6	1.4	ZV322S_P732_0160 EZ503U	7.0	14	245	16.00	0.69	1.38	41	20	24	3	22	70.0
1.38	3.1	6.2	3.0	1.2	ZV322S_P732_0160 EZ702U	7.0	14	245	16.00	0.69	1.38	41	20	24	3	22	70.0
2.20	1.4	2.2	1.5	2.2	ZV322S_P731_0100 EZ701U	5.5	14	194	10.00	1.10	2.20	31	10	23	3	22	70.0
2.20	2.0	4.0	2.0	1.6	ZV322S_P731_0100 EZ702U	7.0	14	245	10.00	1.10	2.20	31	10	23	3	22	70.0
2.75	1.2	1.8	1.5	2.5	ZV322S_P731_0080 EZ701U	4.4	14	155	8.000	1.38	2.75	31	10	23	3	22	70.0
2.75	1.6	3.2	2.1	1.8	ZV322S_P731_0080 EZ702U	7.0	14	245	8.000	1.38	2.75	31	10	23	3	22	70.0
3.14	1.0	1.5	1.6	2.8	ZV322S_P731_0070 EZ701U	3.9	14	136	7.000	1.57	3.14	31	10	23	3	22	70.0
3.14	1.4	2.8	2.3	2.0	ZV322S_P731_0070 EZ702U	7.0	14	245	7.000	1.57	3.14	31	10	23	3	22	70.0
ZV4P7 (n_{1N} = 2000 min^{-1}, ($F_{f2acc,max}$ = 7,3 kN)																	
2.67	3.0	3.3	37	1.0	ZV418S_P731_0030 EZ813U	7.3	15	280	3.000	2.93	5.33	33	11	25	4	18	76.4
ZV4P7 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 7,3 kN)																	
0.21	6.0	6.5	0.8	1.2	ZV418S_P732_0560 EZ501U	7.3	15	280	56.00	0.26	0.50	44	22	25	4	18	76.4
0.24	5.3	5.8	0.8	1.3	ZV418S_P732_0500 EZ501U	7.3	15	280	50.00	0.30	0.56	44	22	25	4	18	76.4
0.30	4.3	4.7	1.0	1.5	ZV418S_P732_0400 EZ501U	7.3	15	280	40.00	0.37	0.70	44	22	25	4	18	76.4
0.34	3.7	4.1	0.9	1.6	ZV418S_P732_0350 EZ501U	7.3	15	280	35.00	0.42	0.80	44	22	25	4	18	76.4
0.38	3.4	3.7	1.1	1.7	ZV418S_P732_0320 EZ501U	7.3	15	280	32.00	0.38	0.75	44	22	25	4	18	76.4
0.38	5.9	6.4	1.9	1.0	ZV418S_P732_0320 EZ502U	7.3	15	280	32.00	0.38	0.75	44	22	25	4	18	76.4
0.38	5.9	6.6	1.9	1.0	ZV418S_P732_0320 EZ701U	7.3	15	280	32.00	0.38	0.75	44	22	25	4	18	76.4
0.43	3.0	3.3	1.0	1.9	ZV418S_P732_0280 EZ501U	7.3	15	280	28.00	0.53	1.00	44	22	25	4	18	76.4
0.43	5.2	5.6	1.8	1.1	ZV418S_P732_0280 EZ502U	7.3	15	280	28.00	0.53	1.00	44	22	25	4	18	76.4
0.43	5.2	5.8	1.8	1.1	ZV418S_P732_0280 EZ701U	7.3	15	280	28.00	0.53	1.00	44	22	25	4	18	76.4
0.48	2.7	2.9	1.2	2.0	ZV418S_P732_0250 EZ501U	7.3	15	280	25.00	0.56	1.12	44	22	25	4	18	76.4
0.48	4.6	5.0	2.0	1.2	ZV418S_P732_0250 EZ502U	7.3	15	280	25.00	0.56	1.12	44	22	25	4	18	76.4
0.48	4.6	5.2	2.0	1.2	ZV418S_P732_0250 EZ701U	7.3	15	280	25.00	0.56	1.12	44	22	25	4	18	76.4
0.60	2.1	2.3	1.4	2.4	ZV418S_P732_0200 EZ501U	7.3	15	280	20.00	0.60	1.20	44	22	25	4	18	76.4
0.60	3.7	4.0	2.5	1.4	ZV418S_P732_0200 EZ502U	7.3	15	280	20.00	0.60	1.20	44	22	25	4	18	76.4
0.60	3.7	4.1	2.5	1.4	ZV418S_P732_0200 EZ701U	7.3	15	280	20.00	0.60	1.20	44	22	25	4	18	76.4

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV4P7 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 7,3 kN)																	
0.60	4.8	5.5	3.2	1.0	ZV418S_P732_0200 EZ503U	7.3	15	280	20.00	0.60	1.20	44	22	25	4	18	76.4
0.75	1.7	1.9	1.6	2.7	ZV418S_P732_0160 EZ501U	6.4	15	243	16.00	0.75	1.50	44	22	25	4	18	76.4
0.75	2.9	3.2	2.8	1.6	ZV418S_P732_0160 EZ502U	7.3	15	280	16.00	0.75	1.50	44	22	25	4	18	76.4
0.75	2.9	3.3	2.8	1.6	ZV418S_P732_0160 EZ701U	7.3	15	280	16.00	0.75	1.50	44	22	25	4	18	76.4
0.75	3.9	4.4	3.7	1.2	ZV418S_P732_0160 EZ503U	7.3	15	280	16.00	0.75	1.50	44	22	25	4	18	76.4
1.00	1.3	1.4	2.9	3.3	ZV418S_P732_0120 EZ501U	4.8	15	182	12.00	0.83	1.67	44	22	25	4	18	76.4
1.00	2.2	2.4	5.0	1.9	ZV418S_P732_0120 EZ502U	7.3	15	280	12.00	0.83	1.67	44	22	25	4	18	76.4
1.00	2.2	2.5	5.0	1.9	ZV418S_P732_0120 EZ701U	6.0	15	228	12.00	0.83	1.67	44	22	25	4	18	76.4
1.00	2.9	3.3	6.5	1.5	ZV418S_P732_0120 EZ503U	7.3	15	280	12.00	0.83	1.67	44	22	25	4	18	76.4
1.00	3.6	4.3	8.0	1.2	ZV418S_P732_0120 EZ702U	7.3	15	280	12.00	0.83	1.67	44	22	25	4	18	76.4
1.00	4.0	4.8	9.0	1.1	ZV418S_P732_0120 EZ505U	7.3	15	280	12.00	0.83	1.67	44	22	25	4	18	76.4
1.20	1.9	2.1	1.7	2.1	ZV418S_P731_0100 EZ701U	5.1	15	194	10.00	1.20	2.40	33	11	24	4	18	76.4
1.20	3.0	3.7	2.7	1.3	ZV418S_P731_0100 EZ702U	7.3	15	280	10.00	1.20	2.40	33	11	24	4	18	76.4
1.50	1.5	1.7	1.7	2.5	ZV418S_P731_0080 EZ701U	4.1	15	155	8.000	1.50	3.00	33	11	25	4	18	76.4
1.50	2.4	2.9	2.8	1.5	ZV418S_P731_0080 EZ702U	7.3	15	280	8.000	1.50	3.00	33	11	25	4	18	76.4
1.50	3.4	4.2	3.9	1.1	ZV418S_P731_0080 EZ703U	7.3	15	280	8.000	1.50	3.00	33	11	25	4	18	76.4
1.71	1.3	1.5	1.8	2.7	ZV418S_P731_0070 EZ701U	3.6	15	136	7.000	1.71	3.43	33	11	25	4	18	76.4
1.71	2.1	2.6	3.0	1.7	ZV418S_P731_0070 EZ702U	7.3	15	278	7.000	1.71	3.43	33	11	25	4	18	76.4
1.71	2.9	3.7	4.1	1.2	ZV418S_P731_0070 EZ703U	7.3	15	280	7.000	1.71	3.43	33	11	25	4	18	76.4
2.40	0.9	1.1	2.8	3.4	ZV418S_P731_0050 EZ701U	2.5	15	97	5.000	2.16	4.40	33	11	25	4	18	76.4
2.40	1.5	1.8	4.5	2.1	ZV418S_P731_0050 EZ702U	5.2	15	199	5.000	2.16	4.40	33	11	25	4	18	76.4
2.40	2.1	2.6	6.2	1.5	ZV418S_P731_0050 EZ703U	7.3	15	280	5.000	2.16	4.40	33	11	25	4	18	76.4
2.40	2.7	3.8	7.9	1.2	ZV418S_P731_0050 EZ705U	7.3	15	280	5.000	2.16	4.40	33	11	25	4	18	76.4
3.00	0.8	0.8	3.6	3.9	ZV418S_P731_0040 EZ701U	2.0	15	78	4.000	2.50	5.00	33	11	25	4	18	76.4
3.00	1.2	1.5	5.9	2.4	ZV418S_P731_0040 EZ702U	4.2	15	159	4.000	2.50	5.00	33	11	25	4	18	76.4
3.00	1.7	2.1	8.0	1.8	ZV418S_P731_0040 EZ703U	6.6	15	252	4.000	2.50	5.00	33	11	25	4	18	76.4
3.00	2.2	3.1	10	1.4	ZV418S_P731_0040 EZ705U	7.3	15	280	4.000	2.50	5.00	33	11	25	4	18	76.4
4.00	0.6	0.6	8.0	4.8	ZV418S_P731_0030 EZ701U	1.5	15	58	3.000	2.93	5.33	33	11	25	4	18	76.4
4.00	0.9	1.1	13	2.9	ZV418S_P731_0030 EZ702U	3.1	15	119	3.000	2.93	5.33	33	11	25	4	18	76.4
4.00	1.3	1.6	18	2.1	ZV418S_P731_0030 EZ703U	5.0	15	189	3.000	2.93	5.33	33	11	25	4	18	76.4
4.00	1.6	2.3	23	1.7	ZV418S_P731_0030 EZ705U	7.3	15	280	3.000	2.93	5.33	33	11	25	4	18	76.4
ZV4P7 (n_{1N} = 4000 min^{-1}, ($F_{f2acc,max}$ = 7,3 kN)																	
4.00	2.6	4.4	14	1.0	ZV418S_P731_0040 EZ813U	7.3	15	280	4.000	2.50	5.00	33	11	25	4	18	76.4
4.00	2.7	6.8	14	1.0	ZV418S_P731_0040 EZ815U	7.3	15	280	4.000	2.50	5.00	33	11	25	4	18	76.4
5.33	1.9	3.3	30	1.3	ZV418S_P731_0030 EZ813U	7.3	15	280	3.000	2.93	5.33	33	11	25	4	18	76.4
5.33	2.0	5.1	31	1.2	ZV418S_P731_0030 EZ815U	7.3	15	280	3.000	2.93	5.33	33	11	25	4	18	76.4
ZV4P7 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 7,3 kN)																	
1.13	3.8	6.1	3.6	1.1	ZV418S_P732_0160 EZ505U	7.3	15	280	16.00	0.75	1.50	44	22	25	4	18	76.4
1.50	2.8	4.6	6.6	1.3	ZV418S_P732_0120 EZ505U	7.3	15	280	12.00	0.83	1.67	44	22	25	4	18	76.4
1.50	3.6	6.0	8.4	1.0	ZV418S_P732_0120 EZ703U	7.3	15	280	12.00	0.83	1.67	44	22	25	4	18	76.4
1.80	3.1	5.1	3.1	1.1	ZV418S_P731_0100 EZ703U	7.3	15	280	10.00	1.20	2.40	33	11	24	4	18	76.4
2.25	2.5	4.1	3.2	1.3	ZV418S_P731_0080 EZ703U	7.3	15	280	8.000	1.50	3.00	33	11	25	4	18	76.4
2.57	2.2	3.6	3.5	1.4	ZV418S_P731_0070 EZ703U	7.3	15	280	7.000	1.71	3.43	33	11	25	4	18	76.4
2.57	2.9	5.3	4.7	1.1	ZV418S_P731_0070 EZ705U	7.3	15	280	7.000	1.71	3.43	33	11	25	4	18	76.4
3.60	1.5	2.5	5.2	1.8	ZV418S_P731_0050 EZ703U	7.3	15	280	5.000	2.16	4.40	33	11	25	4	18	76.4
3.60	2.1	3.8	7.0	1.3	ZV418S_P731_0050 EZ705U	7.3	15	280	5.000	2.16	4.40	33	11	25	4	18	76.4
4.50	1.2	2.0	6.8	2.1	ZV418S_P731_0040 EZ703U	6.6	15	252	4.000	2.50	5.00	33	11	25	4	18	76.4
4.50	1.7	3.0	9.2	1.5	ZV418S_P731_0040 EZ705U	7.3	15	280	4.000	2.50	5.00	33	11	25	4	18	76.4
ZV4P7 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 7,3 kN)																	
0.34	5.9	7.7	0.6	1.0	ZV418S_P732_0700 EZ501U	7.3	15	280	70.00	0.21	0.40	44	22	25	4	18	76.4
0.43	4.7	6.1	0.8	1.2	ZV418S_P732_0560 EZ501U	7.3	15	280	56.00	0.26	0.50	44	22	25	4	18	76.4
0.48	4.2	5.5	0.7	1.3	ZV418S_P732_0500 EZ501U	7.3	15	280	50.00	0.30	0.56	44	22	25	4	18	76.4
0.60	3.4	4.4	1.0	1.5	ZV418S_P732_0400 EZ501U	7.3	15	280	40.00	0.37	0.70	44	22	25	4	18	76.4
0.69	3.0	3.8	0.9	1.6	ZV418S_P732_0350 EZ501U	7.3	15	280	35.00	0.42	0.80	44	22	25	4	18	76.4
0.69	4.5	6.8	1.4	1.1	ZV418S_P732_0350 EZ502U	7.3	15	280	35.00	0.42	0.80	44	22	25	4	18	76.4
0.69	4.5	6.9	1.4	1.1	ZV418S_P732_0350 EZ701U	7.3	15	280	35.00	0.42	0.80	44	22	25	4	18	76.4
0.75	2.7	3.5	1.1	1.7	ZV418S_P732_0320 EZ501U	7.3	15	280	32.00	0.38	0.75	44	22	25	4	18	76.4
0.75	4.1	6.2	1.6	1.1	ZV418S_P732_0320 EZ502U	7.3	15	280	32.00	0.38	0.75	44	22	25	4	18	76.4
0.75	4.1	6.3	1.6	1.1	ZV418S_P732_0320 EZ701U	7.3	15	280	32.00	0.38	0.75	44	22	25	4	18	76.4
0.86	2.4	3.1	1.0	1.9	ZV418S_P732_0280 EZ501U	7.3	15	280	28.00	0.53	1.00	44	22	25	4	18	76.4
0.86	3.6	5.4	1.5	1.2	ZV418S_P732_0280 EZ502U	7.3	15	280	28.00	0.53	1.00	44	22	25	4	18	76.4
0.86	3.6	5.5	1.5	1.2	ZV418S_P732_0280 EZ701U	7.3	15	280	28.00	0.53	1.00	44	22	25	4	18	76.4
0.86	4.3	7.4	1.8	1.0	ZV418S_P732_0280 EZ503U	7.3	15	280	28.00	0.53	1.00	44	22	25	4	18	76.4
0.96	2.1	2.7	1.1	2.0	ZV418S_P732_0250 EZ501U	7.3	15	280	25.00	0.56	1.12	44	22	25	4	18	76.4
0.96	3.2	4.8	1.7	1.3	ZV418S_P732_0250 EZ502U	7.3	15	280	25.00	0.56	1.12	44	22	25	4	18	76.4
0.96	3.2	4.9	1.7	1.3	ZV418S_P732_0250 EZ701U	7.3	15	280	25.00	0.56	1.12	44	22	25	4	18	76.4

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{red}$ [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV4P7 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 7,3 kN)																	
0.96	3.9	6.6	2.0	1.1	ZV418S_P732_0250 EZ503U	7.3	15	280	25.00	0.56	1.12	44	22	25	4	18	76.4
1.20	1.7	2.2	1.3	2.4	ZV418S_P732_0200 EZ501U	7.3	15	280	20.00	0.60	1.20	44	22	25	4	18	76.4
1.20	2.6	3.9	1.9	1.5	ZV418S_P732_0200 EZ502U	7.3	15	280	20.00	0.60	1.20	44	22	25	4	18	76.4
1.20	2.6	3.9	1.9	1.5	ZV418S_P732_0200 EZ701U	7.3	15	280	20.00	0.60	1.20	44	22	25	4	18	76.4
1.20	3.1	5.3	2.3	1.3	ZV418S_P732_0200 EZ503U	7.3	15	280	20.00	0.60	1.20	44	22	25	4	18	76.4
1.20	3.6	7.1	2.7	1.1	ZV418S_P732_0200 EZ702U	7.3	15	280	20.00	0.60	1.20	44	22	25	4	18	76.4
1.50	1.4	1.8	1.4	2.8	ZV418S_P732_0160 EZ501U	6.4	15	243	16.00	0.75	1.50	44	22	25	4	18	76.4
1.50	2.1	3.1	2.2	1.8	ZV418S_P732_0160 EZ502U	7.3	15	280	16.00	0.75	1.50	44	22	25	4	18	76.4
1.50	2.1	3.1	2.2	1.8	ZV418S_P732_0160 EZ701U	7.3	15	280	16.00	0.75	1.50	44	22	25	4	18	76.4
1.50	2.5	4.2	2.6	1.5	ZV418S_P732_0160 EZ503U	7.3	15	280	16.00	0.75	1.50	44	22	25	4	18	76.4
1.50	2.9	5.7	3.0	1.3	ZV418S_P732_0160 EZ702U	7.3	15	280	16.00	0.75	1.50	44	22	25	4	18	76.4
2.40	1.3	2.0	1.5	2.4	ZV418S_P731_0100 EZ701U	5.1	15	194	10.00	1.20	2.40	33	11	24	4	18	76.4
2.40	1.8	3.6	2.0	1.7	ZV418S_P731_0100 EZ702U	7.3	15	280	10.00	1.20	2.40	33	11	24	4	18	76.4
3.00	1.1	1.6	1.5	2.8	ZV418S_P731_0080 EZ701U	4.1	15	155	8.000	1.50	3.00	33	11	25	4	18	76.4
3.00	1.5	2.9	2.1	2.0	ZV418S_P731_0080 EZ702U	7.3	15	280	8.000	1.50	3.00	33	11	25	4	18	76.4
3.43	0.9	1.4	1.6	3.1	ZV418S_P731_0070 EZ701U	3.6	15	136	7.000	1.71	3.43	33	11	25	4	18	76.4
3.43	1.3	2.5	2.3	2.2	ZV418S_P731_0070 EZ702U	7.3	15	278	7.000	1.71	3.43	33	11	25	4	18	76.4

8.3 Dimensional drawings

This chapter shows you the dimensions of rack and pinion drives with EZ synchronous servo motors.

Dimension az in the tables of dimensions applies to STOBER gear racks. In general: az = ½ d0 + h0 + x*mn

The pinion is helical (left-hand 19° 31' 42"). The pinion gearing quality is 5.

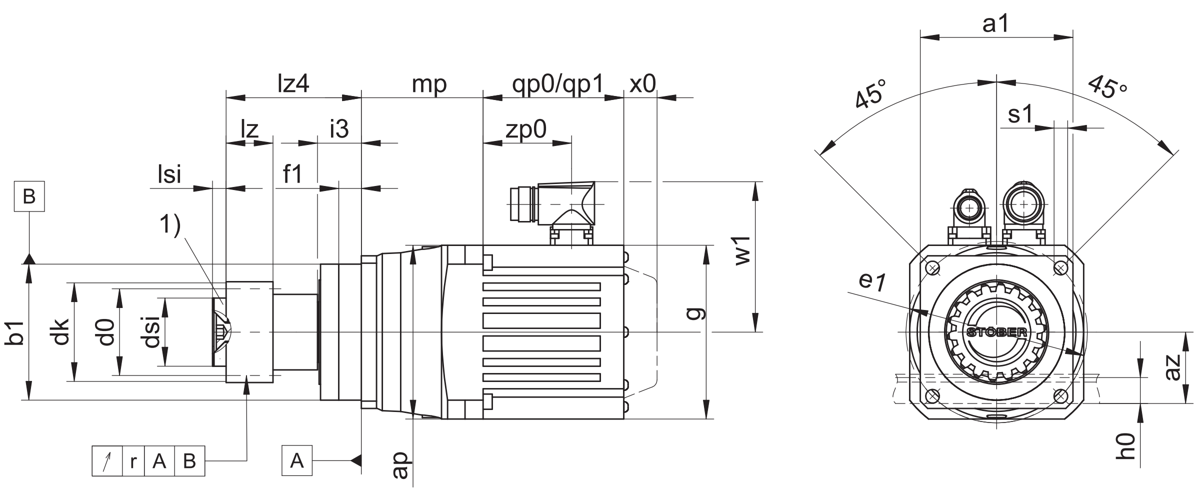
Dimensions can exceed the specifications of ISO 2768-mK due to casting tolerances or accumulation of individual tolerances.

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

You can download 3D models of our standard drives at https://configurator.stoeber.de/en-US/.

Combination options and the dimensions of forced ventilated geared motors can also be found at https://configurator.stoeber.de/en-US/.

8.3.1 Pinion position E



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x0	Applies to encoders using an optical measuring method.	w1	Different for the One Cable Solution (OCS), see the chapter [14.4]
1)	Axial locking (optional)	–	The radial runout specification applies only to the reinforced bearing D.

Dimensions of gearboxes

Type	mn	□a1	az	∅b1	∅d0	∅dk	∅dsi	∅e1	f1	h0	i3	lz	lz4	lsi	r	∅s1	x
ZV216SEP3_	2	72	39.98	60_{h6}	33.95	39.81	25	75	7.5	22	18	26	49.5	4	0.025	5.5	0.50
ZV220SEP4_	2	76	44.02	70_{h6}	42.44	47.90	30	85	7.5	22	18	26	57.5	6	0.025	6.6	0.40
ZV225SEP5_	2	101	49.33	90_{h6}	53.05	58.52	45	120	15.0	22	28	26	89.5	8	0.030	9.0	0.40
ZV318SEP5_	3	101	55.55	90_{h6}	57.30	65.01	45	120	15.0	26	28	31	89.5	8	0.030	9.0	0.30
ZV322SEP7_	3	144	62.21	130_{h6}	70.03	78.35	55	165	3.5	26	28	31	113.5	10	0.035	11.0	0.40
ZV418SEP7_	4	144	74.40	130_{h6}	76.40	86.77	55	165	3.5	35	28	41	113.5	10	0.035	11.0	0.30

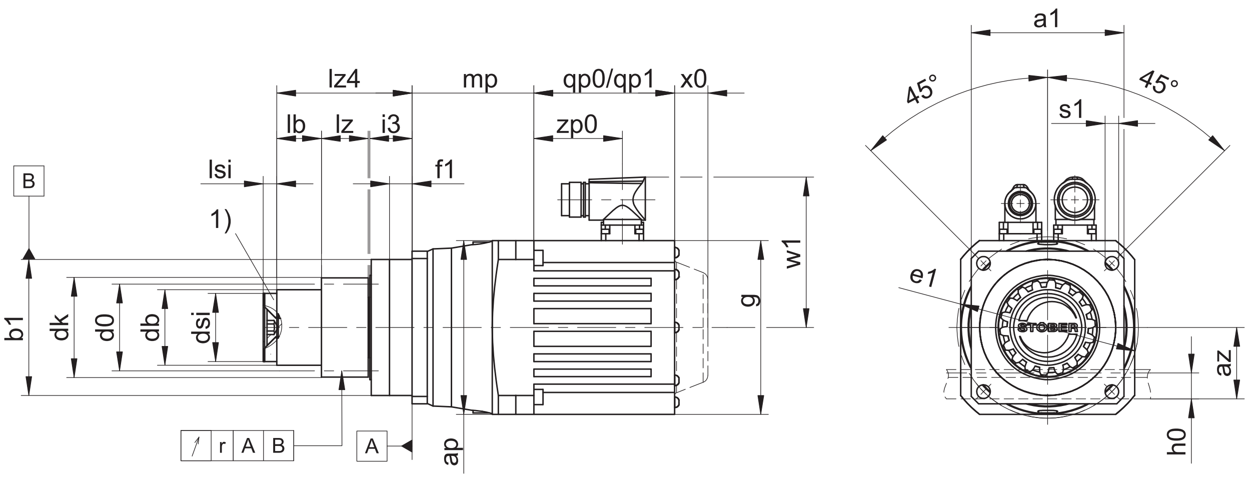
Dimensions of motors

Type	□g	qp0	qp1	w1	x0	zp0
EZ202U	55	141	150.0	47.0	25	86.0
EZ203U	55	159	168.0	47.0	25	104.0
EZ301U	72	90	130.0	55.5	21	54.5
EZ302U	72	112	152.0	55.5	21	76.5
EZ303U	72	134	174.0	55.5	21	98.5
EZ401U	98	98	146.5	91.0	22	56.0
EZ402U	98	123	171.5	91.0	22	81.0
EZ404U	98	173	221.5	91.0	22	131.0
EZ501U	115	93	147.5	100.0	22	58.5
EZ502U	115	118	172.5	100.0	22	83.5
EZ503U	115	143	197.5	100.0	22	108.5
EZ505U	115	193	247.5	100.0	22	158.5
EZ701U	145	102	161.0	115.0	22	64.0
EZ702U	145	127	186.0	115.0	22	89.0
EZ703U	145	152	211.0	115.0	22	114.0
EZ705U	145	207	266.0	134.0	22	165.0
EZ813U	190	238	315.0	156.5	22	184.0
EZ815U	190	320	397.0	156.5	22	266.0

Dimensions of geared motors

Type	EZ2		EZ3		EZ4		EZ5		EZ7		EZ8	
	ap	mp	ap	mp	ap	mp	ap	mp	ap	mp	ap	mp
ZV_P331_	–	–	□72	68.5	□98	65.0	–	–	–	–	–	–
ZV_P332_	∅75	89.5	∅75	103.0	–	–	–	–	–	–	–	–
ZV_P431_	–	–	–	–	□98	80.5	□115	80.0	–	–	–	–
ZV_P432_	–	–	∅100	117.5	∅100	114.0	–	–	–	–	–	–
ZV_P531_	–	–	–	–	–	–	□115	80.5	□145	83.5	–	–
ZV_P532_	–	–	–	–	∅120	122.5	∅120	122.0	–	–	–	–
ZV_P731_	–	–	–	–	–	–	–	–	□158	100.5	□190	110.5
ZV_P732_	–	–	–	–	–	–	∅150	148.5	∅150	151.5	–	–

8.3.2 Pinion position S



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x0	Applies to encoders using an optical measuring method.	w1	Different for the One Cable Solution (OCS), see the chapter [▷ 14.4]
1)	Axial locking (optional)	–	The radial runout specification applies only to the reinforced bearing D.

Dimensions of gearboxes

Type	mn	□a1	az	∅b1	∅d0	∅db	∅dk	∅dsi	∅e1	f1	h0	i3	lb	lz	lz4	lsi	r	∅s1	x
ZV216SSP3_	2	72	39.98	60_{h6}	34.0	30	39.81	25	75	7.5	22	18	4.5	26	49.5	4	0.025	5.5	0.50
ZV220SSP4_	2	76	44.02	70_{h6}	42.4	38	47.90	30	85	7.5	22	18	12.5	26	57.5	6	0.025	6.6	0.40
ZV225SSP5_	2	101	49.33	90_{h6}	53.1	50	58.52	45	120	15.0	22	28	34.5	26	89.5	8	0.030	9.0	0.40
ZV318SSP5_	3	101	55.55	90_{h6}	57.3	50	65.01	45	120	15.0	26	28	29.5	31	89.5	8	0.030	9.0	0.30
ZV322SSP7_	3	144	62.21	130_{h6}	70.0	62	78.35	55	165	3.5	26	28	53.5	31	113.5	10	0.035	11.0	0.40
ZV418SSP7_	4	144	74.40	130_{h6}	76.4	62	86.77	55	165	3.5	35	28	43.5	41	113.5	10	0.035	11.0	0.30

Dimensions of motors

Type	□g	qp0	qp1	w1	x0	zp0
EZ202U	55	141	150.0	47.0	25	86.0
EZ203U	55	159	168.0	47.0	25	104.0
EZ301U	72	90	130.0	55.5	21	54.5
EZ302U	72	112	152.0	55.5	21	76.5
EZ303U	72	134	174.0	55.5	21	98.5
EZ401U	98	98	146.5	91.0	22	56.0
EZ402U	98	123	171.5	91.0	22	81.0
EZ404U	98	173	221.5	91.0	22	131.0
EZ501U	115	93	147.5	100.0	22	58.5
EZ502U	115	118	172.5	100.0	22	83.5
EZ503U	115	143	197.5	100.0	22	108.5
EZ505U	115	193	247.5	100.0	22	158.5
EZ701U	145	102	161.0	115.0	22	64.0
EZ702U	145	127	186.0	115.0	22	89.0
EZ703U	145	152	211.0	115.0	22	114.0
EZ705U	145	207	266.0	134.0	22	165.0
EZ813U	190	238	315.0	156.5	22	184.0
EZ815U	190	320	397.0	156.5	22	266.0

Dimensions of geared motors

Type	EZ2		EZ3		EZ4		EZ5		EZ7		EZ8	
	ap	mp	ap	mp	ap	mp	ap	mp	ap	mp	ap	mp
ZV_P331_	–	–	□72	68.5	□98	65.0	–	–	–	–	–	–
ZV_P332_	∅75	89.5	∅75	103.0	–	–	–	–	–	–	–	–
ZV_P431_	–	–	–	–	□98	80.5	□115	80.0	–	–	–	–
ZV_P432_	–	–	∅100	117.5	∅100	114.0	–	–	–	–	–	–
ZV_P531_	–	–	–	–	–	–	□115	80.5	□145	83.5	–	–
ZV_P532_	–	–	–	–	∅120	122.5	∅120	122.0	–	–	–	–
ZV_P731_	–	–	–	–	–	–	–	–	□158	100.5	□190	110.5
ZV_P732_	–	–	–	–	–	–	∅150	148.5	∅150	151.5	–	–

8.4 Type designation

In this chapter, you will find an explanation of the type designation with the associated options.

Additional ordering information not included in the type designation can be found at the end of the chapter.

Example code

Z	V	3	22	S	S	P	7	3	1	S	P	S	S	0050	EZ813U

Explanation

Code	Designation	Design
Z	Type	Rack and pinion gearbox
V	Design	Plug-on pinion
3	Normal module	m_n = 3 mm (example)
22	Number of teeth	z = 22 (example)
S	Helix angle	Left-hand 19° 31' 42"
E	Pinion position	Shaft end
S		Shaft shoulder
P	Type	Planetary gearbox
7	Size	7 (example)
3	Generation	Generation 3
1	Stages	Single-stage
2		Two-stage
S	Housing	Standard
P	Shaft	Solid shaft with feather key
S	Bearing	Standard bearing
D		Axially reinforced bearing
S	Backlash	Standard
R		Reduced
0050	Transmission ratio (i x 10)	i = 5 (example)
EZ813U	Motor	EZ synchronous servo motor

To complete the type designation, also specify the following in your order:

- A detailed type designation of the motor, see the chapter [▸ 14.5]
- Radial shaft seal rings at the output made of NBR or FKM (option), see the chapter [▸ 8.6.2]
- Position of the plug connectors, see the chapter [▸ 8.5.5]
- Axial locking (optional), see the chapter [▸ 8.3]
- Reverse operation of the output shaft from ±20° to ±90° for horizontal installation on request

This catalog shows you all the information on rack and pinion drives with EZ synchronous servo motors. All input options available on request are shown in the chapter [▸ 8.5.1].

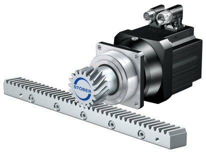
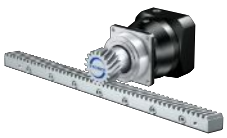
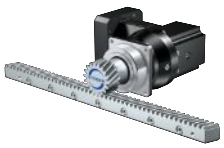
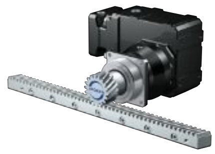
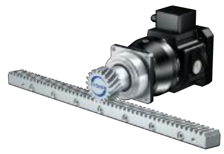
To make selecting your rack and pinion drive easy, use our STOBER Configurator at https://configurator.stoeber.de/en-US/.

A detailed description of the nameplate, see the chapter [▸ 14.5.1].

8.5 Product description

8.5.1 Input options

This chapter shows you all available input options:

EZ synchronous servo motor	Motor adapter	KX right-angle input with MF motor adapter	K right-angle input with ME motor adapter	MB motor adapter	LM Lean motor
					
Catalog ID 443286_en	Catalog ID 443137_en	On request	On request	On request	On request

The corresponding catalogs can be found at http://www.stoeber.de/en/downloads/

Enter the ID of the catalog in the Search term field.

8.5.2 Gear rack

The gear rack used must have a right-hand design (19° 31' 42"); the load capacity must not be exceeded.

8.5.3 Installation conditions

The specified torques and forces only apply when gearboxes are fastened on the machine side using screws of strength class 12.9. In addition, the gear housings must be adjusted at the pilot. The machine-side fit must be H7.

8.5.4 Lubricants

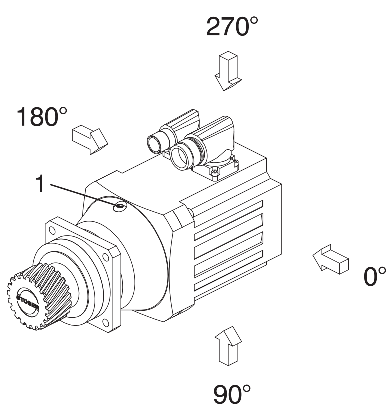
STOBER fills the gearboxes with the amount and type of lubricant specified on the nameplate.

You will receive lubricants for use in the food industry upon request.

8.5.4.1 Lubrication of rack and pinion gearbox

Ensure permanent lubrication with the lubricants recommended in the chapter [▸ 13.5.1].

8.5.5 Position of the plug connectors



In the standard version, the plug connectors are attached in the 270° position (relative to the oil drain plug (1) of the planetary gearbox). Indicate variations for your rack and pinion drive in the order.

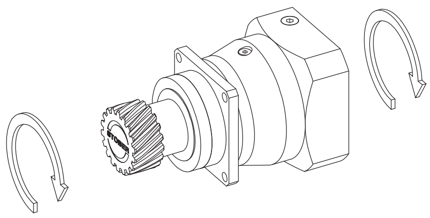
Note that the plug connectors also rotate when the gear rack is rotated to a different position.

8.5.6 Other product features

Feature	Value
Max. permitted gearbox temperature (on the surface of the gearbox)	≤ 90 °C
Paint	Black RAL 9005
(ATEX) Directive 2014/34/EU (Option)	Not suitable.
Protection class: [1]	
Planetary gearboxes	IP65
Motor	IP56, optionally IP66
Pinion/gear rack	IPXX

8.5.7 Direction of rotation

The input and output rotate in the same direction.



8.6 Project configuration

Project your drives using our SERVOsoft designing software. Download SERVOsoft free of charge after registration at https://www.stoeber.de/en/services/info-servosoft/.

It is the most convenient and reliable method of drive selection, as the entire torque/speed curve of the application is displayed and evaluated here in the curve of the geared motor.

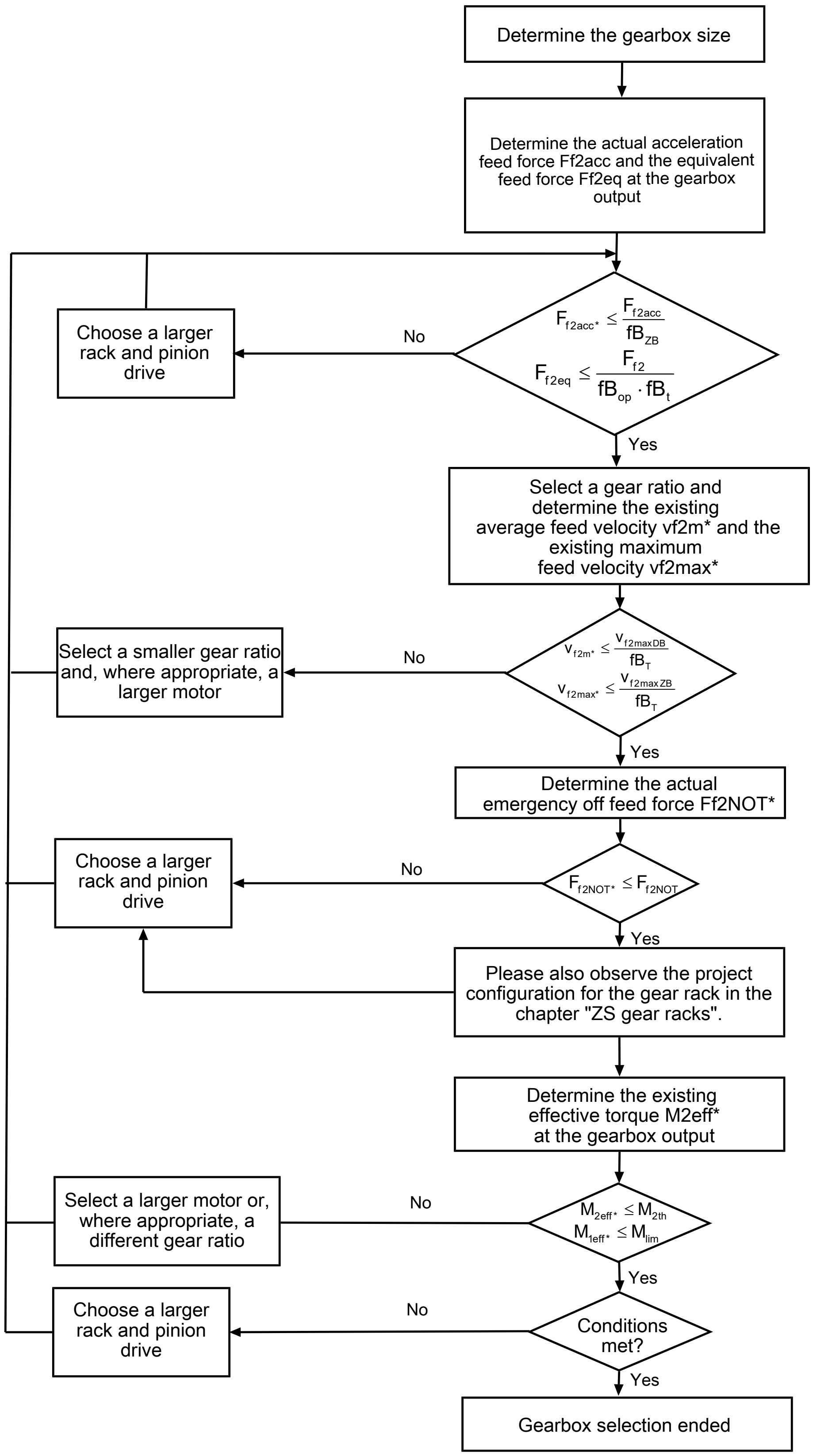
In this chapter, only limit values for specific operating points can be taken into consideration for manual drive selection.

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

An explanation of the formula symbols can be found in the chapter [▸ 17.1].

[1] Observe the protection class of all the components.

8.6.1 Drive selection

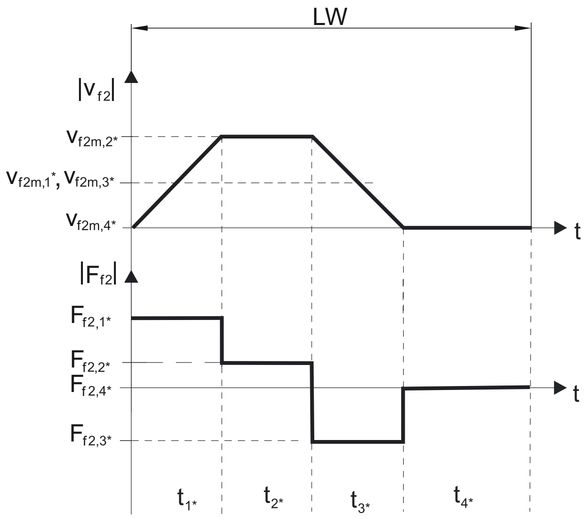


Refer to the selection tables for the values of i, $v_{f2maxDB}$, $v_{f2maxZB}$, F_{f2acc}, F_{f2N} and F_{f2NOT}.

The values for fB_T, fB_{op}, fB_t and fB_{ZB} can be found in the corresponding tables in this chapter.

Example of cyclic operation

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



Calculation of the actual maximum acceleration feed force

$$F_{f2acc^*} = m^* \cdot a^* + F_{L^*}$$

Calculation of the actual average input speed

$$n_{1m^*} = \frac{v_{f2m^*} \cdot i}{d_0 \cdot \pi}$$

$$v_{f2m^*} = \frac{\left|v_{f2m,1^*}\right| \cdot t_{1^*} + \ldots + \left|v_{f2m,n^*}\right| \cdot t_{n^*}}{t_{1^*} + \ldots + t_{n^*}}$$

If $t_{1^*} + \ldots + t_{3^*} \geq 6$ min, determine v_{2m^*} without the rest phase t_{4^*}.

The values for the ratio i can be found in the selection tables.

Calculation of the actual emergency off feed force

$$F_{f2NOT^*} = m^* \cdot a_{NOT^*} + F_{L^*}$$

Calculation of the actual equivalent feed force

$$F_{f2eq^*} = \sqrt[3]{\frac{\left|v_{f2m,1^*}\right| \cdot t_{1^*} \cdot \left|F_{f2,1^*}{}^3\right| + \ldots + \left|v_{f2m,n^*}\right| \cdot t_{n^*} \cdot \left|F_{f2,n^*}{}^3\right|}{\left|v_{f2m,1^*}\right| \cdot t_{1^*} + \ldots + \left|v_{f2m,n^*}\right| \cdot t_{n^*}}}$$

Calculation of the thermal limit torque

Calculate the thermal limit torque M_{2th} for a duty cycle ED_{10} > 50% and the actual average input speed n_{1m^*}. (At $K_{mot,th} \leq 0$ you must reduce the average input speed n_{1m^*} accordingly or select another geared motor size.)

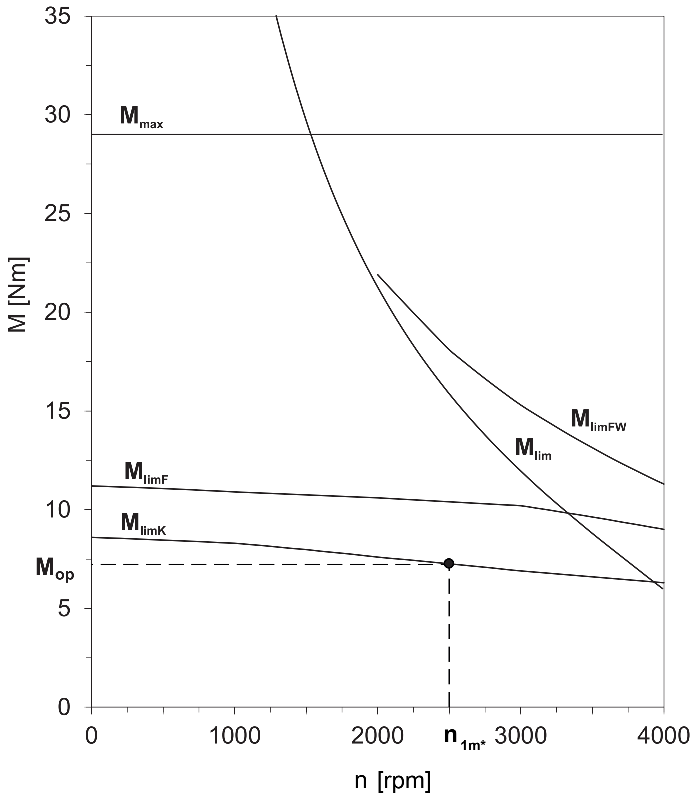
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

$$K_{mot,th} = 0{,}95 - \frac{a_{th}}{1000} \cdot fB_T \cdot \left(\frac{n_{1m^*}}{1000}\right)^3$$

Refer to the selection tables for the values of i and a_{th}.

The values for fB_T can be found in the corresponding table in this chapter.

The value for the torque of the motor at operating point M_{op} with the determined average input speed n_{1m*} can be found in the motor characteristic curve in the chapter Torque/speed curves. Note the size, nominal speed n_N and cooling type of the motor. The figure below shows an example of reading the torque M_{op} of a motor with convection cooling at the operating point.



Calculation of the actual effective torque

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

$$M_{2,n*} = \frac{F_{f2,n*} \cdot d_0}{2}$$

$$M_{1eff*} = \frac{M_{2eff*}}{i \cdot \eta}$$

Operating factors

Operating mode	fB_{op}
Uniform continuous operation	1.00
Cyclic operation	1.00
Reversing load cyclic operation	1.00

Run time	fB_t
Daily runtime ≤ 8 h	1.00
Daily runtime ≤ 16 h	1.15
Daily runtime ≤ 24 h	1.20

Cyclic operation	fB_{ZB}
≤ 1000 load changes/hour (LW/h)	1.00
> 1000 load changes/hour (LW/h)	1.15

Temperature		fB_T
Motor cooling	**Surrounding temperature**	
Motor with forced ventilation	≤ 20 °C	0.9
	≤ 30 °C	1.0
	≤ 40 °C	1.15
Motor with convection cooling	≤ 20 °C	1.0
	≤ 30 °C	1.1
	≤ 40 °C	1.25

Notes

- The maximum permitted gearbox temperature (see the "Other product features" chapter) must not be exceeded, as that could result in damage.
- For braking from full speed (for example, when the power fails or when setting up the machine), note the permitted gearbox feed forces (F_{f2acc}, F_{f2NOT}) in the selection tables.

8.6.2 Recommendation for radial shaft seal rings

For a duty cycle > 60% and higher surrounding temperatures, we recommend radial shaft seal rings made of FKM at the output.

Properties:

- Excellent temperature resistance
- High chemical stability
- Very good resistance to aging
- Excellent resistance in oils and greases
- For use in the food, beverage and pharmaceutical industries

Leak-proofness

Our gearboxes are equipped with high-quality radial shaft seal rings and checked for leaks. However, a leak cannot be fully ruled out over the length of use of a gearbox. If you use a gearbox with goods incompatible with the lubricant, you must take measures to prevent direct contact with the gearbox lubricant in case of a leak.

8.7 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 term field.

Documentation	ID
Operating manual gearboxes, geared motors P23 – P93	443356_en
Operating manual for EZ synchronous servo motors	443032_en
Operating manual gear racks	443392_en

9 ZVPE rack and pinion drives

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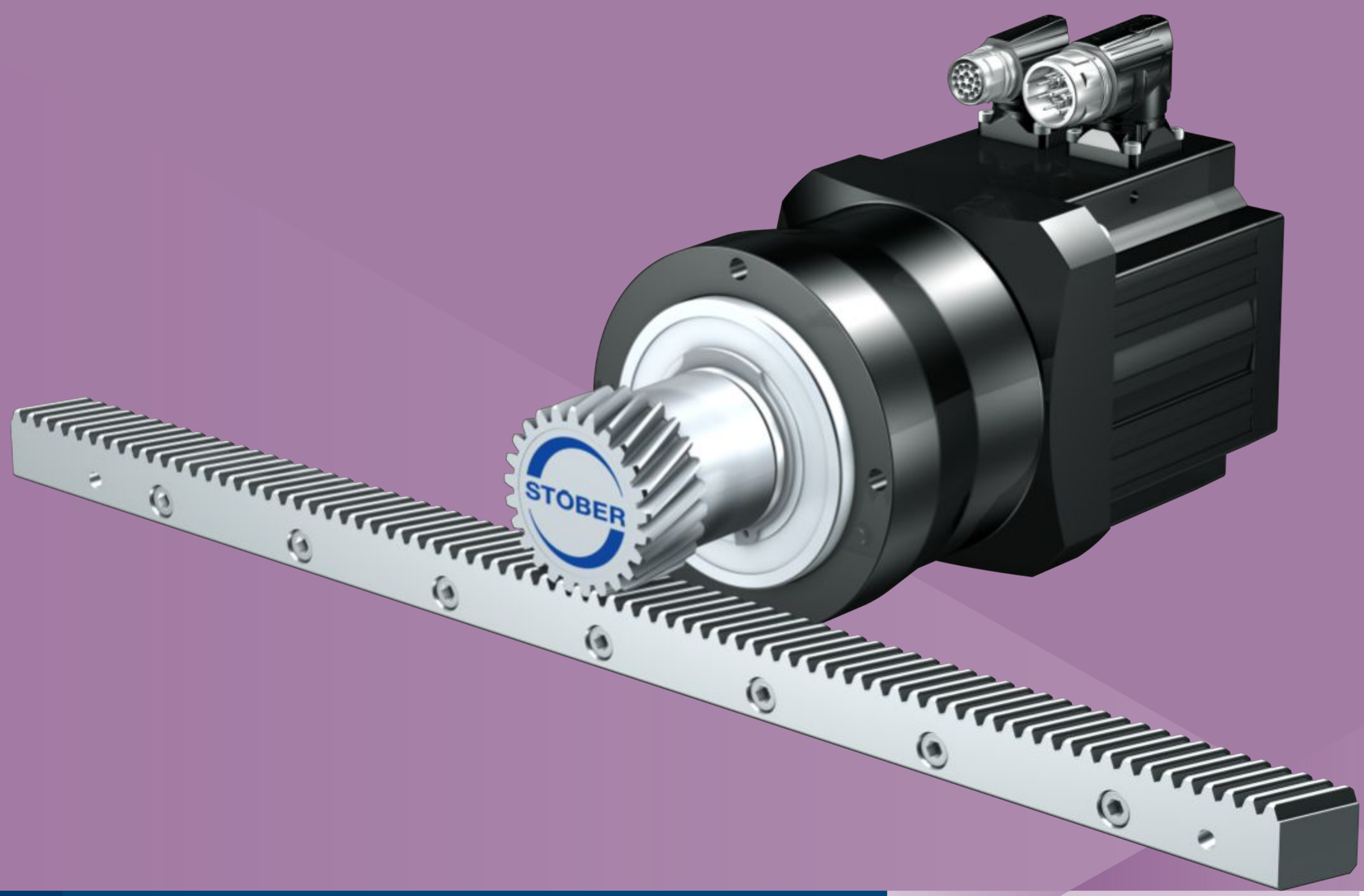


9 Rack and pinion drives

ZVPE

9.1 Overview

High Flexibility cost-effective planetary geared motors with plug-on pinions

Features

Power density	★★☆☆☆
Linear clearance	★★☆☆☆
Price category	€
Smooth operation	★★★☆☆
Linear rigidity	★★☆☆☆
Mass moment of inertia	★★★★☆
Ready-to-install drive solution	✓
Pinion gearing quality 6 (DIN 3962)	✓
Helical gearing	✓
Case-hardened and smoothed	✓
Compact and highly dynamic due to direct motor attachment	✓

Key ★☆☆☆☆ good | ★★★★★ excellent
€ Economy | €€€€€ Premium

Technical data

m_n	2 – 3 mm
z	16 – 25
F_{f2acc}	0.5 – 6.1 kN
v_{f2}	0.13 – 4.5 m/s
Δs	40 – 83 µm

9.2 Selection tables

The technical data specified in the selection tables applies to:

- Pinion position E
- Installation without tension
- Permanent lubrication with the lubricants recommended in the chapter on gear racks [▷ 13.5.1]
- Case-hardened pinions, helical (left-hand 19° 31' 42"), gearing quality 5
- Installation altitudes up to 1000 m above sea level
- Surrounding temperatures from 0 °C to 40 °C
- Without consideration of the thermal limiting performance
- Drives with convection-cooled motors (e.g. EZ401**U**)

For the technical data on drives with forced ventilated motors (e.g. EZ401**B**), refer to https://configurator.stoeber.de/en-US/

For all other technical data, refer to https://configurator.stoeber.de/en-US/.

An explanation of the formula symbols can be found in the chapter [▷ 17.1].

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV2PE3 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 1,7 kN)																
0.21	1.3	1.3	3.6	1.1	ZV216S_PE322_0250 EZ301U	1.7	3.4	29	25.00	0.28	0.57	49	5.3	2	16	34.0
0.27	1.0	1.1	4.0	1.3	ZV216S_PE322_0200 EZ301U	1.7	3.4	29	20.00	0.36	0.71	49	5.3	2	16	34.0
0.33	0.8	0.9	4.5	1.5	ZV216S_PE322_0160 EZ301U	1.7	3.4	29	16.00	0.44	0.89	49	5.3	2	16	34.0
0.53	0.5	0.5	0.7	2.0	ZV216S_PE321_0100 EZ301U	1.6	3.4	27	10.00	0.71	1.24	40	5.2	2	16	34.0
0.53	0.9	1.0	1.2	1.2	ZV216S_PE321_0100 EZ302U	1.7	3.4	29	10.00	0.71	1.24	40	5.2	2	16	34.0
0.76	0.4	0.4	1.1	2.6	ZV216S_PE321_0070 EZ301U	1.1	3.4	19	7.000	1.02	1.78	40	5.3	2	16	34.0
0.76	0.6	0.7	1.8	1.5	ZV216S_PE321_0070 EZ302U	1.7	3.4	29	7.000	1.02	1.78	40	5.3	2	16	34.0
0.76	0.8	0.9	2.4	1.2	ZV216S_PE321_0070 EZ303U	1.7	3.4	29	7.000	1.02	1.78	40	5.3	2	16	34.0
1.07	0.3	0.3	1.7	3.2	ZV216S_PE321_0050 EZ301U	0.8	3.4	14	5.000	1.32	2.49	40	5.3	2	16	34.0
1.07	0.5	0.5	2.9	1.9	ZV216S_PE321_0050 EZ302U	1.4	3.4	24	5.000	1.32	2.49	40	5.3	2	16	34.0
1.07	0.6	0.6	3.7	1.5	ZV216S_PE321_0050 EZ303U	1.7	3.4	29	5.000	1.32	2.49	40	5.3	2	16	34.0
1.07	0.8	0.9	5.1	1.1	ZV216S_PE321_0050 EZ401U	1.7	3.4	29	5.000	1.32	2.49	40	5.3	2	16	34.0
1.33	0.2	0.2	2.3	3.8	ZV216S_PE321_0040 EZ301U	0.6	3.4	11	4.000	1.64	3.11	40	5.3	2	16	34.0
1.33	0.4	0.4	3.9	2.2	ZV216S_PE321_0040 EZ302U	1.1	3.4	19	4.000	1.64	3.11	40	5.3	2	16	34.0
1.33	0.5	0.5	5.1	1.7	ZV216S_PE321_0040 EZ303U	1.6	3.4	27	4.000	1.64	3.11	40	5.3	2	16	34.0
1.33	0.6	0.7	6.9	1.3	ZV216S_PE321_0040 EZ401U	1.7	3.4	29	4.000	1.64	3.11	40	5.3	2	16	34.0
1.78	0.2	0.2	3.7	4.6	ZV216S_PE321_0030 EZ301U	0.5	3.4	8.1	3.000	2.07	3.56	40	5.2	2	16	34.0
1.78	0.3	0.3	6.3	2.7	ZV216S_PE321_0030 EZ302U	0.9	3.4	15	3.000	2.07	3.56	40	5.2	2	16	34.0
1.78	0.4	0.4	8.2	2.1	ZV216S_PE321_0030 EZ303U	1.2	3.4	20	3.000	2.07	3.56	40	5.2	2	16	34.0
1.78	0.5	0.5	11	1.5	ZV216S_PE321_0030 EZ401U	1.5	3.4	25	3.000	2.07	3.56	40	5.2	2	16	34.0
ZV2PE3 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 1,7 kN)																
0.27	0.9	1.0	1.5	1.2	ZV216S_PE322_0400 EZ202U	1.7	3.4	29	40.00	0.20	0.36	49	5.2	2	16	34.0
0.31	0.8	0.9	1.6	1.4	ZV216S_PE322_0350 EZ202U	1.7	3.4	29	35.00	0.20	0.41	49	5.3	2	16	34.0
0.38	0.6	0.7	1.8	1.8	ZV216S_PE322_0280 EZ202U	1.7	3.4	29	28.00	0.25	0.51	49	5.2	2	16	34.0
0.38	1.0	1.1	2.8	1.2	ZV216S_PE322_0280 EZ203U	1.7	3.4	29	28.00	0.25	0.51	49	5.2	2	16	34.0
0.43	0.6	0.6	1.9	2.0	ZV216S_PE322_0250 EZ202U	1.7	3.4	29	25.00	0.28	0.57	49	5.3	2	16	34.0
0.43	0.9	1.0	2.9	1.3	ZV216S_PE322_0250 EZ203U	1.7	3.4	29	25.00	0.28	0.57	49	5.3	2	16	34.0
0.53	0.4	0.5	2.2	2.4	ZV216S_PE322_0200 EZ202U	1.7	3.4	28	20.00	0.36	0.71	49	5.3	2	16	34.0
0.53	0.7	0.8	3.3	1.6	ZV216S_PE322_0200 EZ203U	1.7	3.4	29	20.00	0.36	0.71	49	5.3	2	16	34.0
0.53	1.0	1.1	4.8	1.1	ZV216S_PE322_0200 EZ301U	1.7	3.4	29	20.00	0.36	0.71	49	5.3	2	16	34.0
0.67	0.4	0.4	2.4	2.8	ZV216S_PE322_0160 EZ202U	1.3	3.4	22	16.00	0.44	0.89	49	5.3	2	16	34.0
0.67	0.5	0.6	3.7	1.8	ZV216S_PE322_0160 EZ203U	1.7	3.4	29	16.00	0.44	0.89	49	5.3	2	16	34.0
0.67	0.8	0.9	5.4	1.3	ZV216S_PE322_0160 EZ301U	1.7	3.4	29	16.00	0.44	0.89	49	5.3	2	16	34.0
1.07	0.5	0.5	0.9	1.7	ZV216S_PE321_0100 EZ301U	1.6	3.4	27	10.00	0.71	1.24	40	5.2	2	16	34.0
1.07	0.9	1.0	1.4	1.0	ZV216S_PE321_0100 EZ302U	1.7	3.4	29	10.00	0.71	1.24	40	5.2	2	16	34.0
1.52	0.4	0.4	1.3	2.2	ZV216S_PE321_0070 EZ301U	1.1	3.4	19	7.000	1.02	1.78	40	5.3	2	16	34.0
1.52	0.6	0.7	2.2	1.3	ZV216S_PE321_0070 EZ302U	1.7	3.4	29	7.000	1.02	1.78	40	5.3	2	16	34.0
2.13	0.3	0.3	2.0	2.7	ZV216S_PE321_0050 EZ301U	0.8	3.4	14	5.000	1.32	2.49	40	5.3	2	16	34.0
2.13	0.4	0.5	3.4	1.6	ZV216S_PE321_0050 EZ302U	1.4	3.4	24	5.000	1.32	2.49	40	5.3	2	16	34.0
2.13	0.6	0.6	4.5	1.2	ZV216S_PE321_0050 EZ303U	1.7	3.4	29	5.000	1.32	2.49	40	5.3	2	16	34.0
2.13	0.7	0.8	5.2	1.0	ZV216S_PE321_0050 EZ401U	1.7	3.4	29	5.000	1.32	2.49	40	5.3	2	16	34.0
2.67	0.2	0.2	2.8	3.1	ZV216S_PE321_0040 EZ301U	0.6	3.4	11	4.000	1.64	3.11	40	5.3	2	16	34.0
2.67	0.3	0.4	4.7	1.9	ZV216S_PE321_0040 EZ302U	1.1	3.4	19	4.000	1.64	3.11	40	5.3	2	16	34.0
2.67	0.4	0.5	6.1	1.4	ZV216S_PE321_0040 EZ303U	1.6	3.4	27	4.000	1.64	3.11	40	5.3	2	16	34.0
2.67	0.5	0.6	7.1	1.2	ZV216S_PE321_0040 EZ401U	1.7	3.4	29	4.000	1.64	3.11	40	5.3	2	16	34.0
3.56	0.2	0.2	4.5	3.8	ZV216S_PE321_0030 EZ301U	0.5	3.4	8.1	3.000	2.07	3.56	40	5.2	2	16	34.0

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV2PE3 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 1,7 kN)																
3.56	0.3	0.3	7.5	2.2	ZV216S_PE321_0030 EZ302U	0.9	3.4	15	3.000	2.07	3.56	40	5.2	2	16	34.0
3.56	0.3	0.4	9.8	1.7	ZV216S_PE321_0030 EZ303U	1.2	3.4	20	3.000	2.07	3.56	40	5.2	2	16	34.0
3.56	0.4	0.5	12	1.5	ZV216S_PE321_0030 EZ401U	1.5	3.4	25	3.000	2.07	3.56	40	5.2	2	16	34.0
ZV2PE4 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 2,1 kN)																
0.17	1.7	1.7	1.5	1.1	ZV220S_PE422_0400 EZ301U	2.1	4.3	45	40.00	0.22	0.39	62	6.4	2	20	42.4
0.19	1.5	1.5	1.6	1.2	ZV220S_PE422_0350 EZ301U	2.1	4.3	45	35.00	0.25	0.44	62	6.4	2	20	42.4
0.24	1.2	1.2	1.7	1.4	ZV220S_PE422_0280 EZ301U	2.1	4.3	45	28.00	0.32	0.56	62	6.4	2	20	42.4
0.27	1.0	1.1	1.8	1.5	ZV220S_PE422_0250 EZ301U	2.1	4.3	45	25.00	0.33	0.62	62	6.4	2	20	42.4
0.33	0.8	0.9	2.1	1.8	ZV220S_PE422_0200 EZ301U	2.1	4.3	45	20.00	0.41	0.78	62	6.4	2	20	42.4
0.33	1.4	1.5	3.5	1.0	ZV220S_PE422_0200 EZ302U	2.1	4.3	45	20.00	0.41	0.78	62	6.4	2	20	42.4
0.42	0.7	0.7	2.3	2.1	ZV220S_PE422_0160 EZ301U	2.0	4.3	43	16.00	0.51	0.97	62	6.4	2	20	42.4
0.42	1.1	1.2	4.0	1.2	ZV220S_PE422_0160 EZ302U	2.1	4.3	45	16.00	0.51	0.97	62	6.4	2	20	42.4
0.95	0.9	1.0	1.7	1.2	ZV220S_PE421_0070 EZ401U	2.1	4.3	45	7.000	1.14	1.91	49	6.4	2	20	42.4
1.33	0.6	0.7	2.8	1.4	ZV220S_PE421_0050 EZ401U	1.9	4.3	41	5.000	1.51	2.67	49	6.4	2	20	42.4
1.67	0.5	0.5	3.7	1.7	ZV220S_PE421_0040 EZ401U	1.6	4.3	33	4.000	1.89	3.33	49	6.4	2	20	42.4
1.67	0.8	0.9	5.6	1.1	ZV220S_PE421_0040 EZ501U	2.1	4.3	45	4.000	1.89	3.33	49	6.4	2	20	42.4
1.67	0.9	1.0	6.2	1.0	ZV220S_PE421_0040 EZ402U	2.1	4.3	45	4.000	1.89	3.33	49	6.4	2	20	42.4
2.22	0.4	0.4	6.3	2.0	ZV220S_PE421_0030 EZ401U	1.2	4.3	25	3.000	2.22	4.07	49	6.4	2	20	42.4
2.22	0.6	0.6	9.7	1.3	ZV220S_PE421_0030 EZ501U	2.1	4.3	45	3.000	2.22	4.07	49	6.4	2	20	42.4
2.22	0.6	0.7	11	1.2	ZV220S_PE421_0030 EZ402U	2.1	4.3	45	3.000	2.22	4.07	49	6.4	2	20	42.4
ZV2PE4 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 2,1 kN)																
0.38	1.4	1.5	1.9	1.0	ZV220S_PE422_0350 EZ301U	2.1	4.3	45	35.00	0.25	0.44	62	6.4	2	20	42.4
0.48	1.1	1.2	2.1	1.2	ZV220S_PE422_0280 EZ301U	2.1	4.3	45	28.00	0.32	0.56	62	6.4	2	20	42.4
0.53	1.0	1.1	2.2	1.3	ZV220S_PE422_0250 EZ301U	2.1	4.3	45	25.00	0.33	0.62	62	6.4	2	20	42.4
0.67	0.8	0.9	2.5	1.5	ZV220S_PE422_0200 EZ301U	2.1	4.3	45	20.00	0.41	0.78	62	6.4	2	20	42.4
0.83	0.6	0.7	2.8	1.7	ZV220S_PE422_0160 EZ301U	2.0	4.3	43	16.00	0.51	0.97	62	6.4	2	20	42.4
0.83	1.1	1.2	4.7	1.0	ZV220S_PE422_0160 EZ302U	2.1	4.3	45	16.00	0.51	0.97	62	6.4	2	20	42.4
1.91	0.7	0.9	1.8	1.1	ZV220S_PE421_0070 EZ401U	2.1	4.3	45	7.000	1.14	1.91	49	6.4	2	20	42.4
2.67	0.5	0.6	2.9	1.4	ZV220S_PE421_0050 EZ401U	1.9	4.3	41	5.000	1.51	2.67	49	6.4	2	20	42.4
3.33	0.4	0.5	3.8	1.6	ZV220S_PE421_0040 EZ401U	1.6	4.3	33	4.000	1.89	3.33	49	6.4	2	20	42.4
3.33	0.6	0.8	5.6	1.1	ZV220S_PE421_0040 EZ501U	2.1	4.3	45	4.000	1.89	3.33	49	6.4	2	20	42.4
3.33	0.6	0.9	5.8	1.1	ZV220S_PE421_0040 EZ402U	2.1	4.3	45	4.000	1.89	3.33	49	6.4	2	20	42.4
ZV2PE5 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 3,8 kN)																
0.24	3.5	3.8	2.1	1.0	ZV225S_PE522_0350 EZ401U	3.8	7.6	101	35.00	0.29	0.48	77	6.5	2	25	53.1
0.30	2.8	3.0	2.4	1.2	ZV225S_PE522_0280 EZ401U	3.8	7.6	101	28.00	0.36	0.60	77	6.5	2	25	53.1
0.33	2.5	2.7	2.5	1.3	ZV225S_PE522_0250 EZ401U	3.8	7.6	101	25.00	0.38	0.67	77	6.5	2	25	53.1
0.42	2.0	2.1	2.8	1.5	ZV225S_PE522_0200 EZ401U	3.8	7.6	101	20.00	0.47	0.83	77	6.5	2	25	53.1
0.52	1.6	1.7	3.1	1.7	ZV225S_PE522_0160 EZ401U	3.8	7.6	101	16.00	0.59	1.04	77	6.5	2	25	53.1
0.52	2.5	2.7	4.8	1.1	ZV225S_PE522_0160 EZ501U	3.8	7.6	101	16.00	0.59	1.04	77	6.5	2	25	53.1
0.52	2.7	3.0	5.3	1.0	ZV225S_PE522_0160 EZ402U	3.8	7.6	101	16.00	0.59	1.04	77	6.5	2	25	53.1
0.83	1.6	1.7	2.2	1.5	ZV225S_PE521_0100 EZ501U	3.8	7.6	101	10.00	0.83	1.39	62	6.5	2	25	53.1
1.19	1.1	1.2	3.3	1.9	ZV225S_PE521_0070 EZ501U	3.8	7.6	101	7.000	1.11	1.98	62	6.5	2	25	53.1
1.19	1.9	2.0	5.7	1.1	ZV225S_PE521_0070 EZ502U	3.8	7.6	101	7.000	1.11	1.98	62	6.5	2	25	53.1
1.19	1.9	2.1	5.7	1.1	ZV225S_PE521_0070 EZ701U	3.8	7.6	101	7.000	1.11	1.98	62	6.5	2	25	53.1
1.67	0.8	0.9	5.0	2.3	ZV225S_PE521_0050 EZ501U	2.9	7.6	78	5.000	1.44	2.78	62	6.6	2	25	53.1
1.67	1.4	1.5	8.6	1.4	ZV225S_PE521_0050 EZ502U	3.8	7.6	101	5.000	1.44	2.78	62	6.6	2	25	53.1
1.67	1.4	1.5	8.6	1.4	ZV225S_PE521_0050 EZ701U	3.7	7.6	97	5.000	1.44	2.78	62	6.6	2	25	53.1
1.67	1.8	2.0	11	1.0	ZV225S_PE521_0050 EZ503U	3.8	7.6	101	5.000	1.44	2.78	62	6.6	2	25	53.1
2.08	0.6	0.7	6.5	2.7	ZV225S_PE521_0040 EZ501U	2.3	7.6	62	4.000	1.81	3.47	62	6.6	2	25	53.1
2.08	1.1	1.2	11	1.6	ZV225S_PE521_0040 EZ502U	3.8	7.6	101	4.000	1.81	3.47	62	6.6	2	25	53.1
2.08	1.1	1.2	11	1.6	ZV225S_PE521_0040 EZ701U	2.9	7.6	78	4.000	1.81	3.47	62	6.6	2	25	53.1
2.08	1.4	1.6	15	1.2	ZV225S_PE521_0040 EZ503U	3.8	7.6	101	4.000	1.81	3.47	62	6.6	2	25	53.1
2.78	0.5	0.5	13	3.3	ZV225S_PE521_0030 EZ501U	1.8	7.6	47	3.000	2.32	4.17	62	6.5	2	25	53.1
2.78	0.8	0.9	23	1.9	ZV225S_PE521_0030 EZ502U	3.4	7.6	90	3.000	2.32	4.17	62	6.5	2	25	53.1
2.78	0.8	0.9	23	1.9	ZV225S_PE521_0030 EZ701U	2.2	7.6	58	3.000	2.32	4.17	62	6.5	2	25	53.1
2.78	1.1	1.2	30	1.5	ZV225S_PE521_0030 EZ503U	3.8	7.6	101	3.000	2.32	4.17	62	6.5	2	25	53.1
2.78	1.3	1.6	37	1.2	ZV225S_PE521_0030 EZ702U	3.8	7.6	101	3.000	2.32	4.17	62	6.5	2	25	53.1
2.78	1.5	1.8	42	1.0	ZV225S_PE521_0030 EZ505U	3.8	7.6	101	3.000	2.32	4.17	62	6.5	2	25	53.1
ZV2PE5 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 3,8 kN)																
3.13	1.4	2.2	16	1.1	ZV225S_PE521_0040 EZ505U	3.8	7.6	101	4.000	1.81	3.47	62	6.6	2	25	53.1
4.17	1.0	1.7	34	1.3	ZV225S_PE521_0030 EZ505U	3.8	7.6	101	3.000	2.32	4.17	62	6.5	2	25	53.1
4.17	1.3	2.2	43	1.0	ZV225S_PE521_0030 EZ703U	3.8	7.6	101	3.000	2.32	4.17	62	6.5	2	25	53.1
ZV2PE5 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 3,8 kN)																
0.60	2.3	2.8	2.5	1.1	ZV225S_PE522_0280 EZ401U	3.8	7.6	101	28.00	0.36	0.60	77	6.5	2	25	53.1
0.67	2.1	2.5	2.6	1.2	ZV225S_PE522_0250 EZ401U	3.8	7.6	101	25.00	0.38	0.67	77	6.5	2	25	53.1

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV2PE5 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 3,8 kN)																
0.83	1.6	2.0	2.9	1.4	ZV225S_PE522_0200 EZ401U	3.8	7.6	101	20.00	0.47	0.83	77	6.5	2	25	53.1
1.04	1.3	1.6	3.3	1.6	ZV225S_PE522_0160 EZ401U	3.8	7.6	101	16.00	0.59	1.04	77	6.5	2	25	53.1
1.04	1.9	2.5	4.8	1.1	ZV225S_PE522_0160 EZ501U	3.8	7.6	101	16.00	0.59	1.04	77	6.5	2	25	53.1
1.04	2.0	2.8	4.9	1.1	ZV225S_PE522_0160 EZ402U	3.8	7.6	101	16.00	0.59	1.04	77	6.5	2	25	53.1
ZV3PE5 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 3,9 kN)																
0.23	3.7	4.0	2.0	1.0	ZV318S_PE522_0400 EZ401U	3.9	7.8	111	40.00	0.27	0.45	83	6.8	3	18	57.3
0.26	3.2	3.5	2.1	1.1	ZV318S_PE522_0350 EZ401U	3.9	7.8	111	35.00	0.31	0.51	83	6.8	3	18	57.3
0.32	2.6	2.8	2.4	1.3	ZV318S_PE522_0280 EZ401U	3.9	7.8	111	28.00	0.39	0.64	83	6.8	3	18	57.3
0.36	2.3	2.5	2.5	1.4	ZV318S_PE522_0250 EZ401U	3.9	7.8	111	25.00	0.41	0.72	83	6.8	3	18	57.3
0.45	1.9	2.0	2.8	1.6	ZV318S_PE522_0200 EZ401U	3.9	7.8	111	20.00	0.51	0.90	83	6.8	3	18	57.3
0.45	2.9	3.1	4.3	1.0	ZV318S_PE522_0200 EZ501U	3.9	7.8	111	20.00	0.51	0.90	83	6.8	3	18	57.3
0.56	1.5	1.6	3.1	1.9	ZV318S_PE522_0160 EZ401U	3.9	7.8	111	16.00	0.64	1.13	83	6.8	3	18	57.3
0.56	2.3	2.5	4.8	1.2	ZV318S_PE522_0160 EZ501U	3.9	7.8	111	16.00	0.64	1.13	83	6.8	3	18	57.3
0.56	2.5	2.8	5.3	1.1	ZV318S_PE522_0160 EZ402U	3.9	7.8	111	16.00	0.64	1.13	83	6.8	3	18	57.3
0.90	1.5	1.6	2.2	1.6	ZV318S_PE521_0100 EZ501U	3.9	7.8	111	10.00	0.90	1.50	67	6.7	3	18	57.3
1.29	1.0	1.1	3.3	2.1	ZV318S_PE521_0070 EZ501U	3.8	7.8	109	7.000	1.20	2.14	67	6.8	3	18	57.3
1.29	1.8	1.9	5.7	1.2	ZV318S_PE521_0070 EZ502U	3.9	7.8	111	7.000	1.20	2.14	67	6.8	3	18	57.3
1.29	1.8	2.0	5.7	1.2	ZV318S_PE521_0070 EZ701U	3.9	7.8	111	7.000	1.20	2.14	67	6.8	3	18	57.3
1.80	0.7	0.8	5.0	2.6	ZV318S_PE521_0050 EZ501U	2.7	7.8	78	5.000	1.56	3.00	67	6.9	3	18	57.3
1.80	1.3	1.4	8.6	1.5	ZV318S_PE521_0050 EZ502U	3.9	7.8	111	5.000	1.56	3.00	67	6.9	3	18	57.3
1.80	1.3	1.4	8.6	1.5	ZV318S_PE521_0050 EZ701U	3.4	7.8	97	5.000	1.56	3.00	67	6.9	3	18	57.3
1.80	1.6	1.9	11	1.1	ZV318S_PE521_0050 EZ503U	3.9	7.8	111	5.000	1.56	3.00	67	6.9	3	18	57.3
2.25	0.6	0.6	6.5	3.0	ZV318S_PE521_0040 EZ501U	2.2	7.8	62	4.000	1.95	3.75	67	6.9	3	18	57.3
2.25	1.0	1.1	11	1.7	ZV318S_PE521_0040 EZ502U	3.9	7.8	111	4.000	1.95	3.75	67	6.9	3	18	57.3
2.25	1.0	1.1	11	1.7	ZV318S_PE521_0040 EZ701U	2.7	7.8	78	4.000	1.95	3.75	67	6.9	3	18	57.3
2.25	1.3	1.5	15	1.3	ZV318S_PE521_0040 EZ503U	3.9	7.8	111	4.000	1.95	3.75	67	6.9	3	18	57.3
2.25	1.6	2.0	18	1.1	ZV318S_PE521_0040 EZ702U	3.9	7.8	111	4.000	1.95	3.75	67	6.9	3	18	57.3
3.00	0.4	0.5	13	3.6	ZV318S_PE521_0030 EZ501U	1.6	7.8	47	3.000	2.50	4.50	67	6.8	3	18	57.3
3.00	0.8	0.8	23	2.1	ZV318S_PE521_0030 EZ502U	3.1	7.8	90	3.000	2.50	4.50	67	6.8	3	18	57.3
3.00	0.8	0.8	23	2.1	ZV318S_PE521_0030 EZ701U	2.0	7.8	58	3.000	2.50	4.50	67	6.8	3	18	57.3
3.00	1.0	1.1	30	1.6	ZV318S_PE521_0030 EZ503U	3.9	7.8	111	3.000	2.50	4.50	67	6.8	3	18	57.3
3.00	1.2	1.5	37	1.3	ZV318S_PE521_0030 EZ702U	3.9	7.8	111	3.000	2.50	4.50	67	6.8	3	18	57.3
3.00	1.4	1.6	42	1.2	ZV318S_PE521_0030 EZ505U	3.9	7.8	111	3.000	2.50	4.50	67	6.8	3	18	57.3
ZV3PE5 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 3,9 kN)																
2.70	1.6	2.6	13	1.0	ZV318S_PE521_0050 EZ505U	3.9	7.8	111	5.000	1.56	3.00	67	6.9	3	18	57.3
3.38	1.3	2.1	16	1.2	ZV318S_PE521_0040 EZ505U	3.9	7.8	111	4.000	1.95	3.75	67	6.9	3	18	57.3
4.50	1.0	1.6	34	1.4	ZV318S_PE521_0030 EZ505U	3.9	7.8	111	3.000	2.50	4.50	67	6.8	3	18	57.3
4.50	1.2	2.0	43	1.1	ZV318S_PE521_0030 EZ703U	3.9	7.8	111	3.000	2.50	4.50	67	6.8	3	18	57.3
ZV3PE5 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 3,9 kN)																
0.51	2.7	3.2	2.2	1.1	ZV318S_PE522_0350 EZ401U	3.9	7.8	111	35.00	0.31	0.51	83	6.8	3	18	57.3
0.64	2.1	2.6	2.5	1.2	ZV318S_PE522_0280 EZ401U	3.9	7.8	111	28.00	0.39	0.64	83	6.8	3	18	57.3
0.72	1.9	2.3	2.6	1.3	ZV318S_PE522_0250 EZ401U	3.9	7.8	111	25.00	0.41	0.72	83	6.8	3	18	57.3
0.90	1.5	1.9	2.9	1.5	ZV318S_PE522_0200 EZ401U	3.9	7.8	111	20.00	0.51	0.90	83	6.8	3	18	57.3
0.90	2.3	2.9	4.3	1.0	ZV318S_PE522_0200 EZ501U	3.9	7.8	111	20.00	0.51	0.90	83	6.8	3	18	57.3
0.90	2.3	3.2	4.4	1.0	ZV318S_PE522_0200 EZ402U	3.9	7.8	111	20.00	0.51	0.90	83	6.8	3	18	57.3
1.13	1.2	1.5	3.3	1.8	ZV318S_PE522_0160 EZ401U	3.9	7.8	111	16.00	0.64	1.13	83	6.8	3	18	57.3
1.13	1.8	2.3	4.8	1.2	ZV318S_PE522_0160 EZ501U	3.9	7.8	111	16.00	0.64	1.13	83	6.8	3	18	57.3
1.13	1.9	2.6	4.9	1.2	ZV318S_PE522_0160 EZ402U	3.9	7.8	111	16.00	0.64	1.13	83	6.8	3	18	57.3

9.3 Dimensional drawings

This chapter shows you the dimensions of rack and pinion drives with EZ synchronous servo motors.

Dimension az in the tables of dimensions applies to STOBER gear racks. In general: az = ½ d0 + h0 + x*mn

The pinion is helical (left-hand 19° 31' 42"). The pinion gearing quality is 5.

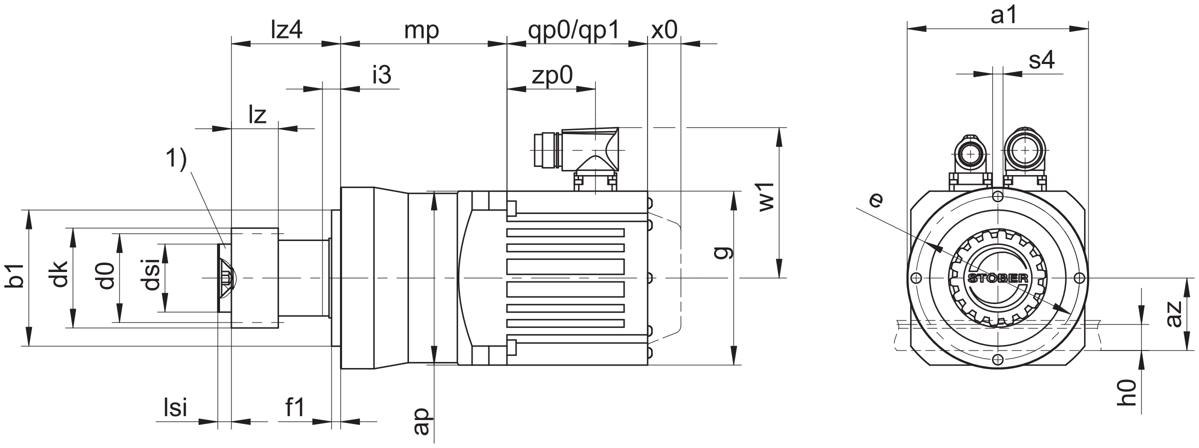
Dimensions can exceed the specifications of ISO 2768-mK due to casting tolerances or accumulation of individual tolerances.

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

You can download 3D models of our standard drives at https://configurator.stoeber.de/en-US/.

Combination options and the dimensions of forced ventilated geared motors can also be found at https://configurator.stoeber.de/en-US/.

9.3.1 Pinion position E



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x0	Applies to encoders using an optical measuring method.	w1	Different for the One Cable Solution (OCS), see the chapter [▷ 14.4]
1)	Axial locking (optional)		

Dimensions of gearboxes

Type	mn	⌀a1	az	⌀b1	⌀d0	⌀dk	⌀dsi	⌀e	f1	h0	i3	lz	lz4	lsi	⌀s4	x
ZV216SEPE3_	2	70	39.98	52_{h6}	33.95	39.81	25	62	5	22	7	26	37.5	4	M5	0.50
ZV220SEPE4_	2	90	44.02	68_{h6}	42.44	47.90	30	80	5	22	10	26	48.5	6	M6	0.40
ZV225SEPE5_	2	120	49.33	90_{h6}	53.05	58.52	45	108	6	22	12	26	72.5	8	M8	0.40
ZV318SEPE5_	3	120	55.55	90_{h6}	57.30	65.01	45	108	6	26	12	31	72.5	8	M8	0.30

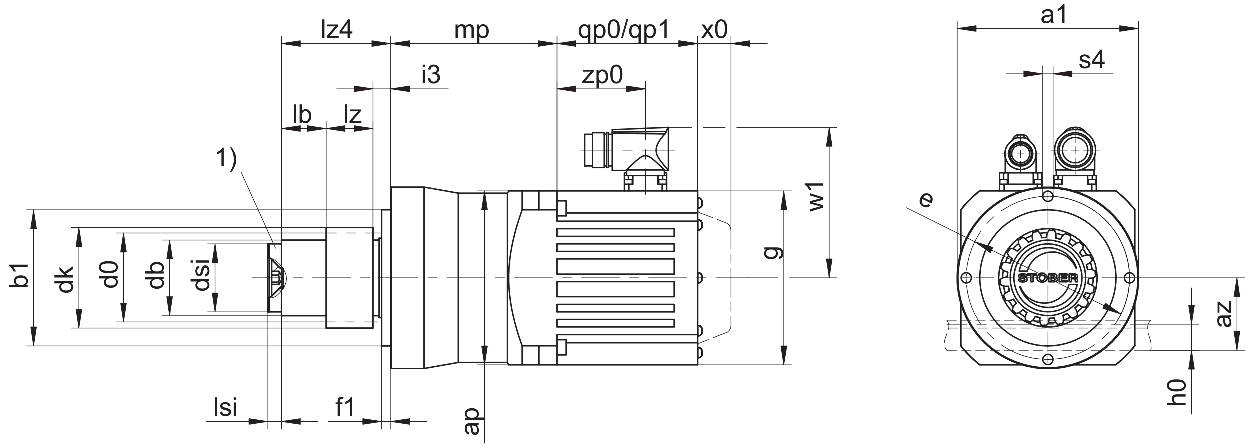
Dimensions of motors

Type	□g	qp0	qp1	w1	x0	zp0
EZ202U	55	141	150.0	47.0	25	86.0
EZ203U	55	159	168.0	47.0	25	104.0
EZ301U	72	90	130.0	55.5	21	54.5
EZ302U	72	112	152.0	55.5	21	76.5
EZ303U	72	134	174.0	55.5	21	98.5
EZ401U	98	98	146.5	91.0	22	56.0
EZ402U	98	123	171.5	91.0	22	81.0
EZ404U	98	173	221.5	91.0	22	131.0
EZ501U	115	93	147.5	100.0	22	58.5
EZ502U	115	118	172.5	100.0	22	83.5
EZ503U	115	143	197.5	100.0	22	108.5
EZ505U	115	193	247.5	100.0	22	158.5
EZ701U	145	102	161.0	115.0	22	64.0
EZ702U	145	127	186.0	115.0	22	89.0
EZ703U	145	152	211.0	115.0	22	114.0
EZ705U	145	207	266.0	134.0	22	165.0

Dimensions of geared motors

Type	EZ2		EZ3		EZ4		EZ5		EZ7	
	ap	mp	ap	mp	ap	mp	ap	mp	ap	mp
ZV_PE321_	–	–	□72	86.5	□98	83.0	–	–	–	–
ZV_PE322_	⌀75	106.5	⌀75	120.0	–	–	–	–	–	–
ZV_PE421_	–	–	–	–	□98	89.0	□115	91.5	–	–
ZV_PE422_	–	–	⌀100	129.0	–	–	–	–	–	–
ZV_PE521_	–	–	–	–	–	–	⌀120	110.0	□145	113.0
ZV_PE522_	–	–	–	–	⌀120	152.0	⌀120	151.5	–	–

9.3.2 Pinion position S



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x0	Applies to encoders using an optical measuring method.	w1	Different for the One Cable Solution (OCS), see the chapter [▶ 14.4]
1)	Axial locking (optional)		

Dimensions of gearboxes

Type	mn	∅a1	az	∅b1	∅d0	∅db	∅dk	∅dsi	∅e	f1	h0	i3	lb	lz	lz4	lsi	∅s4	x
ZV216SSPE3_	2	70	39.98	52_{h6}	33.95	30	39.81	25	62	5	22	7	4.5	26	37.5	4	M5	0.50
ZV220SSPE4_	2	90	44.02	68_{h6}	42.44	38	47.90	30	80	5	22	10	12.5	26	48.5	6	M6	0.40
ZV225SSPE5_	2	120	49.33	90_{h6}	53.05	50	58.52	45	108	6	22	12	34.5	26	72.5	8	M8	0.40
ZV318SSPE5_	3	120	55.55	90_{h6}	57.30	50	65.01	45	108	6	26	12	29.5	31	72.5	8	M8	0.30

Dimensions of motors

Type	□g	qp0	qp1	w1	x0	zp0
EZ202U	55	141	150.0	47.0	25	86.0
EZ203U	55	159	168.0	47.0	25	104.0
EZ301U	72	90	130.0	55.5	21	54.5
EZ302U	72	112	152.0	55.5	21	76.5
EZ303U	72	134	174.0	55.5	21	98.5
EZ401U	98	98	146.5	91.0	22	56.0
EZ402U	98	123	171.5	91.0	22	81.0
EZ404U	98	173	221.5	91.0	22	131.0
EZ501U	115	93	147.5	100.0	22	58.5
EZ502U	115	118	172.5	100.0	22	83.5
EZ503U	115	143	197.5	100.0	22	108.5
EZ505U	115	193	247.5	100.0	22	158.5
EZ701U	145	102	161.0	115.0	22	64.0
EZ702U	145	127	186.0	115.0	22	89.0
EZ703U	145	152	211.0	115.0	22	114.0
EZ705U	145	207	266.0	134.0	22	165.0

Dimensions of geared motors

Type	EZ2		EZ3		EZ4		EZ5		EZ7	
	ap	mp	ap	mp	ap	mp	ap	mp	ap	mp
ZV_PE321_	–	–	□72	86.5	□98	83.0	–	–	–	–
ZV_PE322_	∅75	106.5	∅75	120.0	–	–	–	–	–	–
ZV_PE421_	–	–	–	–	□98	89.0	□115	91.5	–	–
ZV_PE422_	–	–	∅100	129.0	–	–	–	–	–	–
ZV_PE521_	–	–	–	–	–	–	∅120	110.0	□145	113.0
ZV_PE522_	–	–	–	–	∅120	152.0	∅120	151.5	–	–

9.4 Type designation

This chapter shows you an explanation of the type designation with the associated options.

Additional ordering information not included in the type designation can be found at the end of the chapter.

Example code

Z	V	2	20	S	S	PE	4	2	1	S	P	S	S	0050	EZ401U

Explanation

Code	Designation	Design
Z	Type	Rack and pinion gearbox
V	Design	Plug-on pinion
2	Normal module	m_n = 2 mm (example)
20	Number of teeth	z = 20 (example)
S	Helix angle	Left-hand 19° 31' 42"
E	Pinion position	Shaft end
S		Shaft shoulder
PE	Type	Planetary gearbox
4	Size	4 (example)
2	Generation	Generation 2
1	Stages	Single-stage
2		Two-stage
S	Housing	Standard
P	Shaft	Solid shaft with feather key
S	Bearing	Standard bearing
S	Backlash	Standard
0050	Transmission ratio (i x 10)	i = 5 (example)
EZ401U	Motor	EZ synchronous servo motor

To complete the type designation, also specify the following in your order:

- A detailed type designation of the motor, see the chapter [▷ 14.5]
- Axial locking (optional), see the chapter [▷ 9.3]

This catalog shows you all the information on rack and pinion drives with EZ synchronous servo motors. All input options available on request are shown in the chapter [▷ 9.5.1].

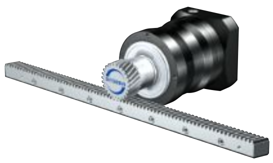
To make selecting your rack and pinion drive easy, use our STOBER Configurator at https://configurator.stoeber.de/en-US/.

A detailed description of the nameplate, see the chapter [▷ 14.5.1].

9.5 Product description

9.5.1 Input options

This chapter shows you all available input options:

EZ synchronous servo motor	ME motor adapter	LM Lean motor
		
Catalog ID 443286_en	Catalog ID 443137_en	On request

The corresponding catalogs can be found at http://www.stoeber.de/en/downloads/

Enter the ID of the catalog in the Search term field.

9.5.2 Gear rack

The gear rack used must have a right-hand design (19° 31' 42"); the load capacity must not be exceeded.

9.5.3 Installation conditions

The specified torques and forces only apply when gearboxes are fastened on the machine side using screws of strength class 10.9. In addition, the gear housings must be adjusted at the pilot. The machine-side fit must be H7.

9.5.4 Lubricants

STOBER fills the gearboxes with the amount and type of lubricant specified on the nameplate.

You will receive lubricants for use in the food industry upon request.

9.5.4.1 Lubrication of rack and pinion gearbox

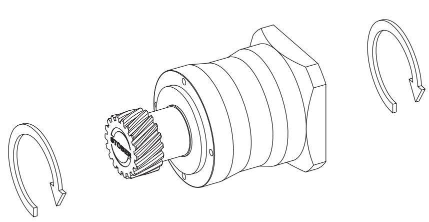
Ensure permanent lubrication with the lubricants recommended in the chapter [13.5.1].

9.5.5 Other product features

Feature	Value
Max. permitted gearbox temperature (on the surface of the gearbox)	≤ 80 °C
Paint	Black RAL 9005
(ATEX) Directive 2014/34/EU (Option)	Not suitable
Protection class: [1]	
Planetary gearboxes	IP64
Motor	IP56, optionally IP66
Pinion/gear rack	IPXX

9.5.6 Direction of rotation

The input and output rotate in the same direction.



[1] Observe the protection class of all the components.

9.6 Project configuration

Project your drives using our SERVOsoft designing software. Download SERVOsoft free of charge after registration at https://www.stoeber.de/en/services/info-servosoft/.

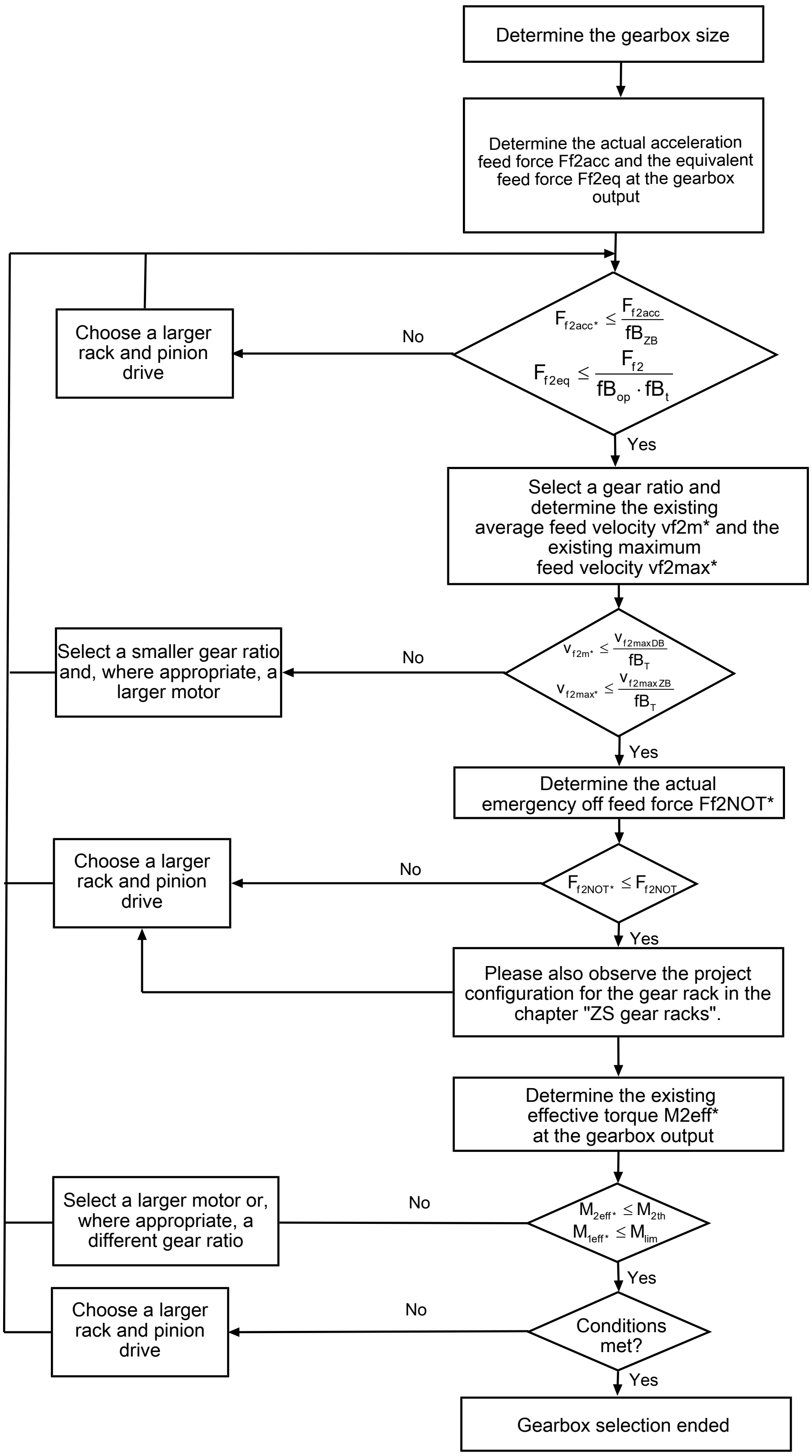
It is the most convenient and reliable method of drive selection, as the entire torque/speed curve of the application is displayed and evaluated here in the curve of the geared motor.

In this chapter, only limit values for specific operating points can be taken into consideration for manual drive selection.

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

An explanation of the formula symbols can be found in the chapter [▸ 17.1].

9.6.1 Drive selection

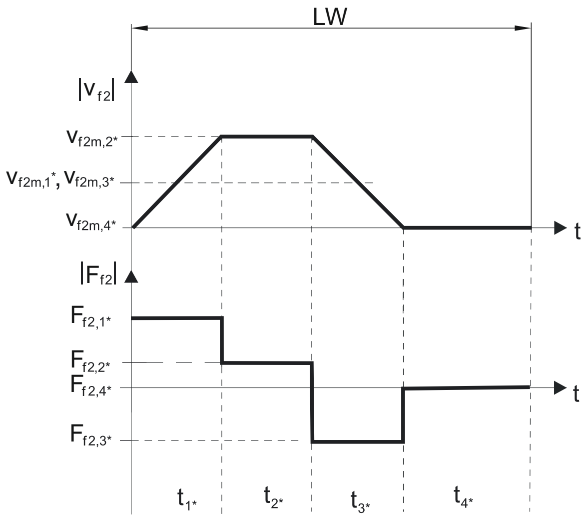


Refer to the selection tables for the values of i, $v_{f2maxDB}$, $v_{f2maxZB}$, F_{f2acc}, F_{f2N} and F_{f2NOT}.

The values for fB_T, fB_{op}, fB_t and fB_{ZB} can be found in the corresponding tables in this chapter.

Example of cyclic operation

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



Calculation of the actual maximum acceleration feed force

$$F_{f2acc^*} = m^* \cdot a^* + F_{L^*}$$

Calculation of the actual average input speed

$$n_{1m^*} = \frac{v_{f2m^*} \cdot i}{d_0 \cdot \pi}$$

$$v_{f2m^*} = \frac{|v_{f2m,1^*}| \cdot t_{1^*} + \ldots + |v_{f2m,n^*}| \cdot t_{n^*}}{t_{1^*} + \ldots + t_{n^*}}$$

If $t_{1^*} + \ldots + t_{3^*} \geq 6$ min, determine v_{2m^*} without the rest phase t_{4^*}.

The values for the ratio i can be found in the selection tables.

Calculation of the actual emergency off feed force

$$F_{f2NOT^*} = m^* \cdot a_{NOT^*} + F_{L^*}$$

Calculation of the actual equivalent feed force

$$F_{f2eq^*} = \sqrt[3]{\frac{|v_{f2m,1^*}| \cdot t_{1^*} \cdot |F_{f2,1^*}{}^3| + \ldots + |v_{f2m,n^*}| \cdot t_{n^*} \cdot |F_{f2,n^*}{}^3|}{|v_{f2m,1^*}| \cdot t_{1^*} + \ldots + |v_{f2m,n^*}| \cdot t_{n^*}}}$$

Calculation of the thermal limit torque

Calculate the thermal limit torque M_{2th} for a duty cycle $ED_{10} > 50\%$ and the actual average input speed n_{1m^*}. (At $K_{mot,th} \leq 0$ you must reduce the average input speed n_{1m^*} accordingly or select another geared motor size.)

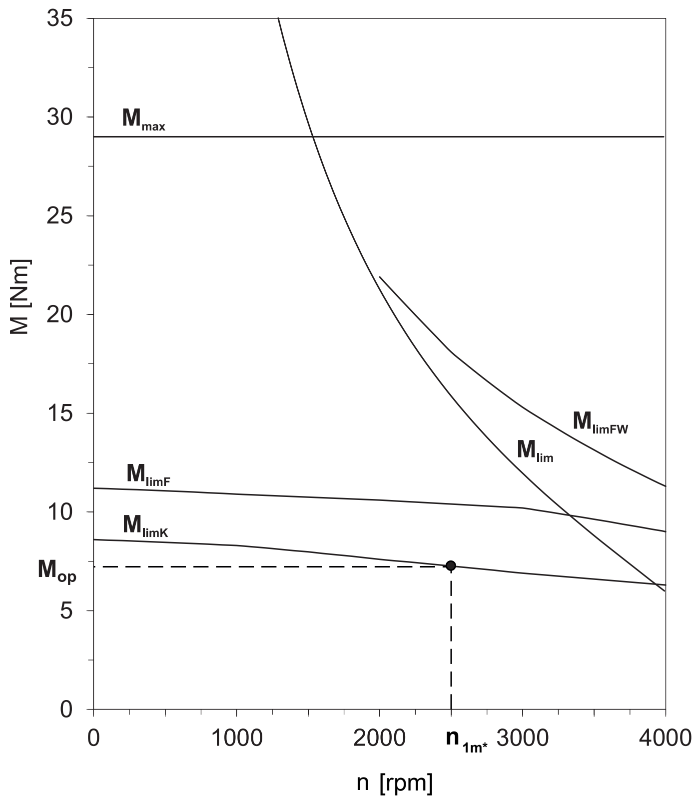
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

$$K_{mot,th} = 0{,}95 - \frac{a_{th}}{1000} \cdot fB_T \cdot \left(\frac{n_{1m^*}}{1000}\right)^3$$

Refer to the selection tables for the values of i and a_{th}.

The values for fB_T can be found in the corresponding table in this chapter.

The value for the torque of the motor at operating point M_{op} with the determined average input speed n_{1m^*} can be found in the motor characteristic curve in the chapter Torque/speed curves. Note the size, nominal speed n_N and cooling type of the motor. The figure below shows an example of reading the torque M_{op} of a motor with convection cooling at the operating point.



Calculation of the actual effective torque

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

$$M_{2,n^*} = \frac{F_{f2,n^*} \cdot d_0}{2}$$

$$M_{1eff^*} = \frac{M_{2eff^*}}{i \cdot \eta}$$

Operating factors

Operating mode	fB_{op}
Uniform continuous operation	1.00
Cyclic operation	1.00
Reversing load cyclic operation	1.00

Run time	fB_t
Daily runtime ≤ 8 h	1.00
Daily runtime ≤ 16 h	1.15
Daily runtime ≤ 24 h	1.20

Cyclic operation	fB_{ZB}
≤ 1000 load changes/hour (LW/h)	1.00
> 1000 load changes/hour (LW/h)	1.15

Temperature		fB_T
Motor cooling	**Surrounding temperature**	
Motor with forced ventilation	≤ 20 °C	0.9
	≤ 30 °C	1.0
	≤ 40 °C	1.15
Motor with convection cooling	≤ 20 °C	1.0
	≤ 30 °C	1.1
	≤ 40 °C	1.25

Notes

- The maximum permitted gearbox temperature (see the "Other product features" chapter) must not be exceeded, as that could result in damage.
- For braking from full speed (for example, when the power fails or when setting up the machine), note the permitted gearbox feed forces (F_{f2acc}, F_{f2NOT}) in the selection tables.

9.6.2 Radial shaft seal rings

Leak-proofness

Our gearboxes are equipped with high-quality radial shaft seal rings and checked for leaks. However, a leak cannot be fully ruled out over the length of use of a gearbox. If you use a gearbox with goods incompatible with the lubricant, you must take measures to prevent direct contact with the gearbox lubricant in case of a leak.

9.7 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 term field.

Documentation	ID
Operating manual for PE22 – PE52 planetary gearboxes and planetary geared motors	443252_en
Operating manual for EZ synchronous servo motors	443032_en
Operating manual gear racks	443392_en

10 ZVKS rack and pinion drives

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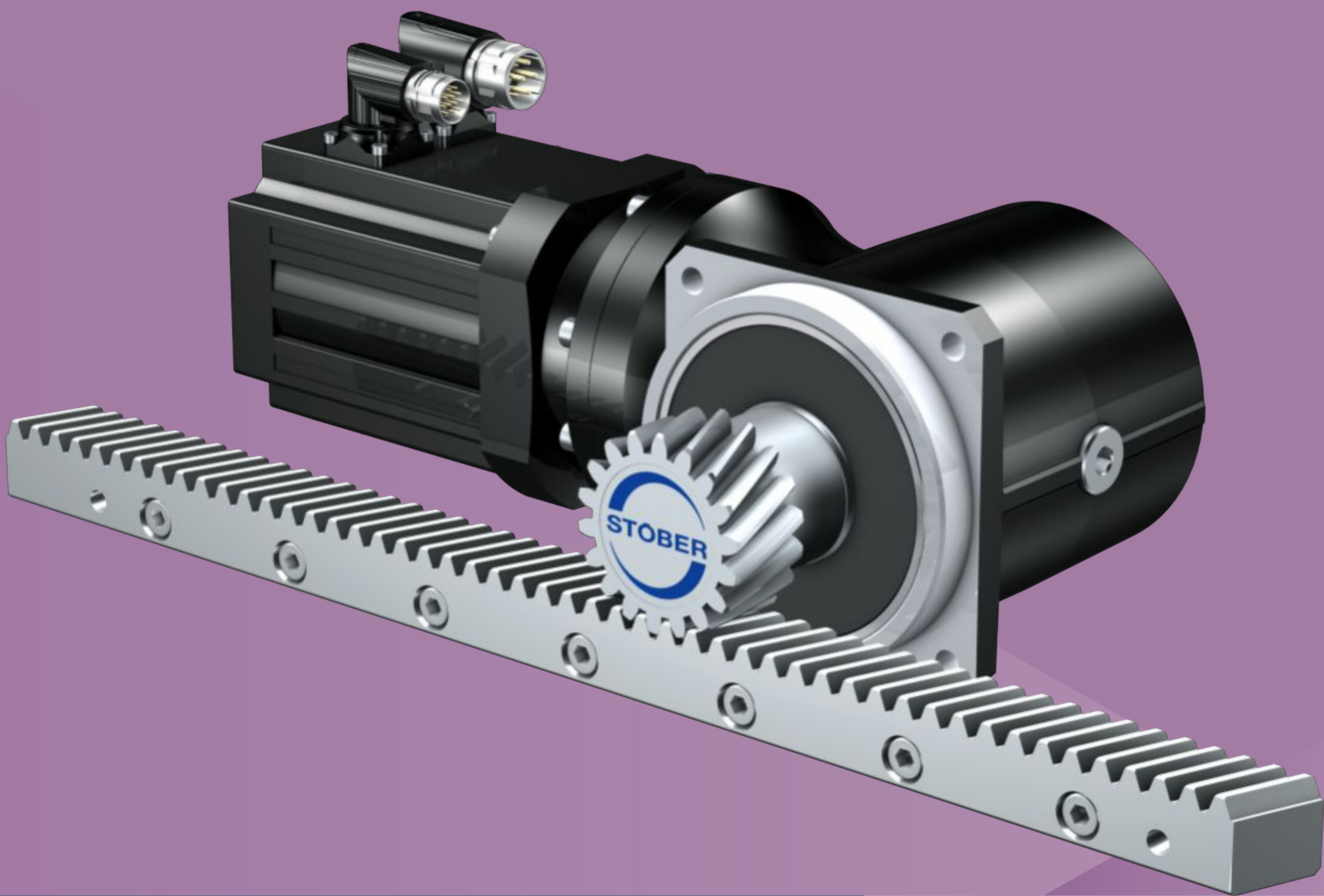


10 Rack and pinion drives

ZVKS

10.1 Overview

High Flexibility right-angle servo geared motors with plug-on pinion

Features

Power density	★★★☆☆
Linear clearance	★★★☆☆
Price category	€€€
Smooth operation	★★★★☆
Linear rigidity	★★★☆☆
Mass moment of inertia	★★★★☆
Ready-to-install drive solution	✓
Pinion gearing quality 6 (DIN 3962)	✓
Helical gearing	✓
Case-hardened and smoothed	✓
Compact and highly dynamic due to direct motor attachment	✓

Key ★☆☆☆☆ good | ★★★★★ excellent
€ Economy | €€€€€ Premium

Technical data

m_n	2 – 4 mm
z	16 – 25
F_{f2acc}	0.6 – 11 kN
v_{f2}	0.08 – 6.8 m/s
Δs	30 – 44 µm

10.2 Selection table

The technical data specified in the selection tables applies to:

- Pinion position E
- Installation without tension
- Permanent lubrication with the lubricants recommended in the chapter on gear racks [▸ 13.5.1]
- Case-hardened pinions, helical (left-hand 19° 31' 42"), gearing quality 5
- Installation altitudes up to 1000 m above sea level
- Surrounding temperatures from 0 °C to 40 °C
- Without consideration of the thermal limiting performance
- Drives with convection-cooled motors (e.g. EZ401**U**)

For the technical data on drives with forced ventilated motors (e.g. EZ401**B**), refer to https://configurator.stoeber.de/en-US/

For all other technical data, refer to https://configurator.stoeber.de/en-US/.

An explanation of the formula symbols can be found in the chapter [▸ 17.1].

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs_{red} [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV2KS3 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 2,1 kN)																
0.27	1.0	1.1	1.4	1.2	ZV216S_KS312_0200 EZ301U	2.1	4.1	36	20.00	0.53	0.71	35	8.9	2	16	34.0
0.33	0.8	0.9	7.2	1.7	ZV216S_KS312_0160 EZ301U	1.9	3.8	32	16.00	0.67	0.89	35	9.8	2	16	34.0
0.38	1.2	1.3	3.4	1.1	ZV216S_KS312_0140 EZ302U	2.1	4.1	36	14.00	0.76	1.02	35	9.0	2	16	34.0
0.38	0.7	0.7	2.0	1.8	ZV216S_KS312_0140 EZ301U	2.1	4.1	36	14.00	0.76	1.02	35	9.0	2	16	34.0
0.53	1.2	1.2	6.1	1.2	ZV216S_KS312_0100 EZ303U	2.1	4.1	36	10.00	1.07	1.42	35	9.1	2	16	34.0
0.53	0.9	0.9	4.7	1.6	ZV216S_KS312_0100 EZ302U	2.1	4.1	36	10.00	1.07	1.42	35	9.1	2	16	34.0
0.53	0.5	0.5	2.7	2.7	ZV216S_KS312_0100 EZ301U	1.6	4.1	27	10.00	1.07	1.42	35	9.1	2	16	34.0
0.67	0.9	1.0	8.0	1.5	ZV216S_KS312_0080 EZ303U	2.1	4.1	36	8.000	1.33	1.78	35	9.2	2	16	34.0
0.67	0.4	0.4	3.6	3.4	ZV216S_KS312_0080 EZ301U	1.3	4.1	21	8.000	1.33	1.78	35	9.2	2	16	34.0
0.67	0.7	0.8	6.1	2.0	ZV216S_KS312_0080 EZ302U	2.1	4.1	36	8.000	1.33	1.78	35	9.2	2	16	34.0
1.33	0.6	0.7	152	1.7	ZV216S_KS311_0040 MF EZ401U	1.9	3.8	32	4.000	1.78	2.67	30	9.3	2	16	34.0
1.33	0.5	0.5	112	2.3	ZV216S_KS311_0040 MF EZ303U	1.6	3.8	27	4.000	1.78	2.67	30	9.3	2	16	34.0
1.33	0.4	0.4	86	3.0	ZV216S_KS311_0040 MF EZ302U	1.1	3.8	19	4.000	1.78	2.67	30	9.3	2	16	34.0
1.33	1.1	1.2	255	1.0	ZV216S_KS311_0040 MF EZ402U	1.9	3.8	32	4.000	1.78	2.67	30	9.3	2	16	34.0
2.67	0.2	0.3	56	4.5	ZV216S_KS311_0020 MF EZ303U	0.8	3.6	14	2.000	2.84	5.33	30	8.6	2	16	34.0
2.67	0.3	0.3	76	3.4	ZV216S_KS311_0020 MF EZ401U	1.0	3.6	16	2.000	2.84	5.33	30	8.6	2	16	34.0
2.67	0.5	0.6	128	2.0	ZV216S_KS311_0020 MF EZ402U	1.8	3.6	31	2.000	2.84	5.33	30	8.6	2	16	34.0
2.67	0.8	1.0	187	1.4	ZV216S_KS311_0020 MF EZ404U	2.1	3.6	36	2.000	2.84	5.33	30	8.6	2	16	34.0
ZV2KS3 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 2,1 kN)																
0.21	1.1	1.2	0.2	1.1	ZV216S_KS313_0500 EZ202U	2.1	4.1	36	50.00	0.21	0.28	35	9.1	2	16	34.0
0.27	0.9	1.0	1.3	1.2	ZV216S_KS312_0400 EZ202U	1.9	3.8	32	40.00	0.27	0.36	35	9.6	2	16	34.0
0.33	1.1	1.2	0.6	1.0	ZV216S_KS313_0320 EZ203U	2.1	4.1	36	32.00	0.33	0.44	35	9.2	2	16	34.0
0.33	0.7	0.8	0.4	1.6	ZV216S_KS313_0320 EZ202U	2.1	4.1	36	32.00	0.33	0.44	35	9.2	2	16	34.0
0.38	0.6	0.7	2.0	1.8	ZV216S_KS312_0280 EZ202U	1.9	3.8	32	28.00	0.38	0.51	35	9.6	2	16	34.0
0.38	1.0	1.1	3.0	1.2	ZV216S_KS312_0280 EZ203U	1.9	3.8	32	28.00	0.38	0.51	35	9.6	2	16	34.0
0.53	0.4	0.5	0.7	2.2	ZV216S_KS312_0200 EZ202U	1.7	4.1	28	20.00	0.53	0.71	35	8.9	2	16	34.0
0.53	0.7	0.8	1.1	1.4	ZV216S_KS312_0200 EZ203U	2.1	4.1	36	20.00	0.53	0.71	35	8.9	2	16	34.0
0.67	0.8	0.9	8.7	1.4	ZV216S_KS312_0160 EZ301U	1.9	3.8	32	16.00	0.67	0.89	35	9.8	2	16	34.0
0.67	0.5	0.6	5.9	2.0	ZV216S_KS312_0160 EZ203U	1.9	3.8	32	16.00	0.67	0.89	35	9.8	2	16	34.0
0.67	0.4	0.4	3.9	3.1	ZV216S_KS312_0160 EZ202U	1.3	3.8	22	16.00	0.67	0.89	35	9.8	2	16	34.0
0.76	0.5	0.5	1.6	2.2	ZV216S_KS312_0140 EZ203U	2.1	4.1	36	14.00	0.76	1.02	35	9.0	2	16	34.0
0.76	0.3	0.3	1.1	3.3	ZV216S_KS312_0140 EZ202U	1.2	4.1	20	14.00	0.76	1.02	35	9.0	2	16	34.0
0.76	0.7	0.7	2.4	1.5	ZV216S_KS312_0140 EZ301U	2.1	4.1	36	14.00	0.76	1.02	35	9.0	2	16	34.0
1.07	1.1	1.3	7.3	1.0	ZV216S_KS312_0100 EZ303U	2.1	4.1	36	10.00	1.07	1.42	35	9.1	2	16	34.0
1.07	0.8	0.9	5.6	1.3	ZV216S_KS312_0100 EZ302U	2.1	4.1	36	10.00	1.07	1.42	35	9.1	2	16	34.0
1.07	0.5	0.5	3.3	2.2	ZV216S_KS312_0100 EZ301U	1.6	4.1	27	10.00	1.07	1.42	35	9.1	2	16	34.0
1.07	0.3	0.4	2.3	3.3	ZV216S_KS312_0100 EZ203U	1.5	4.1	26	10.00	1.07	1.42	35	9.1	2	16	34.0
1.07	0.2	0.2	1.5	5.0	ZV216S_KS312_0100 EZ202U	0.8	4.1	14	10.00	1.07	1.42	35	9.1	2	16	34.0
1.33	0.4	0.4	4.3	2.8	ZV216S_KS312_0080 EZ301U	1.3	4.1	21	8.000	1.33	1.78	35	9.2	2	16	34.0
1.33	0.9	1.0	9.5	1.3	ZV216S_KS312_0080 EZ303U	2.1	4.1	36	8.000	1.33	1.78	35	9.2	2	16	34.0
1.33	0.7	0.8	7.3	1.7	ZV216S_KS312_0080 EZ302U	2.1	4.1	36	8.000	1.33	1.78	35	9.2	2	16	34.0
1.33	0.3	0.3	3.0	4.1	ZV216S_KS312_0080 EZ203U	1.2	4.1	21	8.000	1.33	1.78	35	9.2	2	16	34.0
2.67	0.3	0.4	103	2.5	ZV216S_KS311_0040 MF EZ302U	1.1	3.8	19	4.000	1.78	2.67	30	9.3	2	16	34.0
2.67	0.4	0.5	134	1.9	ZV216S_KS311_0040 MF EZ303U	1.6	3.8	27	4.000	1.78	2.67	30	9.3	2	16	34.0
2.67	0.2	0.2	61	4.2	ZV216S_KS311_0040 MF EZ301U	0.6	3.8	11	4.000	1.78	2.67	30	9.3	2	16	34.0
2.67	0.8	1.1	239	1.1	ZV216S_KS311_0040 MF EZ402U	1.9	3.8	32	4.000	1.78	2.67	30	9.3	2	16	34.0

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs_{red} [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV2KS3 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 2,1 kN)																
2.67	0.5	0.6	157	1.6	ZV216S_KS311_0040 MF EZ401U	1.9	3.8	32	4.000	1.78	2.67	30	9.3	2	16	34.0
5.33	0.2	0.3	67	3.8	ZV216S_KS311_0020 MF EZ303U	0.8	3.6	14	2.000	2.84	5.33	30	8.6	2	16	34.0
5.33	0.2	0.2	51	5.0	ZV216S_KS311_0020 MF EZ302U	0.6	3.6	9.7	2.000	2.84	5.33	30	8.6	2	16	34.0
5.33	0.7	1.0	198	1.3	ZV216S_KS311_0020 MF EZ404U	2.1	3.6	36	2.000	2.84	5.33	30	8.6	2	16	34.0
5.33	0.4	0.6	120	2.1	ZV216S_KS311_0020 MF EZ402U	1.8	3.6	31	2.000	2.84	5.33	30	8.6	2	16	34.0
5.33	0.3	0.3	79	3.2	ZV216S_KS311_0020 MF EZ401U	1.0	3.6	16	2.000	2.84	5.33	30	8.6	2	16	34.0
ZV2KS4 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 3,6 kN)																
0.13	2.0	2.1	0.2	1.4	ZV220S_KS413_0500 EZ301U	3.6	6.6	76	50.00	0.20	0.27	37	26	2	20	42.4
0.17	1.7	1.7	1.3	1.5	ZV220S_KS412_0400 EZ301U	3.1	6.6	65	40.00	0.28	0.33	37	29	2	20	42.4
0.21	1.3	1.3	0.3	2.2	ZV220S_KS413_0320 EZ301U	3.6	6.6	76	32.00	0.28	0.42	37	26	2	20	42.4
0.21	2.2	2.4	0.6	1.3	ZV220S_KS413_0320 EZ302U	3.6	6.6	76	32.00	0.28	0.42	37	26	2	20	42.4
0.24	2.0	2.1	3.5	1.2	ZV220S_KS412_0280 EZ302U	3.1	6.6	65	28.00	0.36	0.48	37	29	2	20	42.4
0.24	1.2	1.2	2.1	2.1	ZV220S_KS412_0280 EZ301U	3.1	6.6	65	28.00	0.36	0.48	37	29	2	20	42.4
0.33	1.9	2.0	1.5	1.3	ZV220S_KS412_0200 EZ303U	3.6	6.6	76	20.00	0.56	0.67	37	25	2	20	42.4
0.33	1.4	1.5	1.2	1.7	ZV220S_KS412_0200 EZ302U	3.6	6.6	76	20.00	0.56	0.67	37	25	2	20	42.4
0.33	0.8	0.9	0.7	2.9	ZV220S_KS412_0200 EZ301U	2.5	6.6	53	20.00	0.56	0.67	37	25	2	20	42.4
0.42	1.5	1.6	9.0	1.6	ZV220S_KS412_0160 EZ303U	3.1	6.6	65	16.00	0.56	0.83	37	30	2	20	42.4
0.42	2.0	2.1	12	1.2	ZV220S_KS412_0160 EZ401U	3.1	6.6	65	16.00	0.56	0.83	37	30	2	20	42.4
0.42	1.1	1.2	6.9	2.1	ZV220S_KS412_0160 EZ302U	3.1	6.6	65	16.00	0.56	0.83	37	30	2	20	42.4
0.42	0.7	0.7	4.0	3.7	ZV220S_KS412_0160 EZ301U	2.0	6.6	43	16.00	0.56	0.83	37	30	2	20	42.4
0.48	1.8	1.9	3.1	1.4	ZV220S_KS412_0140 EZ401U	3.6	6.6	76	14.00	0.71	0.95	37	26	2	20	42.4
0.48	1.3	1.4	2.3	1.9	ZV220S_KS412_0140 EZ303U	3.6	6.6	76	14.00	0.71	0.95	37	26	2	20	42.4
0.48	1.0	1.1	1.8	2.4	ZV220S_KS412_0140 EZ302U	3.1	6.6	67	14.00	0.71	0.95	37	26	2	20	42.4
0.48	0.6	0.6	1.0	4.2	ZV220S_KS412_0140 EZ301U	1.8	6.6	37	14.00	0.71	0.95	37	26	2	20	42.4
0.56	1.5	1.6	17	1.6	ZV220S_KS412_0120 EZ401U	3.1	6.6	65	12.00	0.74	1.11	37	30	2	20	42.4
0.56	0.9	0.9	9.8	2.8	ZV220S_KS412_0120 EZ302U	2.7	6.6	57	12.00	0.74	1.11	37	30	2	20	42.4
0.56	0.5	0.5	5.7	4.9	ZV220S_KS412_0120 EZ301U	1.5	6.6	32	12.00	0.74	1.11	37	30	2	20	42.4
0.56	1.1	1.2	13	2.2	ZV220S_KS412_0120 EZ303U	3.1	6.6	65	12.00	0.74	1.11	37	30	2	20	42.4
0.67	0.7	0.8	2.6	3.4	ZV220S_KS412_0100 EZ302U	2.2	6.6	48	10.00	1.00	1.33	37	26	2	20	42.4
0.67	2.1	2.3	7.8	1.2	ZV220S_KS412_0100 EZ402U	3.6	6.6	76	10.00	1.00	1.33	37	26	2	20	42.4
0.67	0.9	1.0	3.4	2.6	ZV220S_KS412_0100 EZ303U	3.1	6.6	67	10.00	1.00	1.33	37	26	2	20	42.4
0.67	1.3	1.3	4.7	1.9	ZV220S_KS412_0100 EZ401U	3.6	6.6	76	10.00	1.00	1.33	37	26	2	20	42.4
0.83	1.0	1.1	6.1	2.4	ZV220S_KS412_0080 EZ401U	3.0	6.6	65	8.000	1.11	1.67	37	26	2	20	42.4
0.83	0.7	0.8	4.5	3.3	ZV220S_KS412_0080 EZ303U	2.5	6.6	53	8.000	1.11	1.67	37	26	2	20	42.4
0.83	0.6	0.6	3.5	4.3	ZV220S_KS412_0080 EZ302U	1.8	6.6	38	8.000	1.11	1.67	37	26	2	20	42.4
0.83	1.7	1.9	10	1.4	ZV220S_KS412_0080 EZ402U	3.6	6.6	76	8.000	1.11	1.67	37	26	2	20	42.4
1.11	0.6	0.6	6.9	4.0	ZV220S_KS412_0060 EZ303U	1.9	6.6	40	6.000	1.30	2.22	37	26	2	20	42.4
1.11	1.3	1.4	16	1.8	ZV220S_KS412_0060 EZ402U	3.6	6.6	76	6.000	1.30	2.22	37	26	2	20	42.4
1.11	0.8	0.8	9.3	3.0	ZV220S_KS412_0060 EZ401U	2.3	6.6	48	6.000	1.30	2.22	37	26	2	20	42.4
1.67	0.9	1.0	143	2.2	ZV220S_KS411_0040 MF EZ402U	2.9	6.1	62	4.000	1.94	3.33	31	26	2	20	42.4
1.67	1.3	1.6	210	1.5	ZV220S_KS411_0040 MF EZ404U	3.1	6.1	65	4.000	1.94	3.33	31	26	2	20	42.4
1.67	0.8	0.9	131	2.4	ZV220S_KS411_0040 MF EZ501U	2.9	6.1	62	4.000	1.94	3.33	31	26	2	20	42.4
1.67	1.4	1.5	225	1.4	ZV220S_KS411_0040 MF EZ502U	3.1	6.1	65	4.000	1.94	3.33	31	26	2	20	42.4
1.67	1.8	2.0	296	1.1	ZV220S_KS411_0040 MF EZ503U	3.1	6.1	65	4.000	1.94	3.33	31	26	2	20	42.4
1.67	0.5	0.5	85	3.7	ZV220S_KS411_0040 MF EZ401U	1.6	6.1	33	4.000	1.94	3.33	31	26	2	20	42.4
3.33	0.6	0.8	105	3.0	ZV220S_KS411_0020 MF EZ404U	2.7	6.1	56	2.000	2.78	5.56	31	22	2	20	42.4
3.33	0.4	0.4	65	4.8	ZV220S_KS411_0020 MF EZ501U	1.5	6.1	31	2.000	2.78	5.56	31	22	2	20	42.4
3.33	0.7	0.7	113	2.8	ZV220S_KS411_0020 MF EZ502U	2.8	6.1	60	2.000	2.78	5.56	31	22	2	20	42.4
3.33	0.9	1.0	148	2.1	ZV220S_KS411_0020 MF EZ503U	3.6	6.1	76	2.000	2.78	5.56	31	22	2	20	42.4
3.33	1.2	1.5	206	1.5	ZV220S_KS411_0020 MF EZ505U	3.6	6.1	76	2.000	2.78	5.56	31	22	2	20	42.4
3.33	0.4	0.5	72	4.4	ZV220S_KS411_0020 MF EZ402U	1.5	6.1	31	2.000	2.78	5.56	31	22	2	20	42.4
ZV2KS4 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 3,6 kN)																
0.13	1.8	1.9	–	1.3	ZV220S_KS413_1000 EZ202U	3.6	6.6	76	100.0	0.11	0.13	37	26	2	20	42.4
0.17	1.4	1.5	0.1	1.6	ZV220S_KS413_0800 EZ202U	3.6	6.6	76	80.00	0.14	0.17	37	30	2	20	42.4
0.17	2.1	2.4	0.1	1.0	ZV220S_KS413_0800 EZ203U	3.6	6.6	76	80.00	0.14	0.17	37	30	2	20	42.4
0.19	1.9	2.1	0.1	1.2	ZV220S_KS413_0700 EZ203U	3.6	6.6	76	70.00	0.14	0.19	37	26	2	20	42.4
0.19	1.2	1.3	0.1	1.8	ZV220S_KS413_0700 EZ202U	3.6	6.6	76	70.00	0.14	0.19	37	26	2	20	42.4
0.21	1.1	1.2	0.4	1.7	ZV220S_KS413_0640 EZ202U	3.1	6.6	65	64.00	0.14	0.21	37	30	2	20	42.4
0.21	1.7	1.9	0.6	1.1	ZV220S_KS413_0640 EZ203U	3.1	6.6	65	64.00	0.14	0.21	37	30	2	20	42.4
0.27	2.0	2.1	0.2	1.1	ZV220S_KS413_0500 EZ301U	3.6	6.6	76	50.00	0.20	0.27	37	26	2	20	42.4
0.27	1.3	1.5	0.2	1.7	ZV220S_KS413_0500 EZ203U	3.6	6.6	76	50.00	0.20	0.27	37	26	2	20	42.4
0.27	0.9	1.0	0.1	2.5	ZV220S_KS413_0500 EZ202U	3.2	6.6	69	50.00	0.20	0.27	37	26	2	20	42.4
0.33	1.6	1.7	1.6	1.2	ZV220S_KS412_0400 EZ301U	3.1	6.6	65	40.00	0.28	0.33	37	29	2	20	42.4
0.42	2.1	2.4	0.7	1.1	ZV220S_KS413_0320 EZ302U	3.6	6.6	76	32.00	0.28	0.42	37	26	2	20	42.4
0.42	1.2	1.3	0.4	1.8	ZV220S_KS413_0320 EZ301U	3.6	6.6	76	32.00	0.28	0.42	37	26	2	20	42.4
0.42	0.9	1.0	0.3	2.6	ZV220S_KS413_0320 EZ203U	3.6	6.6	76	32.00	0.28	0.42	37	26	2	20	42.4

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs_{red} [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV2KS4 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 3,6 kN)																
0.42	0.6	0.6	0.2	4.0	ZV220S_KS413_0320 EZ202U	2.1	6.6	44	32.00	0.28	0.42	37	26	2	20	42.4
0.48	1.9	2.1	4.2	1.0	ZV220S_KS412_0280 EZ302U	3.1	6.6	65	28.00	0.36	0.48	37	29	2	20	42.4
0.48	1.1	1.2	2.5	1.7	ZV220S_KS412_0280 EZ301U	3.1	6.6	65	28.00	0.36	0.48	37	29	2	20	42.4
0.67	1.3	1.5	1.4	1.4	ZV220S_KS412_0200 EZ302U	3.6	6.6	76	20.00	0.56	0.67	37	25	2	20	42.4
0.67	0.8	0.9	0.8	2.4	ZV220S_KS412_0200 EZ301U	2.5	6.6	53	20.00	0.56	0.67	37	25	2	20	42.4
0.67	1.8	2.0	1.8	1.1	ZV220S_KS412_0200 EZ303U	3.6	6.6	76	20.00	0.56	0.67	37	25	2	20	42.4
0.83	1.6	2.0	13	1.2	ZV220S_KS412_0160 EZ401U	3.1	6.6	65	16.00	0.56	0.83	37	30	2	20	42.4
0.83	1.4	1.6	11	1.4	ZV220S_KS412_0160 EZ303U	3.1	6.6	65	16.00	0.56	0.83	37	30	2	20	42.4
0.83	1.1	1.2	8.2	1.8	ZV220S_KS412_0160 EZ302U	3.1	6.6	65	16.00	0.56	0.83	37	30	2	20	42.4
0.83	0.6	0.7	4.9	3.0	ZV220S_KS412_0160 EZ301U	2.0	6.6	43	16.00	0.56	0.83	37	30	2	20	42.4
0.95	1.4	1.8	3.2	1.3	ZV220S_KS412_0140 EZ401U	3.6	6.6	76	14.00	0.71	0.95	37	26	2	20	42.4
0.95	1.2	1.4	2.7	1.6	ZV220S_KS412_0140 EZ303U	3.6	6.6	76	14.00	0.71	0.95	37	26	2	20	42.4
0.95	0.9	1.1	2.1	2.1	ZV220S_KS412_0140 EZ302U	3.1	6.6	67	14.00	0.71	0.95	37	26	2	20	42.4
0.95	0.6	0.6	1.2	3.5	ZV220S_KS412_0140 EZ301U	1.8	6.6	37	14.00	0.71	0.95	37	26	2	20	42.4
1.11	0.5	0.5	6.9	4.0	ZV220S_KS412_0120 EZ301U	1.5	6.6	32	12.00	0.74	1.11	37	30	2	20	42.4
1.11	1.9	2.6	27	1.0	ZV220S_KS412_0120 EZ402U	3.1	6.6	65	12.00	0.74	1.11	37	30	2	20	42.4
1.11	1.2	1.5	18	1.6	ZV220S_KS412_0120 EZ401U	3.1	6.6	65	12.00	0.74	1.11	37	30	2	20	42.4
1.11	1.1	1.2	15	1.8	ZV220S_KS412_0120 EZ303U	3.1	6.6	65	12.00	0.74	1.11	37	30	2	20	42.4
1.11	0.8	0.9	12	2.4	ZV220S_KS412_0120 EZ302U	2.7	6.6	57	12.00	0.74	1.11	37	30	2	20	42.4
1.33	0.4	0.4	1.9	4.8	ZV220S_KS412_0100 EZ301U	1.3	6.6	27	10.00	1.00	1.33	37	26	2	20	42.4
1.33	0.7	0.8	3.1	2.9	ZV220S_KS412_0100 EZ302U	2.2	6.6	48	10.00	1.00	1.33	37	26	2	20	42.4
1.33	0.9	1.0	4.1	2.2	ZV220S_KS412_0100 EZ303U	3.1	6.6	67	10.00	1.00	1.33	37	26	2	20	42.4
1.33	1.0	1.3	4.8	1.9	ZV220S_KS412_0100 EZ401U	3.6	6.6	76	10.00	1.00	1.33	37	26	2	20	42.4
1.33	1.6	2.2	7.3	1.2	ZV220S_KS412_0100 EZ402U	3.6	6.6	76	10.00	1.00	1.33	37	26	2	20	42.4
1.67	0.7	0.8	5.4	2.7	ZV220S_KS412_0080 EZ303U	2.5	6.6	53	8.000	1.11	1.67	37	26	2	20	42.4
1.67	0.8	1.0	6.3	2.3	ZV220S_KS412_0080 EZ401U	3.0	6.6	65	8.000	1.11	1.67	37	26	2	20	42.4
1.67	1.3	1.8	9.6	1.5	ZV220S_KS412_0080 EZ402U	3.6	6.6	76	8.000	1.11	1.67	37	26	2	20	42.4
1.67	0.5	0.6	4.1	3.6	ZV220S_KS412_0080 EZ302U	1.8	6.6	38	8.000	1.11	1.67	37	26	2	20	42.4
2.22	0.6	0.8	9.6	2.9	ZV220S_KS412_0060 EZ401U	2.3	6.6	48	6.000	1.30	2.22	37	26	2	20	42.4
2.22	0.5	0.6	8.2	3.4	ZV220S_KS412_0060 EZ303U	1.9	6.6	40	6.000	1.30	2.22	37	26	2	20	42.4
2.22	0.9	1.3	15	1.9	ZV220S_KS412_0060 EZ402U	3.6	6.6	76	6.000	1.30	2.22	37	26	2	20	42.4
2.22	0.4	0.5	6.3	4.4	ZV220S_KS412_0060 EZ302U	1.3	6.6	29	6.000	1.30	2.22	37	26	2	20	42.4
3.33	0.6	0.9	134	2.3	ZV220S_KS411_0040 MF EZ402U	2.9	6.1	62	4.000	1.94	3.33	31	26	2	20	42.4
3.33	1.0	1.4	200	1.6	ZV220S_KS411_0040 MF EZ502U	3.1	6.1	65	4.000	1.94	3.33	31	26	2	20	42.4
3.33	1.1	1.5	223	1.4	ZV220S_KS411_0040 MF EZ404U	3.1	6.1	65	4.000	1.94	3.33	31	26	2	20	42.4
3.33	0.6	0.8	130	2.4	ZV220S_KS411_0040 MF EZ501U	2.9	6.1	62	4.000	1.94	3.33	31	26	2	20	42.4
3.33	0.4	0.5	88	3.5	ZV220S_KS411_0040 MF EZ401U	1.6	6.1	33	4.000	1.94	3.33	31	26	2	20	42.4
3.33	1.1	1.9	238	1.3	ZV220S_KS411_0040 MF EZ503U	3.1	6.1	65	4.000	1.94	3.33	31	26	2	20	42.4
ZV2KS5 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 5,5 kN)																
0.08	3.3	3.3	–	1.4	ZV225S_KS513_1000 EZ301U	5.5	11	147	100.0	0.12	0.17	39	32	2	25	53.1
0.10	2.6	2.7	0.1	1.7	ZV225S_KS513_0800 EZ301U	5.5	11	147	80.00	0.15	0.21	39	32	2	25	53.1
0.10	4.5	4.7	0.1	1.0	ZV225S_KS513_0800 EZ302U	5.5	11	147	80.00	0.15	0.21	39	32	2	25	53.1
0.12	2.3	2.3	0.1	2.0	ZV225S_KS513_0700 EZ301U	5.5	11	147	70.00	0.17	0.24	39	32	2	25	53.1
0.12	3.9	4.1	0.1	1.2	ZV225S_KS513_0700 EZ302U	5.5	11	147	70.00	0.17	0.24	39	32	2	25	53.1
0.13	2.1	2.1	0.5	1.8	ZV225S_KS513_0640 EZ301U	5.3	11	140	64.00	0.14	0.26	39	31	2	25	53.1
0.13	3.6	3.8	0.8	1.0	ZV225S_KS513_0640 EZ302U	5.3	11	140	64.00	0.14	0.26	39	31	2	25	53.1
0.17	2.8	2.9	0.2	1.6	ZV225S_KS513_0500 EZ302U	5.5	11	147	50.00	0.19	0.33	39	32	2	25	53.1
0.17	1.6	1.7	0.1	2.8	ZV225S_KS513_0500 EZ301U	4.9	11	130	50.00	0.19	0.33	39	32	2	25	53.1
0.17	3.6	3.8	0.3	1.2	ZV225S_KS513_0500 EZ303U	5.5	11	147	50.00	0.19	0.33	39	32	2	25	53.1
0.26	2.3	2.5	0.4	1.9	ZV225S_KS513_0320 EZ303U	5.5	11	147	32.00	0.30	0.52	39	32	2	25	53.1
0.26	1.0	1.1	0.2	4.3	ZV225S_KS513_0320 EZ301U	3.1	11	83	32.00	0.30	0.52	39	32	2	25	53.1
0.26	1.8	1.9	0.3	2.5	ZV225S_KS513_0320 EZ302U	5.5	11	147	32.00	0.30	0.52	39	32	2	25	53.1
0.26	3.1	3.4	0.6	1.4	ZV225S_KS513_0320 EZ401U	5.5	11	147	32.00	0.30	0.52	39	32	2	25	53.1
0.30	2.8	3.0	3.8	1.3	ZV225S_KS512_0280 EZ401U	5.3	11	140	28.00	0.37	0.60	39	30	2	25	53.1
0.42	3.1	3.4	1.9	1.2	ZV225S_KS512_0200 EZ501U	5.5	11	147	20.00	0.51	0.83	39	31	2	25	53.1
0.42	3.4	3.7	2.1	1.1	ZV225S_KS512_0200 EZ402U	5.5	11	147	20.00	0.51	0.83	39	31	2	25	53.1
0.42	2.0	2.1	1.2	1.9	ZV225S_KS512_0200 EZ401U	5.5	11	147	20.00	0.51	0.83	39	31	2	25	53.1
0.52	1.6	1.7	7.5	2.3	ZV225S_KS512_0160 EZ401U	4.9	11	129	16.00	0.57	1.04	39	31	2	25	53.1
0.52	2.7	3.0	13	1.4	ZV225S_KS512_0160 EZ402U	5.3	11	140	16.00	0.57	1.04	39	31	2	25	53.1
0.52	2.5	2.7	11	1.5	ZV225S_KS512_0160 EZ501U	5.3	11	140	16.00	0.57	1.04	39	31	2	25	53.1
0.60	3.7	4.0	5.0	1.0	ZV225S_KS512_0140 EZ502U	5.5	11	147	14.00	0.73	1.19	39	31	2	25	53.1
0.60	2.2	2.4	2.9	1.7	ZV225S_KS512_0140 EZ501U	5.5	11	147	14.00	0.73	1.19	39	31	2	25	53.1
0.60	3.5	4.3	4.7	1.1	ZV225S_KS512_0140 EZ404U	5.5	11	147	14.00	0.73	1.19	39	31	2	25	53.1
0.60	2.4	2.6	3.2	1.6	ZV225S_KS512_0140 EZ402U	5.5	11	147	14.00	0.73	1.19	39	31	2	25	53.1
0.60	1.4	1.5	1.9	2.7	ZV225S_KS512_0140 EZ401U	4.3	11	113	14.00	0.73	1.19	39	31	2	25	53.1
0.69	3.2	3.4	28	1.2	ZV225S_KS512_0120 EZ502U	5.3	11	140	12.00	0.58	1.27	39	31	2	25	53.1

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs_{red} [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV2KS5 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 5,5 kN)																
0.69	1.2	1.3	11	3.1	ZV225S_KS512_0120 EZ401U	3.7	11	97	12.00	0.58	1.27	39	31	2	25	53.1
0.69	2.0	2.2	18	1.9	ZV225S_KS512_0120 EZ402U	5.3	11	140	12.00	0.58	1.27	39	31	2	25	53.1
0.69	1.8	2.0	16	2.0	ZV225S_KS512_0120 EZ501U	5.3	11	140	12.00	0.58	1.27	39	31	2	25	53.1
0.69	3.0	3.7	26	1.3	ZV225S_KS512_0120 EZ404U	5.3	11	140	12.00	0.58	1.27	39	31	2	25	53.1
0.83	1.7	1.9	4.8	2.2	ZV225S_KS512_0100 EZ402U	5.5	11	147	10.00	0.97	1.67	39	32	2	25	53.1
0.83	1.0	1.1	2.9	3.7	ZV225S_KS512_0100 EZ401U	3.0	11	81	10.00	0.97	1.67	39	32	2	25	53.1
0.83	3.5	4.0	9.9	1.1	ZV225S_KS512_0100 EZ503U	5.5	11	147	10.00	0.97	1.67	39	32	2	25	53.1
0.83	2.7	2.9	7.6	1.4	ZV225S_KS512_0100 EZ502U	5.5	11	147	10.00	0.97	1.67	39	32	2	25	53.1
0.83	1.5	1.7	4.4	2.4	ZV225S_KS512_0100 EZ501U	5.5	11	147	10.00	0.97	1.67	39	32	2	25	53.1
0.83	2.5	3.1	7.0	1.5	ZV225S_KS512_0100 EZ404U	5.5	11	147	10.00	0.97	1.67	39	32	2	25	53.1
1.04	2.8	3.2	13	1.3	ZV225S_KS512_0080 EZ503U	5.5	11	147	8.000	1.15	2.08	39	32	2	25	53.1
1.04	2.1	2.3	9.9	1.8	ZV225S_KS512_0080 EZ502U	5.5	11	147	8.000	1.15	2.08	39	32	2	25	53.1
1.04	1.2	1.3	5.7	3.0	ZV225S_KS512_0080 EZ501U	4.6	11	122	8.000	1.15	2.08	39	32	2	25	53.1
1.04	2.0	2.5	9.2	1.9	ZV225S_KS512_0080 EZ404U	5.5	11	147	8.000	1.15	2.08	39	32	2	25	53.1
1.04	1.3	1.5	6.3	2.8	ZV225S_KS512_0080 EZ402U	4.6	11	122	8.000	1.15	2.08	39	32	2	25	53.1
1.04	0.8	0.9	3.7	4.7	ZV225S_KS512_0080 EZ401U	2.4	11	65	8.000	1.15	2.08	39	32	2	25	53.1
1.39	2.9	3.4	32	1.0	ZV225S_KS512_0060 EZ505U	5.5	11	147	6.000	1.16	2.55	39	32	2	25	53.1
1.39	0.6	0.6	6.6	5.0	ZV225S_KS512_0060 EZ401U	1.8	11	48	6.000	1.16	2.55	39	32	2	25	53.1
1.39	1.0	1.1	11	3.0	ZV225S_KS512_0060 EZ402U	3.4	11	91	6.000	1.16	2.55	39	32	2	25	53.1
1.39	1.5	1.8	16	2.0	ZV225S_KS512_0060 EZ404U	5.5	11	147	6.000	1.16	2.55	39	32	2	25	53.1
1.39	0.9	1.0	10	3.2	ZV225S_KS512_0060 EZ501U	3.4	11	91	6.000	1.16	2.55	39	32	2	25	53.1
1.39	2.1	2.4	23	1.4	ZV225S_KS512_0060 EZ503U	5.5	11	147	6.000	1.16	2.55	39	32	2	25	53.1
1.39	1.6	1.7	17	1.9	ZV225S_KS512_0060 EZ502U	5.5	11	147	6.000	1.16	2.55	39	32	2	25	53.1
2.08	1.4	1.6	174	2.1	ZV225S_KS511_0040 MF EZ503U	5.3	11	140	4.000	1.74	4.17	31	33	2	25	53.1
2.08	1.1	1.2	133	2.8	ZV225S_KS511_0040 MF EZ502U	4.5	11	120	4.000	1.74	4.17	31	33	2	25	53.1
2.08	2.4	3.0	296	1.2	ZV225S_KS511_0040 MF EZ703U	5.3	11	140	4.000	1.74	4.17	31	33	2	25	53.1
2.08	1.8	2.1	216	1.7	ZV225S_KS511_0040 MF EZ702U	5.3	11	140	4.000	1.74	4.17	31	33	2	25	53.1
2.08	2.0	2.3	243	1.5	ZV225S_KS511_0040 MF EZ505U	5.3	11	140	4.000	1.74	4.17	31	33	2	25	53.1
2.08	0.6	0.7	77	4.8	ZV225S_KS511_0040 MF EZ501U	2.3	11	62	4.000	1.74	4.17	31	33	2	25	53.1
2.08	1.1	1.2	133	2.8	ZV225S_KS511_0040 MF EZ701U	2.9	11	78	4.000	1.74	4.17	31	33	2	25	53.1
4.17	1.6	2.2	191	1.9	ZV225S_KS511_0020 MF EZ705U	5.5	8.5	147	2.000	2.78	6.39	31	34	2	25	53.1
4.17	1.2	1.5	148	2.5	ZV225S_KS511_0020 MF EZ703U	4.8	8.5	126	2.000	2.78	6.39	31	34	2	25	53.1
4.17	0.9	1.1	108	3.4	ZV225S_KS511_0020 MF EZ702U	3.0	8.5	80	2.000	2.78	6.39	31	34	2	25	53.1
4.17	1.0	1.2	121	3.0	ZV225S_KS511_0020 MF EZ505U	4.9	8.5	130	2.000	2.78	6.39	31	34	2	25	53.1
4.17	0.7	0.8	87	4.2	ZV225S_KS511_0020 MF EZ503U	3.1	8.5	83	2.000	2.78	6.39	31	34	2	25	53.1
ZV2KS5 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 5,5 kN)																
1.56	2.7	4.4	15	1.2	ZV225S_KS512_0080 EZ505U	5.5	11	147	8.000	1.15	2.08	39	32	2	25	53.1
2.08	2.0	3.3	26	1.3	ZV225S_KS512_0060 EZ505U	5.5	11	147	6.000	1.16	2.55	39	32	2	25	53.1
3.13	1.4	2.2	195	1.9	ZV225S_KS511_0040 MF EZ505U	5.3	11	140	4.000	1.74	4.17	31	33	2	25	53.1
3.13	1.8	2.9	249	1.5	ZV225S_KS511_0040 MF EZ703U	5.3	11	140	4.000	1.74	4.17	31	33	2	25	53.1
3.13	2.4	4.4	337	1.1	ZV225S_KS511_0040 MF EZ705U	5.3	11	140	4.000	1.74	4.17	31	33	2	25	53.1
6.25	1.2	2.2	169	2.2	ZV225S_KS511_0020 MF EZ705U	5.5	8.5	147	2.000	2.78	6.39	31	34	2	25	53.1
6.25	0.7	1.1	98	3.8	ZV225S_KS511_0020 MF EZ505U	4.9	8.5	130	2.000	2.78	6.39	31	34	2	25	53.1
6.25	0.9	1.5	124	3.0	ZV225S_KS511_0020 MF EZ703U	4.8	8.5	126	2.000	2.78	6.39	31	34	2	25	53.1
ZV2KS5 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 5,5 kN)																
0.17	3.1	3.3	0.1	1.1	ZV225S_KS513_1000 EZ301U	5.5	11	147	100.0	0.12	0.17	39	32	2	25	53.1
0.21	2.5	2.7	0.1	1.4	ZV225S_KS513_0800 EZ301U	5.5	11	147	80.00	0.15	0.21	39	32	2	25	53.1
0.24	2.2	2.3	0.1	1.6	ZV225S_KS513_0700 EZ301U	5.5	11	147	70.00	0.17	0.24	39	32	2	25	53.1
0.26	2.0	2.1	0.6	1.5	ZV225S_KS513_0640 EZ301U	5.3	11	140	64.00	0.14	0.26	39	31	2	25	53.1
0.33	3.4	3.9	0.3	1.0	ZV225S_KS513_0500 EZ303U	5.5	11	147	50.00	0.19	0.33	39	32	2	25	53.1
0.33	2.6	2.9	0.2	1.4	ZV225S_KS513_0500 EZ302U	5.5	11	147	50.00	0.19	0.33	39	32	2	25	53.1
0.33	1.6	1.7	0.1	2.3	ZV225S_KS513_0500 EZ301U	4.9	11	130	50.00	0.19	0.33	39	32	2	25	53.1
0.52	1.7	1.9	0.4	2.1	ZV225S_KS513_0320 EZ302U	5.5	11	147	32.00	0.30	0.52	39	32	2	25	53.1
0.52	1.0	1.1	0.2	3.6	ZV225S_KS513_0320 EZ301U	3.1	11	83	32.00	0.30	0.52	39	32	2	25	53.1
0.52	2.2	2.5	0.5	1.6	ZV225S_KS513_0320 EZ303U	5.5	11	147	32.00	0.30	0.52	39	32	2	25	53.1
0.52	2.6	3.1	0.6	1.4	ZV225S_KS513_0320 EZ401U	5.5	11	147	32.00	0.30	0.52	39	32	2	25	53.1
0.60	2.3	2.8	3.9	1.3	ZV225S_KS512_0280 EZ401U	5.3	11	140	28.00	0.37	0.60	39	30	2	25	53.1
0.83	2.4	3.2	1.9	1.2	ZV225S_KS512_0200 EZ501U	5.5	11	147	20.00	0.51	0.83	39	31	2	25	53.1
0.83	2.5	3.5	2.0	1.2	ZV225S_KS512_0200 EZ402U	5.5	11	147	20.00	0.51	0.83	39	31	2	25	53.1
0.83	1.6	2.0	1.3	1.8	ZV225S_KS512_0200 EZ401U	5.5	11	147	20.00	0.51	0.83	39	31	2	25	53.1
1.04	2.0	2.8	12	1.5	ZV225S_KS512_0160 EZ402U	5.3	11	140	16.00	0.57	1.04	39	31	2	25	53.1
1.04	1.9	2.5	11	1.5	ZV225S_KS512_0160 EZ501U	5.3	11	140	16.00	0.57	1.04	39	31	2	25	53.1
1.04	1.3	1.6	7.7	2.3	ZV225S_KS512_0160 EZ401U	4.9	11	129	16.00	0.57	1.04	39	31	2	25	53.1
1.19	1.2	1.4	2.0	2.6	ZV225S_KS512_0140 EZ401U	4.3	11	113	14.00	0.73	1.19	39	31	2	25	53.1
1.19	1.8	2.5	3.0	1.7	ZV225S_KS512_0140 EZ402U	5.5	11	147	14.00	0.73	1.19	39	31	2	25	53.1
1.19	2.9	4.2	5.0	1.0	ZV225S_KS512_0140 EZ404U	5.5	11	147	14.00	0.73	1.19	39	31	2	25	53.1

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs_{red} [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV2KS5 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 5,5 kN)																
1.19	1.7	2.2	2.9	1.7	ZV225S_KS512_0140 EZ501U	5.5	11	147	14.00	0.73	1.19	39	31	2	25	53.1
1.19	2.6	3.9	4.5	1.1	ZV225S_KS512_0140 EZ502U	5.5	11	147	14.00	0.73	1.19	39	31	2	25	53.1
1.67	1.2	1.6	4.4	2.4	ZV225S_KS512_0100 EZ501U	5.5	11	147	10.00	0.97	1.67	39	32	2	25	53.1
1.67	2.2	3.8	8.0	1.3	ZV225S_KS512_0100 EZ503U	5.5	11	147	10.00	0.97	1.67	39	32	2	25	53.1
1.67	2.1	3.0	7.5	1.4	ZV225S_KS512_0100 EZ404U	5.5	11	147	10.00	0.97	1.67	39	32	2	25	53.1
1.67	1.3	1.8	4.5	2.4	ZV225S_KS512_0100 EZ402U	5.5	11	147	10.00	0.97	1.67	39	32	2	25	53.1
1.67	0.8	1.0	3.0	3.6	ZV225S_KS512_0100 EZ401U	3.0	11	81	10.00	0.97	1.67	39	32	2	25	53.1
1.67	1.9	2.8	6.7	1.6	ZV225S_KS512_0100 EZ502U	5.5	11	147	10.00	0.97	1.67	39	32	2	25	53.1
2.08	1.8	3.0	10	1.7	ZV225S_KS512_0080 EZ503U	5.5	11	147	8.000	1.15	2.08	39	32	2	25	53.1
2.08	1.5	2.2	8.7	2.0	ZV225S_KS512_0080 EZ502U	5.5	11	147	8.000	1.15	2.08	39	32	2	25	53.1
2.08	1.0	1.3	5.7	3.0	ZV225S_KS512_0080 EZ501U	4.6	11	122	8.000	1.15	2.08	39	32	2	25	53.1
2.08	1.7	2.4	9.7	1.8	ZV225S_KS512_0080 EZ404U	5.5	11	147	8.000	1.15	2.08	39	32	2	25	53.1
2.08	1.0	1.4	5.9	3.0	ZV225S_KS512_0080 EZ402U	4.6	11	122	8.000	1.15	2.08	39	32	2	25	53.1
2.08	0.7	0.8	3.9	4.5	ZV225S_KS512_0080 EZ401U	2.4	11	65	8.000	1.15	2.08	39	32	2	25	53.1
4.17	0.5	0.6	77	4.8	ZV225S_KS511_0040 MF EZ501U	2.3	11	62	4.000	1.74	4.17	31	33	2	25	53.1
4.17	0.9	1.6	140	2.6	ZV225S_KS511_0040 MF EZ503U	5.3	11	140	4.000	1.74	4.17	31	33	2	25	53.1
4.17	1.1	2.1	163	2.3	ZV225S_KS511_0040 MF EZ702U	5.3	11	140	4.000	1.74	4.17	31	33	2	25	53.1
4.17	0.8	1.2	118	3.1	ZV225S_KS511_0040 MF EZ701U	2.9	11	78	4.000	1.74	4.17	31	33	2	25	53.1
4.17	0.8	1.1	118	3.1	ZV225S_KS511_0040 MF EZ502U	4.5	11	120	4.000	1.74	4.17	31	33	2	25	53.1
ZV3KS5 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 5,7 kN)																
0.09	3.0	3.1	–	1.4	ZV318S_KS513_1000 EZ301U	5.7	10	163	100.0	0.13	0.18	42	31	3	18	57.3
0.11	2.4	2.5	0.1	1.7	ZV318S_KS513_0800 EZ301U	5.7	10	163	80.00	0.16	0.23	42	32	3	18	57.3
0.11	4.1	4.4	0.1	1.0	ZV318S_KS513_0800 EZ302U	5.7	10	163	80.00	0.16	0.23	42	32	3	18	57.3
0.13	3.6	3.8	0.1	1.2	ZV318S_KS513_0700 EZ302U	5.7	10	163	70.00	0.18	0.26	42	31	3	18	57.3
0.13	2.1	2.2	0.1	2.0	ZV318S_KS513_0700 EZ301U	5.7	10	163	70.00	0.18	0.26	42	31	3	18	57.3
0.14	3.3	3.5	0.8	1.0	ZV318S_KS513_0640 EZ302U	4.9	9.8	140	64.00	0.16	0.28	42	31	3	18	57.3
0.14	1.9	2.0	0.5	1.8	ZV318S_KS513_0640 EZ301U	4.9	9.8	140	64.00	0.16	0.28	42	31	3	18	57.3
0.18	2.6	2.7	0.2	1.6	ZV318S_KS513_0500 EZ302U	5.7	10	163	50.00	0.21	0.36	42	31	3	18	57.3
0.18	3.4	3.6	0.3	1.2	ZV318S_KS513_0500 EZ303U	5.7	10	163	50.00	0.21	0.36	42	31	3	18	57.3
0.18	1.5	1.5	0.1	2.8	ZV318S_KS513_0500 EZ301U	4.5	10	130	50.00	0.21	0.36	42	31	3	18	57.3
0.28	2.9	3.1	0.6	1.4	ZV318S_KS513_0320 EZ401U	5.7	10	163	32.00	0.33	0.56	42	32	3	18	57.3
0.28	1.7	1.7	0.3	2.5	ZV318S_KS513_0320 EZ302U	5.2	10	149	32.00	0.33	0.56	42	32	3	18	57.3
0.28	2.2	2.3	0.4	1.9	ZV318S_KS513_0320 EZ303U	5.7	10	163	32.00	0.33	0.56	42	32	3	18	57.3
0.28	1.0	1.0	0.2	4.3	ZV318S_KS513_0320 EZ301U	2.9	10	83	32.00	0.33	0.56	42	32	3	18	57.3
0.32	2.6	2.8	3.8	1.3	ZV318S_KS512_0280 EZ401U	4.9	9.8	140	28.00	0.40	0.64	42	29	3	18	57.3
0.45	3.1	3.4	2.1	1.1	ZV318S_KS512_0200 EZ402U	5.7	10	163	20.00	0.56	0.90	42	30	3	18	57.3
0.45	1.9	2.0	1.2	1.9	ZV318S_KS512_0200 EZ401U	5.6	10	162	20.00	0.56	0.90	42	30	3	18	57.3
0.45	2.9	3.1	1.9	1.2	ZV318S_KS512_0200 EZ501U	5.7	10	163	20.00	0.56	0.90	42	30	3	18	57.3
0.56	2.5	2.8	13	1.4	ZV318S_KS512_0160 EZ402U	4.9	9.8	140	16.00	0.62	1.13	42	31	3	18	57.3
0.56	1.5	1.6	7.5	2.3	ZV318S_KS512_0160 EZ401U	4.5	9.8	129	16.00	0.62	1.13	42	31	3	18	57.3
0.56	2.3	2.5	11	1.5	ZV318S_KS512_0160 EZ501U	4.9	9.8	140	16.00	0.62	1.13	42	31	3	18	57.3
0.64	1.3	1.4	1.9	2.7	ZV318S_KS512_0140 EZ401U	3.9	10	113	14.00	0.79	1.29	42	31	3	18	57.3
0.64	3.4	3.7	5.0	1.0	ZV318S_KS512_0140 EZ502U	5.7	10	163	14.00	0.79	1.29	42	31	3	18	57.3
0.64	2.0	2.2	2.9	1.7	ZV318S_KS512_0140 EZ501U	5.7	10	163	14.00	0.79	1.29	42	31	3	18	57.3
0.64	3.2	4.0	4.7	1.1	ZV318S_KS512_0140 EZ404U	5.7	10	163	14.00	0.79	1.29	42	31	3	18	57.3
0.64	2.2	2.4	3.2	1.6	ZV318S_KS512_0140 EZ402U	5.7	10	163	14.00	0.79	1.29	42	31	3	18	57.3
0.75	2.7	3.4	26	1.3	ZV318S_KS512_0120 EZ404U	4.9	9.8	140	12.00	0.63	1.38	42	31	3	18	57.3
0.75	1.9	2.1	18	1.9	ZV318S_KS512_0120 EZ402U	4.9	9.8	140	12.00	0.63	1.38	42	31	3	18	57.3
0.75	1.1	1.2	11	3.1	ZV318S_KS512_0120 EZ401U	3.4	9.8	97	12.00	0.63	1.38	42	31	3	18	57.3
0.75	2.9	3.2	28	1.2	ZV318S_KS512_0120 EZ502U	4.9	9.8	140	12.00	0.63	1.38	42	31	3	18	57.3
0.75	1.7	1.9	16	2.0	ZV318S_KS512_0120 EZ501U	4.9	9.8	140	12.00	0.63	1.38	42	31	3	18	57.3
0.90	2.3	2.9	7.0	1.5	ZV318S_KS512_0100 EZ404U	5.7	10	163	10.00	1.05	1.80	42	31	3	18	57.3
0.90	1.6	1.7	4.8	2.2	ZV318S_KS512_0100 EZ402U	5.3	10	152	10.00	1.05	1.80	42	31	3	18	57.3
0.90	1.4	1.6	4.4	2.4	ZV318S_KS512_0100 EZ501U	5.3	10	152	10.00	1.05	1.80	42	31	3	18	57.3
0.90	2.5	2.7	7.6	1.4	ZV318S_KS512_0100 EZ502U	5.7	10	163	10.00	1.05	1.80	42	31	3	18	57.3
0.90	3.2	3.7	9.9	1.1	ZV318S_KS512_0100 EZ503U	5.7	10	163	10.00	1.05	1.80	42	31	3	18	57.3
0.90	0.9	1.0	2.9	3.7	ZV318S_KS512_0100 EZ401U	2.8	10	81	10.00	1.05	1.80	42	31	3	18	57.3
1.13	2.6	2.9	13	1.3	ZV318S_KS512_0080 EZ503U	5.7	10	163	8.000	1.24	2.25	42	32	3	18	57.3
1.13	2.0	2.1	9.9	1.8	ZV318S_KS512_0080 EZ502U	5.7	10	163	8.000	1.24	2.25	42	32	3	18	57.3
1.13	1.1	1.2	5.7	3.0	ZV318S_KS512_0080 EZ501U	4.2	10	122	8.000	1.24	2.25	42	32	3	18	57.3
1.13	1.8	2.3	9.2	1.9	ZV318S_KS512_0080 EZ404U	5.7	10	163	8.000	1.24	2.25	42	32	3	18	57.3
1.13	1.2	1.4	6.3	2.8	ZV318S_KS512_0080 EZ402U	4.2	10	122	8.000	1.24	2.25	42	32	3	18	57.3
1.13	0.7	0.8	3.7	4.7	ZV318S_KS512_0080 EZ401U	2.3	10	65	8.000	1.24	2.25	42	32	3	18	57.3
1.50	1.4	1.7	16	2.0	ZV318S_KS512_0060 EZ404U	5.7	10	163	6.000	1.25	2.75	42	32	3	18	57.3
1.50	0.9	1.0	11	3.0	ZV318S_KS512_0060 EZ402U	3.2	10	91	6.000	1.25	2.75	42	32	3	18	57.3
1.50	0.9	0.9	10	3.2	ZV318S_KS512_0060 EZ501U	3.2	10	91	6.000	1.25	2.75	42	32	3	18	57.3

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs_{red} [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV3KS5 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 5,7 kN)																
1.50	0.6	0.6	6.6	5.0	ZV318S_KS512_0060 EZ401U	1.7	10	48	6.000	1.25	2.75	42	32	3	18	57.3
1.50	2.7	3.2	32	1.0	ZV318S_KS512_0060 EZ505U	5.7	10	163	6.000	1.25	2.75	42	32	3	18	57.3
1.50	1.9	2.2	23	1.4	ZV318S_KS512_0060 EZ503U	5.7	10	163	6.000	1.25	2.75	42	32	3	18	57.3
1.50	1.5	1.6	17	1.9	ZV318S_KS512_0060 EZ502U	5.7	10	163	6.000	1.25	2.75	42	32	3	18	57.3
2.25	2.2	2.8	296	1.2	ZV318S_KS511_0040 MF EZ703U	4.9	9.8	140	4.000	1.88	4.50	33	32	3	18	57.3
2.25	1.8	2.2	243	1.5	ZV318S_KS511_0040 MF EZ505U	4.9	9.8	140	4.000	1.88	4.50	33	32	3	18	57.3
2.25	1.3	1.5	174	2.1	ZV318S_KS511_0040 MF EZ503U	4.9	9.8	140	4.000	1.88	4.50	33	32	3	18	57.3
2.25	1.0	1.1	133	2.8	ZV318S_KS511_0040 MF EZ502U	4.2	9.8	120	4.000	1.88	4.50	33	32	3	18	57.3
2.25	1.0	1.1	133	2.8	ZV318S_KS511_0040 MF EZ701U	2.7	9.8	78	4.000	1.88	4.50	33	32	3	18	57.3
2.25	1.6	2.0	216	1.7	ZV318S_KS511_0040 MF EZ702U	4.9	9.8	140	4.000	1.88	4.50	33	32	3	18	57.3
2.25	0.6	0.6	77	4.8	ZV318S_KS511_0040 MF EZ501U	2.2	9.8	62	4.000	1.88	4.50	33	32	3	18	57.3
4.50	1.4	2.0	191	1.9	ZV318S_KS511_0020 MF EZ705U	5.7	7.9	163	2.000	3.00	6.90	33	34	3	18	57.3
4.50	0.9	1.1	121	3.0	ZV318S_KS511_0020 MF EZ505U	4.5	7.9	130	2.000	3.00	6.90	33	34	3	18	57.3
4.50	0.8	1.0	108	3.4	ZV318S_KS511_0020 MF EZ702U	2.8	7.9	80	2.000	3.00	6.90	33	34	3	18	57.3
4.50	0.7	0.8	87	4.2	ZV318S_KS511_0020 MF EZ503U	2.9	7.9	83	2.000	3.00	6.90	33	34	3	18	57.3
4.50	1.1	1.4	148	2.5	ZV318S_KS511_0020 MF EZ703U	4.4	7.9	126	2.000	3.00	6.90	33	34	3	18	57.3
ZV3KS5 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 5,7 kN)																
1.69	2.5	4.1	15	1.2	ZV318S_KS512_0080 EZ505U	5.7	10	163	8.000	1.24	2.25	42	32	3	18	57.3
2.25	1.9	3.0	26	1.3	ZV318S_KS512_0060 EZ505U	5.7	10	163	6.000	1.25	2.75	42	32	3	18	57.3
3.38	1.3	2.1	195	1.9	ZV318S_KS511_0040 MF EZ505U	4.9	9.8	140	4.000	1.88	4.50	33	32	3	18	57.3
3.38	2.2	4.1	337	1.1	ZV318S_KS511_0040 MF EZ705U	4.9	9.8	140	4.000	1.88	4.50	33	32	3	18	57.3
3.38	1.6	2.7	249	1.5	ZV318S_KS511_0040 MF EZ703U	4.9	9.8	140	4.000	1.88	4.50	33	32	3	18	57.3
6.75	0.8	1.4	124	3.0	ZV318S_KS511_0020 MF EZ703U	4.4	7.9	126	2.000	3.00	6.90	33	34	3	18	57.3
6.75	0.6	1.0	98	3.8	ZV318S_KS511_0020 MF EZ505U	4.5	7.9	130	2.000	3.00	6.90	33	34	3	18	57.3
6.75	1.1	2.0	169	2.2	ZV318S_KS511_0020 MF EZ705U	5.7	7.9	163	2.000	3.00	6.90	33	34	3	18	57.3
ZV3KS5 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 5,7 kN)																
0.18	2.9	3.1	0.1	1.1	ZV318S_KS513_1000 EZ301U	5.7	10	163	100.0	0.13	0.18	42	31	3	18	57.3
0.23	2.3	2.5	0.1	1.4	ZV318S_KS513_0800 EZ301U	5.7	10	163	80.00	0.16	0.23	42	32	3	18	57.3
0.26	2.0	2.2	0.1	1.6	ZV318S_KS513_0700 EZ301U	5.7	10	163	70.00	0.18	0.26	42	31	3	18	57.3
0.28	1.8	2.0	0.6	1.5	ZV318S_KS513_0640 EZ301U	4.9	9.8	140	64.00	0.16	0.28	42	31	3	18	57.3
0.36	1.4	1.5	0.1	2.3	ZV318S_KS513_0500 EZ301U	4.5	10	130	50.00	0.21	0.36	42	31	3	18	57.3
0.36	2.4	2.7	0.2	1.4	ZV318S_KS513_0500 EZ302U	5.7	10	163	50.00	0.21	0.36	42	31	3	18	57.3
0.36	3.2	3.7	0.3	1.0	ZV318S_KS513_0500 EZ303U	5.7	10	163	50.00	0.21	0.36	42	31	3	18	57.3
0.56	0.9	1.0	0.2	3.6	ZV318S_KS513_0320 EZ301U	2.9	10	83	32.00	0.33	0.56	42	32	3	18	57.3
0.56	1.6	1.7	0.4	2.1	ZV318S_KS513_0320 EZ302U	5.2	10	149	32.00	0.33	0.56	42	32	3	18	57.3
0.56	2.0	2.3	0.5	1.6	ZV318S_KS513_0320 EZ303U	5.7	10	163	32.00	0.33	0.56	42	32	3	18	57.3
0.56	2.4	2.9	0.6	1.4	ZV318S_KS513_0320 EZ401U	5.7	10	163	32.00	0.33	0.56	42	32	3	18	57.3
0.64	2.1	2.6	3.9	1.3	ZV318S_KS512_0280 EZ401U	4.9	9.8	140	28.00	0.40	0.64	42	29	3	18	57.3
0.90	2.3	2.9	1.9	1.2	ZV318S_KS512_0200 EZ501U	5.7	10	163	20.00	0.56	0.90	42	30	3	18	57.3
0.90	2.3	3.2	2.0	1.2	ZV318S_KS512_0200 EZ402U	5.7	10	163	20.00	0.56	0.90	42	30	3	18	57.3
0.90	1.5	1.9	1.3	1.8	ZV318S_KS512_0200 EZ401U	5.6	10	162	20.00	0.56	0.90	42	30	3	18	57.3
1.13	1.2	1.5	7.7	2.3	ZV318S_KS512_0160 EZ401U	4.5	9.8	129	16.00	0.62	1.13	42	31	3	18	57.3
1.13	1.9	2.6	12	1.5	ZV318S_KS512_0160 EZ402U	4.9	9.8	140	16.00	0.62	1.13	42	31	3	18	57.3
1.13	1.8	2.3	11	1.5	ZV318S_KS512_0160 EZ501U	4.9	9.8	140	16.00	0.62	1.13	42	31	3	18	57.3
1.29	2.7	3.9	5.0	1.0	ZV318S_KS512_0140 EZ404U	5.7	10	163	14.00	0.79	1.29	42	31	3	18	57.3
1.29	1.1	1.3	2.0	2.6	ZV318S_KS512_0140 EZ401U	3.9	10	113	14.00	0.79	1.29	42	31	3	18	57.3
1.29	1.6	2.3	3.0	1.7	ZV318S_KS512_0140 EZ402U	5.7	10	163	14.00	0.79	1.29	42	31	3	18	57.3
1.29	1.6	2.0	2.9	1.7	ZV318S_KS512_0140 EZ501U	5.7	10	163	14.00	0.79	1.29	42	31	3	18	57.3
1.29	2.4	3.6	4.5	1.1	ZV318S_KS512_0140 EZ502U	5.7	10	163	14.00	0.79	1.29	42	31	3	18	57.3
1.80	1.9	2.8	7.5	1.4	ZV318S_KS512_0100 EZ404U	5.7	10	163	10.00	1.05	1.80	42	31	3	18	57.3
1.80	0.8	0.9	3.0	3.6	ZV318S_KS512_0100 EZ401U	2.8	10	81	10.00	1.05	1.80	42	31	3	18	57.3
1.80	2.1	3.5	8.0	1.3	ZV318S_KS512_0100 EZ503U	5.7	10	163	10.00	1.05	1.80	42	31	3	18	57.3
1.80	1.2	1.6	4.5	2.4	ZV318S_KS512_0100 EZ402U	5.3	10	152	10.00	1.05	1.80	42	31	3	18	57.3
1.80	1.7	2.6	6.7	1.6	ZV318S_KS512_0100 EZ502U	5.7	10	163	10.00	1.05	1.80	42	31	3	18	57.3
1.80	1.1	1.5	4.4	2.4	ZV318S_KS512_0100 EZ501U	5.3	10	152	10.00	1.05	1.80	42	31	3	18	57.3
2.25	1.5	2.2	9.7	1.8	ZV318S_KS512_0080 EZ404U	5.7	10	163	8.000	1.24	2.25	42	32	3	18	57.3
2.25	0.9	1.2	5.7	3.0	ZV318S_KS512_0080 EZ501U	4.2	10	122	8.000	1.24	2.25	42	32	3	18	57.3
2.25	1.4	2.1	8.7	2.0	ZV318S_KS512_0080 EZ502U	5.7	10	163	8.000	1.24	2.25	42	32	3	18	57.3
2.25	1.6	2.8	10	1.7	ZV318S_KS512_0080 EZ503U	5.7	10	163	8.000	1.24	2.25	42	32	3	18	57.3
2.25	0.6	0.7	3.9	4.5	ZV318S_KS512_0080 EZ401U	2.3	10	65	8.000	1.24	2.25	42	32	3	18	57.3
2.25	0.9	1.3	5.9	3.0	ZV318S_KS512_0080 EZ402U	4.2	10	122	8.000	1.24	2.25	42	32	3	18	57.3
4.50	1.0	1.9	163	2.3	ZV318S_KS511_0040 MF EZ702U	4.9	9.8	140	4.000	1.88	4.50	33	32	3	18	57.3
4.50	0.7	1.1	118	3.1	ZV318S_KS511_0040 MF EZ502U	4.2	9.8	120	4.000	1.88	4.50	33	32	3	18	57.3
4.50	0.7	1.1	118	3.1	ZV318S_KS511_0040 MF EZ701U	2.7	9.8	78	4.000	1.88	4.50	33	32	3	18	57.3
4.50	0.8	1.4	140	2.6	ZV318S_KS511_0040 MF EZ503U	4.9	9.8	140	4.000	1.88	4.50	33	32	3	18	57.3
4.50	0.5	0.6	77	4.8	ZV318S_KS511_0040 MF EZ501U	2.2	9.8	62	4.000	1.88	4.50	33	32	3	18	57.3

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs_{red} [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV3KS7 (n_{1N} = 2000 min^{-1}, ($F_{f2acc,max}$ = 6,7 kN)																
1.83	4.3	4.8	849	1.2	ZV322S_KS711_0040 MF EZ813U	6.7	16	236	4.000	2.02	3.67	31	38	3	22	70.0
3.67	2.2	2.4	425	2.4	ZV322S_KS711_0020 MF EZ813U	6.7	13	236	2.000	2.93	6.42	31	37	3	22	70.0
3.67	3.2	3.8	629	1.6	ZV322S_KS711_0020 MF EZ815U	6.7	13	236	2.000	2.93	6.42	31	37	3	22	70.0
ZV3KS7 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 6,7 kN)																
0.14	5.9	6.4	0.1	1.1	ZV322S_KS713_0800 EZ401U	6.7	17	236	80.00	0.18	0.28	41	38	3	22	70.0
0.16	5.2	5.6	0.1	1.3	ZV322S_KS713_0700 EZ401U	6.7	17	236	70.00	0.18	0.31	41	38	3	22	70.0
0.17	4.8	5.1	0.9	1.2	ZV322S_KS713_0640 EZ401U	6.7	16	236	64.00	0.17	0.34	41	39	3	22	70.0
0.22	6.2	6.9	0.4	1.1	ZV322S_KS713_0500 EZ402U	6.7	17	236	50.00	0.26	0.44	41	38	3	22	70.0
0.22	3.7	4.0	0.2	1.8	ZV322S_KS713_0500 EZ401U	6.7	17	236	50.00	0.26	0.44	41	38	3	22	70.0
0.22	5.7	6.2	0.3	1.2	ZV322S_KS713_0500 EZ501U	6.7	17	236	50.00	0.26	0.44	41	38	3	22	70.0
0.28	4.7	5.1	5.3	1.2	ZV322S_KS712_0400 EZ501U	6.7	16	236	40.00	0.30	0.55	41	39	3	22	70.0
0.34	6.3	6.8	1.0	1.1	ZV322S_KS713_0320 EZ502U	6.7	17	236	32.00	0.34	0.69	41	38	3	22	70.0
0.34	3.7	4.0	0.6	1.8	ZV322S_KS713_0320 EZ501U	6.7	17	236	32.00	0.34	0.69	41	38	3	22	70.0
0.34	2.4	2.5	0.4	2.8	ZV322S_KS713_0320 EZ401U	6.7	17	236	32.00	0.34	0.69	41	38	3	22	70.0
0.34	4.0	4.4	0.6	1.7	ZV322S_KS713_0320 EZ402U	6.7	17	236	32.00	0.34	0.69	41	38	3	22	70.0
0.34	5.9	7.3	0.9	1.1	ZV322S_KS713_0320 EZ404U	6.7	17	236	32.00	0.34	0.69	41	38	3	22	70.0
0.39	3.3	3.6	8.1	1.7	ZV322S_KS712_0280 EZ501U	6.7	16	236	28.00	0.43	0.79	41	39	3	22	70.0
0.39	5.6	6.1	14	1.0	ZV322S_KS712_0280 EZ502U	6.7	16	236	28.00	0.43	0.79	41	39	3	22	70.0
0.39	5.6	6.3	14	1.0	ZV322S_KS712_0280 EZ701U	6.7	16	236	28.00	0.43	0.79	41	39	3	22	70.0
0.55	2.3	2.6	2.7	2.4	ZV322S_KS712_0200 EZ501U	6.7	17	236	20.00	0.61	1.10	41	38	3	22	70.0
0.55	4.0	4.3	4.6	1.4	ZV322S_KS712_0200 EZ502U	6.7	17	236	20.00	0.61	1.10	41	38	3	22	70.0
0.55	5.3	6.0	6.0	1.1	ZV322S_KS712_0200 EZ503U	6.7	17	236	20.00	0.61	1.10	41	38	3	22	70.0
0.55	4.0	4.5	4.6	1.4	ZV322S_KS712_0200 EZ701U	6.7	17	236	20.00	0.61	1.10	41	38	3	22	70.0
0.69	5.2	6.3	44	1.1	ZV322S_KS712_0160 EZ702U	6.7	16	236	16.00	0.69	1.38	41	39	3	22	70.0
0.69	4.2	4.8	36	1.3	ZV322S_KS712_0160 EZ503U	6.7	16	236	16.00	0.69	1.38	41	39	3	22	70.0
0.69	3.2	3.5	27	1.8	ZV322S_KS712_0160 EZ502U	6.7	16	236	16.00	0.69	1.38	41	39	3	22	70.0
0.69	1.9	2.0	16	3.0	ZV322S_KS712_0160 EZ501U	6.7	16	236	16.00	0.69	1.38	41	39	3	22	70.0
0.69	3.2	3.6	27	1.8	ZV322S_KS712_0160 EZ701U	6.7	16	236	16.00	0.69	1.38	41	39	3	22	70.0
0.79	3.7	4.2	9.2	1.5	ZV322S_KS712_0140 EZ503U	6.7	17	236	14.00	0.84	1.57	41	38	3	22	70.0
0.79	2.8	3.0	7.0	2.0	ZV322S_KS712_0140 EZ502U	6.7	17	236	14.00	0.84	1.57	41	38	3	22	70.0
0.79	2.8	3.2	7.0	2.0	ZV322S_KS712_0140 EZ701U	6.7	17	236	14.00	0.84	1.57	41	38	3	22	70.0
0.79	4.6	5.5	11	1.2	ZV322S_KS712_0140 EZ702U	6.7	17	236	14.00	0.84	1.57	41	38	3	22	70.0
0.79	5.1	6.1	13	1.1	ZV322S_KS712_0140 EZ505U	6.7	17	236	14.00	0.84	1.57	41	38	3	22	70.0
0.79	1.6	1.8	4.1	3.5	ZV322S_KS712_0140 EZ501U	6.1	17	213	14.00	0.84	1.57	41	38	3	22	70.0
0.92	1.4	1.5	22	4.0	ZV322S_KS712_0120 EZ501U	5.2	16	182	12.00	0.67	1.53	41	39	3	22	70.0
0.92	2.4	2.7	39	2.4	ZV322S_KS712_0120 EZ701U	6.5	16	228	12.00	0.67	1.53	41	39	3	22	70.0
0.92	5.4	6.8	86	1.1	ZV322S_KS712_0120 EZ703U	6.7	16	236	12.00	0.67	1.53	41	39	3	22	70.0
0.92	3.9	4.7	63	1.5	ZV322S_KS712_0120 EZ702U	6.7	16	236	12.00	0.67	1.53	41	39	3	22	70.0
0.92	4.4	5.2	71	1.3	ZV322S_KS712_0120 EZ505U	6.7	16	236	12.00	0.67	1.53	41	39	3	22	70.0
0.92	2.4	2.6	39	2.4	ZV322S_KS712_0120 EZ502U	6.7	16	236	12.00	0.67	1.53	41	39	3	22	70.0
0.92	3.2	3.6	51	1.8	ZV322S_KS712_0120 EZ503U	6.7	16	236	12.00	0.67	1.53	41	39	3	22	70.0
1.10	3.7	4.3	19	1.5	ZV322S_KS712_0100 EZ505U	6.7	17	236	10.00	1.10	2.20	41	38	3	22	70.0
1.10	2.0	2.2	10	2.8	ZV322S_KS712_0100 EZ502U	6.7	17	236	10.00	1.10	2.20	41	38	3	22	70.0
1.10	1.2	1.3	6.1	4.9	ZV322S_KS712_0100 EZ501U	4.3	17	152	10.00	1.10	2.20	41	38	3	22	70.0
1.10	3.3	3.9	17	1.7	ZV322S_KS712_0100 EZ702U	6.7	17	236	10.00	1.10	2.20	41	38	3	22	70.0
1.10	2.0	2.3	10	2.8	ZV322S_KS712_0100 EZ701U	5.4	17	190	10.00	1.10	2.20	41	38	3	22	70.0
1.10	2.6	3.0	14	2.2	ZV322S_KS712_0100 EZ503U	6.7	17	236	10.00	1.10	2.20	41	38	3	22	70.0
1.10	4.5	5.6	23	1.3	ZV322S_KS712_0100 EZ703U	6.7	17	236	10.00	1.10	2.20	41	38	3	22	70.0
1.38	1.6	1.7	14	3.5	ZV322S_KS712_0080 EZ502U	6.7	17	236	8.000	1.38	2.75	41	38	3	22	70.0
1.38	4.6	6.6	39	1.2	ZV322S_KS712_0080 EZ705U	6.7	17	236	8.000	1.38	2.75	41	38	3	22	70.0
1.38	3.6	4.5	31	1.6	ZV322S_KS712_0080 EZ703U	6.7	17	236	8.000	1.38	2.75	41	38	3	22	70.0
1.38	2.6	3.1	22	2.2	ZV322S_KS712_0080 EZ702U	6.7	17	236	8.000	1.38	2.75	41	38	3	22	70.0
1.38	1.6	1.8	14	3.5	ZV322S_KS712_0080 EZ701U	4.3	17	152	8.000	1.38	2.75	41	38	3	22	70.0
1.38	2.1	2.4	18	2.7	ZV322S_KS712_0080 EZ503U	6.7	17	236	8.000	1.38	2.75	41	38	3	22	70.0
1.38	2.9	3.5	25	1.9	ZV322S_KS712_0080 EZ505U	6.7	17	236	8.000	1.38	2.75	41	38	3	22	70.0
1.83	1.2	1.4	24	3.8	ZV322S_KS712_0060 EZ701U	3.3	17	114	6.000	1.34	3.06	41	38	3	22	70.0
1.83	2.0	2.3	39	2.3	ZV322S_KS712_0060 EZ702U	6.7	17	234	6.000	1.34	3.06	41	38	3	22	70.0
1.83	2.7	3.4	54	1.7	ZV322S_KS712_0060 EZ703U	6.7	17	236	6.000	1.34	3.06	41	38	3	22	70.0
1.83	1.6	1.8	32	2.9	ZV322S_KS712_0060 EZ503U	6.7	17	236	6.000	1.34	3.06	41	38	3	22	70.0
1.83	3.5	4.9	70	1.3	ZV322S_KS712_0060 EZ705U	6.7	17	236	6.000	1.34	3.06	41	38	3	22	70.0
1.83	2.2	2.6	44	2.1	ZV322S_KS712_0060 EZ505U	6.7	17	236	6.000	1.34	3.06	41	38	3	22	70.0
1.83	1.2	1.3	24	3.8	ZV322S_KS712_0060 EZ502U	5.0	17	177	6.000	1.34	3.06	41	38	3	22	70.0
2.75	1.8	2.3	411	2.5	ZV322S_KS711_0040 MF EZ703U	6.7	16	236	4.000	2.02	3.67	31	38	3	22	70.0
2.75	1.3	1.6	299	3.4	ZV322S_KS711_0040 MF EZ702U	4.5	16	159	4.000	2.02	3.67	31	38	3	22	70.0
2.75	2.4	3.3	531	1.9	ZV322S_KS711_0040 MF EZ705U	6.7	16	236	4.000	2.02	3.67	31	38	3	22	70.0

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs_{red} [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV3KS7 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 6,7 kN)																
5.50	0.9	1.2	206	5.0	ZV322S_KS711_0020 MF EZ703U	3.6	13	126	2.000	2.93	6.42	31	37	3	22	70.0
5.50	1.2	1.7	265	3.8	ZV322S_KS711_0020 MF EZ705U	5.8	13	202	2.000	2.93	6.42	31	37	3	22	70.0
ZV3KS7 (n_{1N} = 4000 min^{-1}, ($F_{f2acc,max}$ = 6,7 kN)																
3.67	2.9	7.4	716	1.4	ZV322S_KS711_0040 MF EZ815U	6.7	16	236	4.000	2.02	3.67	31	38	3	22	70.0
3.67	2.8	4.8	692	1.5	ZV322S_KS711_0040 MF EZ813U	6.7	16	236	4.000	2.02	3.67	31	38	3	22	70.0
ZV3KS7 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 6,7 kN)																
1.03	4.1	6.6	40	1.2	ZV322S_KS712_0160 EZ505U	6.7	16	236	16.00	0.69	1.38	41	39	3	22	70.0
1.18	4.6	7.6	13	1.1	ZV322S_KS712_0140 EZ703U	6.7	17	236	14.00	0.84	1.57	41	38	3	22	70.0
1.18	3.6	5.8	10	1.4	ZV322S_KS712_0140 EZ505U	6.7	17	236	14.00	0.84	1.57	41	38	3	22	70.0
1.38	3.1	5.0	57	1.6	ZV322S_KS712_0120 EZ505U	6.7	16	236	12.00	0.67	1.53	41	39	3	22	70.0
1.38	3.9	6.5	72	1.3	ZV322S_KS712_0120 EZ703U	6.7	16	236	12.00	0.67	1.53	41	39	3	22	70.0
1.65	3.3	5.4	20	1.5	ZV322S_KS712_0100 EZ703U	6.7	17	236	10.00	1.10	2.20	41	38	3	22	70.0
1.65	4.4	8.1	27	1.1	ZV322S_KS712_0100 EZ705U	6.7	17	236	10.00	1.10	2.20	41	38	3	22	70.0
1.65	2.6	4.2	15	1.9	ZV322S_KS712_0100 EZ505U	6.7	17	236	10.00	1.10	2.20	41	38	3	22	70.0
2.06	2.1	3.3	20	2.4	ZV322S_KS712_0080 EZ505U	6.7	17	236	8.000	1.38	2.75	41	38	3	22	70.0
2.06	2.6	4.3	26	1.9	ZV322S_KS712_0080 EZ703U	6.7	17	236	8.000	1.38	2.75	41	38	3	22	70.0
2.06	3.6	6.5	35	1.4	ZV322S_KS712_0080 EZ705U	6.7	17	236	8.000	1.38	2.75	41	38	3	22	70.0
2.75	1.5	2.5	36	2.6	ZV322S_KS712_0060 EZ505U	6.7	17	236	6.000	1.34	3.06	41	38	3	22	70.0
2.75	2.0	3.3	45	2.0	ZV322S_KS712_0060 EZ703U	6.7	17	236	6.000	1.34	3.06	41	38	3	22	70.0
2.75	2.7	4.9	61	1.5	ZV322S_KS712_0060 EZ705U	6.7	17	236	6.000	1.34	3.06	41	38	3	22	70.0
ZV3KS7 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 6,7 kN)																
0.28	4.9	5.9	0.1	1.1	ZV322S_KS713_0800 EZ401U	6.7	17	236	80.00	0.18	0.28	41	38	3	22	70.0
0.31	4.3	5.2	0.2	1.3	ZV322S_KS713_0700 EZ401U	6.7	17	236	70.00	0.18	0.31	41	38	3	22	70.0
0.34	3.9	4.8	0.9	1.2	ZV322S_KS713_0640 EZ401U	6.7	16	236	64.00	0.17	0.34	41	39	3	22	70.0
0.44	3.1	3.7	0.2	1.8	ZV322S_KS713_0500 EZ401U	6.7	17	236	50.00	0.26	0.44	41	38	3	22	70.0
0.44	4.6	6.5	0.3	1.2	ZV322S_KS713_0500 EZ402U	6.7	17	236	50.00	0.26	0.44	41	38	3	22	70.0
0.44	4.5	5.8	0.3	1.2	ZV322S_KS713_0500 EZ501U	6.7	17	236	50.00	0.26	0.44	41	38	3	22	70.0
0.55	3.7	4.8	5.3	1.2	ZV322S_KS712_0400 EZ501U	6.7	16	236	40.00	0.30	0.55	41	39	3	22	70.0
0.69	2.9	3.7	0.6	1.9	ZV322S_KS713_0320 EZ501U	6.7	17	236	32.00	0.34	0.69	41	38	3	22	70.0
0.69	4.4	6.6	0.9	1.2	ZV322S_KS713_0320 EZ502U	6.7	17	236	32.00	0.34	0.69	41	38	3	22	70.0
0.69	4.9	7.1	1.0	1.1	ZV322S_KS713_0320 EZ404U	6.7	17	236	32.00	0.34	0.69	41	38	3	22	70.0
0.69	3.0	4.2	0.6	1.8	ZV322S_KS713_0320 EZ402U	6.7	17	236	32.00	0.34	0.69	41	38	3	22	70.0
0.69	2.0	2.4	0.4	2.8	ZV322S_KS713_0320 EZ401U	6.7	17	236	32.00	0.34	0.69	41	38	3	22	70.0
0.69	5.3	9.0	1.1	1.0	ZV322S_KS713_0320 EZ503U	6.7	17	236	32.00	0.34	0.69	41	38	3	22	70.0
0.79	4.0	6.0	12	1.1	ZV322S_KS712_0280 EZ701U	6.7	16	236	28.00	0.43	0.79	41	39	3	22	70.0
0.79	4.0	5.9	12	1.1	ZV322S_KS712_0280 EZ502U	6.7	16	236	28.00	0.43	0.79	41	39	3	22	70.0
0.79	2.6	3.3	8.1	1.7	ZV322S_KS712_0280 EZ501U	6.7	16	236	28.00	0.43	0.79	41	39	3	22	70.0
1.10	3.9	7.8	5.6	1.2	ZV322S_KS712_0200 EZ702U	6.7	17	236	20.00	0.61	1.10	41	38	3	22	70.0
1.10	2.8	4.3	4.0	1.6	ZV322S_KS712_0200 EZ701U	6.7	17	236	20.00	0.61	1.10	41	38	3	22	70.0
1.10	3.4	5.8	4.8	1.3	ZV322S_KS712_0200 EZ503U	6.7	17	236	20.00	0.61	1.10	41	38	3	22	70.0
1.10	2.8	4.2	4.0	1.6	ZV322S_KS712_0200 EZ502U	6.7	17	236	20.00	0.61	1.10	41	38	3	22	70.0
1.10	1.8	2.4	2.6	2.4	ZV322S_KS712_0200 EZ501U	6.7	17	236	20.00	0.61	1.10	41	38	3	22	70.0
1.38	1.5	1.9	16	3.0	ZV322S_KS712_0160 EZ501U	6.7	16	236	16.00	0.69	1.38	41	39	3	22	70.0
1.38	3.1	6.2	34	1.4	ZV322S_KS712_0160 EZ702U	6.7	16	236	16.00	0.69	1.38	41	39	3	22	70.0
1.38	2.3	3.4	24	2.0	ZV322S_KS712_0160 EZ701U	6.7	16	236	16.00	0.69	1.38	41	39	3	22	70.0
1.38	2.7	4.6	29	1.7	ZV322S_KS712_0160 EZ503U	6.7	16	236	16.00	0.69	1.38	41	39	3	22	70.0
1.38	2.3	3.4	24	2.0	ZV322S_KS712_0160 EZ502U	6.7	16	236	16.00	0.69	1.38	41	39	3	22	70.0
1.57	2.0	3.0	6.2	2.3	ZV322S_KS712_0140 EZ701U	6.7	17	236	14.00	0.84	1.57	41	38	3	22	70.0
1.57	2.4	4.0	7.4	1.9	ZV322S_KS712_0140 EZ503U	6.7	17	236	14.00	0.84	1.57	41	38	3	22	70.0
1.57	2.0	3.0	6.2	2.3	ZV322S_KS712_0140 EZ502U	6.7	17	236	14.00	0.84	1.57	41	38	3	22	70.0
1.57	1.3	1.7	4.1	3.5	ZV322S_KS712_0140 EZ501U	6.1	17	213	14.00	0.84	1.57	41	38	3	22	70.0
1.57	2.7	5.4	8.6	1.6	ZV322S_KS712_0140 EZ702U	6.7	17	236	14.00	0.84	1.57	41	38	3	22	70.0
2.20	2.0	3.9	13	2.3	ZV322S_KS712_0100 EZ702U	6.7	17	236	10.00	1.10	2.20	41	38	3	22	70.0
2.20	1.4	2.1	9.3	3.2	ZV322S_KS712_0100 EZ701U	5.4	17	190	10.00	1.10	2.20	41	38	3	22	70.0
2.20	1.7	2.9	11	2.7	ZV322S_KS712_0100 EZ503U	6.7	17	236	10.00	1.10	2.20	41	38	3	22	70.0
2.20	1.4	2.1	9.3	3.2	ZV322S_KS712_0100 EZ502U	6.7	17	236	10.00	1.10	2.20	41	38	3	22	70.0
2.20	0.9	1.2	6.1	4.9	ZV322S_KS712_0100 EZ501U	4.3	17	152	10.00	1.10	2.20	41	38	3	22	70.0
2.75	1.1	1.7	12	4.0	ZV322S_KS712_0080 EZ701U	4.3	17	152	8.000	1.38	2.75	41	38	3	22	70.0
2.75	1.1	1.7	12	4.0	ZV322S_KS712_0080 EZ502U	6.7	17	236	8.000	1.38	2.75	41	38	3	22	70.0
2.75	1.3	2.3	14	3.3	ZV322S_KS712_0080 EZ503U	6.7	17	236	8.000	1.38	2.75	41	38	3	22	70.0
2.75	1.6	3.1	17	2.9	ZV322S_KS712_0080 EZ702U	6.7	17	236	8.000	1.38	2.75	41	38	3	22	70.0
ZV4KS7 (n_{1N} = 2000 min^{-1}, ($F_{f2acc,max}$ = 7,1 kN)																
2.00	4.0	4.4	849	1.2	ZV418S_KS711_0040 MF EZ813U	7.1	15	271	4.000	2.20	4.00	33	37	4	18	76.4
4.00	2.9	3.5	629	1.6	ZV418S_KS711_0020 MF EZ815U	7.1	12	271	2.000	3.20	7.00	33	36	4	18	76.4
4.00	2.0	2.2	425	2.4	ZV418S_KS711_0020 MF EZ813U	7.1	12	271	2.000	3.20	7.00	33	36	4	18	76.4

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs_{red} [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV4KS7 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 7,1 kN)																
0.15	5.5	5.8	0.1	1.1	ZV418S_KS713_0800 EZ401U	7.1	16	271	80.00	0.20	0.30	44	38	4	18	76.4
0.17	4.8	5.1	0.1	1.3	ZV418S_KS713_0700 EZ401U	7.1	16	271	70.00	0.20	0.34	44	38	4	18	76.4
0.19	4.4	4.7	0.9	1.2	ZV418S_KS713_0640 EZ401U	7.1	15	271	64.00	0.19	0.38	44	39	4	18	76.4
0.24	5.2	5.7	0.3	1.2	ZV418S_KS713_0500 EZ501U	7.1	16	271	50.00	0.28	0.48	44	38	4	18	76.4
0.24	3.4	3.7	0.2	1.8	ZV418S_KS713_0500 EZ401U	7.1	16	271	50.00	0.28	0.48	44	38	4	18	76.4
0.24	5.7	6.3	0.4	1.1	ZV418S_KS713_0500 EZ402U	7.1	16	271	50.00	0.28	0.48	44	38	4	18	76.4
0.30	4.3	4.7	5.3	1.2	ZV418S_KS712_0400 EZ501U	7.1	15	271	40.00	0.33	0.60	44	39	4	18	76.4
0.38	3.7	4.1	0.6	1.7	ZV418S_KS713_0320 EZ402U	7.1	16	271	32.00	0.38	0.75	44	38	4	18	76.4
0.38	5.8	6.2	1.0	1.1	ZV418S_KS713_0320 EZ502U	7.1	16	271	32.00	0.38	0.75	44	38	4	18	76.4
0.38	5.4	6.7	0.9	1.2	ZV418S_KS713_0320 EZ404U	7.1	16	271	32.00	0.38	0.75	44	38	4	18	76.4
0.38	2.2	2.3	0.4	2.9	ZV418S_KS713_0320 EZ401U	6.6	16	253	32.00	0.38	0.75	44	38	4	18	76.4
0.38	3.4	3.7	0.6	1.9	ZV418S_KS713_0320 EZ501U	7.1	16	271	32.00	0.38	0.75	44	38	4	18	76.4
0.43	5.2	5.6	14	1.0	ZV418S_KS712_0280 EZ502U	7.1	15	271	28.00	0.47	0.86	44	39	4	18	76.4
0.43	3.0	3.3	8.1	1.7	ZV418S_KS712_0280 EZ501U	7.1	15	271	28.00	0.47	0.86	44	39	4	18	76.4
0.43	5.2	5.8	14	1.0	ZV418S_KS712_0280 EZ701U	7.1	15	271	28.00	0.47	0.86	44	39	4	18	76.4
0.60	3.7	4.1	4.6	1.4	ZV418S_KS712_0200 EZ701U	7.1	16	271	20.00	0.66	1.20	44	38	4	18	76.4
0.60	4.8	5.5	6.0	1.1	ZV418S_KS712_0200 EZ503U	7.1	16	271	20.00	0.66	1.20	44	38	4	18	76.4
0.60	3.7	4.0	4.6	1.4	ZV418S_KS712_0200 EZ502U	7.1	16	271	20.00	0.66	1.20	44	38	4	18	76.4
0.60	2.1	2.3	2.7	2.4	ZV418S_KS712_0200 EZ501U	7.1	16	271	20.00	0.66	1.20	44	38	4	18	76.4
0.75	4.8	5.7	44	1.1	ZV418S_KS712_0160 EZ702U	7.1	15	271	16.00	0.75	1.50	44	39	4	18	76.4
0.75	1.7	1.9	16	3.0	ZV418S_KS712_0160 EZ501U	6.4	15	243	16.00	0.75	1.50	44	39	4	18	76.4
0.75	2.9	3.2	27	1.8	ZV418S_KS712_0160 EZ502U	7.1	15	271	16.00	0.75	1.50	44	39	4	18	76.4
0.75	2.9	3.3	27	1.8	ZV418S_KS712_0160 EZ701U	7.1	15	271	16.00	0.75	1.50	44	39	4	18	76.4
0.75	3.9	4.4	36	1.3	ZV418S_KS712_0160 EZ503U	7.1	15	271	16.00	0.75	1.50	44	39	4	18	76.4
0.86	4.2	5.0	11	1.2	ZV418S_KS712_0140 EZ702U	7.1	16	271	14.00	0.91	1.71	44	38	4	18	76.4
0.86	2.6	2.9	7.0	2.0	ZV418S_KS712_0140 EZ701U	7.0	16	266	14.00	0.91	1.71	44	38	4	18	76.4
0.86	4.7	5.6	13	1.1	ZV418S_KS712_0140 EZ505U	7.1	16	271	14.00	0.91	1.71	44	38	4	18	76.4
0.86	3.4	3.9	9.2	1.5	ZV418S_KS712_0140 EZ503U	7.1	16	271	14.00	0.91	1.71	44	38	4	18	76.4
0.86	2.6	2.8	7.0	2.0	ZV418S_KS712_0140 EZ502U	7.1	16	271	14.00	0.91	1.71	44	38	4	18	76.4
0.86	1.5	1.6	4.1	3.5	ZV418S_KS712_0140 EZ501U	5.6	16	213	14.00	0.91	1.71	44	38	4	18	76.4
1.00	4.0	4.8	71	1.3	ZV418S_KS712_0120 EZ505U	7.1	15	271	12.00	0.73	1.67	44	39	4	18	76.4
1.00	1.3	1.4	22	4.0	ZV418S_KS712_0120 EZ501U	4.8	15	182	12.00	0.73	1.67	44	39	4	18	76.4
1.00	2.2	2.4	39	2.4	ZV418S_KS712_0120 EZ502U	7.1	15	271	12.00	0.73	1.67	44	39	4	18	76.4
1.00	2.9	3.3	51	1.8	ZV418S_KS712_0120 EZ503U	7.1	15	271	12.00	0.73	1.67	44	39	4	18	76.4
1.00	4.9	6.2	86	1.1	ZV418S_KS712_0120 EZ703U	7.1	15	271	12.00	0.73	1.67	44	39	4	18	76.4
1.00	3.6	4.3	63	1.5	ZV418S_KS712_0120 EZ702U	7.1	15	271	12.00	0.73	1.67	44	39	4	18	76.4
1.00	2.2	2.5	39	2.4	ZV418S_KS712_0120 EZ701U	6.0	15	228	12.00	0.73	1.67	44	39	4	18	76.4
1.20	4.1	5.2	23	1.3	ZV418S_KS712_0100 EZ703U	7.1	16	271	10.00	1.20	2.40	44	38	4	18	76.4
1.20	1.1	1.2	6.1	4.9	ZV418S_KS712_0100 EZ501U	4.0	16	152	10.00	1.20	2.40	44	38	4	18	76.4
1.20	1.8	2.0	10	2.8	ZV418S_KS712_0100 EZ502U	7.1	16	271	10.00	1.20	2.40	44	38	4	18	76.4
1.20	2.4	2.8	14	2.2	ZV418S_KS712_0100 EZ503U	7.1	16	271	10.00	1.20	2.40	44	38	4	18	76.4
1.20	3.4	4.0	19	1.5	ZV418S_KS712_0100 EZ505U	7.1	16	271	10.00	1.20	2.40	44	38	4	18	76.4
1.20	3.0	3.6	17	1.7	ZV418S_KS712_0100 EZ702U	7.1	16	271	10.00	1.20	2.40	44	38	4	18	76.4
1.20	1.8	2.1	10	2.8	ZV418S_KS712_0100 EZ701U	5.0	16	190	10.00	1.20	2.40	44	38	4	18	76.4
1.50	1.5	1.6	14	3.5	ZV418S_KS712_0080 EZ502U	6.2	16	236	8.000	1.50	3.00	44	38	4	18	76.4
1.50	1.9	2.2	18	2.7	ZV418S_KS712_0080 EZ503U	7.1	16	271	8.000	1.50	3.00	44	38	4	18	76.4
1.50	2.7	3.2	25	1.9	ZV418S_KS712_0080 EZ505U	7.1	16	271	8.000	1.50	3.00	44	38	4	18	76.4
1.50	1.5	1.7	14	3.5	ZV418S_KS712_0080 EZ701U	4.0	16	152	8.000	1.50	3.00	44	38	4	18	76.4
1.50	2.4	2.9	22	2.2	ZV418S_KS712_0080 EZ702U	7.1	16	271	8.000	1.50	3.00	44	38	4	18	76.4
1.50	3.3	4.1	31	1.6	ZV418S_KS712_0080 EZ703U	7.1	16	271	8.000	1.50	3.00	44	38	4	18	76.4
1.50	4.2	6.0	39	1.2	ZV418S_KS712_0080 EZ705U	7.1	16	271	8.000	1.50	3.00	44	38	4	18	76.4
2.00	1.4	1.7	32	2.9	ZV418S_KS712_0060 EZ503U	6.4	16	245	6.000	1.47	3.33	44	38	4	18	76.4
2.00	1.1	1.2	24	3.8	ZV418S_KS712_0060 EZ502U	4.6	16	177	6.000	1.47	3.33	44	38	4	18	76.4
2.00	1.1	1.2	24	3.8	ZV418S_KS712_0060 EZ701U	3.0	16	114	6.000	1.47	3.33	44	38	4	18	76.4
2.00	2.0	2.4	44	2.1	ZV418S_KS712_0060 EZ505U	7.1	16	271	6.000	1.47	3.33	44	38	4	18	76.4
2.00	1.8	2.1	39	2.3	ZV418S_KS712_0060 EZ702U	6.1	16	234	6.000	1.47	3.33	44	38	4	18	76.4
2.00	2.5	3.1	54	1.7	ZV418S_KS712_0060 EZ703U	7.1	16	271	6.000	1.47	3.33	44	38	4	18	76.4
2.00	3.2	4.5	70	1.3	ZV418S_KS712_0060 EZ705U	7.1	16	271	6.000	1.47	3.33	44	38	4	18	76.4
3.00	2.2	3.1	531	1.9	ZV418S_KS711_0040 MF EZ705U	7.1	15	271	4.000	2.20	4.00	33	37	4	18	76.4
3.00	1.7	2.1	411	2.5	ZV418S_KS711_0040 MF EZ703U	6.6	15	252	4.000	2.20	4.00	33	37	4	18	76.4
3.00	1.2	1.5	299	3.4	ZV418S_KS711_0040 MF EZ702U	4.2	15	159	4.000	2.20	4.00	33	37	4	18	76.4
6.00	0.8	1.1	206	5.0	ZV418S_KS711_0020 MF EZ703U	3.3	12	126	2.000	3.20	7.00	33	36	4	18	76.4
6.00	1.1	1.5	265	3.8	ZV418S_KS711_0020 MF EZ705U	5.3	12	202	2.000	3.20	7.00	33	36	4	18	76.4
ZV4KS7 (n_{1N} = 4000 min^{-1}, ($F_{f2acc,max}$ = 7,1 kN)																
4.00	2.6	4.4	692	1.5	ZV418S_KS711_0040 MF EZ813U	7.1	15	271	4.000	2.20	4.00	33	37	4	18	76.4
4.00	2.7	6.8	716	1.4	ZV418S_KS711_0040 MF EZ815U	7.1	15	271	4.000	2.20	4.00	33	37	4	18	76.4

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs_{red} [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV4KS7 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 7,1 kN)																
1.13	3.8	6.1	40	1.2	ZV418S_KS712_0160 EZ505U	7.1	15	271	16.00	0.75	1.50	44	39	4	18	76.4
1.29	4.2	7.0	13	1.1	ZV418S_KS712_0140 EZ703U	7.1	16	271	14.00	0.91	1.71	44	38	4	18	76.4
1.29	3.3	5.3	10	1.4	ZV418S_KS712_0140 EZ505U	7.1	16	271	14.00	0.91	1.71	44	38	4	18	76.4
1.50	3.6	6.0	72	1.3	ZV418S_KS712_0120 EZ703U	7.1	15	271	12.00	0.73	1.67	44	39	4	18	76.4
1.50	2.8	4.6	57	1.6	ZV418S_KS712_0120 EZ505U	7.1	15	271	12.00	0.73	1.67	44	39	4	18	76.4
1.80	2.4	3.8	15	1.9	ZV418S_KS712_0100 EZ505U	7.1	16	271	10.00	1.20	2.40	44	38	4	18	76.4
1.80	3.0	5.0	20	1.5	ZV418S_KS712_0100 EZ703U	7.1	16	271	10.00	1.20	2.40	44	38	4	18	76.4
1.80	4.1	7.5	27	1.1	ZV418S_KS712_0100 EZ705U	7.1	16	271	10.00	1.20	2.40	44	38	4	18	76.4
2.25	1.9	3.0	20	2.4	ZV418S_KS712_0080 EZ505U	7.1	16	271	8.000	1.50	3.00	44	38	4	18	76.4
2.25	2.4	4.0	26	1.9	ZV418S_KS712_0080 EZ703U	7.1	16	271	8.000	1.50	3.00	44	38	4	18	76.4
2.25	3.3	6.0	35	1.4	ZV418S_KS712_0080 EZ705U	7.1	16	271	8.000	1.50	3.00	44	38	4	18	76.4
3.00	1.8	3.0	45	2.0	ZV418S_KS712_0060 EZ703U	7.1	16	271	6.000	1.47	3.33	44	38	4	18	76.4
3.00	1.4	2.3	36	2.6	ZV418S_KS712_0060 EZ505U	7.1	16	271	6.000	1.47	3.33	44	38	4	18	76.4
3.00	2.4	4.5	61	1.5	ZV418S_KS712_0060 EZ705U	7.1	16	271	6.000	1.47	3.33	44	38	4	18	76.4
ZV4KS7 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 7,1 kN)																
0.30	4.5	5.5	0.1	1.1	ZV418S_KS713_0800 EZ401U	7.1	16	271	80.00	0.20	0.30	44	38	4	18	76.4
0.34	3.9	4.8	0.2	1.3	ZV418S_KS713_0700 EZ401U	7.1	16	271	70.00	0.20	0.34	44	38	4	18	76.4
0.38	3.6	4.4	0.9	1.2	ZV418S_KS713_0640 EZ401U	7.1	15	271	64.00	0.19	0.38	44	39	4	18	76.4
0.48	2.8	3.4	0.2	1.8	ZV418S_KS713_0500 EZ401U	7.1	16	271	50.00	0.28	0.48	44	38	4	18	76.4
0.48	4.1	5.4	0.3	1.2	ZV418S_KS713_0500 EZ501U	7.1	16	271	50.00	0.28	0.48	44	38	4	18	76.4
0.48	4.3	6.0	0.3	1.2	ZV418S_KS713_0500 EZ402U	7.1	16	271	50.00	0.28	0.48	44	38	4	18	76.4
0.60	3.4	4.4	5.3	1.2	ZV418S_KS712_0400 EZ501U	7.1	15	271	40.00	0.33	0.60	44	39	4	18	76.4
0.75	4.8	8.3	1.1	1.0	ZV418S_KS713_0320 EZ503U	7.1	16	271	32.00	0.38	0.75	44	38	4	18	76.4
0.75	4.5	6.5	1.0	1.1	ZV418S_KS713_0320 EZ404U	7.1	16	271	32.00	0.38	0.75	44	38	4	18	76.4
0.75	4.1	6.1	0.9	1.2	ZV418S_KS713_0320 EZ502U	7.1	16	271	32.00	0.38	0.75	44	38	4	18	76.4
0.75	2.7	3.8	0.6	1.8	ZV418S_KS713_0320 EZ402U	7.1	16	271	32.00	0.38	0.75	44	38	4	18	76.4
0.75	1.8	2.2	0.4	2.8	ZV418S_KS713_0320 EZ401U	6.6	16	253	32.00	0.38	0.75	44	38	4	18	76.4
0.75	2.6	3.4	0.6	1.9	ZV418S_KS713_0320 EZ501U	7.1	16	271	32.00	0.38	0.75	44	38	4	18	76.4
0.86	2.4	3.1	8.1	1.7	ZV418S_KS712_0280 EZ501U	7.1	15	271	28.00	0.47	0.86	44	39	4	18	76.4
0.86	3.6	5.5	12	1.1	ZV418S_KS712_0280 EZ701U	7.1	15	271	28.00	0.47	0.86	44	39	4	18	76.4
0.86	3.6	5.4	12	1.1	ZV418S_KS712_0280 EZ502U	7.1	15	271	28.00	0.47	0.86	44	39	4	18	76.4
1.20	2.6	3.9	4.0	1.6	ZV418S_KS712_0200 EZ502U	7.1	16	271	20.00	0.66	1.20	44	38	4	18	76.4
1.20	3.6	7.1	5.6	1.2	ZV418S_KS712_0200 EZ702U	7.1	16	271	20.00	0.66	1.20	44	38	4	18	76.4
1.20	2.6	3.9	4.0	1.6	ZV418S_KS712_0200 EZ701U	7.1	16	271	20.00	0.66	1.20	44	38	4	18	76.4
1.20	3.1	5.3	4.8	1.3	ZV418S_KS712_0200 EZ503U	7.1	16	271	20.00	0.66	1.20	44	38	4	18	76.4
1.20	1.7	2.2	2.6	2.4	ZV418S_KS712_0200 EZ501U	7.1	16	271	20.00	0.66	1.20	44	38	4	18	76.4
1.50	2.1	3.1	24	2.0	ZV418S_KS712_0160 EZ701U	7.1	15	271	16.00	0.75	1.50	44	39	4	18	76.4
1.50	2.5	4.2	29	1.7	ZV418S_KS712_0160 EZ503U	7.1	15	271	16.00	0.75	1.50	44	39	4	18	76.4
1.50	2.1	3.1	24	2.0	ZV418S_KS712_0160 EZ502U	7.1	15	271	16.00	0.75	1.50	44	39	4	18	76.4
1.50	1.4	1.8	16	3.0	ZV418S_KS712_0160 EZ501U	6.4	15	243	16.00	0.75	1.50	44	39	4	18	76.4
1.50	2.9	5.7	34	1.4	ZV418S_KS712_0160 EZ702U	7.1	15	271	16.00	0.75	1.50	44	39	4	18	76.4
1.71	2.5	5.0	8.6	1.6	ZV418S_KS712_0140 EZ702U	7.1	16	271	14.00	0.91	1.71	44	38	4	18	76.4
1.71	1.8	2.8	6.2	2.3	ZV418S_KS712_0140 EZ701U	7.0	16	266	14.00	0.91	1.71	44	38	4	18	76.4
1.71	2.2	3.7	7.4	1.9	ZV418S_KS712_0140 EZ503U	7.1	16	271	14.00	0.91	1.71	44	38	4	18	76.4
1.71	1.8	2.7	6.2	2.3	ZV418S_KS712_0140 EZ502U	7.1	16	271	14.00	0.91	1.71	44	38	4	18	76.4
1.71	1.2	1.5	4.1	3.5	ZV418S_KS712_0140 EZ501U	5.6	16	213	14.00	0.91	1.71	44	38	4	18	76.4
2.40	1.3	1.9	9.3	3.2	ZV418S_KS712_0100 EZ502U	7.1	16	271	10.00	1.20	2.40	44	38	4	18	76.4
2.40	1.8	3.6	13	2.3	ZV418S_KS712_0100 EZ702U	7.1	16	271	10.00	1.20	2.40	44	38	4	18	76.4
2.40	1.5	2.6	11	2.7	ZV418S_KS712_0100 EZ503U	7.1	16	271	10.00	1.20	2.40	44	38	4	18	76.4
2.40	0.8	1.1	6.1	4.9	ZV418S_KS712_0100 EZ501U	4.0	16	152	10.00	1.20	2.40	44	38	4	18	76.4
2.40	1.3	2.0	9.3	3.2	ZV418S_KS712_0100 EZ701U	5.0	16	190	10.00	1.20	2.40	44	38	4	18	76.4
3.00	1.4	2.8	17	2.9	ZV418S_KS712_0080 EZ702U	7.1	16	271	8.000	1.50	3.00	44	38	4	18	76.4
3.00	1.0	1.6	12	4.0	ZV418S_KS712_0080 EZ701U	4.0	16	152	8.000	1.50	3.00	44	38	4	18	76.4
3.00	1.2	2.1	14	3.3	ZV418S_KS712_0080 EZ503U	7.1	16	271	8.000	1.50	3.00	44	38	4	18	76.4
3.00	1.0	1.6	12	4.0	ZV418S_KS712_0080 EZ502U	6.2	16	236	8.000	1.50	3.00	44	38	4	18	76.4

10.3 Dimensional drawings

This chapter shows you the dimensions of rack and pinion drives with EZ synchronous servo motors.

Dimension az in the tables of dimensions applies to STOBER gear racks. In general: az = ½ d0 + h0 + x*mn

The pinion is helical (left-hand 19° 31' 42"). The pinion gearing quality is 5.

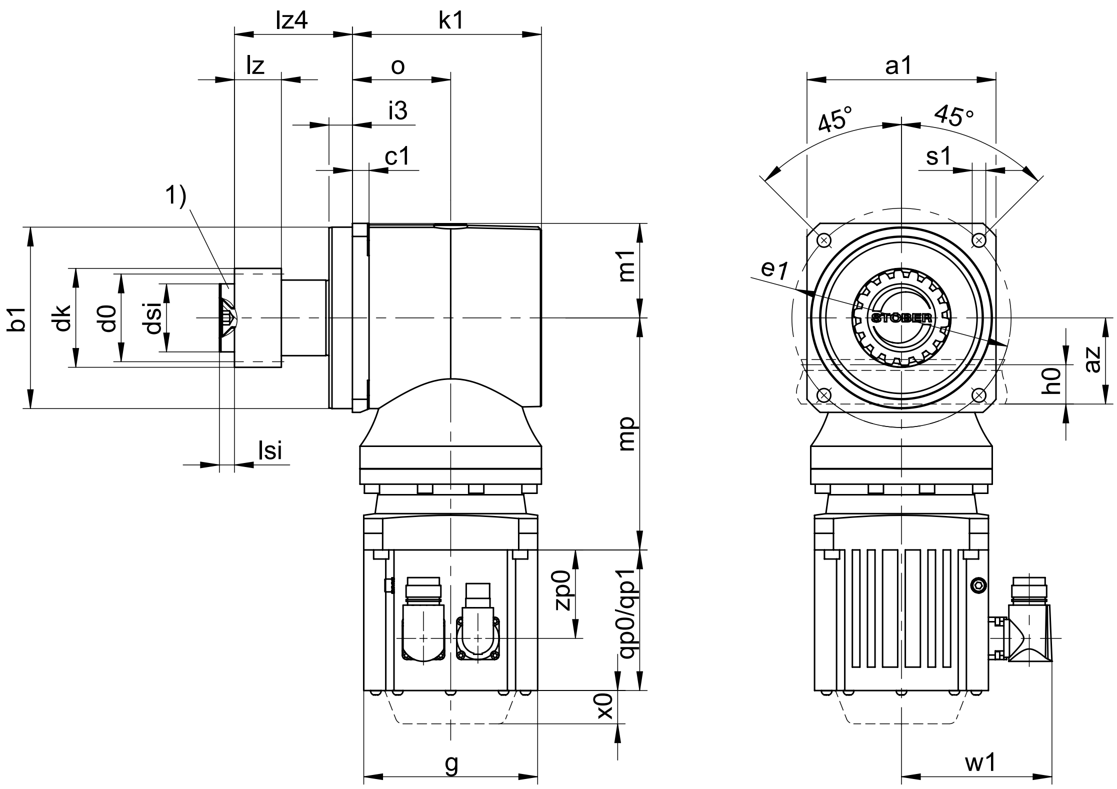
Dimensions can exceed the specifications of ISO 2768-mK due to casting tolerances or accumulation of individual tolerances.

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

You can download 3D models of our standard drives at https://configurator.stoeber.de/en-US/.

Combination options and the dimensions of forced ventilated geared motors can also be found at https://configurator.stoeber.de/en-US/.

10.3.1 Pinion position E



qp0 Applies to motors without brake.

qp1 Applies to motors with brake.

x0 Applies to encoders using an optical measuring method.

w1 Different for the One Cable Solution (OCS), see the chapter [▸ 14.4]

1) Axial locking (optional)

Dimensions of gearboxes

Type	mn	a1	az	∅b1	c1	∅d0	∅dk	∅dsi	∅e1	h0	i3	k1	lz	lz4	lsi	m1	o	∅s1	x
ZV216SEKS3_	2	80	39.98	75_{h6}	8	33.95	39.81	25	90	22	13.0	88.5	26	45.5	4	40.0	43	6.6	0.50
ZV220SEKS4_	2	101	44.02	95_{h6}	10	42.44	47.90	30	120	22	14.0	106.0	26	54.5	6	50.5	55	6.6	0.40
ZV225SEKS5_	2	125	49.33	120_{h6}	10	53.05	58.52	45	145	22	15.5	125.0	26	78.0	8	62.5	65	9.0	0.40
ZV318SEKS5_	3	125	55.55	120_{h6}	10	57.30	65.01	45	145	26	15.5	125.0	31	78.0	8	62.5	65	9.0	0.30
ZV322SEKS7_	3	155	62.21	150_{h6}	15	70.03	78.35	55	180	26	20.0	150.0	31	107.5	10	77.5	80	11.0	0.40
ZV418SEKS7_	4	155	74.40	150_{h6}	15	76.40	86.77	55	180	35	20.0	150.0	41	107.5	10	77.5	80	11.0	0.30

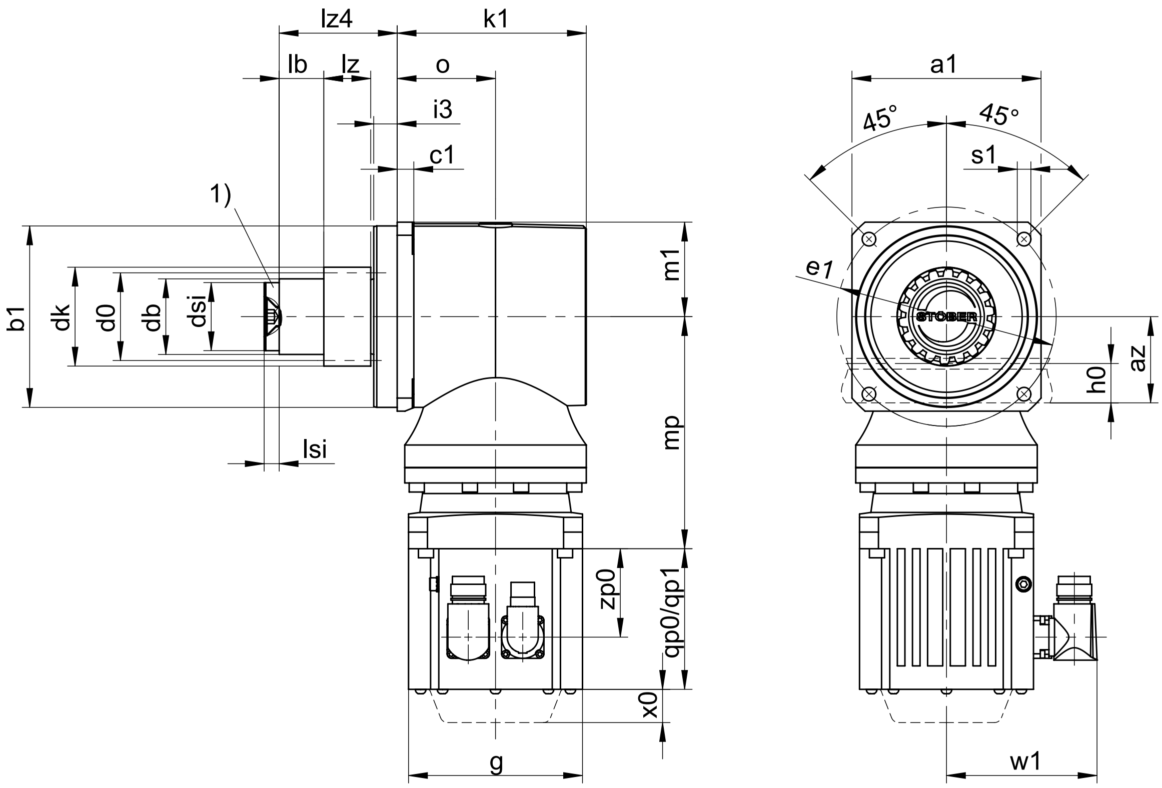
Dimensions of motors

Type	□g	qp0	qp1	w1	x0	zp0
EZ202U	55	141	150.0	47.0	25	86.0
EZ203U	55	159	168.0	47.0	25	104.0
EZ301U	72	90	130.0	55.5	21	54.5
EZ302U	72	112	152.0	55.5	21	76.5
EZ303U	72	134	174.0	55.5	21	98.5
EZ401U	98	98	146.5	91.0	22	56.0
EZ402U	98	123	171.5	91.0	22	81.0
EZ404U	98	173	221.5	91.0	22	131.0
EZ501U	115	93	147.5	100.0	22	58.5
EZ502U	115	118	172.5	100.0	22	83.5
EZ503U	115	143	197.5	100.0	22	108.5
EZ505U	115	193	247.5	100.0	22	158.5
EZ701U	145	102	161.0	115.0	22	64.0
EZ702U	145	127	186.0	115.0	22	89.0
EZ703U	145	152	211.0	115.0	22	114.0
EZ705U	145	207	266.0	134.0	22	165.0
EZ813U	190	238	315.0	156.5	22	184.0
EZ815U	190	320	397.0	156.5	22	266.0

Dimensions of geared motors

Type	EZ2	EZ3	EZ4	EZ5	EZ7	EZ8
	mp	mp	mp	mp	mp	mp
ZV_KS311_	–	151.5	146.0	–	–	–
ZV_KS312_	99.0	112.5	–	–	–	–
ZV_KS313_	131.0	–	–	–	–	–
ZV_KS411_	–	–	165.8	170.3	–	–
ZV_KS412_	–	128.8	125.3	–	–	–
ZV_KS413_	149.8	163.3	–	–	–	–
ZV_KS511_	–	–	–	196.0	199.0	–
ZV_KS512_	–	–	154.0	153.5	–	–
ZV_KS513_	–	191.0	187.5	–	–	–
ZV_KS711_	–	–	–	–	236.0	242.0
ZV_KS712_	–	–	–	185.0	188.0	–
ZV_KS713_	–	–	227.0	226.5	–	–

10.3.2 Pinion position S



qp0 Applies to motors without brake.

qp1 Applies to motors with brake.

x0 Applies to encoders using an optical measuring method.

w1 Different for the One Cable Solution (OCS), see the chapter [▷ 14.4]

1) Axial locking (optional)

Dimensions of gearboxes

Type	mn	a1	az	Øb1	c1	Ød0	Ødb	Ødk	Ødsi	Øe1	h0	i3	k1	lb	lz	lz4	lsi	m1	o	Øs1	x
ZV216SSKS3_	2	80	39.98	75_{h6}	8	33.95	30	39.81	25	90	22	13.0	88.5	4.5	26	45.5	4	40.0	43	6.6	0.50
ZV220SSKS4_	2	101	44.02	95_{h6}	10	42.44	38	47.90	30	120	22	14.0	106.0	12.5	26	54.5	6	50.5	55	6.6	0.40
ZV225SSKS5_	2	125	49.33	120_{h6}	10	53.05	50	58.52	45	145	22	15.5	125.0	34.5	26	78.0	8	62.5	65	9.0	0.40
ZV318SSKS5_	3	125	55.55	120_{h6}	10	57.30	50	65.01	45	145	26	15.5	125.0	29.5	31	78.0	8	62.5	65	9.0	0.30
ZV322SSKS7_	3	155	62.21	150_{h6}	15	70.03	62	78.35	55	180	26	20.0	150.0	53.5	31	107.5	10	77.5	80	11.0	0.40
ZV418SSKS7_	4	155	74.40	150_{h6}	15	76.40	62	86.77	55	180	35	20.0	150.0	43.5	41	107.5	10	77.5	80	11.0	0.30

Dimensions of motors

Type	□g	qp0	qp1	w1	x0	zp0
EZ202U	55	141	150.0	47.0	25	86.0
EZ203U	55	159	168.0	47.0	25	104.0
EZ301U	72	90	130.0	55.5	21	54.5
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EZ303U	72	134	174.0	55.5	21	98.5
EZ401U	98	98	146.5	91.0	22	56.0
EZ402U	98	123	171.5	91.0	22	81.0
EZ404U	98	173	221.5	91.0	22	131.0
EZ501U	115	93	147.5	100.0	22	58.5
EZ502U	115	118	172.5	100.0	22	83.5
EZ503U	115	143	197.5	100.0	22	108.5
EZ505U	115	193	247.5	100.0	22	158.5
EZ701U	145	102	161.0	115.0	22	64.0
EZ702U	145	127	186.0	115.0	22	89.0
EZ703U	145	152	211.0	115.0	22	114.0
EZ705U	145	207	266.0	134.0	22	165.0
EZ813U	190	238	315.0	156.5	22	184.0
EZ815U	190	320	397.0	156.5	22	266.0

Dimensions of geared motors

Type	EZ2	EZ3	EZ4	EZ5	EZ7	EZ8
	mp	mp	mp	mp	mp	mp
ZV_KS311_	–	151.5	146.0	–	–	–
ZV_KS312_	99.0	112.5	–	–	–	–
ZV_KS313_	131.0	–	–	–	–	–
ZV_KS411_	–	–	165.8	170.3	–	–
ZV_KS412_	–	128.8	125.3	–	–	–
ZV_KS413_	149.8	163.3	–	–	–	–
ZV_KS511_	–	–	–	196.0	199.0	–
ZV_KS512_	–	–	154.0	153.5	–	–
ZV_KS513_	–	191.0	187.5	–	–	–
ZV_KS711_	–	–	–	–	236.0	242.0
ZV_KS712_	–	–	–	185.0	188.0	–
ZV_KS713_	–	–	227.0	226.5	–	–

10.4 Type designation

In this chapter, you will find an explanation of the type designation with the associated options.

Additional ordering information not included in the type designation can be found at the end of the chapter.

Example code

Z	V	2	20	S	S	KS	4	1	2	S	P	S	R	0080	EZ401U

Explanation

Code	Designation	Design
Z	Type	Rack and pinion gearbox
V	Design	Plug-on pinion
2	Normal module	m_n = 2 mm (example)
20	Number of teeth	z = 20 (example)
S	Helix angle	Left-hand 19° 31' 42"
E	Pinion position	Shaft end
S		Shaft shoulder
KS	Type	Right-angle servo gearbox
4	Size	4 (example)
1	Generation	Generation 1
1	Stages	Single-stage
2		Two-stage
3		Three-stage
S	Housing	Standard
P	Shaft	Solid shaft with feather key
S	Bearing	Standard bearing
R	Backlash	Reduced
0080	Transmission ratio (i x 10)	i = 8 (example)
EZ401U	Motor	EZ synchronous servo motor

To complete the type designation, also specify the following in your order:

- A detailed type designation of the motor, see the chapter [▷ 14.5]
- Mounting position, see the chapter [▷ 10.5.4]
- Radial shaft seal rings at the output made of NBR or FKM (option), see the chapter [▷ 10.6.2]
- Position of the plug connectors, see the chapter [▷ 10.5.6]
- Axial locking (optional), see the chapter [▷ 10.3]

This catalog shows you all the information on rack and pinion drives with EZ synchronous servo motors. All input options available on request are shown in the chapter [▷ 10.5.1].

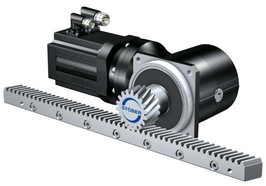
To make selecting your rack and pinion drive easy, use our STOBER Configurator at https://configurator.stoeber.de/en-US/.

A detailed description of the nameplate, see the chapter [▷ 14.5.1].

10.5 Product description

10.5.1 Input options

This chapter shows you all available input options:

EZ synchronous servo motor	ME motor adapter
	
Catalog ID 443286_en	Catalog ID 443137_en

The corresponding catalogs can be found at http://www.stoeber.de/en/downloads/

Enter the ID of the catalog in the Search term field.

10.5.2 Gear rack

The gear rack used must have a right-hand design (19° 31' 42"); the load capacity must not be exceeded.

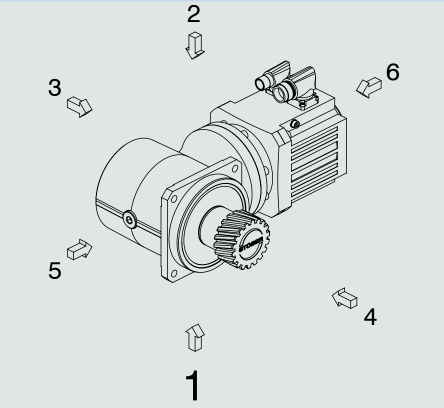
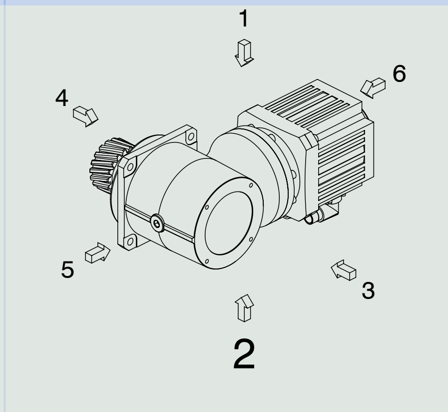
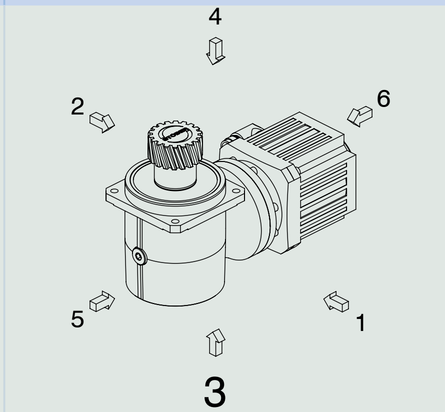
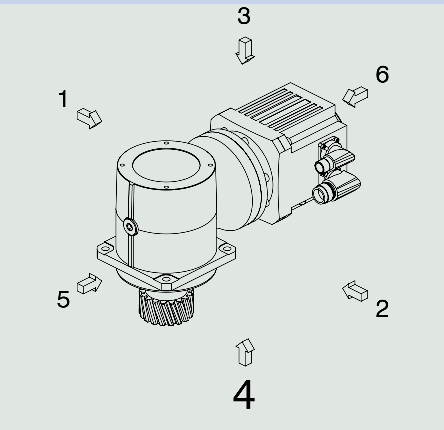
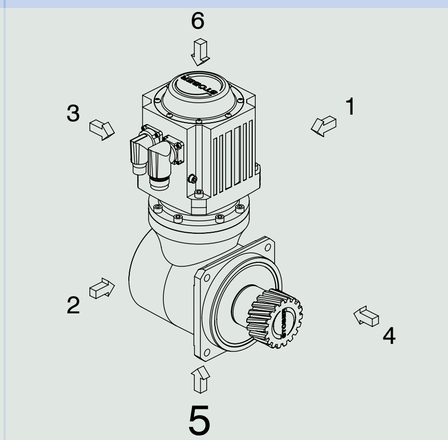
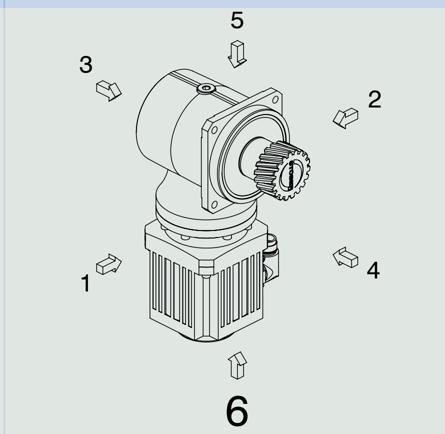
10.5.3 Installation conditions

The specified torques and forces only apply when gearboxes are fastened on the machine side using screws of strength class 10.9. In addition, the gear housings must be adjusted at the pilot. The machine-side fit must be H7.

10.5.4 Mounting positions

The following table shows the standard mounting positions for two- and three-stage gearboxes. Single-stage gearboxes can be used in any mounting position.

The numbers identify the gearbox sides. The mounting position is defined by the gearbox side facing downwards.

EL1	EL2	EL3
		
EL4	**EL5**	**EL6**
		

Since the lubricant filling volume of the gearbox depends on the mounting position, the mounting position for two- and three-stage gearboxes must be specified when ordering.

10.5.5 Lubricants

STOBER fills the gearboxes with the amount and type of lubricant specified on the nameplate. The filling volume and the structure of the gearboxes depend on the mounting position.

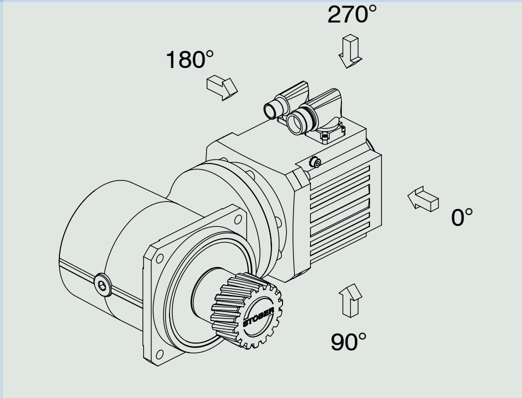
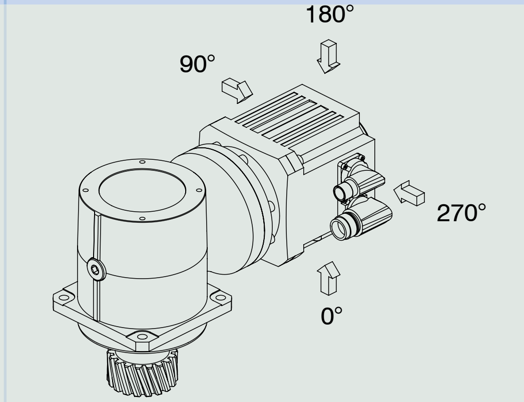
Only install the gearboxes in the intended mounting position! Reposition the gearboxes only after consulting STOBER. Otherwise, STOBER assumes no liability for the gearboxes.

You will receive lubricants for use in the food industry upon request.

10.5.5.1 Lubrication of rack and pinion gearbox

Ensure permanent lubrication with the lubricants recommended in the chapter [▸ 13.5.1].

10.5.6 Position of the plug connectors

Mounting position EL1 Plug connector in 270° position (standard)	Mounting position EL4 Plug connector in 270° position (standard)
	

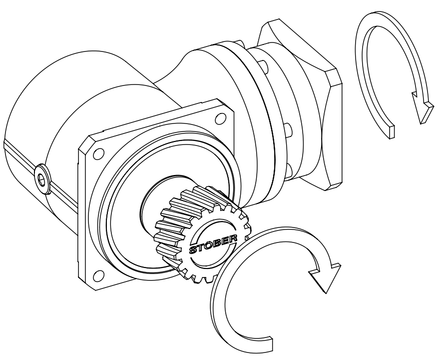
The plug connectors are in the 270° position as standard. Indicate variations for your rack and pinion drive in the order.

Note that the plug connectors also rotate when the gear rack is rotated to a different position.

10.5.7 Other product features

Feature	Value
Max. permitted gearbox temperature (on the surface of the gearbox)	≤ 90 °C
Paint	Black RAL 9005
(ATEX) Directive 2014/34/EU (Option)	Not suitable.
Protection class: [1] Planetary gearboxes Motor Pinion/gear rack	 IP65 IP56, optionally IP66 IPXX

10.5.8 Direction of rotation



The figure shows the mounting position EL1.

10.6 Project configuration

Project your drives using our SERVOsoft designing software. Download SERVOsoft free of charge after registration at https://www.stoeber.de/en/services/info-servosoft/.

It is the most convenient and reliable method of drive selection, as the entire torque/speed curve of the application is displayed and evaluated here in the curve of the geared motor.

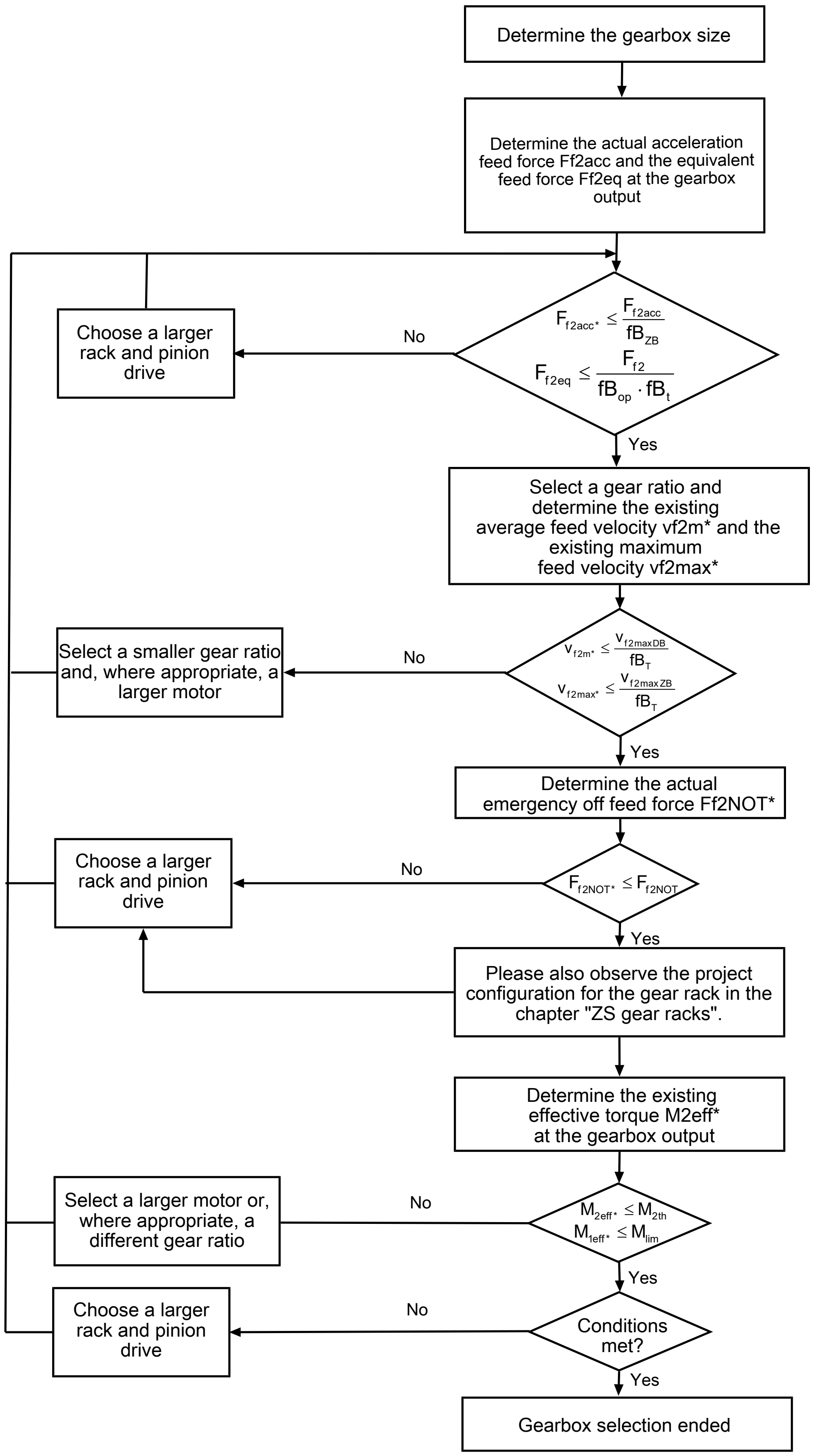
In this chapter, only limit values for specific operating points can be taken into consideration for manual drive selection.

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

An explanation of the formula symbols can be found in the chapter [▹ 17.1].

[1] Observe the protection class of all the components.

10.6.1 Drive selection

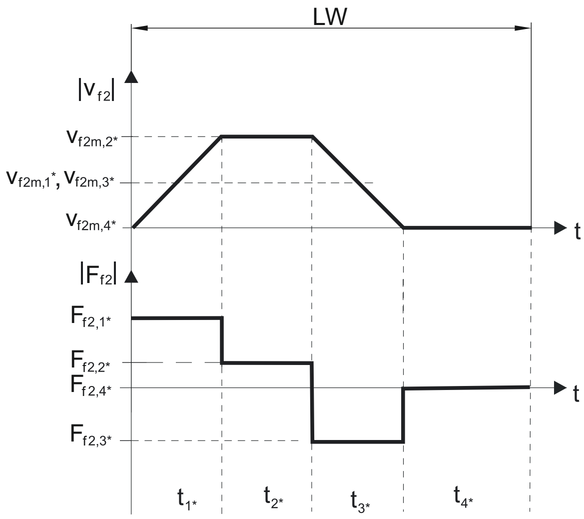


Refer to the selection tables for the values of i, $v_{f2maxDB}$, $v_{f2maxZB}$, F_{f2acc}, F_{f2N} and F_{f2NOT}.

The values for fB_T, fB_{op}, fB_t and fB_{ZB} can be found in the corresponding tables in this chapter.

Example of cyclic operation

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



Calculation of the actual maximum acceleration feed force

$$F_{f2acc^*} = m^* \cdot a^* + F_{L^*}$$

Calculation of the actual average input speed

$$n_{1m^*} = \frac{v_{f2m^*} \cdot i}{d_0 \cdot \pi}$$

$$v_{f2m^*} = \frac{\left|v_{f2m,1^*}\right| \cdot t_{1^*} + \ldots + \left|v_{f2m,n^*}\right| \cdot t_{n^*}}{t_{1^*} + \ldots + t_{n^*}}$$

If $t_{1^*} + \ldots + t_{3^*} \geq 6$ min, determine v_{2m^*} without the rest phase t_{4^*}.

The values for the ratio i can be found in the selection tables.

Calculation of the actual emergency off feed force

$$F_{f2NOT^*} = m^* \cdot a_{NOT^*} + F_{L^*}$$

Calculation of the actual equivalent feed force

$$F_{f2eq^*} = \sqrt[3]{\frac{\left|v_{f2m,1^*}\right| \cdot t_{1^*} \cdot \left|F_{f2,1^*}{}^3\right| + \ldots + \left|v_{f2m,n^*}\right| \cdot t_{n^*} \cdot \left|F_{f2,n^*}{}^3\right|}{\left|v_{f2m,1^*}\right| \cdot t_{1^*} + \ldots + \left|v_{f2m,n^*}\right| \cdot t_{n^*}}}$$

Calculation of the thermal limit torque

Calculate the thermal limit torque M_{2th} for a duty cycle $ED_{10} > 50\%$ and the actual average input speed n_{1m^*}. (At $K_{mot,th} \leq 0$ you must reduce the average input speed n_{1m^*} accordingly or select another geared motor size.)

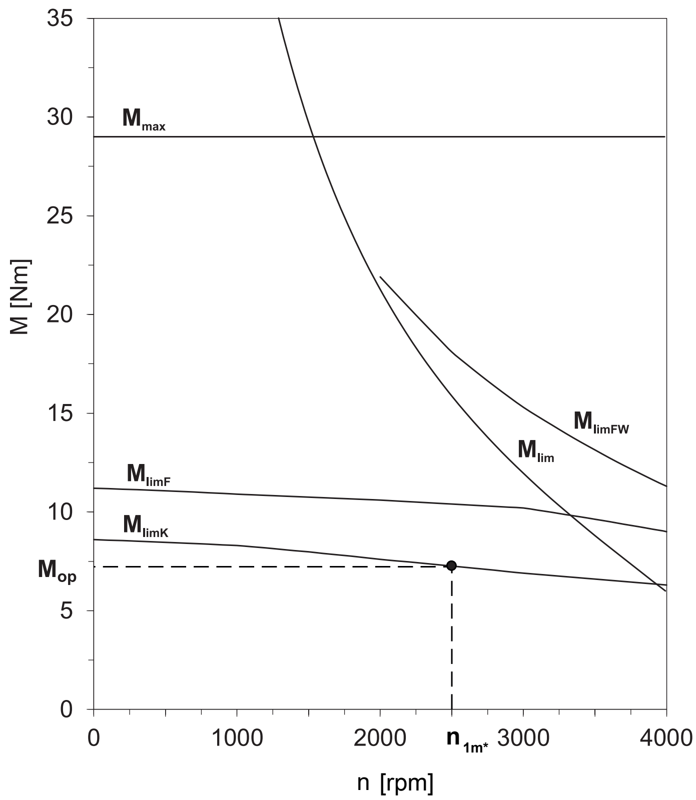
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

$$K_{mot,th} = 0{,}93 - \frac{a_{th}}{1000} \cdot fB_T \cdot \left(\frac{n_{1m^*}}{1000}\right)^3$$

Refer to the selection tables for the values of i and a_{th}.

The values for fB_T can be found in the corresponding table in this chapter.

The value for the torque of the motor at operating point M_{op} with the determined average input speed n_{1m*} can be found in the motor characteristic curve in the chapter Torque/speed curves. Note the size, nominal speed n_N and cooling type of the motor. The figure below shows an example of reading the torque M_{op} of a motor with convection cooling at the operating point.



Calculation of the actual effective torque

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

$$M_{2,n*} = \frac{F_{f2,n*} \cdot d_0}{2}$$

$$M_{1eff*} = \frac{M_{2eff*}}{i \cdot \eta}$$

Operating factors

Operating mode	fB_{op}
Uniform continuous operation	1.00
Cyclic operation	1.00
Reversing load cyclic operation	1.00

Run time	fB_t
Daily runtime ≤ 8 h	1.00
Daily runtime ≤ 16 h	1.15
Daily runtime ≤ 24 h	1.20

Cyclic operation	fB_{ZB}
≤ 1000 load changes/hour (LW/h)	1.00
> 1000 load changes/hour (LW/h)	1.15

Temperature		fB_T
Motor cooling	**Surrounding temperature**	
Motor with forced ventilation	≤ 20 °C	0.9
	≤ 30 °C	1.0
	≤ 40 °C	1.15
Motor with convection cooling	≤ 20 °C	1.0
	≤ 30 °C	1.1
	≤ 40 °C	1.25

Notes

- The maximum permitted gearbox temperature (see the "Other product features" chapter) must not be exceeded, as that could result in damage.
- For braking from full speed (for example, when the power fails or when setting up the machine), note the permitted gearbox feed forces (F_{f2acc}, F_{f2NOT}) in the selection tables.

10.6.2 Recommendation for radial shaft seal rings

For a duty cycle > 60% and higher surrounding temperatures, we recommend radial shaft seal rings made of FKM at the output.

Properties:

- Excellent temperature resistance
- High chemical stability
- Very good resistance to aging
- Excellent resistance in oils and greases
- For use in the food, beverage and pharmaceutical industries

Leak-proofness

Our gearboxes are equipped with high-quality radial shaft seal rings and checked for leaks. However, a leak cannot be fully ruled out over the length of use of a gearbox. If you use a gearbox with goods incompatible with the lubricant, you must take measures to prevent direct contact with the gearbox lubricant in case of a leak.

10.6.3 Oil expansion tank

The gearboxes have a higher fill level in mounting position EL5. The oil expansion tank prevents oil from escaping out of the gearbox.

Notes

- Three-stage KS gearboxes in mounting position EL5 can be used only in combination with an oil expansion tank!
- It is not possible to use an oil expansion tank if the plug connector and oil expansion tank are on the same side!
- Please specify the attachment side (gearbox side 1 or 2) in the order.
- Note that mounting an oil expansion tank is not possible with every motor adapter (collision between motor adapter and oil expansion tank).

10.7 Additional documentation

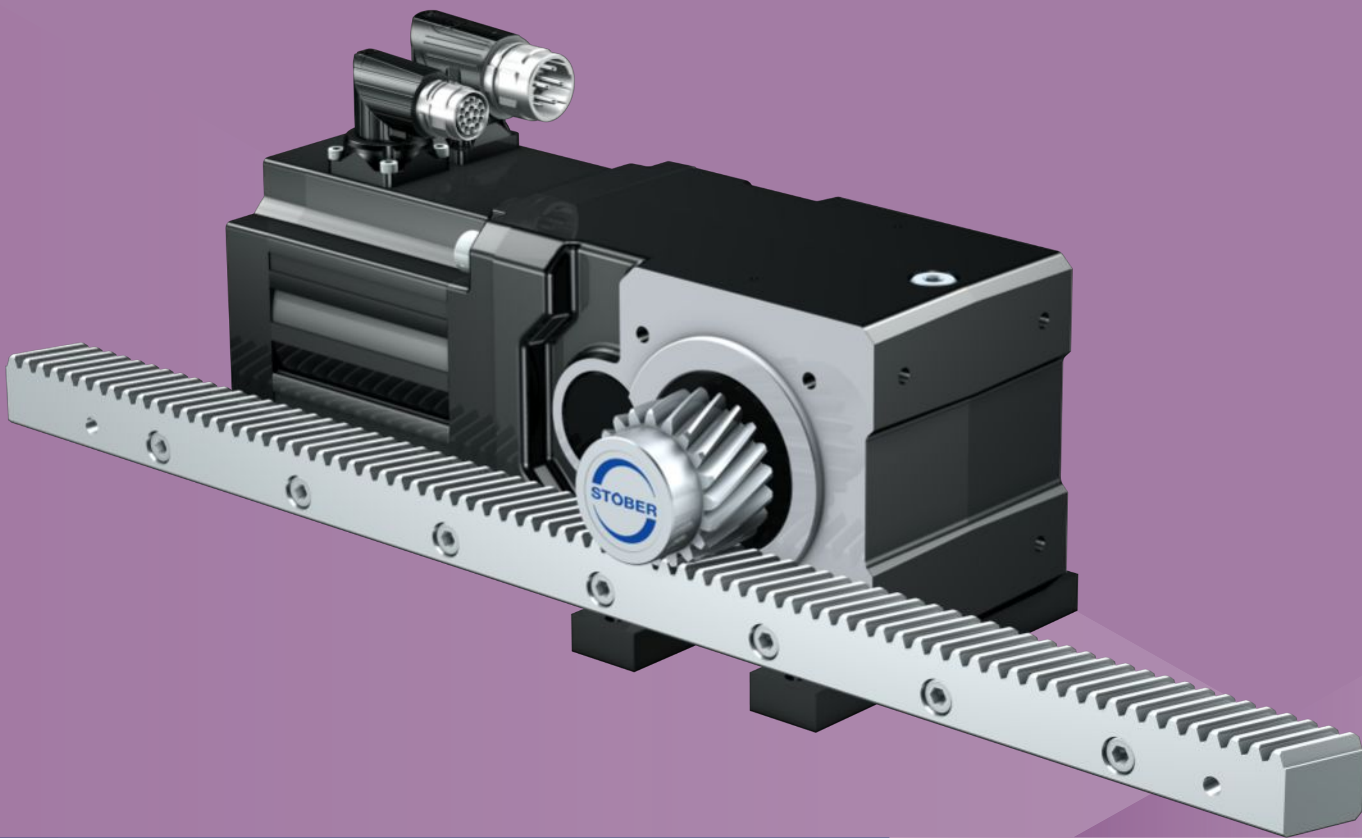
Additional documentation related to the product can be found at
http://www.stoeber.de/en/downloads/

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

Documentation	ID
Operating manual for gearboxes, geared motors KS31 – KS71	443506_en
Operating manual for EZ synchronous servo motors	443032_en
Operating manual gear racks	443392_en

11 ZVKL rack and pinion drives

Table of contents



11 Rack and pinion drives

ZVKL

11.1 Overview

High Flexibility compact right-angle geared motors with plug-on pinion

Features

Power density	★★☆☆☆
Linear clearance	★☆☆☆☆
Price category	€
Smooth operation	★★☆☆☆
Linear rigidity	★☆☆☆☆
Mass moment of inertia	★★★★☆
Ready-to-install drive solution	✓
Pinion gearing quality 6 (DIN 3962)	✓
Helical gearing	✓
Case-hardened and smoothed	✓
Compact and highly dynamic due to direct motor attachment	✓

Key ★☆☆☆☆ good | ★★★★★ excellent
€ Economy | €€€€€ Premium

Technical data

m_n	2 mm
z	16 – 20
F_{f2acc}	0.3 – 2.7 kN
v_{f2}	0.21 – 3.3 m/s
Δs	99 – 123 µm

11.2 Selection table

The technical data specified in the selection tables applies to:

- Pinion position E
- Installation without tension
- Permanent lubrication with the lubricants recommended in the chapter on gear racks [▸ 13.5.1]
- Case-hardened pinions, helical (left-hand 19° 31' 42"), gearing quality 5
- Installation altitudes up to 1000 m above sea level
- Surrounding temperatures from 0 °C to 40 °C
- Without consideration of the thermal limiting performance
- Drives with convection-cooled motors (e.g. EZ401**U**)

For the technical data on drives with forced ventilated motors (e.g. EZ401**B**), refer to https://configurator.stoeber.de/en-US/

For all other technical data, refer to https://configurator.stoeber.de/en-US/.

An explanation of the formula symbols can be found in the chapter [▸ 17.1].

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV2KL1 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 1,5 kN)																
0.33	0.9	0.9	16	1.0	ZV216S_KL102_0160 EZ301U	1.5	3.5	26	16.00	0.44	0.67	99	5.1	2	16	34.0
0.67	0.4	0.4	17	1.6	ZV216S_KL102_0080 EZ301U	1.3	3.5	22	8.000	0.78	1.33	99	5.1	2	16	34.0
1.33	0.2	0.2	22	2.6	ZV216S_KL102_0040 EZ301U	0.6	1.7	11	4.000	1.56	2.67	123	4.7	2	16	34.0
1.33	0.4	0.4	37	1.5	ZV216S_KL102_0040 EZ302U	1.1	1.7	19	4.000	1.56	2.67	123	4.7	2	16	34.0
1.33	0.5	0.5	49	1.2	ZV216S_KL102_0040 EZ303U	1.3	1.7	22	4.000	1.56	2.67	123	4.7	2	16	34.0
ZV2KL1 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 1,5 kN)																
0.33	0.7	0.8	11	1.2	ZV216S_KL102_0320 EZ202U	1.5	3.8	26	32.00	0.22	0.33	99	5.1	2	16	34.0
0.67	0.4	0.4	8.8	1.9	ZV216S_KL102_0160 EZ202U	1.4	3.5	23	16.00	0.44	0.67	99	5.1	2	16	34.0
0.67	0.6	0.6	13	1.2	ZV216S_KL102_0160 EZ203U	1.5	3.5	26	16.00	0.44	0.67	99	5.1	2	16	34.0
1.33	0.2	0.2	9.3	3.0	ZV216S_KL102_0080 EZ202U	0.7	3.5	11	8.000	0.78	1.33	99	5.1	2	16	34.0
1.33	0.3	0.3	14	2.0	ZV216S_KL102_0080 EZ203U	1.2	3.5	21	8.000	0.78	1.33	99	5.1	2	16	34.0
1.33	0.4	0.4	21	1.4	ZV216S_KL102_0080 EZ301U	1.3	3.5	22	8.000	0.78	1.33	99	5.1	2	16	34.0
2.67	0.1	0.1	12	4.8	ZV216S_KL102_0040 EZ202U	0.3	1.7	5.7	4.000	1.56	2.67	123	4.7	2	16	34.0
2.67	0.1	0.2	18	3.1	ZV216S_KL102_0040 EZ203U	0.6	1.7	10	4.000	1.56	2.67	123	4.7	2	16	34.0
2.67	0.2	0.2	26	2.1	ZV216S_KL102_0040 EZ301U	0.6	1.7	11	4.000	1.56	2.67	123	4.7	2	16	34.0
2.67	0.3	0.4	45	1.3	ZV216S_KL102_0040 EZ302U	1.1	1.7	19	4.000	1.56	2.67	123	4.7	2	16	34.0
ZV2KL2 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 2,5 kN)																
0.21	1.4	1.4	11	1.1	ZV220S_KL202_0320 EZ301U	2.5	6.1	53	32.00	0.28	0.42	99	8.1	2	20	42.4
0.42	0.7	0.7	9.0	1.8	ZV220S_KL202_0160 EZ301U	2.0	5.6	43	16.00	0.56	0.83	99	8.7	2	20	42.4
0.42	1.2	1.2	15	1.1	ZV220S_KL202_0160 EZ302U	2.5	5.6	53	16.00	0.56	0.83	99	8.7	2	20	42.4
0.83	0.3	0.3	15	2.9	ZV220S_KL202_0080 EZ301U	1.0	2.8	22	8.000	1.11	1.67	123	7.3	2	20	42.4
0.83	0.6	0.6	26	1.7	ZV220S_KL202_0080 EZ302U	1.7	2.8	35	8.000	1.11	1.67	123	7.3	2	20	42.4
0.83	0.8	0.8	33	1.3	ZV220S_KL202_0080 EZ303U	1.7	2.8	35	8.000	1.11	1.67	123	7.3	2	20	42.4
1.67	0.5	0.5	34	1.5	ZV220S_KL202_0040 EZ401U	1.6	5.1	33	4.000	1.94	3.33	123	7.3	2	20	42.4
ZV2KL2 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 2,0 kN)																
0.83	0.7	0.7	11	1.5	ZV220S_KL202_0160 EZ301U	2.0	5.6	43	16.00	0.56	0.83	99	8.7	2	20	42.4
1.67	0.3	0.3	14	2.4	ZV220S_KL202_0080 EZ301U	1.0	2.8	22	8.000	1.11	1.67	123	7.3	2	20	42.4
1.67	0.5	0.6	24	1.4	ZV220S_KL202_0080 EZ302U	1.7	2.8	35	8.000	1.11	1.67	123	7.3	2	20	42.4
1.67	0.7	0.8	32	1.1	ZV220S_KL202_0080 EZ303U	1.7	2.8	35	8.000	1.11	1.67	123	7.3	2	20	42.4
3.33	0.4	0.5	35	1.5	ZV220S_KL202_0040 EZ401U	1.6	5.1	33	4.000	1.94	3.33	123	7.3	2	20	42.4

11.3 Dimensional drawings

This chapter shows you the dimensions of rack and pinion drives with EZ synchronous servo motors.

Dimension az in the tables of dimensions applies to STOBER gear racks. In general: az = ½ d0 + h0 + x*mn

The pinion is helical (left-hand 19° 31' 42"). The pinion gearing quality is 5.

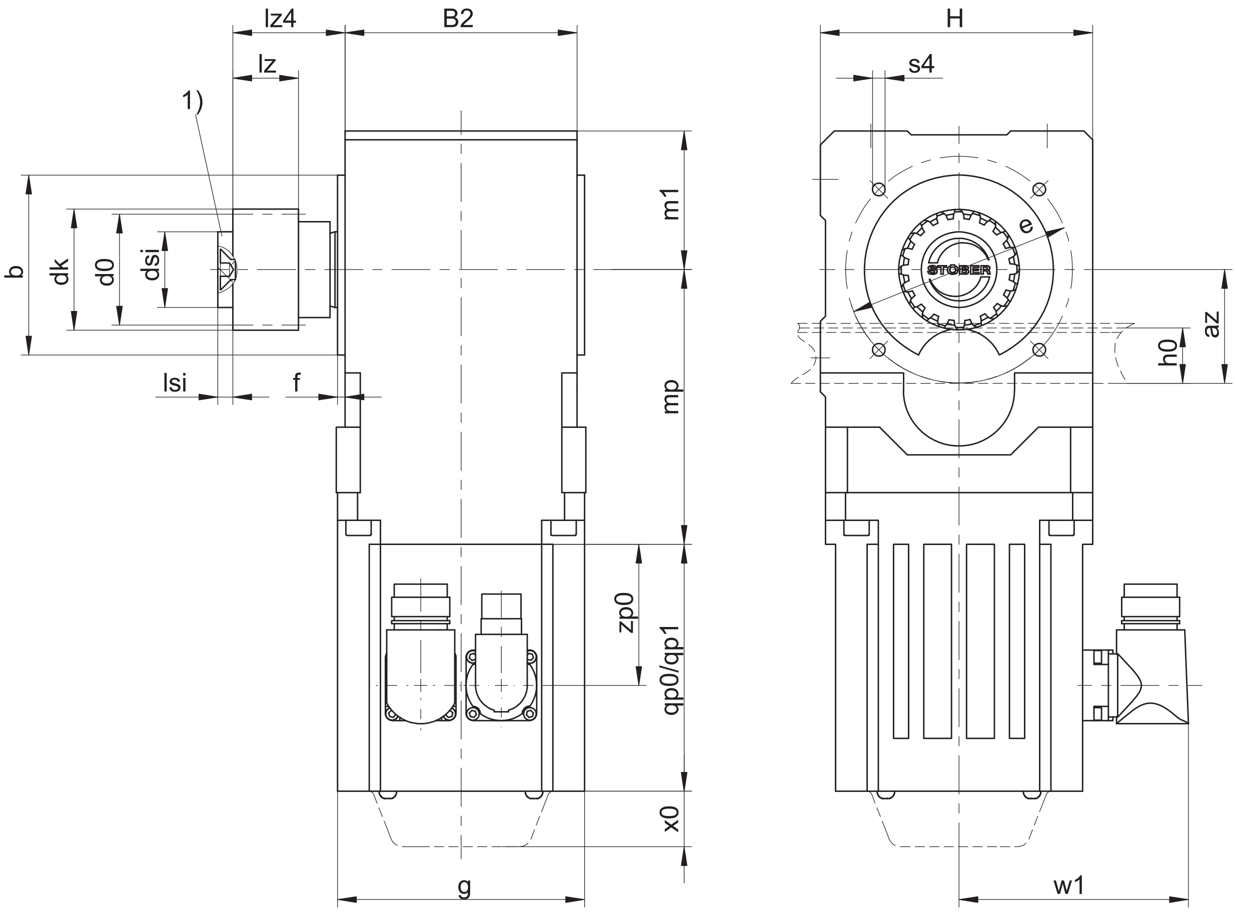
Dimensions can exceed the specifications of ISO 2768-mK due to casting tolerances or accumulation of individual tolerances.

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

You can download 3D models of our standard drives at https://configurator.stoeber.de/en-US/.

Combination options and the dimensions of forced ventilated geared motors can also be found at https://configurator.stoeber.de/en-US/.

11.3.1 Pinion position E



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x0	Applies to encoders using an optical measuring method.	w1	Different for the One Cable Solution (OCS), see the chapter [▷ 14.4]
1)	Axial locking (optional)		

Dimensions of gearboxes

Type	mn	az	∅b	B2	∅d0	∅dk	∅dsi	∅e	f	h0	H	lz	lz4	lsi	m1	s4	x
ZV216SEKL1_	2	39.98	60_{j6}	75	33.95	39.81	25	75	3	22	90	26	35.5	5	46	M6	0.50
ZV220SEKL2_	2	44.02	75_{j6}	92	42.44	47.90	30	90	3	22	108	26	44.5	7	55	M6	0.40

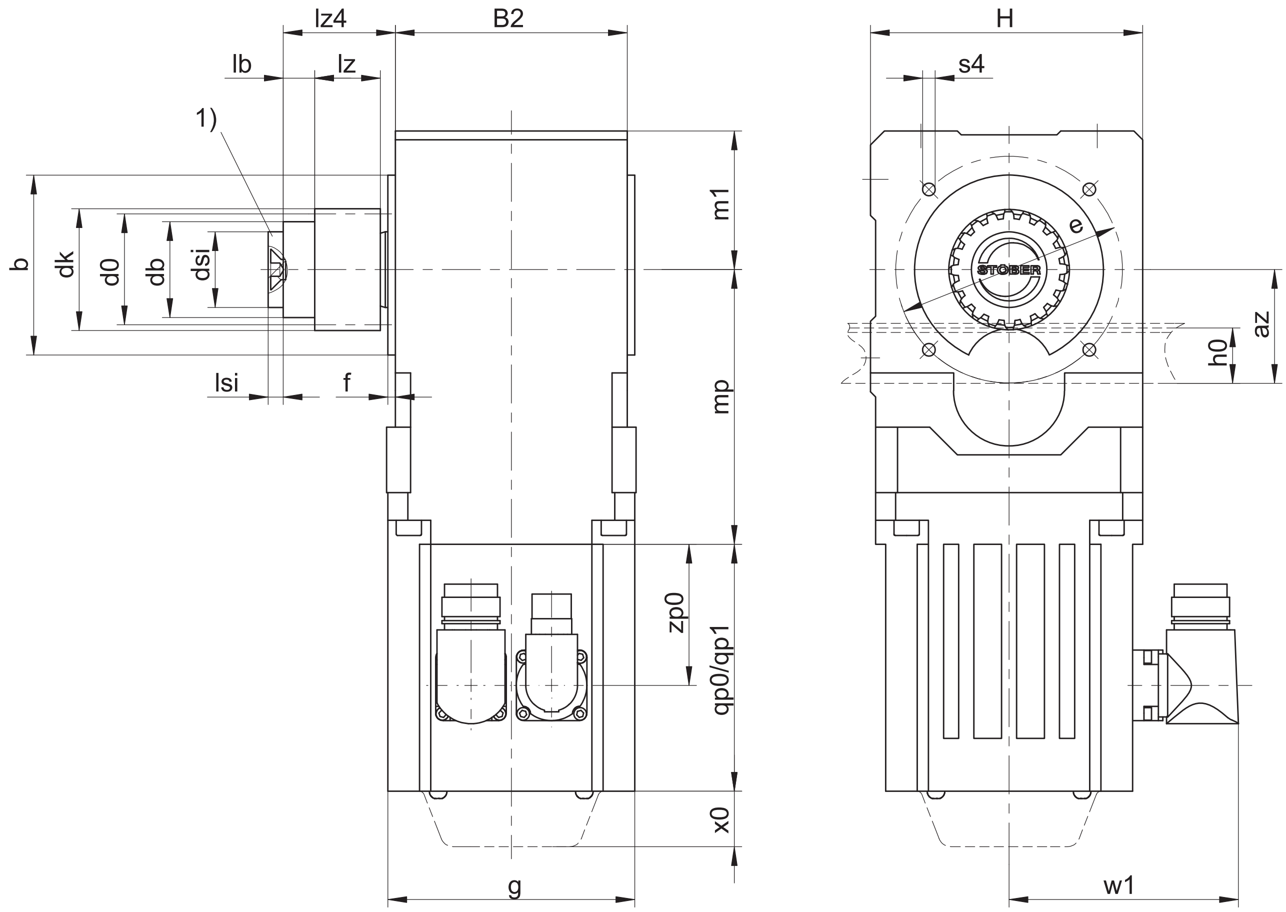
Dimensions of motors

Type	□g	qp0	qp1	w1	x0	zp0
EZ202U	55	141	150.0	47.0	25	86.0
EZ203U	55	159	168.0	47.0	25	104.0
EZ301U	72	90	130.0	55.5	21	54.5
EZ302U	72	112	152.0	55.5	21	76.5
EZ303U	72	134	174.0	55.5	21	98.5
EZ401U	98	98	146.5	91.0	22	56.0
EZ402U	98	123	171.5	91.0	22	81.0

Dimensions of geared motors

Type	EZ2	EZ3	EZ4
	mp	mp	mp
ZV_KL102_	78.5	95.5	–
ZV_KL202_	–	112.5	109.0

11.3.2 Pinion position S



qp0 Applies to motors without brake.

qp1 Applies to motors with brake.

x0 Applies to encoders using an optical measuring method.

w1 Different for the One Cable Solution (OCS), see the chapter [▷ 14.4]

1) Axial locking (optional)

Dimensions of gearboxes

Type	mn	az	∅b	B2	∅d0	∅db	∅dk	∅dsi	∅e	f	h0	H	lb	lz	lz4	lsi	m1	s4	x
ZV216SSKL1_	2	39.98	60_{j6}	75	33.95	30	39.81	25	75	3	22	90	4.5	26	35.5	5	46	M6	0.50
ZV220SSKL2_	2	44.02	75_{j6}	92	42.44	38	47.90	30	90	3	22	108	12.5	26	44.5	7	55	M6	0.40

Dimensions of motors

Type	□g	qp0	qp1	w1	x0	zp0
EZ202U	55	141	150.0	47.0	25	86.0
EZ203U	55	159	168.0	47.0	25	104.0
EZ301U	72	90	130.0	55.5	21	54.5
EZ302U	72	112	152.0	55.5	21	76.5
EZ303U	72	134	174.0	55.5	21	98.5
EZ401U	98	98	146.5	91.0	22	56.0
EZ402U	98	123	171.5	91.0	22	81.0

Dimensions of geared motors

Type	EZ2	EZ3	EZ4
	mp	mp	mp
ZV_KL102_	78.5	95.5	–
ZV_KL202_	–	112.5	109.0

11.4 Type designation

This chapter shows you an explanation of the type designation with the associated options.

Additional ordering information not included in the type designation can be found at the end of the chapter.

Example code

Z	V	2	20	S	S	KL	2	0	2	P	G	0080	EZ401U

Explanation

Code	Designation	Design
Z	Type	Rack and pinion gearbox
V	Design	Plug-on pinion
2	Normal module	m_n = 2 mm (example)
20	Number of teeth	z = 20 (example)
S	Helix angle	Left-hand 19° 31' 42"
E	Pinion position	Shaft end
S		Shaft shoulder
KL	Type	Helical bevel gearbox
2	Size	2 (example)
0	Generation	Generation 0
2	Stages	Two-stage
P	Shaft	Solid shaft with feather key
G	Housing	Pitch circle diameter
0080	Transmission ratio (i x 10)	i = 8 (example)
EZ401U	Motor	EZ synchronous servo motor

To complete the type designation, also specify the following in your order:

- A detailed type designation of the motor, see the chapter [▹ 14.5]
- Attachment of solid shaft: gearbox side 3 or 4
- Pitch circle diameter: gearbox side 3 or 4
- Position of the plug connectors, see the chapter [▹ 11.5.6]
- Axial locking (optional), see the chapter [▹ 11.3]

An explanation of the gearbox sides can be found in the chapter [▹ 11.5.4]

This catalog shows you all the information on rack and pinion drives with EZ synchronous servo motors. All input options available on request are shown in the chapter [▹ 11.5.1].

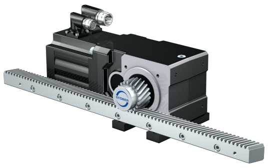
To make selecting your rack and pinion drive easy, use our STOBER Configurator at https://configurator.stoeber.de/en-US/.

A detailed description of the nameplate, see the chapter [▹ 14.5.1].

11.5 Product description

11.5.1 Input options

This chapter shows you all available input options:

EZ synchronous servo motor	MQ motor adapter	LM Lean motor
		
Catalog ID 443286_en	Catalog ID 443137_en	On request

The corresponding catalogs can be found at http://www.stoeber.de/en/downloads/

Enter the ID of the catalog in the Search term field.

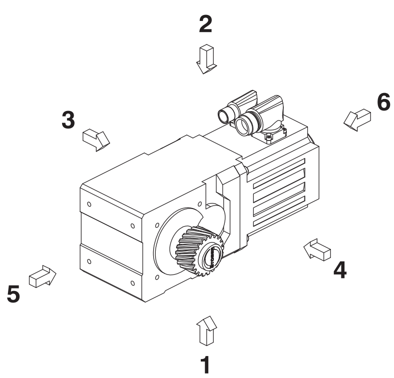
11.5.2 Gear rack

The gear rack used must have a right-hand design (19° 31' 42"); the load capacity must not be exceeded.

11.5.3 Installation conditions

The specified torques and forces only apply when gearboxes are fastened on the machine side using screws of strength class 10.9. In addition, the gear housings must be adjusted at the pilot. The machine-side fit must be H7.

11.5.4 Gearbox sides



The numbers identify the gearbox sides.

11.5.5 Lubricants

STOBER fills the gearboxes with the amount and type of lubricant specified on the nameplate.

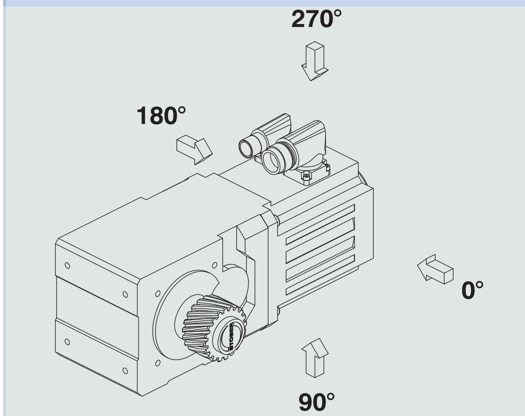
You will receive lubricants for use in the food industry upon request.

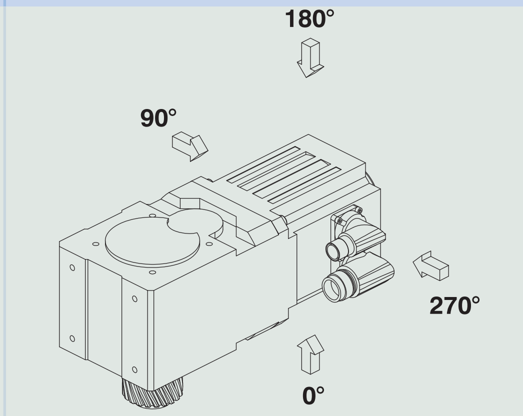
11.5.5.1 Lubrication of rack and pinion gearbox

Ensure permanent lubrication with the lubricants recommended in the chapter [13.5.1].

11.5.6 Position of the plug connectors

Mounting position EL1	Mounting position EL4
Plug connector in 270° position (standard)	Plug connector in 270° position (standard)





The plug connectors are in the 270° position as standard. Indicate variations for your rack and pinion drive in the order.

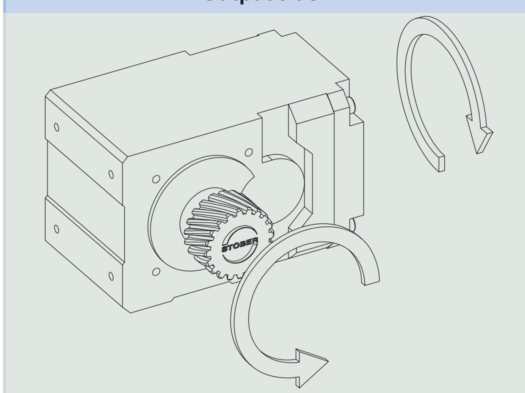
Note that the plug connectors also rotate when the gear rack is rotated to a different position.

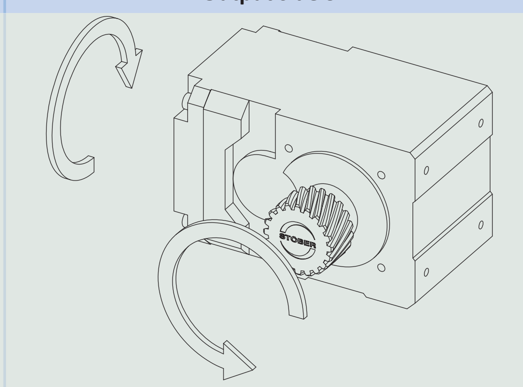
11.5.7 Other product features

Feature	Value
Max. permitted gearbox temperature (on the surface of the gearbox)	≤ 80 °C
Paint	Black RAL 9005
(ATEX) Directive 2014/34/EU (Option)	Not suitable.
Protection class: [1]	
Planetary gearboxes	IP65
Motor	IP56, optionally IP66
Pinion/gear rack	IPXX

11.5.8 Direction of rotation

Output side 4	Output side 3





The pictures show mounting position EL1.

[1] Observe the protection class of all the components.

11.6 Project configuration

Project your drives using our SERVOsoft designing software. Download SERVOsoft free of charge after registration at https://www.stoeber.de/en/services/info-servosoft/.

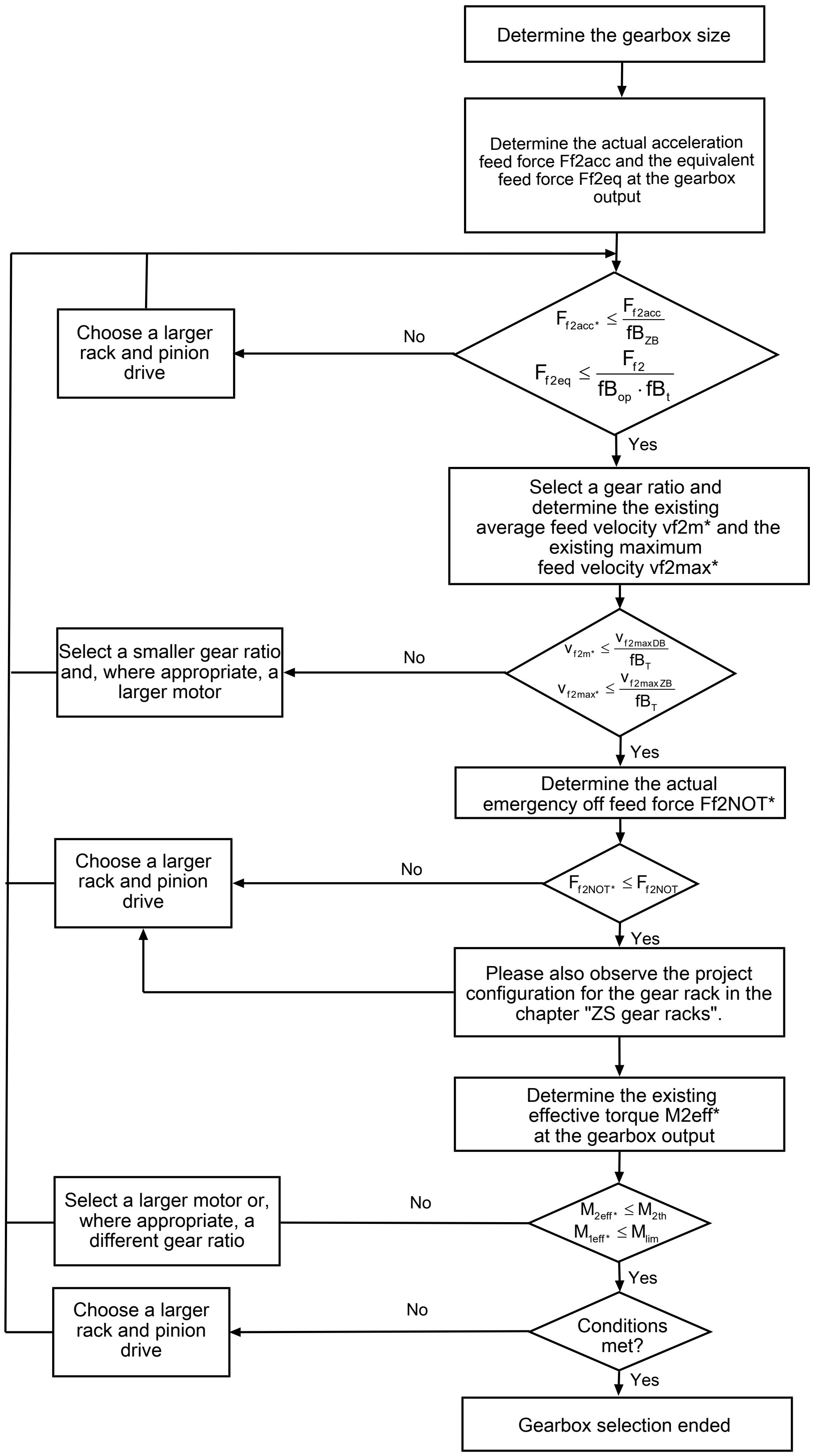
It is the most convenient and reliable method of drive selection, as the entire torque/speed curve of the application is displayed and evaluated here in the curve of the geared motor.

In this chapter, only limit values for specific operating points can be taken into consideration for manual drive selection.

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

An explanation of the formula symbols can be found in the chapter [▸ 17.1].

11.6.1 Drive selection

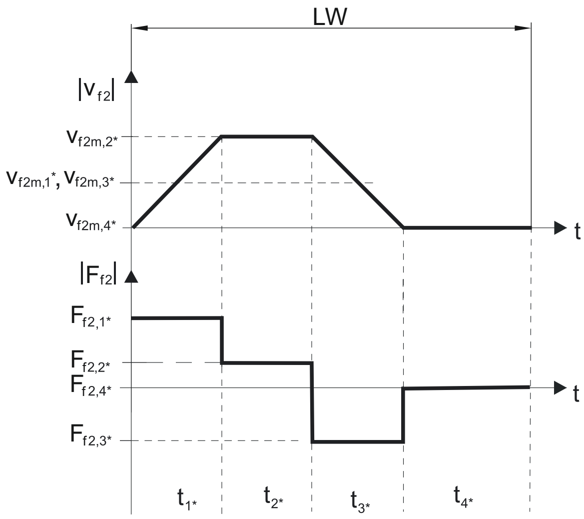


Refer to the selection tables for the values of i, $v_{f2maxDB}$, $v_{f2maxZB}$, F_{f2acc}, F_{f2N} and F_{f2NOT}.

The values for fB_T, fB_{op}, fB_t and fB_{ZB} can be found in the corresponding tables in this chapter.

Example of cyclic operation

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



Calculation of the actual maximum acceleration feed force

$$F_{f2acc*} = m^* \cdot a^* + F_{L*}$$

Calculation of the actual average input speed

$$n_{1m*} = \frac{v_{f2m*} \cdot i}{d_0 \cdot \pi}$$

$$v_{f2m*} = \frac{|v_{f2m,1*}| \cdot t_{1*} + \ldots + |v_{f2m,n*}| \cdot t_{n*}}{t_{1*} + \ldots + t_{n*}}$$

If $t_{1*} + \ldots + t_{3*} \geq 6$ min, determine v_{2m*} without the rest phase t_{4*}.

The values for the ratio i can be found in the selection tables.

Calculation of the actual emergency off feed force

$$F_{f2NOT*} = m^* \cdot a_{NOT*} + F_{L*}$$

Calculation of the actual equivalent feed force

$$F_{f2eq*} = \sqrt[3]{\frac{|v_{f2m,1*}| \cdot t_{1*} \cdot |F_{f2,1*}{}^3| + \ldots + |v_{f2m,n*}| \cdot t_{n*} \cdot |F_{f2,n*}{}^3|}{|v_{f2m,1*}| \cdot t_{1*} + \ldots + |v_{f2m,n*}| \cdot t_{n*}}}$$

Calculation of the thermal limit torque

Calculate the thermal limit torque M_{2th} for a duty cycle ED_{10} > 50% and the actual average input speed n_{1m*}. (At $K_{mot,th} \leq 0$ you must reduce the average input speed n_{1m*} accordingly or select another geared motor size.)

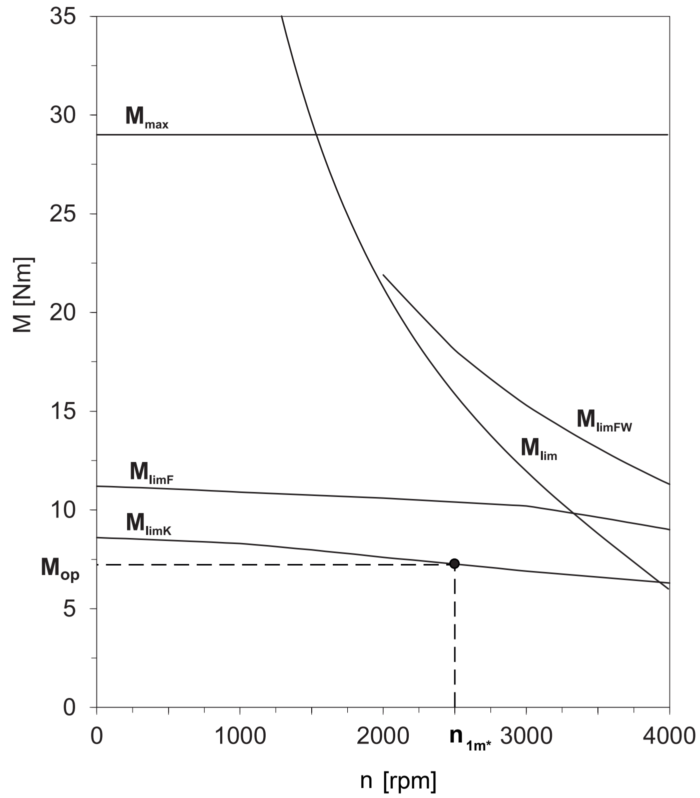
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

$$K_{mot,th} = 0{,}9 - \frac{a_{th}}{1000} \cdot fB_T \cdot \left(\frac{n_{1m*}}{1000}\right)^2$$

Refer to the selection tables for the values of i and a_{th}.

The values for fB_T can be found in the corresponding table in this chapter.

The value for the torque of the motor at operating point M_{op} with the determined average input speed n_{1m*} can be found in the motor characteristic curve in the chapter Torque/speed curves. Note the size, nominal speed n_N and cooling type of the motor. The figure below shows an example of reading the torque M_{op} of a motor with convection cooling at the operating point.



Calculation of the actual effective torque

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

$$M_{2,n*} = \frac{F_{f2,n*} \cdot d_0}{2}$$

$$M_{1eff*} = \frac{M_{2eff*}}{i \cdot \eta}$$

Operating factors

Operating mode	fB_{op}
Uniform continuous operation	1.00
Cyclic operation	1.00
Reversing load cyclic operation	1.00

Run time	fB_t
Daily runtime ≤ 8 h	1.00
Daily runtime ≤ 16 h	1.15
Daily runtime ≤ 24 h	1.20

Cyclic operation	fB_{ZB}
≤ 1000 load changes/hour (LW/h)	1.00
> 1000 load changes/hour (LW/h)	1.15

Temperature		fB_T
Motor cooling	**Surrounding temperature**	
Motor with forced ventilation	≤ 20 °C	0.9
	≤ 30 °C	1.0
	≤ 40 °C	1.15
Motor with convection cooling	≤ 20 °C	1.0
	≤ 30 °C	1.1
	≤ 40 °C	1.25

Notes

- The maximum permitted gearbox temperature (see the "Other product features" chapter) must not be exceeded, as that could result in damage.
- For braking from full speed (for example, when the power fails or when setting up the machine), note the permitted gearbox feed forces (F_{f2acc}, F_{f2NOT}) in the selection tables.

11.7 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 term field.

Documentation	ID
Operating manual gearboxes, geared motors KL	443363_en
Operating manual for EZ synchronous servo motors	443032_en
Operating manual gear racks	443392_en

12 ZVK rack and pinion drives

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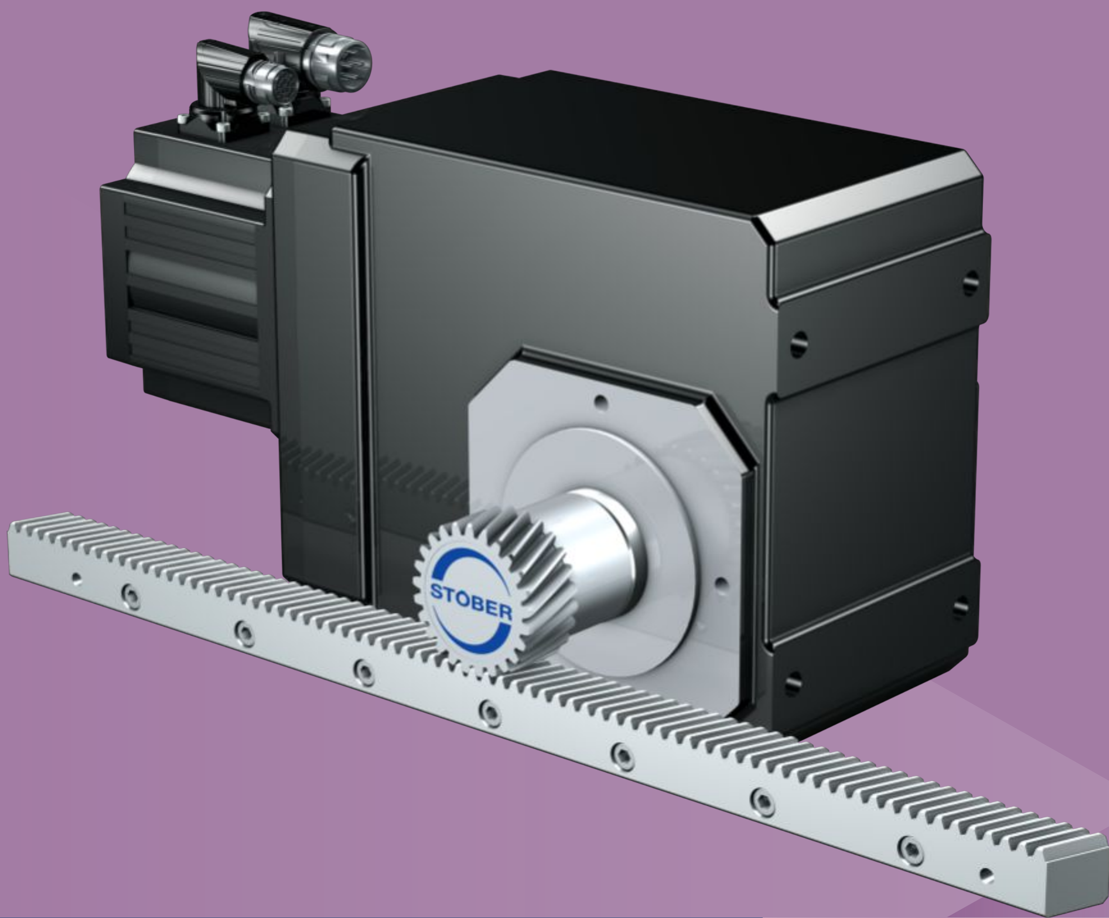


12 Rack and pinion drives

ZVK

12.1 Overview

High Flexibility highly rigid right-angle geared with plug-on pinion

Features

Power density	★☆☆☆☆
Linear clearance	★★★☆☆
Price category	€
Smooth operation	★★★☆☆
Linear rigidity	★☆☆☆☆
Mass moment of inertia	★★★★☆
Ready-to-install drive solution	✓
Pinion gearing quality 6 (DIN 3962)	✓
Helical gearing	✓
Case-hardened and smoothed	✓
Compact and highly dynamic due to direct motor attachment	✓

Key ★☆☆☆☆ good | ★★★★★ excellent
€ Economy | €€€€€ Premium

Technical data

m_n	2 – 4 mm
z	18 – 25
F_{f2acc}	0.9 – 16 kN
v_{f2}	0.04 – 3.4 m/s
Δs	12 – 111 µm

12.2 Selection table

The technical data specified in the selection tables applies to:

- Pinion position E
- Installation without tension
- Permanent lubrication with the lubricants recommended in the chapter on gear racks [▹ 13.5.1]
- Case-hardened pinions, helical (left-hand 19° 31' 42"), gearing quality 5
- Installation altitudes up to 1000 m above sea level
- Surrounding temperatures from 0 °C to 40 °C
- Without consideration of the thermal limiting performance
- Drives with convection-cooled motors (e.g. EZ401**U**)

For the technical data on drives with forced ventilated motors (e.g. EZ401**B**), refer to https://configurator.stoeber.de/en-US/

For all other technical data, refer to https://configurator.stoeber.de/en-US/.

An explanation of the formula symbols can be found in the chapter [▹ 17.1].

v_{f2}	F_{f2}	$F_{f2,0}$	a_{th}	S	Type	F_{f2accE}	$F_{f2NOT,E}$	M_{2accE}	i	$v_{f2maxDB}$		$v_{f2maxZB}$	Δs	$Δs_{redII}$	$Δs_{redI}$	C_{linE}	m_n	z	d_0
										EL1,2	EL3,4,5,6								
[m/s]	[kN]	[kN]				[kN]	[kN]	[Nm]		[m/s]	[m/s]	[m/s]	[µm]	[µm]	[µm]	[N/µm]	[mm]		[mm]
ZV2K1 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 3,2 kN)																			
0.10	3.0	3.0	8.4	1.1	ZV220S_K102_0700 EZ301U	3.2	6.6	68	70.03	0.13	0.13	0.22	74	37	–	14	2	20	42.4
0.12	2.4	2.4	6.5	1.4	ZV220S_K102_0560 EZ301U	3.2	8.1	68	56.10	0.16	0.16	0.28	74	37	–	14	2	20	42.4
0.13	2.1	2.2	11	1.1	ZV220S_K102_0500 EZ301U	2.8	4.7	60	50.31	0.18	0.18	0.31	74	37	–	14	2	20	42.4
0.14	2.0	2.0	5.2	1.6	ZV220S_K102_0470 EZ301U	3.2	9.6	68	46.92	0.19	0.19	0.33	74	37	–	14	2	20	42.4
0.17	1.7	1.8	8.3	1.7	ZV220S_K102_0400 EZ301U	3.2	5.8	68	40.30	0.22	0.22	0.39	74	37	–	14	2	20	42.4
0.19	1.5	1.5	4.6	2.2	ZV220S_K102_0350 EZ301U	3.2	9.2	68	35.11	0.25	0.25	0.44	74	37	–	14	2	20	42.4
0.19	2.6	2.7	7.9	1.3	ZV220S_K102_0350 EZ302U	3.2	9.2	68	35.11	0.25	0.25	0.44	74	37	–	14	2	20	42.4
0.20	1.4	1.5	6.7	2.3	ZV220S_K102_0340 EZ301U	3.2	6.9	68	33.71	0.26	0.26	0.46	74	37	–	14	2	20	42.4
0.20	2.4	2.6	11	1.3	ZV220S_K102_0340 EZ302U	3.2	6.9	68	33.71	0.26	0.26	0.46	74	37	–	14	2	20	42.4
0.20	3.2	3.4	15	1.0	ZV220S_K102_0340 EZ303U	3.2	6.9	68	33.71	0.26	0.26	0.46	74	37	–	14	2	20	42.4
0.24	1.2	1.2	4.7	2.7	ZV220S_K102_0280 EZ301U	3.2	7.9	68	28.05	0.32	0.32	0.56	74	37	–	14	2	20	42.4
0.24	2.0	2.2	8.1	1.6	ZV220S_K102_0280 EZ302U	3.2	7.9	68	28.05	0.32	0.32	0.56	74	37	–	14	2	20	42.4
0.24	2.7	2.8	11	1.2	ZV220S_K102_0280 EZ303U	3.2	7.9	68	28.05	0.32	0.32	0.56	74	37	–	14	2	20	42.4
0.26	1.1	1.1	4.8	3.0	ZV220S_K102_0250 EZ301U	3.2	6.6	68	25.22	0.35	0.35	0.62	74	37	–	14	2	20	42.4
0.26	1.8	1.9	8.1	1.8	ZV220S_K102_0250 EZ302U	3.2	6.6	68	25.22	0.35	0.35	0.62	74	37	–	14	2	20	42.4
0.26	2.4	2.5	11	1.4	ZV220S_K102_0250 EZ303U	3.2	6.6	68	25.22	0.35	0.35	0.62	74	37	–	14	2	20	42.4
0.29	1.0	1.0	4.8	3.3	ZV220S_K102_0230 EZ301U	3.0	7.5	63	23.27	0.38	0.38	0.67	74	37	–	14	2	20	42.4
0.29	1.7	1.8	8.2	1.9	ZV220S_K102_0230 EZ302U	3.2	7.5	68	23.27	0.38	0.38	0.67	74	37	–	14	2	20	42.4
0.29	2.2	2.3	11	1.5	ZV220S_K102_0230 EZ303U	3.2	7.5	68	23.27	0.38	0.38	0.67	74	37	–	14	2	20	42.4
0.29	3.0	3.2	14	1.1	ZV220S_K102_0230 EZ401U	3.2	11	68	23.27	0.38	0.38	0.67	74	37	–	14	2	20	42.4
0.33	0.9	0.9	4.9	3.8	ZV220S_K102_0200 EZ301U	2.6	5.7	55	20.15	0.44	0.44	0.77	74	37	–	14	2	20	42.4
0.33	1.5	1.5	8.3	2.2	ZV220S_K102_0200 EZ302U	3.2	5.7	68	20.15	0.44	0.44	0.77	74	37	–	14	2	20	42.4
0.33	1.9	2.0	11	1.7	ZV220S_K102_0200 EZ303U	3.2	5.7	68	20.15	0.44	0.44	0.77	74	37	–	14	2	20	42.4
0.33	2.6	2.8	15	1.3	ZV220S_K102_0200 EZ401U	3.2	10	68	20.15	0.44	0.44	0.77	74	37	–	14	2	20	42.4
0.38	0.7	0.8	4.9	4.3	ZV220S_K102_0175 EZ301U	2.2	6.0	48	17.56	0.51	0.48	0.76	74	37	–	14	2	20	42.4
0.38	1.3	1.3	8.4	2.5	ZV220S_K102_0175 EZ302U	3.2	6.0	68	17.56	0.51	0.48	0.76	74	37	–	14	2	20	42.4
0.38	1.7	1.8	11	1.9	ZV220S_K102_0175 EZ303U	3.2	6.0	68	17.56	0.51	0.48	0.76	74	37	–	14	2	20	42.4
0.38	2.2	2.4	15	1.4	ZV220S_K102_0175 EZ401U	3.2	11	68	17.56	0.51	0.48	0.76	74	37	–	14	2	20	42.4
0.40	0.7	0.7	4.9	4.5	ZV220S_K102_0165 EZ301U	2.1	5.4	45	16.71	0.53	0.53	0.93	74	37	–	14	2	20	42.4
0.40	1.2	1.3	8.4	2.7	ZV220S_K102_0165 EZ302U	3.2	5.4	68	16.71	0.53	0.53	0.93	74	37	–	14	2	20	42.4
0.40	1.6	1.7	11	2.0	ZV220S_K102_0165 EZ303U	3.2	5.4	68	16.71	0.53	0.53	0.93	74	37	–	14	2	20	42.4
0.40	2.1	2.3	15	1.5	ZV220S_K102_0165 EZ401U	3.2	10	68	16.71	0.53	0.53	0.93	74	37	–	14	2	20	42.4
0.47	1.0	1.1	8.5	3.1	ZV220S_K102_0140 EZ302U	3.2	4.8	68	14.11	0.63	0.60	0.95	74	37	–	14	2	20	42.4
0.47	1.3	1.4	11	2.4	ZV220S_K102_0140 EZ303U	3.2	4.8	68	14.11	0.63	0.60	0.95	74	37	–	14	2	20	42.4
0.47	1.8	1.9	15	1.8	ZV220S_K102_0140 EZ401U	3.2	11	68	14.11	0.63	0.60	0.95	74	37	–	14	2	20	42.4
0.47	2.8	3.0	23	1.2	ZV220S_K102_0140 EZ501U	3.2	11	68	14.11	0.63	0.60	0.95	74	37	–	14	2	20	42.4
0.47	3.0	3.4	25	1.1	ZV220S_K102_0140 EZ402U	3.2	11	68	14.11	0.63	0.60	0.95	74	37	–	14	2	20	42.4
0.53	0.9	1.0	8.9	3.5	ZV220S_K102_0125 EZ302U	2.9	4.3	61	12.62	0.70	0.67	1.06	74	37	–	14	2	20	42.4
0.53	1.2	1.3	12	2.7	ZV220S_K102_0125 EZ303U	3.2	4.3	68	12.62	0.70	0.67	1.06	74	37	–	14	2	20	42.4
0.53	1.6	1.7	15	2.0	ZV220S_K102_0125 EZ401U	3.2	10	68	12.62	0.70	0.67	1.06	74	37	–	14	2	20	42.4
0.53	2.5	2.7	23	1.3	ZV220S_K102_0125 EZ501U	3.2	10	68	12.62	0.70	0.67	1.06	74	37	–	14	2	20	42.4
0.53	2.7	3.0	25	1.2	ZV220S_K102_0125 EZ402U	3.2	10	68	12.62	0.70	0.67	1.06	74	37	–	14	2	20	42.4
0.58	0.8	0.9	9.5	3.8	ZV220S_K102_0115 EZ302U	2.6	4.0	56	11.57	0.69	0.63	1.06	74	37	–	14	2	20	42.4
0.58	1.1	1.2	12	2.9	ZV220S_K102_0115 EZ303U	3.2	4.0	67	11.57	0.69	0.63	1.06	74	37	–	14	2	20	42.4

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ EL1,2 [m/s]	$v_{f2maxDB}$ EL3,4,5,6 [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{redII}$ [µm]	$Δs_{redI}$ [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV2K1 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 3,2 kN)																			
0.58	1.5	1.6	15	2.2	ZV220S_K102_0115 EZ401U	3.2	11	68	11.57	0.69	0.63	1.06	74	37	–	14	2	20	42.4
0.58	2.3	2.5	23	1.4	ZV220S_K102_0115 EZ501U	3.2	11	68	11.57	0.69	0.63	1.06	74	37	–	14	2	20	42.4
0.58	2.5	2.7	26	1.3	ZV220S_K102_0115 EZ402U	3.2	11	68	11.57	0.69	0.63	1.06	74	37	–	14	2	20	42.4
0.66	0.7	0.8	10	3.8	ZV220S_K102_0100 EZ302U	2.3	3.5	49	10.14	0.88	0.83	1.32	74	37	–	14	2	20	42.4
0.66	1.0	1.0	14	2.9	ZV220S_K102_0100 EZ303U	2.8	3.5	59	10.14	0.88	0.83	1.32	74	37	–	14	2	20	42.4
0.66	1.3	1.4	15	2.5	ZV220S_K102_0100 EZ401U	3.2	10	68	10.14	0.88	0.83	1.32	74	37	–	14	2	20	42.4
0.66	2.0	2.2	24	1.6	ZV220S_K102_0100 EZ501U	3.2	10	68	10.14	0.88	0.83	1.32	74	37	–	14	2	20	42.4
0.66	2.2	2.4	26	1.5	ZV220S_K102_0100 EZ402U	3.2	10	68	10.14	0.88	0.83	1.32	74	37	–	14	2	20	42.4
0.66	3.2	4.0	38	1.0	ZV220S_K102_0100 EZ404U	3.2	10	68	10.14	0.88	0.83	1.32	74	37	–	14	2	20	42.4
0.72	0.7	0.7	11	3.8	ZV220S_K102_0092 EZ302U	2.1	3.2	45	9.249	0.87	0.79	1.32	74	37	–	14	2	20	42.4
0.72	0.9	0.9	15	2.9	ZV220S_K102_0092 EZ303U	2.5	3.2	54	9.249	0.87	0.79	1.32	74	37	–	14	2	20	42.4
0.72	1.2	1.3	16	2.7	ZV220S_K102_0092 EZ401U	3.2	11	68	9.249	0.87	0.79	1.32	74	37	–	14	2	20	42.4
0.72	1.8	2.0	24	1.8	ZV220S_K102_0092 EZ501U	3.2	11	68	9.249	0.87	0.79	1.32	74	37	–	14	2	20	42.4
0.72	2.0	2.2	26	1.6	ZV220S_K102_0092 EZ402U	3.2	11	68	9.249	0.87	0.79	1.32	74	37	–	14	2	20	42.4
0.72	2.9	3.6	38	1.1	ZV220S_K102_0092 EZ404U	3.2	11	68	9.249	0.87	0.79	1.32	74	37	–	14	2	20	42.4
0.72	3.1	3.4	41	1.0	ZV220S_K102_0092 EZ502U	3.2	11	68	9.249	0.87	0.79	1.32	74	37	–	14	2	20	42.4
0.72	3.1	3.5	41	1.0	ZV220S_K102_0092 EZ701U	3.2	11	68	9.249	0.87	0.79	1.32	74	37	–	14	2	20	42.4
0.80	0.6	0.6	12	3.8	ZV220S_K102_0083 EZ302U	1.9	2.8	40	8.309	0.96	0.88	1.47	74	37	–	14	2	20	42.4
0.80	0.8	0.8	16	2.9	ZV220S_K102_0083 EZ303U	2.3	2.8	48	8.309	0.96	0.88	1.47	74	37	–	14	2	20	42.4
0.80	1.1	1.1	16	2.9	ZV220S_K102_0083 EZ401U	3.2	10	68	8.309	0.96	0.88	1.47	74	37	–	14	2	20	42.4
0.80	1.6	1.8	24	1.9	ZV220S_K102_0083 EZ501U	3.2	10	68	8.309	0.96	0.88	1.47	74	37	–	14	2	20	42.4
0.80	1.8	2.0	26	1.7	ZV220S_K102_0083 EZ402U	3.2	10	68	8.309	0.96	0.88	1.47	74	37	–	14	2	20	42.4
0.80	2.6	3.3	39	1.2	ZV220S_K102_0083 EZ404U	3.2	10	68	8.309	0.96	0.88	1.47	74	37	–	14	2	20	42.4
0.80	2.8	3.0	42	1.1	ZV220S_K102_0083 EZ502U	3.2	10	68	8.309	0.96	0.88	1.47	74	37	–	14	2	20	42.4
0.80	2.8	3.2	42	1.1	ZV220S_K102_0083 EZ701U	3.2	10	68	8.309	0.96	0.88	1.47	74	37	–	14	2	20	42.4
1.00	0.5	0.5	14	3.8	ZV220S_K102_0066 EZ302U	1.5	2.3	32	6.644	1.20	1.10	1.84	74	37	–	14	2	20	42.4
1.00	0.6	0.7	19	2.9	ZV220S_K102_0066 EZ303U	1.8	2.3	39	6.644	1.20	1.10	1.84	74	37	–	14	2	20	42.4
1.00	0.9	0.9	16	3.4	ZV220S_K102_0066 EZ401U	2.6	9.1	55	6.644	1.20	1.10	1.84	74	37	–	14	2	20	42.4
1.00	1.3	1.4	25	2.2	ZV220S_K102_0066 EZ501U	3.2	9.1	68	6.644	1.20	1.10	1.84	74	37	–	14	2	20	42.4
1.00	1.4	1.6	27	2.0	ZV220S_K102_0066 EZ402U	3.2	9.1	68	6.644	1.20	1.10	1.84	74	37	–	14	2	20	42.4
1.00	2.1	2.6	39	1.4	ZV220S_K102_0066 EZ404U	3.2	9.1	68	6.644	1.20	1.10	1.84	74	37	–	14	2	20	42.4
1.00	2.2	2.4	42	1.3	ZV220S_K102_0066 EZ502U	3.2	9.1	68	6.644	1.20	1.10	1.84	74	37	–	14	2	20	42.4
1.00	2.2	2.5	42	1.3	ZV220S_K102_0066 EZ701U	3.2	9.1	68	6.644	1.20	1.10	1.84	74	37	–	14	2	20	42.4
1.11	0.8	0.8	16	3.6	ZV220S_K102_0060 EZ401U	2.3	8.2	49	6.000	1.22	1.04	1.85	74	37	–	14	2	20	42.4
1.11	1.2	1.3	25	2.4	ZV220S_K102_0060 EZ501U	3.2	8.2	68	6.000	1.22	1.04	1.85	74	37	–	14	2	20	42.4
1.11	1.3	1.4	27	2.2	ZV220S_K102_0060 EZ402U	3.2	8.2	68	6.000	1.22	1.04	1.85	74	37	–	14	2	20	42.4
1.11	1.9	2.4	40	1.5	ZV220S_K102_0060 EZ404U	3.2	8.2	68	6.000	1.22	1.04	1.85	74	37	–	14	2	20	42.4
1.11	2.0	2.2	43	1.4	ZV220S_K102_0060 EZ502U	3.2	8.2	68	6.000	1.22	1.04	1.85	74	37	–	14	2	20	42.4
1.11	2.0	2.3	43	1.4	ZV220S_K102_0060 EZ701U	3.2	8.2	68	6.000	1.22	1.04	1.85	74	37	–	14	2	20	42.4
1.11	2.7	3.0	56	1.0	ZV220S_K102_0060 EZ503U	3.2	8.2	68	6.000	1.22	1.04	1.85	74	37	–	14	2	20	42.4
1.20	0.4	0.4	16	3.8	ZV220S_K102_0056 EZ302U	1.3	1.9	27	5.568	1.32	1.12	2.00	74	37	–	14	2	20	42.4
1.20	0.5	0.6	21	2.9	ZV220S_K102_0056 EZ303U	1.5	1.9	32	5.568	1.32	1.12	2.00	74	37	–	14	2	20	42.4
1.20	0.7	0.8	16	3.8	ZV220S_K102_0056 EZ401U	2.2	7.6	46	5.568	1.32	1.12	2.00	74	37	–	14	2	20	42.4
1.20	1.1	1.2	25	2.5	ZV220S_K102_0056 EZ501U	3.2	7.6	68	5.568	1.32	1.12	2.00	74	37	–	14	2	20	42.4
1.20	1.2	1.3	27	2.3	ZV220S_K102_0056 EZ402U	3.2	7.6	68	5.568	1.32	1.12	2.00	74	37	–	14	2	20	42.4
1.20	1.8	2.2	40	1.5	ZV220S_K102_0056 EZ404U	3.2	7.6	68	5.568	1.32	1.12	2.00	74	37	–	14	2	20	42.4
1.20	1.9	2.0	43	1.4	ZV220S_K102_0056 EZ502U	3.2	7.6	68	5.568	1.32	1.12	2.00	74	37	–	14	2	20	42.4
1.20	1.9	2.1	43	1.4	ZV220S_K102_0056 EZ701U	3.2	7.6	68	5.568	1.32	1.12	2.00	74	37	–	14	2	20	42.4
1.20	2.5	2.8	56	1.1	ZV220S_K102_0056 EZ503U	3.2	7.6	68	5.568	1.32	1.12	2.00	74	37	–	14	2	20	42.4
1.67	0.3	0.3	21	3.8	ZV220S_K102_0040 EZ302U	0.9	1.4	19	4.000	1.83	1.56	2.78	74	37	–	14	2	20	42.4
1.67	0.4	0.4	27	2.9	ZV220S_K102_0040 EZ303U	1.1	1.4	23	4.000	1.83	1.56	2.78	74	37	–	14	2	20	42.4
1.67	0.5	0.5	17	4.8	ZV220S_K102_0040 EZ401U	1.6	5.5	33	4.000	1.83	1.56	2.78	74	37	–	14	2	20	42.4
1.67	0.8	0.9	26	3.1	ZV220S_K102_0040 EZ501U	2.9	5.5	62	4.000	1.83	1.56	2.78	74	37	–	14	2	20	42.4
1.67	0.9	1.0	28	2.8	ZV220S_K102_0040 EZ402U	2.9	5.5	62	4.000	1.83	1.56	2.78	74	37	–	14	2	20	42.4
1.67	1.3	1.6	41	1.9	ZV220S_K102_0040 EZ404U	3.2	5.5	68	4.000	1.83	1.56	2.78	74	37	–	14	2	20	42.4
1.67	1.4	1.5	44	1.8	ZV220S_K102_0040 EZ502U	3.2	5.5	68	4.000	1.83	1.56	2.78	74	37	–	14	2	20	42.4
1.67	1.4	1.5	44	1.8	ZV220S_K102_0040 EZ701U	3.2	5.5	68	4.000	1.83	1.56	2.78	74	37	–	14	2	20	42.4
1.67	1.8	2.0	58	1.4	ZV220S_K102_0040 EZ503U	3.2	5.5	68	4.000	1.83	1.56	2.78	74	37	–	14	2	20	42.4
ZV2K1 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 3,2 kN)																			
0.19	1.3	1.4	3.6	2.5	ZV220S_K102_0700 EZ202U	3.2	6.6	68	70.03	0.13	0.13	0.22	74	37	–	14	2	20	42.4
0.19	2.0	2.2	5.5	1.7	ZV220S_K102_0700 EZ203U	3.2	6.6	68	70.03	0.13	0.13	0.22	74	37	–	14	2	20	42.4
0.19	2.8	3.0	8.1	1.1	ZV220S_K102_0700 EZ301U	3.2	6.6	68	70.03	0.13	0.13	0.22	74	37	–	14	2	20	42.4
0.24	1.0	1.1	2.8	3.1	ZV220S_K102_0560 EZ202U	3.2	8.1	68	56.10	0.16	0.16	0.28	74	37	–	14	2	20	42.4
0.24	1.6	1.8	4.3	2.1	ZV220S_K102_0560 EZ203U	3.2	8.1	68	56.10	0.16	0.16	0.28	74	37	–	14	2	20	42.4

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ EL1,2 [m/s]	$v_{f2maxDB}$ EL3,4,5,6 [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{redII}$ [µm]	$Δs_{redI}$ [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV2K1 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 3,2 kN)																			
0.24	2.3	2.4	6.2	1.4	ZV220S_K102_0560 EZ301U	3.2	8.1	68	56.10	0.16	0.16	0.28	74	37	–	14	2	20	42.4
0.27	0.9	1.0	4.7	2.6	ZV220S_K102_0500 EZ202U	2.8	4.7	60	50.31	0.18	0.18	0.31	74	37	–	14	2	20	42.4
0.27	1.4	1.6	7.1	1.7	ZV220S_K102_0500 EZ203U	2.8	4.7	60	50.31	0.18	0.18	0.31	74	37	–	14	2	20	42.4
0.27	2.0	2.2	10	1.2	ZV220S_K102_0500 EZ301U	2.8	4.7	60	50.31	0.18	0.18	0.31	74	37	–	14	2	20	42.4
0.28	0.9	0.9	2.5	3.8	ZV220S_K102_0470 EZ202U	3.2	9.6	67	46.92	0.19	0.19	0.33	74	37	–	14	2	20	42.4
0.28	1.3	1.5	3.7	2.5	ZV220S_K102_0470 EZ203U	3.2	9.6	68	46.92	0.19	0.19	0.33	74	37	–	14	2	20	42.4
0.28	1.9	2.0	5.5	1.7	ZV220S_K102_0470 EZ301U	3.2	9.6	68	46.92	0.19	0.19	0.33	74	37	–	14	2	20	42.4
0.28	3.2	3.6	9.2	1.0	ZV220S_K102_0470 EZ302U	3.2	9.6	68	46.92	0.19	0.19	0.33	74	37	–	14	2	20	42.4
0.33	0.7	0.8	3.6	3.9	ZV220S_K102_0400 EZ202U	2.7	5.8	58	40.30	0.22	0.22	0.39	74	37	–	14	2	20	42.4
0.33	1.1	1.3	5.5	2.6	ZV220S_K102_0400 EZ203U	3.2	5.8	68	40.30	0.22	0.22	0.39	74	37	–	14	2	20	42.4
0.33	1.6	1.8	8.0	1.8	ZV220S_K102_0400 EZ301U	3.2	5.8	68	40.30	0.22	0.22	0.39	74	37	–	14	2	20	42.4
0.33	2.8	3.1	13	1.0	ZV220S_K102_0400 EZ302U	3.2	5.8	68	40.30	0.22	0.22	0.39	74	37	–	14	2	20	42.4
0.38	1.0	1.1	3.8	3.3	ZV220S_K102_0350 EZ203U	3.2	9.2	68	35.11	0.25	0.25	0.44	74	37	–	14	2	20	42.4
0.38	1.4	1.5	5.6	2.3	ZV220S_K102_0350 EZ301U	3.2	9.2	68	35.11	0.25	0.25	0.44	74	37	–	14	2	20	42.4
0.38	2.4	2.7	9.4	1.3	ZV220S_K102_0350 EZ302U	3.2	9.2	68	35.11	0.25	0.25	0.44	74	37	–	14	2	20	42.4
0.38	3.1	3.6	12	1.0	ZV220S_K102_0350 EZ303U	3.2	9.2	68	35.11	0.25	0.25	0.44	74	37	–	14	2	20	42.4
0.40	0.9	1.1	4.4	3.4	ZV220S_K102_0340 EZ203U	3.2	6.9	68	33.71	0.26	0.26	0.46	74	37	–	14	2	20	42.4
0.40	1.4	1.5	6.4	2.4	ZV220S_K102_0340 EZ301U	3.2	6.9	68	33.71	0.26	0.26	0.46	74	37	–	14	2	20	42.4
0.40	2.3	2.6	11	1.4	ZV220S_K102_0340 EZ302U	3.2	6.9	68	33.71	0.26	0.26	0.46	74	37	–	14	2	20	42.4
0.40	3.0	3.5	14	1.1	ZV220S_K102_0340 EZ303U	3.2	6.9	68	33.71	0.26	0.26	0.46	74	37	–	14	2	20	42.4
0.48	0.8	0.9	3.9	4.1	ZV220S_K102_0280 EZ203U	3.2	7.9	68	28.05	0.32	0.32	0.56	74	37	–	14	2	20	42.4
0.48	1.1	1.2	5.7	2.8	ZV220S_K102_0280 EZ301U	3.2	7.9	68	28.05	0.32	0.32	0.56	74	37	–	14	2	20	42.4
0.48	1.9	2.2	9.6	1.7	ZV220S_K102_0280 EZ302U	3.2	7.9	68	28.05	0.32	0.32	0.56	74	37	–	14	2	20	42.4
0.48	2.5	2.9	13	1.3	ZV220S_K102_0280 EZ303U	3.2	7.9	68	28.05	0.32	0.32	0.56	74	37	–	14	2	20	42.4
0.48	2.9	3.6	15	1.1	ZV220S_K102_0280 EZ401U	3.2	11	68	28.05	0.32	0.32	0.56	74	37	–	14	2	20	42.4
0.53	0.7	0.8	3.9	4.6	ZV220S_K102_0250 EZ203U	3.1	6.6	66	25.22	0.35	0.35	0.62	74	37	–	14	2	20	42.4
0.53	1.0	1.1	5.7	3.1	ZV220S_K102_0250 EZ301U	3.2	6.6	68	25.22	0.35	0.35	0.62	74	37	–	14	2	20	42.4
0.53	1.7	1.9	9.7	1.9	ZV220S_K102_0250 EZ302U	3.2	6.6	68	25.22	0.35	0.35	0.62	74	37	–	14	2	20	42.4
0.53	2.3	2.6	13	1.4	ZV220S_K102_0250 EZ303U	3.2	6.6	68	25.22	0.35	0.35	0.62	74	37	–	14	2	20	42.4
0.53	2.7	3.2	15	1.2	ZV220S_K102_0250 EZ401U	3.2	9.1	68	25.22	0.35	0.35	0.62	74	37	–	14	2	20	42.4
0.57	0.6	0.7	4.0	5.0	ZV220S_K102_0230 EZ203U	2.9	7.5	61	23.27	0.38	0.38	0.67	74	37	–	14	2	20	42.4
0.57	0.9	1.0	5.8	3.4	ZV220S_K102_0230 EZ301U	3.0	7.5	63	23.27	0.38	0.38	0.67	74	37	–	14	2	20	42.4
0.57	1.6	1.8	9.7	2.0	ZV220S_K102_0230 EZ302U	3.2	7.5	68	23.27	0.38	0.38	0.67	74	37	–	14	2	20	42.4
0.57	2.1	2.4	13	1.5	ZV220S_K102_0230 EZ303U	3.2	7.5	68	23.27	0.38	0.38	0.67	74	37	–	14	2	20	42.4
0.57	2.4	3.0	15	1.3	ZV220S_K102_0230 EZ401U	3.2	11	68	23.27	0.38	0.38	0.67	74	37	–	14	2	20	42.4
0.66	0.8	0.9	5.9	3.9	ZV220S_K102_0200 EZ301U	2.6	5.7	55	20.15	0.44	0.44	0.77	74	37	–	14	2	20	42.4
0.66	1.4	1.5	9.9	2.3	ZV220S_K102_0200 EZ302U	3.2	5.7	68	20.15	0.44	0.44	0.77	74	37	–	14	2	20	42.4
0.66	1.8	2.1	13	1.8	ZV220S_K102_0200 EZ303U	3.2	5.7	68	20.15	0.44	0.44	0.77	74	37	–	14	2	20	42.4
0.66	2.1	2.6	15	1.5	ZV220S_K102_0200 EZ401U	3.2	10	68	20.15	0.44	0.44	0.77	74	37	–	14	2	20	42.4
0.66	3.1	4.1	22	1.0	ZV220S_K102_0200 EZ501U	3.2	10	68	20.15	0.44	0.44	0.77	74	37	–	14	2	20	42.4
0.66	3.2	4.5	23	1.0	ZV220S_K102_0200 EZ402U	3.2	10	68	20.15	0.44	0.44	0.77	74	37	–	14	2	20	42.4
0.76	0.7	0.8	5.9	4.4	ZV220S_K102_0175 EZ301U	2.2	6.0	48	17.56	0.51	0.48	0.76	74	37	–	14	2	20	42.4
0.76	1.2	1.3	10	2.6	ZV220S_K102_0175 EZ302U	3.2	6.0	68	17.56	0.51	0.48	0.76	74	37	–	14	2	20	42.4
0.76	1.6	1.8	13	2.0	ZV220S_K102_0175 EZ303U	3.2	6.0	68	17.56	0.51	0.48	0.76	74	37	–	14	2	20	42.4
0.76	1.8	2.2	15	1.7	ZV220S_K102_0175 EZ401U	3.2	11	68	17.56	0.51	0.48	0.76	74	37	–	14	2	20	42.4
0.76	2.7	3.5	23	1.2	ZV220S_K102_0175 EZ501U	3.2	11	68	17.56	0.51	0.48	0.76	74	37	–	14	2	20	42.4
0.76	2.8	3.9	23	1.1	ZV220S_K102_0175 EZ402U	3.2	11	68	17.56	0.51	0.48	0.76	74	37	–	14	2	20	42.4
0.80	0.7	0.7	5.9	4.6	ZV220S_K102_0165 EZ301U	2.1	5.4	45	16.71	0.53	0.53	0.93	74	37	–	14	2	20	42.4
0.80	1.1	1.3	10	2.7	ZV220S_K102_0165 EZ302U	3.2	5.4	68	16.71	0.53	0.53	0.93	74	37	–	14	2	20	42.4
0.80	1.5	1.7	13	2.1	ZV220S_K102_0165 EZ303U	3.2	5.4	68	16.71	0.53	0.53	0.93	74	37	–	14	2	20	42.4
0.80	1.8	2.1	15	1.8	ZV220S_K102_0165 EZ401U	3.2	10	68	16.71	0.53	0.53	0.93	74	37	–	14	2	20	42.4
0.80	2.6	3.4	23	1.2	ZV220S_K102_0165 EZ501U	3.2	10	68	16.71	0.53	0.53	0.93	74	37	–	14	2	20	42.4
0.80	2.7	3.7	23	1.2	ZV220S_K102_0165 EZ402U	3.2	10	68	16.71	0.53	0.53	0.93	74	37	–	14	2	20	42.4
0.95	1.0	1.1	10	3.0	ZV220S_K102_0140 EZ302U	3.2	4.8	68	14.11	0.63	0.60	0.95	74	37	–	14	2	20	42.4
0.95	1.3	1.5	13	2.3	ZV220S_K102_0140 EZ303U	3.2	4.8	68	14.11	0.63	0.60	0.95	74	37	–	14	2	20	42.4
0.95	1.5	1.8	16	2.0	ZV220S_K102_0140 EZ401U	3.2	11	68	14.11	0.63	0.60	0.95	74	37	–	14	2	20	42.4
0.95	2.2	2.8	23	1.3	ZV220S_K102_0140 EZ501U	3.2	11	68	14.11	0.63	0.60	0.95	74	37	–	14	2	20	42.4
0.95	2.3	3.2	24	1.3	ZV220S_K102_0140 EZ402U	3.2	11	68	14.11	0.63	0.60	0.95	74	37	–	14	2	20	42.4
1.06	0.9	1.0	10	3.3	ZV220S_K102_0125 EZ302U	2.9	4.3	61	12.62	0.70	0.67	1.06	74	37	–	14	2	20	42.4
1.06	1.1	1.3	13	2.5	ZV220S_K102_0125 EZ303U	3.2	4.3	68	12.62	0.70	0.67	1.06	74	37	–	14	2	20	42.4
1.06	1.3	1.6	16	2.1	ZV220S_K102_0125 EZ401U	3.2	10	68	12.62	0.70	0.67	1.06	74	37	–	14	2	20	42.4
1.06	2.0	2.5	23	1.4	ZV220S_K102_0125 EZ501U	3.2	10	68	12.62	0.70	0.67	1.06	74	37	–	14	2	20	42.4
1.06	2.0	2.8	24	1.4	ZV220S_K102_0125 EZ402U	3.2	10	68	12.62	0.70	0.67	1.06	74	37	–	14	2	20	42.4
1.32	0.7	0.8	10	3.8	ZV220S_K102_0100 EZ302U	2.3	3.5	49	10.14	0.88	0.83	1.32	74	37	–	14	2	20	42.4

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ EL1,2 [m/s]	EL3,4,5,6 [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{redII}$ [µm]	$Δs_{redI}$ [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV2K1 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 3,2 kN)																			
1.32	0.9	1.0	14	2.9	ZV220S_K102_0100 EZ303U	2.8	3.5	59	10.14	0.88	0.83	1.32	74	37	–	14	2	20	42.4
1.32	1.1	1.3	16	2.5	ZV220S_K102_0100 EZ401U	3.2	10	68	10.14	0.88	0.83	1.32	74	37	–	14	2	20	42.4
1.32	1.6	2.0	24	1.7	ZV220S_K102_0100 EZ501U	3.2	10	68	10.14	0.88	0.83	1.32	74	37	–	14	2	20	42.4
1.32	1.6	2.3	24	1.6	ZV220S_K102_0100 EZ402U	3.2	10	68	10.14	0.88	0.83	1.32	74	37	–	14	2	20	42.4
1.32	2.4	3.6	36	1.1	ZV220S_K102_0100 EZ502U	3.2	10	68	10.14	0.88	0.83	1.32	74	37	–	14	2	20	42.4
1.32	2.4	3.7	36	1.1	ZV220S_K102_0100 EZ701U	3.2	10	68	10.14	0.88	0.83	1.32	74	37	–	14	2	20	42.4
ZV2K2 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 5,2 kN)																			
0.06	4.5	4.6	3.8	1.1	ZV225S_K203_1350 EZ301U	5.2	15	138	135.3	0.08	0.08	0.13	77	46	19	16	2	25	53.1
0.08	3.7	3.7	3.6	1.4	ZV225S_K203_1090 EZ301U	5.2	15	138	109.5	0.10	0.10	0.17	77	46	19	16	2	25	53.1
0.09	3.0	3.1	3.4	1.7	ZV225S_K203_0910 EZ301U	5.2	15	138	90.79	0.12	0.12	0.20	77	46	19	16	2	25	53.1
0.09	5.2	5.5	5.9	1.0	ZV225S_K203_0910 EZ302U	5.2	15	138	90.79	0.12	0.12	0.20	77	46	19	16	2	25	53.1
0.11	2.7	2.7	3.3	2.0	ZV225S_K203_0800 EZ301U	5.2	15	138	79.62	0.14	0.14	0.23	77	46	19	16	2	25	53.1
0.11	4.6	4.8	5.7	1.1	ZV225S_K203_0800 EZ302U	5.2	15	138	79.62	0.14	0.14	0.23	77	46	19	16	2	25	53.1
0.12	2.4	2.4	4.9	2.1	ZV225S_K202_0690 EZ301U	5.2	9.5	138	69.43	0.16	0.16	0.26	77	39	12	16	2	25	53.1
0.12	4.0	4.3	8.4	1.2	ZV225S_K202_0690 EZ302U	5.2	9.5	138	69.43	0.16	0.16	0.26	77	39	12	16	2	25	53.1
0.12	2.3	2.3	3.2	2.3	ZV225S_K203_0680 EZ301U	5.2	15	138	68.42	0.16	0.16	0.26	77	46	19	16	2	25	53.1
0.12	3.9	4.1	5.5	1.3	ZV225S_K203_0680 EZ302U	5.2	15	138	68.42	0.16	0.16	0.26	77	46	19	16	2	25	53.1
0.12	5.1	5.4	7.1	1.0	ZV225S_K203_0680 EZ303U	5.2	15	138	68.42	0.16	0.16	0.26	77	46	19	16	2	25	53.1
0.13	2.2	2.3	3.2	2.4	ZV225S_K203_0660 EZ301U	5.2	15	138	66.03	0.17	0.16	0.27	77	46	19	16	2	25	53.1
0.13	3.8	4.0	5.4	1.4	ZV225S_K203_0660 EZ302U	5.2	15	138	66.03	0.17	0.16	0.27	77	46	19	16	2	25	53.1
0.13	4.9	5.2	7.1	1.1	ZV225S_K203_0660 EZ303U	5.2	15	138	66.03	0.17	0.16	0.27	77	46	19	16	2	25	53.1
0.15	1.9	1.9	3.9	2.8	ZV225S_K202_0560 EZ301U	5.2	10	138	55.54	0.20	0.20	0.33	77	39	12	16	2	25	53.1
0.15	3.2	3.4	6.6	1.6	ZV225S_K202_0560 EZ302U	5.2	10	138	55.54	0.20	0.20	0.33	77	39	12	16	2	25	53.1
0.15	4.2	4.4	8.6	1.2	ZV225S_K202_0560 EZ303U	5.2	10	138	55.54	0.20	0.20	0.33	77	39	12	16	2	25	53.1
0.15	1.8	1.9	3.0	2.9	ZV225S_K203_0540 EZ301U	5.2	13	138	54.25	0.21	0.20	0.33	77	46	19	16	2	25	53.1
0.15	3.1	3.3	5.2	1.7	ZV225S_K203_0540 EZ302U	5.2	13	138	54.25	0.21	0.20	0.33	77	46	19	16	2	25	53.1
0.15	4.0	4.3	6.7	1.3	ZV225S_K203_0540 EZ303U	5.2	13	138	54.25	0.21	0.20	0.33	77	46	19	16	2	25	53.1
0.17	1.7	1.8	6.2	2.1	ZV225S_K202_0500 EZ301U	4.4	6.9	116	50.49	0.22	0.22	0.36	77	39	12	16	2	25	53.1
0.17	2.9	3.1	11	1.2	ZV225S_K202_0500 EZ302U	4.4	6.9	116	50.49	0.22	0.22	0.36	77	39	12	16	2	25	53.1
0.17	1.7	1.7	3.0	3.1	ZV225S_K203_0500 EZ301U	5.0	12	133	49.76	0.22	0.22	0.36	77	46	19	16	2	25	53.1
0.17	2.9	3.0	5.0	1.8	ZV225S_K203_0500 EZ302U	5.2	12	138	49.76	0.22	0.22	0.36	77	46	19	16	2	25	53.1
0.17	3.7	3.9	6.6	1.4	ZV225S_K203_0500 EZ303U	5.2	12	138	49.76	0.22	0.22	0.36	77	46	19	16	2	25	53.1
0.17	5.0	5.4	8.9	1.0	ZV225S_K203_0500 EZ401U	5.2	12	138	49.76	0.22	0.22	0.36	77	46	19	16	2	25	53.1
0.18	1.6	1.6	2.9	3.3	ZV225S_K202_0460 EZ301U	4.7	9.7	126	46.23	0.24	0.23	0.39	77	39	12	16	2	25	53.1
0.18	2.7	2.8	5.0	1.9	ZV225S_K202_0460 EZ302U	5.2	9.7	138	46.23	0.24	0.23	0.39	77	39	12	16	2	25	53.1
0.18	3.5	3.7	6.5	1.5	ZV225S_K202_0460 EZ303U	5.2	9.7	138	46.23	0.24	0.23	0.39	77	39	12	16	2	25	53.1
0.18	4.7	5.1	8.9	1.1	ZV225S_K202_0460 EZ401U	5.2	15	138	46.23	0.24	0.23	0.39	77	39	12	16	2	25	53.1
0.18	1.5	1.5	2.9	3.4	ZV225S_K203_0450 EZ301U	4.6	11	121	45.22	0.25	0.24	0.40	77	46	19	16	2	25	53.1
0.18	2.6	2.7	4.9	2.0	ZV225S_K203_0450 EZ302U	5.2	11	138	45.22	0.25	0.24	0.40	77	46	19	16	2	25	53.1
0.18	3.4	3.6	6.4	1.5	ZV225S_K203_0450 EZ303U	5.2	11	138	45.22	0.25	0.24	0.40	77	46	19	16	2	25	53.1
0.18	4.6	4.9	8.7	1.1	ZV225S_K203_0450 EZ401U	5.2	11	138	45.22	0.25	0.24	0.40	77	46	19	16	2	25	53.1
0.21	1.4	1.4	4.9	3.2	ZV225S_K202_0400 EZ301U	4.1	7.4	110	40.39	0.28	0.27	0.45	77	39	12	16	2	25	53.1
0.21	2.3	2.5	8.4	1.9	ZV225S_K202_0400 EZ302U	5.2	7.4	138	40.39	0.28	0.27	0.45	77	39	12	16	2	25	53.1
0.21	3.1	3.2	11	1.4	ZV225S_K202_0400 EZ303U	5.2	7.4	138	40.39	0.28	0.27	0.45	77	39	12	16	2	25	53.1
0.21	4.1	4.4	15	1.1	ZV225S_K202_0400 EZ401U	5.2	7.4	138	40.39	0.28	0.27	0.45	77	39	12	16	2	25	53.1
0.21	1.3	1.4	2.8	3.9	ZV225S_K203_0390 EZ301U	4.0	9.5	106	39.45	0.28	0.28	0.46	77	46	19	16	2	25	53.1
0.21	2.3	2.4	4.8	2.3	ZV225S_K203_0390 EZ302U	5.2	9.5	138	39.45	0.28	0.28	0.46	77	46	19	16	2	25	53.1
0.21	2.9	3.1	6.3	1.8	ZV225S_K203_0390 EZ303U	5.2	9.5	138	39.45	0.28	0.28	0.46	77	46	19	16	2	25	53.1
0.21	4.0	4.3	8.5	1.3	ZV225S_K203_0390 EZ401U	5.2	9.5	138	39.45	0.28	0.28	0.46	77	46	19	16	2	25	53.1
0.24	1.2	1.2	3.2	4.4	ZV225S_K202_0350 EZ301U	3.5	8.1	94	34.55	0.32	0.31	0.52	77	39	12	16	2	25	53.1
0.24	2.0	2.1	5.5	2.6	ZV225S_K202_0350 EZ302U	5.2	8.1	138	34.55	0.32	0.31	0.52	77	39	12	16	2	25	53.1
0.24	2.6	2.8	7.1	2.0	ZV225S_K202_0350 EZ303U	5.2	8.1	138	34.55	0.32	0.31	0.52	77	39	12	16	2	25	53.1
0.24	3.5	3.8	8.7	1.5	ZV225S_K202_0350 EZ401U	5.2	15	138	34.55	0.32	0.31	0.52	77	39	12	16	2	25	53.1
0.25	1.1	1.2	3.6	4.6	ZV225S_K202_0340 EZ301U	3.4	7.1	91	33.62	0.33	0.32	0.54	77	39	12	16	2	25	53.1
0.25	2.0	2.1	6.2	2.7	ZV225S_K202_0340 EZ302U	5.2	7.1	138	33.62	0.33	0.32	0.54	77	39	12	16	2	25	53.1
0.25	2.5	2.7	8.1	2.0	ZV225S_K202_0340 EZ303U	5.2	7.1	138	33.62	0.33	0.32	0.54	77	39	12	16	2	25	53.1
0.25	3.4	3.7	11	1.5	ZV225S_K202_0340 EZ401U	5.2	12	138	33.62	0.33	0.32	0.54	77	39	12	16	2	25	53.1
0.30	2.9	3.1	8.8	1.8	ZV225S_K202_0280 EZ401U	5.2	15	138	27.95	0.40	0.39	0.65	77	39	12	16	2	25	53.1
0.30	4.4	4.8	14	1.2	ZV225S_K202_0280 EZ501U	5.2	15	138	27.95	0.40	0.39	0.65	77	39	12	16	2	25	53.1
0.30	4.8	5.3	15	1.1	ZV225S_K202_0280 EZ402U	5.2	15	138	27.95	0.40	0.39	0.65	77	39	12	16	2	25	53.1
0.33	1.5	1.5	6.9	3.2	ZV225S_K202_0250 EZ302U	4.6	5.9	122	25.13	0.44	0.43	0.72	77	39	12	16	2	25	53.1
0.33	1.9	2.0	9.0	2.5	ZV225S_K202_0250 EZ303U	4.7	5.9	125	25.13	0.44	0.43	0.72	77	39	12	16	2	25	53.1
0.33	2.6	2.8	8.9	2.0	ZV225S_K202_0250 EZ401U	5.2	15	138	25.13	0.44	0.43	0.72	77	39	12	16	2	25	53.1
0.33	4.0	4.3	14	1.3	ZV225S_K202_0250 EZ501U	5.2	15	138	25.13	0.44	0.43	0.72	77	39	12	16	2	25	53.1

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ EL1,2 [m/s]	EL3,4,5,6 [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{redII}$ [µm]	$Δs_{redI}$ [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV2K2 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 5,2 kN)																			
0.33	4.3	4.8	15	1.2	ZV225S_K202_0250 EZ402U	5.2	15	138	25.13	0.44	0.43	0.72	77	39	12	16	2	25	53.1
0.36	1.3	1.4	6.3	3.8	ZV225S_K202_0230 EZ302U	4.2	6.4	112	23.18	0.48	0.47	0.78	77	39	12	16	2	25	53.1
0.36	1.8	1.9	8.2	2.9	ZV225S_K202_0230 EZ303U	5.1	6.4	135	23.18	0.48	0.47	0.78	77	39	12	16	2	25	53.1
0.36	2.4	2.5	9.0	2.2	ZV225S_K202_0230 EZ401U	5.2	15	138	23.18	0.48	0.47	0.78	77	39	12	16	2	25	53.1
0.36	3.6	4.0	14	1.4	ZV225S_K202_0230 EZ501U	5.2	15	138	23.18	0.48	0.47	0.78	77	39	12	16	2	25	53.1
0.36	4.0	4.4	15	1.3	ZV225S_K202_0230 EZ402U	5.2	15	138	23.18	0.48	0.47	0.78	77	39	12	16	2	25	53.1
0.41	2.1	2.2	9.1	2.5	ZV225S_K202_0200 EZ401U	5.2	15	138	20.33	0.55	0.53	0.89	77	39	12	16	2	25	53.1
0.41	3.2	3.5	14	1.6	ZV225S_K202_0200 EZ501U	5.2	15	138	20.33	0.55	0.53	0.89	77	39	12	16	2	25	53.1
0.41	3.5	3.9	15	1.5	ZV225S_K202_0200 EZ402U	5.2	15	138	20.33	0.55	0.53	0.89	77	39	12	16	2	25	53.1
0.41	5.1	6.4	22	1.0	ZV225S_K202_0200 EZ404U	5.2	15	138	20.33	0.55	0.53	0.89	77	39	12	16	2	25	53.1
0.48	1.0	1.1	7.8	3.8	ZV225S_K202_0175 EZ302U	3.2	4.8	85	17.47	0.62	0.56	0.88	77	39	12	16	2	25	53.1
0.48	1.3	1.4	10	2.9	ZV225S_K202_0175 EZ303U	3.8	4.8	102	17.47	0.62	0.56	0.88	77	39	12	16	2	25	53.1
0.48	1.8	1.9	9.2	2.9	ZV225S_K202_0175 EZ401U	5.2	15	138	17.47	0.62	0.56	0.88	77	39	12	16	2	25	53.1
0.48	2.7	3.0	14	1.9	ZV225S_K202_0175 EZ501U	5.2	15	138	17.47	0.62	0.56	0.88	77	39	12	16	2	25	53.1
0.48	3.0	3.3	15	1.7	ZV225S_K202_0175 EZ402U	5.2	15	138	17.47	0.62	0.56	0.88	77	39	12	16	2	25	53.1
0.48	4.4	5.5	23	1.2	ZV225S_K202_0175 EZ404U	5.2	15	138	17.47	0.62	0.56	0.88	77	39	12	16	2	25	53.1
0.48	4.7	5.1	24	1.1	ZV225S_K202_0175 EZ502U	5.2	15	138	17.47	0.62	0.56	0.88	77	39	12	16	2	25	53.1
0.48	4.7	5.3	24	1.1	ZV225S_K202_0175 EZ701U	5.2	15	138	17.47	0.62	0.56	0.88	77	39	12	16	2	25	53.1
0.49	1.0	1.0	8.0	3.8	ZV225S_K202_0170 EZ302U	3.1	4.6	82	16.86	0.66	0.64	1.07	77	39	12	16	2	25	53.1
0.49	1.3	1.4	10	2.9	ZV225S_K202_0170 EZ303U	3.7	4.6	98	16.86	0.66	0.64	1.07	77	39	12	16	2	25	53.1
0.49	1.7	1.8	9.2	3.0	ZV225S_K202_0170 EZ401U	5.2	15	138	16.86	0.66	0.64	1.07	77	39	12	16	2	25	53.1
0.49	2.7	2.9	14	2.0	ZV225S_K202_0170 EZ501U	5.2	15	138	16.86	0.66	0.64	1.07	77	39	12	16	2	25	53.1
0.49	2.9	3.2	15	1.8	ZV225S_K202_0170 EZ402U	5.2	15	138	16.86	0.66	0.64	1.07	77	39	12	16	2	25	53.1
0.49	4.3	5.3	23	1.2	ZV225S_K202_0170 EZ404U	5.2	15	138	16.86	0.66	0.64	1.07	77	39	12	16	2	25	53.1
0.49	4.6	4.9	24	1.1	ZV225S_K202_0170 EZ502U	5.2	15	138	16.86	0.66	0.64	1.07	77	39	12	16	2	25	53.1
0.49	4.6	5.1	24	1.1	ZV225S_K202_0170 EZ701U	5.2	15	138	16.86	0.66	0.64	1.07	77	39	12	16	2	25	53.1
0.60	1.4	1.5	9.4	3.5	ZV225S_K202_0140 EZ401U	4.3	15	114	13.85	0.78	0.70	1.10	77	39	12	16	2	25	53.1
0.60	2.2	2.4	14	2.3	ZV225S_K202_0140 EZ501U	5.2	15	138	13.85	0.78	0.70	1.10	77	39	12	16	2	25	53.1
0.60	2.4	2.6	16	2.1	ZV225S_K202_0140 EZ402U	5.2	15	138	13.85	0.78	0.70	1.10	77	39	12	16	2	25	53.1
0.60	3.5	4.4	23	1.4	ZV225S_K202_0140 EZ404U	5.2	15	138	13.85	0.78	0.70	1.10	77	39	12	16	2	25	53.1
0.60	3.7	4.1	25	1.3	ZV225S_K202_0140 EZ502U	5.2	15	138	13.85	0.78	0.70	1.10	77	39	12	16	2	25	53.1
0.60	3.7	4.2	25	1.3	ZV225S_K202_0140 EZ701U	5.2	15	138	13.85	0.78	0.70	1.10	77	39	12	16	2	25	53.1
0.60	4.9	5.6	32	1.0	ZV225S_K202_0140 EZ503U	5.2	15	138	13.85	0.78	0.70	1.10	77	39	12	16	2	25	53.1
0.66	0.7	0.8	9.8	3.8	ZV225S_K202_0125 EZ302U	2.3	3.5	62	12.71	0.85	0.77	1.20	77	39	12	16	2	25	53.1
0.66	1.0	1.0	13	2.9	ZV225S_K202_0125 EZ303U	2.8	3.5	74	12.71	0.85	0.77	1.20	77	39	12	16	2	25	53.1
0.66	1.3	1.4	9.4	3.7	ZV225S_K202_0125 EZ401U	3.9	14	105	12.71	0.85	0.77	1.20	77	39	12	16	2	25	53.1
0.66	2.0	2.2	15	2.4	ZV225S_K202_0125 EZ501U	5.2	14	138	12.71	0.85	0.77	1.20	77	39	12	16	2	25	53.1
0.66	2.2	2.4	16	2.2	ZV225S_K202_0125 EZ402U	5.2	14	138	12.71	0.85	0.77	1.20	77	39	12	16	2	25	53.1
0.66	3.2	4.0	23	1.5	ZV225S_K202_0125 EZ404U	5.2	14	138	12.71	0.85	0.77	1.20	77	39	12	16	2	25	53.1
0.66	3.4	3.7	25	1.4	ZV225S_K202_0125 EZ502U	5.2	14	138	12.71	0.85	0.77	1.20	77	39	12	16	2	25	53.1
0.66	3.4	3.9	25	1.4	ZV225S_K202_0125 EZ701U	5.2	15	138	12.71	0.85	0.77	1.20	77	39	12	16	2	25	53.1
0.66	4.5	5.2	33	1.1	ZV225S_K202_0125 EZ503U	5.2	14	138	12.71	0.85	0.77	1.20	77	39	12	16	2	25	53.1
0.72	0.7	0.7	11	3.8	ZV225S_K202_0115 EZ302U	2.1	3.2	56	11.55	0.84	0.75	1.20	77	39	12	16	2	25	53.1
0.72	0.9	0.9	14	2.9	ZV225S_K202_0115 EZ303U	2.5	3.2	67	11.55	0.84	0.75	1.20	77	39	12	16	2	25	53.1
0.72	1.2	1.3	9.5	3.9	ZV225S_K202_0115 EZ401U	3.6	13	95	11.55	0.84	0.75	1.20	77	39	12	16	2	25	53.1
0.72	1.8	2.0	15	2.6	ZV225S_K202_0115 EZ501U	5.2	13	138	11.55	0.84	0.75	1.20	77	39	12	16	2	25	53.1
0.72	2.0	2.2	16	2.4	ZV225S_K202_0115 EZ402U	5.2	13	138	11.55	0.84	0.75	1.20	77	39	12	16	2	25	53.1
0.72	2.9	3.6	23	1.6	ZV225S_K202_0115 EZ404U	5.2	13	138	11.55	0.84	0.75	1.20	77	39	12	16	2	25	53.1
0.72	3.1	3.4	25	1.5	ZV225S_K202_0115 EZ502U	5.2	13	138	11.55	0.84	0.75	1.20	77	39	12	16	2	25	53.1
0.72	3.1	3.5	25	1.5	ZV225S_K202_0115 EZ701U	5.2	15	138	11.55	0.84	0.75	1.20	77	39	12	16	2	25	53.1
0.72	4.1	4.7	33	1.1	ZV225S_K202_0115 EZ503U	5.2	13	138	11.55	0.84	0.75	1.20	77	39	12	16	2	25	53.1
0.83	1.0	1.1	9.6	4.3	ZV225S_K202_0100 EZ401U	3.1	11	83	10.07	1.08	0.97	1.52	77	39	12	16	2	25	53.1
0.83	1.6	1.7	15	2.8	ZV225S_K202_0100 EZ501U	5.2	11	138	10.07	1.08	0.97	1.52	77	39	12	16	2	25	53.1
0.83	1.7	1.9	16	2.6	ZV225S_K202_0100 EZ402U	5.2	11	138	10.07	1.08	0.97	1.52	77	39	12	16	2	25	53.1
0.83	2.5	3.2	24	1.8	ZV225S_K202_0100 EZ404U	5.2	11	138	10.07	1.08	0.97	1.52	77	39	12	16	2	25	53.1
0.83	2.7	2.9	25	1.6	ZV225S_K202_0100 EZ502U	5.2	11	138	10.07	1.08	0.97	1.52	77	39	12	16	2	25	53.1
0.83	2.7	3.1	25	1.6	ZV225S_K202_0100 EZ701U	5.2	15	138	10.07	1.08	0.97	1.52	77	39	12	16	2	25	53.1
0.83	3.6	4.1	33	1.2	ZV225S_K202_0100 EZ503U	5.2	11	138	10.07	1.08	0.97	1.52	77	39	12	16	2	25	53.1
0.83	4.4	5.3	41	1.0	ZV225S_K202_0100 EZ702U	5.2	15	138	10.07	1.08	0.97	1.52	77	39	12	16	2	25	53.1
0.91	0.9	1.0	9.7	4.6	ZV225S_K202_0092 EZ401U	2.9	10	76	9.190	1.06	0.94	1.51	77	39	12	16	2	25	53.1
0.91	1.4	1.6	15	3.0	ZV225S_K202_0092 EZ501U	5.2	10	138	9.190	1.06	0.94	1.51	77	39	12	16	2	25	53.1
0.91	1.6	1.7	16	2.7	ZV225S_K202_0092 EZ402U	5.2	10	138	9.190	1.06	0.94	1.51	77	39	12	16	2	25	53.1
0.91	2.3	2.9	24	1.9	ZV225S_K202_0092 EZ404U	5.2	10	138	9.190	1.06	0.94	1.51	77	39	12	16	2	25	53.1
0.91	2.5	2.7	26	1.7	ZV225S_K202_0092 EZ502U	5.2	10	138	9.190	1.06	0.94	1.51	77	39	12	16	2	25	53.1

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ EL1,2 [m/s]	EL3,4,5,6 [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{redII}$ [µm]	$Δs_{redI}$ [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV2K2 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 5,2 kN)																			
0.91	2.5	2.8	26	1.7	ZV225S_K202_0092 EZ701U	5.2	15	138	9.190	1.06	0.94	1.51	77	39	12	16	2	25	53.1
0.91	3.3	3.7	34	1.3	ZV225S_K202_0092 EZ503U	5.2	10	138	9.190	1.06	0.94	1.51	77	39	12	16	2	25	53.1
0.91	4.0	4.8	42	1.1	ZV225S_K202_0092 EZ702U	5.2	15	138	9.190	1.06	0.94	1.51	77	39	12	16	2	25	53.1
0.99	0.5	0.5	13	3.8	ZV225S_K202_0084 EZ302U	1.5	2.3	41	8.397	1.16	1.03	1.65	77	39	12	16	2	25	53.1
0.99	0.6	0.7	17	2.9	ZV225S_K202_0084 EZ303U	1.8	2.3	49	8.397	1.16	1.03	1.65	77	39	12	16	2	25	53.1
0.99	0.9	0.9	9.8	4.9	ZV225S_K202_0084 EZ401U	2.6	9.2	69	8.397	1.16	1.03	1.65	77	39	12	16	2	25	53.1
0.99	1.3	1.4	15	3.2	ZV225S_K202_0084 EZ501U	4.9	9.2	130	8.397	1.16	1.03	1.65	77	39	12	16	2	25	53.1
0.99	1.4	1.6	16	2.9	ZV225S_K202_0084 EZ402U	4.9	9.2	130	8.397	1.16	1.03	1.65	77	39	12	16	2	25	53.1
0.99	2.1	2.6	24	2.0	ZV225S_K202_0084 EZ404U	5.2	9.2	138	8.397	1.16	1.03	1.65	77	39	12	16	2	25	53.1
0.99	2.3	2.5	26	1.8	ZV225S_K202_0084 EZ502U	5.2	9.2	138	8.397	1.16	1.03	1.65	77	39	12	16	2	25	53.1
0.99	2.3	2.5	26	1.8	ZV225S_K202_0084 EZ701U	5.2	15	138	8.397	1.16	1.03	1.65	77	39	12	16	2	25	53.1
0.99	3.0	3.4	34	1.4	ZV225S_K202_0084 EZ503U	5.2	9.2	138	8.397	1.16	1.03	1.65	77	39	12	16	2	25	53.1
0.99	3.7	4.4	42	1.1	ZV225S_K202_0084 EZ702U	5.2	15	138	8.397	1.16	1.03	1.65	77	39	12	16	2	25	53.1
0.99	4.1	4.9	47	1.0	ZV225S_K202_0084 EZ505U	5.2	15	138	8.397	1.16	1.03	1.65	77	39	12	16	2	25	53.1
1.17	1.9	2.2	26	2.1	ZV225S_K202_0071 EZ701U	5.2	15	138	7.118	1.17	1.02	1.76	77	39	12	16	2	25	53.1
1.17	3.1	3.7	42	1.3	ZV225S_K202_0071 EZ702U	5.2	15	138	7.118	1.17	1.02	1.76	77	39	12	16	2	25	53.1
1.17	3.5	4.2	48	1.1	ZV225S_K202_0071 EZ505U	5.2	15	138	7.118	1.17	1.02	1.76	77	39	12	16	2	25	53.1
1.25	1.1	1.1	15	3.7	ZV225S_K202_0067 EZ501U	3.9	7.3	104	6.683	1.46	1.29	2.08	77	39	12	16	2	25	53.1
1.25	1.1	1.3	17	3.4	ZV225S_K202_0067 EZ402U	3.9	7.3	104	6.683	1.46	1.29	2.08	77	39	12	16	2	25	53.1
1.25	1.7	2.1	25	2.3	ZV225S_K202_0067 EZ404U	5.2	7.3	138	6.683	1.46	1.29	2.08	77	39	12	16	2	25	53.1
1.25	1.8	2.0	26	2.1	ZV225S_K202_0067 EZ502U	5.2	7.3	138	6.683	1.46	1.29	2.08	77	39	12	16	2	25	53.1
1.25	1.8	2.0	26	2.1	ZV225S_K202_0067 EZ701U	4.9	15	130	6.683	1.46	1.29	2.08	77	39	12	16	2	25	53.1
1.25	2.4	2.7	35	1.6	ZV225S_K202_0067 EZ503U	5.2	7.3	138	6.683	1.46	1.29	2.08	77	39	12	16	2	25	53.1
1.25	2.9	3.5	43	1.3	ZV225S_K202_0067 EZ702U	5.2	15	138	6.683	1.46	1.29	2.08	77	39	12	16	2	25	53.1
1.25	3.3	3.9	48	1.2	ZV225S_K202_0067 EZ505U	5.2	15	138	6.683	1.46	1.29	2.08	77	39	12	16	2	25	53.1
1.39	0.9	1.0	15	4.0	ZV225S_K202_0060 EZ501U	3.5	6.6	93	6.000	1.39	1.20	2.08	77	39	12	16	2	25	53.1
1.39	1.0	1.1	17	3.6	ZV225S_K202_0060 EZ402U	3.5	6.6	93	6.000	1.39	1.20	2.08	77	39	12	16	2	25	53.1
1.39	1.5	1.9	25	2.5	ZV225S_K202_0060 EZ404U	5.2	6.6	138	6.000	1.39	1.20	2.08	77	39	12	16	2	25	53.1
1.39	1.6	1.8	27	2.3	ZV225S_K202_0060 EZ502U	5.2	6.6	138	6.000	1.39	1.20	2.08	77	39	12	16	2	25	53.1
1.39	1.6	1.8	27	2.3	ZV225S_K202_0060 EZ701U	4.4	15	116	6.000	1.39	1.20	2.08	77	39	12	16	2	25	53.1
1.39	2.1	2.4	35	1.8	ZV225S_K202_0060 EZ503U	5.2	6.6	138	6.000	1.39	1.20	2.08	77	39	12	16	2	25	53.1
1.39	2.6	3.2	43	1.4	ZV225S_K202_0060 EZ702U	5.2	15	138	6.000	1.39	1.20	2.08	77	39	12	16	2	25	53.1
1.39	3.0	3.5	48	1.3	ZV225S_K202_0060 EZ505U	5.2	15	138	6.000	1.39	1.20	2.08	77	39	12	16	2	25	53.1
1.39	3.6	4.6	59	1.0	ZV225S_K202_0060 EZ703U	5.2	15	138	6.000	1.39	1.20	2.08	77	39	12	16	2	25	53.1
1.61	1.4	1.6	27	2.5	ZV225S_K202_0052 EZ701U	3.8	14	100	5.177	1.61	1.40	2.41	77	39	12	16	2	25	53.1
1.61	2.3	2.7	44	1.6	ZV225S_K202_0052 EZ702U	5.2	14	138	5.177	1.61	1.40	2.41	77	39	12	16	2	25	53.1
1.61	2.6	3.0	49	1.4	ZV225S_K202_0052 EZ505U	5.2	14	138	5.177	1.61	1.40	2.41	77	39	12	16	2	25	53.1
1.61	3.1	3.9	60	1.1	ZV225S_K202_0052 EZ703U	5.2	14	138	5.177	1.61	1.40	2.41	77	39	12	16	2	25	53.1
1.91	0.7	0.8	16	4.9	ZV225S_K202_0044 EZ501U	2.6	4.8	68	4.364	1.91	1.66	2.86	77	39	12	16	2	25	53.1
1.91	0.8	0.8	17	4.5	ZV225S_K202_0044 EZ402U	2.6	4.8	68	4.364	1.91	1.66	2.86	77	39	12	16	2	25	53.1
1.91	1.1	1.4	25	3.1	ZV225S_K202_0044 EZ404U	3.8	4.8	102	4.364	1.91	1.66	2.86	77	39	12	16	2	25	53.1
1.91	1.2	1.3	27	2.9	ZV225S_K202_0044 EZ502U	3.8	4.8	102	4.364	1.91	1.66	2.86	77	39	12	16	2	25	53.1
1.91	1.2	1.3	27	2.9	ZV225S_K202_0044 EZ701U	3.2	12	85	4.364	1.91	1.66	2.86	77	39	12	16	2	25	53.1
1.91	1.5	1.8	36	2.2	ZV225S_K202_0044 EZ503U	3.8	4.8	102	4.364	1.91	1.66	2.86	77	39	12	16	2	25	53.1
1.91	1.9	2.3	44	1.8	ZV225S_K202_0044 EZ702U	5.2	12	138	4.364	1.91	1.66	2.86	77	39	12	16	2	25	53.1
1.91	2.2	2.6	50	1.6	ZV225S_K202_0044 EZ505U	5.2	12	138	4.364	1.91	1.66	2.86	77	39	12	16	2	25	53.1
1.91	2.6	3.3	61	1.3	ZV225S_K202_0044 EZ703U	5.2	12	138	4.364	1.91	1.66	2.86	77	39	12	16	2	25	53.1
2.08	1.1	1.2	27	3.0	ZV225S_K202_0040 EZ701U	2.9	11	78	4.000	2.08	1.81	3.13	77	39	12	16	2	25	53.1
2.08	1.8	2.1	45	1.9	ZV225S_K202_0040 EZ702U	5.2	11	138	4.000	2.08	1.81	3.13	77	39	12	16	2	25	53.1
2.08	2.0	2.3	50	1.7	ZV225S_K202_0040 EZ505U	5.2	11	138	4.000	2.08	1.81	3.13	77	39	12	16	2	25	53.1
2.08	2.4	3.0	61	1.4	ZV225S_K202_0040 EZ703U	5.2	11	138	4.000	2.08	1.81	3.13	77	39	12	16	2	25	53.1
ZV2K2 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 5,2 kN)																			
1.08	4.0	6.5	37	1.0	ZV225S_K202_0115 EZ505U	5.2	15	138	11.55	0.84	0.75	1.20	77	39	12	16	2	25	53.1
1.24	3.5	5.6	37	1.1	ZV225S_K202_0100 EZ505U	5.2	15	138	10.07	1.08	0.97	1.52	77	39	12	16	2	25	53.1
1.36	3.2	5.1	38	1.2	ZV225S_K202_0092 EZ505U	5.2	15	138	9.190	1.06	0.94	1.51	77	39	12	16	2	25	53.1
1.49	2.9	4.7	38	1.3	ZV225S_K202_0084 EZ505U	5.2	15	138	8.397	1.16	1.03	1.65	77	39	12	16	2	25	53.1
1.76	2.5	4.0	39	1.4	ZV225S_K202_0071 EZ505U	5.2	15	138	7.118	1.17	1.02	1.76	77	39	12	16	2	25	53.1
1.76	3.1	5.2	49	1.1	ZV225S_K202_0071 EZ703U	5.2	15	138	7.118	1.17	1.02	1.76	77	39	12	16	2	25	53.1
1.87	2.3	3.7	39	1.5	ZV225S_K202_0067 EZ505U	5.2	15	138	6.683	1.46	1.29	2.08	77	39	12	16	2	25	53.1
1.87	3.0	4.9	49	1.1	ZV225S_K202_0067 EZ703U	5.2	15	138	6.683	1.46	1.29	2.08	77	39	12	16	2	25	53.1
2.08	2.1	3.4	39	1.6	ZV225S_K202_0060 EZ505U	5.2	15	138	6.000	1.39	1.20	2.08	77	39	12	16	2	25	53.1
2.08	2.7	4.4	50	1.2	ZV225S_K202_0060 EZ703U	5.2	15	138	6.000	1.39	1.20	2.08	77	39	12	16	2	25	53.1
2.41	1.8	2.9	40	1.7	ZV225S_K202_0052 EZ505U	5.2	14	138	5.177	1.61	1.40	2.41	77	39	12	16	2	25	53.1
2.41	2.3	3.8	50	1.4	ZV225S_K202_0052 EZ703U	5.2	14	138	5.177	1.61	1.40	2.41	77	39	12	16	2	25	53.1

v_{f2}	F_{f2}	$F_{f2,0}$	a_{th}	S	Type	F_{f2accE}	$F_{f2NOT,E}$	M_{2accE}	i	$v_{f2maxDB}$		$v_{f2maxZB}$	Δs	$Δs_{redII}$	$Δs_{redI}$	C_{linE}	m_n	z	d_0
										EL1,2	EL3,4,5,6								
[m/s]	[kN]	[kN]				[kN]	[kN]	[Nm]		[m/s]	[m/s]	[m/s]	[µm]	[µm]	[µm]	[N/µm]	[mm]		[mm]
ZV2K2 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 5,2 kN)																			
2.86	1.5	2.4	40	1.9	ZV225S_K202_0044 EZ505U	5.2	12	138	4.364	1.91	1.66	2.86	77	39	12	16	2	25	53.1
2.86	1.9	3.2	51	1.5	ZV225S_K202_0044 EZ703U	5.2	12	138	4.364	1.91	1.66	2.86	77	39	12	16	2	25	53.1
3.13	1.4	2.2	40	2.1	ZV225S_K202_0040 EZ505U	5.2	11	138	4.000	2.08	1.81	3.13	77	39	12	16	2	25	53.1
3.13	1.8	2.9	51	1.6	ZV225S_K202_0040 EZ703U	5.2	11	138	4.000	2.08	1.81	3.13	77	39	12	16	2	25	53.1
ZV2K2 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 5,2 kN)																			
0.12	4.3	4.6	3.6	1.2	ZV225S_K203_1350 EZ301U	5.2	15	138	135.3	0.08	0.08	0.13	77	46	19	16	2	25	53.1
0.15	3.5	3.7	3.4	1.5	ZV225S_K203_1090 EZ301U	5.2	15	138	109.5	0.10	0.10	0.17	77	46	19	16	2	25	53.1
0.18	2.9	3.1	3.3	1.8	ZV225S_K203_0910 EZ301U	5.2	15	138	90.79	0.12	0.12	0.20	77	46	19	16	2	25	53.1
0.18	4.9	5.5	5.5	1.1	ZV225S_K203_0910 EZ302U	5.2	15	138	90.79	0.12	0.12	0.20	77	46	19	16	2	25	53.1
0.21	2.6	2.7	3.2	2.0	ZV225S_K203_0800 EZ301U	5.2	15	138	79.62	0.14	0.14	0.23	77	46	19	16	2	25	53.1
0.21	4.3	4.8	5.4	1.2	ZV225S_K203_0800 EZ302U	5.2	15	138	79.62	0.14	0.14	0.23	77	46	19	16	2	25	53.1
0.24	2.3	2.4	4.7	2.2	ZV225S_K202_0690 EZ301U	5.2	9.5	138	69.43	0.16	0.16	0.26	77	39	12	16	2	25	53.1
0.24	3.8	4.3	7.9	1.3	ZV225S_K202_0690 EZ302U	5.2	9.5	138	69.43	0.16	0.16	0.26	77	39	12	16	2	25	53.1
0.24	5.0	5.7	10	1.0	ZV225S_K202_0690 EZ303U	5.2	9.5	138	69.43	0.16	0.16	0.26	77	39	12	16	2	25	53.1
0.24	2.2	2.3	3.2	2.4	ZV225S_K203_0680 EZ301U	5.2	15	138	68.42	0.16	0.16	0.26	77	46	19	16	2	25	53.1
0.24	3.7	4.1	5.5	1.4	ZV225S_K203_0680 EZ302U	5.2	15	138	68.42	0.16	0.16	0.26	77	46	19	16	2	25	53.1
0.24	4.8	5.5	7.1	1.1	ZV225S_K203_0680 EZ303U	5.2	15	138	68.42	0.16	0.16	0.26	77	46	19	16	2	25	53.1
0.25	2.1	2.3	3.3	2.5	ZV225S_K203_0660 EZ301U	5.2	15	138	66.03	0.17	0.16	0.27	77	46	19	16	2	25	53.1
0.25	3.6	4.0	5.5	1.5	ZV225S_K203_0660 EZ302U	5.2	15	138	66.03	0.17	0.16	0.27	77	46	19	16	2	25	53.1
0.25	4.7	5.4	7.2	1.1	ZV225S_K203_0660 EZ303U	5.2	15	138	66.03	0.17	0.16	0.27	77	46	19	16	2	25	53.1
0.30	1.8	1.9	3.7	2.9	ZV225S_K202_0560 EZ301U	5.2	10	138	55.54	0.20	0.20	0.33	77	39	12	16	2	25	53.1
0.30	3.0	3.4	6.3	1.7	ZV225S_K202_0560 EZ302U	5.2	10	138	55.54	0.20	0.20	0.33	77	39	12	16	2	25	53.1
0.30	4.0	4.6	8.2	1.3	ZV225S_K202_0560 EZ303U	5.2	10	138	55.54	0.20	0.20	0.33	77	39	12	16	2	25	53.1
0.30	4.7	5.7	9.6	1.1	ZV225S_K202_0560 EZ401U	5.2	10	138	55.54	0.20	0.20	0.33	77	39	12	16	2	25	53.1
0.31	1.7	1.9	3.3	3.0	ZV225S_K203_0540 EZ301U	5.2	13	138	54.25	0.21	0.20	0.33	77	46	19	16	2	25	53.1
0.31	2.9	3.3	5.6	1.8	ZV225S_K203_0540 EZ302U	5.2	13	138	54.25	0.21	0.20	0.33	77	46	19	16	2	25	53.1
0.31	3.8	4.4	7.3	1.4	ZV225S_K203_0540 EZ303U	5.2	13	138	54.25	0.21	0.20	0.33	77	46	19	16	2	25	53.1
0.31	4.5	5.5	8.5	1.2	ZV225S_K203_0540 EZ401U	5.2	13	138	54.25	0.21	0.20	0.33	77	46	19	16	2	25	53.1
0.33	1.6	1.8	6.0	2.2	ZV225S_K202_0500 EZ301U	4.4	6.9	116	50.49	0.22	0.22	0.36	77	39	12	16	2	25	53.1
0.33	2.8	3.1	10	1.3	ZV225S_K202_0500 EZ302U	4.4	6.9	116	50.49	0.22	0.22	0.36	77	39	12	16	2	25	53.1
0.33	3.6	4.2	13	1.0	ZV225S_K202_0500 EZ303U	4.4	6.9	116	50.49	0.22	0.22	0.36	77	39	12	16	2	25	53.1
0.34	1.6	1.7	3.3	3.3	ZV225S_K203_0500 EZ301U	5.0	12	133	49.76	0.22	0.22	0.36	77	46	19	16	2	25	53.1
0.34	2.7	3.0	5.6	1.9	ZV225S_K203_0500 EZ302U	5.2	12	138	49.76	0.22	0.22	0.36	77	46	19	16	2	25	53.1
0.34	3.5	4.0	7.3	1.5	ZV225S_K203_0500 EZ303U	5.2	12	138	49.76	0.22	0.22	0.36	77	46	19	16	2	25	53.1
0.34	4.1	5.0	8.6	1.3	ZV225S_K203_0500 EZ401U	5.2	12	138	49.76	0.22	0.22	0.36	77	46	19	16	2	25	53.1
0.36	1.5	1.6	3.4	3.5	ZV225S_K202_0460 EZ301U	4.7	9.7	126	46.23	0.24	0.23	0.39	77	39	12	16	2	25	53.1
0.36	2.5	2.8	5.7	2.1	ZV225S_K202_0460 EZ302U	5.2	9.7	138	46.23	0.24	0.23	0.39	77	39	12	16	2	25	53.1
0.36	3.3	3.8	7.5	1.6	ZV225S_K202_0460 EZ303U	5.2	9.7	138	46.23	0.24	0.23	0.39	77	39	12	16	2	25	53.1
0.36	3.9	4.7	8.8	1.3	ZV225S_K202_0460 EZ401U	5.2	15	138	46.23	0.24	0.23	0.39	77	39	12	16	2	25	53.1
0.37	1.5	1.5	3.4	3.6	ZV225S_K203_0450 EZ301U	4.6	11	121	45.22	0.25	0.24	0.40	77	46	19	16	2	25	53.1
0.37	2.4	2.7	5.7	2.1	ZV225S_K203_0450 EZ302U	5.2	11	138	45.22	0.25	0.24	0.40	77	46	19	16	2	25	53.1
0.37	3.2	3.7	7.4	1.6	ZV225S_K203_0450 EZ303U	5.2	11	138	45.22	0.25	0.24	0.40	77	46	19	16	2	25	53.1
0.37	3.7	4.6	8.7	1.4	ZV225S_K203_0450 EZ401U	5.2	11	138	45.22	0.25	0.24	0.40	77	46	19	16	2	25	53.1
0.41	1.3	1.4	4.7	3.3	ZV225S_K202_0400 EZ301U	4.1	7.4	110	40.39	0.28	0.27	0.45	77	39	12	16	2	25	53.1
0.41	2.2	2.5	7.9	2.0	ZV225S_K202_0400 EZ302U	5.2	7.4	138	40.39	0.28	0.27	0.45	77	39	12	16	2	25	53.1
0.41	2.9	3.3	10	1.5	ZV225S_K202_0400 EZ303U	5.2	7.4	138	40.39	0.28	0.27	0.45	77	39	12	16	2	25	53.1
0.41	3.4	4.1	12	1.3	ZV225S_K202_0400 EZ401U	5.2	7.4	138	40.39	0.28	0.27	0.45	77	39	12	16	2	25	53.1
0.42	1.3	1.4	3.4	4.1	ZV225S_K203_0390 EZ301U	4.0	9.5	106	39.45	0.28	0.28	0.46	77	46	19	16	2	25	53.1
0.42	2.1	2.4	5.7	2.4	ZV225S_K203_0390 EZ302U	5.2	9.5	138	39.45	0.28	0.28	0.46	77	46	19	16	2	25	53.1
0.42	2.8	3.2	7.5	1.9	ZV225S_K203_0390 EZ303U	5.2	9.5	138	39.45	0.28	0.28	0.46	77	46	19	16	2	25	53.1
0.42	3.3	4.0	8.8	1.6	ZV225S_K203_0390 EZ401U	5.2	9.5	138	39.45	0.28	0.28	0.46	77	46	19	16	2	25	53.1
0.48	1.1	1.2	3.5	4.6	ZV225S_K202_0350 EZ301U	3.5	8.1	94	34.55	0.32	0.31	0.52	77	39	12	16	2	25	53.1
0.48	1.9	2.1	5.9	2.8	ZV225S_K202_0350 EZ302U	5.2	8.1	138	34.55	0.32	0.31	0.52	77	39	12	16	2	25	53.1
0.48	2.5	2.8	7.7	2.1	ZV225S_K202_0350 EZ303U	5.2	8.1	138	34.55	0.32	0.31	0.52	77	39	12	16	2	25	53.1
0.48	2.9	3.5	9.0	1.8	ZV225S_K202_0350 EZ401U	5.2	15	138	34.55	0.32	0.31	0.52	77	39	12	16	2	25	53.1
0.48	4.3	5.6	13	1.2	ZV225S_K202_0350 EZ501U	5.2	15	138	34.55	0.32	0.31	0.52	77	39	12	16	2	25	53.1
0.48	4.4	6.2	14	1.2	ZV225S_K202_0350 EZ402U	5.2	15	138	34.55	0.32	0.31	0.52	77	39	12	16	2	25	53.1
0.50	1.1	1.2	3.5	4.8	ZV225S_K202_0340 EZ301U	3.4	7.1	91	33.62	0.33	0.32	0.54	77	39	12	16	2	25	53.1
0.50	1.8	2.1	5.9	2.8	ZV225S_K202_0340 EZ302U	5.2	7.1	138	33.62	0.33	0.32	0.54	77	39	12	16	2	25	53.1
0.50	2.4	2.8	7.7	2.2	ZV225S_K202_0340 EZ303U	5.2	7.1	138	33.62	0.33	0.32	0.54	77	39	12	16	2	25	53.1
0.50	2.8	3.4	9.0	1.8	ZV225S_K202_0340 EZ401U	5.2	12	138	33.62	0.33	0.32	0.54	77	39	12	16	2	25	53.1
0.50	4.2	5.4	13	1.2	ZV225S_K202_0340 EZ501U	5.2	12	138	33.62	0.33	0.32	0.54	77	39	12	16	2	25	53.1
0.50	4.3	6.0	14	1.2	ZV225S_K202_0340 EZ402U	5.2	12	138	33.62	0.33	0.32	0.54	77	39	12	16	2	25	53.1
0.60	2.4	2.9	9.2	2.1	ZV225S_K202_0280 EZ401U	5.2	15	138	27.95	0.40	0.39	0.65	77	39	12	16	2	25	53.1

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ EL1,2 [m/s]	$v_{f2maxDB}$ EL3,4,5,6 [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{redII}$ [µm]	$Δs_{redI}$ [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV2K2 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 5,2 kN)																			
0.60	3.5	4.5	14	1.4	ZV225S_K202_0280 EZ501U	5.2	15	138	27.95	0.40	0.39	0.65	77	39	12	16	2	25	53.1
0.60	3.6	5.0	14	1.4	ZV225S_K202_0280 EZ402U	5.2	15	138	27.95	0.40	0.39	0.65	77	39	12	16	2	25	53.1
0.66	1.4	1.5	6.5	3.4	ZV225S_K202_0250 EZ302U	4.6	5.9	122	25.13	0.44	0.43	0.72	77	39	12	16	2	25	53.1
0.66	1.8	2.1	8.5	2.6	ZV225S_K202_0250 EZ303U	4.7	5.9	125	25.13	0.44	0.43	0.72	77	39	12	16	2	25	53.1
0.66	2.1	2.6	9.2	2.3	ZV225S_K202_0250 EZ401U	5.2	15	138	25.13	0.44	0.43	0.72	77	39	12	16	2	25	53.1
0.66	3.1	4.0	14	1.5	ZV225S_K202_0250 EZ501U	5.2	15	138	25.13	0.44	0.43	0.72	77	39	12	16	2	25	53.1
0.66	3.2	4.5	14	1.5	ZV225S_K202_0250 EZ402U	5.2	15	138	25.13	0.44	0.43	0.72	77	39	12	16	2	25	53.1
0.66	4.8	7.2	21	1.0	ZV225S_K202_0250 EZ502U	5.2	15	138	25.13	0.44	0.43	0.72	77	39	12	16	2	25	53.1
0.66	4.8	7.3	21	1.0	ZV225S_K202_0250 EZ701U	5.2	15	138	25.13	0.44	0.43	0.72	77	39	12	16	2	25	53.1
0.72	1.3	1.4	6.1	3.7	ZV225S_K202_0230 EZ302U	4.2	6.4	112	23.18	0.48	0.47	0.78	77	39	12	16	2	25	53.1
0.72	1.7	1.9	7.9	2.8	ZV225S_K202_0230 EZ303U	5.1	6.4	135	23.18	0.48	0.47	0.78	77	39	12	16	2	25	53.1
0.72	1.9	2.4	9.3	2.4	ZV225S_K202_0230 EZ401U	5.2	15	138	23.18	0.48	0.47	0.78	77	39	12	16	2	25	53.1
0.72	2.9	3.7	14	1.6	ZV225S_K202_0230 EZ501U	5.2	15	138	23.18	0.48	0.47	0.78	77	39	12	16	2	25	53.1
0.72	3.0	4.2	14	1.6	ZV225S_K202_0230 EZ402U	5.2	15	138	23.18	0.48	0.47	0.78	77	39	12	16	2	25	53.1
0.72	4.4	6.6	21	1.1	ZV225S_K202_0230 EZ502U	5.2	15	138	23.18	0.48	0.47	0.78	77	39	12	16	2	25	53.1
0.72	4.4	6.7	21	1.1	ZV225S_K202_0230 EZ701U	5.2	15	138	23.18	0.48	0.47	0.78	77	39	12	16	2	25	53.1
0.82	1.7	2.1	9.4	2.6	ZV225S_K202_0200 EZ401U	5.2	15	138	20.33	0.55	0.53	0.89	77	39	12	16	2	25	53.1
0.82	2.5	3.3	14	1.8	ZV225S_K202_0200 EZ501U	5.2	15	138	20.33	0.55	0.53	0.89	77	39	12	16	2	25	53.1
0.82	2.6	3.6	14	1.7	ZV225S_K202_0200 EZ402U	5.2	15	138	20.33	0.55	0.53	0.89	77	39	12	16	2	25	53.1
0.82	3.9	5.8	21	1.2	ZV225S_K202_0200 EZ502U	5.2	15	138	20.33	0.55	0.53	0.89	77	39	12	16	2	25	53.1
0.82	3.9	5.9	21	1.2	ZV225S_K202_0200 EZ701U	5.2	15	138	20.33	0.55	0.53	0.89	77	39	12	16	2	25	53.1
0.82	4.3	6.2	24	1.0	ZV225S_K202_0200 EZ404U	5.2	15	138	20.33	0.55	0.53	0.89	77	39	12	16	2	25	53.1
0.99	0.9	1.0	7.5	4.0	ZV225S_K202_0170 EZ302U	3.1	4.6	82	16.86	0.66	0.64	1.07	77	39	12	16	2	25	53.1
0.99	1.2	1.4	9.8	3.1	ZV225S_K202_0170 EZ303U	3.7	4.6	98	16.86	0.66	0.64	1.07	77	39	12	16	2	25	53.1
0.99	1.4	1.7	9.5	3.0	ZV225S_K202_0170 EZ401U	5.2	15	138	16.86	0.66	0.64	1.07	77	39	12	16	2	25	53.1
0.99	2.1	2.7	14	2.0	ZV225S_K202_0170 EZ501U	5.2	15	138	16.86	0.66	0.64	1.07	77	39	12	16	2	25	53.1
0.99	2.2	3.0	15	1.9	ZV225S_K202_0170 EZ402U	5.2	15	138	16.86	0.66	0.64	1.07	77	39	12	16	2	25	53.1
0.99	3.2	4.8	22	1.3	ZV225S_K202_0170 EZ502U	5.2	15	138	16.86	0.66	0.64	1.07	77	39	12	16	2	25	53.1
0.99	3.2	4.9	22	1.3	ZV225S_K202_0170 EZ701U	5.2	15	138	16.86	0.66	0.64	1.07	77	39	12	16	2	25	53.1
0.99	3.6	5.2	24	1.2	ZV225S_K202_0170 EZ404U	5.2	15	138	16.86	0.66	0.64	1.07	77	39	12	16	2	25	53.1
0.99	3.8	6.5	26	1.1	ZV225S_K202_0170 EZ503U	5.2	15	138	16.86	0.66	0.64	1.07	77	39	12	16	2	25	53.1
ZV3K2 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 5,4 kN)																			
0.07	4.2	4.3	3.8	1.3	ZV318S_K203_1350 EZ301U	5.4	14	154	135.3	0.09	0.09	0.14	83	50	21	16	3	18	57.3
0.08	3.4	3.5	3.6	1.6	ZV318S_K203_1090 EZ301U	5.4	14	154	109.5	0.11	0.11	0.18	83	50	21	16	3	18	57.3
0.10	2.8	2.9	3.4	1.9	ZV318S_K203_0910 EZ301U	5.4	14	154	90.79	0.13	0.13	0.22	83	50	21	16	3	18	57.3
0.10	4.8	5.1	5.9	1.1	ZV318S_K203_0910 EZ302U	5.4	14	154	90.79	0.13	0.13	0.22	83	50	21	16	3	18	57.3
0.11	2.5	2.5	3.3	2.2	ZV318S_K203_0800 EZ301U	5.4	14	154	79.62	0.15	0.15	0.25	83	50	21	16	3	18	57.3
0.11	4.2	4.5	5.7	1.3	ZV318S_K203_0800 EZ302U	5.4	14	154	79.62	0.15	0.15	0.25	83	50	21	16	3	18	57.3
0.13	2.2	2.2	4.9	2.1	ZV318S_K202_0690 EZ301U	5.4	8.8	154	69.43	0.17	0.17	0.28	83	42	12	16	3	18	57.3
0.13	3.7	3.9	8.4	1.2	ZV318S_K202_0690 EZ302U	5.4	8.8	154	69.43	0.17	0.17	0.28	83	42	12	16	3	18	57.3
0.13	2.1	2.2	3.2	2.5	ZV318S_K203_0680 EZ301U	5.4	14	154	68.42	0.18	0.17	0.29	83	50	21	16	3	18	57.3
0.13	3.6	3.8	5.5	1.5	ZV318S_K203_0680 EZ302U	5.4	14	154	68.42	0.18	0.17	0.29	83	50	21	16	3	18	57.3
0.13	4.7	5.0	7.1	1.1	ZV318S_K203_0680 EZ303U	5.4	14	154	68.42	0.18	0.17	0.29	83	50	21	16	3	18	57.3
0.14	2.0	2.1	3.2	2.6	ZV318S_K203_0660 EZ301U	5.4	14	154	66.03	0.18	0.18	0.30	83	50	21	16	3	18	57.3
0.14	3.5	3.7	5.4	1.5	ZV318S_K203_0660 EZ302U	5.4	14	154	66.03	0.18	0.18	0.30	83	50	21	16	3	18	57.3
0.14	4.6	4.8	7.1	1.2	ZV318S_K203_0660 EZ303U	5.4	14	154	66.03	0.18	0.18	0.30	83	50	21	16	3	18	57.3
0.16	1.7	1.8	3.9	3.1	ZV318S_K202_0560 EZ301U	5.3	9.4	151	55.54	0.22	0.21	0.35	83	42	12	16	3	18	57.3
0.16	3.0	3.2	6.6	1.8	ZV318S_K202_0560 EZ302U	5.4	9.4	154	55.54	0.22	0.21	0.35	83	42	12	16	3	18	57.3
0.16	3.9	4.1	8.6	1.4	ZV318S_K202_0560 EZ303U	5.4	9.4	154	55.54	0.22	0.21	0.35	83	42	12	16	3	18	57.3
0.16	5.3	5.6	12	1.0	ZV318S_K202_0560 EZ401U	5.4	9.4	154	55.54	0.22	0.21	0.35	83	42	12	16	3	18	57.3
0.17	1.7	1.7	3.0	3.2	ZV318S_K203_0540 EZ301U	5.1	12	145	54.25	0.22	0.22	0.36	83	50	21	16	3	18	57.3
0.17	2.9	3.0	5.2	1.9	ZV318S_K203_0540 EZ302U	5.4	12	154	54.25	0.22	0.22	0.36	83	50	21	16	3	18	57.3
0.17	3.7	4.0	6.7	1.4	ZV318S_K203_0540 EZ303U	5.4	12	154	54.25	0.22	0.22	0.36	83	50	21	16	3	18	57.3
0.17	5.1	5.4	9.1	1.1	ZV318S_K203_0540 EZ401U	5.4	12	154	54.25	0.22	0.22	0.36	83	50	21	16	3	18	57.3
0.18	1.6	1.6	6.2	2.1	ZV318S_K202_0500 EZ301U	4.0	6.4	116	50.49	0.24	0.23	0.39	83	42	12	16	3	18	57.3
0.18	2.7	2.9	11	1.2	ZV318S_K202_0500 EZ302U	4.0	6.4	116	50.49	0.24	0.23	0.39	83	42	12	16	3	18	57.3
0.18	1.5	1.6	3.0	3.5	ZV318S_K203_0500 EZ301U	4.6	11	133	49.76	0.24	0.24	0.39	83	50	21	16	3	18	57.3
0.18	2.6	2.8	5.0	2.0	ZV318S_K203_0500 EZ302U	5.4	11	154	49.76	0.24	0.24	0.39	83	50	21	16	3	18	57.3
0.18	3.4	3.6	6.6	1.6	ZV318S_K203_0500 EZ303U	5.4	11	154	49.76	0.24	0.24	0.39	83	50	21	16	3	18	57.3
0.18	4.6	5.0	8.9	1.2	ZV318S_K203_0500 EZ401U	5.4	11	154	49.76	0.24	0.24	0.39	83	50	21	16	3	18	57.3
0.20	1.5	1.5	2.9	3.7	ZV318S_K202_0460 EZ301U	4.4	9.0	126	46.23	0.26	0.25	0.42	83	42	12	16	3	18	57.3
0.20	2.5	2.6	5.0	2.2	ZV318S_K202_0460 EZ302U	5.4	9.0	154	46.23	0.26	0.25	0.42	83	42	12	16	3	18	57.3
0.20	3.2	3.4	6.5	1.7	ZV318S_K202_0460 EZ303U	5.4	9.0	154	46.23	0.26	0.25	0.42	83	42	12	16	3	18	57.3
0.20	4.4	4.7	8.9	1.2	ZV318S_K202_0460 EZ401U	5.4	14	154	46.23	0.26	0.25	0.42	83	42	12	16	3	18	57.3

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ EL1,2 [m/s]	$v_{f2maxDB}$ EL3,4,5,6 [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{redII}$ [µm]	$Δs_{redI}$ [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV3K2 (n_{1N} = 3000 min^{-1}), ($F_{f2acc,max}$ = 5,4 kN)																			
0.20	1.4	1.4	2.9	3.8	ZV318S_K203_0450 EZ301U	4.2	10	121	45.22	0.27	0.26	0.43	83	50	21	16	3	18	57.3
0.20	2.4	2.5	4.9	2.2	ZV318S_K203_0450 EZ302U	5.4	10	154	45.22	0.27	0.26	0.43	83	50	21	16	3	18	57.3
0.20	3.1	3.3	6.4	1.7	ZV318S_K203_0450 EZ303U	5.4	10	154	45.22	0.27	0.26	0.43	83	50	21	16	3	18	57.3
0.20	4.2	4.5	8.7	1.3	ZV318S_K203_0450 EZ401U	5.4	10	154	45.22	0.27	0.26	0.43	83	50	21	16	3	18	57.3
0.22	1.3	1.3	4.9	3.2	ZV318S_K202_0400 EZ301U	3.8	6.9	110	40.39	0.30	0.29	0.48	83	42	12	16	3	18	57.3
0.22	2.2	2.3	8.4	1.9	ZV318S_K202_0400 EZ302U	4.8	6.9	139	40.39	0.30	0.29	0.48	83	42	12	16	3	18	57.3
0.22	2.8	3.0	11	1.4	ZV318S_K202_0400 EZ303U	4.8	6.9	139	40.39	0.30	0.29	0.48	83	42	12	16	3	18	57.3
0.22	3.8	4.1	15	1.1	ZV318S_K202_0400 EZ401U	4.8	6.9	139	40.39	0.30	0.29	0.48	83	42	12	16	3	18	57.3
0.23	1.2	1.3	2.8	4.4	ZV318S_K203_0390 EZ301U	3.7	8.8	106	39.45	0.30	0.30	0.49	83	50	21	16	3	18	57.3
0.23	2.1	2.2	4.8	2.6	ZV318S_K203_0390 EZ302U	5.4	8.8	154	39.45	0.30	0.30	0.49	83	50	21	16	3	18	57.3
0.23	2.7	2.9	6.3	2.0	ZV318S_K203_0390 EZ303U	5.4	8.8	154	39.45	0.30	0.30	0.49	83	50	21	16	3	18	57.3
0.23	3.7	3.9	8.5	1.5	ZV318S_K203_0390 EZ401U	5.4	8.8	154	39.45	0.30	0.30	0.49	83	50	21	16	3	18	57.3
0.26	1.1	1.1	3.2	4.9	ZV318S_K202_0350 EZ301U	3.3	7.5	94	34.55	0.35	0.34	0.56	83	42	12	16	3	18	57.3
0.26	1.9	2.0	5.5	2.9	ZV318S_K202_0350 EZ302U	5.4	7.5	154	34.55	0.35	0.34	0.56	83	42	12	16	3	18	57.3
0.26	2.4	2.6	7.1	2.2	ZV318S_K202_0350 EZ303U	5.4	7.5	154	34.55	0.35	0.34	0.56	83	42	12	16	3	18	57.3
0.26	3.3	3.5	8.7	1.6	ZV318S_K202_0350 EZ401U	5.4	14	154	34.55	0.35	0.34	0.56	83	42	12	16	3	18	57.3
0.26	5.0	5.5	13	1.1	ZV318S_K202_0350 EZ501U	5.4	14	154	34.55	0.35	0.34	0.56	83	42	12	16	3	18	57.3
0.27	1.1	1.1	3.6	4.9	ZV318S_K202_0340 EZ301U	3.2	6.5	91	33.62	0.36	0.35	0.58	83	42	12	16	3	18	57.3
0.27	1.8	1.9	6.2	2.9	ZV318S_K202_0340 EZ302U	5.2	6.5	150	33.62	0.36	0.35	0.58	83	42	12	16	3	18	57.3
0.27	2.4	2.5	8.1	2.2	ZV318S_K202_0340 EZ303U	5.2	6.5	150	33.62	0.36	0.35	0.58	83	42	12	16	3	18	57.3
0.27	3.2	3.4	11	1.7	ZV318S_K202_0340 EZ401U	5.4	11	154	33.62	0.36	0.35	0.58	83	42	12	16	3	18	57.3
0.27	4.9	5.3	16	1.1	ZV318S_K202_0340 EZ501U	5.4	11	154	33.62	0.36	0.35	0.58	83	42	12	16	3	18	57.3
0.27	5.3	5.9	18	1.0	ZV318S_K202_0340 EZ402U	5.4	11	154	33.62	0.36	0.35	0.58	83	42	12	16	3	18	57.3
0.32	2.6	2.8	8.8	2.0	ZV318S_K202_0280 EZ401U	5.4	14	154	27.95	0.43	0.42	0.70	83	42	12	16	3	18	57.3
0.32	4.1	4.4	14	1.3	ZV318S_K202_0280 EZ501U	5.4	14	154	27.95	0.43	0.42	0.70	83	42	12	16	3	18	57.3
0.32	4.4	4.9	15	1.2	ZV318S_K202_0280 EZ402U	5.4	14	154	27.95	0.43	0.42	0.70	83	42	12	16	3	18	57.3
0.36	1.4	1.4	6.9	3.2	ZV318S_K202_0250 EZ302U	4.3	5.4	122	25.13	0.48	0.47	0.78	83	42	12	16	3	18	57.3
0.36	1.8	1.9	9.0	2.5	ZV318S_K202_0250 EZ303U	4.4	5.4	125	25.13	0.48	0.47	0.78	83	42	12	16	3	18	57.3
0.36	2.4	2.6	8.9	2.3	ZV318S_K202_0250 EZ401U	5.4	14	154	25.13	0.48	0.47	0.78	83	42	12	16	3	18	57.3
0.36	3.7	4.0	14	1.5	ZV318S_K202_0250 EZ501U	5.4	14	154	25.13	0.48	0.47	0.78	83	42	12	16	3	18	57.3
0.36	4.0	4.4	15	1.3	ZV318S_K202_0250 EZ402U	5.4	14	154	25.13	0.48	0.47	0.78	83	42	12	16	3	18	57.3
0.39	1.2	1.3	6.3	3.8	ZV318S_K202_0230 EZ302U	3.9	5.9	112	23.18	0.52	0.51	0.84	83	42	12	16	3	18	57.3
0.39	1.6	1.7	8.2	2.9	ZV318S_K202_0230 EZ303U	4.7	5.9	135	23.18	0.52	0.51	0.84	83	42	12	16	3	18	57.3
0.39	2.2	2.4	9.0	2.4	ZV318S_K202_0230 EZ401U	5.4	14	154	23.18	0.52	0.51	0.84	83	42	12	16	3	18	57.3
0.39	3.4	3.7	14	1.6	ZV318S_K202_0230 EZ501U	5.4	14	154	23.18	0.52	0.51	0.84	83	42	12	16	3	18	57.3
0.39	3.7	4.1	15	1.5	ZV318S_K202_0230 EZ402U	5.4	14	154	23.18	0.52	0.51	0.84	83	42	12	16	3	18	57.3
0.44	1.9	2.1	9.1	2.8	ZV318S_K202_0200 EZ401U	5.4	14	154	20.33	0.59	0.58	0.96	83	42	12	16	3	18	57.3
0.44	3.0	3.2	14	1.8	ZV318S_K202_0200 EZ501U	5.4	14	154	20.33	0.59	0.58	0.96	83	42	12	16	3	18	57.3
0.44	3.2	3.6	15	1.7	ZV318S_K202_0200 EZ402U	5.4	14	154	20.33	0.59	0.58	0.96	83	42	12	16	3	18	57.3
0.44	4.7	5.9	22	1.1	ZV318S_K202_0200 EZ404U	5.4	14	154	20.33	0.59	0.58	0.96	83	42	12	16	3	18	57.3
0.44	5.1	5.5	24	1.1	ZV318S_K202_0200 EZ502U	5.4	14	154	20.33	0.59	0.58	0.96	83	42	12	16	3	18	57.3
0.44	5.1	5.7	24	1.1	ZV318S_K202_0200 EZ701U	5.4	14	154	20.33	0.59	0.58	0.96	83	42	12	16	3	18	57.3
0.52	0.9	1.0	7.8	3.8	ZV318S_K202_0175 EZ302U	3.0	4.4	85	17.47	0.67	0.60	0.95	83	42	12	16	3	18	57.3
0.52	1.2	1.3	10	2.9	ZV318S_K202_0175 EZ303U	3.5	4.4	102	17.47	0.67	0.60	0.95	83	42	12	16	3	18	57.3
0.52	1.7	1.8	9.2	3.2	ZV318S_K202_0175 EZ401U	5.0	14	144	17.47	0.67	0.60	0.95	83	42	12	16	3	18	57.3
0.52	2.5	2.8	14	2.1	ZV318S_K202_0175 EZ501U	5.4	14	154	17.47	0.67	0.60	0.95	83	42	12	16	3	18	57.3
0.52	2.8	3.1	15	1.9	ZV318S_K202_0175 EZ402U	5.4	14	154	17.47	0.67	0.60	0.95	83	42	12	16	3	18	57.3
0.52	4.1	5.1	23	1.3	ZV318S_K202_0175 EZ404U	5.4	14	154	17.47	0.67	0.60	0.95	83	42	12	16	3	18	57.3
0.52	4.4	4.7	24	1.2	ZV318S_K202_0175 EZ502U	5.4	14	154	17.47	0.67	0.60	0.95	83	42	12	16	3	18	57.3
0.52	4.4	4.9	24	1.2	ZV318S_K202_0175 EZ701U	5.4	14	154	17.47	0.67	0.60	0.95	83	42	12	16	3	18	57.3
0.53	0.9	1.0	8.0	3.8	ZV318S_K202_0170 EZ302U	2.9	4.3	82	16.86	0.71	0.69	1.16	83	42	12	16	3	18	57.3
0.53	1.2	1.3	10	2.9	ZV318S_K202_0170 EZ303U	3.4	4.3	98	16.86	0.71	0.69	1.16	83	42	12	16	3	18	57.3
0.53	1.6	1.7	9.2	3.3	ZV318S_K202_0170 EZ401U	4.9	14	139	16.86	0.71	0.69	1.16	83	42	12	16	3	18	57.3
0.53	2.5	2.7	14	2.1	ZV318S_K202_0170 EZ501U	5.4	14	154	16.86	0.71	0.69	1.16	83	42	12	16	3	18	57.3
0.53	2.7	3.0	15	1.9	ZV318S_K202_0170 EZ402U	5.4	14	154	16.86	0.71	0.69	1.16	83	42	12	16	3	18	57.3
0.53	3.9	4.9	23	1.3	ZV318S_K202_0170 EZ404U	5.4	14	154	16.86	0.71	0.69	1.16	83	42	12	16	3	18	57.3
0.53	4.2	4.6	24	1.2	ZV318S_K202_0170 EZ502U	5.4	14	154	16.86	0.71	0.69	1.16	83	42	12	16	3	18	57.3
0.53	4.2	4.7	24	1.2	ZV318S_K202_0170 EZ701U	5.4	14	154	16.86	0.71	0.69	1.16	83	42	12	16	3	18	57.3
0.65	1.3	1.4	9.4	3.7	ZV318S_K202_0140 EZ401U	4.0	14	114	13.85	0.85	0.76	1.19	83	42	12	16	3	18	57.3
0.65	2.0	2.2	14	2.4	ZV318S_K202_0140 EZ501U	5.4	14	154	13.85	0.85	0.76	1.19	83	42	12	16	3	18	57.3
0.65	2.2	2.4	16	2.2	ZV318S_K202_0140 EZ402U	5.4	14	154	13.85	0.85	0.76	1.19	83	42	12	16	3	18	57.3
0.65	3.2	4.0	23	1.5	ZV318S_K202_0140 EZ404U	5.4	14	154	13.85	0.85	0.76	1.19	83	42	12	16	3	18	57.3
0.65	3.5	3.8	25	1.4	ZV318S_K202_0140 EZ502U	5.4	14	154	13.85	0.85	0.76	1.19	83	42	12	16	3	18	57.3
0.65	3.5	3.9	25	1.4	ZV318S_K202_0140 EZ701U	5.4	14	154	13.85	0.85	0.76	1.19	83	42	12	16	3	18	57.3

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ EL1,2 [m/s]	$v_{f2maxDB}$ EL3,4,5,6 [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{redII}$ [µm]	$Δs_{redI}$ [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV3K2 (n_{1N} = 3000 min^{-1}), ($F_{f2acc,max}$ = 5,4 kN)																			
0.65	4.5	5.2	32	1.1	ZV318S_K202_0140 EZ503U	5.4	14	154	13.85	0.85	0.76	1.19	83	42	12	16	3	18	57.3
0.71	0.7	0.7	9.8	3.8	ZV318S_K202_0125 EZ302U	2.2	3.2	62	12.71	0.92	0.83	1.30	83	42	12	16	3	18	57.3
0.71	0.9	0.9	13	2.9	ZV318S_K202_0125 EZ303U	2.6	3.2	74	12.71	0.92	0.83	1.30	83	42	12	16	3	18	57.3
0.71	1.2	1.3	9.4	3.9	ZV318S_K202_0125 EZ401U	3.7	13	105	12.71	0.92	0.83	1.30	83	42	12	16	3	18	57.3
0.71	1.8	2.0	15	2.6	ZV318S_K202_0125 EZ501U	5.4	13	154	12.71	0.92	0.83	1.30	83	42	12	16	3	18	57.3
0.71	2.0	2.2	16	2.3	ZV318S_K202_0125 EZ402U	5.4	13	154	12.71	0.92	0.83	1.30	83	42	12	16	3	18	57.3
0.71	3.0	3.7	23	1.6	ZV318S_K202_0125 EZ404U	5.4	13	154	12.71	0.92	0.83	1.30	83	42	12	16	3	18	57.3
0.71	3.2	3.4	25	1.5	ZV318S_K202_0125 EZ502U	5.4	13	154	12.71	0.92	0.83	1.30	83	42	12	16	3	18	57.3
0.71	3.2	3.6	25	1.5	ZV318S_K202_0125 EZ701U	5.4	14	154	12.71	0.92	0.83	1.30	83	42	12	16	3	18	57.3
0.71	4.2	4.8	33	1.1	ZV318S_K202_0125 EZ503U	5.4	13	154	12.71	0.92	0.83	1.30	83	42	12	16	3	18	57.3
0.78	0.6	0.7	11	3.8	ZV318S_K202_0115 EZ302U	2.0	2.9	56	11.55	0.91	0.81	1.30	83	42	12	16	3	18	57.3
0.78	0.8	0.9	14	2.9	ZV318S_K202_0115 EZ303U	2.3	2.9	67	11.55	0.91	0.81	1.30	83	42	12	16	3	18	57.3
0.78	1.1	1.2	9.5	4.2	ZV318S_K202_0115 EZ401U	3.3	12	95	11.55	0.91	0.81	1.30	83	42	12	16	3	18	57.3
0.78	1.7	1.8	15	2.7	ZV318S_K202_0115 EZ501U	5.4	12	154	11.55	0.91	0.81	1.30	83	42	12	16	3	18	57.3
0.78	1.8	2.0	16	2.5	ZV318S_K202_0115 EZ402U	5.4	12	154	11.55	0.91	0.81	1.30	83	42	12	16	3	18	57.3
0.78	2.7	3.4	23	1.7	ZV318S_K202_0115 EZ404U	5.4	12	154	11.55	0.91	0.81	1.30	83	42	12	16	3	18	57.3
0.78	2.9	3.1	25	1.6	ZV318S_K202_0115 EZ502U	5.4	12	154	11.55	0.91	0.81	1.30	83	42	12	16	3	18	57.3
0.78	2.9	3.2	25	1.6	ZV318S_K202_0115 EZ701U	5.4	14	154	11.55	0.91	0.81	1.30	83	42	12	16	3	18	57.3
0.78	3.8	4.3	33	1.2	ZV318S_K202_0115 EZ503U	5.4	12	154	11.55	0.91	0.81	1.30	83	42	12	16	3	18	57.3
0.89	1.0	1.0	9.6	4.6	ZV318S_K202_0100 EZ401U	2.9	10	83	10.07	1.16	1.04	1.64	83	42	12	16	3	18	57.3
0.89	1.5	1.6	15	3.0	ZV318S_K202_0100 EZ501U	5.4	10	154	10.07	1.16	1.04	1.64	83	42	12	16	3	18	57.3
0.89	1.6	1.8	16	2.7	ZV318S_K202_0100 EZ402U	5.4	10	154	10.07	1.16	1.04	1.64	83	42	12	16	3	18	57.3
0.89	2.4	2.9	24	1.9	ZV318S_K202_0100 EZ404U	5.4	10	154	10.07	1.16	1.04	1.64	83	42	12	16	3	18	57.3
0.89	2.5	2.7	25	1.7	ZV318S_K202_0100 EZ502U	5.4	10	154	10.07	1.16	1.04	1.64	83	42	12	16	3	18	57.3
0.89	2.5	2.8	25	1.7	ZV318S_K202_0100 EZ701U	5.4	14	154	10.07	1.16	1.04	1.64	83	42	12	16	3	18	57.3
0.89	3.3	3.8	33	1.3	ZV318S_K202_0100 EZ503U	5.4	10	154	10.07	1.16	1.04	1.64	83	42	12	16	3	18	57.3
0.89	4.1	4.9	41	1.1	ZV318S_K202_0100 EZ702U	5.4	14	154	10.07	1.16	1.04	1.64	83	42	12	16	3	18	57.3
0.98	0.9	0.9	9.7	4.9	ZV318S_K202_0092 EZ401U	2.6	9.3	76	9.190	1.14	1.01	1.63	83	42	12	16	3	18	57.3
0.98	1.3	1.5	15	3.2	ZV318S_K202_0092 EZ501U	5.0	9.3	143	9.190	1.14	1.01	1.63	83	42	12	16	3	18	57.3
0.98	1.5	1.6	16	2.9	ZV318S_K202_0092 EZ402U	5.0	9.3	143	9.190	1.14	1.01	1.63	83	42	12	16	3	18	57.3
0.98	2.1	2.7	24	2.0	ZV318S_K202_0092 EZ404U	5.4	9.3	154	9.190	1.14	1.01	1.63	83	42	12	16	3	18	57.3
0.98	2.3	2.5	26	1.8	ZV318S_K202_0092 EZ502U	5.4	9.3	154	9.190	1.14	1.01	1.63	83	42	12	16	3	18	57.3
0.98	2.3	2.6	26	1.8	ZV318S_K202_0092 EZ701U	5.4	14	154	9.190	1.14	1.01	1.63	83	42	12	16	3	18	57.3
0.98	3.0	3.5	34	1.4	ZV318S_K202_0092 EZ503U	5.4	9.3	154	9.190	1.14	1.01	1.63	83	42	12	16	3	18	57.3
0.98	3.7	4.5	42	1.1	ZV318S_K202_0092 EZ702U	5.4	14	154	9.190	1.14	1.01	1.63	83	42	12	16	3	18	57.3
0.98	4.2	5.0	47	1.0	ZV318S_K202_0092 EZ505U	5.4	14	154	9.190	1.14	1.01	1.63	83	42	12	16	3	18	57.3
1.07	0.5	0.5	13	3.8	ZV318S_K202_0084 EZ302U	1.4	2.1	41	8.397	1.25	1.11	1.79	83	42	12	16	3	18	57.3
1.07	0.6	0.6	17	2.9	ZV318S_K202_0084 EZ303U	1.7	2.1	49	8.397	1.25	1.11	1.79	83	42	12	16	3	18	57.3
1.07	1.2	1.3	15	3.4	ZV318S_K202_0084 EZ501U	4.5	8.5	130	8.397	1.25	1.11	1.79	83	42	12	16	3	18	57.3
1.07	1.3	1.5	16	3.1	ZV318S_K202_0084 EZ402U	4.5	8.5	130	8.397	1.25	1.11	1.79	83	42	12	16	3	18	57.3
1.07	2.0	2.4	24	2.1	ZV318S_K202_0084 EZ404U	5.4	8.5	154	8.397	1.25	1.11	1.79	83	42	12	16	3	18	57.3
1.07	2.1	2.3	26	2.0	ZV318S_K202_0084 EZ502U	5.4	8.5	154	8.397	1.25	1.11	1.79	83	42	12	16	3	18	57.3
1.07	2.1	2.4	26	2.0	ZV318S_K202_0084 EZ701U	5.4	14	154	8.397	1.25	1.11	1.79	83	42	12	16	3	18	57.3
1.07	2.8	3.2	34	1.5	ZV318S_K202_0084 EZ503U	5.4	8.5	154	8.397	1.25	1.11	1.79	83	42	12	16	3	18	57.3
1.07	3.4	4.1	42	1.2	ZV318S_K202_0084 EZ702U	5.4	14	154	8.397	1.25	1.11	1.79	83	42	12	16	3	18	57.3
1.07	3.8	4.5	47	1.1	ZV318S_K202_0084 EZ505U	5.4	14	154	8.397	1.25	1.11	1.79	83	42	12	16	3	18	57.3
1.26	1.8	2.0	26	2.2	ZV318S_K202_0071 EZ701U	4.8	14	138	7.118	1.26	1.10	1.90	83	42	12	16	3	18	57.3
1.26	2.9	3.5	42	1.4	ZV318S_K202_0071 EZ702U	5.4	14	154	7.118	1.26	1.10	1.90	83	42	12	16	3	18	57.3
1.26	3.3	3.9	48	1.2	ZV318S_K202_0071 EZ505U	5.4	14	154	7.118	1.26	1.10	1.90	83	42	12	16	3	18	57.3
1.35	1.0	1.1	15	3.9	ZV318S_K202_0067 EZ501U	3.6	6.8	104	6.683	1.57	1.39	2.24	83	42	12	16	3	18	57.3
1.35	1.1	1.2	17	3.6	ZV318S_K202_0067 EZ402U	3.6	6.8	104	6.683	1.57	1.39	2.24	83	42	12	16	3	18	57.3
1.35	1.6	1.9	25	2.4	ZV318S_K202_0067 EZ404U	5.4	6.8	154	6.683	1.57	1.39	2.24	83	42	12	16	3	18	57.3
1.35	1.7	1.8	26	2.3	ZV318S_K202_0067 EZ502U	5.4	6.8	154	6.683	1.57	1.39	2.24	83	42	12	16	3	18	57.3
1.35	1.7	1.9	26	2.3	ZV318S_K202_0067 EZ701U	4.5	14	130	6.683	1.57	1.39	2.24	83	42	12	16	3	18	57.3
1.35	2.2	2.5	35	1.7	ZV318S_K202_0067 EZ503U	5.4	6.8	154	6.683	1.57	1.39	2.24	83	42	12	16	3	18	57.3
1.35	2.7	3.3	43	1.4	ZV318S_K202_0067 EZ702U	5.4	14	154	6.683	1.57	1.39	2.24	83	42	12	16	3	18	57.3
1.35	3.1	3.6	48	1.3	ZV318S_K202_0067 EZ505U	5.4	14	154	6.683	1.57	1.39	2.24	83	42	12	16	3	18	57.3
1.35	3.7	4.7	59	1.0	ZV318S_K202_0067 EZ703U	5.4	14	154	6.683	1.57	1.39	2.24	83	42	12	16	3	18	57.3
1.50	0.9	1.0	15	4.2	ZV318S_K202_0060 EZ501U	3.3	6.1	93	6.000	1.50	1.30	2.25	83	42	12	16	3	18	57.3
1.50	1.0	1.1	17	3.9	ZV318S_K202_0060 EZ402U	3.3	6.1	93	6.000	1.50	1.30	2.25	83	42	12	16	3	18	57.3
1.50	1.4	1.7	25	2.6	ZV318S_K202_0060 EZ404U	4.9	6.1	140	6.000	1.50	1.30	2.25	83	42	12	16	3	18	57.3
1.50	1.5	1.6	27	2.5	ZV318S_K202_0060 EZ502U	4.9	6.1	140	6.000	1.50	1.30	2.25	83	42	12	16	3	18	57.3
1.50	1.5	1.7	27	2.5	ZV318S_K202_0060 EZ701U	4.1	14	116	6.000	1.50	1.30	2.25	83	42	12	16	3	18	57.3
1.50	2.0	2.3	35	1.9	ZV318S_K202_0060 EZ503U	4.9	6.1	140	6.000	1.50	1.30	2.25	83	42	12	16	3	18	57.3

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ EL1,2 [m/s]	$v_{f2maxDB}$ EL3,4,5,6 [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{redII}$ [µm]	$Δs_{redI}$ [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV3K2 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 5,4 kN)																			
1.50	2.4	2.9	43	1.5	ZV318S_K202_0060 EZ702U	5.4	14	154	6.000	1.50	1.30	2.25	83	42	12	16	3	18	57.3
1.50	2.7	3.3	48	1.3	ZV318S_K202_0060 EZ505U	5.4	14	154	6.000	1.50	1.30	2.25	83	42	12	16	3	18	57.3
1.50	3.4	4.2	59	1.1	ZV318S_K202_0060 EZ703U	5.4	14	154	6.000	1.50	1.30	2.25	83	42	12	16	3	18	57.3
1.74	1.3	1.5	27	2.7	ZV318S_K202_0052 EZ701U	3.5	13	100	5.177	1.74	1.51	2.61	83	42	12	16	3	18	57.3
1.74	2.1	2.5	44	1.7	ZV318S_K202_0052 EZ702U	5.4	13	154	5.177	1.74	1.51	2.61	83	42	12	16	3	18	57.3
1.74	2.4	2.8	49	1.5	ZV318S_K202_0052 EZ505U	5.4	13	154	5.177	1.74	1.51	2.61	83	42	12	16	3	18	57.3
1.74	2.9	3.6	60	1.2	ZV318S_K202_0052 EZ703U	5.4	13	154	5.177	1.74	1.51	2.61	83	42	12	16	3	18	57.3
2.06	0.7	0.8	17	4.8	ZV318S_K202_0044 EZ402U	2.4	4.4	68	4.364	2.06	1.79	3.09	83	42	12	16	3	18	57.3
2.06	1.0	1.3	25	3.3	ZV318S_K202_0044 EZ404U	3.5	4.4	102	4.364	2.06	1.79	3.09	83	42	12	16	3	18	57.3
2.06	1.1	1.2	27	3.0	ZV318S_K202_0044 EZ502U	3.5	4.4	102	4.364	2.06	1.79	3.09	83	42	12	16	3	18	57.3
2.06	1.1	1.2	27	3.0	ZV318S_K202_0044 EZ701U	3.0	11	85	4.364	2.06	1.79	3.09	83	42	12	16	3	18	57.3
2.06	1.4	1.6	36	2.3	ZV318S_K202_0044 EZ503U	3.5	4.4	102	4.364	2.06	1.79	3.09	83	42	12	16	3	18	57.3
2.06	1.8	2.1	44	1.9	ZV318S_K202_0044 EZ702U	5.4	11	154	4.364	2.06	1.79	3.09	83	42	12	16	3	18	57.3
2.06	2.0	2.4	50	1.7	ZV318S_K202_0044 EZ505U	5.4	11	154	4.364	2.06	1.79	3.09	83	42	12	16	3	18	57.3
2.06	2.4	3.1	61	1.4	ZV318S_K202_0044 EZ703U	5.4	11	154	4.364	2.06	1.79	3.09	83	42	12	16	3	18	57.3
2.25	1.0	1.1	27	3.2	ZV318S_K202_0040 EZ701U	2.7	10	78	4.000	2.25	1.95	3.38	83	42	12	16	3	18	57.3
2.25	1.6	2.0	45	2.0	ZV318S_K202_0040 EZ702U	5.4	10	154	4.000	2.25	1.95	3.38	83	42	12	16	3	18	57.3
2.25	1.8	2.2	50	1.8	ZV318S_K202_0040 EZ505U	5.4	10	154	4.000	2.25	1.95	3.38	83	42	12	16	3	18	57.3
2.25	2.2	2.8	61	1.4	ZV318S_K202_0040 EZ703U	5.4	10	154	4.000	2.25	1.95	3.38	83	42	12	16	3	18	57.3
ZV3K2 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 5,4 kN)																			
1.06	4.1	6.6	37	1.0	ZV318S_K202_0125 EZ505U	5.4	14	154	12.71	0.92	0.83	1.30	83	42	12	16	3	18	57.3
1.17	3.7	6.0	37	1.1	ZV318S_K202_0115 EZ505U	5.4	14	154	11.55	0.91	0.81	1.30	83	42	12	16	3	18	57.3
1.34	3.2	5.2	37	1.2	ZV318S_K202_0100 EZ505U	5.4	14	154	10.07	1.16	1.04	1.64	83	42	12	16	3	18	57.3
1.47	3.0	4.8	38	1.3	ZV318S_K202_0092 EZ505U	5.4	14	154	9.190	1.14	1.01	1.63	83	42	12	16	3	18	57.3
1.61	2.7	4.4	38	1.3	ZV318S_K202_0084 EZ505U	5.4	14	154	8.397	1.25	1.11	1.79	83	42	12	16	3	18	57.3
1.61	3.4	5.7	48	1.0	ZV318S_K202_0084 EZ703U	5.4	14	154	8.397	1.25	1.11	1.79	83	42	12	16	3	18	57.3
1.90	2.3	3.7	39	1.5	ZV318S_K202_0071 EZ505U	5.4	14	154	7.118	1.26	1.10	1.90	83	42	12	16	3	18	57.3
1.90	2.9	4.8	49	1.2	ZV318S_K202_0071 EZ703U	5.4	14	154	7.118	1.26	1.10	1.90	83	42	12	16	3	18	57.3
2.02	2.1	3.5	39	1.6	ZV318S_K202_0067 EZ505U	5.4	14	154	6.683	1.57	1.39	2.24	83	42	12	16	3	18	57.3
2.02	2.7	4.5	49	1.2	ZV318S_K202_0067 EZ703U	5.4	14	154	6.683	1.57	1.39	2.24	83	42	12	16	3	18	57.3
2.25	1.9	3.1	39	1.7	ZV318S_K202_0060 EZ505U	5.4	14	154	6.000	1.50	1.30	2.25	83	42	12	16	3	18	57.3
2.25	2.5	4.1	50	1.3	ZV318S_K202_0060 EZ703U	5.4	14	154	6.000	1.50	1.30	2.25	83	42	12	16	3	18	57.3
2.61	1.7	2.7	40	1.8	ZV318S_K202_0052 EZ505U	5.4	13	154	5.177	1.74	1.51	2.61	83	42	12	16	3	18	57.3
2.61	2.1	3.5	50	1.4	ZV318S_K202_0052 EZ703U	5.4	13	154	5.177	1.74	1.51	2.61	83	42	12	16	3	18	57.3
3.09	1.4	2.3	40	2.1	ZV318S_K202_0044 EZ505U	5.4	11	154	4.364	2.06	1.79	3.09	83	42	12	16	3	18	57.3
3.09	1.8	3.0	51	1.6	ZV318S_K202_0044 EZ703U	5.4	11	154	4.364	2.06	1.79	3.09	83	42	12	16	3	18	57.3
3.38	1.3	2.1	40	2.2	ZV318S_K202_0040 EZ505U	5.4	10	154	4.000	2.25	1.95	3.38	83	42	12	16	3	18	57.3
3.38	1.6	2.7	51	1.7	ZV318S_K202_0040 EZ703U	5.4	10	154	4.000	2.25	1.95	3.38	83	42	12	16	3	18	57.3
ZV3K2 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 5,4 kN)																			
0.13	4.0	4.3	3.6	1.3	ZV318S_K203_1350 EZ301U	5.4	14	154	135.3	0.09	0.09	0.14	83	50	21	16	3	18	57.3
0.16	3.3	3.5	3.4	1.7	ZV318S_K203_1090 EZ301U	5.4	14	154	109.5	0.11	0.11	0.18	83	50	21	16	3	18	57.3
0.20	2.7	2.9	3.3	2.0	ZV318S_K203_0910 EZ301U	5.4	14	154	90.79	0.13	0.13	0.22	83	50	21	16	3	18	57.3
0.20	4.5	5.1	5.5	1.2	ZV318S_K203_0910 EZ302U	5.4	14	154	90.79	0.13	0.13	0.22	83	50	21	16	3	18	57.3
0.23	2.4	2.5	3.2	2.3	ZV318S_K203_0800 EZ301U	5.4	14	154	79.62	0.15	0.15	0.25	83	50	21	16	3	18	57.3
0.23	4.0	4.5	5.4	1.3	ZV318S_K203_0800 EZ302U	5.4	14	154	79.62	0.15	0.15	0.25	83	50	21	16	3	18	57.3
0.23	5.2	6.0	7.0	1.0	ZV318S_K203_0800 EZ303U	5.4	14	154	79.62	0.15	0.15	0.25	83	50	21	16	3	18	57.3
0.26	2.1	2.2	4.7	2.2	ZV318S_K202_0690 EZ301U	5.4	8.8	154	69.43	0.17	0.17	0.28	83	42	12	16	3	18	57.3
0.26	3.5	3.9	7.9	1.3	ZV318S_K202_0690 EZ302U	5.4	8.8	154	69.43	0.17	0.17	0.28	83	42	12	16	3	18	57.3
0.26	4.6	5.3	10	1.0	ZV318S_K202_0690 EZ303U	5.4	8.8	154	69.43	0.17	0.17	0.28	83	42	12	16	3	18	57.3
0.26	2.0	2.2	3.2	2.6	ZV318S_K203_0680 EZ301U	5.4	14	154	68.42	0.18	0.17	0.29	83	50	21	16	3	18	57.3
0.26	3.4	3.8	5.5	1.6	ZV318S_K203_0680 EZ302U	5.4	14	154	68.42	0.18	0.17	0.29	83	50	21	16	3	18	57.3
0.26	4.5	5.1	7.1	1.2	ZV318S_K203_0680 EZ303U	5.4	14	154	68.42	0.18	0.17	0.29	83	50	21	16	3	18	57.3
0.26	5.3	6.4	8.4	1.0	ZV318S_K203_0680 EZ401U	5.4	14	154	68.42	0.18	0.17	0.29	83	50	21	16	3	18	57.3
0.27	2.0	2.1	3.3	2.7	ZV318S_K203_0660 EZ301U	5.4	14	154	66.03	0.18	0.18	0.30	83	50	21	16	3	18	57.3
0.27	3.3	3.7	5.5	1.6	ZV318S_K203_0660 EZ302U	5.4	14	154	66.03	0.18	0.18	0.30	83	50	21	16	3	18	57.3
0.27	4.3	5.0	7.2	1.2	ZV318S_K203_0660 EZ303U	5.4	14	154	66.03	0.18	0.18	0.30	83	50	21	16	3	18	57.3
0.27	5.1	6.2	8.4	1.1	ZV318S_K203_0660 EZ401U	5.4	14	154	66.03	0.18	0.18	0.30	83	50	21	16	3	18	57.3
0.32	1.7	1.8	3.7	3.2	ZV318S_K202_0560 EZ301U	5.3	9.4	151	55.54	0.22	0.21	0.35	83	42	12	16	3	18	57.3
0.32	2.8	3.2	6.3	1.9	ZV318S_K202_0560 EZ302U	5.4	9.4	154	55.54	0.22	0.21	0.35	83	42	12	16	3	18	57.3
0.32	3.7	4.2	8.2	1.5	ZV318S_K202_0560 EZ303U	5.4	9.4	154	55.54	0.22	0.21	0.35	83	42	12	16	3	18	57.3
0.32	4.3	5.3	9.6	1.2	ZV318S_K202_0560 EZ401U	5.4	9.4	154	55.54	0.22	0.21	0.35	83	42	12	16	3	18	57.3
0.33	1.6	1.7	3.3	3.3	ZV318S_K203_0540 EZ301U	5.1	12	145	54.25	0.22	0.22	0.36	83	50	21	16	3	18	57.3
0.33	2.7	3.0	5.6	2.0	ZV318S_K203_0540 EZ302U	5.4	12	154	54.25	0.22	0.22	0.36	83	50	21	16	3	18	57.3
0.33	3.5	4.1	7.3	1.5	ZV318S_K203_0540 EZ303U	5.4	12	154	54.25	0.22	0.22	0.36	83	50	21	16	3	18	57.3

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ EL1,2 [m/s]	$v_{f2maxDB}$ EL3,4,5,6 [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{redII}$ [µm]	$Δs_{redI}$ [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV3K2 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 5,4 kN)																			
0.33	4.2	5.1	8.5	1.3	ZV318S_K203_0540 EZ401U	5.4	12	154	54.25	0.22	0.22	0.36	83	50	21	16	3	18	57.3
0.36	1.5	1.6	6.0	2.2	ZV318S_K202_0500 EZ301U	4.0	6.4	116	50.49	0.24	0.23	0.39	83	42	12	16	3	18	57.3
0.36	2.6	2.9	10	1.3	ZV318S_K202_0500 EZ302U	4.0	6.4	116	50.49	0.24	0.23	0.39	83	42	12	16	3	18	57.3
0.36	3.4	3.8	13	1.0	ZV318S_K202_0500 EZ303U	4.0	6.4	116	50.49	0.24	0.23	0.39	83	42	12	16	3	18	57.3
0.36	1.5	1.6	3.3	3.6	ZV318S_K203_0500 EZ301U	4.6	11	133	49.76	0.24	0.24	0.39	83	50	21	16	3	18	57.3
0.36	2.5	2.8	5.6	2.2	ZV318S_K203_0500 EZ302U	5.4	11	154	49.76	0.24	0.24	0.39	83	50	21	16	3	18	57.3
0.36	3.3	3.7	7.3	1.7	ZV318S_K203_0500 EZ303U	5.4	11	154	49.76	0.24	0.24	0.39	83	50	21	16	3	18	57.3
0.36	3.8	4.6	8.6	1.4	ZV318S_K203_0500 EZ401U	5.4	11	154	49.76	0.24	0.24	0.39	83	50	21	16	3	18	57.3
0.39	1.4	1.5	3.4	3.9	ZV318S_K202_0460 EZ301U	4.4	9.0	126	46.23	0.26	0.25	0.42	83	42	12	16	3	18	57.3
0.39	2.3	2.6	5.7	2.3	ZV318S_K202_0460 EZ302U	5.4	9.0	154	46.23	0.26	0.25	0.42	83	42	12	16	3	18	57.3
0.39	3.1	3.5	7.5	1.8	ZV318S_K202_0460 EZ303U	5.4	9.0	154	46.23	0.26	0.25	0.42	83	42	12	16	3	18	57.3
0.39	3.6	4.4	8.8	1.5	ZV318S_K202_0460 EZ401U	5.4	14	154	46.23	0.26	0.25	0.42	83	42	12	16	3	18	57.3
0.39	5.3	6.9	13	1.0	ZV318S_K202_0460 EZ501U	5.4	14	154	46.23	0.26	0.25	0.42	83	42	12	16	3	18	57.3
0.40	1.3	1.4	3.4	4.0	ZV318S_K203_0450 EZ301U	4.2	10	121	45.22	0.27	0.26	0.43	83	50	21	16	3	18	57.3
0.40	2.3	2.5	5.7	2.4	ZV318S_K203_0450 EZ302U	5.4	10	154	45.22	0.27	0.26	0.43	83	50	21	16	3	18	57.3
0.40	3.0	3.4	7.4	1.8	ZV318S_K203_0450 EZ303U	5.4	10	154	45.22	0.27	0.26	0.43	83	50	21	16	3	18	57.3
0.40	3.5	4.2	8.7	1.5	ZV318S_K203_0450 EZ401U	5.4	10	154	45.22	0.27	0.26	0.43	83	50	21	16	3	18	57.3
0.45	1.2	1.3	4.7	3.3	ZV318S_K202_0400 EZ301U	3.8	6.9	110	40.39	0.30	0.29	0.48	83	42	12	16	3	18	57.3
0.45	2.1	2.3	7.9	2.0	ZV318S_K202_0400 EZ302U	4.8	6.9	139	40.39	0.30	0.29	0.48	83	42	12	16	3	18	57.3
0.45	2.7	3.1	10	1.5	ZV318S_K202_0400 EZ303U	4.8	6.9	139	40.39	0.30	0.29	0.48	83	42	12	16	3	18	57.3
0.45	3.1	3.8	12	1.3	ZV318S_K202_0400 EZ401U	4.8	6.9	139	40.39	0.30	0.29	0.48	83	42	12	16	3	18	57.3
0.46	1.2	1.3	3.4	4.6	ZV318S_K203_0390 EZ301U	3.7	8.8	106	39.45	0.30	0.30	0.49	83	50	21	16	3	18	57.3
0.46	2.0	2.2	5.7	2.7	ZV318S_K203_0390 EZ302U	5.4	8.8	154	39.45	0.30	0.30	0.49	83	50	21	16	3	18	57.3
0.46	2.6	3.0	7.5	2.1	ZV318S_K203_0390 EZ303U	5.4	8.8	154	39.45	0.30	0.30	0.49	83	50	21	16	3	18	57.3
0.46	3.0	3.7	8.8	1.8	ZV318S_K203_0390 EZ401U	5.4	8.8	154	39.45	0.30	0.30	0.49	83	50	21	16	3	18	57.3
0.52	1.8	2.0	5.9	3.0	ZV318S_K202_0350 EZ302U	5.4	7.5	154	34.55	0.35	0.34	0.56	83	42	12	16	3	18	57.3
0.52	2.3	2.6	7.7	2.3	ZV318S_K202_0350 EZ303U	5.4	7.5	154	34.55	0.35	0.34	0.56	83	42	12	16	3	18	57.3
0.52	2.7	3.3	9.0	2.0	ZV318S_K202_0350 EZ401U	5.4	14	154	34.55	0.35	0.34	0.56	83	42	12	16	3	18	57.3
0.52	4.0	5.1	13	1.3	ZV318S_K202_0350 EZ501U	5.4	14	154	34.55	0.35	0.34	0.56	83	42	12	16	3	18	57.3
0.52	4.1	5.7	14	1.3	ZV318S_K202_0350 EZ402U	5.4	14	154	34.55	0.35	0.34	0.56	83	42	12	16	3	18	57.3
0.54	1.7	1.9	5.9	3.0	ZV318S_K202_0340 EZ302U	5.2	6.5	150	33.62	0.36	0.35	0.58	83	42	12	16	3	18	57.3
0.54	2.2	2.6	7.7	2.3	ZV318S_K202_0340 EZ303U	5.2	6.5	150	33.62	0.36	0.35	0.58	83	42	12	16	3	18	57.3
0.54	2.6	3.2	9.0	2.0	ZV318S_K202_0340 EZ401U	5.4	11	154	33.62	0.36	0.35	0.58	83	42	12	16	3	18	57.3
0.54	3.9	5.0	13	1.3	ZV318S_K202_0340 EZ501U	5.4	11	154	33.62	0.36	0.35	0.58	83	42	12	16	3	18	57.3
0.54	4.0	5.6	14	1.3	ZV318S_K202_0340 EZ402U	5.4	11	154	33.62	0.36	0.35	0.58	83	42	12	16	3	18	57.3
0.64	2.2	2.6	9.2	2.2	ZV318S_K202_0280 EZ401U	5.4	14	154	27.95	0.43	0.42	0.70	83	42	12	16	3	18	57.3
0.64	3.2	4.2	14	1.5	ZV318S_K202_0280 EZ501U	5.4	14	154	27.95	0.43	0.42	0.70	83	42	12	16	3	18	57.3
0.64	3.3	4.6	14	1.5	ZV318S_K202_0280 EZ402U	5.4	14	154	27.95	0.43	0.42	0.70	83	42	12	16	3	18	57.3
0.72	1.3	1.4	6.5	3.4	ZV318S_K202_0250 EZ302U	4.3	5.4	122	25.13	0.48	0.47	0.78	83	42	12	16	3	18	57.3
0.72	1.7	1.9	8.5	2.6	ZV318S_K202_0250 EZ303U	4.4	5.4	125	25.13	0.48	0.47	0.78	83	42	12	16	3	18	57.3
0.72	2.0	2.4	9.2	2.4	ZV318S_K202_0250 EZ401U	5.4	14	154	25.13	0.48	0.47	0.78	83	42	12	16	3	18	57.3
0.72	2.9	3.7	14	1.6	ZV318S_K202_0250 EZ501U	5.4	14	154	25.13	0.48	0.47	0.78	83	42	12	16	3	18	57.3
0.72	3.0	4.2	14	1.6	ZV318S_K202_0250 EZ402U	5.4	14	154	25.13	0.48	0.47	0.78	83	42	12	16	3	18	57.3
0.72	4.4	6.6	21	1.1	ZV318S_K202_0250 EZ502U	5.4	14	154	25.13	0.48	0.47	0.78	83	42	12	16	3	18	57.3
0.72	4.4	6.7	21	1.1	ZV318S_K202_0250 EZ701U	5.4	14	154	25.13	0.48	0.47	0.78	83	42	12	16	3	18	57.3
0.78	1.2	1.3	6.1	3.9	ZV318S_K202_0230 EZ302U	3.9	5.9	112	23.18	0.52	0.51	0.84	83	42	12	16	3	18	57.3
0.78	1.5	1.8	7.9	3.0	ZV318S_K202_0230 EZ303U	4.7	5.9	135	23.18	0.52	0.51	0.84	83	42	12	16	3	18	57.3
0.78	1.8	2.2	9.3	2.5	ZV318S_K202_0230 EZ401U	5.4	14	154	23.18	0.52	0.51	0.84	83	42	12	16	3	18	57.3
0.78	2.7	3.5	14	1.7	ZV318S_K202_0230 EZ501U	5.4	14	154	23.18	0.52	0.51	0.84	83	42	12	16	3	18	57.3
0.78	2.7	3.8	14	1.7	ZV318S_K202_0230 EZ402U	5.4	14	154	23.18	0.52	0.51	0.84	83	42	12	16	3	18	57.3
0.78	4.1	6.1	21	1.1	ZV318S_K202_0230 EZ502U	5.4	14	154	23.18	0.52	0.51	0.84	83	42	12	16	3	18	57.3
0.78	4.1	6.2	21	1.1	ZV318S_K202_0230 EZ701U	5.4	14	154	23.18	0.52	0.51	0.84	83	42	12	16	3	18	57.3
0.78	4.6	6.6	23	1.0	ZV318S_K202_0230 EZ404U	5.4	14	154	23.18	0.52	0.51	0.84	83	42	12	16	3	18	57.3
0.89	1.6	1.9	9.4	2.8	ZV318S_K202_0200 EZ401U	5.4	14	154	20.33	0.59	0.58	0.96	83	42	12	16	3	18	57.3
0.89	2.3	3.0	14	1.9	ZV318S_K202_0200 EZ501U	5.4	14	154	20.33	0.59	0.58	0.96	83	42	12	16	3	18	57.3
0.89	2.4	3.4	14	1.8	ZV318S_K202_0200 EZ402U	5.4	14	154	20.33	0.59	0.58	0.96	83	42	12	16	3	18	57.3
0.89	3.6	5.4	21	1.2	ZV318S_K202_0200 EZ502U	5.4	14	154	20.33	0.59	0.58	0.96	83	42	12	16	3	18	57.3
0.89	3.6	5.4	21	1.2	ZV318S_K202_0200 EZ701U	5.4	14	154	20.33	0.59	0.58	0.96	83	42	12	16	3	18	57.3
0.89	4.0	5.8	24	1.1	ZV318S_K202_0200 EZ404U	5.4	14	154	20.33	0.59	0.58	0.96	83	42	12	16	3	18	57.3
0.89	4.3	7.3	25	1.0	ZV318S_K202_0200 EZ503U	5.4	14	154	20.33	0.59	0.58	0.96	83	42	12	16	3	18	57.3
1.07	0.9	1.0	7.5	4.0	ZV318S_K202_0170 EZ302U	2.9	4.3	82	16.86	0.71	0.69	1.16	83	42	12	16	3	18	57.3
1.07	1.1	1.3	9.8	3.1	ZV318S_K202_0170 EZ303U	3.4	4.3	98	16.86	0.71	0.69	1.16	83	42	12	16	3	18	57.3
1.07	1.3	1.6	9.5	3.1	ZV318S_K202_0170 EZ401U	4.9	14	139	16.86	0.71	0.69	1.16	83	42	12	16	3	18	57.3
1.07	1.9	2.5	14	2.1	ZV318S_K202_0170 EZ501U	5.4	14	154	16.86	0.71	0.69	1.16	83	42	12	16	3	18	57.3

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ EL1,2 [m/s]	$v_{f2maxDB}$ EL3,4,5,6 [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{redII}$ [µm]	$Δs_{redI}$ [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV3K2 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 5,4 kN)																			
1.07	2.0	2.8	15	2.1	ZV318S_K202_0170 EZ402U	5.4	14	154	16.86	0.71	0.69	1.16	83	42	12	16	3	18	57.3
1.07	3.0	4.5	22	1.4	ZV318S_K202_0170 EZ502U	5.4	14	154	16.86	0.71	0.69	1.16	83	42	12	16	3	18	57.3
1.07	3.0	4.5	22	1.4	ZV318S_K202_0170 EZ701U	5.4	14	154	16.86	0.71	0.69	1.16	83	42	12	16	3	18	57.3
1.07	3.3	4.8	24	1.2	ZV318S_K202_0170 EZ404U	5.4	14	154	16.86	0.71	0.69	1.16	83	42	12	16	3	18	57.3
1.07	3.5	6.1	26	1.2	ZV318S_K202_0170 EZ503U	5.4	14	154	16.86	0.71	0.69	1.16	83	42	12	16	3	18	57.3
1.07	4.1	8.2	30	1.0	ZV318S_K202_0170 EZ702U	5.4	14	154	16.86	0.71	0.69	1.16	83	42	12	16	3	18	57.3
ZV2K3 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 5,2 kN)																			
0.06	4.6	4.7	2.4	1.1	ZV225S_K303_1360 EZ301U	5.2	26	137	136.0	0.08	0.07	0.12	77	39	19	20	2	25	53.1
0.08	3.7	3.7	2.3	1.4	ZV225S_K303_1090 EZ301U	5.2	26	137	109.2	0.10	0.09	0.15	77	39	19	20	2	25	53.1
0.09	3.1	3.1	2.2	1.7	ZV225S_K303_0910 EZ301U	5.2	22	137	91.23	0.12	0.11	0.18	77	39	19	20	2	25	53.1
0.11	2.7	2.7	2.6	1.9	ZV225S_K303_0790 EZ301U	5.2	19	137	79.42	0.13	0.12	0.21	77	39	19	20	2	25	53.1
0.11	4.6	4.8	4.4	1.1	ZV225S_K303_0790 EZ302U	5.2	19	137	79.42	0.13	0.12	0.21	77	39	19	20	2	25	53.1
0.12	2.4	2.4	3.4	2.2	ZV225S_K302_0690 EZ301U	5.2	11	137	69.43	0.15	0.14	0.24	77	31	12	20	2	25	53.1
0.12	4.0	4.3	5.8	1.3	ZV225S_K302_0690 EZ302U	5.2	11	137	69.43	0.15	0.14	0.24	77	31	12	20	2	25	53.1
0.12	2.3	2.3	2.1	2.3	ZV225S_K303_0680 EZ301U	5.2	16	137	67.73	0.16	0.14	0.25	77	39	19	20	2	25	53.1
0.12	3.9	4.1	3.5	1.3	ZV225S_K303_0680 EZ302U	5.2	16	137	67.73	0.16	0.14	0.25	77	39	19	20	2	25	53.1
0.12	5.1	5.3	4.6	1.0	ZV225S_K303_0680 EZ303U	5.2	16	137	67.73	0.16	0.14	0.25	77	39	19	20	2	25	53.1
0.13	2.2	2.3	2.6	2.3	ZV225S_K303_0660 EZ301U	5.2	16	137	66.35	0.16	0.15	0.25	77	39	19	20	2	25	53.1
0.13	3.8	4.0	4.4	1.4	ZV225S_K303_0660 EZ302U	5.2	16	137	66.35	0.16	0.15	0.25	77	39	19	20	2	25	53.1
0.13	4.9	5.2	5.8	1.0	ZV225S_K303_0660 EZ303U	5.2	16	137	66.35	0.16	0.15	0.25	77	39	19	20	2	25	53.1
0.15	1.8	1.9	2.4	2.8	ZV225S_K303_0550 EZ301U	5.2	13	137	54.58	0.19	0.18	0.31	77	39	19	20	2	25	53.1
0.15	3.1	3.3	4.1	1.7	ZV225S_K303_0550 EZ302U	5.2	13	137	54.58	0.19	0.18	0.31	77	39	19	20	2	25	53.1
0.15	4.1	4.3	5.3	1.3	ZV225S_K303_0550 EZ303U	5.2	13	137	54.58	0.19	0.18	0.31	77	39	19	20	2	25	53.1
0.17	1.7	1.8	4.3	3.0	ZV225S_K302_0500 EZ301U	5.2	8.2	137	50.49	0.21	0.19	0.33	77	31	12	20	2	25	53.1
0.17	2.9	3.1	7.3	1.8	ZV225S_K302_0500 EZ302U	5.2	8.2	137	50.49	0.21	0.19	0.33	77	31	12	20	2	25	53.1
0.17	3.8	4.0	9.6	1.4	ZV225S_K302_0500 EZ303U	5.2	8.2	137	50.49	0.21	0.19	0.33	77	31	12	20	2	25	53.1
0.17	5.2	5.5	13	1.0	ZV225S_K302_0500 EZ401U	5.2	8.2	137	50.49	0.21	0.19	0.33	77	31	12	20	2	25	53.1
0.17	1.7	1.7	2.6	3.1	ZV225S_K303_0490 EZ301U	5.0	12	132	49.26	0.21	0.20	0.34	77	39	19	20	2	25	53.1
0.17	2.8	3.0	4.5	1.8	ZV225S_K303_0490 EZ302U	5.2	12	137	49.26	0.21	0.20	0.34	77	39	19	20	2	25	53.1
0.17	3.7	3.9	5.8	1.4	ZV225S_K303_0490 EZ303U	5.2	12	137	49.26	0.21	0.20	0.34	77	39	19	20	2	25	53.1
0.17	5.0	5.3	7.8	1.0	ZV225S_K303_0490 EZ401U	5.2	12	137	49.26	0.21	0.20	0.34	77	39	19	20	2	25	53.1
0.18	4.7	5.1	5.7	1.1	ZV225S_K302_0460 EZ401U	5.2	26	137	46.23	0.23	0.21	0.36	77	31	12	20	2	25	53.1
0.21	4.1	4.4	9.8	1.2	ZV225S_K302_0410 EZ401U	5.2	15	137	40.51	0.26	0.24	0.41	77	31	12	20	2	25	53.1
0.24	3.6	3.8	5.5	1.5	ZV225S_K302_0350 EZ401U	5.2	26	137	34.73	0.30	0.28	0.48	77	31	12	20	2	25	53.1
0.25	3.4	3.7	7.2	1.5	ZV225S_K302_0340 EZ401U	5.2	19	137	33.62	0.31	0.29	0.50	77	31	12	20	2	25	53.1
0.26	5.1	5.5	8.3	1.0	ZV225S_K303_0330 EZ501U	5.2	22	137	32.65	0.32	0.30	0.51	77	39	19	20	2	25	53.1
0.30	2.9	3.1	5.6	1.8	ZV225S_K302_0280 EZ401U	5.2	26	137	27.88	0.38	0.35	0.60	77	31	12	20	2	25	53.1
0.30	4.4	4.8	8.5	1.2	ZV225S_K302_0280 EZ501U	5.2	26	137	27.88	0.38	0.35	0.60	77	31	12	20	2	25	53.1
0.30	4.8	5.3	9.3	1.1	ZV225S_K302_0280 EZ402U	5.2	26	137	27.88	0.38	0.35	0.60	77	31	12	20	2	25	53.1
0.33	2.6	2.8	5.6	2.0	ZV225S_K302_0250 EZ401U	5.2	23	137	25.26	0.42	0.39	0.66	77	31	12	20	2	25	53.1
0.33	4.0	4.3	8.6	1.3	ZV225S_K302_0250 EZ501U	5.2	23	137	25.26	0.42	0.39	0.66	77	31	12	20	2	25	53.1
0.33	4.3	4.8	9.4	1.2	ZV225S_K302_0250 EZ402U	5.2	23	137	25.26	0.42	0.39	0.66	77	31	12	20	2	25	53.1
0.36	2.4	2.6	5.6	2.2	ZV225S_K302_0230 EZ401U	5.2	24	137	23.29	0.45	0.42	0.72	77	31	12	20	2	25	53.1
0.36	3.7	4.0	8.7	1.4	ZV225S_K302_0230 EZ501U	5.2	24	137	23.29	0.45	0.42	0.72	77	31	12	20	2	25	53.1
0.36	4.0	4.4	9.5	1.3	ZV225S_K302_0230 EZ402U	5.2	24	137	23.29	0.45	0.42	0.72	77	31	12	20	2	25	53.1
0.41	2.1	2.2	5.7	2.5	ZV225S_K302_0200 EZ401U	5.2	19	137	20.28	0.52	0.48	0.82	77	31	12	20	2	25	53.1
0.41	3.2	3.5	8.8	1.6	ZV225S_K302_0200 EZ501U	5.2	19	137	20.28	0.52	0.48	0.82	77	31	12	20	2	25	53.1
0.41	3.5	3.9	9.6	1.5	ZV225S_K302_0200 EZ402U	5.2	19	137	20.28	0.52	0.48	0.82	77	31	12	20	2	25	53.1
0.41	5.1	6.4	14	1.0	ZV225S_K302_0200 EZ404U	5.2	19	137	20.28	0.52	0.48	0.82	77	31	12	20	2	25	53.1
0.48	1.8	1.9	5.8	2.9	ZV225S_K302_0175 EZ401U	5.2	19	137	17.29	0.56	0.50	0.80	77	31	12	20	2	25	53.1
0.48	2.7	3.0	8.9	1.9	ZV225S_K302_0175 EZ501U	5.2	19	137	17.29	0.56	0.50	0.80	77	31	12	20	2	25	53.1
0.48	3.0	3.3	9.7	1.7	ZV225S_K302_0175 EZ402U	5.2	19	137	17.29	0.56	0.50	0.80	77	31	12	20	2	25	53.1
0.48	4.4	5.4	14	1.2	ZV225S_K302_0175 EZ404U	5.2	19	137	17.29	0.56	0.50	0.80	77	31	12	20	2	25	53.1
0.48	4.7	5.1	15	1.1	ZV225S_K302_0175 EZ502U	5.2	19	137	17.29	0.56	0.50	0.80	77	31	12	20	2	25	53.1
0.48	4.7	5.2	15	1.1	ZV225S_K302_0175 EZ701U	5.2	26	137	17.29	0.56	0.50	0.80	77	31	12	20	2	25	53.1
0.49	1.7	1.9	5.8	3.0	ZV225S_K302_0170 EZ401U	5.2	18	137	16.94	0.62	0.57	0.98	77	31	12	20	2	25	53.1
0.49	2.7	2.9	8.9	1.9	ZV225S_K302_0170 EZ501U	5.2	18	137	16.94	0.62	0.57	0.98	77	31	12	20	2	25	53.1
0.49	2.9	3.2	9.7	1.8	ZV225S_K302_0170 EZ402U	5.2	18	137	16.94	0.62	0.57	0.98	77	31	12	20	2	25	53.1
0.49	4.3	5.3	14	1.2	ZV225S_K302_0170 EZ404U	5.2	18	137	16.94	0.62	0.57	0.98	77	31	12	20	2	25	53.1
0.49	4.6	5.0	15	1.1	ZV225S_K302_0170 EZ502U	5.2	18	137	16.94	0.62	0.57	0.98	77	31	12	20	2	25	53.1
0.49	4.6	5.1	15	1.1	ZV225S_K302_0170 EZ701U	5.2	26	137	16.94	0.62	0.57	0.98	77	31	12	20	2	25	53.1
0.60	1.4	1.5	5.9	3.6	ZV225S_K302_0140 EZ401U	4.3	15	115	13.94	0.70	0.62	1.00	77	31	12	20	2	25	53.1
0.60	2.2	2.4	9.0	2.4	ZV225S_K302_0140 EZ501U	5.2	15	137	13.94	0.70	0.62	1.00	77	31	12	20	2	25	53.1
0.60	2.4	2.6	9.9	2.2	ZV225S_K302_0140 EZ402U	5.2	15	137	13.94	0.70	0.62	1.00	77	31	12	20	2	25	53.1

v_{f2}	F_{f2}	$F_{f2,0}$	a_{th}	S	Type	F_{f2accE}	$F_{f2NOT,E}$	M_{2accE}	i	$v_{f2maxDB}$ EL1,2	$v_{f2maxDB}$ EL3,4,5,6	$v_{f2maxZB}$	Δs	$Δs_{redII}$	$Δs_{redI}$	C_{linE}	m_n	z	d_0
[m/s]	[kN]	[kN]				[kN]	[kN]	[Nm]		[m/s]	[m/s]	[m/s]	[µm]	[µm]	[µm]	[N/µm]	[mm]		[mm]
ZV2K3 (n_{1N} = 3000 min^{-1}), ($F_{f2acc,max}$ = 5,2 kN)																			
0.60	3.5	4.4	15	1.5	ZV225S_K302_0140 EZ404U	5.2	15	137	13.94	0.70	0.62	1.00	77	31	12	20	2	25	53.1
0.60	3.8	4.1	16	1.4	ZV225S_K302_0140 EZ502U	5.2	15	137	13.94	0.70	0.62	1.00	77	31	12	20	2	25	53.1
0.60	3.8	4.2	16	1.4	ZV225S_K302_0140 EZ701U	5.2	26	137	13.94	0.70	0.62	1.00	77	31	12	20	2	25	53.1
0.60	4.9	5.7	20	1.0	ZV225S_K302_0140 EZ503U	5.2	15	137	13.94	0.70	0.62	1.00	77	31	12	20	2	25	53.1
0.66	1.3	1.4	5.9	4.0	ZV225S_K302_0125 EZ401U	3.9	14	104	12.58	0.77	0.69	1.10	77	31	12	20	2	25	53.1
0.66	2.0	2.2	9.1	2.6	ZV225S_K302_0125 EZ501U	5.2	14	137	12.58	0.77	0.69	1.10	77	31	12	20	2	25	53.1
0.66	2.2	2.4	10	2.4	ZV225S_K302_0125 EZ402U	5.2	14	137	12.58	0.77	0.69	1.10	77	31	12	20	2	25	53.1
0.66	3.2	4.0	15	1.6	ZV225S_K302_0125 EZ404U	5.2	14	137	12.58	0.77	0.69	1.10	77	31	12	20	2	25	53.1
0.66	3.4	3.7	16	1.5	ZV225S_K302_0125 EZ502U	5.2	14	137	12.58	0.77	0.69	1.10	77	31	12	20	2	25	53.1
0.66	3.4	3.8	16	1.5	ZV225S_K302_0125 EZ701U	5.2	26	137	12.58	0.77	0.69	1.10	77	31	12	20	2	25	53.1
0.66	4.5	5.1	21	1.2	ZV225S_K302_0125 EZ503U	5.2	14	137	12.58	0.77	0.69	1.10	77	31	12	20	2	25	53.1
0.72	1.2	1.3	6.0	4.3	ZV225S_K302_0115 EZ401U	3.6	13	96	11.61	0.77	0.67	1.08	77	31	12	20	2	25	53.1
0.72	1.8	2.0	9.2	2.8	ZV225S_K302_0115 EZ501U	5.2	13	137	11.61	0.77	0.67	1.08	77	31	12	20	2	25	53.1
0.72	2.0	2.2	10	2.6	ZV225S_K302_0115 EZ402U	5.2	13	137	11.61	0.77	0.67	1.08	77	31	12	20	2	25	53.1
0.72	2.9	3.7	15	1.8	ZV225S_K302_0115 EZ404U	5.2	13	137	11.61	0.77	0.67	1.08	77	31	12	20	2	25	53.1
0.72	3.1	3.4	16	1.6	ZV225S_K302_0115 EZ502U	5.2	13	137	11.61	0.77	0.67	1.08	77	31	12	20	2	25	53.1
0.72	3.1	3.5	16	1.6	ZV225S_K302_0115 EZ701U	5.2	26	137	11.61	0.77	0.67	1.08	77	31	12	20	2	25	53.1
0.72	4.1	4.7	21	1.3	ZV225S_K302_0115 EZ503U	5.2	13	137	11.61	0.77	0.67	1.08	77	31	12	20	2	25	53.1
0.72	5.1	6.1	26	1.0	ZV225S_K302_0115 EZ702U	5.2	26	137	11.61	0.77	0.67	1.08	77	31	12	20	2	25	53.1
0.82	1.0	1.1	6.0	5.0	ZV225S_K302_0100 EZ401U	3.2	11	84	10.14	0.96	0.85	1.37	77	31	12	20	2	25	53.1
0.82	1.6	1.7	9.3	3.2	ZV225S_K302_0100 EZ501U	5.2	11	137	10.14	0.96	0.85	1.37	77	31	12	20	2	25	53.1
0.82	1.7	1.9	10	3.0	ZV225S_K302_0100 EZ402U	5.2	11	137	10.14	0.96	0.85	1.37	77	31	12	20	2	25	53.1
0.82	2.6	3.2	15	2.0	ZV225S_K302_0100 EZ404U	5.2	11	137	10.14	0.96	0.85	1.37	77	31	12	20	2	25	53.1
0.82	2.7	3.0	16	1.9	ZV225S_K302_0100 EZ502U	5.2	11	137	10.14	0.96	0.85	1.37	77	31	12	20	2	25	53.1
0.82	2.7	3.1	16	1.9	ZV225S_K302_0100 EZ701U	5.2	26	137	10.14	0.96	0.85	1.37	77	31	12	20	2	25	53.1
0.82	3.6	4.1	21	1.4	ZV225S_K302_0100 EZ503U	5.2	11	137	10.14	0.96	0.85	1.37	77	31	12	20	2	25	53.1
0.82	4.4	5.3	26	1.2	ZV225S_K302_0100 EZ702U	5.2	26	137	10.14	0.96	0.85	1.37	77	31	12	20	2	25	53.1
0.82	5.0	5.9	29	1.0	ZV225S_K302_0100 EZ505U	5.2	26	137	10.14	0.96	0.85	1.37	77	31	12	20	2	25	53.1
0.90	2.5	2.8	16	2.0	ZV225S_K302_0093 EZ701U	5.2	25	137	9.267	0.96	0.84	1.35	77	31	12	20	2	25	53.1
0.90	4.1	4.9	26	1.2	ZV225S_K302_0093 EZ702U	5.2	25	137	9.267	0.96	0.84	1.35	77	31	12	20	2	25	53.1
0.90	4.6	5.4	29	1.1	ZV225S_K302_0093 EZ505U	5.2	25	137	9.267	0.96	0.84	1.35	77	31	12	20	2	25	53.1
0.99	1.3	1.5	9.9	3.7	ZV225S_K302_0084 EZ501U	4.9	9.3	131	8.444	1.05	0.92	1.48	77	31	12	20	2	25	53.1
0.99	1.5	1.6	11	3.4	ZV225S_K302_0084 EZ402U	4.9	9.3	131	8.444	1.05	0.92	1.48	77	31	12	20	2	25	53.1
0.99	2.1	2.7	16	2.3	ZV225S_K302_0084 EZ404U	5.2	9.3	137	8.444	1.05	0.92	1.48	77	31	12	20	2	25	53.1
0.99	2.3	2.5	17	2.1	ZV225S_K302_0084 EZ502U	5.2	9.3	137	8.444	1.05	0.92	1.48	77	31	12	20	2	25	53.1
0.99	2.3	2.6	16	2.1	ZV225S_K302_0084 EZ701U	5.2	23	137	8.444	1.05	0.92	1.48	77	31	12	20	2	25	53.1
0.99	3.0	3.4	22	1.6	ZV225S_K302_0084 EZ503U	5.2	9.3	137	8.444	1.05	0.92	1.48	77	31	12	20	2	25	53.1
0.99	3.7	4.4	26	1.3	ZV225S_K302_0084 EZ702U	5.2	23	137	8.444	1.05	0.92	1.48	77	31	12	20	2	25	53.1
0.99	4.2	4.9	30	1.2	ZV225S_K302_0084 EZ505U	5.2	23	137	8.444	1.05	0.92	1.48	77	31	12	20	2	25	53.1
1.13	2.0	2.2	16	2.3	ZV225S_K302_0074 EZ701U	5.2	20	137	7.391	1.02	0.86	1.50	77	31	12	20	2	25	53.1
1.13	3.2	3.9	27	1.4	ZV225S_K302_0074 EZ702U	5.2	20	137	7.391	1.02	0.86	1.50	77	31	12	20	2	25	53.1
1.13	3.6	4.3	30	1.3	ZV225S_K302_0074 EZ505U	5.2	20	137	7.391	1.02	0.86	1.50	77	31	12	20	2	25	53.1
1.13	4.5	5.6	37	1.0	ZV225S_K302_0074 EZ703U	5.2	20	137	7.391	1.02	0.86	1.50	77	31	12	20	2	25	53.1
1.24	1.8	2.0	17	2.5	ZV225S_K302_0067 EZ701U	4.9	18	131	6.740	1.32	1.15	1.86	77	31	12	20	2	25	53.1
1.24	3.0	3.5	27	1.5	ZV225S_K302_0067 EZ702U	5.2	18	137	6.740	1.32	1.15	1.86	77	31	12	20	2	25	53.1
1.24	3.3	3.9	30	1.4	ZV225S_K302_0067 EZ505U	5.2	18	137	6.740	1.32	1.15	1.86	77	31	12	20	2	25	53.1
1.24	4.1	5.1	37	1.1	ZV225S_K302_0067 EZ703U	5.2	18	137	6.740	1.32	1.15	1.86	77	31	12	20	2	25	53.1
1.39	1.6	1.8	17	2.7	ZV225S_K302_0060 EZ701U	4.4	16	116	6.000	1.25	1.07	1.85	77	31	12	20	2	25	53.1
1.39	2.6	3.2	27	1.7	ZV225S_K302_0060 EZ702U	5.2	16	137	6.000	1.25	1.07	1.85	77	31	12	20	2	25	53.1
1.39	3.0	3.5	30	1.5	ZV225S_K302_0060 EZ505U	5.2	16	137	6.000	1.25	1.07	1.85	77	31	12	20	2	25	53.1
1.39	3.6	4.6	37	1.2	ZV225S_K302_0060 EZ703U	5.2	16	137	6.000	1.25	1.07	1.85	77	31	12	20	2	25	53.1
1.55	1.5	1.6	17	2.9	ZV225S_K302_0054 EZ701U	3.9	15	104	5.375	1.40	1.19	2.07	77	31	12	20	2	25	53.1
1.55	2.4	2.8	27	1.8	ZV225S_K302_0054 EZ702U	5.2	15	137	5.375	1.40	1.19	2.07	77	31	12	20	2	25	53.1
1.55	2.7	3.1	31	1.6	ZV225S_K302_0054 EZ505U	5.2	15	137	5.375	1.40	1.19	2.07	77	31	12	20	2	25	53.1
1.55	3.2	4.1	38	1.3	ZV225S_K302_0054 EZ703U	5.2	15	137	5.375	1.40	1.19	2.07	77	31	12	20	2	25	53.1
1.91	1.2	1.3	17	3.3	ZV225S_K302_0044 EZ701U	3.2	12	85	4.364	1.72	1.46	2.55	77	31	12	20	2	25	53.1
1.91	1.9	2.3	28	2.0	ZV225S_K302_0044 EZ702U	5.2	12	137	4.364	1.72	1.46	2.55	77	31	12	20	2	25	53.1
1.91	2.2	2.6	31	1.8	ZV225S_K302_0044 EZ505U	5.2	12	137	4.364	1.72	1.46	2.55	77	31	12	20	2	25	53.1
1.91	2.6	3.3	38	1.5	ZV225S_K302_0044 EZ703U	5.2	12	137	4.364	1.72	1.46	2.55	77	31	12	20	2	25	53.1
1.91	3.4	4.8	49	1.2	ZV225S_K302_0044 EZ705U	5.2	26	137	4.364	1.72	1.46	2.55	77	31	12	20	2	25	53.1
2.08	1.1	1.2	17	3.5	ZV225S_K302_0040 EZ701U	2.9	11	78	4.000	1.88	1.60	2.78	77	31	12	20	2	25	53.1
2.08	1.8	2.1	28	2.2	ZV225S_K302_0040 EZ702U	5.2	11	137	4.000	1.88	1.60	2.78	77	31	12	20	2	25	53.1
2.08	2.0	2.3	31	1.9	ZV225S_K302_0040 EZ505U	5.2	11	137	4.000	1.88	1.60	2.78	77	31	12	20	2	25	53.1

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ EL1,2 [m/s]	$v_{f2maxDB}$ EL3,4,5,6 [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{redII}$ [µm]	$Δs_{redI}$ [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV2K3 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 5,2 kN)																			
2.08	2.4	3.0	38	1.6	ZV225S_K302_0040 EZ703U	5.2	11	137	4.000	1.88	1.60	2.78	77	31	12	20	2	25	53.1
2.08	3.1	4.4	50	1.2	ZV225S_K302_0040 EZ705U	5.2	26	137	4.000	1.88	1.60	2.78	77	31	12	20	2	25	53.1
ZV2K3 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 5,2 kN)																			
0.90	4.8	7.8	23	1.0	ZV225S_K302_0140 EZ505U	5.2	26	137	13.94	0.70	0.62	1.00	77	31	12	20	2	25	53.1
0.99	4.4	7.0	23	1.1	ZV225S_K302_0125 EZ505U	5.2	26	137	12.58	0.77	0.69	1.10	77	31	12	20	2	25	53.1
1.08	4.0	6.5	23	1.2	ZV225S_K302_0115 EZ505U	5.2	26	137	11.61	0.77	0.67	1.08	77	31	12	20	2	25	53.1
1.23	3.5	5.7	23	1.3	ZV225S_K302_0100 EZ505U	5.2	26	137	10.14	0.96	0.85	1.37	77	31	12	20	2	25	53.1
1.23	4.5	7.4	30	1.0	ZV225S_K302_0100 EZ703U	5.2	26	137	10.14	0.96	0.85	1.37	77	31	12	20	2	25	53.1
1.35	3.2	5.2	24	1.4	ZV225S_K302_0093 EZ505U	5.2	25	137	9.267	0.96	0.84	1.35	77	31	12	20	2	25	53.1
1.35	4.1	6.8	30	1.1	ZV225S_K302_0093 EZ703U	5.2	25	137	9.267	0.96	0.84	1.35	77	31	12	20	2	25	53.1
1.48	2.9	4.7	24	1.5	ZV225S_K302_0084 EZ505U	5.2	23	137	8.444	1.05	0.92	1.48	77	31	12	20	2	25	53.1
1.48	3.7	6.2	30	1.1	ZV225S_K302_0084 EZ703U	5.2	23	137	8.444	1.05	0.92	1.48	77	31	12	20	2	25	53.1
1.86	2.3	3.8	24	1.7	ZV225S_K302_0067 EZ505U	5.2	18	137	6.740	1.32	1.15	1.86	77	31	12	20	2	25	53.1
1.86	3.0	4.9	31	1.3	ZV225S_K302_0067 EZ703U	5.2	18	137	6.740	1.32	1.15	1.86	77	31	12	20	2	25	53.1
ZV2K3 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 5,2 kN)																			
0.12	4.4	4.7	2.5	1.2	ZV225S_K303_1360 EZ301U	5.2	26	137	136.0	0.08	0.07	0.12	77	39	19	20	2	25	53.1
0.15	3.5	3.7	2.4	1.5	ZV225S_K303_1090 EZ301U	5.2	26	137	109.2	0.10	0.09	0.15	77	39	19	20	2	25	53.1
0.18	2.9	3.1	2.5	1.8	ZV225S_K303_0910 EZ301U	5.2	22	137	91.23	0.12	0.11	0.18	77	39	19	20	2	25	53.1
0.18	4.9	5.5	4.2	1.0	ZV225S_K303_0910 EZ302U	5.2	22	137	91.23	0.12	0.11	0.18	77	39	19	20	2	25	53.1
0.21	2.5	2.7	3.1	2.0	ZV225S_K303_0790 EZ301U	5.2	19	137	79.42	0.13	0.12	0.21	77	39	19	20	2	25	53.1
0.21	4.3	4.8	5.2	1.2	ZV225S_K303_0790 EZ302U	5.2	19	137	79.42	0.13	0.12	0.21	77	39	19	20	2	25	53.1
0.24	2.3	2.4	3.2	2.3	ZV225S_K302_0690 EZ301U	5.2	11	137	69.43	0.15	0.14	0.24	77	31	12	20	2	25	53.1
0.24	3.8	4.3	5.5	1.4	ZV225S_K302_0690 EZ302U	5.2	11	137	69.43	0.15	0.14	0.24	77	31	12	20	2	25	53.1
0.24	5.0	5.7	7.1	1.0	ZV225S_K302_0690 EZ303U	5.2	11	137	69.43	0.15	0.14	0.24	77	31	12	20	2	25	53.1
0.25	2.2	2.3	2.5	2.4	ZV225S_K303_0680 EZ301U	5.2	16	137	67.73	0.16	0.14	0.25	77	39	19	20	2	25	53.1
0.25	3.7	4.1	4.2	1.4	ZV225S_K303_0680 EZ302U	5.2	16	137	67.73	0.16	0.14	0.25	77	39	19	20	2	25	53.1
0.25	4.8	5.5	5.4	1.1	ZV225S_K303_0680 EZ303U	5.2	16	137	67.73	0.16	0.14	0.25	77	39	19	20	2	25	53.1
0.25	2.1	2.3	3.1	2.4	ZV225S_K303_0660 EZ301U	5.2	16	137	66.35	0.16	0.15	0.25	77	39	19	20	2	25	53.1
0.25	3.6	4.0	5.3	1.4	ZV225S_K303_0660 EZ302U	5.2	16	137	66.35	0.16	0.15	0.25	77	39	19	20	2	25	53.1
0.25	4.7	5.4	6.9	1.1	ZV225S_K303_0660 EZ303U	5.2	16	137	66.35	0.16	0.15	0.25	77	39	19	20	2	25	53.1
0.30	4.7	5.7	6.3	1.1	ZV225S_K302_0560 EZ401U	5.2	20	137	55.71	0.19	0.18	0.30	77	31	12	20	2	25	53.1
0.31	1.8	1.9	2.5	3.0	ZV225S_K303_0550 EZ301U	5.2	13	137	54.58	0.19	0.18	0.31	77	39	19	20	2	25	53.1
0.31	3.0	3.3	4.2	1.8	ZV225S_K303_0550 EZ302U	5.2	13	137	54.58	0.19	0.18	0.31	77	39	19	20	2	25	53.1
0.31	3.9	4.4	5.5	1.3	ZV225S_K303_0550 EZ303U	5.2	13	137	54.58	0.19	0.18	0.31	77	39	19	20	2	25	53.1
0.31	4.5	5.5	6.5	1.1	ZV225S_K303_0550 EZ401U	5.2	13	137	54.58	0.19	0.18	0.31	77	39	19	20	2	25	53.1
0.33	1.6	1.8	4.1	3.1	ZV225S_K302_0500 EZ301U	5.2	8.2	137	50.49	0.21	0.19	0.33	77	31	12	20	2	25	53.1
0.33	2.8	3.1	6.9	1.9	ZV225S_K302_0500 EZ302U	5.2	8.2	137	50.49	0.21	0.19	0.33	77	31	12	20	2	25	53.1
0.33	3.6	4.2	9.1	1.4	ZV225S_K302_0500 EZ303U	5.2	8.2	137	50.49	0.21	0.19	0.33	77	31	12	20	2	25	53.1
0.33	4.2	5.2	11	1.2	ZV225S_K302_0500 EZ401U	5.2	8.2	137	50.49	0.21	0.19	0.33	77	31	12	20	2	25	53.1
0.34	1.6	1.7	3.1	3.3	ZV225S_K303_0490 EZ301U	5.0	12	132	49.26	0.21	0.20	0.34	77	39	19	20	2	25	53.1
0.34	2.7	3.0	5.3	1.9	ZV225S_K303_0490 EZ302U	5.2	12	137	49.26	0.21	0.20	0.34	77	39	19	20	2	25	53.1
0.34	3.5	4.0	6.9	1.5	ZV225S_K303_0490 EZ303U	5.2	12	137	49.26	0.21	0.20	0.34	77	39	19	20	2	25	53.1
0.34	4.1	5.0	8.1	1.3	ZV225S_K303_0490 EZ401U	5.2	12	137	49.26	0.21	0.20	0.34	77	39	19	20	2	25	53.1
0.36	3.9	4.7	5.5	1.3	ZV225S_K302_0460 EZ401U	5.2	26	137	46.23	0.23	0.21	0.36	77	31	12	20	2	25	53.1
0.41	3.4	4.1	8.0	1.5	ZV225S_K302_0410 EZ401U	5.2	15	137	40.51	0.26	0.24	0.41	77	31	12	20	2	25	53.1
0.41	5.0	6.5	12	1.0	ZV225S_K302_0410 EZ501U	5.2	15	137	40.51	0.26	0.24	0.41	77	31	12	20	2	25	53.1
0.43	4.8	6.2	8.1	1.1	ZV225S_K303_0390 EZ501U	5.2	26	137	39.19	0.27	0.25	0.43	77	39	19	20	2	25	53.1
0.47	4.4	5.7	8.2	1.2	ZV225S_K303_0360 EZ501U	5.2	24	137	35.83	0.30	0.27	0.47	77	39	19	20	2	25	53.1
0.48	2.9	3.6	5.6	1.8	ZV225S_K302_0350 EZ401U	5.2	26	137	34.73	0.30	0.28	0.48	77	31	12	20	2	25	53.1
0.48	4.3	5.6	8.3	1.2	ZV225S_K302_0350 EZ501U	5.2	26	137	34.73	0.30	0.28	0.48	77	31	12	20	2	25	53.1
0.48	4.4	6.2	8.6	1.2	ZV225S_K302_0350 EZ402U	5.2	26	137	34.73	0.30	0.28	0.48	77	31	12	20	2	25	53.1
0.50	2.8	3.4	5.9	1.8	ZV225S_K302_0340 EZ401U	5.2	19	137	33.62	0.31	0.29	0.50	77	31	12	20	2	25	53.1
0.50	4.2	5.4	8.7	1.2	ZV225S_K302_0340 EZ501U	5.2	19	137	33.62	0.31	0.29	0.50	77	31	12	20	2	25	53.1
0.50	4.3	6.0	9.0	1.2	ZV225S_K302_0340 EZ402U	5.2	19	137	33.62	0.31	0.29	0.50	77	31	12	20	2	25	53.1
0.51	4.0	5.2	8.3	1.3	ZV225S_K303_0330 EZ501U	5.2	22	137	32.65	0.32	0.30	0.51	77	39	19	20	2	25	53.1
0.60	2.3	2.9	5.8	2.2	ZV225S_K302_0280 EZ401U	5.2	26	137	27.88	0.38	0.35	0.60	77	31	12	20	2	25	53.1
0.60	3.5	4.5	8.5	1.5	ZV225S_K302_0280 EZ501U	5.2	26	137	27.88	0.38	0.35	0.60	77	31	12	20	2	25	53.1
0.60	3.6	5.0	8.8	1.4	ZV225S_K302_0280 EZ402U	5.2	26	137	27.88	0.38	0.35	0.60	77	31	12	20	2	25	53.1
0.66	2.1	2.6	5.8	2.4	ZV225S_K302_0250 EZ401U	5.2	23	137	25.26	0.42	0.39	0.66	77	31	12	20	2	25	53.1
0.66	3.1	4.1	8.6	1.6	ZV225S_K302_0250 EZ501U	5.2	23	137	25.26	0.42	0.39	0.66	77	31	12	20	2	25	53.1
0.66	3.2	4.5	8.8	1.6	ZV225S_K302_0250 EZ402U	5.2	23	137	25.26	0.42	0.39	0.66	77	31	12	20	2	25	53.1
0.66	4.8	7.2	13	1.1	ZV225S_K302_0250 EZ502U	5.2	23	137	25.26	0.42	0.39	0.66	77	31	12	20	2	25	53.1
0.66	4.8	7.3	13	1.1	ZV225S_K302_0250 EZ701U	5.2	23	137	25.26	0.42	0.39	0.66	77	31	12	20	2	25	53.1
0.72	2.0	2.4	5.8	2.6	ZV225S_K302_0230 EZ401U	5.2	24	137	23.29	0.45	0.42	0.72	77	31	12	20	2	25	53.1

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ EL1,2 [m/s]	$v_{f2maxDB}$ EL3,4,5,6 [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{redII}$ [µm]	$Δs_{redI}$ [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV2K3 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 5,2 kN)																			
0.72	2.9	3.7	8.6	1.8	ZV225S_K302_0230 EZ501U	5.2	24	137	23.29	0.45	0.42	0.72	77	31	12	20	2	25	53.1
0.72	3.0	4.2	8.9	1.7	ZV225S_K302_0230 EZ402U	5.2	24	137	23.29	0.45	0.42	0.72	77	31	12	20	2	25	53.1
0.72	4.4	6.6	13	1.2	ZV225S_K302_0230 EZ502U	5.2	24	137	23.29	0.45	0.42	0.72	77	31	12	20	2	25	53.1
0.72	4.4	6.7	13	1.2	ZV225S_K302_0230 EZ701U	5.2	26	137	23.29	0.45	0.42	0.72	77	31	12	20	2	25	53.1
0.72	4.9	7.2	15	1.0	ZV225S_K302_0230 EZ404U	5.2	24	137	23.29	0.45	0.42	0.72	77	31	12	20	2	25	53.1
0.82	1.7	2.1	5.9	3.0	ZV225S_K302_0200 EZ401U	5.2	19	137	20.28	0.52	0.48	0.82	77	31	12	20	2	25	53.1
0.82	2.5	3.3	8.7	2.1	ZV225S_K302_0200 EZ501U	5.2	19	137	20.28	0.52	0.48	0.82	77	31	12	20	2	25	53.1
0.82	2.6	3.6	9.0	2.0	ZV225S_K302_0200 EZ402U	5.2	19	137	20.28	0.52	0.48	0.82	77	31	12	20	2	25	53.1
0.82	3.9	5.8	13	1.3	ZV225S_K302_0200 EZ502U	5.2	19	137	20.28	0.52	0.48	0.82	77	31	12	20	2	25	53.1
0.82	3.9	5.9	13	1.3	ZV225S_K302_0200 EZ701U	5.2	26	137	20.28	0.52	0.48	0.82	77	31	12	20	2	25	53.1
0.82	4.3	6.2	15	1.2	ZV225S_K302_0200 EZ404U	5.2	19	137	20.28	0.52	0.48	0.82	77	31	12	20	2	25	53.1
0.82	4.6	7.9	16	1.1	ZV225S_K302_0200 EZ503U	5.2	19	137	20.28	0.52	0.48	0.82	77	31	12	20	2	25	53.1
0.98	1.4	1.7	6.0	3.4	ZV225S_K302_0170 EZ401U	5.2	18	137	16.94	0.62	0.57	0.98	77	31	12	20	2	25	53.1
0.98	2.1	2.7	8.9	2.3	ZV225S_K302_0170 EZ501U	5.2	18	137	16.94	0.62	0.57	0.98	77	31	12	20	2	25	53.1
0.98	2.2	3.0	9.1	2.3	ZV225S_K302_0170 EZ402U	5.2	18	137	16.94	0.62	0.57	0.98	77	31	12	20	2	25	53.1
0.98	3.2	4.8	14	1.5	ZV225S_K302_0170 EZ502U	5.2	18	137	16.94	0.62	0.57	0.98	77	31	12	20	2	25	53.1
0.98	3.2	4.9	14	1.5	ZV225S_K302_0170 EZ701U	5.2	26	137	16.94	0.62	0.57	0.98	77	31	12	20	2	25	53.1
0.98	3.6	5.2	15	1.4	ZV225S_K302_0170 EZ404U	5.2	18	137	16.94	0.62	0.57	0.98	77	31	12	20	2	25	53.1
0.98	3.8	6.6	16	1.3	ZV225S_K302_0170 EZ503U	5.2	18	137	16.94	0.62	0.57	0.98	77	31	12	20	2	25	53.1
0.98	4.5	8.9	19	1.1	ZV225S_K302_0170 EZ702U	5.2	26	137	16.94	0.62	0.57	0.98	77	31	12	20	2	25	53.1
ZV3K3 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 5,3 kN)																			
0.07	4.2	4.3	2.4	1.3	ZV318S_K303_1360 EZ301U	5.3	24	153	136.0	0.08	0.08	0.13	83	42	21	20	3	18	57.3
0.08	3.4	3.5	2.3	1.6	ZV318S_K303_1090 EZ301U	5.3	24	153	109.2	0.10	0.10	0.17	83	42	21	20	3	18	57.3
0.10	2.8	2.9	2.2	1.9	ZV318S_K303_0910 EZ301U	5.3	20	153	91.23	0.13	0.12	0.20	83	42	21	20	3	18	57.3
0.10	4.8	5.1	3.7	1.1	ZV318S_K303_0910 EZ302U	5.3	20	153	91.23	0.13	0.12	0.20	83	42	21	20	3	18	57.3
0.11	2.5	2.5	2.6	2.2	ZV318S_K303_0790 EZ301U	5.3	18	153	79.42	0.14	0.13	0.23	83	42	21	20	3	18	57.3
0.11	4.2	4.5	4.4	1.3	ZV318S_K303_0790 EZ302U	5.3	18	153	79.42	0.14	0.13	0.23	83	42	21	20	3	18	57.3
0.13	2.2	2.2	3.4	2.4	ZV318S_K302_0690 EZ301U	5.3	10	153	69.43	0.16	0.15	0.26	83	33	12	20	3	18	57.3
0.13	3.7	3.9	5.8	1.4	ZV318S_K302_0690 EZ302U	5.3	10	153	69.43	0.16	0.15	0.26	83	33	12	20	3	18	57.3
0.13	4.9	5.1	7.5	1.1	ZV318S_K302_0690 EZ303U	5.3	10	153	69.43	0.16	0.15	0.26	83	33	12	20	3	18	57.3
0.13	2.1	2.1	2.1	2.5	ZV318S_K303_0680 EZ301U	5.3	15	153	67.73	0.17	0.16	0.27	83	42	21	20	3	18	57.3
0.13	3.6	3.8	3.5	1.5	ZV318S_K303_0680 EZ302U	5.3	15	153	67.73	0.17	0.16	0.27	83	42	21	20	3	18	57.3
0.13	4.7	5.0	4.6	1.1	ZV318S_K303_0680 EZ303U	5.3	15	153	67.73	0.17	0.16	0.27	83	42	21	20	3	18	57.3
0.14	2.1	2.1	2.6	2.6	ZV318S_K303_0660 EZ301U	5.3	15	153	66.35	0.17	0.16	0.27	83	42	21	20	3	18	57.3
0.14	3.5	3.7	4.4	1.5	ZV318S_K303_0660 EZ302U	5.3	15	153	66.35	0.17	0.16	0.27	83	42	21	20	3	18	57.3
0.14	4.6	4.8	5.8	1.2	ZV318S_K303_0660 EZ303U	5.3	15	153	66.35	0.17	0.16	0.27	83	42	21	20	3	18	57.3
0.16	5.3	5.7	7.7	1.0	ZV318S_K302_0560 EZ401U	5.3	18	153	55.71	0.21	0.19	0.32	83	33	12	20	3	18	57.3
0.17	1.7	1.7	2.4	3.1	ZV318S_K303_0550 EZ301U	5.1	12	146	54.58	0.21	0.19	0.33	83	42	21	20	3	18	57.3
0.17	2.9	3.1	4.1	1.8	ZV318S_K303_0550 EZ302U	5.3	12	153	54.58	0.21	0.19	0.33	83	42	21	20	3	18	57.3
0.17	3.8	4.0	5.3	1.4	ZV318S_K303_0550 EZ303U	5.3	12	153	54.58	0.21	0.19	0.33	83	42	21	20	3	18	57.3
0.17	5.1	5.5	7.1	1.0	ZV318S_K303_0550 EZ401U	5.3	12	153	54.58	0.21	0.19	0.33	83	42	21	20	3	18	57.3
0.18	1.6	1.6	4.3	3.4	ZV318S_K302_0500 EZ301U	4.8	7.6	137	50.49	0.23	0.21	0.36	83	33	12	20	3	18	57.3
0.18	2.7	2.9	7.3	2.0	ZV318S_K302_0500 EZ302U	5.3	7.6	153	50.49	0.23	0.21	0.36	83	33	12	20	3	18	57.3
0.18	3.5	3.7	9.6	1.5	ZV318S_K302_0500 EZ303U	5.3	7.6	153	50.49	0.23	0.21	0.36	83	33	12	20	3	18	57.3
0.18	4.8	5.1	13	1.1	ZV318S_K302_0500 EZ401U	5.3	7.6	153	50.49	0.23	0.21	0.36	83	33	12	20	3	18	57.3
0.18	1.5	1.6	2.6	3.5	ZV318S_K303_0490 EZ301U	4.6	11	132	49.26	0.23	0.21	0.37	83	42	21	20	3	18	57.3
0.18	2.6	2.8	4.5	2.0	ZV318S_K303_0490 EZ302U	5.3	11	153	49.26	0.23	0.21	0.37	83	42	21	20	3	18	57.3
0.18	3.4	3.6	5.8	1.6	ZV318S_K303_0490 EZ303U	5.3	11	153	49.26	0.23	0.21	0.37	83	42	21	20	3	18	57.3
0.18	4.6	4.9	7.8	1.2	ZV318S_K303_0490 EZ401U	5.3	11	153	49.26	0.23	0.21	0.37	83	42	21	20	3	18	57.3
0.20	4.4	4.7	5.7	1.2	ZV318S_K302_0460 EZ401U	5.3	24	153	46.23	0.25	0.23	0.39	83	33	12	20	3	18	57.3
0.22	3.8	4.1	9.8	1.4	ZV318S_K302_0410 EZ401U	5.3	13	153	40.51	0.28	0.26	0.44	83	33	12	20	3	18	57.3
0.25	5.1	5.6	8.2	1.0	ZV318S_K303_0360 EZ501U	5.3	22	153	35.83	0.32	0.29	0.50	83	42	21	20	3	18	57.3
0.26	3.3	3.5	5.5	1.6	ZV318S_K302_0350 EZ401U	5.3	24	153	34.73	0.33	0.30	0.52	83	33	12	20	3	18	57.3
0.26	5.1	5.5	8.4	1.1	ZV318S_K302_0350 EZ501U	5.3	24	153	34.73	0.33	0.30	0.52	83	33	12	20	3	18	57.3
0.27	3.2	3.4	7.2	1.7	ZV318S_K302_0340 EZ401U	5.3	17	153	33.62	0.34	0.31	0.54	83	33	12	20	3	18	57.3
0.27	4.9	5.3	11	1.1	ZV318S_K302_0340 EZ501U	5.3	17	153	33.62	0.34	0.31	0.54	83	33	12	20	3	18	57.3
0.28	4.7	5.1	8.3	1.1	ZV318S_K303_0330 EZ501U	5.3	20	153	32.65	0.35	0.32	0.55	83	42	21	20	3	18	57.3
0.32	2.6	2.8	5.6	2.0	ZV318S_K302_0280 EZ401U	5.3	24	153	27.88	0.41	0.38	0.65	83	33	12	20	3	18	57.3
0.32	4.1	4.4	8.5	1.3	ZV318S_K302_0280 EZ501U	5.3	24	153	27.88	0.41	0.38	0.65	83	33	12	20	3	18	57.3
0.32	4.4	4.9	9.3	1.2	ZV318S_K302_0280 EZ402U	5.3	24	153	27.88	0.41	0.38	0.65	83	33	12	20	3	18	57.3
0.36	2.4	2.6	5.6	2.2	ZV318S_K302_0250 EZ401U	5.3	21	153	25.26	0.45	0.42	0.71	83	33	12	20	3	18	57.3
0.36	3.7	4.0	8.6	1.4	ZV318S_K302_0250 EZ501U	5.3	21	153	25.26	0.45	0.42	0.71	83	33	12	20	3	18	57.3
0.36	4.0	4.4	9.4	1.3	ZV318S_K302_0250 EZ402U	5.3	21	153	25.26	0.45	0.42	0.71	83	33	12	20	3	18	57.3
0.39	2.2	2.4	5.6	2.4	ZV318S_K302_0230 EZ401U	5.3	23	153	23.29	0.49	0.45	0.77	83	33	12	20	3	18	57.3

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ EL1,2 [m/s]	$v_{f2maxDB}$ EL3,4,5,6 [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	Δs_{redII} [µm]	Δs_{redI} [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV3K3 (n_{1N} = 3000 min^{-1}), ($F_{f2acc,max}$ = 5,3 kN)																			
0.39	3.4	3.7	8.7	1.6	ZV318S_K302_0230 EZ501U	5.3	23	153	23.29	0.49	0.45	0.77	83	33	12	20	3	18	57.3
0.39	3.7	4.1	9.5	1.4	ZV318S_K302_0230 EZ402U	5.3	23	153	23.29	0.49	0.45	0.77	83	33	12	20	3	18	57.3
0.44	1.9	2.1	5.7	2.8	ZV318S_K302_0200 EZ401U	5.3	18	153	20.28	0.56	0.52	0.89	83	33	12	20	3	18	57.3
0.44	3.0	3.2	8.8	1.8	ZV318S_K302_0200 EZ501U	5.3	18	153	20.28	0.56	0.52	0.89	83	33	12	20	3	18	57.3
0.44	3.2	3.6	9.6	1.7	ZV318S_K302_0200 EZ402U	5.3	18	153	20.28	0.56	0.52	0.89	83	33	12	20	3	18	57.3
0.44	4.7	5.9	14	1.1	ZV318S_K302_0200 EZ404U	5.3	18	153	20.28	0.56	0.52	0.89	83	33	12	20	3	18	57.3
0.44	5.1	5.5	15	1.0	ZV318S_K302_0200 EZ502U	5.3	18	153	20.28	0.56	0.52	0.89	83	33	12	20	3	18	57.3
0.44	5.1	5.7	15	1.0	ZV318S_K302_0200 EZ701U	5.3	24	153	20.28	0.56	0.52	0.89	83	33	12	20	3	18	57.3
0.52	1.6	1.8	5.8	3.2	ZV318S_K302_0175 EZ401U	5.0	18	143	17.29	0.61	0.54	0.87	83	33	12	20	3	18	57.3
0.52	2.5	2.8	8.9	2.1	ZV318S_K302_0175 EZ501U	5.3	18	153	17.29	0.61	0.54	0.87	83	33	12	20	3	18	57.3
0.52	2.8	3.0	9.7	1.9	ZV318S_K302_0175 EZ402U	5.3	18	153	17.29	0.61	0.54	0.87	83	33	12	20	3	18	57.3
0.52	4.0	5.0	14	1.3	ZV318S_K302_0175 EZ404U	5.3	18	153	17.29	0.61	0.54	0.87	83	33	12	20	3	18	57.3
0.52	4.3	4.7	15	1.2	ZV318S_K302_0175 EZ502U	5.3	18	153	17.29	0.61	0.54	0.87	83	33	12	20	3	18	57.3
0.52	4.3	4.9	15	1.2	ZV318S_K302_0175 EZ701U	5.3	24	153	17.29	0.61	0.54	0.87	83	33	12	20	3	18	57.3
0.53	1.6	1.7	5.8	3.3	ZV318S_K302_0170 EZ401U	4.9	16	140	16.94	0.67	0.62	1.06	83	33	12	20	3	18	57.3
0.53	2.5	2.7	8.9	2.2	ZV318S_K302_0170 EZ501U	5.3	16	153	16.94	0.67	0.62	1.06	83	33	12	20	3	18	57.3
0.53	2.7	3.0	9.7	2.0	ZV318S_K302_0170 EZ402U	5.3	16	153	16.94	0.67	0.62	1.06	83	33	12	20	3	18	57.3
0.53	4.0	4.9	14	1.3	ZV318S_K302_0170 EZ404U	5.3	16	153	16.94	0.67	0.62	1.06	83	33	12	20	3	18	57.3
0.53	4.2	4.6	15	1.3	ZV318S_K302_0170 EZ502U	5.3	16	153	16.94	0.67	0.62	1.06	83	33	12	20	3	18	57.3
0.53	4.2	4.8	15	1.3	ZV318S_K302_0170 EZ701U	5.3	24	153	16.94	0.67	0.62	1.06	83	33	12	20	3	18	57.3
0.65	1.3	1.4	5.9	4.0	ZV318S_K302_0140 EZ401U	4.0	14	115	13.94	0.75	0.67	1.08	83	33	12	20	3	18	57.3
0.65	2.0	2.2	9.0	2.6	ZV318S_K302_0140 EZ501U	5.3	14	153	13.94	0.75	0.67	1.08	83	33	12	20	3	18	57.3
0.65	2.2	2.5	9.9	2.4	ZV318S_K302_0140 EZ402U	5.3	14	153	13.94	0.75	0.67	1.08	83	33	12	20	3	18	57.3
0.65	3.3	4.1	15	1.6	ZV318S_K302_0140 EZ404U	5.3	14	153	13.94	0.75	0.67	1.08	83	33	12	20	3	18	57.3
0.65	3.5	3.8	16	1.5	ZV318S_K302_0140 EZ502U	5.3	14	153	13.94	0.75	0.67	1.08	83	33	12	20	3	18	57.3
0.65	3.5	3.9	16	1.5	ZV318S_K302_0140 EZ701U	5.3	24	153	13.94	0.75	0.67	1.08	83	33	12	20	3	18	57.3
0.65	4.6	5.2	20	1.2	ZV318S_K302_0140 EZ503U	5.3	14	153	13.94	0.75	0.67	1.08	83	33	12	20	3	18	57.3
0.72	1.2	1.3	5.9	4.5	ZV318S_K302_0125 EZ401U	3.6	13	104	12.58	0.84	0.74	1.19	83	33	12	20	3	18	57.3
0.72	1.8	2.0	9.1	2.9	ZV318S_K302_0125 EZ501U	5.3	13	153	12.58	0.84	0.74	1.19	83	33	12	20	3	18	57.3
0.72	2.0	2.2	10	2.7	ZV318S_K302_0125 EZ402U	5.3	13	153	12.58	0.84	0.74	1.19	83	33	12	20	3	18	57.3
0.72	2.9	3.7	15	1.8	ZV318S_K302_0125 EZ404U	5.3	13	153	12.58	0.84	0.74	1.19	83	33	12	20	3	18	57.3
0.72	3.2	3.4	16	1.7	ZV318S_K302_0125 EZ502U	5.3	13	153	12.58	0.84	0.74	1.19	83	33	12	20	3	18	57.3
0.72	3.2	3.5	16	1.7	ZV318S_K302_0125 EZ701U	5.3	24	153	12.58	0.84	0.74	1.19	83	33	12	20	3	18	57.3
0.72	4.1	4.7	21	1.3	ZV318S_K302_0125 EZ503U	5.3	13	153	12.58	0.84	0.74	1.19	83	33	12	20	3	18	57.3
0.72	5.1	6.1	25	1.0	ZV318S_K302_0125 EZ702U	5.3	24	153	12.58	0.84	0.74	1.19	83	33	12	20	3	18	57.3
0.78	1.1	1.2	6.0	4.8	ZV318S_K302_0115 EZ401U	3.3	12	96	11.61	0.83	0.72	1.16	83	33	12	20	3	18	57.3
0.78	1.7	1.8	9.2	3.2	ZV318S_K302_0115 EZ501U	5.3	12	153	11.61	0.83	0.72	1.16	83	33	12	20	3	18	57.3
0.78	1.8	2.0	10	2.9	ZV318S_K302_0115 EZ402U	5.3	12	153	11.61	0.83	0.72	1.16	83	33	12	20	3	18	57.3
0.78	2.7	3.4	15	2.0	ZV318S_K302_0115 EZ404U	5.3	12	153	11.61	0.83	0.72	1.16	83	33	12	20	3	18	57.3
0.78	2.9	3.1	16	1.8	ZV318S_K302_0115 EZ502U	5.3	12	153	11.61	0.83	0.72	1.16	83	33	12	20	3	18	57.3
0.78	2.9	3.3	16	1.8	ZV318S_K302_0115 EZ701U	5.3	24	153	11.61	0.83	0.72	1.16	83	33	12	20	3	18	57.3
0.78	3.8	4.4	21	1.4	ZV318S_K302_0115 EZ503U	5.3	12	153	11.61	0.83	0.72	1.16	83	33	12	20	3	18	57.3
0.78	4.7	5.7	26	1.1	ZV318S_K302_0115 EZ702U	5.3	24	153	11.61	0.83	0.72	1.16	83	33	12	20	3	18	57.3
0.78	5.3	6.3	29	1.0	ZV318S_K302_0115 EZ505U	5.3	24	153	11.61	0.83	0.72	1.16	83	33	12	20	3	18	57.3
0.89	1.5	1.6	9.3	3.6	ZV318S_K302_0100 EZ501U	5.3	10	153	10.14	1.04	0.92	1.48	83	33	12	20	3	18	57.3
0.89	1.6	1.8	10	3.3	ZV318S_K302_0100 EZ402U	5.3	10	153	10.14	1.04	0.92	1.48	83	33	12	20	3	18	57.3
0.89	2.4	3.0	15	2.2	ZV318S_K302_0100 EZ404U	5.3	10	153	10.14	1.04	0.92	1.48	83	33	12	20	3	18	57.3
0.89	2.5	2.7	16	2.1	ZV318S_K302_0100 EZ502U	5.3	10	153	10.14	1.04	0.92	1.48	83	33	12	20	3	18	57.3
0.89	2.5	2.8	16	2.1	ZV318S_K302_0100 EZ701U	5.3	24	153	10.14	1.04	0.92	1.48	83	33	12	20	3	18	57.3
0.89	3.3	3.8	21	1.6	ZV318S_K302_0100 EZ503U	5.3	10	153	10.14	1.04	0.92	1.48	83	33	12	20	3	18	57.3
0.89	4.1	4.9	26	1.3	ZV318S_K302_0100 EZ702U	5.3	24	153	10.14	1.04	0.92	1.48	83	33	12	20	3	18	57.3
0.89	4.6	5.5	29	1.1	ZV318S_K302_0100 EZ505U	5.3	24	153	10.14	1.04	0.92	1.48	83	33	12	20	3	18	57.3
0.97	2.3	2.6	16	2.2	ZV318S_K302_0093 EZ701U	5.3	24	153	9.267	1.04	0.91	1.46	83	33	12	20	3	18	57.3
0.97	3.8	4.5	26	1.4	ZV318S_K302_0093 EZ702U	5.3	24	153	9.267	1.04	0.91	1.46	83	33	12	20	3	18	57.3
0.97	4.2	5.0	29	1.2	ZV318S_K302_0093 EZ505U	5.3	24	153	9.267	1.04	0.91	1.46	83	33	12	20	3	18	57.3
1.07	1.2	1.3	9.9	4.0	ZV318S_K302_0084 EZ501U	4.6	8.6	131	8.444	1.14	1.00	1.60	83	33	12	20	3	18	57.3
1.07	1.3	1.5	11	3.7	ZV318S_K302_0084 EZ402U	4.6	8.6	131	8.444	1.14	1.00	1.60	83	33	12	20	3	18	57.3
1.07	2.0	2.5	16	2.5	ZV318S_K302_0084 EZ404U	5.3	8.6	153	8.444	1.14	1.00	1.60	83	33	12	20	3	18	57.3
1.07	2.1	2.3	17	2.3	ZV318S_K302_0084 EZ502U	5.3	8.6	153	8.444	1.14	1.00	1.60	83	33	12	20	3	18	57.3
1.07	2.1	2.4	16	2.3	ZV318S_K302_0084 EZ701U	5.3	21	153	8.444	1.14	1.00	1.60	83	33	12	20	3	18	57.3
1.07	2.8	3.2	22	1.8	ZV318S_K302_0084 EZ503U	5.3	8.6	153	8.444	1.14	1.00	1.60	83	33	12	20	3	18	57.3
1.07	3.4	4.1	26	1.4	ZV318S_K302_0084 EZ702U	5.3	21	153	8.444	1.14	1.00	1.60	83	33	12	20	3	18	57.3
1.07	3.9	4.6	30	1.3	ZV318S_K302_0084 EZ505U	5.3	21	153	8.444	1.14	1.00	1.60	83	33	12	20	3	18	57.3
1.07	4.7	5.9	36	1.1	ZV318S_K302_0084 EZ703U	5.3	21	153	8.444	1.14	1.00	1.60	83	33	12	20	3	18	57.3

v_{f2}	F_{f2}	$F_{f2,0}$	a_{th}	S	Type	F_{f2accE}	$F_{f2NOT,E}$	M_{2accE}	i	$v_{f2maxDB}$ EL1,2	$v_{f2maxDB}$ EL3,4,5,6	$v_{f2maxZB}$	Δs	$Δs_{redII}$	$Δs_{redI}$	C_{linE}	m_n	z	d_0
[m/s]	[kN]	[kN]				[kN]	[kN]	[Nm]		[m/s]	[m/s]	[m/s]	[µm]	[µm]	[µm]	[N/µm]	[mm]		[mm]
ZV3K3 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 5,3 kN)																			
1.22	1.9	2.1	16	2.6	ZV318S_K302_0074 EZ701U	5.0	19	143	7.391	1.10	0.93	1.62	83	33	12	20	3	18	57.3
1.22	3.0	3.6	27	1.6	ZV318S_K302_0074 EZ702U	5.3	19	153	7.391	1.10	0.93	1.62	83	33	12	20	3	18	57.3
1.22	3.4	4.0	30	1.4	ZV318S_K302_0074 EZ505U	5.3	19	153	7.391	1.10	0.93	1.62	83	33	12	20	3	18	57.3
1.22	4.1	5.2	37	1.1	ZV318S_K302_0074 EZ703U	5.3	19	153	7.391	1.10	0.93	1.62	83	33	12	20	3	18	57.3
1.34	1.7	1.9	17	2.7	ZV318S_K302_0067 EZ701U	4.6	17	131	6.740	1.42	1.25	2.00	83	33	12	20	3	18	57.3
1.34	2.7	3.3	27	1.7	ZV318S_K302_0067 EZ702U	5.3	17	153	6.740	1.42	1.25	2.00	83	33	12	20	3	18	57.3
1.34	3.1	3.7	30	1.5	ZV318S_K302_0067 EZ505U	5.3	17	153	6.740	1.42	1.25	2.00	83	33	12	20	3	18	57.3
1.34	3.8	4.7	37	1.2	ZV318S_K302_0067 EZ703U	5.3	17	153	6.740	1.42	1.25	2.00	83	33	12	20	3	18	57.3
1.50	1.5	1.7	17	2.9	ZV318S_K302_0060 EZ701U	4.1	15	116	6.000	1.35	1.15	2.00	83	33	12	20	3	18	57.3
1.50	2.4	2.9	27	1.8	ZV318S_K302_0060 EZ702U	5.3	15	153	6.000	1.35	1.15	2.00	83	33	12	20	3	18	57.3
1.50	2.7	3.3	30	1.6	ZV318S_K302_0060 EZ505U	5.3	15	153	6.000	1.35	1.15	2.00	83	33	12	20	3	18	57.3
1.50	3.4	4.2	37	1.3	ZV318S_K302_0060 EZ703U	5.3	15	153	6.000	1.35	1.15	2.00	83	33	12	20	3	18	57.3
1.50	4.3	6.1	48	1.0	ZV318S_K302_0060 EZ705U	5.3	24	153	6.000	1.35	1.15	2.00	83	33	12	20	3	18	57.3
1.67	1.3	1.5	17	3.2	ZV318S_K302_0054 EZ701U	3.6	14	104	5.375	1.51	1.28	2.23	83	33	12	20	3	18	57.3
1.67	2.2	2.6	27	2.0	ZV318S_K302_0054 EZ702U	5.3	14	153	5.375	1.51	1.28	2.23	83	33	12	20	3	18	57.3
1.67	2.5	2.9	31	1.7	ZV318S_K302_0054 EZ505U	5.3	14	153	5.375	1.51	1.28	2.23	83	33	12	20	3	18	57.3
1.67	3.0	3.8	38	1.4	ZV318S_K302_0054 EZ703U	5.3	14	153	5.375	1.51	1.28	2.23	83	33	12	20	3	18	57.3
2.06	1.1	1.2	17	3.6	ZV318S_K302_0044 EZ701U	3.0	11	85	4.364	1.86	1.58	2.75	83	33	12	20	3	18	57.3
2.06	1.8	2.1	28	2.2	ZV318S_K302_0044 EZ702U	5.3	11	153	4.364	1.86	1.58	2.75	83	33	12	20	3	18	57.3
2.06	2.0	2.4	31	2.0	ZV318S_K302_0044 EZ505U	5.3	11	153	4.364	1.86	1.58	2.75	83	33	12	20	3	18	57.3
2.06	2.4	3.1	38	1.6	ZV318S_K302_0044 EZ703U	5.3	11	153	4.364	1.86	1.58	2.75	83	33	12	20	3	18	57.3
2.06	3.1	4.5	49	1.3	ZV318S_K302_0044 EZ705U	5.3	24	153	4.364	1.86	1.58	2.75	83	33	12	20	3	18	57.3
2.25	1.0	1.1	17	3.9	ZV318S_K302_0040 EZ701U	2.7	10	78	4.000	2.03	1.73	3.00	83	33	12	20	3	18	57.3
2.25	1.6	2.0	28	2.4	ZV318S_K302_0040 EZ702U	5.3	10	153	4.000	2.03	1.73	3.00	83	33	12	20	3	18	57.3
2.25	1.8	2.2	31	2.1	ZV318S_K302_0040 EZ505U	5.3	10	153	4.000	2.03	1.73	3.00	83	33	12	20	3	18	57.3
2.25	2.2	2.8	38	1.7	ZV318S_K302_0040 EZ703U	5.3	10	153	4.000	2.03	1.73	3.00	83	33	12	20	3	18	57.3
2.25	2.9	4.1	50	1.3	ZV318S_K302_0040 EZ705U	5.3	24	153	4.000	2.03	1.73	3.00	83	33	12	20	3	18	57.3
ZV3K3 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 5,3 kN)																			
0.97	4.5	7.2	23	1.1	ZV318S_K302_0140 EZ505U	5.3	24	153	13.94	0.75	0.67	1.08	83	33	12	20	3	18	57.3
1.07	4.0	6.5	23	1.2	ZV318S_K302_0125 EZ505U	5.3	24	153	12.58	0.84	0.74	1.19	83	33	12	20	3	18	57.3
1.16	3.7	6.0	23	1.3	ZV318S_K302_0115 EZ505U	5.3	24	153	11.61	0.83	0.72	1.16	83	33	12	20	3	18	57.3
1.16	4.8	7.9	30	1.0	ZV318S_K302_0115 EZ703U	5.3	24	153	11.61	0.83	0.72	1.16	83	33	12	20	3	18	57.3
1.33	3.3	5.3	23	1.4	ZV318S_K302_0100 EZ505U	5.3	24	153	10.14	1.04	0.92	1.48	83	33	12	20	3	18	57.3
1.33	4.2	6.9	30	1.1	ZV318S_K302_0100 EZ703U	5.3	24	153	10.14	1.04	0.92	1.48	83	33	12	20	3	18	57.3
1.46	3.0	4.8	24	1.5	ZV318S_K302_0093 EZ505U	5.3	24	153	9.267	1.04	0.91	1.46	83	33	12	20	3	18	57.3
1.46	3.8	6.3	30	1.2	ZV318S_K302_0093 EZ703U	5.3	24	153	9.267	1.04	0.91	1.46	83	33	12	20	3	18	57.3
1.60	2.7	4.4	24	1.6	ZV318S_K302_0084 EZ505U	5.3	21	153	8.444	1.14	1.00	1.60	83	33	12	20	3	18	57.3
1.60	3.5	5.7	30	1.3	ZV318S_K302_0084 EZ703U	5.3	21	153	8.444	1.14	1.00	1.60	83	33	12	20	3	18	57.3
2.00	2.2	3.5	24	1.9	ZV318S_K302_0067 EZ505U	5.3	17	153	6.740	1.42	1.25	2.00	83	33	12	20	3	18	57.3
2.00	2.8	4.6	31	1.5	ZV318S_K302_0067 EZ703U	5.3	17	153	6.740	1.42	1.25	2.00	83	33	12	20	3	18	57.3
ZV3K3 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 5,3 kN)																			
0.13	4.0	4.3	2.5	1.3	ZV318S_K303_1360 EZ301U	5.3	24	153	136.0	0.08	0.08	0.13	83	42	21	20	3	18	57.3
0.17	3.2	3.5	2.4	1.6	ZV318S_K303_1090 EZ301U	5.3	24	153	109.2	0.10	0.10	0.17	83	42	21	20	3	18	57.3
0.20	2.7	2.9	2.5	2.0	ZV318S_K303_0910 EZ301U	5.3	20	153	91.23	0.13	0.12	0.20	83	42	21	20	3	18	57.3
0.20	4.6	5.1	4.2	1.2	ZV318S_K303_0910 EZ302U	5.3	20	153	91.23	0.13	0.12	0.20	83	42	21	20	3	18	57.3
0.23	2.4	2.5	3.1	2.3	ZV318S_K303_0790 EZ301U	5.3	18	153	79.42	0.14	0.13	0.23	83	42	21	20	3	18	57.3
0.23	4.0	4.5	5.2	1.3	ZV318S_K303_0790 EZ302U	5.3	18	153	79.42	0.14	0.13	0.23	83	42	21	20	3	18	57.3
0.23	5.2	6.0	6.8	1.0	ZV318S_K303_0790 EZ303U	5.3	18	153	79.42	0.14	0.13	0.23	83	42	21	20	3	18	57.3
0.26	2.1	2.2	3.2	2.5	ZV318S_K302_0690 EZ301U	5.3	10	153	69.43	0.16	0.15	0.26	83	33	12	20	3	18	57.3
0.26	3.5	3.9	5.5	1.5	ZV318S_K302_0690 EZ302U	5.3	10	153	69.43	0.16	0.15	0.26	83	33	12	20	3	18	57.3
0.26	4.6	5.3	7.1	1.2	ZV318S_K302_0690 EZ303U	5.3	10	153	69.43	0.16	0.15	0.26	83	33	12	20	3	18	57.3
0.27	2.0	2.1	2.5	2.6	ZV318S_K303_0680 EZ301U	5.3	15	153	67.73	0.17	0.16	0.27	83	42	21	20	3	18	57.3
0.27	3.4	3.8	4.2	1.6	ZV318S_K303_0680 EZ302U	5.3	15	153	67.73	0.17	0.16	0.27	83	42	21	20	3	18	57.3
0.27	4.4	5.1	5.4	1.2	ZV318S_K303_0680 EZ303U	5.3	15	153	67.73	0.17	0.16	0.27	83	42	21	20	3	18	57.3
0.27	5.2	6.3	6.4	1.0	ZV318S_K303_0680 EZ401U	5.3	15	153	67.73	0.17	0.16	0.27	83	42	21	20	3	18	57.3
0.27	2.0	2.1	3.1	2.7	ZV318S_K303_0660 EZ301U	5.3	15	153	66.35	0.17	0.16	0.27	83	42	21	20	3	18	57.3
0.27	3.3	3.7	5.3	1.6	ZV318S_K303_0660 EZ302U	5.3	15	153	66.35	0.17	0.16	0.27	83	42	21	20	3	18	57.3
0.27	4.3	5.0	6.9	1.2	ZV318S_K303_0660 EZ303U	5.3	15	153	66.35	0.17	0.16	0.27	83	42	21	20	3	18	57.3
0.27	5.1	6.2	8.1	1.0	ZV318S_K303_0660 EZ401U	5.3	15	153	66.35	0.17	0.16	0.27	83	42	21	20	3	18	57.3
0.32	4.3	5.3	6.3	1.2	ZV318S_K302_0560 EZ401U	5.3	18	153	55.71	0.21	0.19	0.32	83	33	12	20	3	18	57.3
0.33	1.6	1.7	2.5	3.3	ZV318S_K303_0550 EZ301U	5.1	12	146	54.58	0.21	0.19	0.33	83	42	21	20	3	18	57.3
0.33	2.7	3.1	4.2	1.9	ZV318S_K303_0550 EZ302U	5.3	12	153	54.58	0.21	0.19	0.33	83	42	21	20	3	18	57.3
0.33	3.6	4.1	5.5	1.5	ZV318S_K303_0550 EZ303U	5.3	12	153	54.58	0.21	0.19	0.33	83	42	21	20	3	18	57.3
0.33	4.2	5.1	6.5	1.3	ZV318S_K303_0550 EZ401U	5.3	12	153	54.58	0.21	0.19	0.33	83	42	21	20	3	18	57.3

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ EL1,2 [m/s]	$v_{f2maxDB}$ EL3,4,5,6 [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{redII}$ [µm]	$Δs_{redI}$ [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV3K3 (n_{1N} = 6000 min^{-1}, ($F_{f2acc,max}$ = 5,3 kN)																			
0.36	1.5	1.6	4.1	3.5	ZV318S_K302_0500 EZ301U	4.8	7.6	137	50.49	0.23	0.21	0.36	83	33	12	20	3	18	57.3
0.36	2.6	2.9	6.9	2.1	ZV318S_K302_0500 EZ302U	5.3	7.6	153	50.49	0.23	0.21	0.36	83	33	12	20	3	18	57.3
0.36	3.4	3.8	9.1	1.6	ZV318S_K302_0500 EZ303U	5.3	7.6	153	50.49	0.23	0.21	0.36	83	33	12	20	3	18	57.3
0.36	3.9	4.8	11	1.4	ZV318S_K302_0500 EZ401U	5.3	7.6	153	50.49	0.23	0.21	0.36	83	33	12	20	3	18	57.3
0.37	1.5	1.6	3.1	3.6	ZV318S_K303_0490 EZ301U	4.6	11	132	49.26	0.23	0.21	0.37	83	42	21	20	3	18	57.3
0.37	2.5	2.8	5.3	2.2	ZV318S_K303_0490 EZ302U	5.3	11	153	49.26	0.23	0.21	0.37	83	42	21	20	3	18	57.3
0.37	3.2	3.7	6.9	1.7	ZV318S_K303_0490 EZ303U	5.3	11	153	49.26	0.23	0.21	0.37	83	42	21	20	3	18	57.3
0.37	3.8	4.6	8.1	1.4	ZV318S_K303_0490 EZ401U	5.3	11	153	49.26	0.23	0.21	0.37	83	42	21	20	3	18	57.3
0.39	3.6	4.4	5.5	1.5	ZV318S_K302_0460 EZ401U	5.3	24	153	46.23	0.25	0.23	0.39	83	33	12	20	3	18	57.3
0.39	5.3	6.9	8.2	1.0	ZV318S_K302_0460 EZ501U	5.3	24	153	46.23	0.25	0.23	0.39	83	33	12	20	3	18	57.3
0.40	5.1	6.6	8.1	1.0	ZV318S_K303_0450 EZ501U	5.3	24	153	44.89	0.25	0.23	0.40	83	42	21	20	3	18	57.3
0.44	3.2	3.8	8.0	1.7	ZV318S_K302_0410 EZ401U	5.3	13	153	40.51	0.28	0.26	0.44	83	33	12	20	3	18	57.3
0.44	4.7	6.0	12	1.1	ZV318S_K302_0410 EZ501U	5.3	13	153	40.51	0.28	0.26	0.44	83	33	12	20	3	18	57.3
0.44	4.8	6.7	12	1.1	ZV318S_K302_0410 EZ402U	5.3	13	153	40.51	0.28	0.26	0.44	83	33	12	20	3	18	57.3
0.46	4.4	5.8	8.1	1.2	ZV318S_K303_0390 EZ501U	5.3	24	153	39.19	0.29	0.27	0.46	83	42	21	20	3	18	57.3
0.50	4.1	5.3	8.2	1.3	ZV318S_K303_0360 EZ501U	5.3	22	153	35.83	0.32	0.29	0.50	83	42	21	20	3	18	57.3
0.52	2.7	3.3	5.6	2.0	ZV318S_K302_0350 EZ401U	5.3	24	153	34.73	0.33	0.30	0.52	83	33	12	20	3	18	57.3
0.52	4.0	5.2	8.3	1.3	ZV318S_K302_0350 EZ501U	5.3	24	153	34.73	0.33	0.30	0.52	83	33	12	20	3	18	57.3
0.52	4.1	5.8	8.6	1.3	ZV318S_K302_0350 EZ402U	5.3	24	153	34.73	0.33	0.30	0.52	83	33	12	20	3	18	57.3
0.54	2.6	3.2	5.9	2.0	ZV318S_K302_0340 EZ401U	5.3	17	153	33.62	0.34	0.31	0.54	83	33	12	20	3	18	57.3
0.54	3.9	5.0	8.7	1.4	ZV318S_K302_0340 EZ501U	5.3	17	153	33.62	0.34	0.31	0.54	83	33	12	20	3	18	57.3
0.54	4.0	5.6	9.0	1.3	ZV318S_K302_0340 EZ402U	5.3	17	153	33.62	0.34	0.31	0.54	83	33	12	20	3	18	57.3
0.55	3.7	4.8	8.3	1.4	ZV318S_K303_0330 EZ501U	5.3	20	153	32.65	0.35	0.32	0.55	83	42	21	20	3	18	57.3
0.65	2.2	2.6	5.8	2.5	ZV318S_K302_0280 EZ401U	5.3	24	153	27.88	0.41	0.38	0.65	83	33	12	20	3	18	57.3
0.65	3.2	4.2	8.5	1.7	ZV318S_K302_0280 EZ501U	5.3	24	153	27.88	0.41	0.38	0.65	83	33	12	20	3	18	57.3
0.65	3.3	4.6	8.8	1.6	ZV318S_K302_0280 EZ402U	5.3	24	153	27.88	0.41	0.38	0.65	83	33	12	20	3	18	57.3
0.65	4.9	7.4	13	1.1	ZV318S_K302_0280 EZ502U	5.3	24	153	27.88	0.41	0.38	0.65	83	33	12	20	3	18	57.3
0.65	4.9	7.5	13	1.1	ZV318S_K302_0280 EZ701U	5.3	24	153	27.88	0.41	0.38	0.65	83	33	12	20	3	18	57.3
0.71	2.0	2.4	5.8	2.7	ZV318S_K302_0250 EZ401U	5.3	21	153	25.26	0.45	0.42	0.71	83	33	12	20	3	18	57.3
0.71	2.9	3.8	8.6	1.8	ZV318S_K302_0250 EZ501U	5.3	21	153	25.26	0.45	0.42	0.71	83	33	12	20	3	18	57.3
0.71	3.0	4.2	8.8	1.8	ZV318S_K302_0250 EZ402U	5.3	21	153	25.26	0.45	0.42	0.71	83	33	12	20	3	18	57.3
0.71	4.4	6.7	13	1.2	ZV318S_K302_0250 EZ502U	5.3	21	153	25.26	0.45	0.42	0.71	83	33	12	20	3	18	57.3
0.71	4.4	6.8	13	1.2	ZV318S_K302_0250 EZ701U	5.3	21	153	25.26	0.45	0.42	0.71	83	33	12	20	3	18	57.3
0.71	5.0	7.2	15	1.1	ZV318S_K302_0250 EZ404U	5.3	21	153	25.26	0.45	0.42	0.71	83	33	12	20	3	18	57.3
0.71	5.3	9.1	16	1.0	ZV318S_K302_0250 EZ503U	5.3	21	153	25.26	0.45	0.42	0.71	83	33	12	20	3	18	57.3
0.77	1.8	2.2	5.8	2.9	ZV318S_K302_0230 EZ401U	5.3	23	153	23.29	0.49	0.45	0.77	83	33	12	20	3	18	57.3
0.77	2.7	3.5	8.6	2.0	ZV318S_K302_0230 EZ501U	5.3	23	153	23.29	0.49	0.45	0.77	83	33	12	20	3	18	57.3
0.77	2.8	3.9	8.9	1.9	ZV318S_K302_0230 EZ402U	5.3	23	153	23.29	0.49	0.45	0.77	83	33	12	20	3	18	57.3
0.77	4.1	6.2	13	1.3	ZV318S_K302_0230 EZ502U	5.3	23	153	23.29	0.49	0.45	0.77	83	33	12	20	3	18	57.3
0.77	4.1	6.2	13	1.3	ZV318S_K302_0230 EZ701U	5.3	24	153	23.29	0.49	0.45	0.77	83	33	12	20	3	18	57.3
0.77	4.6	6.6	15	1.2	ZV318S_K302_0230 EZ404U	5.3	23	153	23.29	0.49	0.45	0.77	83	33	12	20	3	18	57.3
0.77	4.9	8.4	16	1.1	ZV318S_K302_0230 EZ503U	5.3	23	153	23.29	0.49	0.45	0.77	83	33	12	20	3	18	57.3
0.89	1.6	1.9	5.9	3.3	ZV318S_K302_0200 EZ401U	5.3	18	153	20.28	0.56	0.52	0.89	83	33	12	20	3	18	57.3
0.89	2.3	3.0	8.7	2.3	ZV318S_K302_0200 EZ501U	5.3	18	153	20.28	0.56	0.52	0.89	83	33	12	20	3	18	57.3
0.89	2.4	3.4	9.0	2.2	ZV318S_K302_0200 EZ402U	5.3	18	153	20.28	0.56	0.52	0.89	83	33	12	20	3	18	57.3
0.89	3.6	5.4	13	1.5	ZV318S_K302_0200 EZ502U	5.3	18	153	20.28	0.56	0.52	0.89	83	33	12	20	3	18	57.3
0.89	3.6	5.4	13	1.5	ZV318S_K302_0200 EZ701U	5.3	24	153	20.28	0.56	0.52	0.89	83	33	12	20	3	18	57.3
0.89	4.0	5.8	15	1.3	ZV318S_K302_0200 EZ404U	5.3	18	153	20.28	0.56	0.52	0.89	83	33	12	20	3	18	57.3
0.89	4.3	7.3	16	1.2	ZV318S_K302_0200 EZ503U	5.3	18	153	20.28	0.56	0.52	0.89	83	33	12	20	3	18	57.3
0.89	4.9	9.8	18	1.1	ZV318S_K302_0200 EZ702U	5.3	24	153	20.28	0.56	0.52	0.89	83	33	12	20	3	18	57.3
1.06	1.3	1.6	6.0	3.8	ZV318S_K302_0170 EZ401U	4.9	16	140	16.94	0.67	0.62	1.06	83	33	12	20	3	18	57.3
1.06	2.0	2.5	8.9	2.5	ZV318S_K302_0170 EZ501U	5.3	16	153	16.94	0.67	0.62	1.06	83	33	12	20	3	18	57.3
1.06	2.0	2.8	9.1	2.5	ZV318S_K302_0170 EZ402U	5.3	16	153	16.94	0.67	0.62	1.06	83	33	12	20	3	18	57.3
1.06	3.0	4.5	14	1.7	ZV318S_K302_0170 EZ502U	5.3	16	153	16.94	0.67	0.62	1.06	83	33	12	20	3	18	57.3
1.06	3.0	4.5	14	1.7	ZV318S_K302_0170 EZ701U	5.3	24	153	16.94	0.67	0.62	1.06	83	33	12	20	3	18	57.3
1.06	3.3	4.8	15	1.5	ZV318S_K302_0170 EZ404U	5.3	16	153	16.94	0.67	0.62	1.06	83	33	12	20	3	18	57.3
1.06	3.6	6.1	16	1.4	ZV318S_K302_0170 EZ503U	5.3	16	153	16.94	0.67	0.62	1.06	83	33	12	20	3	18	57.3
1.06	4.1	8.2	19	1.2	ZV318S_K302_0170 EZ702U	5.3	24	153	16.94	0.67	0.62	1.06	83	33	12	20	3	18	57.3
ZV3K4 (n_{1N} = 2000 min^{-1}, ($F_{f2acc,max}$ = 6,6 kN)																			
1.35	5.9	6.6	56	1.0	ZV322S_K402_0054 EZ813U	6.6	30	232	5.422	1.76	1.49	2.57	102	41	15	20	3	22	70.0
1.68	4.7	5.3	57	1.2	ZV322S_K402_0044 EZ813U	6.6	24	232	4.364	2.18	1.85	3.19	102	41	15	20	3	22	70.0
1.83	4.3	4.8	58	1.2	ZV322S_K402_0040 EZ813U	6.6	22	232	4.000	2.38	2.02	3.48	102	41	15	20	3	22	70.0

v_{f2}	F_{f2}	$F_{f2,0}$	a_{th}	S	Type	F_{f2accE}	$F_{f2NOT,E}$	M_{2accE}	i	$v_{f2maxDB}$		$v_{f2maxZB}$	Δs	$Δs_{redII}$	$Δs_{redI}$	C_{linE}	m_n	z	d_0
										EL1,2	EL3,4,5,6								
[m/s]	[kN]	[kN]				[kN]	[kN]	[Nm]		[m/s]	[m/s]	[m/s]	[µm]	[µm]	[µm]	[N/ µm]	[mm]		[mm]
ZV3K4 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 6,6 kN)																			
0.05	5.5	5.7	2.4	1.2	ZV322S_K403_2180 EZ301U	6.6	24	232	218.2	0.06	0.06	0.09	102	51	25	20	3	22	70.0
0.06	4.6	4.7	2.0	1.4	ZV322S_K403_1810 EZ301U	6.6	28	232	181.4	0.07	0.07	0.11	102	51	25	20	3	22	70.0
0.08	3.5	3.5	2.0	1.9	ZV322S_K403_1360 EZ301U	6.6	23	232	136.1	0.10	0.09	0.15	102	51	25	20	3	22	70.0
0.08	5.9	6.2	3.4	1.1	ZV322S_K403_1360 EZ302U	6.6	23	232	136.1	0.10	0.09	0.15	102	51	25	20	3	22	70.0
0.10	2.8	2.8	2.0	2.4	ZV322S_K403_1090 EZ301U	6.6	20	232	108.8	0.12	0.11	0.19	102	51	25	20	3	22	70.0
0.10	4.7	5.0	3.3	1.4	ZV322S_K403_1090 EZ302U	6.6	20	232	108.8	0.12	0.11	0.19	102	51	25	20	3	22	70.0
0.10	6.1	6.5	4.4	1.1	ZV322S_K403_1090 EZ303U	6.6	20	232	108.8	0.12	0.11	0.19	102	51	25	20	3	22	70.0
0.12	2.3	2.4	2.0	2.9	ZV322S_K403_0910 EZ301U	6.6	17	232	91.23	0.15	0.13	0.22	102	51	25	20	3	22	70.0
0.12	4.0	4.2	3.4	1.7	ZV322S_K403_0910 EZ302U	6.6	17	232	91.23	0.15	0.13	0.22	102	51	25	20	3	22	70.0
0.12	5.2	5.5	4.4	1.3	ZV322S_K403_0910 EZ303U	6.6	17	232	91.23	0.15	0.13	0.22	102	51	25	20	3	22	70.0
0.14	2.0	2.1	2.5	3.3	ZV322S_K403_0790 EZ301U	6.0	14	212	79.11	0.17	0.15	0.26	102	51	25	20	3	22	70.0
0.14	3.4	3.6	4.2	1.9	ZV322S_K403_0790 EZ302U	6.6	14	232	79.11	0.17	0.15	0.26	102	51	25	20	3	22	70.0
0.14	4.5	4.7	5.5	1.5	ZV322S_K403_0790 EZ303U	6.6	14	232	79.11	0.17	0.15	0.26	102	51	25	20	3	22	70.0
0.14	6.0	6.5	7.5	1.1	ZV322S_K403_0790 EZ401U	6.6	14	232	79.11	0.17	0.15	0.26	102	51	25	20	3	22	70.0
0.17	1.7	1.7	2.5	3.9	ZV322S_K403_0660 EZ301U	5.1	12	178	66.35	0.20	0.18	0.30	102	51	25	20	3	22	70.0
0.17	2.9	3.0	4.3	2.3	ZV322S_K403_0660 EZ302U	6.6	12	232	66.35	0.20	0.18	0.30	102	51	25	20	3	22	70.0
0.17	3.7	4.0	5.6	1.8	ZV322S_K403_0660 EZ303U	6.6	12	232	66.35	0.20	0.18	0.30	102	51	25	20	3	22	70.0
0.17	5.1	5.4	7.5	1.3	ZV322S_K403_0660 EZ401U	6.6	12	232	66.35	0.20	0.18	0.30	102	51	25	20	3	22	70.0
0.21	6.3	6.9	6.1	1.0	ZV322S_K403_0540 EZ501U	6.6	27	232	53.69	0.25	0.23	0.38	102	51	25	20	3	22	70.0
0.22	6.0	6.6	12	1.1	ZV322S_K402_0500 EZ501U	6.6	15	232	50.43	0.26	0.24	0.40	102	41	15	20	3	22	70.0
0.23	5.7	6.3	5.9	1.2	ZV322S_K403_0490 EZ501U	6.6	25	232	48.94	0.27	0.25	0.41	102	51	25	20	3	22	70.0
0.24	5.5	6.0	6.1	1.2	ZV322S_K402_0460 EZ501U	6.6	28	232	46.31	0.29	0.26	0.44	102	41	15	20	3	22	70.0
0.25	5.2	5.7	5.9	1.3	ZV322S_K403_0450 EZ501U	6.6	23	232	44.54	0.30	0.27	0.45	102	51	25	20	3	22	70.0
0.27	4.8	5.3	10	1.4	ZV322S_K402_0410 EZ501U	6.6	18	232	40.51	0.33	0.30	0.50	102	41	15	20	3	22	70.0
0.28	4.6	5.0	6.1	1.4	ZV322S_K403_0390 EZ501U	6.6	20	232	39.05	0.34	0.31	0.52	102	51	25	20	3	22	70.0
0.31	4.2	4.6	6.0	1.6	ZV322S_K403_0360 EZ501U	6.6	18	232	35.72	0.37	0.34	0.57	102	51	25	20	3	22	70.0
0.32	4.1	4.5	6.1	1.6	ZV322S_K402_0350 EZ501U	6.6	23	232	34.76	0.38	0.35	0.58	102	41	15	20	3	22	70.0
0.33	4.0	4.4	7.8	1.6	ZV322S_K402_0340 EZ501U	6.6	20	232	33.68	0.39	0.36	0.60	102	41	15	20	3	22	70.0
0.34	3.8	4.2	6.4	1.7	ZV322S_K403_0320 EZ501U	6.6	16	232	32.39	0.41	0.37	0.62	102	51	25	20	3	22	70.0
0.34	6.5	7.1	11	1.0	ZV322S_K403_0320 EZ502U	6.6	16	232	32.39	0.41	0.37	0.62	102	51	25	20	3	22	70.0
0.40	3.3	3.6	6.2	2.0	ZV322S_K402_0280 EZ501U	6.6	21	232	27.77	0.48	0.44	0.73	102	41	15	20	3	22	70.0
0.40	5.7	6.2	11	1.2	ZV322S_K402_0280 EZ502U	6.6	21	232	27.77	0.48	0.44	0.73	102	41	15	20	3	22	70.0
0.40	5.7	6.4	11	1.2	ZV322S_K402_0280 EZ701U	6.6	31	232	27.77	0.48	0.44	0.73	102	41	15	20	3	22	70.0
0.44	3.0	3.3	6.3	2.2	ZV322S_K402_0250 EZ501U	6.6	17	232	25.28	0.52	0.48	0.80	102	41	15	20	3	22	70.0
0.44	5.2	5.6	11	1.3	ZV322S_K402_0250 EZ502U	6.6	17	232	25.28	0.52	0.48	0.80	102	41	15	20	3	22	70.0
0.44	5.2	5.8	11	1.3	ZV322S_K402_0250 EZ701U	6.6	29	232	25.28	0.52	0.48	0.80	102	41	15	20	3	22	70.0
0.47	2.8	3.0	6.3	2.4	ZV322S_K402_0230 EZ501U	6.6	19	232	23.29	0.57	0.52	0.87	102	41	15	20	3	22	70.0
0.47	4.8	5.2	11	1.4	ZV322S_K402_0230 EZ502U	6.6	19	232	23.29	0.57	0.52	0.87	102	41	15	20	3	22	70.0
0.47	4.8	5.4	11	1.4	ZV322S_K402_0230 EZ701U	6.6	31	232	23.29	0.57	0.52	0.87	102	41	15	20	3	22	70.0
0.47	6.3	7.2	14	1.1	ZV322S_K402_0230 EZ503U	6.6	19	232	23.29	0.57	0.52	0.87	102	41	15	20	3	22	70.0
0.55	2.4	2.6	6.4	2.7	ZV322S_K402_0200 EZ501U	6.6	15	232	20.20	0.65	0.60	1.00	102	41	15	20	3	22	70.0
0.55	4.1	4.5	11	1.6	ZV322S_K402_0200 EZ502U	6.6	15	232	20.20	0.65	0.60	1.00	102	41	15	20	3	22	70.0
0.55	4.1	4.6	11	1.6	ZV322S_K402_0200 EZ701U	6.6	31	232	20.20	0.65	0.60	1.00	102	41	15	20	3	22	70.0
0.55	5.4	6.2	14	1.2	ZV322S_K402_0200 EZ503U	6.6	15	232	20.20	0.65	0.60	1.00	102	41	15	20	3	22	70.0
0.63	3.6	4.0	11	1.9	ZV322S_K402_0175 EZ701U	6.6	31	232	17.41	0.72	0.63	1.05	102	41	15	20	3	22	70.0
0.63	5.8	6.9	18	1.1	ZV322S_K402_0175 EZ702U	6.6	31	232	17.41	0.72	0.63	1.05	102	41	15	20	3	22	70.0
0.63	6.5	7.7	20	1.0	ZV322S_K402_0175 EZ505U	6.6	31	232	17.41	0.72	0.63	1.05	102	41	15	20	3	22	70.0
0.65	2.0	2.2	6.5	3.3	ZV322S_K402_0170 EZ501U	6.6	14	232	16.94	0.78	0.71	1.19	102	41	15	20	3	22	70.0
0.65	3.5	3.8	11	1.9	ZV322S_K402_0170 EZ502U	6.6	14	232	16.94	0.78	0.71	1.19	102	41	15	20	3	22	70.0
0.65	3.5	3.9	11	1.9	ZV322S_K402_0170 EZ701U	6.6	29	232	16.94	0.78	0.71	1.19	102	41	15	20	3	22	70.0
0.65	4.6	5.2	15	1.5	ZV322S_K402_0170 EZ503U	6.6	14	232	16.94	0.78	0.71	1.19	102	41	15	20	3	22	70.0
0.65	5.6	6.8	18	1.2	ZV322S_K402_0170 EZ702U	6.6	29	232	16.94	0.78	0.71	1.19	102	41	15	20	3	22	70.0
0.65	6.3	7.5	20	1.0	ZV322S_K402_0170 EZ505U	6.6	29	232	16.94	0.78	0.71	1.19	102	41	15	20	3	22	70.0
0.79	2.8	3.2	11	2.3	ZV322S_K402_0140 EZ701U	6.6	29	232	13.89	0.90	0.79	1.32	102	41	15	20	3	22	70.0
0.79	4.6	5.5	18	1.4	ZV322S_K402_0140 EZ702U	6.6	29	232	13.89	0.90	0.79	1.32	102	41	15	20	3	22	70.0
0.79	5.2	6.2	21	1.3	ZV322S_K402_0140 EZ505U	6.6	29	232	13.89	0.90	0.79	1.32	102	41	15	20	3	22	70.0
0.79	6.3	8.0	25	1.0	ZV322S_K402_0140 EZ703U	6.6	29	232	13.89	0.90	0.79	1.32	102	41	15	20	3	22	70.0
0.87	2.6	2.9	11	2.5	ZV322S_K402_0125 EZ701U	6.6	25	232	12.66	0.99	0.87	1.45	102	41	15	20	3	22	70.0
0.87	4.2	5.0	18	1.6	ZV322S_K402_0125 EZ702U	6.6	25	232	12.66	0.99	0.87	1.45	102	41	15	20	3	22	70.0
0.87	4.7	5.6	21	1.4	ZV322S_K402_0125 EZ505U	6.6	25	232	12.66	0.99	0.87	1.45	102	41	15	20	3	22	70.0
0.87	5.8	7.3	25	1.1	ZV322S_K402_0125 EZ703U	6.6	25	232	12.66	0.99	0.87	1.45	102	41	15	20	3	22	70.0
0.96	2.4	2.6	11	2.8	ZV322S_K402_0115 EZ701U	6.4	24	223	11.52	0.96	0.83	1.43	102	41	15	20	3	22	70.0
0.96	3.8	4.6	19	1.7	ZV322S_K402_0115 EZ702U	6.6	24	232	11.52	0.96	0.83	1.43	102	41	15	20	3	22	70.0
0.96	4.3	5.1	21	1.5	ZV322S_K402_0115 EZ505U	6.6	24	232	11.52	0.96	0.83	1.43	102	41	15	20	3	22	70.0

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ EL1,2 [m/s]	$v_{f2maxDB}$ EL3,4,5,6 [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{redII}$ [µm]	$Δs_{redI}$ [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV3K4 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 6,6 kN)																			
0.96	5.3	6.6	26	1.3	ZV322S_K402_0115 EZ703U	6.6	24	232	11.52	0.96	0.83	1.43	102	41	15	20	3	22	70.0
1.09	2.1	2.3	12	3.1	ZV322S_K402_0100 EZ701U	5.6	21	196	10.10	1.24	1.09	1.82	102	41	15	20	3	22	70.0
1.09	3.4	4.0	19	1.9	ZV322S_K402_0100 EZ702U	6.6	21	232	10.10	1.24	1.09	1.82	102	41	15	20	3	22	70.0
1.09	3.8	4.5	21	1.7	ZV322S_K402_0100 EZ505U	6.6	21	232	10.10	1.24	1.09	1.82	102	41	15	20	3	22	70.0
1.09	4.6	5.8	26	1.4	ZV322S_K402_0100 EZ703U	6.6	21	232	10.10	1.24	1.09	1.82	102	41	15	20	3	22	70.0
1.09	6.0	8.4	33	1.1	ZV322S_K402_0100 EZ705U	6.6	31	232	10.10	1.24	1.09	1.82	102	41	15	20	3	22	70.0
1.19	1.9	2.1	12	3.3	ZV322S_K402_0092 EZ701U	5.1	19	179	9.238	1.19	1.03	1.79	102	41	15	20	3	22	70.0
1.19	3.1	3.7	19	2.0	ZV322S_K402_0092 EZ702U	6.6	19	232	9.238	1.19	1.03	1.79	102	41	15	20	3	22	70.0
1.19	3.5	4.1	21	1.8	ZV322S_K402_0092 EZ505U	6.6	19	232	9.238	1.19	1.03	1.79	102	41	15	20	3	22	70.0
1.19	4.2	5.3	26	1.5	ZV322S_K402_0092 EZ703U	6.6	19	232	9.238	1.19	1.03	1.79	102	41	15	20	3	22	70.0
1.19	5.5	7.7	34	1.1	ZV322S_K402_0092 EZ705U	6.6	31	232	9.238	1.19	1.03	1.79	102	41	15	20	3	22	70.0
1.31	1.7	1.9	12	3.5	ZV322S_K402_0084 EZ701U	4.6	17	163	8.377	1.31	1.14	1.97	102	41	15	20	3	22	70.0
1.31	2.8	3.3	19	2.2	ZV322S_K402_0084 EZ702U	6.6	17	232	8.377	1.31	1.14	1.97	102	41	15	20	3	22	70.0
1.31	3.1	3.7	22	1.9	ZV322S_K402_0084 EZ505U	6.6	17	232	8.377	1.31	1.14	1.97	102	41	15	20	3	22	70.0
1.31	3.8	4.8	26	1.6	ZV322S_K402_0084 EZ703U	6.6	17	232	8.377	1.31	1.14	1.97	102	41	15	20	3	22	70.0
1.31	4.9	7.0	34	1.2	ZV322S_K402_0084 EZ705U	6.6	31	232	8.377	1.31	1.14	1.97	102	41	15	20	3	22	70.0
1.48	4.4	6.2	34	1.3	ZV322S_K402_0075 EZ705U	6.6	31	232	7.456	1.28	1.08	1.87	102	41	15	20	3	22	70.0
1.64	1.4	1.5	12	4.0	ZV322S_K402_0067 EZ701U	3.7	14	130	6.719	1.64	1.42	2.46	102	41	15	20	3	22	70.0
1.64	2.2	2.7	19	2.5	ZV322S_K402_0067 EZ702U	6.6	14	232	6.719	1.64	1.42	2.46	102	41	15	20	3	22	70.0
1.64	2.5	3.0	22	2.2	ZV322S_K402_0067 EZ505U	6.6	14	232	6.719	1.64	1.42	2.46	102	41	15	20	3	22	70.0
1.64	3.1	3.9	27	1.8	ZV322S_K402_0067 EZ703U	6.6	14	232	6.719	1.64	1.42	2.46	102	41	15	20	3	22	70.0
1.64	4.0	5.6	35	1.4	ZV322S_K402_0067 EZ705U	6.6	31	232	6.719	1.64	1.42	2.46	102	41	15	20	3	22	70.0
1.83	3.5	5.0	35	1.5	ZV322S_K402_0060 EZ705U	6.6	31	232	6.000	1.59	1.34	2.32	102	41	15	20	3	22	70.0
2.03	3.2	4.5	35	1.6	ZV322S_K402_0054 EZ705U	6.6	30	232	5.422	1.76	1.49	2.57	102	41	15	20	3	22	70.0
2.52	2.6	3.7	36	1.9	ZV322S_K402_0044 EZ705U	6.6	24	232	4.364	2.18	1.85	3.19	102	41	15	20	3	22	70.0
2.75	2.4	3.3	36	2.0	ZV322S_K402_0040 EZ705U	6.6	22	232	4.000	2.38	2.02	3.48	102	41	15	20	3	22	70.0
ZV3K4 (n_{1N} = 4000 min^{-1}, ($F_{f2acc,max}$ = 6,6 kN)																			
2.18	4.7	8.1	45	1.1	ZV322S_K402_0067 EZ813U	6.6	31	232	6.719	1.64	1.42	2.46	102	41	15	20	3	22	70.0
2.18	4.9	12	47	1.0	ZV322S_K402_0067 EZ815U	6.6	31	232	6.719	1.64	1.42	2.46	102	41	15	20	3	22	70.0
ZV3K4 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 6,6 kN)																			
0.71	6.1	9.9	16	1.1	ZV322S_K402_0230 EZ505U	6.6	31	232	23.29	0.57	0.52	0.87	102	41	15	20	3	22	70.0
0.82	5.3	8.6	16	1.2	ZV322S_K402_0200 EZ505U	6.6	31	232	20.20	0.65	0.60	1.00	102	41	15	20	3	22	70.0
0.95	4.6	7.4	16	1.4	ZV322S_K402_0175 EZ505U	6.6	31	232	17.41	0.72	0.63	1.05	102	41	15	20	3	22	70.0
0.95	5.8	9.6	21	1.1	ZV322S_K402_0175 EZ703U	6.6	31	232	17.41	0.72	0.63	1.05	102	41	15	20	3	22	70.0
0.97	4.5	7.2	16	1.5	ZV322S_K402_0170 EZ505U	6.6	29	232	16.94	0.78	0.71	1.19	102	41	15	20	3	22	70.0
0.97	5.7	9.4	21	1.2	ZV322S_K402_0170 EZ703U	6.6	29	232	16.94	0.78	0.71	1.19	102	41	15	20	3	22	70.0
1.19	3.7	5.9	17	1.7	ZV322S_K402_0140 EZ505U	6.6	29	232	13.89	0.90	0.79	1.32	102	41	15	20	3	22	70.0
1.19	4.7	7.7	21	1.3	ZV322S_K402_0140 EZ703U	6.6	29	232	13.89	0.90	0.79	1.32	102	41	15	20	3	22	70.0
1.30	3.3	5.4	17	1.8	ZV322S_K402_0125 EZ505U	6.6	25	232	12.66	0.99	0.87	1.45	102	41	15	20	3	22	70.0
1.30	4.2	7.0	21	1.4	ZV322S_K402_0125 EZ703U	6.6	25	232	12.66	0.99	0.87	1.45	102	41	15	20	3	22	70.0
1.30	5.8	11	29	1.0	ZV322S_K402_0125 EZ705U	6.6	31	232	12.66	0.99	0.87	1.45	102	41	15	20	3	22	70.0
1.43	3.0	4.9	17	1.9	ZV322S_K402_0115 EZ505U	6.6	24	232	11.52	0.96	0.83	1.43	102	41	15	20	3	22	70.0
1.43	3.9	6.4	22	1.5	ZV322S_K402_0115 EZ703U	6.6	24	232	11.52	0.96	0.83	1.43	102	41	15	20	3	22	70.0
1.43	5.2	9.6	29	1.1	ZV322S_K402_0115 EZ705U	6.6	31	232	11.52	0.96	0.83	1.43	102	41	15	20	3	22	70.0
1.63	2.7	4.3	17	2.1	ZV322S_K402_0100 EZ505U	6.6	21	232	10.10	1.24	1.09	1.82	102	41	15	20	3	22	70.0
1.63	3.4	5.6	22	1.6	ZV322S_K402_0100 EZ703U	6.6	21	232	10.10	1.24	1.09	1.82	102	41	15	20	3	22	70.0
1.63	4.6	8.4	29	1.2	ZV322S_K402_0100 EZ705U	6.6	31	232	10.10	1.24	1.09	1.82	102	41	15	20	3	22	70.0
1.79	2.4	3.9	17	2.2	ZV322S_K402_0092 EZ505U	6.6	19	232	9.238	1.19	1.03	1.79	102	41	15	20	3	22	70.0
1.79	3.1	5.1	22	1.7	ZV322S_K402_0092 EZ703U	6.6	19	232	9.238	1.19	1.03	1.79	102	41	15	20	3	22	70.0
1.79	4.2	7.7	30	1.3	ZV322S_K402_0092 EZ705U	6.6	31	232	9.238	1.19	1.03	1.79	102	41	15	20	3	22	70.0
1.97	2.2	3.6	17	2.4	ZV322S_K402_0084 EZ505U	6.6	17	232	8.377	1.31	1.14	1.97	102	41	15	20	3	22	70.0
1.97	2.8	4.6	22	1.9	ZV322S_K402_0084 EZ703U	6.6	17	232	8.377	1.31	1.14	1.97	102	41	15	20	3	22	70.0
1.97	3.8	7.0	30	1.4	ZV322S_K402_0084 EZ705U	6.6	31	232	8.377	1.31	1.14	1.97	102	41	15	20	3	22	70.0
2.46	1.8	2.8	18	2.7	ZV322S_K402_0067 EZ505U	6.6	14	232	6.719	1.64	1.42	2.46	102	41	15	20	3	22	70.0
2.46	2.3	3.7	23	2.2	ZV322S_K402_0067 EZ703U	6.6	14	232	6.719	1.64	1.42	2.46	102	41	15	20	3	22	70.0
2.46	3.1	5.6	30	1.6	ZV322S_K402_0067 EZ705U	6.6	31	232	6.719	1.64	1.42	2.46	102	41	15	20	3	22	70.0
ZV4K4 (n_{1N} = 2000 min^{-1}, ($F_{f2acc,max}$ = 6,9 kN)																			
1.33	5.9	6.7	56	1.0	ZV418S_K402_0060 EZ813U	6.9	29	265	6.000	1.73	1.47	2.53	111	44	17	20	4	18	76.4
1.48	5.4	6.0	56	1.1	ZV418S_K402_0054 EZ813U	6.9	28	265	5.422	1.92	1.62	2.80	111	44	17	20	4	18	76.4
1.83	4.3	4.8	57	1.3	ZV418S_K402_0044 EZ813U	6.9	22	265	4.364	2.38	2.02	3.48	111	44	17	20	4	18	76.4
2.00	4.0	4.4	58	1.4	ZV418S_K402_0040 EZ813U	6.9	20	265	4.000	2.60	2.20	3.80	111	44	17	20	4	18	76.4

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ EL1,2 [m/s]	$v_{f2maxDB}$ EL3,4,5,6 [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{redII}$ [µm]	$Δs_{redI}$ [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV4K4 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 6,9 kN)																			
0.04	6.3	6.5	2.9	1.1	ZV418S_K403_2720 EZ301U	6.9	19	265	271.6	0.05	0.05	0.08	111	56	28	20	4	18	76.4
0.06	5.1	5.2	2.4	1.4	ZV418S_K403_2180 EZ301U	6.9	22	265	218.2	0.07	0.06	0.10	111	56	28	20	4	18	76.4
0.07	4.2	4.3	2.0	1.6	ZV418S_K403_1810 EZ301U	6.9	26	265	181.4	0.08	0.07	0.12	111	56	28	20	4	18	76.4
0.09	3.2	3.2	2.0	2.2	ZV418S_K403_1360 EZ301U	6.9	21	265	136.1	0.11	0.10	0.16	111	56	28	20	4	18	76.4
0.09	5.4	5.7	3.4	1.3	ZV418S_K403_1360 EZ302U	6.9	21	265	136.1	0.11	0.10	0.16	111	56	28	20	4	18	76.4
0.11	2.5	2.6	2.0	2.7	ZV418S_K403_1090 EZ301U	6.9	18	265	108.8	0.13	0.12	0.20	111	56	28	20	4	18	76.4
0.11	4.3	4.6	3.3	1.6	ZV418S_K403_1090 EZ302U	6.9	18	265	108.8	0.13	0.12	0.20	111	56	28	20	4	18	76.4
0.11	5.6	6.0	4.4	1.2	ZV418S_K403_1090 EZ303U	6.9	18	265	108.8	0.13	0.12	0.20	111	56	28	20	4	18	76.4
0.13	2.1	2.2	2.0	3.3	ZV418S_K403_0910 EZ301U	6.4	15	244	91.23	0.16	0.15	0.24	111	56	28	20	4	18	76.4
0.13	3.6	3.8	3.4	1.9	ZV418S_K403_0910 EZ302U	6.9	15	265	91.23	0.16	0.15	0.24	111	56	28	20	4	18	76.4
0.13	4.7	5.0	4.4	1.5	ZV418S_K403_0910 EZ303U	6.9	15	265	91.23	0.16	0.15	0.24	111	56	28	20	4	18	76.4
0.13	6.4	6.8	5.9	1.1	ZV418S_K403_0910 EZ401U	6.9	15	265	91.23	0.16	0.15	0.24	111	56	28	20	4	18	76.4
0.15	1.8	1.9	2.5	3.8	ZV418S_K403_0790 EZ301U	5.5	13	212	79.11	0.18	0.17	0.28	111	56	28	20	4	18	76.4
0.15	3.1	3.3	4.2	2.2	ZV418S_K403_0790 EZ302U	6.9	13	265	79.11	0.18	0.17	0.28	111	56	28	20	4	18	76.4
0.15	4.1	4.3	5.5	1.7	ZV418S_K403_0790 EZ303U	6.9	13	265	79.11	0.18	0.17	0.28	111	56	28	20	4	18	76.4
0.15	5.5	5.9	7.5	1.3	ZV418S_K403_0790 EZ401U	6.9	13	265	79.11	0.18	0.17	0.28	111	56	28	20	4	18	76.4
0.18	1.5	1.6	2.5	4.5	ZV418S_K403_0660 EZ301U	4.6	11	178	66.35	0.22	0.20	0.33	111	56	28	20	4	18	76.4
0.18	2.6	2.8	4.3	2.6	ZV418S_K403_0660 EZ302U	6.9	11	265	66.35	0.22	0.20	0.33	111	56	28	20	4	18	76.4
0.18	3.4	3.6	5.6	2.0	ZV418S_K403_0660 EZ303U	6.9	11	265	66.35	0.22	0.20	0.33	111	56	28	20	4	18	76.4
0.18	4.6	5.0	7.5	1.5	ZV418S_K403_0660 EZ401U	6.9	11	265	66.35	0.22	0.20	0.33	111	56	28	20	4	18	76.4
0.22	6.1	6.6	8.1	1.1	ZV418S_K402_0560 EZ501U	6.9	22	265	55.71	0.26	0.24	0.40	111	44	17	20	4	18	76.4
0.22	5.8	6.3	6.1	1.2	ZV418S_K403_0540 EZ501U	6.9	25	265	53.69	0.27	0.25	0.41	111	56	28	20	4	18	76.4
0.24	5.5	6.0	12	1.3	ZV418S_K402_0500 EZ501U	6.9	14	265	50.43	0.29	0.26	0.44	111	44	17	20	4	18	76.4
0.25	5.3	5.8	5.9	1.3	ZV418S_K403_0490 EZ501U	6.9	23	265	48.94	0.29	0.27	0.45	111	56	28	20	4	18	76.4
0.26	5.1	5.5	6.1	1.4	ZV418S_K402_0460 EZ501U	6.9	26	265	46.31	0.31	0.29	0.48	111	44	17	20	4	18	76.4
0.27	4.8	5.2	5.9	1.4	ZV418S_K403_0450 EZ501U	6.9	21	265	44.54	0.32	0.30	0.49	111	56	28	20	4	18	76.4
0.30	4.4	4.8	10	1.6	ZV418S_K402_0410 EZ501U	6.9	16	265	40.51	0.36	0.33	0.54	111	44	17	20	4	18	76.4
0.31	4.2	4.6	6.1	1.7	ZV418S_K403_0390 EZ501U	6.9	18	265	39.05	0.37	0.34	0.56	111	56	28	20	4	18	76.4
0.34	3.8	4.2	6.0	1.8	ZV418S_K403_0360 EZ501U	6.9	17	265	35.72	0.40	0.37	0.62	111	56	28	20	4	18	76.4
0.34	6.6	7.2	10	1.1	ZV418S_K403_0360 EZ502U	6.9	17	265	35.72	0.40	0.37	0.62	111	56	28	20	4	18	76.4
0.35	3.8	4.1	6.1	1.8	ZV418S_K402_0350 EZ501U	6.9	21	265	34.76	0.41	0.38	0.63	111	44	17	20	4	18	76.4
0.35	6.5	7.1	10	1.1	ZV418S_K402_0350 EZ502U	6.9	21	265	34.76	0.41	0.38	0.63	111	44	17	20	4	18	76.4
0.35	6.5	7.3	10	1.1	ZV418S_K402_0350 EZ701U	6.9	29	265	34.76	0.41	0.38	0.63	111	44	17	20	4	18	76.4
0.36	3.7	4.0	7.8	1.9	ZV418S_K402_0340 EZ501U	6.9	19	265	33.68	0.43	0.39	0.65	111	44	17	20	4	18	76.4
0.36	6.3	6.8	13	1.1	ZV418S_K402_0340 EZ502U	6.9	19	265	33.68	0.43	0.39	0.65	111	44	17	20	4	18	76.4
0.36	6.3	7.1	13	1.1	ZV418S_K402_0340 EZ701U	6.9	19	265	33.68	0.43	0.39	0.65	111	44	17	20	4	18	76.4
0.37	3.5	3.8	6.4	2.0	ZV418S_K403_0320 EZ501U	6.9	15	265	32.39	0.45	0.41	0.68	111	56	28	20	4	18	76.4
0.37	6.0	6.5	11	1.2	ZV418S_K403_0320 EZ502U	6.9	15	265	32.39	0.45	0.41	0.68	111	56	28	20	4	18	76.4
0.43	3.0	3.3	6.2	2.3	ZV418S_K402_0280 EZ501U	6.9	20	265	27.77	0.52	0.48	0.79	111	44	17	20	4	18	76.4
0.43	5.2	5.6	11	1.3	ZV418S_K402_0280 EZ502U	6.9	20	265	27.77	0.52	0.48	0.79	111	44	17	20	4	18	76.4
0.43	5.2	5.9	11	1.3	ZV418S_K402_0280 EZ701U	6.9	29	265	27.77	0.52	0.48	0.79	111	44	17	20	4	18	76.4
0.43	6.8	7.8	14	1.0	ZV418S_K402_0280 EZ503U	6.9	20	265	27.77	0.52	0.48	0.79	111	44	17	20	4	18	76.4
0.48	2.8	3.0	6.3	2.5	ZV418S_K402_0250 EZ501U	6.9	15	265	25.28	0.57	0.52	0.87	111	44	17	20	4	18	76.4
0.48	4.8	5.1	11	1.5	ZV418S_K402_0250 EZ502U	6.9	15	265	25.28	0.57	0.52	0.87	111	44	17	20	4	18	76.4
0.48	4.8	5.3	11	1.5	ZV418S_K402_0250 EZ701U	6.9	26	265	25.28	0.57	0.52	0.87	111	44	17	20	4	18	76.4
0.48	6.2	7.1	14	1.1	ZV418S_K402_0250 EZ503U	6.9	15	265	25.28	0.57	0.52	0.87	111	44	17	20	4	18	76.4
0.52	2.5	2.8	6.3	2.7	ZV418S_K402_0230 EZ501U	6.9	18	265	23.29	0.62	0.57	0.95	111	44	17	20	4	18	76.4
0.52	4.4	4.7	11	1.6	ZV418S_K402_0230 EZ502U	6.9	18	265	23.29	0.62	0.57	0.95	111	44	17	20	4	18	76.4
0.52	4.4	4.9	11	1.6	ZV418S_K402_0230 EZ701U	6.9	29	265	23.29	0.62	0.57	0.95	111	44	17	20	4	18	76.4
0.52	5.7	6.6	14	1.2	ZV418S_K402_0230 EZ503U	6.9	18	265	23.29	0.62	0.57	0.95	111	44	17	20	4	18	76.4
0.59	2.2	2.4	6.4	3.1	ZV418S_K402_0200 EZ501U	6.9	14	265	20.20	0.71	0.65	1.09	111	44	17	20	4	18	76.4
0.59	3.8	4.1	11	1.8	ZV418S_K402_0200 EZ502U	6.9	14	265	20.20	0.71	0.65	1.09	111	44	17	20	4	18	76.4
0.59	3.8	4.3	11	1.8	ZV418S_K402_0200 EZ701U	6.9	29	265	20.20	0.71	0.65	1.09	111	44	17	20	4	18	76.4
0.59	5.0	5.7	14	1.4	ZV418S_K402_0200 EZ503U	6.9	14	265	20.20	0.71	0.65	1.09	111	44	17	20	4	18	76.4
0.59	6.2	7.4	18	1.1	ZV418S_K402_0200 EZ702U	6.9	29	265	20.20	0.71	0.65	1.09	111	44	17	20	4	18	76.4
0.59	6.9	8.2	20	1.0	ZV418S_K402_0200 EZ505U	6.9	29	265	20.20	0.71	0.65	1.09	111	44	17	20	4	18	76.4
0.69	3.3	3.7	11	2.1	ZV418S_K402_0175 EZ701U	6.9	29	265	17.41	0.78	0.69	1.15	111	44	17	20	4	18	76.4
0.69	5.3	6.4	18	1.3	ZV418S_K402_0175 EZ702U	6.9	29	265	17.41	0.78	0.69	1.15	111	44	17	20	4	18	76.4
0.69	6.0	7.1	20	1.2	ZV418S_K402_0175 EZ505U	6.9	29	265	17.41	0.78	0.69	1.15	111	44	17	20	4	18	76.4
0.71	1.8	2.0	6.5	3.8	ZV418S_K402_0170 EZ501U	6.9	13	263	16.94	0.85	0.78	1.30	111	44	17	20	4	18	76.4
0.71	3.2	3.4	11	2.2	ZV418S_K402_0170 EZ502U	6.9	13	265	16.94	0.85	0.78	1.30	111	44	17	20	4	18	76.4
0.71	3.2	3.6	11	2.2	ZV418S_K402_0170 EZ701U	6.9	27	265	16.94	0.85	0.78	1.30	111	44	17	20	4	18	76.4
0.71	4.2	4.8	15	1.7	ZV418S_K402_0170 EZ503U	6.9	13	265	16.94	0.85	0.78	1.30	111	44	17	20	4	18	76.4
0.71	5.2	6.2	18	1.3	ZV418S_K402_0170 EZ702U	6.9	27	265	16.94	0.85	0.78	1.30	111	44	17	20	4	18	76.4

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ EL1,2 [m/s]	$v_{f2maxDB}$ EL3,4,5,6 [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{redII}$ [µm]	$Δs_{redI}$ [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV4K4 (n_{1N} = 3000 min^{-1}, ($F_{f2acc,max}$ = 6,9 kN)																			
0.71	5.8	6.9	20	1.2	ZV418S_K402_0170 EZ505U	6.9	27	265	16.94	0.85	0.78	1.30	111	44	17	20	4	18	76.4
0.86	2.6	2.9	11	2.7	ZV418S_K402_0140 EZ701U	6.9	26	265	13.89	0.98	0.86	1.44	111	44	17	20	4	18	76.4
0.86	4.2	5.1	18	1.6	ZV418S_K402_0140 EZ702U	6.9	26	265	13.89	0.98	0.86	1.44	111	44	17	20	4	18	76.4
0.86	4.8	5.6	21	1.5	ZV418S_K402_0140 EZ505U	6.9	26	265	13.89	0.98	0.86	1.44	111	44	17	20	4	18	76.4
0.86	5.8	7.3	25	1.2	ZV418S_K402_0140 EZ703U	6.9	26	265	13.89	0.98	0.86	1.44	111	44	17	20	4	18	76.4
0.95	2.4	2.7	11	2.9	ZV418S_K402_0125 EZ701U	6.4	23	246	12.66	1.07	0.95	1.58	111	44	17	20	4	18	76.4
0.95	3.9	4.6	18	1.8	ZV418S_K402_0125 EZ702U	6.9	23	265	12.66	1.07	0.95	1.58	111	44	17	20	4	18	76.4
0.95	4.3	5.1	21	1.6	ZV418S_K402_0125 EZ505U	6.9	23	265	12.66	1.07	0.95	1.58	111	44	17	20	4	18	76.4
0.95	5.3	6.7	25	1.3	ZV418S_K402_0125 EZ703U	6.9	23	265	12.66	1.07	0.95	1.58	111	44	17	20	4	18	76.4
0.95	6.8	9.7	33	1.0	ZV418S_K402_0125 EZ705U	6.9	29	265	12.66	1.07	0.95	1.58	111	44	17	20	4	18	76.4
1.04	2.2	2.4	11	3.1	ZV418S_K402_0115 EZ701U	5.8	22	223	11.52	1.04	0.90	1.56	111	44	17	20	4	18	76.4
1.04	3.5	4.2	19	1.9	ZV418S_K402_0115 EZ702U	6.9	22	265	11.52	1.04	0.90	1.56	111	44	17	20	4	18	76.4
1.04	3.9	4.7	21	1.7	ZV418S_K402_0115 EZ505U	6.9	22	265	11.52	1.04	0.90	1.56	111	44	17	20	4	18	76.4
1.04	4.8	6.1	26	1.4	ZV418S_K402_0115 EZ703U	6.9	22	265	11.52	1.04	0.90	1.56	111	44	17	20	4	18	76.4
1.04	6.2	8.8	33	1.1	ZV418S_K402_0115 EZ705U	6.9	29	265	11.52	1.04	0.90	1.56	111	44	17	20	4	18	76.4
1.19	1.9	2.1	12	3.4	ZV418S_K402_0100 EZ701U	5.1	19	196	10.10	1.35	1.19	1.98	111	44	17	20	4	18	76.4
1.19	3.1	3.7	19	2.1	ZV418S_K402_0100 EZ702U	6.9	19	265	10.10	1.35	1.19	1.98	111	44	17	20	4	18	76.4
1.19	3.5	4.1	21	1.9	ZV418S_K402_0100 EZ505U	6.9	19	265	10.10	1.35	1.19	1.98	111	44	17	20	4	18	76.4
1.19	4.2	5.3	26	1.5	ZV418S_K402_0100 EZ703U	6.9	19	265	10.10	1.35	1.19	1.98	111	44	17	20	4	18	76.4
1.19	5.5	7.7	33	1.2	ZV418S_K402_0100 EZ705U	6.9	29	265	10.10	1.35	1.19	1.98	111	44	17	20	4	18	76.4
1.30	1.7	1.9	12	3.6	ZV418S_K402_0092 EZ701U	4.7	18	179	9.238	1.30	1.13	1.95	111	44	17	20	4	18	76.4
1.30	2.8	3.4	19	2.2	ZV418S_K402_0092 EZ702U	6.9	18	265	9.238	1.30	1.13	1.95	111	44	17	20	4	18	76.4
1.30	3.2	3.8	21	2.0	ZV418S_K402_0092 EZ505U	6.9	18	265	9.238	1.30	1.13	1.95	111	44	17	20	4	18	76.4
1.30	3.9	4.9	26	1.6	ZV418S_K402_0092 EZ703U	6.9	18	265	9.238	1.30	1.13	1.95	111	44	17	20	4	18	76.4
1.30	5.0	7.1	34	1.2	ZV418S_K402_0092 EZ705U	6.9	29	265	9.238	1.30	1.13	1.95	111	44	17	20	4	18	76.4
1.43	1.6	1.8	12	3.8	ZV418S_K402_0084 EZ701U	4.3	16	163	8.377	1.43	1.24	2.15	111	44	17	20	4	18	76.4
1.43	2.6	3.1	19	2.4	ZV418S_K402_0084 EZ702U	6.9	16	265	8.377	1.43	1.24	2.15	111	44	17	20	4	18	76.4
1.43	2.9	3.4	22	2.1	ZV418S_K402_0084 EZ505U	6.9	16	265	8.377	1.43	1.24	2.15	111	44	17	20	4	18	76.4
1.43	3.5	4.4	26	1.7	ZV418S_K402_0084 EZ703U	6.9	16	265	8.377	1.43	1.24	2.15	111	44	17	20	4	18	76.4
1.43	4.5	6.4	34	1.3	ZV418S_K402_0084 EZ705U	6.9	29	265	8.377	1.43	1.24	2.15	111	44	17	20	4	18	76.4
1.61	4.0	5.7	34	1.4	ZV418S_K402_0075 EZ705U	6.9	29	265	7.456	1.40	1.18	2.04	111	44	17	20	4	18	76.4
1.79	1.3	1.4	12	4.4	ZV418S_K402_0067 EZ701U	3.4	13	130	6.719	1.79	1.55	2.68	111	44	17	20	4	18	76.4
1.79	2.0	2.5	19	2.7	ZV418S_K402_0067 EZ702U	6.9	13	265	6.719	1.79	1.55	2.68	111	44	17	20	4	18	76.4
1.79	2.3	2.7	22	2.4	ZV418S_K402_0067 EZ505U	6.9	13	265	6.719	1.79	1.55	2.68	111	44	17	20	4	18	76.4
1.79	2.8	3.5	27	2.0	ZV418S_K402_0067 EZ703U	6.9	13	265	6.719	1.79	1.55	2.68	111	44	17	20	4	18	76.4
1.79	3.6	5.2	35	1.5	ZV418S_K402_0067 EZ705U	6.9	29	265	6.719	1.79	1.55	2.68	111	44	17	20	4	18	76.4
2.00	3.2	4.6	35	1.7	ZV418S_K402_0060 EZ705U	6.9	29	265	6.000	1.73	1.47	2.53	111	44	17	20	4	18	76.4
2.21	2.9	4.2	35	1.8	ZV418S_K402_0054 EZ705U	6.9	28	265	5.422	1.92	1.62	2.80	111	44	17	20	4	18	76.4
2.75	2.4	3.3	36	2.1	ZV418S_K402_0044 EZ705U	6.9	22	265	4.364	2.38	2.02	3.48	111	44	17	20	4	18	76.4
3.00	2.2	3.1	36	2.2	ZV418S_K402_0040 EZ705U	6.9	20	265	4.000	2.60	2.20	3.80	111	44	17	20	4	18	76.4
ZV4K4 (n_{1N} = 4000 min^{-1}, ($F_{f2acc,max}$ = 6,9 kN)																			
1.91	5.4	9.3	44	1.0	ZV418S_K402_0084 EZ813U	6.9	29	265	8.377	1.43	1.24	2.15	111	44	17	20	4	18	76.4
2.38	4.3	7.5	45	1.2	ZV418S_K402_0067 EZ813U	6.9	29	265	6.719	1.79	1.55	2.68	111	44	17	20	4	18	76.4
2.38	4.5	11	47	1.1	ZV418S_K402_0067 EZ815U	6.9	29	265	6.719	1.79	1.55	2.68	111	44	17	20	4	18	76.4
ZV4K4 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 6,9 kN)																			
0.65	6.7	11	16	1.0	ZV418S_K402_0280 EZ505U	6.9	29	265	27.77	0.52	0.48	0.79	111	44	17	20	4	18	76.4
0.71	6.1	9.8	16	1.1	ZV418S_K402_0250 EZ505U	6.9	26	265	25.28	0.57	0.52	0.87	111	44	17	20	4	18	76.4
0.77	5.6	9.0	16	1.2	ZV418S_K402_0230 EZ505U	6.9	29	265	23.29	0.62	0.57	0.95	111	44	17	20	4	18	76.4
0.89	4.9	7.8	16	1.4	ZV418S_K402_0200 EZ505U	6.9	29	265	20.20	0.71	0.65	1.09	111	44	17	20	4	18	76.4
0.89	6.2	10	21	1.1	ZV418S_K402_0200 EZ703U	6.9	29	265	20.20	0.71	0.65	1.09	111	44	17	20	4	18	76.4
1.03	4.2	6.8	16	1.6	ZV418S_K402_0175 EZ505U	6.9	29	265	17.41	0.78	0.69	1.15	111	44	17	20	4	18	76.4
1.03	5.3	8.8	21	1.3	ZV418S_K402_0175 EZ703U	6.9	29	265	17.41	0.78	0.69	1.15	111	44	17	20	4	18	76.4
1.06	4.1	6.6	16	1.6	ZV418S_K402_0170 EZ505U	6.9	27	265	16.94	0.85	0.78	1.30	111	44	17	20	4	18	76.4
1.06	5.2	8.6	21	1.3	ZV418S_K402_0170 EZ703U	6.9	27	265	16.94	0.85	0.78	1.30	111	44	17	20	4	18	76.4
1.30	3.3	5.4	17	1.9	ZV418S_K402_0140 EZ505U	6.9	26	265	13.89	0.98	0.86	1.44	111	44	17	20	4	18	76.4
1.30	4.3	7.1	21	1.5	ZV418S_K402_0140 EZ703U	6.9	26	265	13.89	0.98	0.86	1.44	111	44	17	20	4	18	76.4
1.30	5.8	11	29	1.1	ZV418S_K402_0140 EZ705U	6.9	29	265	13.89	0.98	0.86	1.44	111	44	17	20	4	18	76.4
1.42	3.1	4.9	17	2.0	ZV418S_K402_0125 EZ505U	6.9	23	265	12.66	1.07	0.95	1.58	111	44	17	20	4	18	76.4
1.42	3.9	6.4	21	1.6	ZV418S_K402_0125 EZ703U	6.9	23	265	12.66	1.07	0.95	1.58	111	44	17	20	4	18	76.4
1.42	5.3	9.6	29	1.1	ZV418S_K402_0125 EZ705U	6.9	29	265	12.66	1.07	0.95	1.58	111	44	17	20	4	18	76.4
1.56	2.8	4.5	17	2.1	ZV418S_K402_0115 EZ505U	6.9	22	265	11.52	1.04	0.90	1.56	111	44	17	20	4	18	76.4
1.56	3.5	5.8	22	1.7	ZV418S_K402_0115 EZ703U	6.9	22	265	11.52	1.04	0.90	1.56	111	44	17	20	4	18	76.4
1.56	4.8	8.8	29	1.2	ZV418S_K402_0115 EZ705U	6.9	29	265	11.52	1.04	0.90	1.56	111	44	17	20	4	18	76.4
1.78	2.4	3.9	17	2.3	ZV418S_K402_0100 EZ505U	6.9	19	265	10.10	1.35	1.19	1.98	111	44	17	20	4	18	76.4

v_{f2} [m/s]	F_{f2} [kN]	$F_{f2,0}$ [kN]	a_{th}	S	Type	F_{f2accE} [kN]	$F_{f2NOT,E}$ [kN]	M_{2accE} [Nm]	i	$v_{f2maxDB}$ EL1,2 [m/s]	$v_{f2maxDB}$ EL3,4,5,6 [m/s]	$v_{f2maxZB}$ [m/s]	Δs [µm]	$Δs_{redII}$ [µm]	$Δs_{redI}$ [µm]	C_{linE} [N/µm]	m_n [mm]	z	d_0 [mm]
ZV4K4 (n_{1N} = 4500 min^{-1}, ($F_{f2acc,max}$ = 6,9 kN)																			
1.78	3.1	5.1	22	1.8	ZV418S_K402_0100 EZ703U	6.9	19	265	10.10	1.35	1.19	1.98	111	44	17	20	4	18	76.4
1.78	4.2	7.7	29	1.3	ZV418S_K402_0100 EZ705U	6.9	29	265	10.10	1.35	1.19	1.98	111	44	17	20	4	18	76.4
1.95	2.2	3.6	17	2.4	ZV418S_K402_0092 EZ505U	6.9	18	265	9.238	1.30	1.13	1.95	111	44	17	20	4	18	76.4
1.95	2.8	4.7	22	1.9	ZV418S_K402_0092 EZ703U	6.9	18	265	9.238	1.30	1.13	1.95	111	44	17	20	4	18	76.4
1.95	3.8	7.0	30	1.4	ZV418S_K402_0092 EZ705U	6.9	29	265	9.238	1.30	1.13	1.95	111	44	17	20	4	18	76.4
2.15	2.0	3.3	17	2.6	ZV418S_K402_0084 EZ505U	6.9	16	265	8.377	1.43	1.24	2.15	111	44	17	20	4	18	76.4
2.15	2.6	4.3	22	2.0	ZV418S_K402_0084 EZ703U	6.9	16	265	8.377	1.43	1.24	2.15	111	44	17	20	4	18	76.4
2.15	3.5	6.4	30	1.5	ZV418S_K402_0084 EZ705U	6.9	29	265	8.377	1.43	1.24	2.15	111	44	17	20	4	18	76.4
2.68	1.6	2.6	18	3.0	ZV418S_K402_0067 EZ505U	6.9	13	265	6.719	1.79	1.55	2.68	111	44	17	20	4	18	76.4
2.68	2.1	3.4	23	2.4	ZV418S_K402_0067 EZ703U	6.9	13	265	6.719	1.79	1.55	2.68	111	44	17	20	4	18	76.4
2.68	2.8	5.1	30	1.8	ZV418S_K402_0067 EZ705U	6.9	29	265	6.719	1.79	1.55	2.68	111	44	17	20	4	18	76.4

12.3 Dimensional drawings

This chapter shows you the dimensions of rack and pinion drives with EZ synchronous servo motors.

Dimension az in the tables of dimensions applies to STOBER gear racks. In general: az = ½ d0 + h0 + x*mn

The pinion is helical (left-hand 19° 31' 42"). The pinion gearing quality is 5.

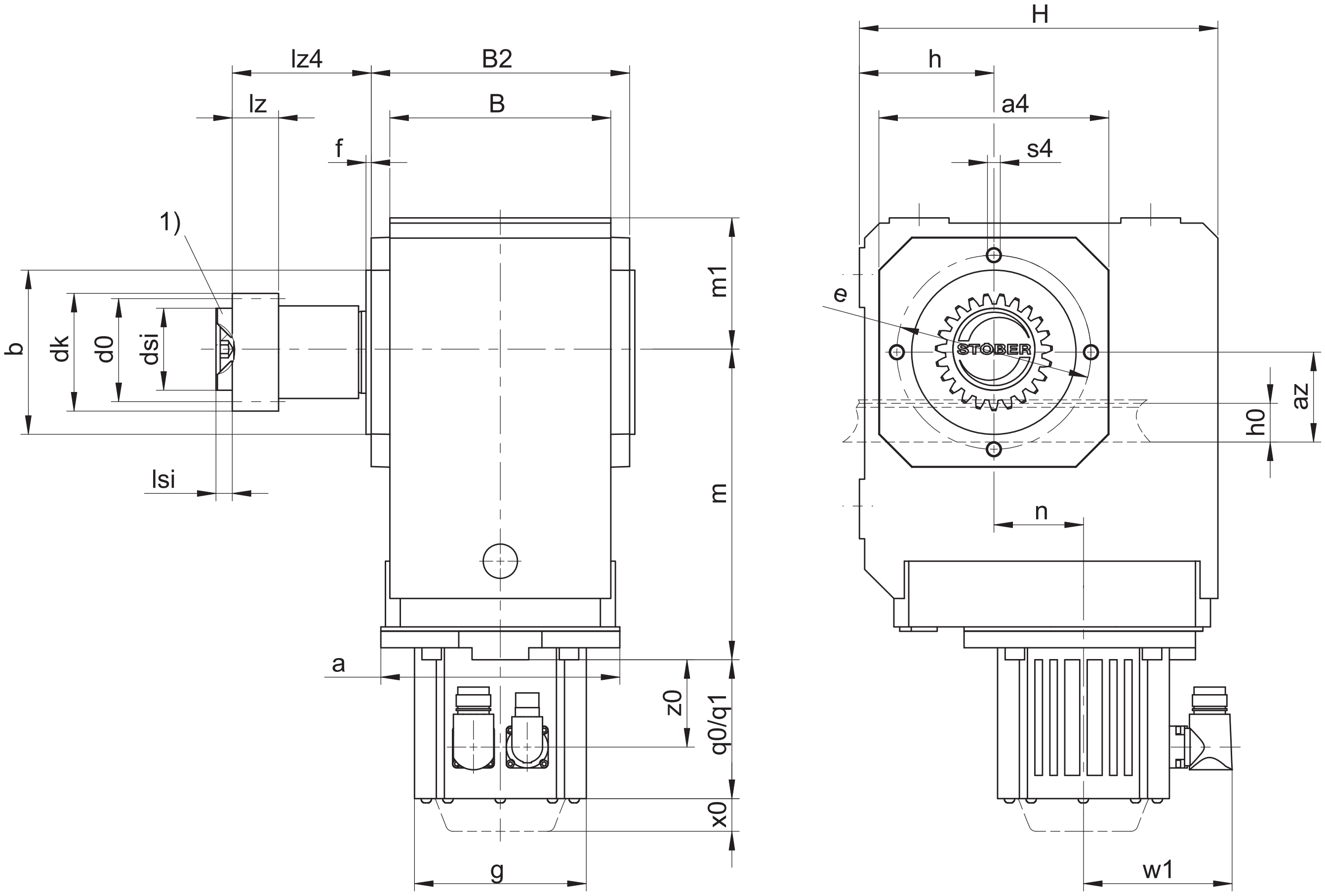
Dimensions can exceed the specifications of ISO 2768-mK due to casting tolerances or accumulation of individual tolerances.

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

You can download 3D models of our standard drives at https://configurator.stoeber.de/en-US/.

Combination options and the dimensions of forced ventilated geared motors can also be found at https://configurator.stoeber.de/en-US/.

12.3.1 Pinion position E



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x0	Applies to encoders using an optical measuring method.	w1	Different for the One Cable Solution (OCS), see the chapter [▷ 14.4]
1)	Axial locking (optional)		

Dimensions of gearboxes

Type	mn	az	□a4	∅b	B	B2	∅d0	∅dk	∅dsi	∅e	f	h	h0	H	lz	lz4	lsi	m1	s4	x
ZV220SEK1_	2	44.02	105	75_{j6}	90	106	42.44	47.90	30	90	3.0	60	22	160	26	50.5	6	60	M8	0.40
ZV225SEK2_	2	49.33	116	82_{j6}	115	134	53.05	58.52	45	100	3.0	65	22	190	26	67.5	8	65	M8	0.40
ZV318SEK2_	3	55.55	116	82_{j6}	115	134	57.30	65.01	45	100	3.0	65	26	190	31	67.5	8	65	M8	0.30
ZV225SEK3_	2	49.33	132	95_{j6}	130	146	53.05	58.52	45	115	3.0	75	22	213	26	68.5	8	75	M8	0.40
ZV318SEK3_	3	55.55	132	95_{j6}	130	146	57.30	65.01	45	115	3.0	75	26	213	31	68.5	8	75	M8	0.30
ZV322SEK4_	3	62.21	152	110_{j6}	148	173	70.03	78.35	55	130	3.5	90	26	240	31	93.0	10	90	M10	0.40
ZV418SEK4_	4	74.40	152	110_{j6}	148	173	76.40	86.77	55	130	3.5	90	35	240	41	93.0	10	90	M10	0.30

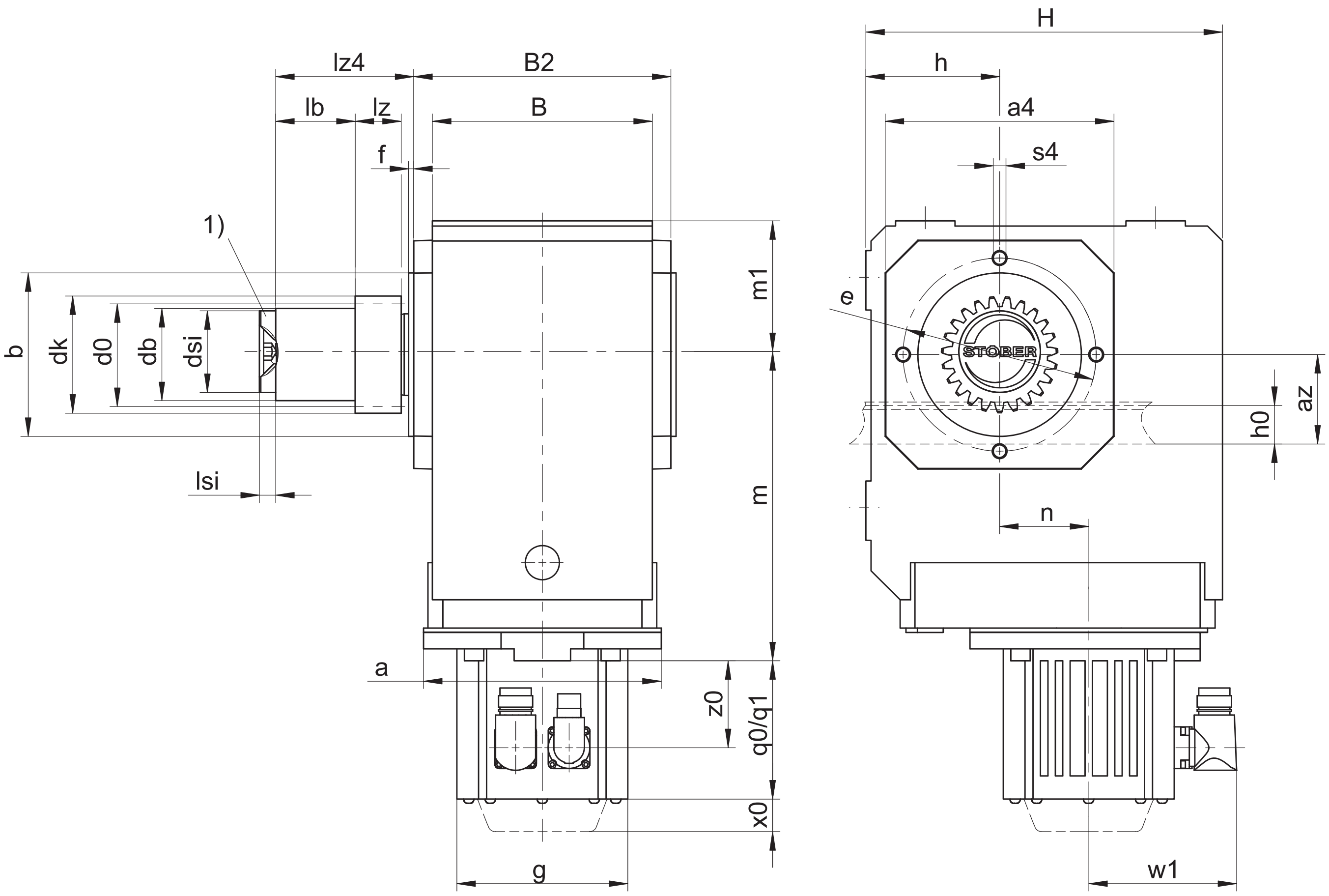
Dimensions of motors

Type	□g	q0	q1	w1	x0	z0
EZ202U	55	148.0	157.0	47.0	25	93.0
EZ203U	55	166.0	175.0	47.0	25	111.0
EZ301U	72	114.0	154.0	55.5	21	78.5
EZ302U	72	136.0	176.0	55.5	21	100.5
EZ303U	72	158.0	198.0	55.5	21	122.5
EZ401U	98	118.5	167.0	91.0	22	76.5
EZ402U	98	143.5	192.0	91.0	22	101.5
EZ404U	98	193.5	242.0	91.0	22	151.5
EZ501U	115	112.0	166.5	100.0	22	77.5
EZ502U	115	137.0	191.5	100.0	22	102.5
EZ503U	115	162.0	216.5	100.0	22	127.5
EZ505U	115	212.0	266.5	100.0	22	177.5
EZ701U	145	125.0	184.0	115.0	22	87.0
EZ702U	145	150.0	209.0	115.0	22	112.0
EZ703U	145	175.0	234.0	115.0	22	137.0
EZ705U	145	230.0	289.0	134.0	22	188.0
EZ813U	190	273.5	350.5	156.5	22	219.5
EZ815U	190	355.5	432.5	156.5	22	301.5

Dimensions of geared motors

Type	EZ2			EZ3			EZ4			EZ5			EZ7			EZ8		
	a	m	n	a	m	n	a	m	n	a	m	n	a	m	n	a	m	n
ZV_K102_	□55	124	36.0	□72	124	36.0	□98	124	36.0	□115	128	36.0	□145	130	36.0	–	–	–
ZV_K202_	–	–	–	□72	143	46.0	□98	143	46.0	□115	147	46.0	□145	149	46.0	–	–	–
ZV_K203_	–	–	–	⌀140	180	46.0	⌀140	180	46.0	–	–	–	–	–	–	–	–	–
ZV_K302_	–	–	–	⌀140	163	52.5	⌀140	163	52.5	□115	167	52.5	□145	169	52.5	–	–	–
ZV_K303_	–	–	–	⌀140	200	52.5	⌀140	200	52.5	⌀160	210	16.0	–	–	–	–	–	–
ZV_K402_	–	–	–	–	–	–	–	–	–	⌀160	187	60.0	□145	189	60.0	□190	192	60.0
ZV_K403_	–	–	–	⌀140	220	60.0	⌀140	220	60.0	⌀160	230	23.0	–	–	–	–	–	–

12.3.2 Pinion position S



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x0	Applies to encoders using an optical measuring method.	w1	Different for the One Cable Solution (OCS), see the chapter [▷ 14.4]
1)	Axial locking (optional)		

Dimensions of gearboxes

Type	mn	az	□a4	Øb	B	B2	Ød0	Ødb	Ødk	Ødsi	Øe	f	h	h0	H	lb	lz	lz4	lsi	m1	Øs4	x
ZV220SSK1_	2	44.02	105	75_{j6}	90	106	42.44	38	47.90	30	90	3.0	60	22	160	12.5	26	50.5	6	60	M8	0.40
ZV225SSK2_	2	49.33	116	82_{j6}	115	134	53.05	50	58.52	45	100	3.0	65	22	190	34.5	26	67.5	8	65	M8	0.40
ZV318SSK2_	3	55.55	116	82_{j6}	115	134	57.30	50	65.01	45	100	3.0	65	26	190	29.5	31	67.5	8	65	M8	0.30
ZV225SSK3_	2	49.33	132	95_{j6}	130	146	53.05	50	58.52	45	115	3.0	75	22	213	34.5	26	68.5	8	75	M8	0.40
ZV318SSK3_	3	55.55	132	95_{j6}	130	146	57.30	50	65.01	45	115	3.0	75	26	213	29.5	31	68.5	8	75	M8	0.30
ZV322SSK4_	3	62.21	152	110_{j6}	148	173	70.03	62	78.35	55	130	3.5	90	26	240	53.5	31	93.0	10	90	M10	0.40
ZV418SSK4_	4	74.40	152	110_{j6}	148	173	76.40	62	86.77	55	130	3.5	90	35	240	43.5	41	93.0	10	90	M10	0.30

Dimensions of motors

Type	□g	q0	q1	w1	x0	z0
EZ202U	55	148.0	157.0	47.0	25	93.0
EZ203U	55	166.0	175.0	47.0	25	111.0
EZ301U	72	114.0	154.0	55.5	21	78.5
EZ302U	72	136.0	176.0	55.5	21	100.5
EZ303U	72	158.0	198.0	55.5	21	122.5
EZ401U	98	118.5	167.0	91.0	22	76.5
EZ402U	98	143.5	192.0	91.0	22	101.5
EZ404U	98	193.5	242.0	91.0	22	151.5
EZ501U	115	112.0	166.5	100.0	22	77.5
EZ502U	115	137.0	191.5	100.0	22	102.5
EZ503U	115	162.0	216.5	100.0	22	127.5
EZ505U	115	212.0	266.5	100.0	22	177.5
EZ701U	145	125.0	184.0	115.0	22	87.0
EZ702U	145	150.0	209.0	115.0	22	112.0
EZ703U	145	175.0	234.0	115.0	22	137.0
EZ705U	145	230.0	289.0	134.0	22	188.0
EZ813U	190	273.5	350.5	156.5	22	219.5
EZ815U	190	355.5	432.5	156.5	22	301.5

Dimensions of geared motors

Type	EZ2			EZ3			EZ4			EZ5			EZ7			EZ8		
	a	m	n	a	m	n	a	m	n	a	m	n	a	m	n	a	m	n
ZV_K102_	□55	124	36.0	□72	124	36.0	□98	124	36.0	□115	128	36.0	□145	130	36.0	–	–	–
ZV_K202_	–	–	–	□72	143	46.0	□98	143	46.0	□115	147	46.0	□145	149	46.0	–	–	–
ZV_K203_	–	–	–	∅140	180	46.0	∅140	180	46.0	–	–	–	–	–	–	–	–	–
ZV_K302_	–	–	–	∅140	163	52.5	∅140	163	52.5	□115	167	52.5	□145	169	52.5	–	–	–
ZV_K303_	–	–	–	∅140	200	52.5	∅140	200	52.5	∅160	210	16.0	–	–	–	–	–	–
ZV_K402_	–	–	–	–	–	–	–	–	–	∅160	187	60.0	□145	189	60.0	□190	192	60.0
ZV_K403_	–	–	–	∅140	220	60.0	∅140	220	60.0	∅160	230	23.0	–	–	–	–	–	–

12.4 Type designation

In this chapter, you will find an explanation of the type designation with the associated options.

Additional ordering information not included in the type designation can be found at the end of the chapter.

Example code

Z	V	3	22	S	S	K	4	0	2	V	G	0084	EZ813U

Explanation

Code	Designation	Design
Z	Type	Rack and pinion gearbox
V	Design	Plug-on pinion
3	Normal module	m_n = 3 mm (example)
22	Number of teeth	z = 22 (example)
S	Helix angle	Left-hand 19° 31' 42"
E	Pinion position	Shaft end
S		Shaft shoulder
K	Type	Helical bevel gearbox
4	Size	4 (example)
0	Generation	Generation 0
1		Generation 1
2	Stages	Two-stage
3		Three-stage
V	Shaft	Solid shaft
G	Housing	Pitch circle diameter
0084	Transmission ratio (i x 10 rounded)	i = 8.377 (example)
EZ813U	Motor	EZ synchronous servo motor

To complete the type designation, also specify the following in your order:

- A detailed type designation of the motor, see the chapter [▹ 14.5]
- Mounting position, see the chapter [▹ 12.5.4]
- Attachment of solid shaft: gearbox side 3 or 4
- Pitch circle diameter: gearbox side 3 or 4
- Backlash: Standard/class II/class I. Backlash class II and class I for an additional cost.
- Axial locking (optional), see the chapter [▹ 12.3]
- Position of the plug connectors, see the chapter [▹ 12.5.6]

An explanation of the gearbox sides can be found in the chapter [▹ 12.5.4]

This catalog shows you all the information on rack and pinion drives with EZ synchronous servo motors. All input options available on request are shown in the chapter [▹ 12.5.1].

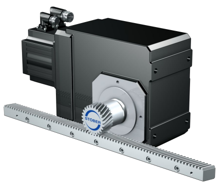
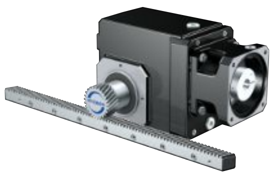
To make selecting your rack and pinion drive easy, use our STOBER Configurator at https://configurator.stoeber.de/en-US/.

A detailed description of the nameplate, see the chapter [▹ 14.5.1].

12.5 Product description

12.5.1 Input options

This chapter shows you all available input options:

EZ synchronous servo motor	ME motor adapter	MB motor adapter	LM Lean motor
			
Catalog ID 443286_en	Catalog ID 443137_en	On request	On request

The corresponding catalogs can be found at http://www.stoeber.de/en/downloads/

Enter the ID of the catalog in the Search term field.

Rack and pinion drives with a low-backlash K gearbox are also available on request. To request one, send us an e-mail at sales@stoeber.de.

12.5.2 Gear rack

The gear rack used must have a right-hand design (19° 31' 42"); the load capacity must not be exceeded.

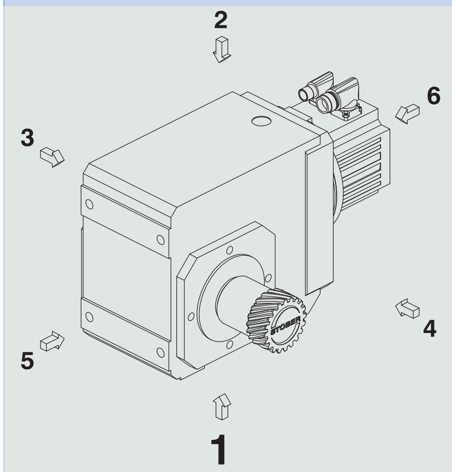
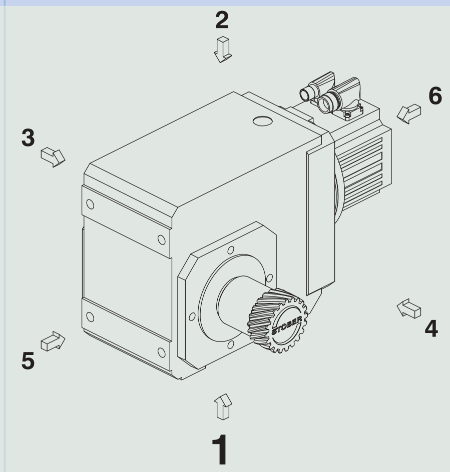
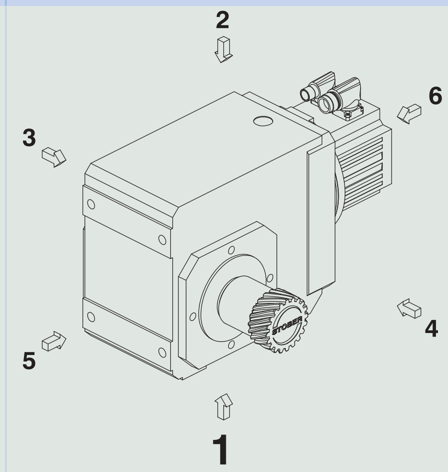
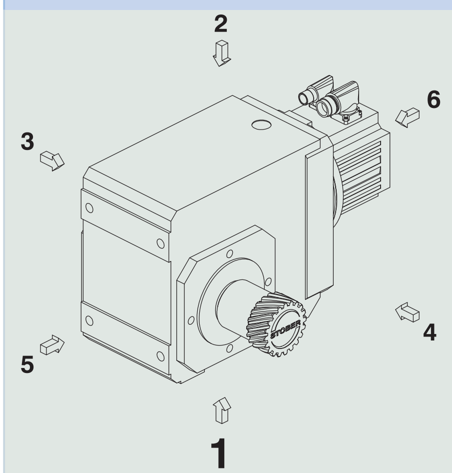
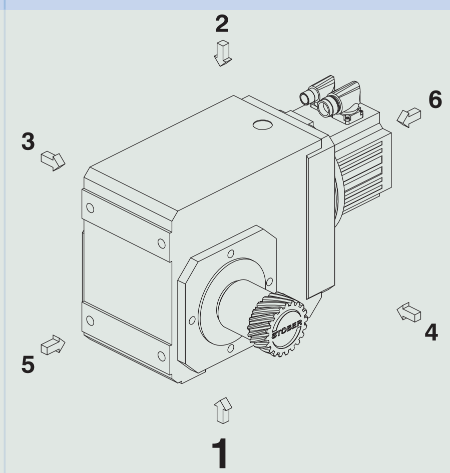
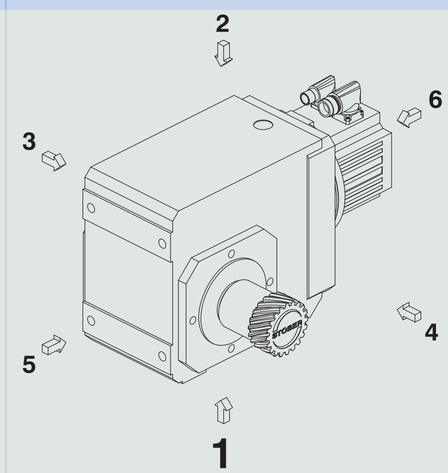
12.5.3 Installation conditions

The specified torques and forces only apply when gearboxes are fastened on the machine side using screws of strength class 10.9. In addition, the gear housings must be adjusted at the pilot. The machine-side fit must be H7.

12.5.4 Mounting positions

The following table shows the standard mounting positions.

The numbers identify the gearbox sides. The mounting position is defined by the gearbox side facing downwards.

EL1	EL2	EL3
		
EL4	**EL5**	**EL6**
		

Since the lubricant filling volume of the gearbox depends on the mounting position, the mounting position must be specified when ordering.

12.5.5 Lubricants

STOBER fills the gearboxes with the amount and type of lubricant specified on the nameplate. The filling volume and the structure of the gearboxes depend on the mounting position.

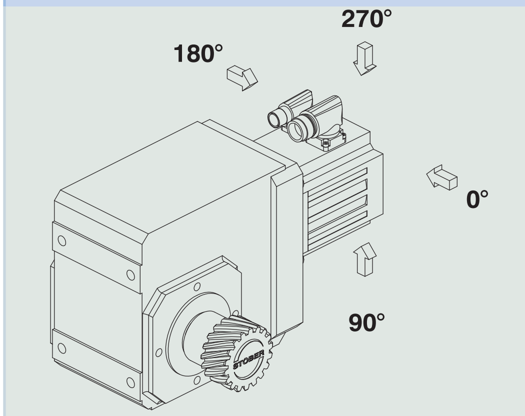
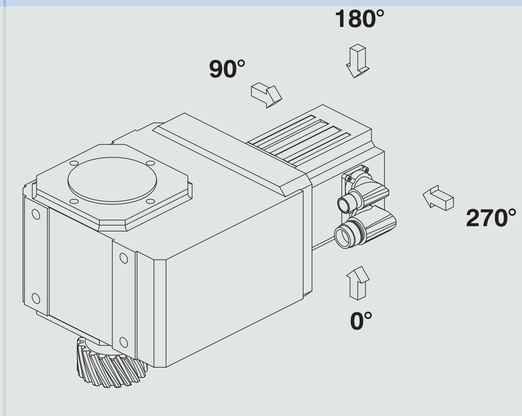
Only install the gearboxes in the intended mounting position! Reposition the gearboxes only after consulting STOBER. Otherwise, STOBER assumes no liability for the gearboxes.

You will receive lubricants for use in the food industry upon request.

12.5.5.1 Lubrication of rack and pinion gearbox

Ensure permanent lubrication with the lubricants recommended in the chapter [▸ 13.5.1].

12.5.6 Position of the plug connectors

Mounting position EL1 Plug connector in 270° position (standard)	Mounting position EL4 Plug connector in 270° position (standard)
	

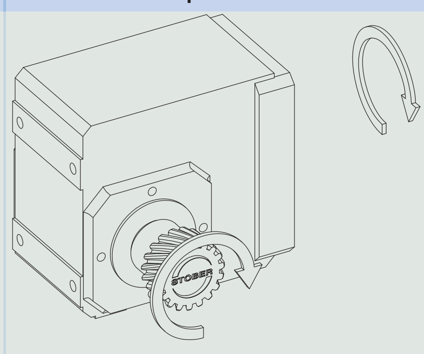
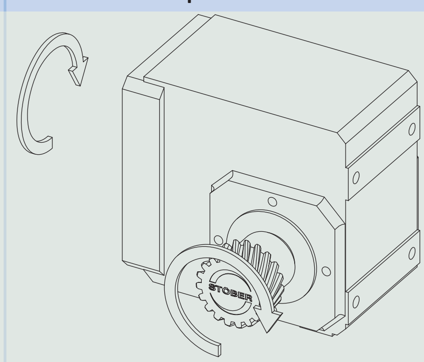
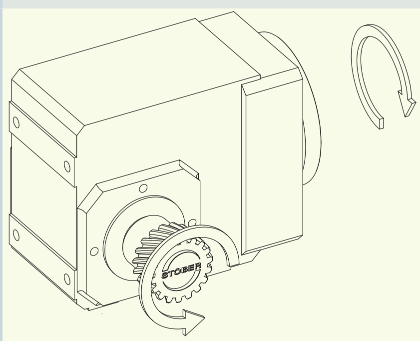
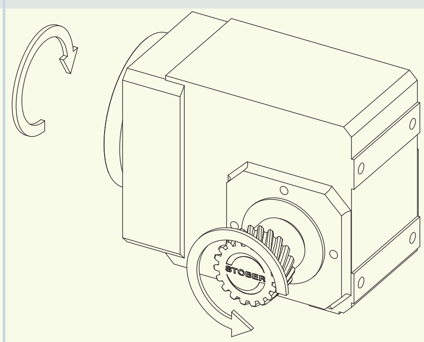
The plug connectors are in the 270° position as standard. Indicate variations for your rack and pinion drive in the order.

Note that the plug connectors also rotate when the gear rack is rotated to a different position.

12.5.7 Other product features

Feature	Value
Max. permitted gearbox temperature (on the surface of the gearbox)	≤ 80 °C
Paint	Black RAL 9005
(ATEX) Directive 2014/34/EU (Option)	Not suitable.
Protection class: [1]	
Planetary gearboxes	IP65
Motor	IP56, optionally IP66
Pinion/gear rack	IPXX

12.5.8 Direction of rotation

Type	Output side 4	Output side 3
K102 – K402		
K203 – K403		

The pictures show mounting position EL1.

[1] Observe the protection class of all the components.

12.6 Project configuration

Project your drives using our SERVOsoft designing software. Download SERVOsoft free of charge after registration at https://www.stoeber.de/en/services/info-servosoft/.

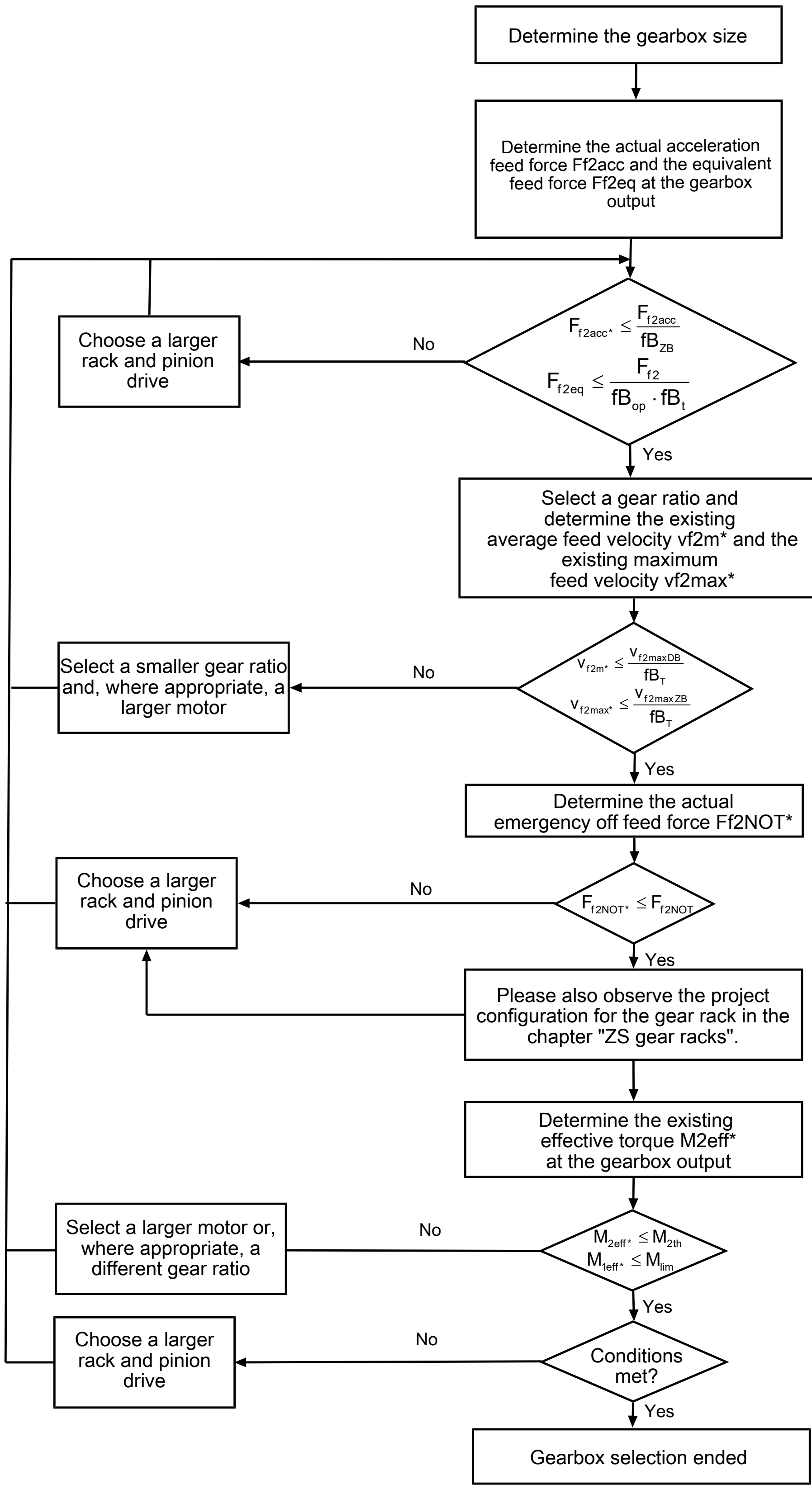
It is the most convenient and reliable method of drive selection, as the entire torque/speed curve of the application is displayed and evaluated here in the curve of the geared motor.

In this chapter, only limit values for specific operating points can be taken into consideration for manual drive selection.

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

An explanation of the formula symbols can be found in the chapter [▶ 17.1].

12.6.1 Drive selection

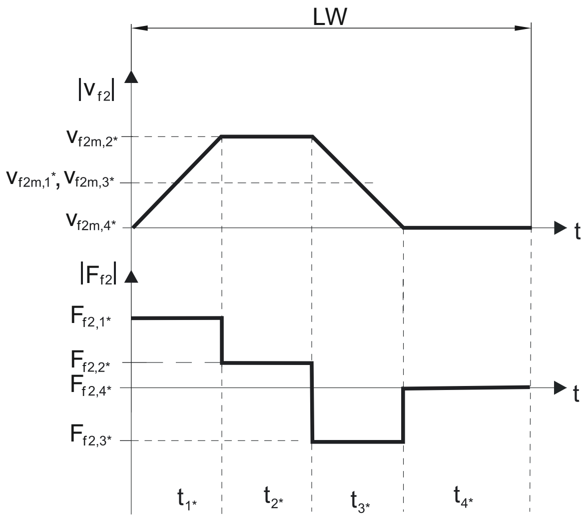


Refer to the selection tables for the values of i, $v_{f2maxDB}$, $v_{f2maxZB}$, F_{f2acc}, F_{f2N} and F_{f2NOT}.

The values for fB_T, fB_{op}, fB_t and fB_{ZB} can be found in the corresponding tables in this chapter.

Example of cyclic operation

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



Calculation of the actual maximum acceleration feed force

$$F_{f2acc^*} = m^* \cdot a^* + F_{L^*}$$

Calculation of the actual average input speed

$$n_{1m^*} = \frac{v_{f2m^*} \cdot i}{d_0 \cdot \pi}$$

$$v_{f2m^*} = \frac{\left|v_{f2m,1^*}\right| \cdot t_{1^*} + \ldots + \left|v_{f2m,n^*}\right| \cdot t_{n^*}}{t_{1^*} + \ldots + t_{n^*}}$$

If $t_{1^*} + \ldots + t_{3^*} \geq 6$ min, determine v_{2m^*} without the rest phase t_{4^*}.

The values for the ratio i can be found in the selection tables.

Calculation of the actual emergency off feed force

$$F_{f2NOT^*} = m^* \cdot a_{NOT^*} + F_{L^*}$$

Calculation of the actual equivalent feed force

$$F_{f2eq^*} = \sqrt[3]{\frac{\left|v_{f2m,1^*}\right| \cdot t_{1^*} \cdot \left|F_{f2,1^*}{}^3\right| + \ldots + \left|v_{f2m,n^*}\right| \cdot t_{n^*} \cdot \left|F_{f2,n^*}{}^3\right|}{\left|v_{f2m,1^*}\right| \cdot t_{1^*} + \ldots + \left|v_{f2m,n^*}\right| \cdot t_{n^*}}}$$

Calculation of the thermal limit torque

Calculate the thermal limit torque M_{2th} for a duty cycle ED_{10} > 50% and the actual average input speed n_{1m^*}. (At $K_{mot,th} \leq 0$ you must reduce the average input speed n_{1m^*} accordingly or select another geared motor size.)

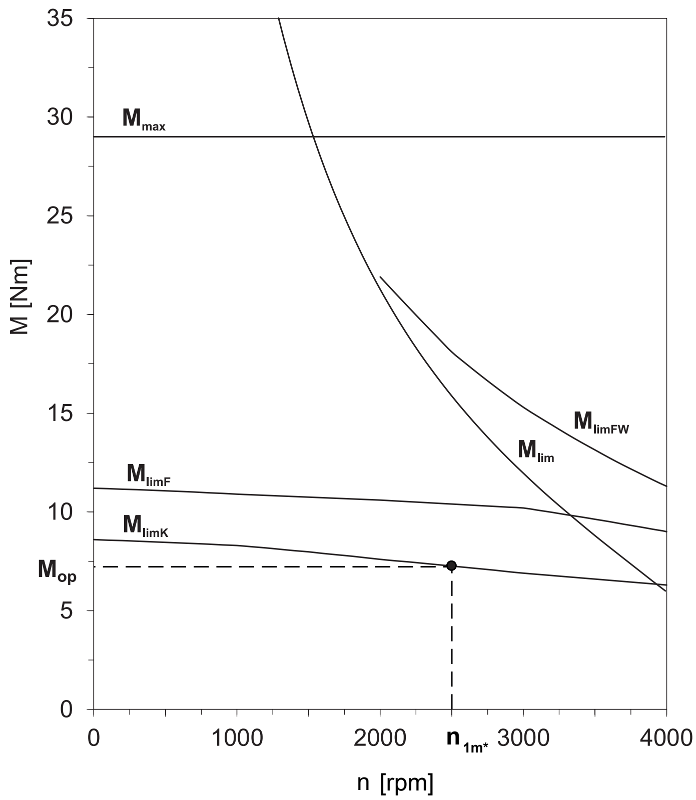
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

$$K_{mot,th} = 0,95 - \frac{a_{th}}{1000} \cdot athEL \cdot fB_T \cdot \left(\frac{n_{1m^*}}{1000}\right)^2$$

Refer to the selection tables for the values of i and a_{th}.

The values for a_{thEL} and fB_T can be found in the corresponding tables in this chapter.

The value for the torque of the motor at operating point M_{op} with the determined average input speed n_{1m*} can be found in the motor characteristic curve in the chapter Torque/speed curves. Note the size, nominal speed n_N and cooling type of the motor. The figure below shows an example of reading the torque M_{op} of a motor with convection cooling at the operating point.



Calculation of the actual effective torque

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

$$M_{2,n*} = \frac{F_{f2,n*} \cdot d_0}{2}$$

$$M_{1eff*} = \frac{M_{2eff*}}{i \cdot \eta}$$

Operating factors

Parameter a_{thEL}

Mounting position	a_{thEL}
EL1, 2	1.0
EL3, 4, 5, 6	1.1

Operating mode	fB_{op}
Uniform continuous operation	1.00
Cyclic operation	1.00
Reversing load cyclic operation	1.00

Run time	fB_t
Daily runtime ≤ 8 h	1.00
Daily runtime ≤ 16 h	1.15
Daily runtime ≤ 24 h	1.20

Cyclic operation	fB_{ZB}
≤ 1000 load changes/hour (LW/h)	1.00
> 1000 load changes/hour (LW/h)	1.15

Temperature		fB_T
Motor cooling	**Surrounding temperature**	
Motor with forced ventilation	≤ 20 °C	0.9
	≤ 30 °C	1.0
	≤ 40 °C	1.15
Motor with convection cooling	≤ 20 °C	1.0
	≤ 30 °C	1.1
	≤ 40 °C	1.25

Notes

- The maximum permitted gearbox temperature (see the "Other product features" chapter) must not be exceeded, as that could result in damage.
- For braking from full speed (for example, when the power fails or when setting up the machine), note the permitted gearbox feed forces (F_{f2acc}, F_{f2NOT}) in the selection tables.

12.7 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 term field.

Documentation	ID
Operating manual gearboxes, geared motors K	443364_en
Operating manual for EZ synchronous servo motors	443032_en
Operating manual gear racks	443392_en

13 ZS gear racks

Table of contents

13 Gear racks

ZS

13.1 Overview

Precisely coordinated: Precision gear racks for STOBER drives

Features

Helical gearing	✓
Heat-treated steel in accordance with STOBER specification	✓
Hardened and smoothed	✓
Gearing quality 6 in accordance with DIN 3962-1	✓
Length 500, 1000 and 2000 mm	✓

Technical data

m_n	2 – 6 mm
$F_{f,max}$	12.6 – 83.1 kN
F_{sv}	8 – 203 kN

13.2 Selection tables

The forces specified in the selection tables applies to:

- De-energized installation
- Permanent lubrication
- Pinion gearing quality at least 6, case-hardened

Please note the gear forces F_f and F_{fNOT} in the chapter [13.6.2], which depend on the number of pinion teeth.

m_n	l_{ZS}	Type	$F_{f,max}$	F_{sv}				m
				LA125	LA125PIN	LA62,5	LA62,5PIN	
[mm]	[mm]		[kN]	[kN]	[kN]	[kN]	[kN]	[kg]
2	500.00	ZS2S0500SQ6VG	12.6	–	8.5	8.0	12.5	1.9
2	1000.00	ZS2S1000SQ6VG	12.6	–	13.5	18.0	22.0	3.9
2	2000.00	ZS2S2000SQ6VG	12.6	19.0	23.5	–	–	8.0
3	500.00	ZS3S0500SQ6VG	22.5	–	16.0	15.5	23.0	2.7
3	1000.00	ZS3S1000SQ6VG	22.5	–	25.0	33.5	41.0	5.4
3	2000.00	ZS3S2000SQ6VG	22.5	36.0	43.5	–	–	11
4	506.67	ZS4S0500SQ6VG	38.7	–	26.0	25.0	37.0	5.1
4	506.67	ZS4S0500VQ6VG	38.7	–	38.0	37.5	54.5	4.8
4	1000.00	ZS4S1000SQ6VG	38.7	–	40.5	55.0	66.5	10
4	1000.00	ZS4S1000VQ6VG	38.7	–	60.0	81.0	98.0	9.5
4	2000.00	ZS4S2000SQ6VG	38.7	58.5	70.0	–	–	20
4	2000.00	ZS4S2000VQ6VG	38.7	86.5	103.5	–	–	20
5	500.00	ZS5S0500SQ6VG	60.0	–	38.5	38.5	55.0	5.8
5	1000.00	ZS5S1000SQ6VG	60.0	–	61.0	83.0	99.5	12
5	2000.00	ZS5S2000SQ6VG	60.0	88.5	105.0	–	–	24
6	500.00	ZS6S0500SQ6VG	83.1	–	72.5	75.0	105.5	8.5
6	1000.00	ZS6S1000SQ6VG	83.1	–	116.0	163.0	192.5	17
6	2000.00	ZS6S2000SQ6VG	83.1	173.0	203.0	–	–	36

13.3 Dimensional drawings

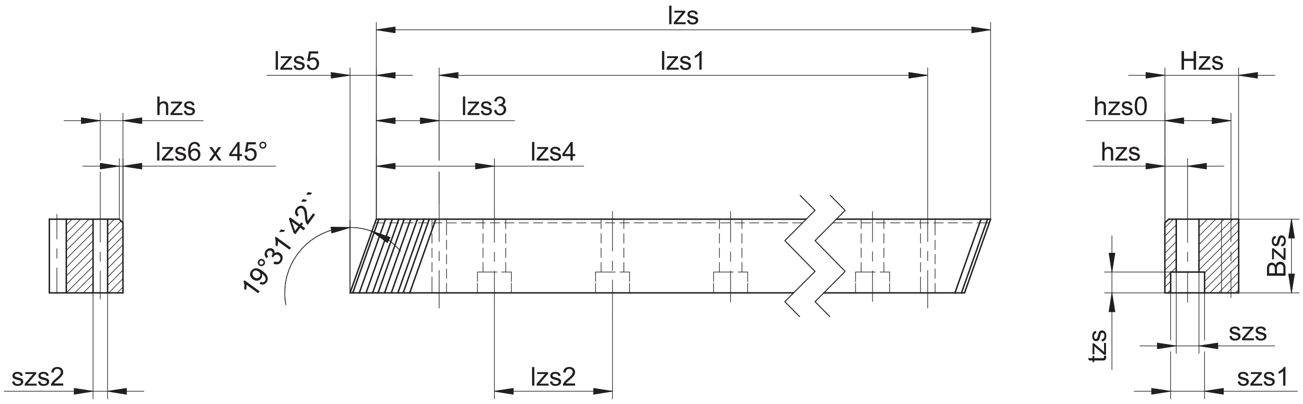
In this chapter, you can find the dimensions of the gear racks.

- Profile smoothed on all sides
- The total pitch error Fp in µm can be found in the table of dimensions below

Information on mounting gear racks can be found in the chapter [▶ 13.5.2]

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

You can download 3D models of our standard drives at https://configurator.stoeber.de/en-US/.



Type	mn	z	lzs	Bzs	Hzs	hzs	hzs0	lzs1	lzs2	lzs3	lzs4	lzs5	lzs6	N°×szs	szs1	szs2	tzs	Fp
ZS2S0500SQ6VG	2	75	500.00	24	24	8	22	436.6	62.5	31.7	62.5	8.5	2	7×7	11	5.7	7	32
ZS2S1000SQ6VG	2	150	1000.00	24	24	8	22	936.6	62.5	31.7	62.5	8.5	2	15×7	11	5.7	7	36
ZS2S2000SQ6VG	2	300	2000.00	24	24	8	22	1936.6	125.0	31.7	62.5	8.5	2	16×7	11	5.7	7	46
ZS3S0500SQ6VG	3	50	500.00	29	29	9	26	430.0	62.5	35.0	62.5	10.3	2	7×10	15	7.7	9	32
ZS3S1000SQ6VG	3	100	1000.00	29	29	9	26	930.0	62.5	35.0	62.5	10.3	2	15×10	15	7.7	9	36
ZS3S2000SQ6VG	3	200	2000.00	29	29	9	26	1930.0	125.0	35.0	62.5	10.3	2	16×10	15	7.7	9	46
ZS4S0500SQ6VG	4	38	506.67	39	39	12	35	433.0	62.5	33.3	62.5	13.8	2	7×12	18	9.7	11	36
ZS4S0500VQ6VG	4	38	506.67	39	39	12	35	433.0	62.5	33.3	62.5	13.8	2	7×14	20	11.7	13	36
ZS4S1000SQ6VG	4	75	1000.00	39	39	12	35	933.4	62.5	33.3	62.5	13.8	2	15×12	18	9.7	11	38
ZS4S1000VQ6VG	4	75	1000.00	39	39	12	35	933.4	62.5	33.3	62.5	13.8	2	15×14	20	11.7	13	38
ZS4S2000SQ6VG	4	150	2000.00	39	39	12	35	1933.4	125.0	33.3	62.5	13.8	2	16×12	18	9.7	11	48
ZS4S2000VQ6VG	4	150	2000.00	39	39	12	35	1933.4	125.0	33.3	62.5	13.8	2	16×14	20	11.7	13	48
ZS5S0500SQ6VG	5	30	500.00	49	39	12	34	425.0	62.5	37.5	62.5	17.4	3	7×14	20	11.7	13	36
ZS5S1000SQ6VG	5	60	1000.00	49	39	12	34	925.0	62.5	37.5	62.5	17.4	3	15×14	20	11.7	13	38
ZS5S2000SQ6VG	5	120	2000.00	49	39	12	34	1925.0	125.0	37.5	62.5	17.4	3	16×14	20	11.7	13	48
ZS6S0500SQ6VG	6	25	500.00	59	49	16	43	425.0	62.5	37.5	62.5	20.9	3	7×18	26	15.7	17	36
ZS6S1000SQ6VG	6	50	1000.00	59	49	16	43	925.0	62.5	37.5	62.5	20.9	3	15×18	26	15.7	17	40
ZS6S2000SQ6VG	6	100	2000.00	59	49	16	43	1925.0	125.0	37.5	62.5	20.9	3	16×18	26	15.7	17	48

13.4 Type designation

In this chapter, you will find an explanation of the type designation of a gear rack with the associated options.

Example code

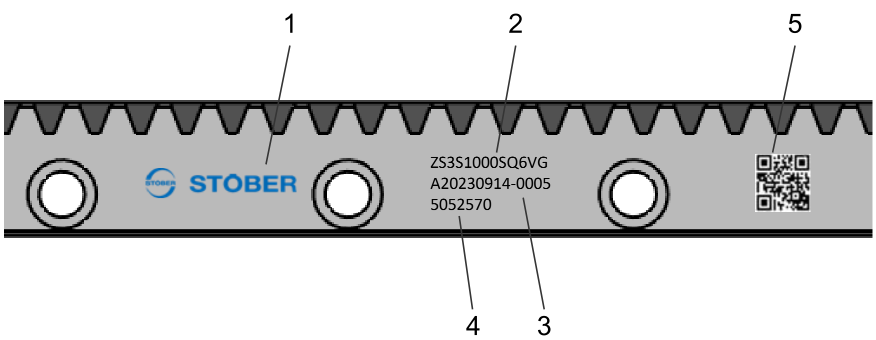
ZS	4	S	1000	S	Q6	V	G

Explanation

Code	Designation	Design
ZS	Type	Gear rack
4	Normal module	m_n = 4 mm (example)
S	Helix angle	Right-hand 19° 31' 42"
0500 **1000** 2000	Length	1000 mm (example)
S V	Fastening bores	Standard Reinforced
Q6	Gearing quality	Quality 6 in accordance with DIN 3962-1
V	Material	Heat-treated steel in accordance with STOBER specification
G	Heat treatment	Hardened

13.4.1 Nameplate

An example gear rack nameplate is explained in the figure below.



Code	Designation
1	Name of manufacturer
2	Type designation
3	Production number of the gear rack
4	ID No.
5	QR code (link to product information)

13.5 Product description

13.5.1 Lubricants

STOBER recommends the following lubricants for rack and pinion gearboxes:

- Klüber Microlube GB 0
- Klüber Structovis AHD
- Oest long-term grease LT 200
- BP Energrease LS EP 00
- DEA Glissando 6833 EP 00
- Fuchs Lubritech Gearmaster ZSA
- Molykote G-Rapid plus 3694

13.5.2 Accessories

13.5.2.1 Lubricant accessories

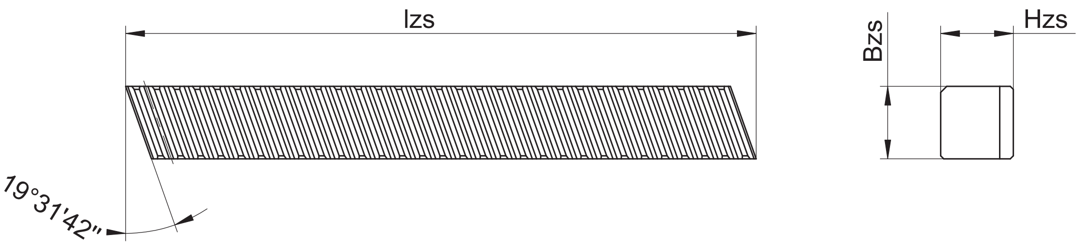
Supply sources

You can obtain lubricant accessories from the following companies:

TriboServ GmbH & Co KG https://www.triboserv.de/de/	**perma-tec GmbH & Co. KG** https://www.perma-tec.com/
STW - Kim Friedrich GmbH https://schmiertechnikwerk.com/	

13.5.2.2 Mounting gear rack

In this chapter, you can find the dimensions of the mounting gear racks.



Type	ID No.	mn	lzs	z	Bzs	Hzs	m
ZSM2S	5052582	2	200	30	24	24	0.82 kg
ZSM3S	5052583	3	200	20	29	29	1.16 kg
ZSM4S	5052584	4	200	15	39	39	2.13 kg
ZSM5S	5052585	5	200	12	49	39	2.60 kg
ZSM6S	5052586	6	200	10	59	49	3.96 kg

13.6 Project configuration

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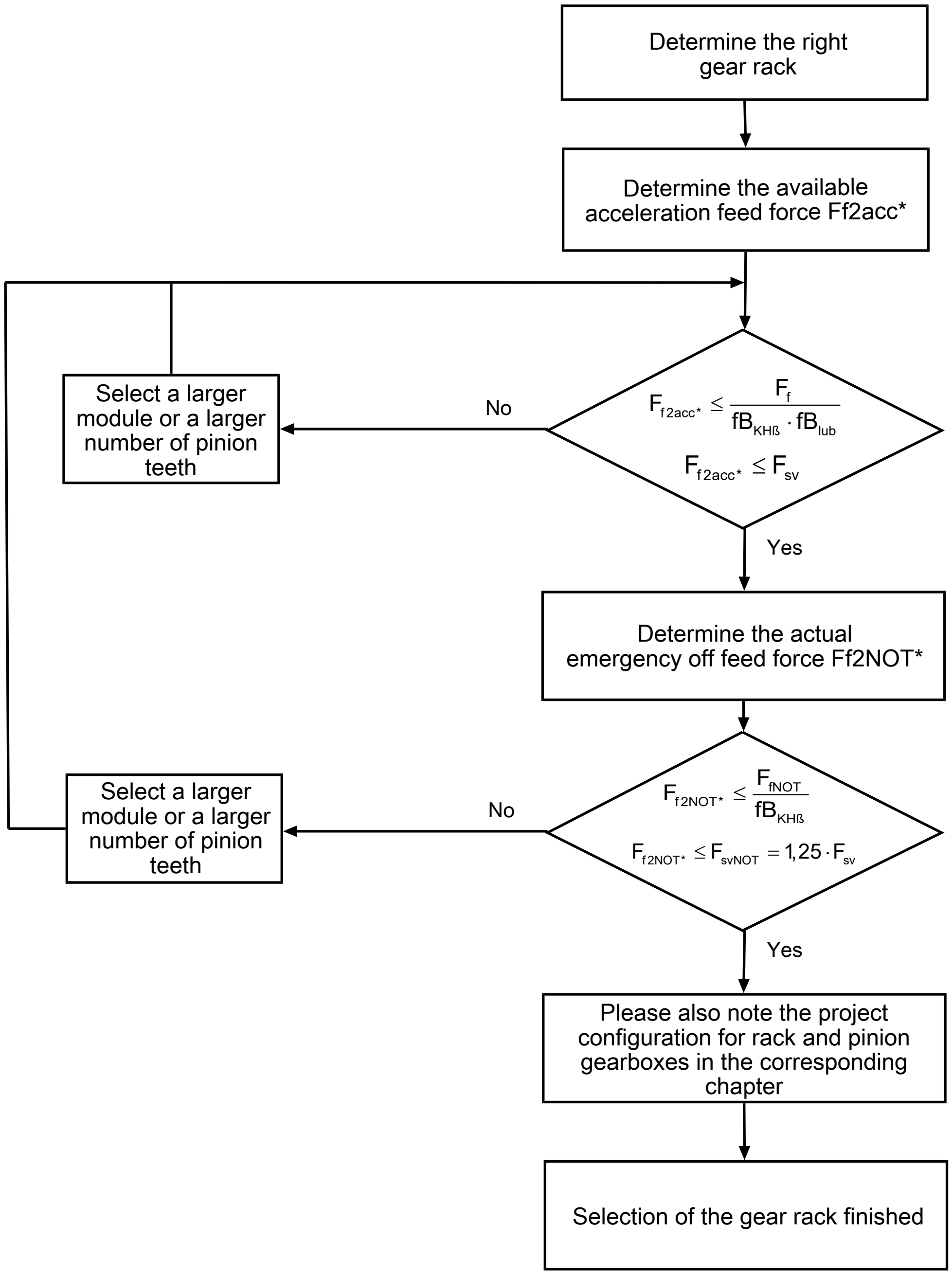
It is the most convenient and reliable method of drive selection, as the entire torque/speed curve of the application is displayed and evaluated here in the curve of the geared motor.

In this chapter, only limit values for specific operating points can be taken into consideration for manual drive selection.

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

An explanation of the formula symbols can be found in the chapter [▷ 17.1].

13.6.1 Drive selection



Refer to the selection tables for the values of F_{sv}.

The values for $fB_{KHß}$, fB_{lub}, F_f and F_{fNOT} can be found in the corresponding table in this chapter.

Calculation of the actual maximum acceleration feed force

$$F_{f2acc*} = m * \cdot a * + F_{L*}$$

Calculation of the actual emergency off feed force

$$F_{f2NOT*} = m * \cdot a_{NOT*} + F_{L*}$$

Operating factors

Load distribution	Bearing design	$fB_{KHß}$
ZTRSPH	S	1.1
	V	1.1
ZTRSPHQ	S	1.1
ZTRSPHV	S	1.1
ZTRPH	S	1.2
	V	1.2
ZTRPHV	S	1.2
ZRPH	S	1.2
	V	1.2
ZVP	S	1.5
	D	1.3
ZVPE	S	1.8
ZVKS	S	1.2
ZVKL	-	1.5
ZVK	-	1.2

Lubrication	fB_{lub}		
	Permanent	Daily	Monthly
$v_{f2maxZB} \leq 1$ m/s	1.0	1.1	5
$v_{f2maxZB} \leq 2$ m/s	1.05	1.3	5
$v_{f2maxZB} \leq 3$ m/s	1.1	1.5	5
$v_{f2maxZB} \leq 5$ m/s	1.25	1.9	5

13.6.2 Permitted feed forces depending on the number of pinion teeth

Permitted feed force F_f in kN:

z_{pin}	m_n = 2 mm	m_n = 3 mm	m_n = 4 mm	m_n = 5 mm	m_n = 6 mm
12	5.8	10.4	19.3	30.8	45.3
13	6.4	11.7	21.2	34.0	50.3
14	7.1	12.8	23.7	37.9	55.2
15	8.1	14.4	26.2	42.0	61.4
16	8.6	15.5	28.0	44.2	64.4
17	9.1	16.5	30.0	47.4	69.3
18	9.8	17.4	31.4	50.3	73.6
19	10.4	18.4	33.4	53.5	77.5
20	11.0	19.3	35.2	55.2	79.2
21	11.5	20.6	36.8	57.9	79.8
22	12.2	21.3	37.3	57.9	80.3
23	12.3	21.6	37.3	57.9	80.3
24	12.4	21.9	37.4	58.0	80.5
25	12.4	21.9	37.6	58.3	81.0
26	12.4	21.9	37.7	58.6	81.0
27	12.4	21.9	37.8	58.6	81.1
28	12.5	22.0	38.0	58.6	81.5
29	12.5	22.0	38.1	58.7	81.5
30	12.5	22.1	38.2	58.9	81.6
31	12.5	22.1	38.3	59.1	81.9
32	12.5	22.1	38.3	59.4	81.9
33	12.6	22.3	38.3	59.6	82.6
34	12.6	22.3	38.3	59.6	82.6
35	12.6	22.4	38.3	59.6	82.6
36	12.6	22.4	38.3	59.6	82.8
37	12.6	22.4	38.4	59.7	82.8
38	12.6	22.4	38.5	59.9	82.8
39	12.6	22.4	38.6	60.0	83.1
40	12.6	22.5	38.7	60.0	83.1

Permitted emergency off feed force F_{fNOT} in kN:

z_{pin}	m_n = 2 mm	m_n = 3 mm	m_n = 4 mm	m_n = 5 mm	m_n = 6 mm
12	11.6	20.8	38.6	61.6	90.6
13	12.8	23.4	42.4	68.0	100.6
14	14.2	25.6	47.4	75.8	110.4
15	16.2	28.8	52.4	84.0	122.8
16	17.2	31.0	56.0	88.4	128.8
17	18.2	33.0	60.0	94.8	138.6
18	19.6	34.8	62.8	100.6	147.2
19	20.8	36.8	66.8	107.0	155.0
20	22.0	38.6	70.4	110.4	158.4
21	23.0	41.2	73.6	115.8	159.6
22	24.4	42.6	74.6	115.8	160.6
23	24.6	43.2	74.6	115.8	160.6
24	24.8	43.8	74.8	116.0	161.0
25	24.8	43.8	75.2	116.6	162.0
26	24.8	43.8	75.4	117.2	162.0
27	24.8	43.8	75.6	117.2	162.2
28	25.0	44.0	76.0	117.2	163.0
29	25.0	44.0	76.2	117.4	163.0
30	25.0	44.2	76.4	117.8	163.2
31	25.0	44.2	76.6	118.2	163.8
32	25.0	44.2	76.6	118.8	163.8
33	25.2	44.6	76.6	119.2	165.2
34	25.2	44.6	76.6	119.2	165.2
35	25.2	44.8	76.6	119.2	165.2
36	25.2	44.8	76.6	119.2	165.6
37	25.2	44.8	76.8	119.4	165.6
38	25.2	44.8	77.0	119.8	165.6
39	25.2	44.8	77.2	120.0	166.2
40	25.2	45.0	77.4	120.0	166.2

13.7 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 term field.

Documentation	ID
Operating manual gear racks	443392_en

14 EZ synchronous servo motors

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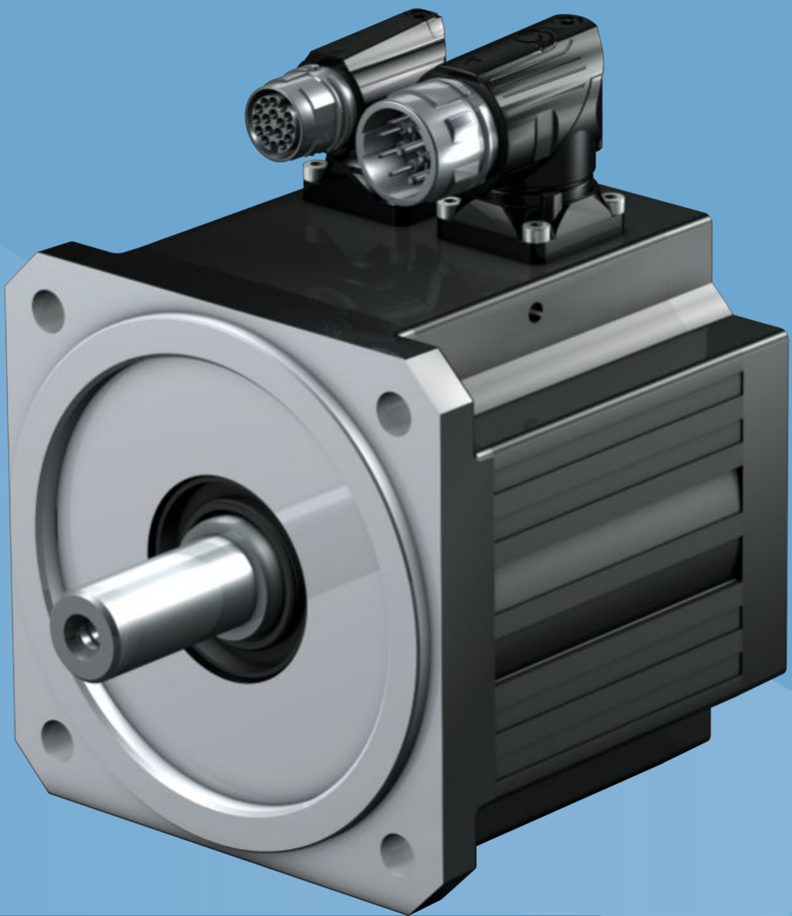


14 Synchronous servo motors EZ

14.1 Overview

Synchronous servo motors with tooth winding

Features

High dynamics	✓
Short length	✓
Super compact due to tooth-coil winding method with the highest possible copper fill factor	✓
Backlash-free holding brake (optional)	✓
Electronic nameplate for fast and reliable commissioning	✓
Convection cooling or forced ventilation (optional)	✓
Optical, inductive EnDat absolute encoders or resolvers	✓
Elimination of referencing with multi-turn absolute encoders (optional)	✓
One Cable Solution (OCS) with EnDat 3 encoder (optional)	✓
Rotatable plug connectors[1] with quick-lock	✓

[1] The plug connectors can be pivoted up to 10 times at a specific angle. They cannot be rotated repeatedly.

Torques

M_N	0.4 – 91 Nm
M_0	0.44 – 100 Nm

14.2 Selection tables

The technical data specified in the selection tables applies to:

- Installation altitudes up to 1000 m above sea level
- Surrounding temperatures from −15 °C to +40 °C
- Operation on a STOBER drive controller
- DC link voltage U_{ZK} = DC 540 V
- Coating: RAL 9005 Jet black, matte

In addition, the technical data applies to an uninsulated design with the following thermal mounting conditions:

Type	Dimensions of steel mounting flange (thickness x width x height)	Convection surface area Steel mounting flange
EZ2 – EZ5	23 x 210 x 275 mm	0.14 m^2
EZ7 – EZ8	28 x 300 x 400 mm	0.3 m^2

Note the differing ambient conditions in Chapter [▸ 14.7.3]

Formula symbols

Observe the additional information on the following formula symbols:

- I_0 = RMS value of the line-to-line current when stall torque M_0 is generated (tolerance ±5%).
- I_{max} = RMS value of the short-term maximum permitted line-to-line current when maximum torque M_{max} is generated (tolerance ±5%). Exceeding I_{max} may lead to irreversible damage (demagnetization) of the rotor.
- I_N = RMS value of the line-to-line current when nominal torque M_N is generated at the nominal point (tolerance ±5%).
- M_0 = Torque that a motor is continuously able to deliver at a speed of 10 rpm (tolerance ±5%). At a speed of 0 rpm, a minor continuous torque has to be taken into account. Contact your STOBER customer advisor for such an application.

14.2.1 EZ motors with convection cooling

Type	K_{EM} [V/1000 min^{-1}]	n_N [rpm]	M_N [Nm]	I_N [A]	$K_{M,N}$ [Nm/A]	P_N [kW]	M_0 [Nm]	I_0 [A]	K_{M0} [Nm/A]	M_R [Nm]	M_{max} [Nm]	I_{max} [A]	R_{U-V} [Ω]	L_{U-V} [mH]	T_{el} [ms]	J_{dyn} [$kgcm^2$]	m_{dyn} [kg]
EZ202U	40	6000	0.40	0.99	0.41	0.25	0.44	1.03	0.45	0.03	1.48	3.48	26.00	15.80	0.61	0.13	1.43
EZ203U	40	6000	0.61	1.54	0.40	0.38	0.69	1.64	0.44	0.03	2.70	5.80	13.20	10.30	0.76	0.17	1.67
EZ301U	40	6000	0.89	1.93	0.46	0.56	0.95	2.02	0.49	0.04	2.80	12.7	11.70	39.80	3.40	0.19	1.50
EZ301U	40	3000	0.93	1.99	0.47	0.29	0.95	2.02	0.49	0.04	2.80	12.7	11.70	39.80	3.40	0.19	1.50
EZ302U	42	6000	1.50	3.18	0.47	0.94	1.68	3.48	0.49	0.04	5.00	17.8	4.50	18.70	4.16	0.29	2.10
EZ302U	86	3000	1.59	1.60	0.99	0.50	1.68	1.67	1.03	0.04	5.00	8.55	17.80	75.00	4.21	0.29	2.10
EZ303U	55	6000	1.96	3.17	0.62	1.2	2.25	3.55	0.65	0.04	7.00	16.9	4.90	21.10	4.31	0.40	2.60
EZ303U	109	3000	2.07	1.63	1.27	0.65	2.19	1.71	1.30	0.04	7.00	8.25	20.30	68.70	5.24	0.40	2.60
EZ401U	47	6000	2.30	4.56	0.50	1.4	2.80	5.36	0.53	0.04	8.50	33.0	1.94	11.52	5.94	0.93	4.00
EZ401U	96	3000	2.80	2.74	1.02	0.88	3.00	2.88	1.06	0.04	8.50	16.5	6.70	37.70	5.63	0.93	4.00
EZ402U	60	6000	3.50	5.65	0.62	2.2	4.90	7.43	0.66	0.04	16.0	43.5	1.20	8.88	7.40	1.63	5.10
EZ402U	94	3000	4.70	4.40	1.07	1.5	5.20	4.80	1.09	0.04	16.0	26.5	3.00	21.80	7.26	1.63	5.10
EZ404U	78	6000	5.80	7.18	0.81	3.6	8.40	9.78	0.86	0.04	29.0	51.0	0.89	7.07	7.94	2.98	7.20
EZ404U	116	3000	6.90	5.80	1.19	2.2	8.60	6.60	1.31	0.04	29.0	35.0	1.85	15.00	8.11	2.98	7.20
EZ501U	68	6000	3.40	4.77	0.71	2.1	4.40	5.80	0.77	0.06	16.0	31.0	2.10	12.10	5.76	2.90	5.00
EZ501U	97	3000	4.30	3.74	1.15	1.4	4.70	4.00	1.19	0.06	16.0	22.0	3.80	23.50	6.18	2.90	5.00
EZ502U	72	6000	5.20	7.35	0.71	3.3	7.80	9.80	0.80	0.06	31.0	59.0	0.76	5.60	7.37	5.20	6.50
EZ502U	121	3000	7.40	5.46	1.36	2.3	8.00	5.76	1.40	0.06	31.0	33.0	2.32	16.80	7.24	5.20	6.50
EZ503U	84	6000	6.20	7.64	0.81	3.9	10.6	11.6	0.92	0.06	43.0	63.5	0.62	5.00	8.06	7.58	8.00
EZ503U	119	3000	9.70	6.90	1.41	3.1	11.1	7.67	1.46	0.06	43.0	41.0	1.25	10.00	8.00	7.58	8.00
EZ505U	103	4500	9.50	8.94	1.06	4.5	15.3	13.4	1.15	0.06	67.0	73.0	0.50	4.47	8.94	12.2	10.9
EZ505U	141	3000	13.5	8.80	1.53	4.2	16.0	10.0	1.61	0.06	67.0	52.0	0.93	8.33	8.96	12.2	10.9
EZ701U	76	6000	5.20	6.68	0.78	3.3	7.90	9.38	0.87	0.24	20.0	31.0	0.87	8.13	9.34	8.50	8.30
EZ701U	95	3000	7.40	7.20	1.03	2.3	8.30	8.00	1.07	0.24	20.0	25.0	1.30	12.83	9.87	8.50	8.30
EZ702U	82	6000	7.20	8.96	0.80	4.5	14.3	16.5	0.88	0.24	41.0	60.5	0.34	3.90	11.47	13.7	10.8
EZ702U	133	3000	12.0	8.20	1.46	3.8	14.4	9.60	1.53	0.24	41.0	36.0	1.00	11.73	11.73	13.7	10.8
EZ703U	99	4500	12.1	11.5	1.05	5.7	20.0	17.8	1.14	0.24	65.0	78.0	0.36	4.42	12.28	21.6	12.8
EZ703U	122	3000	16.5	11.4	1.45	5.2	20.8	14.0	1.50	0.24	65.0	62.0	0.52	6.80	13.08	21.6	12.8
EZ705U	106	4500	16.4	14.8	1.11	7.7	30.0	25.2	1.20	0.24	104	114	0.22	2.76	12.55	34.0	18.3
EZ705U	140	3000	21.3	14.2	1.50	6.7	30.2	19.5	1.56	0.24	104	87.0	0.33	4.80	14.55	34.0	18.3
EZ813U	117	4000	25.2	19.8	1.27	11	43.7	32.8	1.34	0.30	140	130	0.13	1.20	9.09	104	35.8
EZ813U	239	2000	39.0	14.9	2.62	8.1	43.7	16.5	2.67	0.30	140	64.9	0.69	5.10	7.41	104	35.8
EZ815U	117	4000	26.1	20.9	1.25	11	67.1	50.3	1.34	0.30	200	169	0.04	0.72	18.00	167	48.4
EZ815U	239	2000	57.8	21.5	2.68	12	68.8	25.2	2.74	0.30	200	92.4	0.40	3.63	9.08	167	48.4

14.2.2 EZ motors with forced ventilation

Type	K_{EM} [V/1000 min^{-1}]	n_N [rpm]	M_N [Nm]	I_N [A]	$K_{M,N}$ [Nm/A]	P_N [kW]	M_0 [Nm]	I_0 [A]	K_{M0} [Nm/A]	M_R [Nm]	M_{max} [Nm]	I_{max} [A]	R_{U-V} [Ω]	L_{U-V} [mH]	T_{el} [ms]	J_{dyn} [kgcm²]	m_{dyn} [kg]
EZ401B	47	6000	2.90	5.62	0.52	1.8	3.50	6.83	0.52	0.04	8.50	33.0	1.94	11.52	5.94	0.93	5.40
EZ401B	96	3000	3.40	3.40	1.00	1.1	3.70	3.60	1.04	0.04	8.50	16.5	6.70	37.70	5.63	0.93	5.40
EZ402B	60	6000	5.10	7.88	0.65	3.2	6.40	9.34	0.69	0.04	16.0	43.5	1.20	8.88	7.40	1.63	6.50
EZ402B	94	3000	5.90	5.50	1.07	1.9	6.30	5.80	1.09	0.04	16.0	26.5	3.00	21.80	7.26	1.63	6.50
EZ404B	78	6000	8.00	9.98	0.80	5.0	10.5	12.0	0.88	0.04	29.0	51.0	0.89	7.07	7.94	2.98	8.60
EZ404B	116	3000	10.2	8.20	1.24	3.2	11.2	8.70	1.29	0.04	29.0	35.0	1.85	15.00	8.11	2.98	8.60
EZ501B	68	6000	4.50	6.70	0.67	2.8	5.70	7.50	0.77	0.06	16.0	31.0	2.10	12.10	5.76	2.90	7.00
EZ501B	97	3000	5.40	4.70	1.15	1.7	5.80	5.00	1.17	0.06	16.0	22.0	3.80	23.50	6.18	2.90	7.00
EZ502B	72	6000	8.20	11.4	0.72	5.2	10.5	13.4	0.79	0.06	31.0	59.0	0.76	5.60	7.37	5.20	8.50
EZ502B	121	3000	10.3	7.80	1.32	3.2	11.2	8.16	1.38	0.06	31.0	33.0	2.32	16.80	7.24	5.20	8.50
EZ503B	84	6000	10.4	13.5	0.77	6.5	14.8	15.9	1.07	0.06	43.0	63.5	0.62	5.00	8.06	7.58	10.0
EZ503B	119	3000	14.4	10.9	1.32	4.5	15.9	11.8	1.35	0.06	43.0	41.0	1.25	10.00	8.00	7.58	10.0
EZ505B	103	4500	16.4	16.4	1.00	7.7	22.0	19.4	1.14	0.06	67.0	73.0	0.50	4.47	8.94	12.2	12.9
EZ505B	141	3000	20.2	13.7	1.47	6.4	23.4	14.7	1.60	0.06	67.0	52.0	0.93	8.33	8.96	12.2	12.9
EZ701B	76	6000	7.50	10.6	0.71	4.7	10.2	12.4	0.84	0.24	20.0	31.0	0.87	8.13	9.34	8.50	11.2
EZ701B	95	3000	9.70	9.50	1.02	3.1	10.5	10.0	1.07	0.24	20.0	25.0	1.30	12.83	9.87	8.50	11.2
EZ702B	82	6000	12.5	16.7	0.75	7.9	19.3	22.1	0.89	0.24	41.0	60.5	0.34	3.90	11.47	13.7	13.7
EZ702B	133	3000	16.6	11.8	1.41	5.2	19.3	12.9	1.51	0.24	41.0	36.0	1.00	11.73	11.73	13.7	13.7
EZ703B	99	4500	19.8	20.3	0.98	9.3	27.2	24.2	1.13	0.24	65.0	78.0	0.36	4.42	12.28	21.6	15.7
EZ703B	122	3000	24.0	18.2	1.32	7.5	28.0	20.0	1.41	0.24	65.0	62.0	0.52	6.80	13.08	21.6	15.7
EZ705B	106	4500	27.7	25.4	1.09	13	39.4	32.8	1.21	0.24	104	114	0.22	2.76	12.55	34.0	21.2
EZ705B	140	3000	33.8	22.9	1.48	11	41.8	26.5	1.59	0.24	104	87.0	0.33	4.80	14.55	34.0	21.2
EZ813B	117	4000	49.5	38.1	1.30	21	62.9	46.6	1.36	0.30	140	130	0.13	1.20	9.09	104	41.8
EZ813B	239	2000	57.3	21.9	2.62	12	61.6	22.9	2.71	0.30	140	64.9	0.69	5.10	7.41	104	41.8
EZ815B	117	4000	73.6	56.2	1.31	31	90.8	65.0	1.40	0.30	200	169	0.04	0.72	18.00	167	54.4
EZ815B	239	2000	91.0	33.7	2.70	19	100	36.3	2.76	0.30	200	92.4	0.40	3.63	9.08	167	54.4

14.3 Torque/speed curves

Torque/speed curves depend on the nominal speed and/or winding design of the motor and the DC link voltage of the drive controller that is used. The following torque/speed curves apply to the DC link voltage DC 540 V.

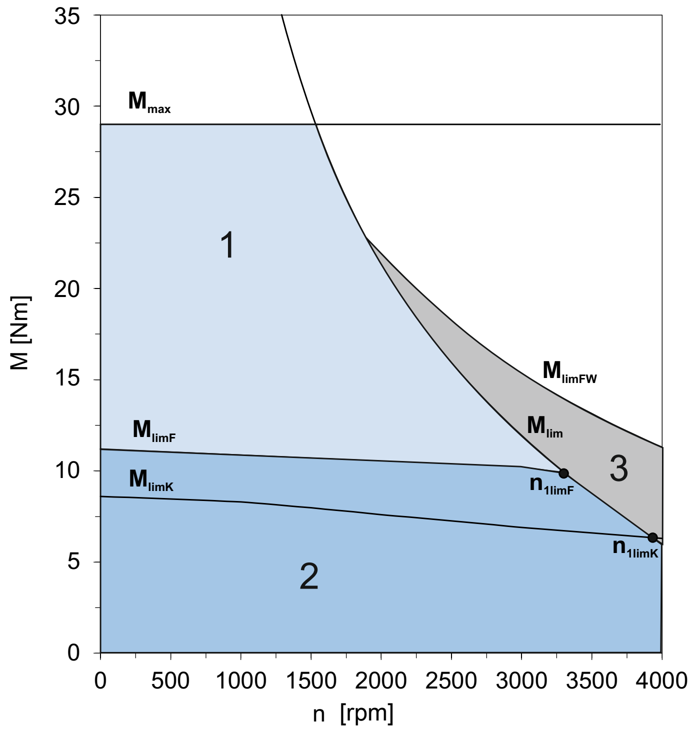
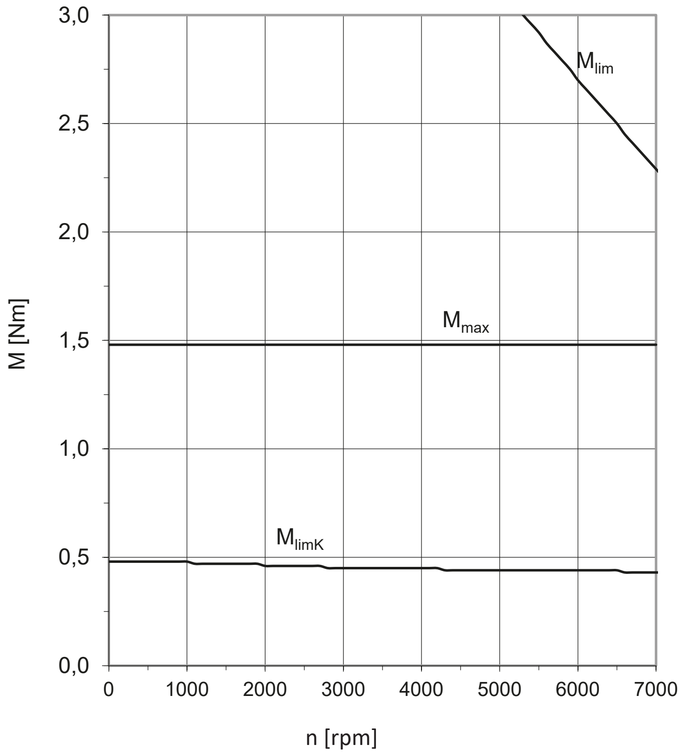


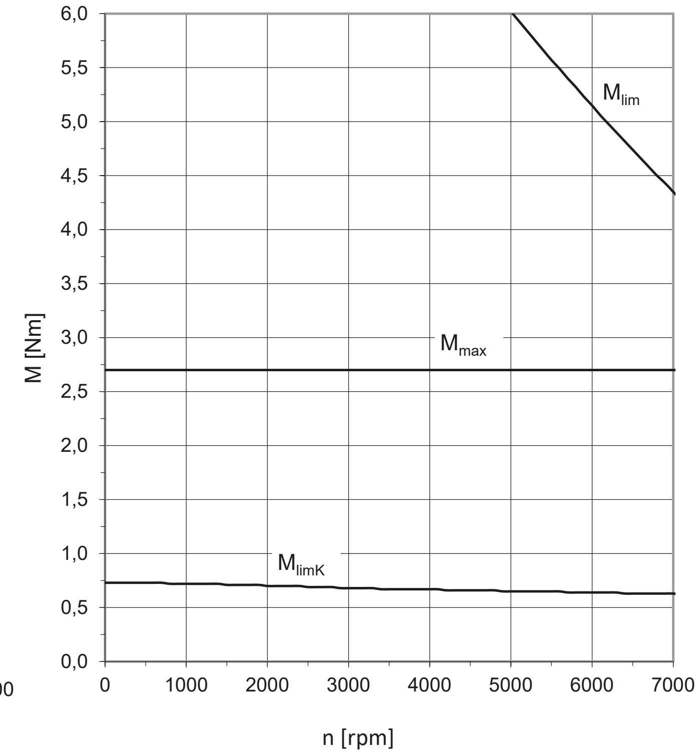
Fig. 1: Explanation of a torque/speed curve

1	Torque range for brief operation (ED_{10} < 100%) with Δϑ = 100 K
2	Torque range for continuous operation with constant load (S1 mode, ED_{10} = 100%) with Δϑ = 100 K
3	Field weakening range (can be used only with operation on STOBER drive controllers)

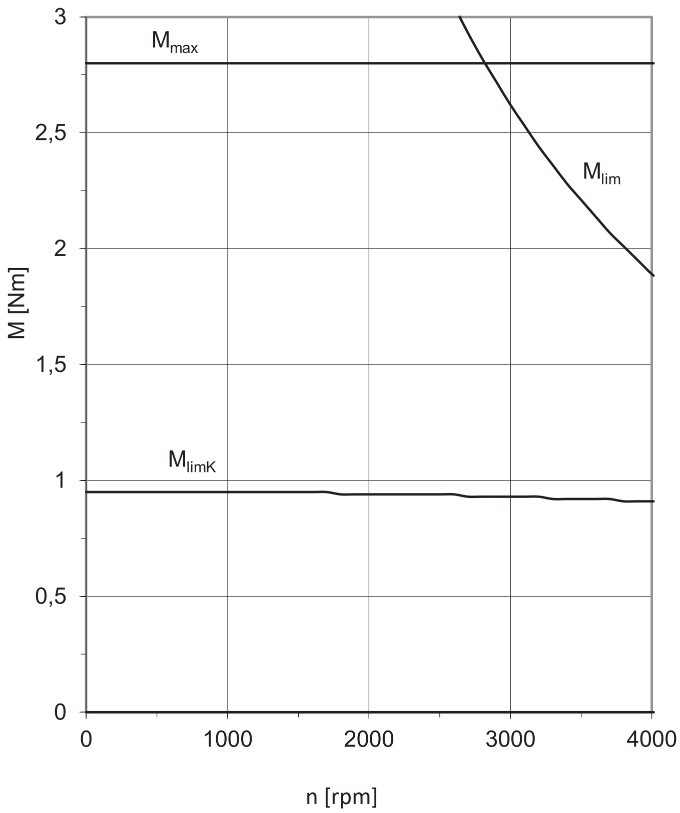
EZ202 (n_N=6000 rpm)



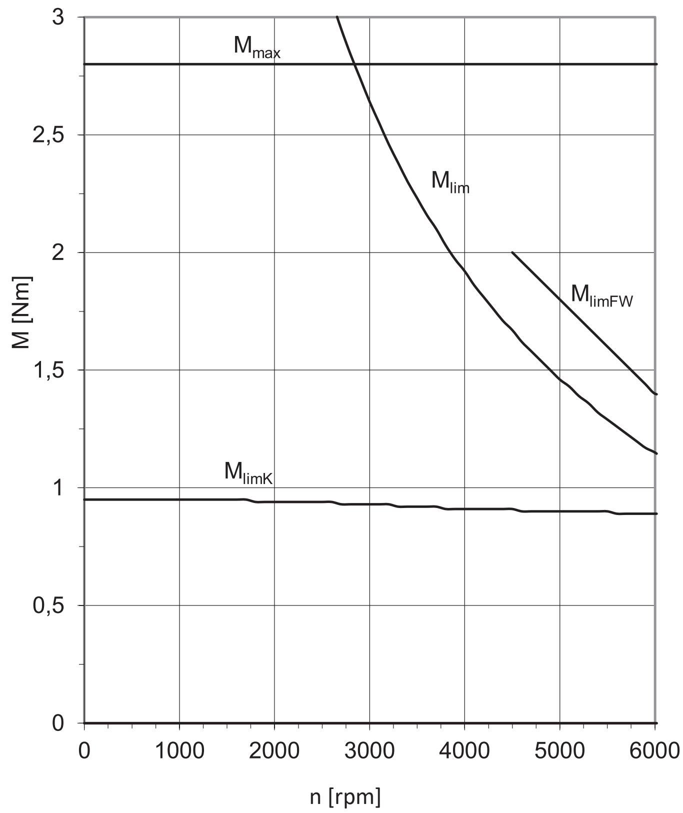
EZ203 (n_N=6000 rpm)



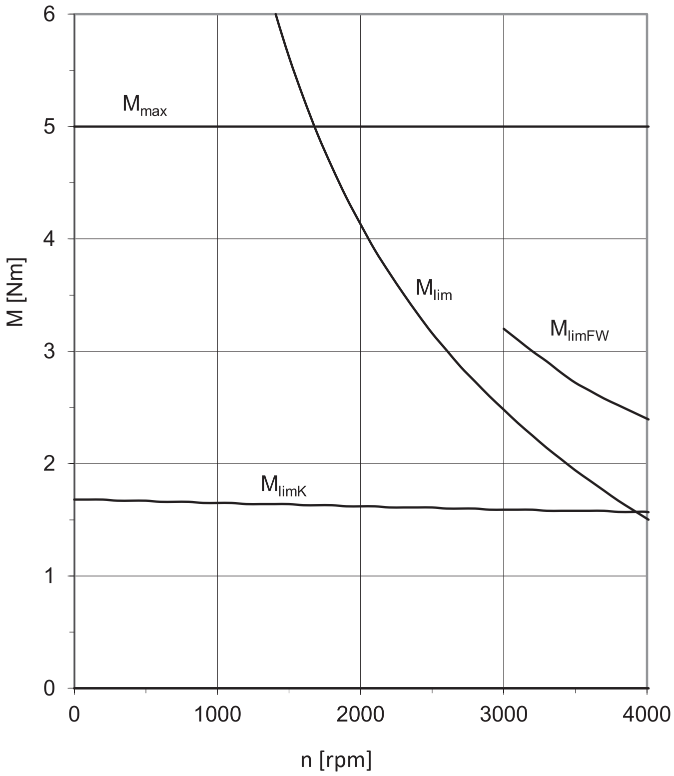
EZ301 (n_N=3000 rpm)



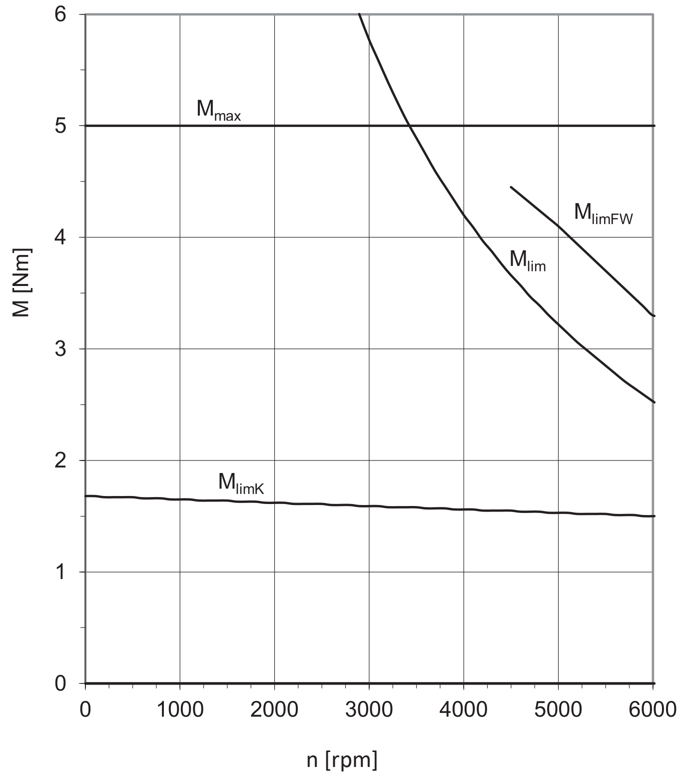
EZ301 (n_N=6000 rpm)



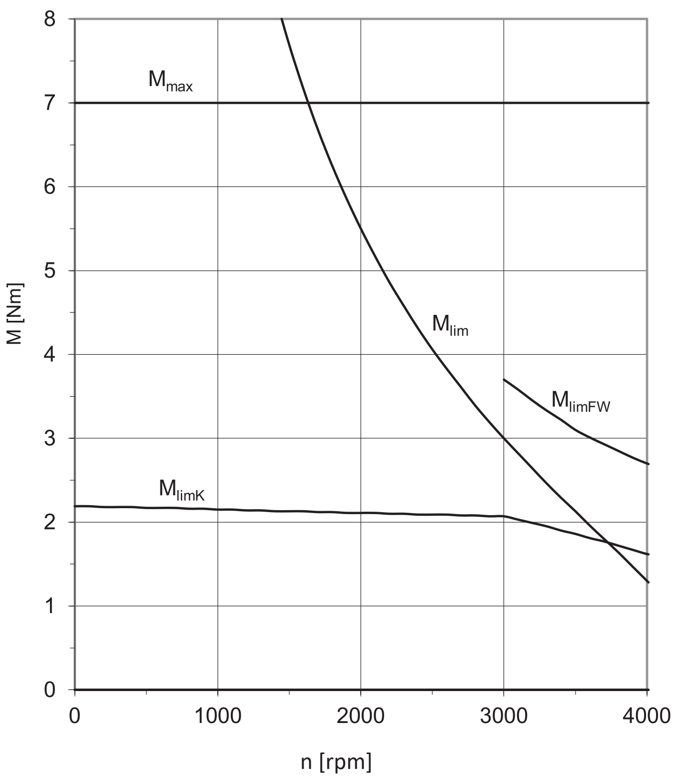
EZ302 (n_N=3000 rpm)



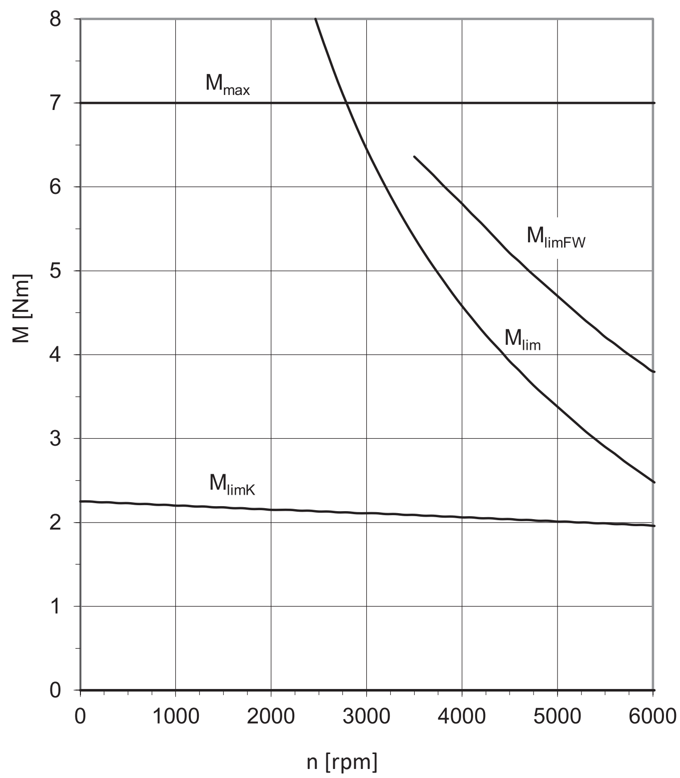
EZ302 (n_N=6000 rpm)



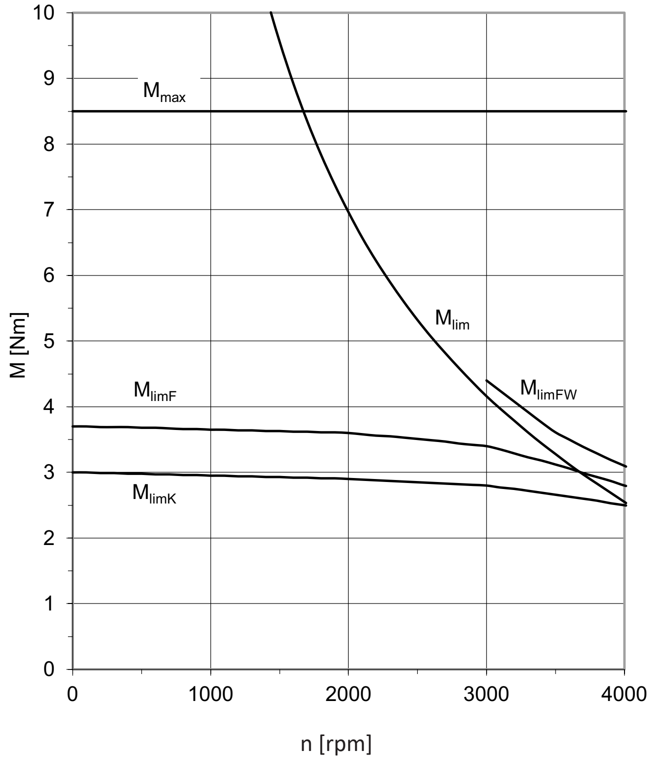
EZ303 (n_N=3000 rpm)



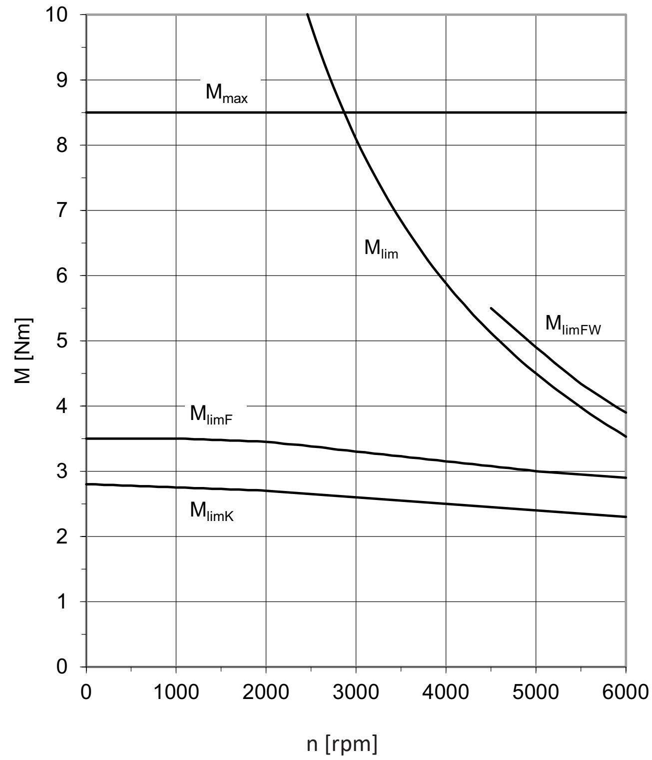
EZ303 (n_N=6000 rpm)



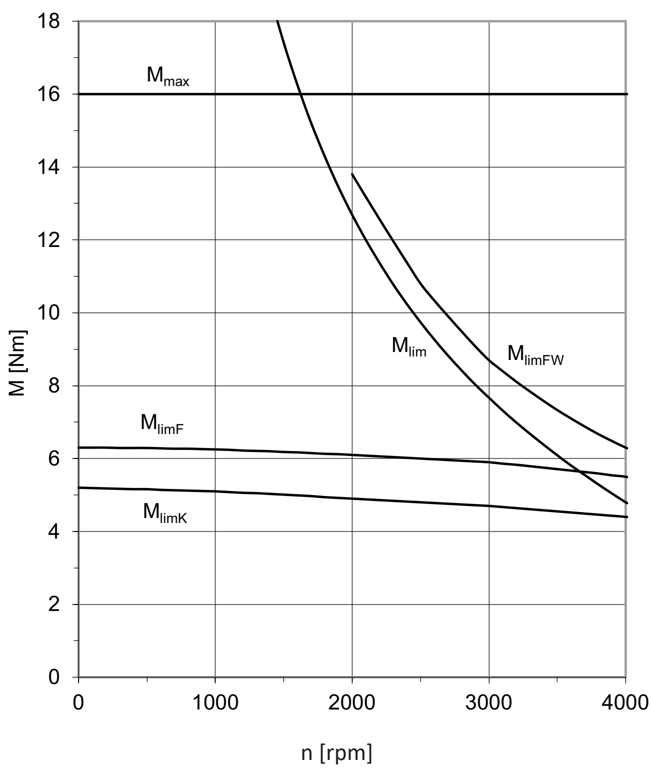
EZ401 (n_N=3000 rpm)



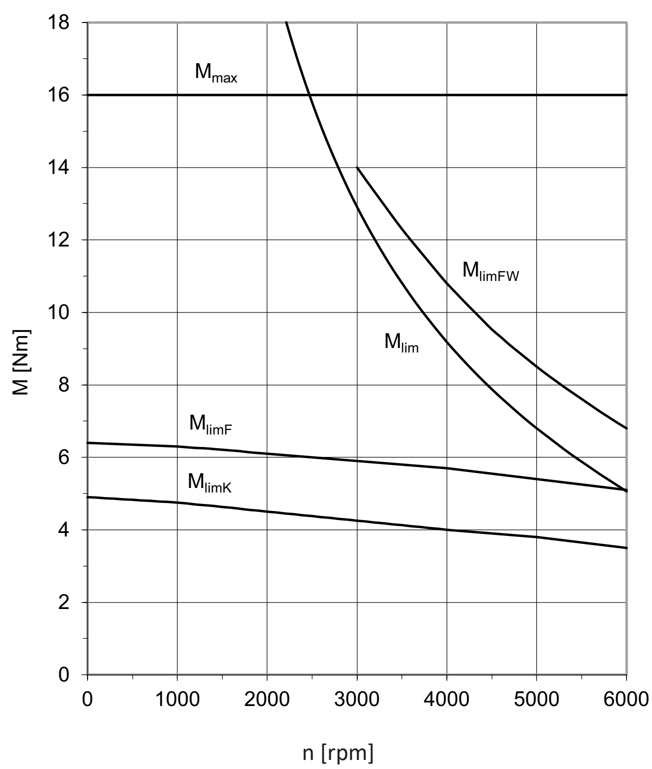
EZ401 (n_N=6000 rpm)

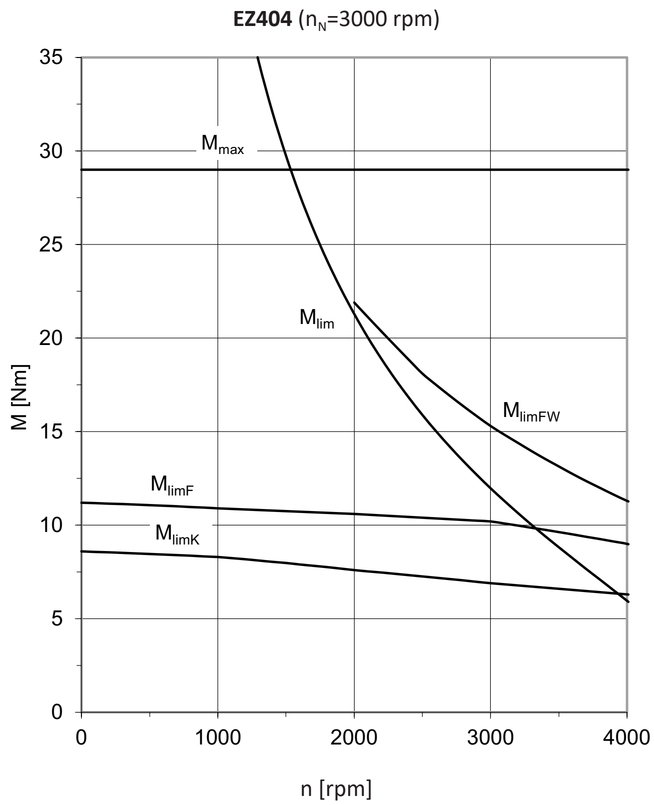


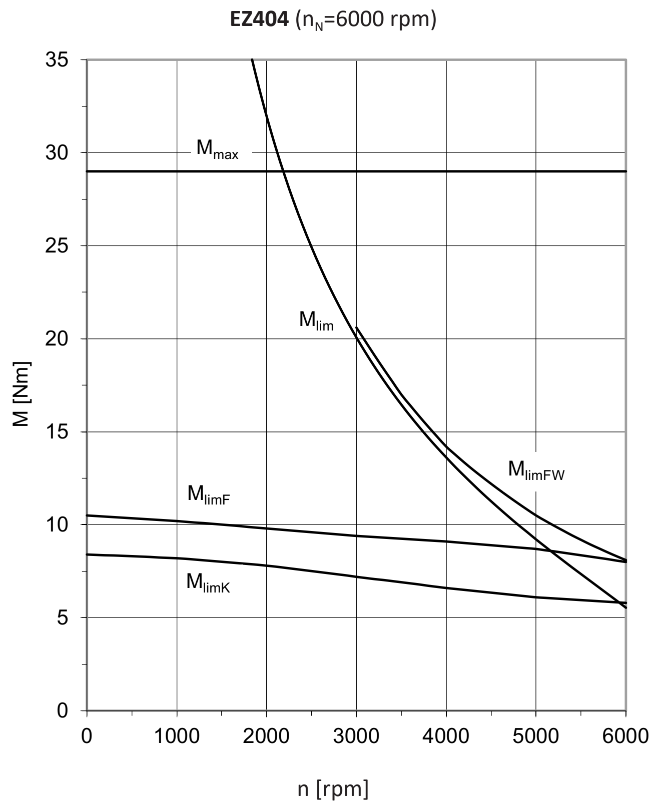
EZ402 (n_N=3000 rpm)

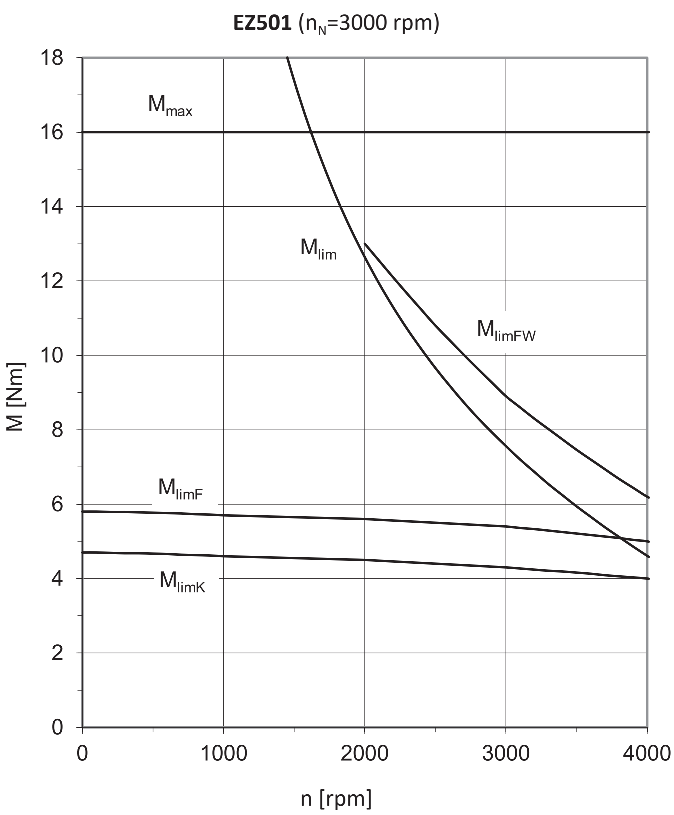


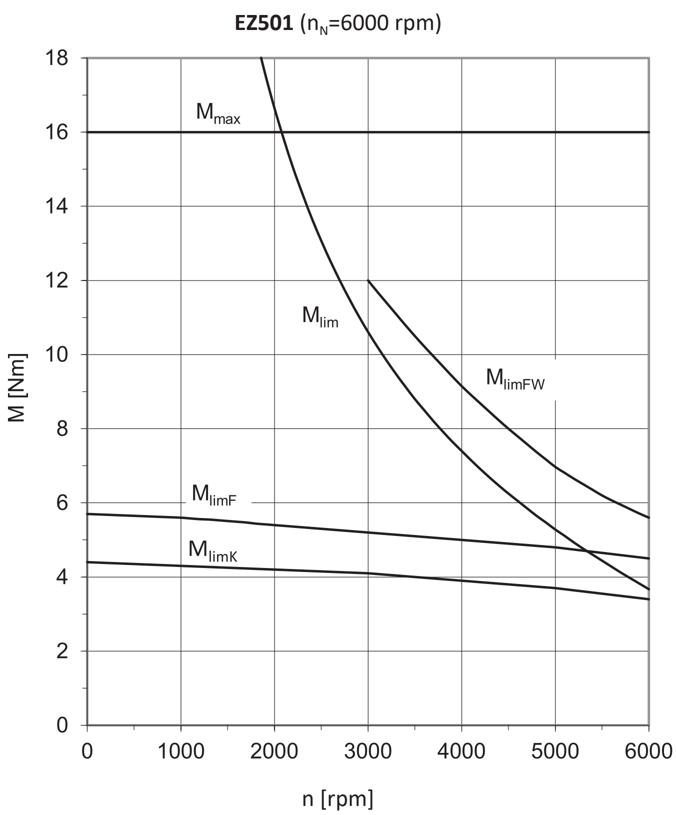
EZ402 (n_N=6000 rpm)

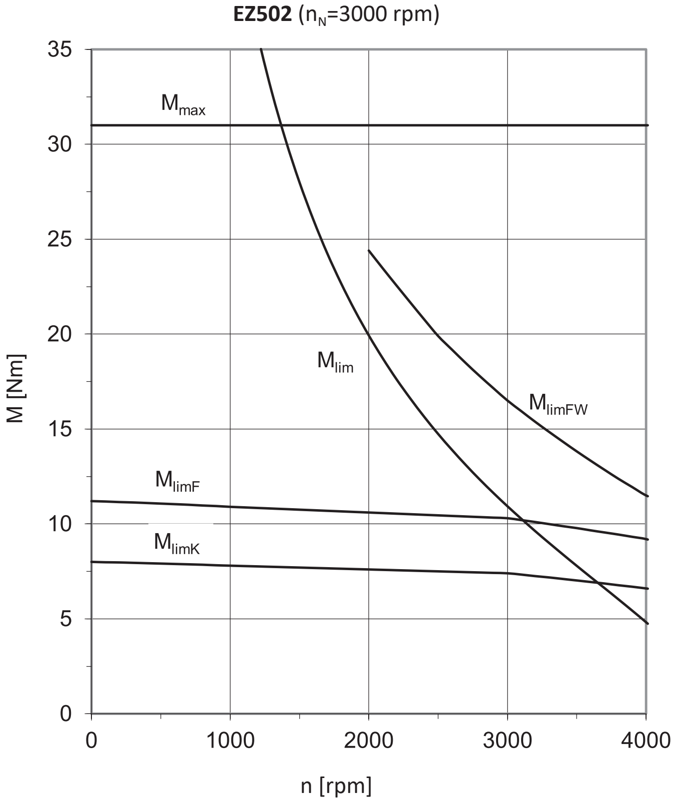


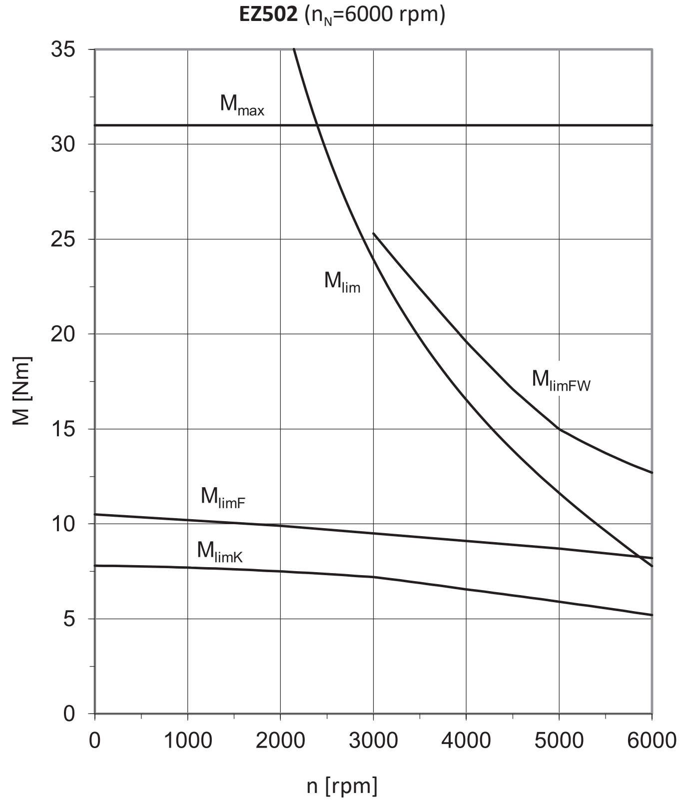

EZ404 (n_N=3000 rpm)
M [Nm]
n [rpm]
M_{max}
M_{lim}
M_{limFW}
M_{limF}
M_{limK}

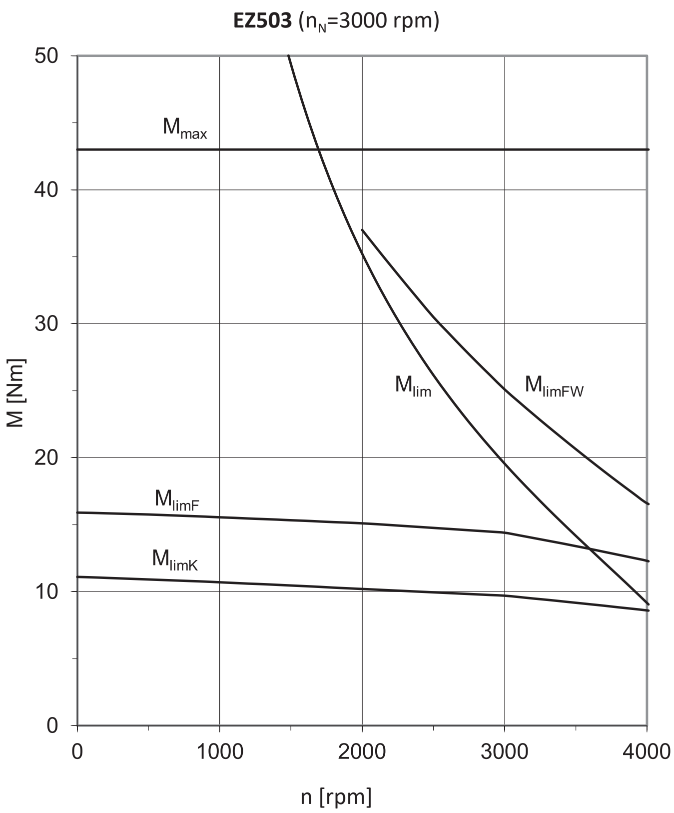

EZ404 (n_N=6000 rpm)
M [Nm]
n [rpm]
M_{max}
M_{lim}
M_{limFW}
M_{limF}
M_{limK}

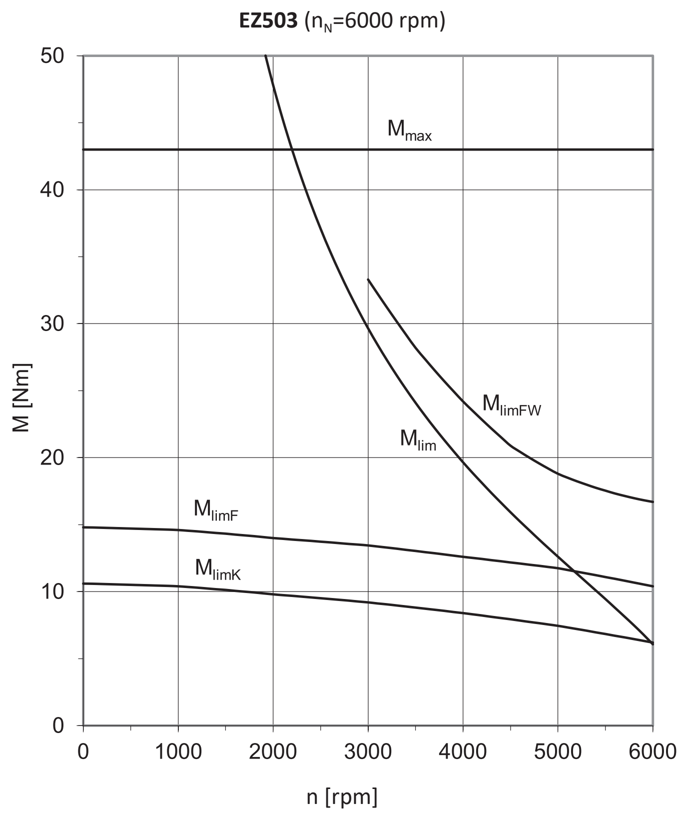

EZ501 (n_N=3000 rpm)
M [Nm]
n [rpm]
M_{max}
M_{lim}
M_{limFW}
M_{limF}
M_{limK}


EZ501 (n_N=6000 rpm)
M [Nm]
n [rpm]
M_{max}
M_{lim}
M_{limFW}
M_{limF}
M_{limK}

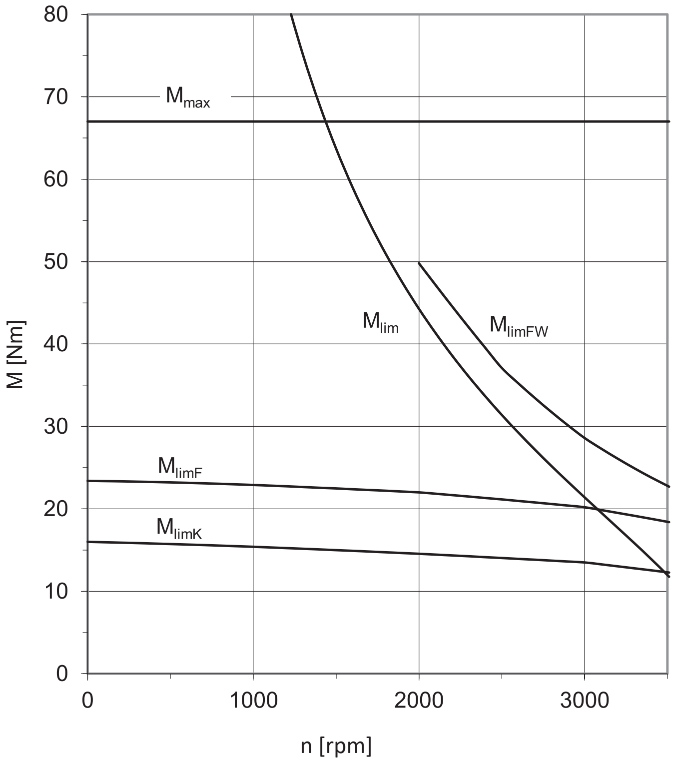

EZ502 (nN=3000 rpm)
Mmax
Mlim
MlimFW
MlimF
MlimK
M [Nm]
n [rpm]
0
5
10
15
20
25
30
35
1000
2000
3000
4000


EZ502 (nN=6000 rpm)
Mmax
Mlim
MlimFW
MlimF
MlimK
M [Nm]
n [rpm]
0
5
10
15
20
25
30
35
1000
2000
3000
4000
5000
6000

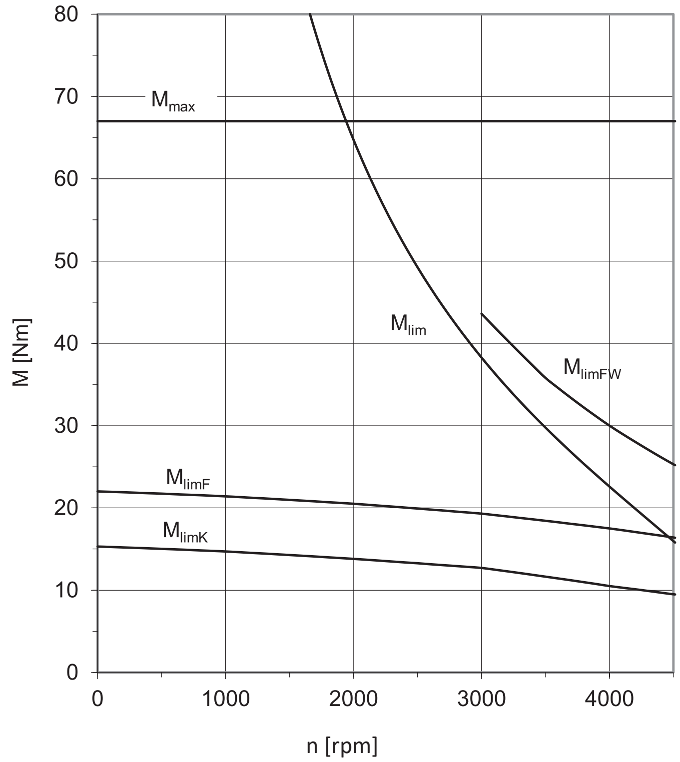

EZ503 (nN=3000 rpm)
Mmax
Mlim
MlimFW
MlimF
MlimK
M [Nm]
n [rpm]
0
10
20
30
40
50
1000
2000
3000
4000


EZ503 (nN=6000 rpm)
Mmax
MlimFW
Mlim
MlimF
MlimK
M [Nm]
n [rpm]
0
10
20
30
40
50
1000
2000
3000
4000
5000
6000

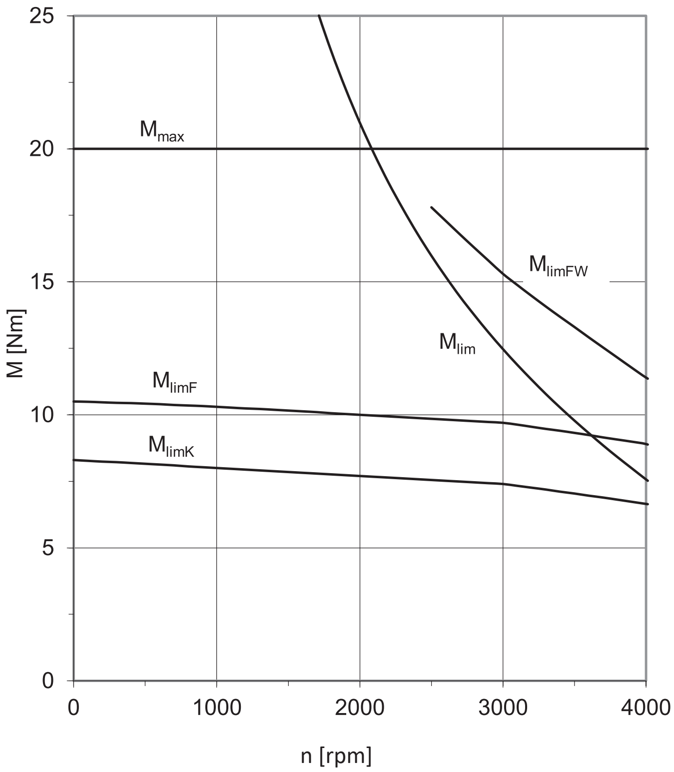
EZ505 (n_N=3000 rpm)



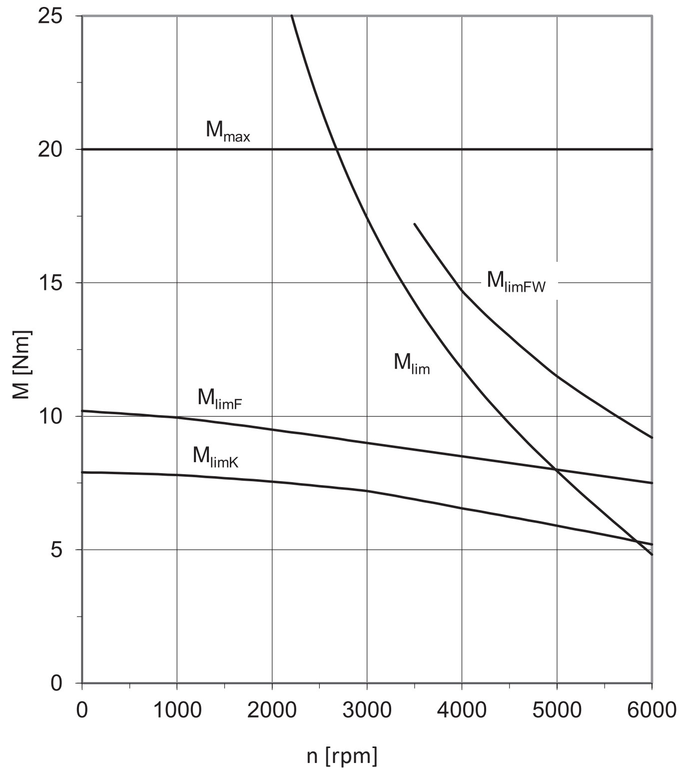
EZ505 (n_N=4500 rpm)



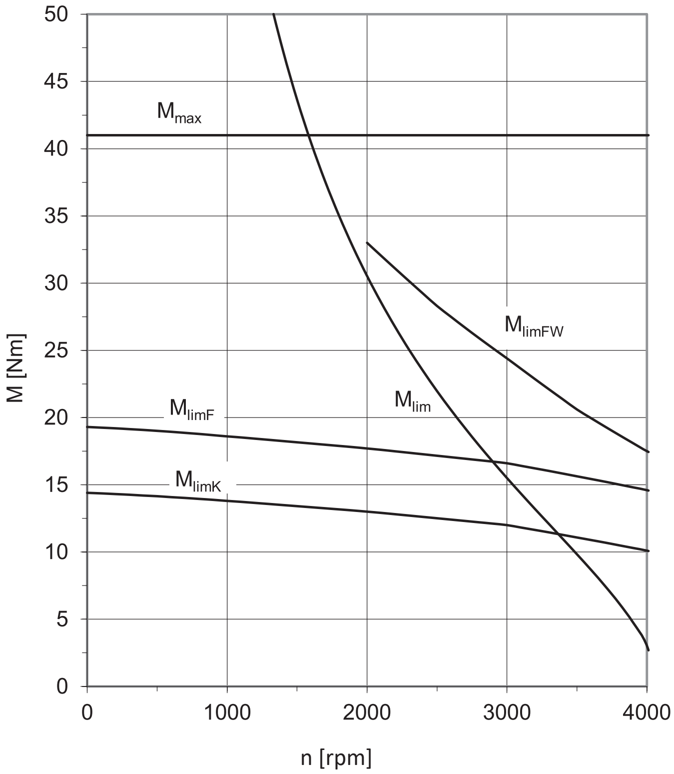
EZ701 (n_N=3000 rpm)



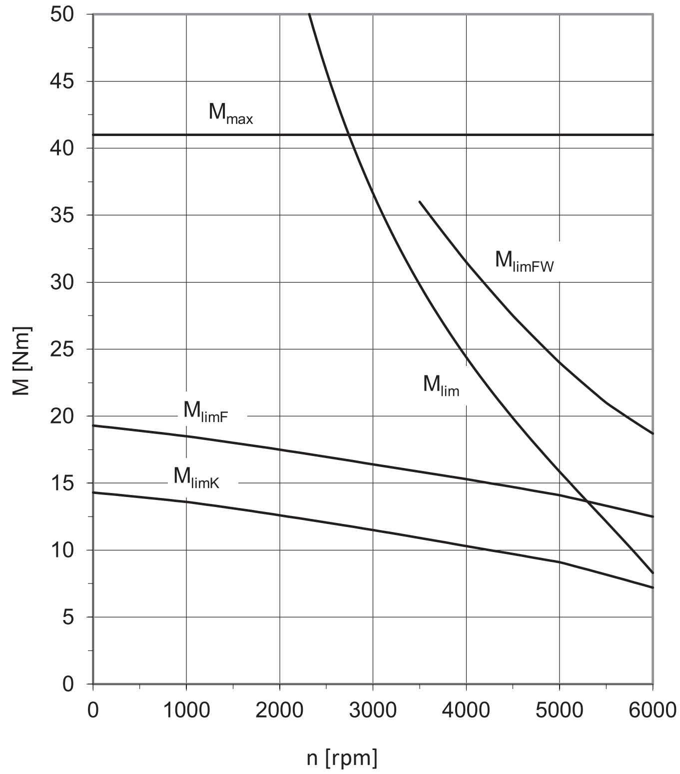
EZ701 (n_N=6000 rpm)



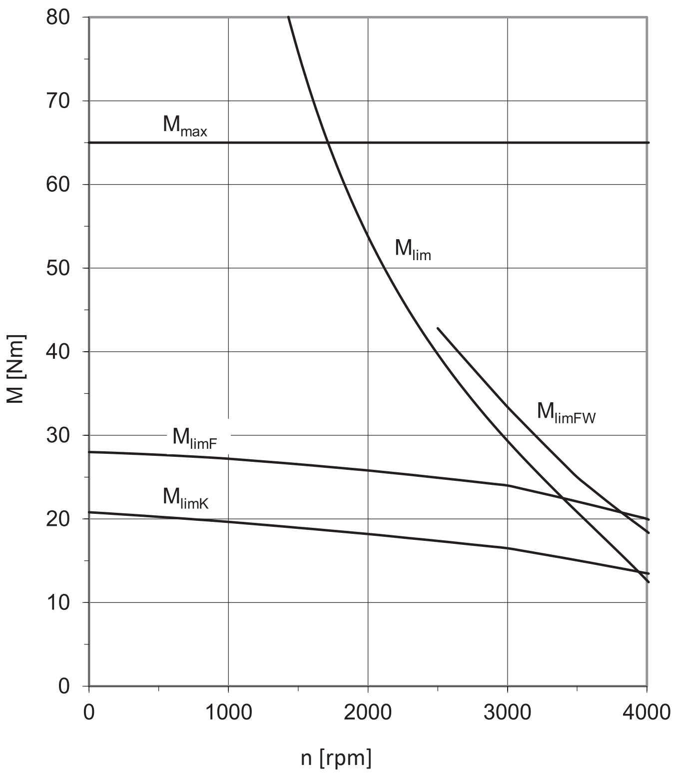
EZ702 (n_N=3000 rpm)



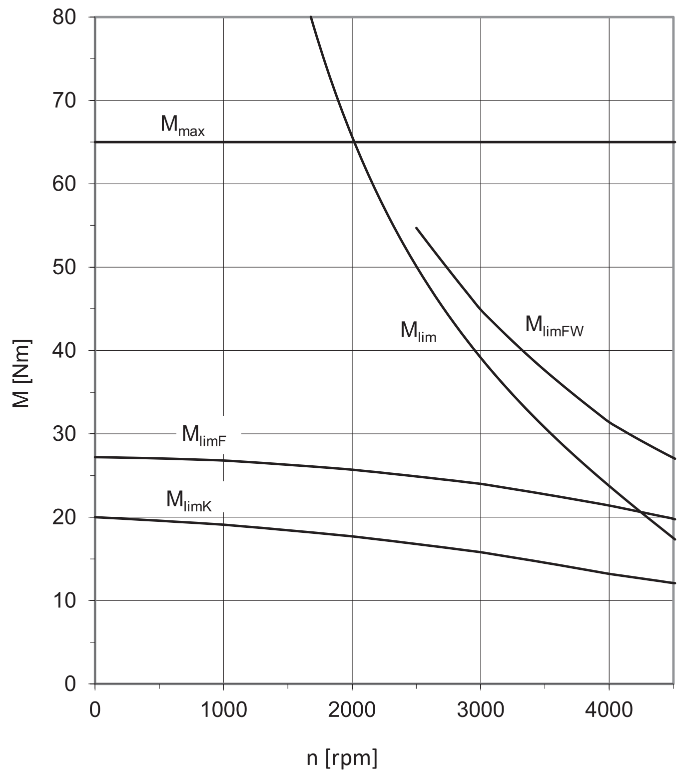
EZ702 (n_N=6000 rpm)



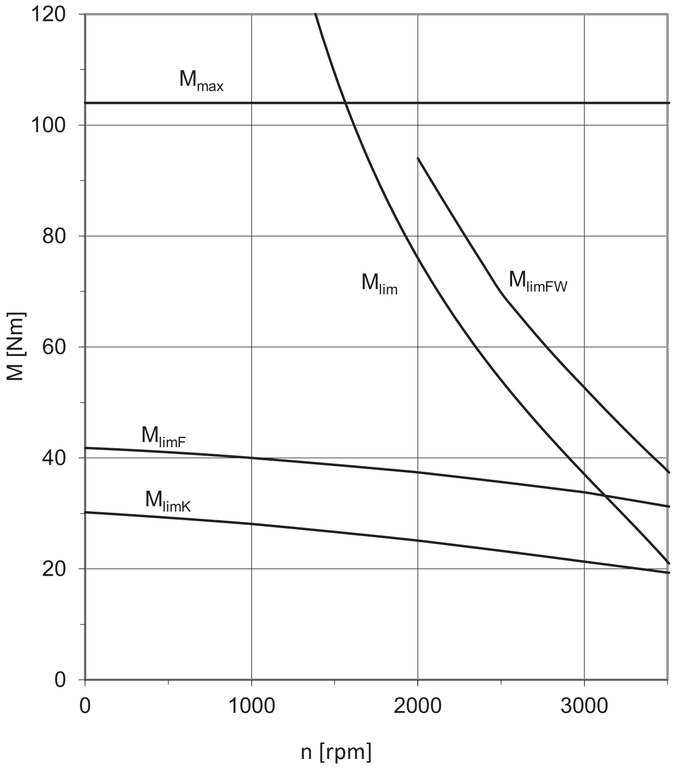
EZ703 (n_N=3000 rpm)



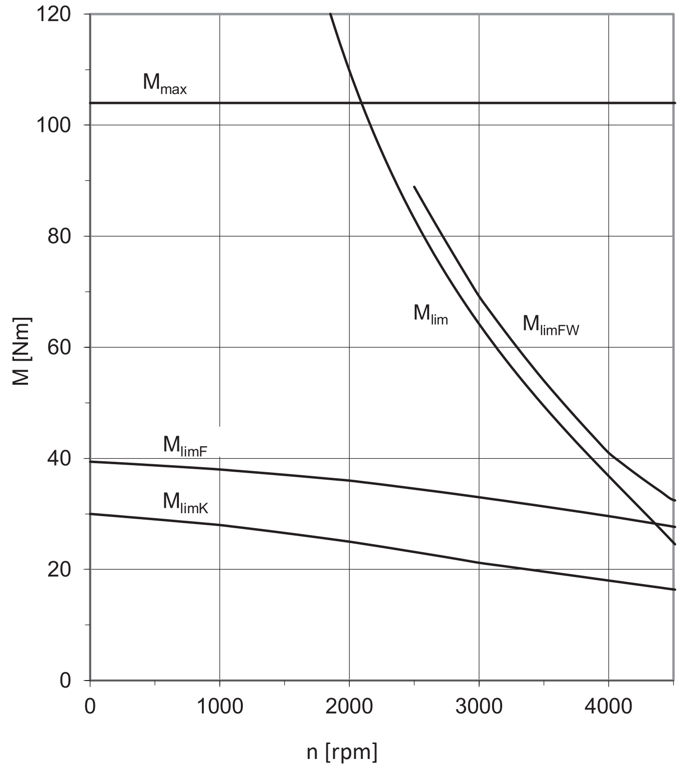
EZ703 (n_N=4500 rpm)



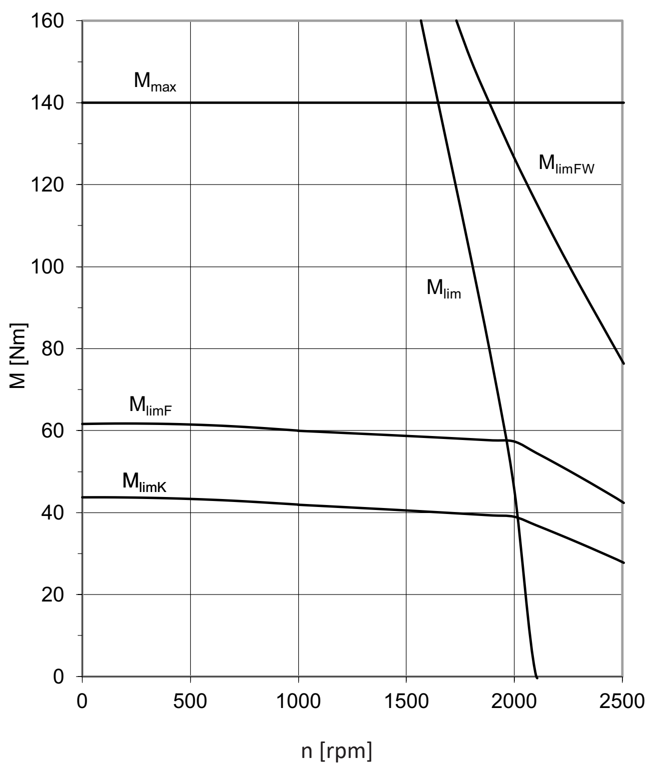
EZ705 (n_N=3000 rpm)



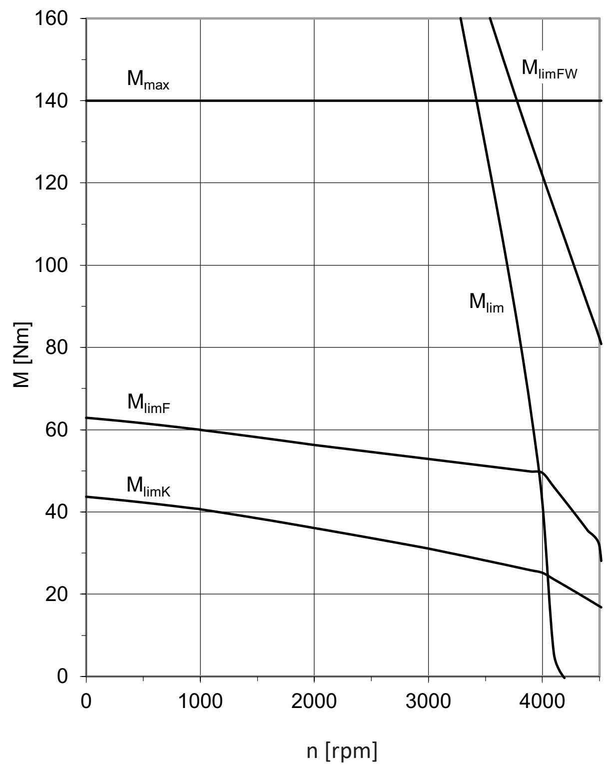
EZ705 (n_N=4500 rpm)



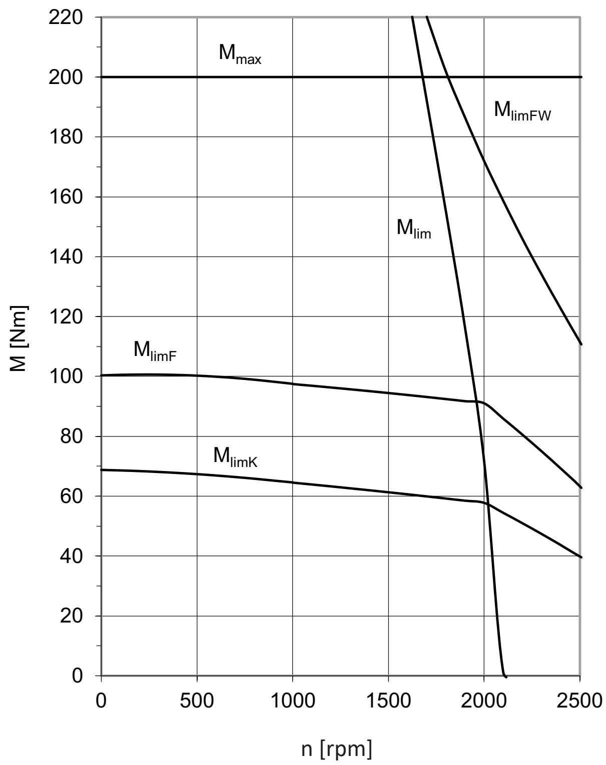
EZ813 (n_N=2000 rpm)



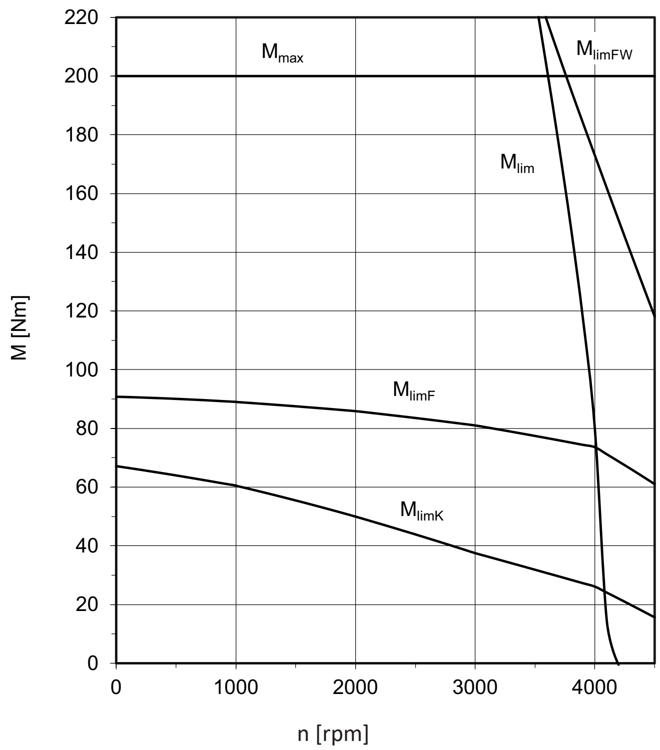
EZ813 (n_N=4000 rpm)



EZ815 (n_N=2000 rpm)



EZ815 (n_N=4000 rpm)



14.4 Dimensional drawings

In this chapter, you can find the dimensions of the motors.

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 https://configurator.stoeber.de/en-US/.

In this chapter, the dimensions p1 and w1 for standard motor designs are presented. In designs for connection to drive controllers of third-party manufacturers, dimensions p1 and w1 may differ. You can find more details at https://configurator.stoeber.de/en-US/.

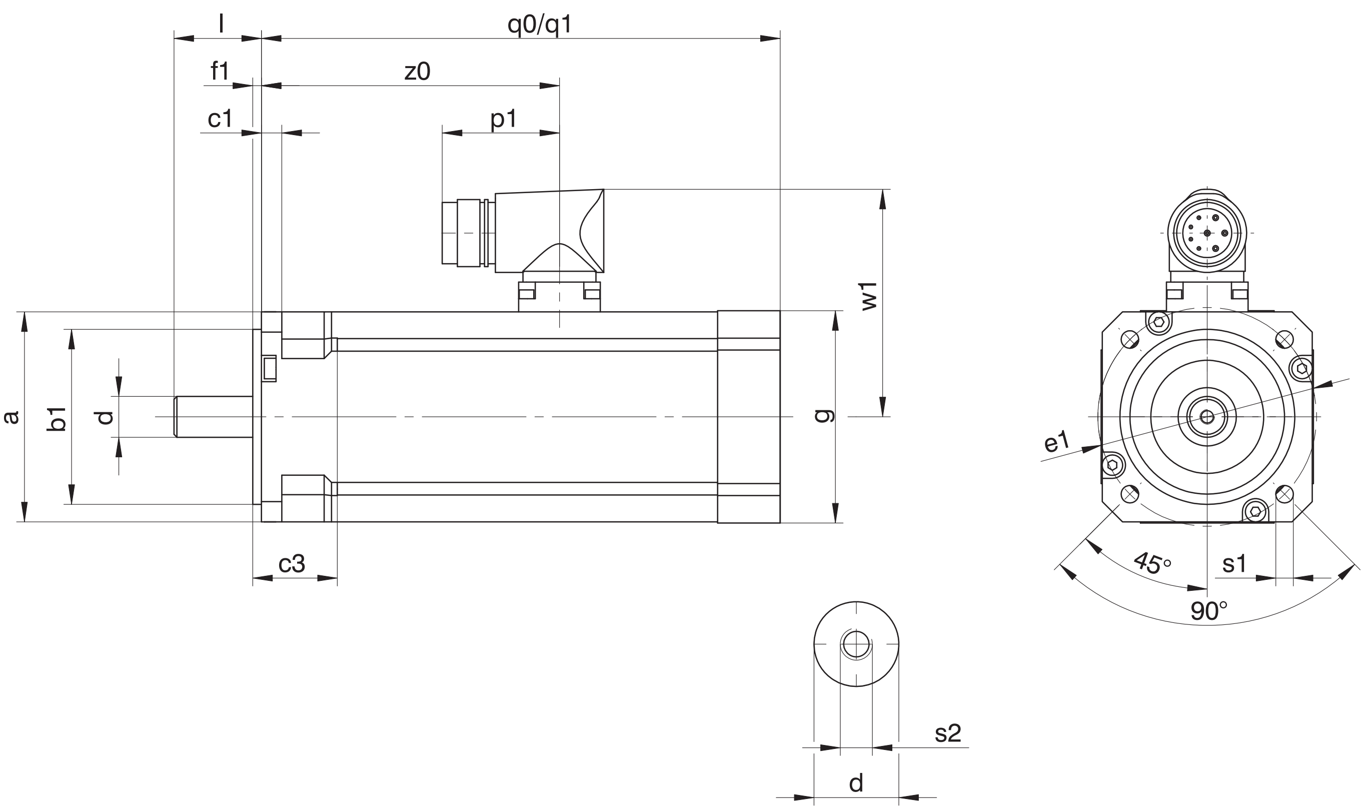
Tolerances

Solid shaft	Tolerance
Shaft ∅ fit ≤ 50 mm	DIN 748-1, ISO k6
Shaft ∅ fit > 50 mm	DIN 748-1, ISO m6

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

14.4.1 EZ2 – EZ3 motors with convection cooling (One Cable Solution)

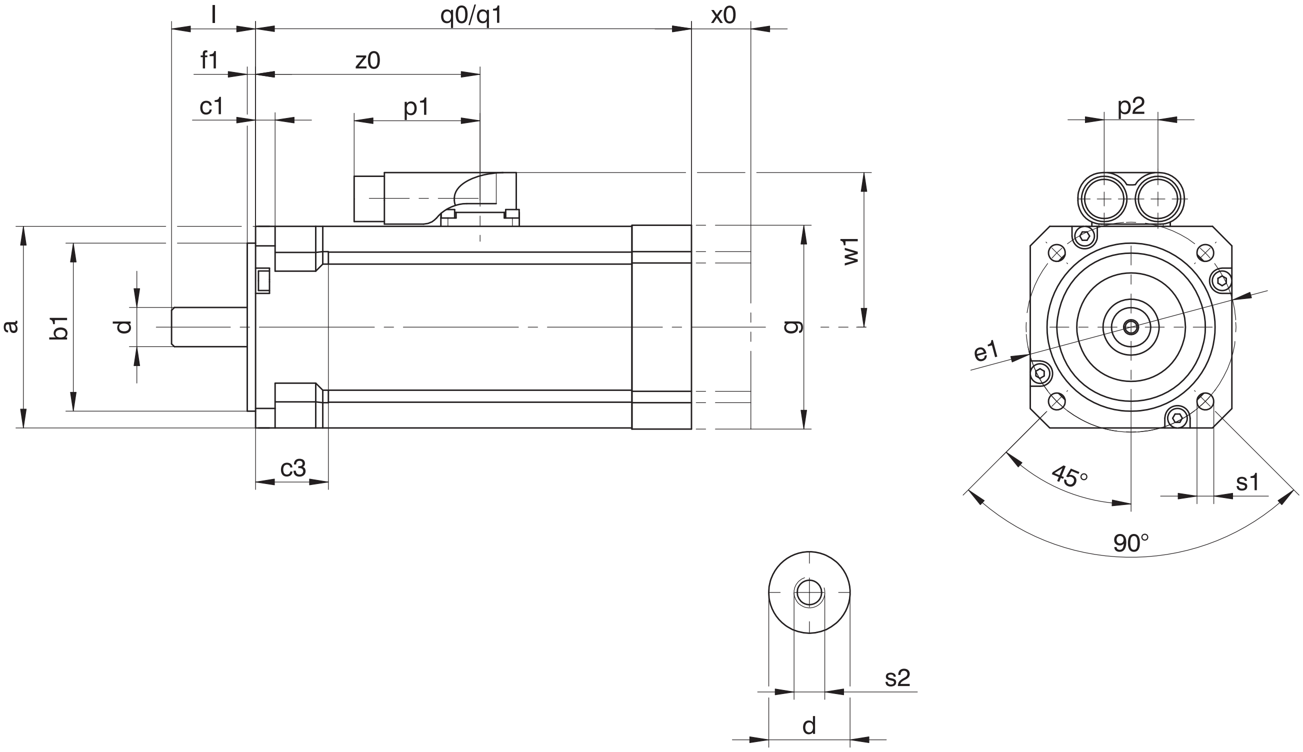


q0 Applies to motors without holding brake

q1 Applies to motors with holding brake

Type	□a	Øb1	c1	c3	Ød	Øe1	f1	□g	l	p1	q0	q1	Øs1	s2	w1	z0
EZ202U	55	40_{j6}	7	7	9_{k6}	63	3.5	55	20	40	148	182	5.8	M4	69.5	93.0
EZ203U	55	40_{j6}	7	7	9_{k6}	63	3.5	55	20	40	166	200	5.8	M4	69.5	111.0
EZ301U	72	60_{j6}	7	26	14_{k6}	75	3.0	72	30	40	116	156	6.0	M5	78.0	80.5
EZ302U	72	60_{j6}	7	26	14_{k6}	75	3.0	72	30	40	138	178	6.0	M5	78.0	102.5
EZ303U	72	60_{j6}	7	26	14_{k6}	75	3.0	72	30	40	160	200	6.0	M5	78.0	124.5

14.4.2 EZ2 – EZ3 motors with convection cooling



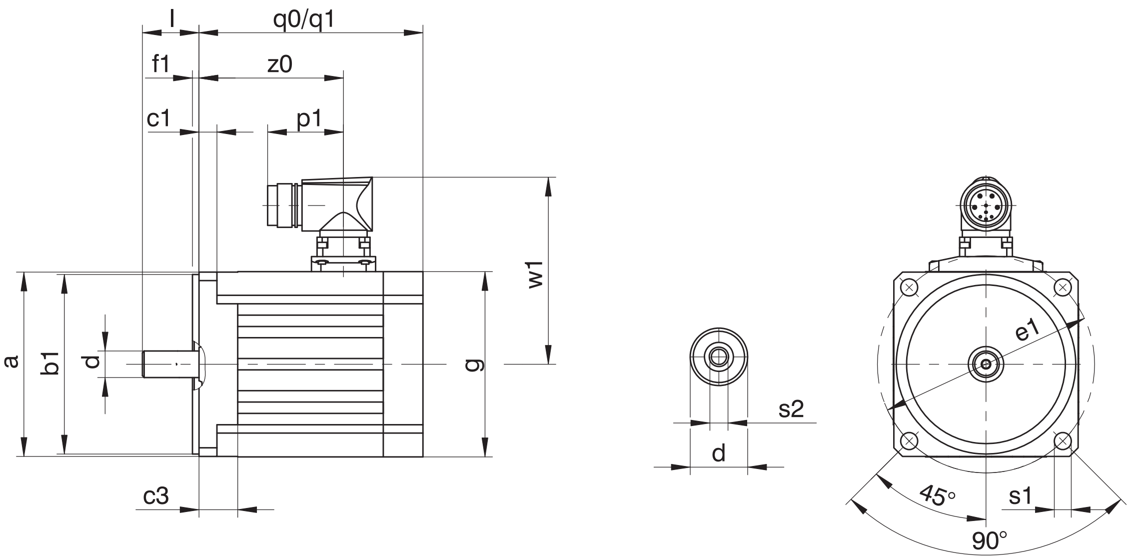
q0 Applies to motors without holding brake

q1 Applies to motors with holding brake

x0 EZ2: Applies only to motors with holding brake and encoders using an optical or inductive measuring method
EZ3: Applies to encoders using an optical measuring method

Type	□a	∅b1	c1	c3	∅d	∅e1	f1	□g	l	p1	p2	q0	q1	∅s1	s2	w1	x0	z0
EZ202U	55	40_{j6}	7	7	9_{k6}	63	3.5	55	20	45	19	148	157	5.8	M4	47.0	25	93.0
EZ203U	55	40_{j6}	7	7	9_{k6}	63	3.5	55	20	45	19	166	175	5.8	M4	47.0	25	111.0
EZ301U	72	60_{j6}	7	26	14_{k6}	75	3.0	72	30	45	19	116	156	6.0	M5	55.5	21	80.5
EZ302U	72	60_{j6}	7	26	14_{k6}	75	3.0	72	30	45	19	138	178	6.0	M5	55.5	21	102.5
EZ303U	72	60_{j6}	7	26	14_{k6}	75	3.0	72	30	45	19	160	200	6.0	M5	55.5	21	124.5

14.4.3 EZ4 – EZ7 motors with convection cooling (One Cable Solution)

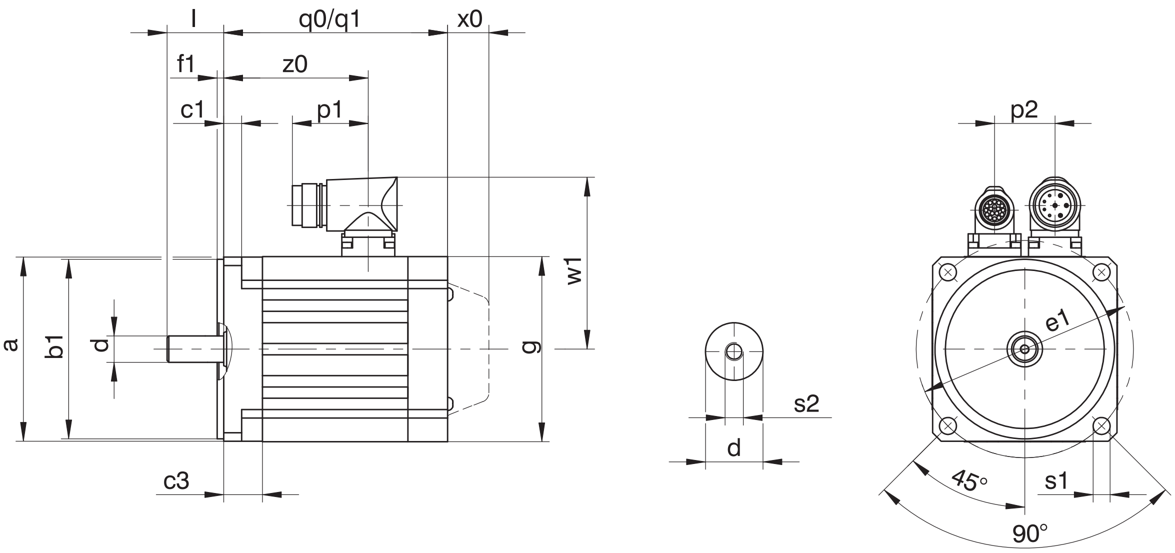


q0 Applies to motors without holding brake

q1 Applies to motors with holding brake

Type	□a	∅b1	c1	c3	∅d	∅e1	f1	□g	l	p1	q0	q1	∅s1	s2	w1	z0
EZ401U	98	95_{j6}	9.5	20.5	14_{k6}	115	3.5	98	30	40	118.5	167.0	9	M5	99	76.5
EZ402U	98	95_{j6}	9.5	20.5	19_{k6}	115	3.5	98	40	40	143.5	192.0	9	M6	99	101.5
EZ404U	98	95_{j6}	9.5	20.5	19_{k6}	115	3.5	98	40	40	193.5	242.0	9	M6	99	151.5
EZ501U	115	110_{j6}	10.0	16.0	19_{k6}	130	3.5	115	40	40	109.0	163.5	9	M6	110	74.5
EZ502U	115	110_{j6}	10.0	16.0	19_{k6}	130	3.5	115	40	40	134.0	188.5	9	M6	110	99.5
EZ503U	115	110_{j6}	10.0	16.0	24_{k6}	130	3.5	115	50	40	159.0	213.5	9	M8	110	124.5
EZ505U	115	110_{j6}	10.0	16.0	24_{k6}	130	3.5	115	50	40	209.0	263.5	9	M8	110	174.5
EZ701U	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	145	50	40	121.0	180.0	11	M8	125	83.0
EZ702U	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	145	50	40	146.0	205.0	11	M8	125	108.0
EZ703U	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	145	50	40	171.0	230.0	11	M8	125	133.0
EZ705U	145	130_{j6}	10.0	19.0	32_{k6}	165	3.5	145	58	40	226.0	285.0	11	M12	125	184.0

14.4.4 EZ4 – EZ8 motors with convection cooling



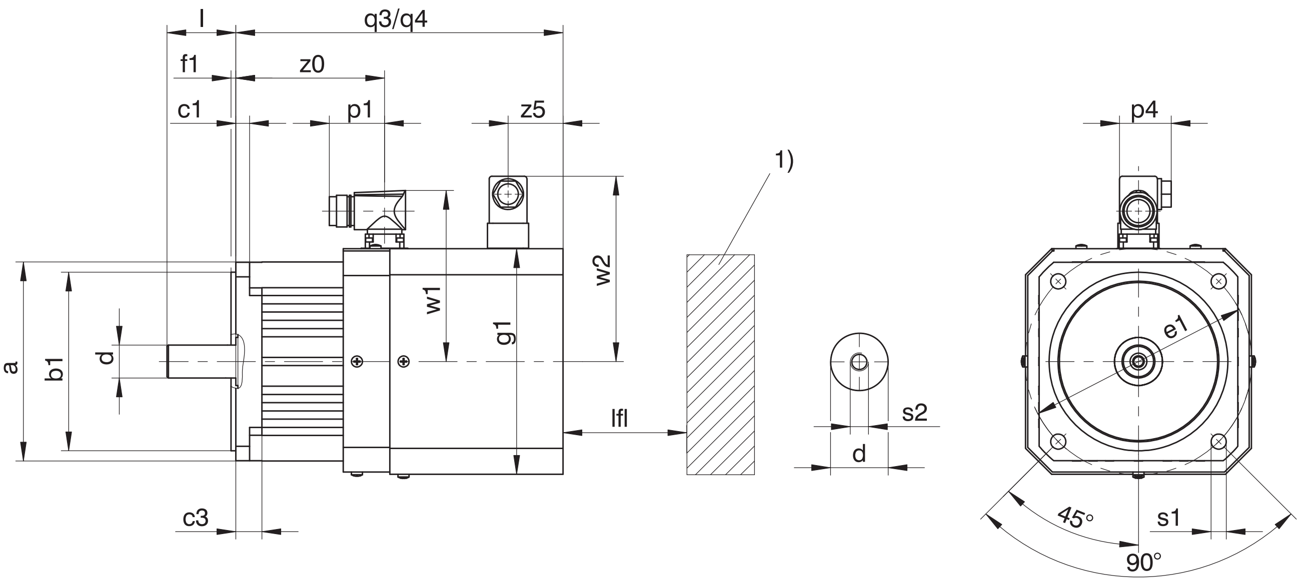
q0 Applies to motors without holding brake

q1 Applies to motors with holding brake

x0 Applies to encoders based on an optical measuring method

Type	□a	∅b1	c1	c3	∅d	∅e1	f1	□g	l	p1	p2	q0	q1	∅s1	s2	w1	x0	z0
EZ401U	98	95_{j6}	9.5	20.5	14_{k6}	115	3.5	98	30	40	32	118.5	167.0	9.0	M5	91.0	22	76.5
EZ402U	98	95_{j6}	9.5	20.5	19_{k6}	115	3.5	98	40	40	32	143.5	192.0	9.0	M6	91.0	22	101.5
EZ404U	98	95_{j6}	9.5	20.5	19_{k6}	115	3.5	98	40	40	32	193.5	242.0	9.0	M6	91.0	22	151.5
EZ501U	115	110_{j6}	10.0	16.0	19_{k6}	130	3.5	115	40	40	36	109.0	163.5	9.0	M6	100.0	22	74.5
EZ502U	115	110_{j6}	10.0	16.0	19_{k6}	130	3.5	115	40	40	36	134.0	188.5	9.0	M6	100.0	22	99.5
EZ503U	115	110_{j6}	10.0	16.0	24_{k6}	130	3.5	115	50	40	36	159.0	213.5	9.0	M8	100.0	22	124.5
EZ505U	115	110_{j6}	10.0	16.0	24_{k6}	130	3.5	115	50	40	36	209.0	263.5	9.0	M8	100.0	22	174.5
EZ701U	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	145	50	40	42	121.0	180.0	11.0	M8	115.0	22	83.0
EZ702U	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	145	50	40	42	146.0	205.0	11.0	M8	115.0	22	108.0
EZ703U	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	145	50	40	42	171.0	230.0	11.0	M8	115.0	22	133.0
EZ705U	145	130_{j6}	10.0	19.0	32_{k6}	165	3.5	145	58	71	42	226.0	285.0	11.0	M12	134.0	22	184.0
EZ813U	190	180_{j6}	15.0	25.0	38_{k6}	215	3.5	190	80	71	60	263.0	340.0	13.5	M12	156.5	22	209.0
EZ815U	190	180_{j6}	15.0	25.0	38_{k6}	215	3.5	190	80	71	60	345.0	422.0	13.5	M12	156.5	22	291.0

14.4.5 EZ4 – EZ7 motors with forced ventilation (One Cable Solution)



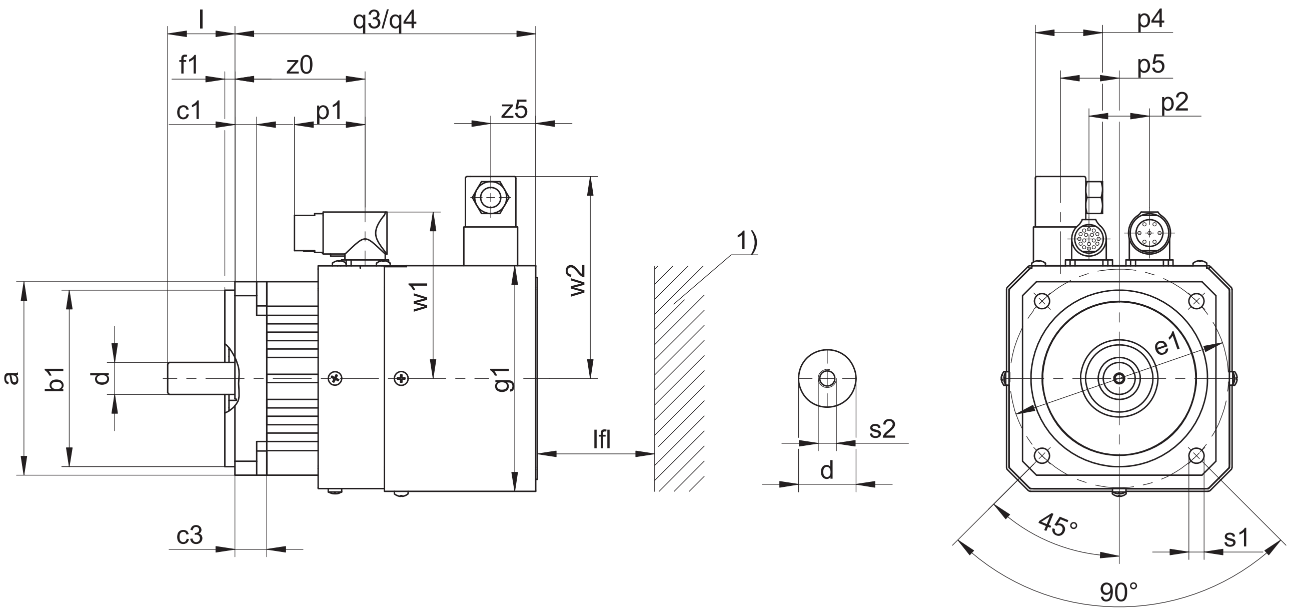
q3 Applies to motors without holding brake

q4 Applies to motors with holding brake

1) Machine wall

Type	□a	∅b1	c1	c3	∅d	∅e1	f1	□g1	l	lfl_{min}	p1	p4	q3	q4	∅s1	s2	w1	w2	z0	z5
EZ401B	98	95_{j6}	9.5	20.5	14_{k6}	115	3.5	118	30	20	40	37.5	175	224	9.0	M5	99	111	76.5	25
EZ402B	98	95_{j6}	9.5	20.5	19_{k6}	115	3.5	118	40	20	40	37.5	200	249	9.0	M6	99	111	101.5	25
EZ404B	98	95_{j6}	9.5	20.5	19_{k6}	115	3.5	118	40	20	40	37.5	250	299	9.0	M6	99	111	151.5	25
EZ501B	115	110_{j6}	10.0	16.0	19_{k6}	130	3.5	135	40	20	40	37.5	179	234	9.0	M6	110	120	74.5	25
EZ502B	115	110_{j6}	10.0	16.0	19_{k6}	130	3.5	135	40	20	40	37.5	204	259	9.0	M6	110	120	99.5	25
EZ503B	115	110_{j6}	10.0	16.0	24_{k6}	130	3.5	135	50	20	40	37.5	229	284	9.0	M8	110	120	124.5	25
EZ505B	115	110_{j6}	10.0	16.0	24_{k6}	130	3.5	135	50	20	40	37.5	279	334	9.0	M8	110	120	174.5	25
EZ701B	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	165	50	30	40	37.5	213	272	11.0	M8	125	134	83.0	40
EZ702B	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	165	50	30	40	37.5	238	297	11.0	M8	125	134	108.0	40
EZ703B	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	165	50	30	40	37.5	263	322	11.0	M8	125	134	133.0	40

14.4.6 EZ4 – EZ8 motors with forced ventilation



q3	Applies to motors without holding brake	q4	Applies to motors with holding brake
1)	Machine wall		

Type	□a	∅b1	c1	c3	∅d	∅e1	f1	□g1	l	lfl_{min}	p1	p2	p4	p5	q3	q4	∅s1	s2	w1	w2	z0	z5
EZ401B	98	95_{j6}	9.5	20.5	14_{k6}	115	3.5	118	30	20	40	32	37.5	0	175	224	9.0	M5	91.0	111	76.5	25
EZ402B	98	95_{j6}	9.5	20.5	19_{k6}	115	3.5	118	40	20	40	32	37.5	0	200	249	9.0	M6	91.0	111	101.5	25
EZ404B	98	95_{j6}	9.5	20.5	19_{k6}	115	3.5	118	40	20	40	32	37.5	0	250	299	9.0	M6	91.0	111	151.5	25
EZ501B	115	110_{j6}	10.0	16.0	19_{k6}	130	3.5	135	40	20	40	36	37.5	0	179	234	9.0	M6	100.0	120	74.5	25
EZ502B	115	110_{j6}	10.0	16.0	19_{k6}	130	3.5	135	40	20	40	36	37.5	0	204	259	9.0	M6	100.0	120	99.5	25
EZ503B	115	110_{j6}	10.0	16.0	24_{k6}	130	3.5	135	50	20	40	36	37.5	0	229	284	9.0	M8	100.0	120	124.5	25
EZ505B	115	110_{j6}	10.0	16.0	24_{k6}	130	3.5	135	50	20	40	36	37.5	0	279	334	9.0	M8	100.0	120	174.5	25
EZ701B	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	165	50	30	40	42	37.5	0	213	272	11.0	M8	115.0	134	83.0	40
EZ702B	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	165	50	30	40	42	37.5	0	238	297	11.0	M8	115.0	134	108.0	40
EZ703B	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	165	50	30	40	42	37.5	0	263	322	11.0	M8	115.0	134	133.0	40
EZ705B	145	130_{j6}	10.0	19.0	32_{k6}	165	3.5	165	58	30	71	42	37.5	0	318	377	11.0	M12	134.0	134	184.0	40
EZ813B	190	180_{j6}	15.0	25.0	38_{k6}	215	3.5	215	80	30	71	60	37.5	62	363	440	13.5	M12	156.5	160	209.0	40
EZ815B	190	180_{j6}	15.0	25.0	38_{k6}	215	3.5	215	80	30	71	60	37.5	62	445	522	13.5	M12	156.5	160	291.0	40

14.5 Type designation

The type designation of a geared motor is composed of the type designation of the gearbox and motor. This chapter describes the type designation of the motor. The type designation of the gearbox is explained in the respective gearbox chapter.

Example code

EZ	4	0	1	U

Explanation

Code	Designation	Design
EZ	Type	Synchronous servo motor
4	Size	4 (example)
0	Generation	Generation 0
1		Generation 1
1	Length	1 (example)
U	Cooling[2]	Convection cooling
B		Forced ventilation

To complete the type designation, also specify the following in your order:

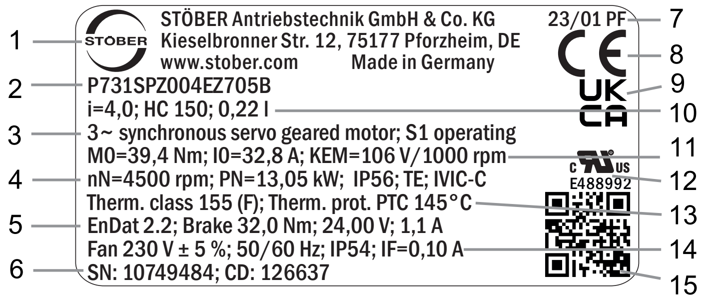
- Code of the drive controller, see the chapter [▶ 14.6.4.6]
- Code of the encoder, see the chapter [▶ 14.6.4]
- With or without holding brake (option), see the chapter Holding brake
- Voltage constant K_{EM}, see the chapter Selection tables

To make selecting your motor easy, use our STOBER Configurator at https://configurator.stoeber.de/en-US/.

[2] EZ2/EZ3 motors only available with convection cooling

14.5.1 Nameplate

The nameplate of a P731_EZ705 synchronous servo geared motor is explained as an example in this chapter.



Line	Value	Description
1	STÖBER Antriebstechnik GmbH + Co. KG	Logo and address of the manufacturer
2	P731SPZ004EZ705B	Type designation of the geared motor
3	3~ synchronous servo geared motor S1 operating	Geared motor type: three-phase synchronous servo geared motor Operating mode
4	nN=4500 rpm PN=13.05 kW IP56 TE IVIC-C	Nominal speed Nominal power Protection class of the motor Protection class in accordance with UL1004 Impulse voltage insulation class
5	EnDat 2.2 Brake 32.0 Nm 24.00 V 1.1 A	Encoder interface Holding brake (optional) Static braking torque at 100 °C Nominal voltage (DC) of the holding brake Nominal current of the holding brake at 20 °C
6	SN: 10749484 CD: 126637	Serial number of the motor Customer-specific data
7	23/01 PF	Date of manufacture (year/calendar week) Place of manufacture (abbreviation)
8	CE	CE mark
9	UKCA	UKCA mark
10	i=4.0 HC 150 0.22 l	Gear ratio of the gearbox Lubricant specification Lubricant fill volume
11	M0=39.4 Nm I0=32.8 A KEM=106 V/1000 rpm	Stall torque Stall current Voltage constant
12	cURus E488992	cURus test symbol, registered under UL number E488992
13	Therm. class 155 (F) Therm. prot. PTC 145 °C	Thermal class Type of temperature sensor
14	Fan 230 V ± 5%; 50/60 Hz IP54 IF = 0.10 A	Forced ventilation unit (option) Nominal voltage of the forced ventilation unit Protection class of the forced ventilation unit Nominal current of the forced ventilation unit
15	QR code	Link to product information

14.6 Product description

14.6.1 General features

Feature	Description
Design	IM B5, IM V1, IM V3 in accordance with EN 60034-7
Protection class	IP56 / IP66 (option)
Thermal class	155 (F) in accordance with EN 60034-1 (155 °C, heating $\Delta\vartheta$ = 100 K)
Surface	Matte black as per RAL 9005
Cooling	IC 410 convection cooling (IC 416 convection cooling with forced ventilation units, optional)
Bearing	Rolling bearing with lifetime lubrication and non-contact sealing
Sealing	Radial shaft seal rings made of FKM (A side)
Shaft	Shaft without feather key, diameter quality k6
Radial runout	Normal tolerance class in accordance with IEC 60072-1
Concentricity	Normal tolerance class in accordance with IEC 60072-1
Axial runout	Normal tolerance class in accordance with IEC 60072-1
Vibration intensity	A in accordance with EN 60034-14
Noise level	Limit values in accordance with EN 60034-9

14.6.2 Electrical features

General electrical features of the motor are described in this chapter. You can find more details in Chapter [▸ 14.2].

Feature	Description
DC link voltage	DC 540 V (max. 750 V) on STOBER drive controllers
Winding	Three-phase
Circuit	Star, center not led through
Protection class	I (protective grounding) in accordance with EN 61140
Impulse voltage insulation class (IVIC)	C in accordance with DIN EN 60034-18-41 (inverter connection voltage 0 – 480 V ± 10%)
Number of pole pairs	2 (EZ2) 5 (EZ3) 7 (EZ4/EZ5/EZ7) 4 (EZ81)

14.6.3 Ambient conditions

Standard ambient conditions for transport, storage and operation of the motor are described in this chapter. Information about differing ambient conditions can be found in the chapter [▸ 14.7.3].

Feature	Description
Surrounding temperature for transport/storage	−30 °C to +85 °C
Surrounding temperature for operation	−15 °C to +40 °C
Relative humidity	5% to 95%, no condensation
Installation altitude	≤ 1000 m above sea level
Shock load	≤ 50 m/s^2 (5 g), 6 ms in accordance with EN 60068-2-27

Notes

- STOBER synchronous servo motors are not suitable for potentially explosive atmospheres.
- Secure the power cables close to the motor so that vibrations of the cable do not place impermissible loads on the motor plug connector.
- Note that the braking torques of the holding brake (optional) may be reduced by shock loading.
- At operating temperatures below 0 °C, note that the discs of the holding brake (optional) may ice up.
- Also take into consideration the shock load of the motor due to output units (such as gearboxes and pumps) which are coupled with the motor.

14.6.4 Encoders

STOBER synchronous servo motors can be designed with different encoder models. The following chapters include information for choosing the optimal encoder for your application.

14.6.4.1 Encoder measuring method selection tool

The following table offers a selection tool for an encoder measuring method that is optimally suited for your application.

Feature	Absolute encoder		Resolvers
Measuring method	Optical	Inductive	Electromagnetic
Temperature resistance	★★☆	★★★	★★★
Vibration strength and shock resistance	★★☆	★★★	★★★
System accuracy	★★★	★★☆	★☆☆
Safety-related position measuring system for use in safety-oriented applications	✓[3]	✓[4]	–
Elimination of referencing with multi-turn design (optional)	✓	✓	–
Simple commissioning with electronic nameplate	✓	✓	–
Key: ★☆☆ = satisfactory, ★★☆ = good, ★★★ = very good			

14.6.4.2 Selection tool for EnDat interface

The following table offers a selection tool for the EnDat interface of absolute encoders.

Feature	EnDat 2.1	EnDat 2.2	EnDat 3
Short cycle times	★★☆	★★★	★★★
Transfer of additional information along with the position value	–	✓	✓
Expanded power supply range	★★☆	★★★	★★★
One Cable Solution (OCS)	–	–	✓
Key: ★★☆ = good, ★★★ = very good			

14.6.4.3 EnDat 3 encoders

EnDat 3 is a robust, purely digital protocol that functions with minimal connection lines. EnDat 3 facilitates the One Cable Solution, which allows the connection lines between the encoder and drive controller to be routed along in the motor's power cable.

The One Cable Solution offers the following advantages:

- Significantly reduced wiring effort by eliminating the encoder cable
- For cable lengths up to 50 m, a choke between the drive controller and motor is not necessary
- Extended safety functions possible (up to SIL 2 / category 3, PL d)
- Significantly reduced space requirements by eliminating the encoder plug connector
- Transmission of measured values from the temperature sensor using the EnDat 3 protocol

A motor with an EnDat 3 encoder can be operated only on a SB6, SC6 or SI6 drive controller from STOBER.

The EnDat 3 encoder has the following features:

Encoder model	Code	Measuring method	Recordable revolutions	Resolution	Position values per revolution	MTTF [years]	PFH [h]
EnDat 3 EQI 1131 Safety	S7	Inductive	4096	19 bit	524288	> 100	≤ 15 × 10^{-9}

[3] The EnDat 2.1 EQN 1125 encoder does not have FS certification from the manufacturer. However, the mechanical attachment complies with the specifications for FS devices.

[4] Not for EnDat 2.2 ECI 1118-G2 encoders

14.6.4.4 EnDat 2 encoders

In this chapter, you can find detailed technical data for encoder models with EnDat 2 interface that can be selected.

Encoders with EnDat 2.2 interface

Encoder model	Code	Measuring method	Recordable revolutions	Resolution	Position values per revolution	MTTF [years]	PFH [h]
EnDat 2.2 EQI 1131 Safety	S2	Inductive	4096	19 bit	524288	> 100	$\leq 15 \times 10^{-9}$
EnDat 2.2 ECI 1118-G2	C5	Inductive	–	18 bit	262144	> 76	$\leq 1.5 \times 10^{-6}$
EnDat 2.2 EQN 1135 Safety	S3	Optical	4096	23 bit	8388608	> 100	$\leq 15 \times 10^{-9}$

Encoders with EnDat 2.1 interface

Encoder model	Code	Measuring method	Recordable revolutions	Resolution	Position values per revolution	Periods per revolution	MTTF [years]	PFH [h]
EnDat 2.1 EQN 1125	Q4	Optical	4096	13 bit	8192	Sin/cos 512	> 57	$\leq 2 \times 10^{-6}$
EnDat 2.1 ECI 1118-G3	C2	Inductive	–	18 bit	262144	Sin/cos 16	> 100	$\leq 6 \times 10^{-7}$
EnDat 2.1 EQI 1130-G3	Q2	Inductive	4096	18 bit	262144	Sin/cos 16	> 100	$\leq 6 \times 10^{-7}$

Notes

- The encoder code is a part of the type designation of the motor.
- Safety = Safety-related position measuring system for use in safety-oriented applications.
- MTTF = Average time before dangerous failure. MTTF values greater than 100 years were reduced in accordance with DIN EN ISO 13849.
- PFH = Probability of a dangerous failure per hour.
- Multiple revolutions of the motor shaft can be recorded only using multi-turn encoders.

14.6.4.5 Resolver

In this chapter, you can find detailed technical data for the resolver that can be installed as an encoder in a STOBER motor.

Feature	Description
Code	R0
Number of poles	2
Input voltage U_{1eff}	7 V ± 5%
Input frequency f_1	10 kHz
Output voltage $U_{2,S1-S3}$	$K_{tr} \cdot U_{R1-R2} \cdot \cos\theta$
Output voltage $U_{2,S2-S4}$	$K_{tr} \cdot U_{R1-R2} \cdot \sin\theta$
Transformation ratio K_{tr}	0.5 ± 5%
Electrical fault	±10 arcmin
MTTF	> 100 years
PFH	$\leq 10^{-9}$

14.6.4.6 Possible combinations with drive controllers

The following table shows the options for combining STOBER drive controllers with selectable encoder models.

Drive controller		**SB6**			**SC6**			**SI6**			**SD6**	
Drive controller code		BC	BD	BE	AU	AV	BA	AP	AQ	BB	AD	AE
Connection plan ID		443376	443377	443378	443052	443053	443174	442771	442772	443175	442450	442451
Encoder	**Encoder code**											
EnDat 3 EQI 1131 Safety	S7	–	✓	–	–	–	✓	–	–	✓	–	–
EnDat 2.2 EQI 1131 Safety	S2	✓	–	–	✓	–	–	✓	–	–	✓	–
EnDat 2.2 EQN 1135 Safety	S3	✓	–	–	✓	–	–	✓	–	–	✓	–
EnDat 2.2 ECI 1118-G2	C5	✓	–	–	✓	–	–	✓	–	–	✓	–
EnDat 2.1 EQN 1125	Q4	–	–	✓	–	–	–	–	–	–	–	✓
EnDat 2.1 ECI 1118-G3	C2	–	–	✓	–	–	–	–	–	–	–	✓
Resolvers	R0	–	–	✓	–	✓	–	–	✓	–	–	✓

Notes

- In Chapter [▸ 15], you can find information about options for connecting STOBER synchronous servo motors to drive controllers from other manufacturers.

14.6.5 Temperature sensor

In this chapter, you can find technical data for the temperature sensors that are installed in STOBER synchronous servo motors for implementing thermal winding protection. To prevent damage to the motor, always monitor the temperature sensor with appropriate devices that will turn off the motor if the maximum permitted winding temperature is exceeded.

Some encoders feature integrated temperature monitoring, the warning and switch-off thresholds of which may overlap with the corresponding values set for the temperature sensor in the drive controller. In some cases, this may result in an instance where an encoder with internal temperature monitoring forces the motor to shut down, even before the motor has reached its nominal data.

Information about the electrical connection of the temperature sensor can be found in the chapter [▸ 14.6.8].

14.6.5.1 PTC thermistor

The PTC thermistor is installed as a standard temperature sensor in STOBER synchronous servo motors.

The PTC thermistor is a triple thermistor in accordance with DIN 44082 that can be used for monitoring the temperature of each winding phase. The resistance values in the following table and curve refer to a single thermistor in accordance with DIN 44081. These values must be multiplied by 3 for a triple thermistor in accordance with DIN 44082.

Feature	Description
Nominal response temperature ϑ_{NAT}	145 °C ± 5 K
Resistance R −20 °C up to ϑ_{NAT} − 20 K	≤ 250 Ω
Resistance R with ϑ_{NAT} − 5 K	≤ 550 Ω
Resistance R with ϑ_{NAT} + 5 K	≥ 1330 Ω
Resistance R with ϑ_{NAT} + 15 K	≥ 4000 Ω
Operating voltage	≤ DC 7.5 V
Thermal response time	< 5 s
Thermal class	155 (F) in accordance with EN 60034-1 (155 °C, heating Δϑ = 100 K)

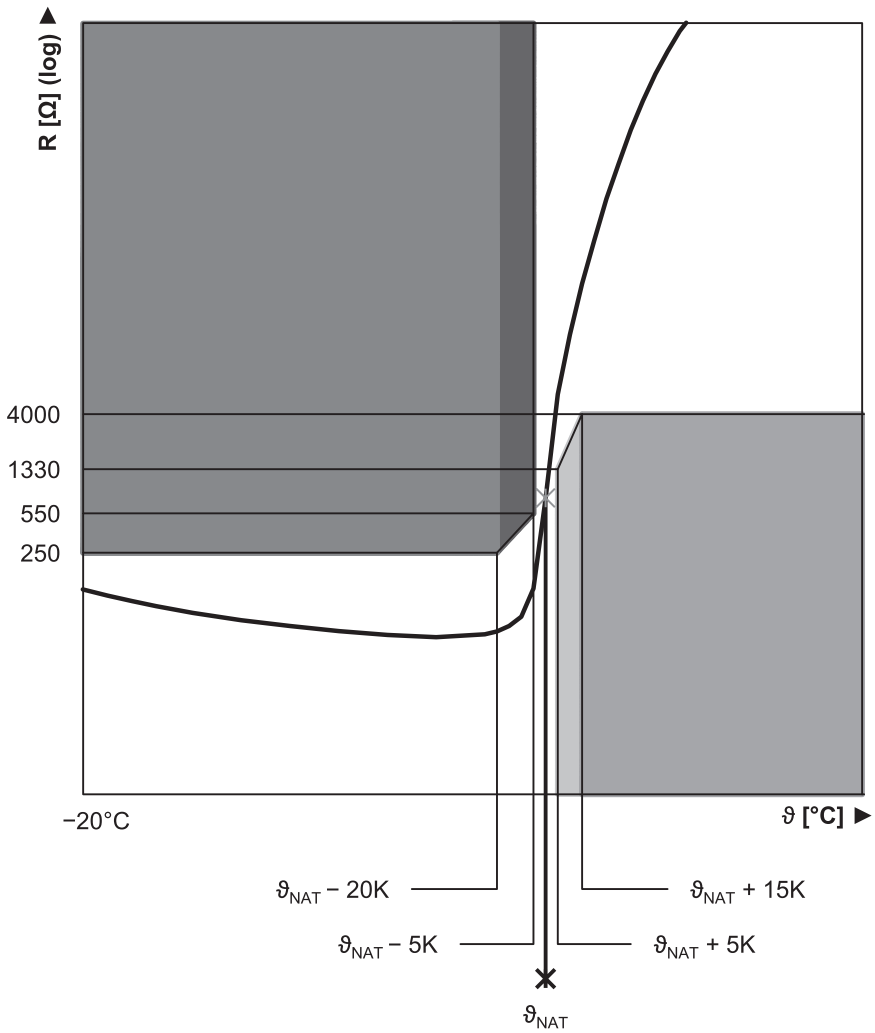


Fig. 2: PTC thermistor curve (single thermistor)

14.6.5.2 Pt1000 temperature sensor

STOBER synchronous servo motors are available in versions with a Pt1000 temperature sensor. The Pt1000 is a temperature-dependent resistor that has a resistance curve with a linear relationship with temperature. As a result, the Pt1000 allows for measurements of the winding temperature. These measurements are limited to one phase of the motor winding, however. In order to adequately protect the motor from exceeding the maximum permitted winding temperature, use a i^2t model in the drive controller to monitor the winding temperature.

Pt1000 temperature sensors can also be used with the One Cable Solution.

Avoid exceeding the specified measurement current so that the measured values are not falsified due to self-heating of the temperature sensor.

Feature	Description
Measurement current (constant)	2 mA
Resistance R for ϑ = 0 °C	1000 Ω
Resistance R for ϑ = 80 °C	1300 Ω
Resistance R for ϑ = 150 °C	1570 Ω

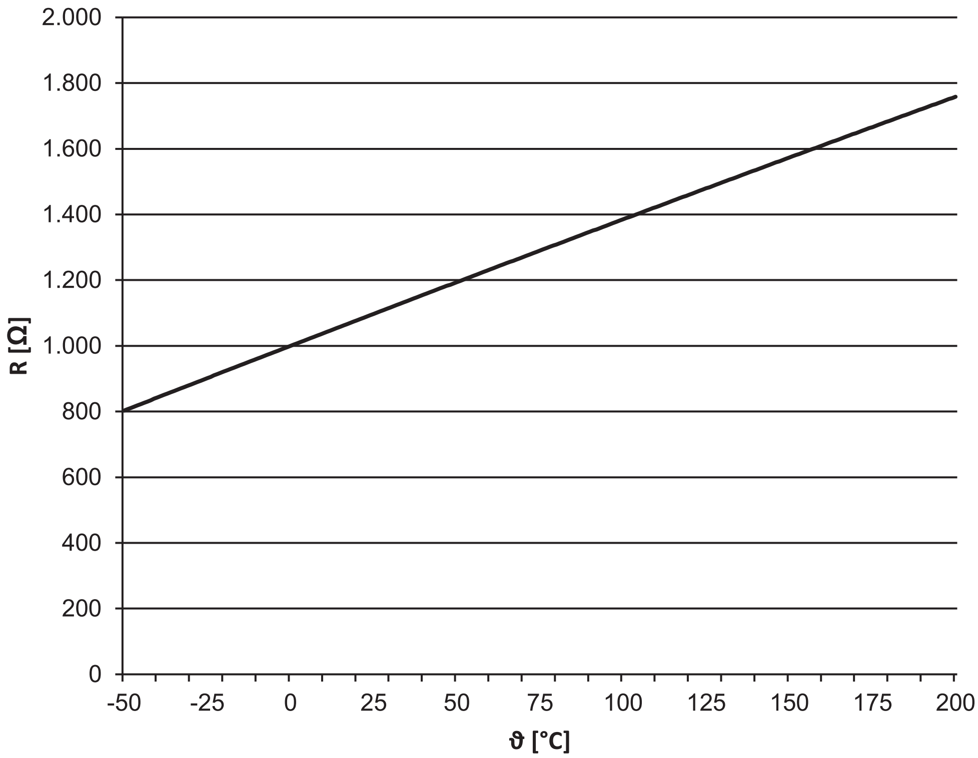


Fig. 3: Pt1000 temperature sensor characteristic curve

14.6.6 Cooling

A synchronous servo motor in the standard version is cooled by convection cooling (IC 410 in accordance with EN 60034-6). Optionally, forced ventilation can be used to cool the motor.

14.6.6.1 Forced ventilation

STOBER synchronous servo motors offer the option of being cooled with forced ventilation in order to increase performance data while maintaining the same size. Retrofitting with a forced ventilation unit is also possible in order to optimize the drive at a later date. When retrofitting, check whether the conductor cross-section of the power cable of the motor must be increased. Also take into account the dimensions of the forced ventilation unit.

The performance data for motors with forced ventilation can be found in the chapter [▸ 14.2] and the dimensional drawings in the chapter [▸ 14.4].

Technical data

Motor	Forced ventilation unit	$U_{N,F}$ [V]	$I_{N,F}$ [A]	$P_{N,F}$ [W]	q_{vF} [m³/h]	$L_{pA,F}$ [dB(A)]	m_F [kg]	Protection class
EZ4_B	FL4	230 V ± 5%, 50/60 Hz	0.07	10	59	41	1.4	IP44
EZ5_B	FL5		0.10	14	160	45	1.9	IP54
EZ7_B	FL7		0.10	14	160	45	2.9	IP54
EZ8_B	FL8		0.20	26	420	54	5.0	IP55

Terminal assignment for forced ventilation unit plug connectors

Connection diagram	Pin	Connection
	1	L1 (phase)
	2	N (neutral conductor)
	3	
	⏚	PE (grounding conductor)

14.6.7 Holding brake

STOBER synchronous servo motors can be equipped with a backlash-free holding brake using permanent magnets in order to secure the motor shaft when at a standstill. The holding brake engages automatically if the voltage drops.

The holding brake is designed for a high number of operations (B_{10} = 10 million operations, B_{10d} = 20 million operations).

Nominal voltage of permanent magnet holding brake: DC 24 V ± 5%, smoothed.

Observe the following during project configuration:

- The holding brake is designed to keep the motor shaft from moving. Activate braking processes during operation using the corresponding electrical functions of the drive controller. In exceptional circumstances, the holding brake can be used for braking from full speed (following a power failure or when setting up the machine). The maximum permitted work done by friction $W_{B,Rmax/h}$ may not be exceeded.
- Note that the braking torque M_{Bdyn} may initially be up to 50% less when braking from full speed. As a result, the braking effect has a delayed action and braking distances become longer.
- Regularly perform a brake test to ensure the functional safety of the brakes. Details can be found in the documentation of the motor and the drive controller.
- Connect a varistor of type S14 K35 (or comparable) in parallel to the brake coil to protect your machine from switching surges. (Not necessary for connecting the holding brake to STOBER drive controllers of the 5th and 6th generation with a BRS/BRM brake module).
- The holding brake of the motor does not offer adequate safety for persons in the hazardous area of gravity-loaded vertical axes. Therefore take additional measures to minimize risk, e.g. by providing a mechanical substructure for maintenance work.
- Take into consideration voltage losses in the connection cables that connect the voltage source to the holding brake connections.
- The holding torque of the brake can be reduced by shock loading. Information about shock loading can be found in the chapter [▷ 14.6.3].
- At operating temperatures from −15 °C to 0 °C, a cold holding brake in the released state may cause operating noises. As the temperature of the holding brake increases, these noises decrease such that operating noises are not heard when using holding brake at operating temperature in the released state.

Calculation of work done by friction per braking process

$$W_{B,R/B} = \frac{J_{tot} \cdot n^2}{182.4} \cdot \frac{M_{Bdyn}}{M_{Bdyn} \pm M_L}, \quad M_{Bdyn} > M_L$$

The sign of M_L is positive if the movement runs vertically upwards or horizontally and it is negative if the movement runs vertically down.

Calculation of the stop time

$$t_{dec} = 2.66 \cdot t_{1B} + \frac{n \cdot J_{tot}}{9.55 \cdot M_{Bdyn}}$$

Switching behavior

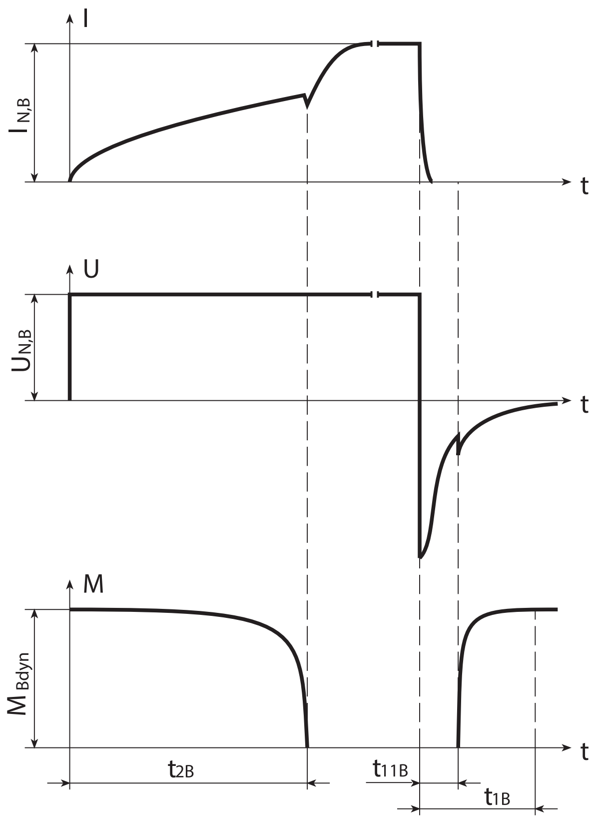


Fig. 4: Holding brake – Switching behavior

Technical data

Type	M_{Bstat} [Nm]	M_{Bdyn} [Nm]	$I_{N,B}$ [A]	$W_{B,Rmax/h}$ [kJ/h]	N_{Bstop}	J_{Bstop} [kgcm²]	$W_{B,Rlim}$ [kJ]	t_{2B} [ms]	t_{11B} [ms]	t_{1B} [ms]	$x_{B,N}$ [mm]	ΔJ_B [kgcm²]	Δm_B [kg]
EZ202	1.2	1.0	0.36	3.0	45000	0.310	70	10	2.0	5	0.15	0.03	0.25
EZ203	1.2	1.0	0.38	3.0	36000	0.390	70	10	2.0	5	0.15	0.03	0.25
EZ301	2.5	2.3	0.51	6.0	48000	0.752	180	25	3.0	20	0.20	0.19	0.55
EZ302	4.0	3.8	0.50	8.5	38000	0.952	180	44	4.0	26	0.30	0.19	0.55
EZ303	4.0	3.8	0.50	8.5	30000	1.17	180	44	4.0	26	0.30	0.19	0.55
EZ401	4.0	3.8	0.50	8.5	16000	2.24	180	44	4.0	26	0.30	0.19	0.76
EZ402	8.0	7.0	0.75	8.5	13500	4.39	300	40	2.0	20	0.30	0.57	0.97
EZ404	8.0	7.0	0.75	8.5	8500	7.09	300	40	2.0	20	0.30	0.57	0.97
EZ501	8.0	7.0	0.75	8.5	8700	6.94	300	40	2.0	20	0.30	0.57	1.19
EZ502	8.0	7.0	0.80	8.5	5200	11.5	300	40	2.0	20	0.30	0.57	1.19
EZ503	15	12	1.0	11.0	5900	18.6	550	60	5.0	30	0.30	1.72	1.62
EZ505	15	12	1.0	11.0	4000	27.8	550	60	5.0	30	0.30	1.72	1.62
EZ701	15	12	1.0	11.0	5400	20.5	550	60	5.0	30	0.30	1.74	1.94
EZ702	15	12	1.0	11.0	3600	30.9	550	60	5.0	30	0.30	1.74	1.94
EZ703	32	28	1.1	25.0	5200	54.6	1400	100	5.0	25	0.40	5.68	2.81
EZ705	32	28	1.1	25.0	3500	79.4	1400	100	5.0	25	0.40	5.68	2.81
EZ813	65	35	1.7	45.0	4500	200	2250	200	10	50	0.40	16.5	5.40
EZ815	115	70	2.1	65.0	7000	376	6500	190	12	65	0.50	55.5	8.40

14.6.8 Connection method

The following chapters describe the connection technology of STOBER synchronous servo motors in the standard version on STOBER drive controllers. You can find further information relating to the drive controller type that was specified in your order in the connection plan that is delivered with every synchronous servo motor.

In Chapter [▹ 15], you can find information about options for connecting STOBER synchronous servo motors to drive controllers from other manufacturers.

14.6.8.1 Connection of the motor housing to the grounding conductor system

Connect the motor housing to the machine's grounding conductor system to protect persons.

All attachment parts required for the connection of the grounding conductor to the motor housing are delivered with the motor. The grounding screw of the motor is identified with the symbol ⏚ in accordance with IEC 60417-DB. The cross-section of the grounding conductor has to be at least as large as the cross-section of the lines in the power connection.

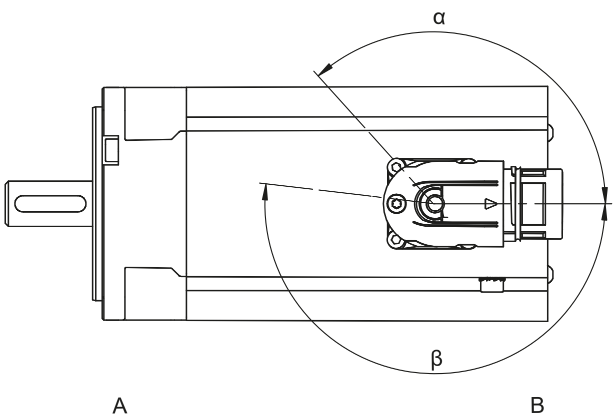
14.6.8.2 Plug connectors (One Cable Solution)

In the One Cable Solution design, the power and encoder lines are connected using a shared plug connector.

For motors with forced ventilation, avoid collisions between the motor connection cables and the plug connector of the forced ventilation unit. In the event of a collision, rotate the plug connectors of the motor by the required angle. Details on the position of the plug connector for the forced ventilation unit can be found in the chapter [▹ 14.4.5].

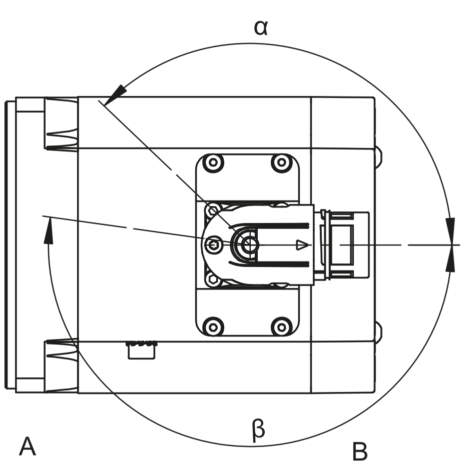
The figures represent the position of the plug connectors upon delivery.

Turning ranges of plug connectors (EZ2 – EZ3 motors)



A	Attachment or output side of the motor	B	Not output side

Turning ranges of plug connectors (EZ4 – EZ7 motors)



A	Attachment or output side of the motor	B	Not output side

Plug connector features

Motor type	Size	Connection	Turning range	
			α	β
EZ2 – EZ5, EZ701 – EZ703, EZ705U	con.23	Quick-lock	130°	190°

Notes

- The number after "con." indicates the approximate external thread diameter of the plug connector in mm (for example, con.23 designates a plug connector with an external thread diameter of about 23 mm).

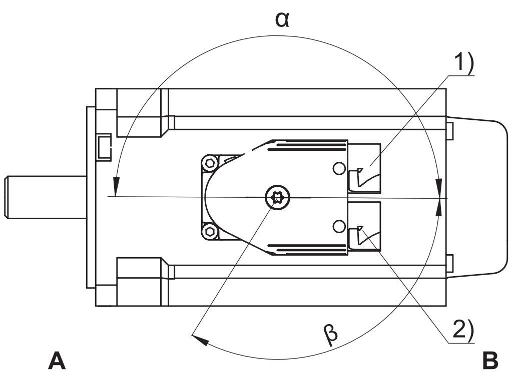
14.6.8.3 Plug connectors

STOBER The standard version of synchronous servo motors is equipped with rotatable quick-lock plug connectors[5]. Details can be found in this chapter.

For motors with forced ventilation, avoid collisions between the motor connection cables and the plug connector of the forced ventilation unit. In the event of a collision, rotate the plug connectors of the motor by the required angle. Details on the position of the plug connector for the forced ventilation unit can be found in the chapter [▶ 14.4.6].

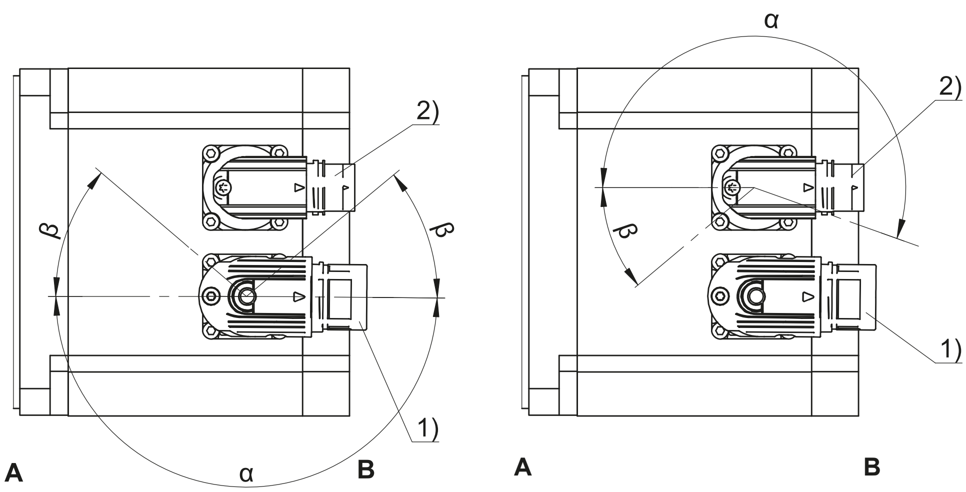
The figures represent the position of the plug connectors upon delivery.

Turning ranges of plug connectors (EZ2 – EZ3 motors)



1	Power plug connector	2	Encoder plug connector
A	Attachment or output side of the motor	B	Not output side

Turning ranges of plug connectors (EZ4 – EZ8 motors)



1	Power plug connector	2	Encoder plug connector
A	Attachment or output side of the motor	B	Not output side

[5] The connectors can be pivoted up to 10 times at a specific angle. They cannot be rotated repeatedly.

Power plug connector features

Motor type	Size	Connection	Turning range	
			α	β
EZ2, EZ3	con.15	Quick-lock	180°	120°
EZ4, EZ5, EZ701, EZ702, EZ703	con.23	Quick-lock	180°	40°
EZ705, EZ8	con.40	Quick-lock	180°	40°

Encoder plug connector features

Motor type	Size	Connection	Turning range	
			α	β
EZ2, EZ3	con.15	Quick-lock	180°	120°
EZ4, EZ5, EZ7, EZ8	con.17	Quick-lock	190°	35°

Notes

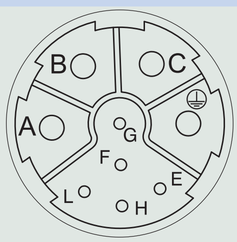
- The number after "con." indicates the approximate external thread diameter of the plug connector in mm (for example, con.23 designates a plug connector with an external thread diameter of about 23 mm).
- In turning range β, the power or encoder plug connectors can be turned only if doing so does not cause them to collide.
- For the EZ2/EZ3 motor, the power and encoder plug connectors are mechanically connected and can only be turned together.

14.6.8.4 Terminal assignment for plug connectors (One Cable Solution)

In the One Cable Solution design, the power and encoder lines are connected using a shared plug connector.

The temperature sensor of the motor is connected to the encoder internally. The measured values from the temperature sensor are transmitted via the EnDat 3 protocol of the encoder.

Plug connector size con.23

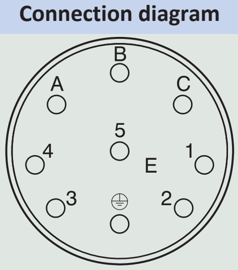


Connection diagram	Pin	Connection
	A	1U1 (U phase)
	B	1V1 (V phase)
	C	1W1 (W phase)
	E	P_SD –
	F	
	G	1BD1 (brake +)
	H	P_SD +
	L	1BD2 (brake –)
	⏚	PE (grounding conductor)

14.6.8.5 Connection assignment of the power plug connector

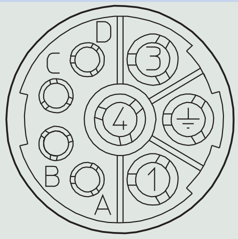
The size and connection diagram of the power plug connector depend on the size of the motor.

Plug connector size con.15

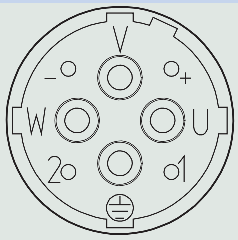


Connection diagram	Pin	Connection
	A	1U1 (U phase)
	B	1V1 (V phase)
	C	1W1 (W phase)
	1	1TP1 (temperature sensor +)
	2	1TP2 (temperature sensor –)
	3	1BD1 (brake +)
	4	1BD2 (brake –)
	5	
	⏚	PE (grounding conductor)

Plug connector size con.23

Connection diagram	Pin	Connection
	1	1U1 (U phase)
	3	1V1 (V phase)
	4	1W1 (W phase)
	A	1BD1 (brake +)
	B	1BD2 (brake –)
	C	1TP1 (temperature sensor +)
	D	1TP2 (temperature sensor –)
	⏚	PE (grounding conductor)

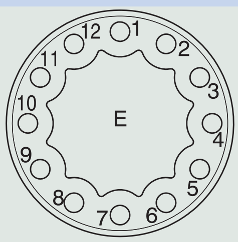
Plug connector size con.40

Connection diagram	Pin	Connection
	U	1U1 (U phase)
	V	1V1 (V phase)
	W	1W1 (W phase)
	+	1BD1 (brake +)
	–	1BD2 (brake –)
	1	1TP1 (temperature sensor +)
	2	1TP2 (temperature sensor –)
	⏚	PE (grounding conductor)

14.6.8.6 Connection assignment of the encoder plug connector

The size and terminal assignment of the encoder plug connectors depend on the model of encoder installed and the size of the motor.

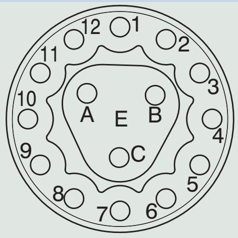
EnDat 2.2 digital encoder, plug connector size con.15

Connection diagram	Pin	Connection
	1	Clock +
	2	Up sense
	3	
	4	
	5	Data –
	6	Data +
	7	
	8	Clock –
	9	
	10	0 V GND
	11	
	12	Up +

EnDat 2.2 digital encoder, plug connector size con.17

Connection diagram	Pin	Connection
	1	Clock +
	2	Up sense
	3	
	4	
	5	Data –
	6	Data +
	7	
	8	Clock –
	9	
	10	0 V GND
	11	
	12	Up +

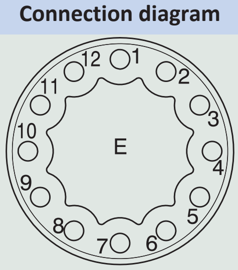
EnDat 2.1 encoder with sin/cos incremental signals, plug connector size con.15

Connection diagram	Pin	Connection
	1	Up sense
	2	0 V sense
	3	Up +
	4	Clock +
	5	Clock –
	6	0 V GND
	7	B + (Sin +)
	8	B – (Sin –)
	9	Data +
	10	A + (Cos +)
	11	A – (Cos –)
	12	Data –
	A	
	B	
	C	

EnDat 2.1 encoder with sin/cos incremental signals, plug connector size con.17

Connection diagram	Pin	Connection
	1	Up sense
	2	
	3	
	4	0 V sense
	5	
	6	
	7	Up +
	8	Clock +
	9	Clock –
	10	0 V GND
	11	
	12	B + (Sin +)
	13	B – (Sin –)
	14	Data +
	15	A + (Cos +)
	16	A – (Cos –)
	17	Data –

Resolver, plug connector size con.15

Connection diagram	Pin	Connection
	1	S3 Cos +
	2	S1 Cos –
	3	S4 Sin +
	4	S2 Sin –
	5	
	6	
	7	R2 Ref +
	8	R1 Ref –
	9	
	10	
	11	
	12	

Resolver, plug connector size con.17

Connection diagram	Pin	Connection
	1	S3 Cos +
	2	S1 Cos –
	3	S4 Sin +
	4	S2 Sin –
	5	
	6	
	7	R2 Ref +
	8	R1 Ref –
	9	
	10	
	11	
	12	

14.7 Project configuration

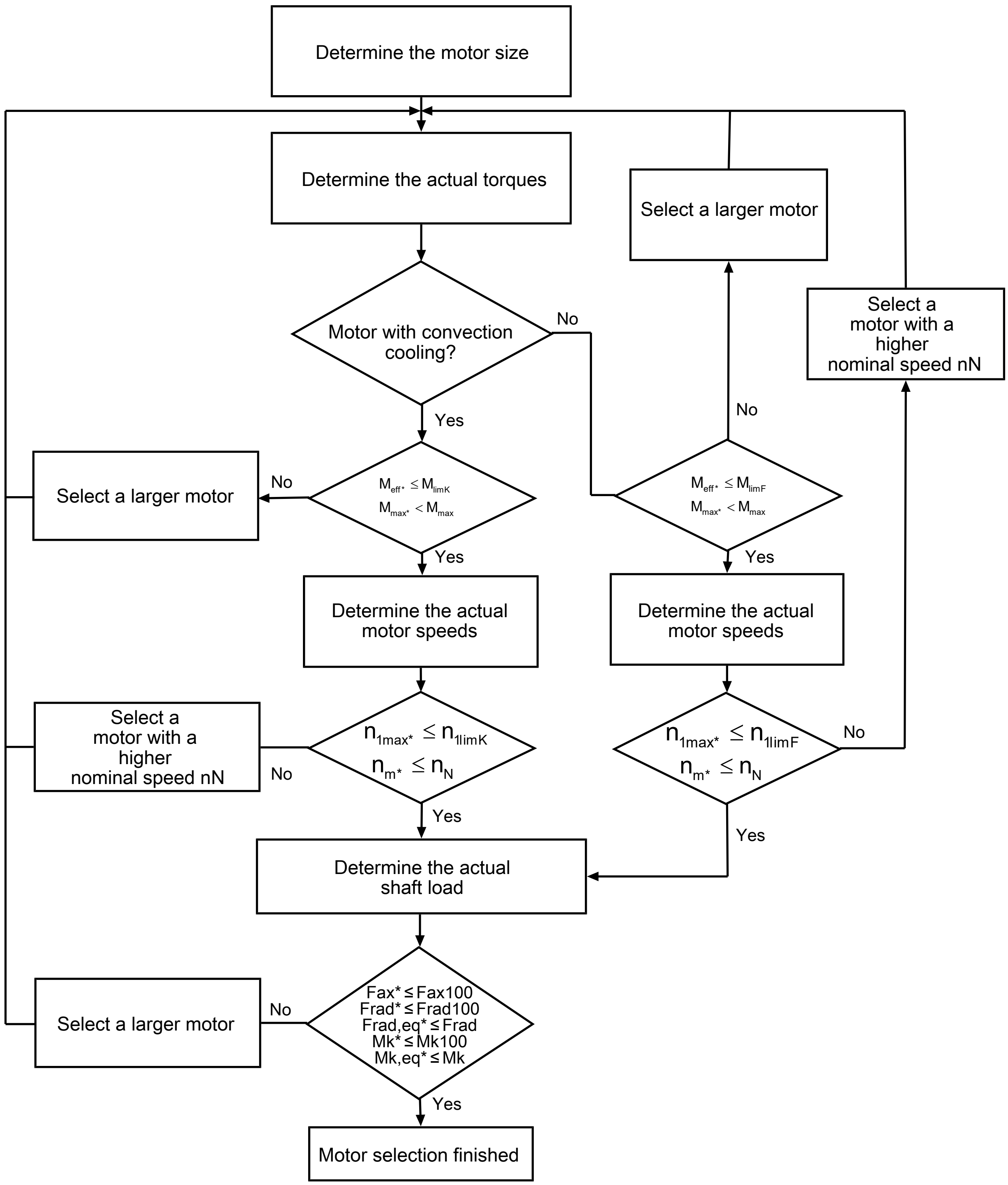
Project your drives using our SERVOsoft designing software. Download SERVOsoft free of charge after registration at https://www.stoeber.de/en/services/info-servosoft/.

It is the most convenient and reliable method of drive selection, as the entire torque/speed curve of the application is displayed and evaluated here in the curve of the geared motor.

In this chapter, only limit values for specific operating points can be taken into consideration for manual drive selection.

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

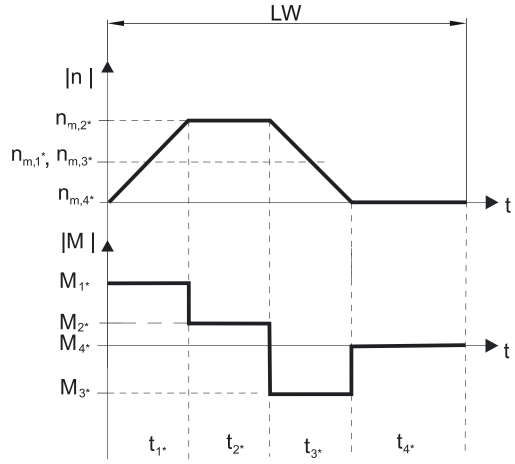
14.7.1 Drive selection



The value for M_{lim}, M_{limK}, M_{limF}, M_{max}, n_{1limK} and n_{1limF} can be found in the motor characteristic curve in the chapter [▹ 14.3]. Note the size, nominal speed n_N and cooling type of the motor.

Example of cyclic operation

The following calculations refer to a representation of the power delivered at the motor shaft in accordance with the following example:



Calculation of the actual average input speed

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

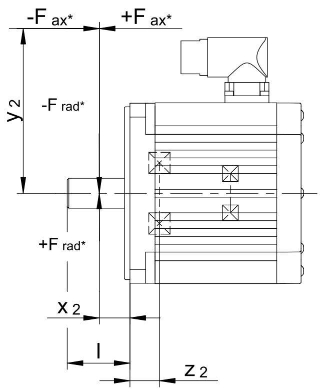
If t_{1*} + ... + $t_{3*} \geq 6$ min, determine n_{m*} without the rest phase t_{4*}.

Calculation of the actual effective torque

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

14.7.2 Permitted shaft loads

This chapter contains information about the maximum permitted shaft loads of the output shaft of the motor.



Type	z_2	F_{ax100}	F_{rad100}	M_{k100}
	[mm]	[N]	[N]	[Nm]
EZ202	12.0	250	750	20
EZ203	12.0	250	750	20
EZ301	24.0	350	1000	39
EZ302	24.0	350	1000	39
EZ303	24.0	350	1000	39
EZ401	19.5	550	1800	62
EZ402	19.5	550	1800	71
EZ404	19.5	550	1800	71
EZ501	19.5	750	2000	79
EZ502	19.5	750	2400	95
EZ503	19.5	750	2400	107
EZ505	19.5	750	2400	107
EZ701	24.5	1300	3500	173
EZ702	24.5	1300	4200	208
EZ703	24.5	1300	4200	208
EZ705	24.5	1300	4200	225
EZ813	28.5	1750	5600	384
EZ815	28.5	1750	5600	384

The values for permitted shaft loads specified in the table apply:

- For shaft dimensions in accordance with the catalog
- A force applied at the center of the output shaft: $x_2 = l / 2$ (shaft dimensions can be found in the chapter [▸ 14.4])
- Output speeds $n_{m*} \leq 100$ rpm ($F_{ax} = F_{ax100}$; $F_{rad} = F_{rad100}$; $M_k = M_{k100}$)

The following applies to output speeds $n_{m*} > 100$ rpm:

$$F_{ax} = \frac{F_{ax100}}{\sqrt[3]{\frac{n_{m*}}{100\text{ rpm}}}} \qquad F_{rad} = \frac{F_{rad100}}{\sqrt[3]{\frac{n_{m*}}{100\text{ rpm}}}} \qquad M_k = \frac{M_{k100}}{\sqrt[3]{\frac{n_{m*}}{100\text{ rpm}}}}$$

The following applies to other force application points:

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

For applications with multiple axial and/or radial forces, you must add the forces as vectors.

Also note the calculation for equivalent values:

$$M_{k,eq^*} = \sqrt[3]{\frac{\left|n_{m,1^*}\right| \cdot t_{1^*} \cdot \left|M_{k,1^*}{}^3\right| + \ldots + \left|n_{m,n^*}\right| \cdot t_{n^*} \cdot \left|M_{k,n^*}{}^3\right|}{\left|n_{m,1^*}\right| \cdot t_{1^*} + \ldots + \left|n_{m,n^*}\right| \cdot t_{n^*}}}$$

$$F_{rad,eq^*} = \sqrt[3]{\frac{\left|n_{m,1^*}\right| \cdot t_{1^*} \cdot \left|F_{rad,1^*}{}^3\right| + \ldots + \left|n_{m,n^*}\right| \cdot t_{n^*} \cdot \left|F_{rad,n^*}{}^3\right|}{\left|n_{m,1^*}\right| \cdot t_{1^*} + \ldots + \left|n_{m,n^*}\right| \cdot t_{n^*}}}$$

14.7.3 Derating

If you use the motor under ambient conditions that differ from the standard ambient conditions, the nominal torque M_N of the motor is reduced. In this chapter, you can find information for calculating the reduced nominal torque.

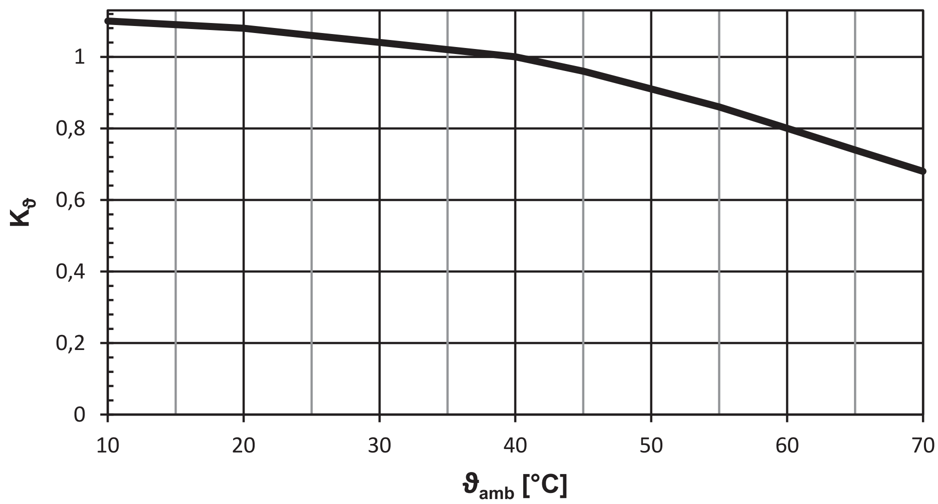


Fig. 5: Derating depending on the surrounding temperature

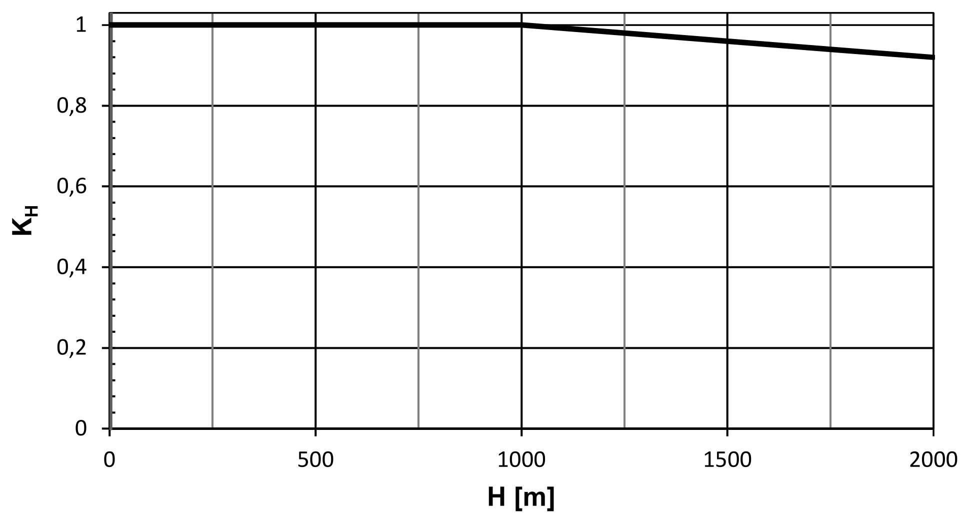


Fig. 6: Derating depending on the installation height

Calculation

If surrounding temperature ϑ_{amb} > 40 °C:

$M_{Nred} = M_N \cdot K_\vartheta$

If installation altitude H > 1000 m above sea level:

$M_{Nred} = M_N \cdot K_H$

If the surrounding temperature ϑ_{amb} > 40 °C and installation altitude H > 1000 m above sea level:

$M_{Nred} = M_N \cdot K_H \cdot K_\vartheta$

14.8 Further information

14.8.1 Directives and standards

STOBER synchronous servo motors meet the requirements of the following directives and standards:

- (Low Voltage) Directive 2014/35/EU
- EN 60034-1: 2010 + Cor.:2010
- EN 60034-5: 2020
- EN 60034-6:1993

14.8.2 Identifiers and test symbols

STOBER synchronous servo motors have the following identifiers and test symbols:

CE mark: The product meets the requirements of EU directives.

UKCA mark: The product meets the requirements of UK directives.

cURus test symbol "Servo and Stepper Motors – Component"; registered under UL number E488992 with Underwriters Laboratories USA.

14.8.3 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 term field.

Documentation	ID
Operating manual for EZ synchronous servo motors	443032_en

15 Connecting to drive controllers of third-party manufacturers

Table of contents

15.1 General notes

STOBER synchronous servo motors are designed for connection to STOBER drive controllers in the standard version. STOBER offers an extensive assortment of high-quality, trusted power and encoder connection cables for this purpose. However, STOBER synchronous servo motors can also be operated on drive controllers from third-party manufacturers. Notes and information for this purpose can be found in the following chapters. You can find all other information about STOBER synchronous servo motors in the chapter [▶ 14].

15.1.1 Nominal data

Nominal data for synchronous servo motors specified in the selection tables of this catalog were calculated for connecting to STOBER drive controllers. Note that this nominal data may change when STOBER synchronous servo motors are connected to drive controllers of third-party manufacturers. The following drive controller plug connectors are determining factors here:

- f_{2PU}
- $f_{PWM,PU}$
- U_{ZK}
- Compensation of the field weakening range.

The maximum achievable speed of a synchronous servo motor depends on the number of pole pairs (p) of the synchronous servo motor and, if applicable, on the restriction of f_{2PU} by Regulation (EC) No. 428/2009 (EC Dual Use Regulation). Details are shown in the figure below.

Some encoders feature integrated temperature monitoring, the warning and switch-off thresholds of which may overlap with the corresponding values set for the thermal winding protection in the drive controller. In some cases, this may result in an instance where an encoder with internal temperature monitoring forces the motor to shut down, even before the motor has reached its nominal data.

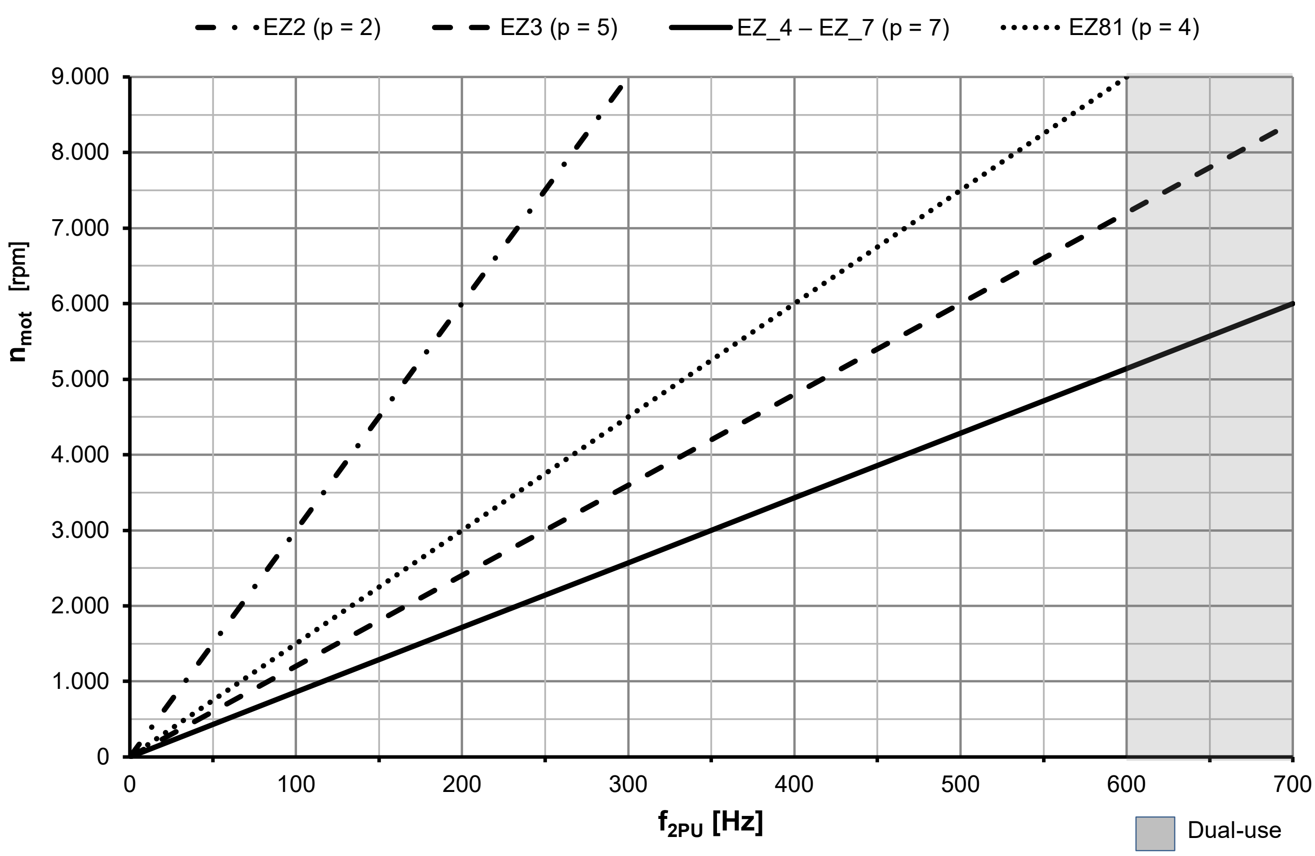


Fig. 1: Speed/frequency graph for EZ motors

15.1.2 Plug connectors (One Cable Solution)

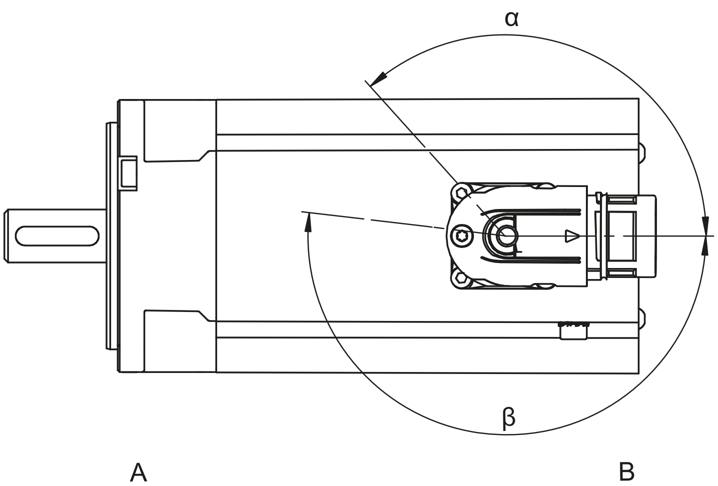
The One Cable Solution option is available for B&R, Control Techniques, Beckhoff, and Allen-Bradley drive controllers.

In the One Cable Solution design, the power and encoder lines are connected using a shared plug connector.

For motors with forced ventilation, avoid collisions between the motor connection cables and the plug connector of the forced ventilation unit. In the event of a collision, rotate the plug connectors of the motor by the required angle. Details on the position of the plug connector for the forced ventilation unit can be found in the chapter [14.4.5].

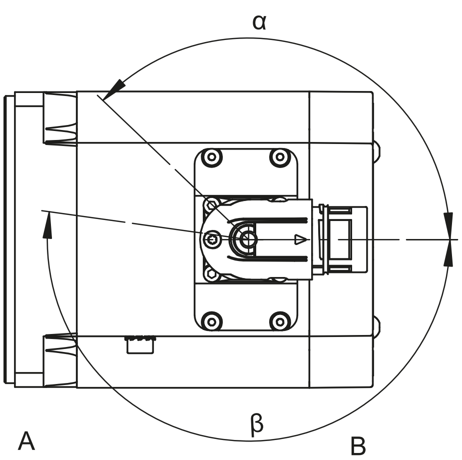
The figures represent the position of the plug connectors upon delivery.

Turning ranges of plug connectors (EZ2 – EZ3 motors)



A	Attachment or output side of the motor	B	Not output side

Turning ranges of plug connectors (EZ4 – EZ7 motors)



A	Attachment or output side of the motor	B	Not output side

Features of B&R/Beckhoff plug connectors

Motor type	Size	Connection	Turning range	
			α	β
EZ2 – EZ5, EZ701 – EZ703, EZ705U, EZ705B (n_N=3000 rpm)	con.23	Quick-lock	130°	190°

Features of Allen-Bradley plug connectors

Motor type	Size	Connection	Turning range	
			α	β
EZ3 – EZ5, EZ701 – EZ703, EZ705U (n_N=3000 rpm)	con.23	Quick-lock	130°	190°
EZ705U (n_N=4500 rpm), EZ705B, EZ813U	con.40	Quick-lock	130°	190°

Notes

- The number after "con." indicates the approximate external thread diameter of the plug connector in mm (for example, con.23 designates a plug connector with an external thread diameter of about 23 mm).

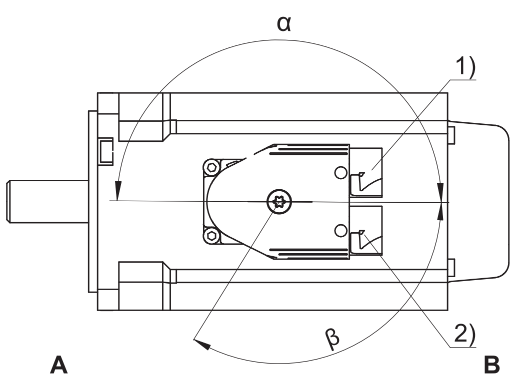
15.1.3 Plug connectors

In the standard version, STOBER synchronous servo motors are equipped with rotatable plug connectors[1] for power and encoder connections. You can find detailed technical information about the plug connectors at http://www.intercontec.biz.

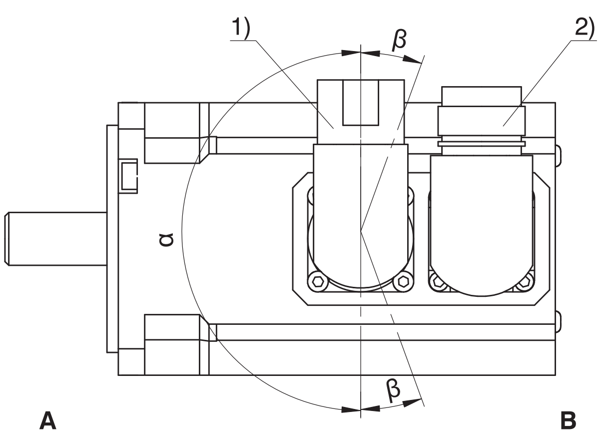
For motors with forced ventilation, avoid collisions between the motor connection cables and the plug connector of the forced ventilation unit. In the event of a collision, rotate the plug connectors of the motor by the required angle. Details on the position of the plug connector for the forced ventilation unit can be found in the chapter [▷ 14.4.6].

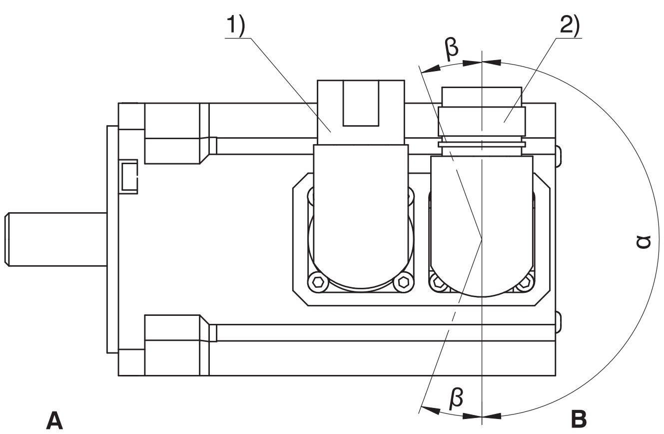
The figures represent the position of the plug connectors upon delivery.

Turning ranges of con.15 ytec plug connectors (motors EZ2 – EZ3, EZ401, EZ402) for connection to B&R drive controllers (drive controller code GY)



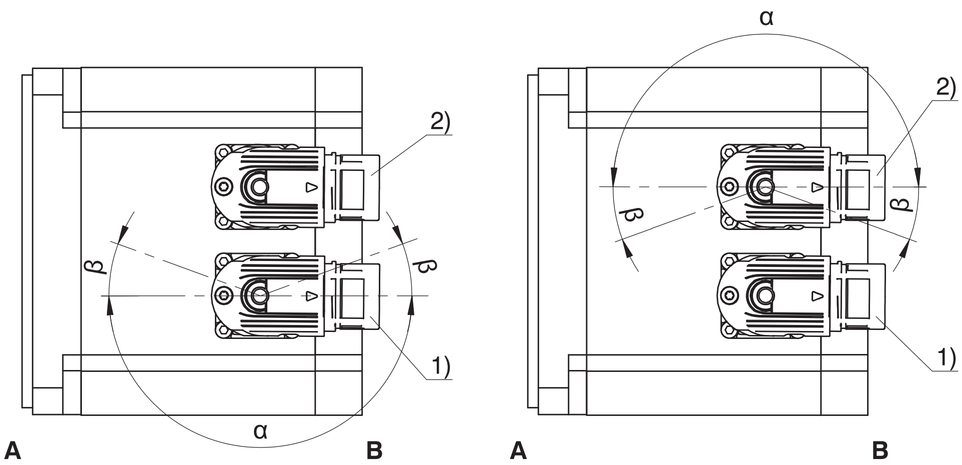
Turning ranges of plug connectors (EZ2 – EZ3 motors)





[1] The connectors can be pivoted up to 10 times at a specific angle. They cannot be rotated repeatedly.

Turning ranges of plug connectors (EZ4 – EZ8 motors)



1	Power plug connector	2	Encoder plug connector
A	Attachment or output side of the motor	B	Not output side

Power plug connector features

Motor type	Size	Connection	Turning range	
			α	β
EZ2 – EZ3, EZ401, EZ402	con.15[2]	Quick-lock (ytec)	180°	140°
EZ2 – EZ5, EZ701 – EZ703	con.23	Quick-lock	180°	40°
EZ705, EZ8	con.40	Quick-lock	180°	40°

Encoder plug connector features

Motor type	Size	Connection	Turning range	
			α	β
EZ2 – EZ3, EZ401, EZ402	con.15[3]	Quick-lock (ytec)	180°	140°
EZ404, EZ5, EZ7, EZ8	con.15[4]	Quick-lock (itec)	180°	20°
EZ2 – EZ8	con.15[5]	Quick-lock (itec)	180°	20°
EZ2 – EZ8	con.23	Quick-lock	180°	20°

Notes

- In turning range β, the power or encoder plug connectors can be turned only if doing so does not cause them to collide.
- The number after "con." indicates the approximate external thread diameter of the plug connector in mm (for example, con.23 designates a plug connector with an external thread diameter of about 23 mm).
- With ytec plug connectors, the power and encoder plug connectors are mechanically connected and can only be turned together.

15.1.4 Connection cables

The plug connectors and terminal assignment of STOBER synchronous servo motors are designed for connecting to drive controllers from third-party manufacturers in a way that allows you to connect the original cable of the respective manufacturer. Keep the following information regarding cable quality and design in mind.

- Because the original cable from Bosch cannot be used, STOBER offers suitable cables for this purpose. More detailed information is available from your STOBER customer consultant.
- Ensure that the cable quality and cable design is suitable for the ambient conditions at the installation location.

You can find more detailed information on our cables in the connection method manual, ID 443101.

Enter the ID of the manual in the Search term field at http://www.stoeber.de/en/downloads/.

[2] Only for connection to B&R ACOPOS P3 with EnDat 2.2 (drive controller code GY)

[3] Only for connection to B&R ACOPOS P3 with EnDat 2.2 (drive controller code GY)

[4] Only for connection to B&R ACOPOS P3 with EnDat 2.2 (drive controller code GY)

[5] Only for connection to B&R ACOPOSmulti with EnDat 2.2 (drive controller code GG)

15.2 Connection to B&R drive controllers

This chapter contains the information for connecting STOBER synchronous servo motors to drive controllers of the above-named manufacturer which differs from connecting to STOBER drive controllers. You can find all other information about STOBER synchronous servo motors in the chapter EZ synchronous servo motors.

STOBER has taken the following measures to minimize the effort of commissioning STOBER motors connected to B&R drive controllers and avoid errors during parameterization:

- The commutation offset of the motor was set so that calibration by the customer is not necessary.
- The electronic nameplate of the motor was designed to be compatible with the B&R controllers.
- Parameter lists are available on request at systemsupport@stoeber.de.

More information on commissioning EZ motors connected to B&R drive controllers can be found in the 443184_en document in the download area on the STOBER website.

15.2.1 Encoders

Encoders with EnDat 2.2 interface

Encoder model	Code	Measuring method	Recordable revolutions	Resolution	Position values per revolution	MTTF [years]	PFH [h]
EnDat 2.2 EQI 1131 Safety	S2	Inductive	4096	19 bit	524288	> 100	$\leq 15 \times 10^{-9}$
EnDat 2.2 EQN 1135 Safety	S3	Optical	4096	23 bit	8388608	> 100	$\leq 15 \times 10^{-9}$
EnDat 2.2 ECI 1118-G2	C5	Inductive	–	18 bit	262144	> 76	$\leq 1.5 \times 10^{-6}$

Encoders with EnDat 2.1 interface

Encoder model	Code	Measuring method	Recordable revolutions	Resolution	Position values per revolution	Periods per revolution	MTTF [years]	PFH [h]
EnDat 2.1 EQN 1125	Q4	Optical	4096	13 bit	8192	Sin/cos 512	> 57	$\leq 2 \times 10^{-6}$
EnDat 2.1 ECI 1118-G3	C2	Inductive	–	18 bit	262144	Sin/cos 16	> 100	$\leq 6 \times 10^{-7}$
EnDat 2.1 EQI 1130-G3	Q2	Inductive	4096	18 bit	262144	Sin/cos 16	> 100	$\leq 6 \times 10^{-7}$

Notes

- The encoder code is a part of the type designation of the motor.
- Safety = Safety-related position measuring system for use in safety-oriented applications.
- Multiple revolutions of the motor shaft can be recorded only using multi-turn encoders.

15.2.2 Resolver

In this chapter, you can find detailed technical data for the resolver that can be installed as an encoder in a STOBER motor.

Feature	Description
Code	R0
Number of poles	2
Input voltage U_{1eff}	7 V ± 5%
Input frequency f_1	10 kHz
Output voltage $U_{2,S1–S3}$	$K_{tr} \cdot U_{R1–R2} \cdot \cos\theta$
Output voltage $U_{2,S2–S4}$	$K_{tr} \cdot U_{R1–R2} \cdot \sin\theta$
Transformation ratio K_{tr}	0.5 ± 5%
Electrical fault	±10 arcmin
MTTF	> 100 years
PFH	$\leq 10^{-9}$

15.2.3 Possible combinations with drive controllers

The following table shows the possible combinations of STOBER synchronous servo motors with drive controllers from B&R depending on the encoder model.

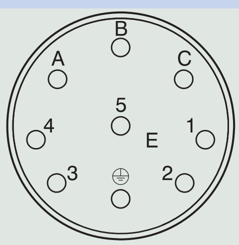
Drive controller		**ACOPOS Standard** EnDat 2.1/resolver	**ACOPOSmulti** EnDat 2.1/resolver	**ACOPOSmulti** EnDat 2.2	**ACOPOS P3** EnDat 2.2	**ACOPOS P3 OCS** EnDat 2.2	**ACOPOSmulti OCS** EnDat 2.2
Drive controller code		FG	FV	GG	GY	GP	GV
Connection plan ID		442313	442444	442677	443095	443022	443092
Encoder	**Encoder code**						
EnDat 2.2 EQI 1131 Safety	S2	–	–	EZ	EZ	EZ	EZ
EnDat 2.2 EQN 1135 Safety	S3	–	–	EZ	EZ	EZ	EZ
EnDat 2.2 ECI 1118-G2	C5	–	–	EZ	EZ	–	–
EnDat 2.1 EQN 1125	Q4	EZ	EZ	–	–	–	–
EnDat 2.1 ECI 1118-G3	C2	–	EZ	–	–	–	–
EnDat 2.1 EQI 1130-G3	Q2	–	EZ	–	–	–	–
Resolvers	R0	EZ	EZ	–	–	–	–

The encoder and drive controller codes are a part of the type designation of the motor.

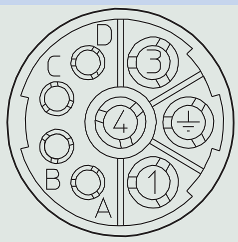
15.2.4 Connection assignment of the power plug connector

The size and connection diagram of the power plug connector depend on the size of the motor.

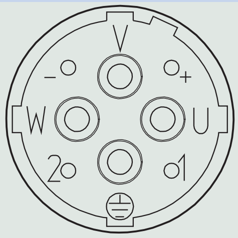
Plug connector size con.15

Connection diagram	Pin	Connection
	A	1U1 (U phase)
	B	1V1 (V phase)
	C	1W1 (W phase)
	1	1TP1 (temperature sensor +)
	2	1TP2 (temperature sensor −)
	3	1BD1 (brake +)
	4	1BD2 (brake −)
	5	
	⏚	PE (grounding conductor)

Plug connector size con.23

Connection diagram	Pin	Connection
	1	1U1 (U phase)
	3	1W1 (W phase)
	4	1V1 (V phase)
	A	1TP1 (temperature sensor +)
	B	1TP2 (temperature sensor −)
	C	1BD1 (brake +)
	D	1BD2 (brake −)
	⏚	PE (grounding conductor)

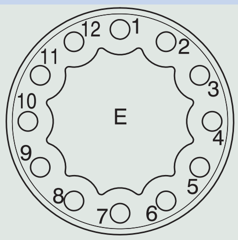
Plug connector size con.40

Connection diagram	Pin	Connection
	U	1U1 (U phase)
	V	1V1 (V phase)
	W	1W1 (W phase)
	+	1BD1 (brake +)
	–	1BD2 (brake –)
	1	1TP1 (temperature sensor +)
	2	1TP2 (temperature sensor –)
	⏚	PE (grounding conductor)

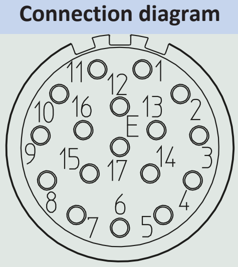
15.2.5 Connection assignment of the encoder plug connector

The size and terminal assignment of the encoder plug connectors depend on the model of encoder installed and the size of the motor.

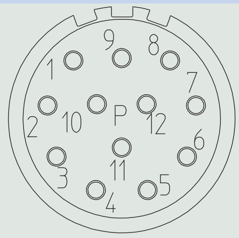
EnDat 2.2 digital encoder, plug connector size con.15

Connection diagram	Pin	Connection
	1	Up +
	2	Data +
	3	Data –
	4	Clock +
	5	Clock –
	6	
	7	0 V GND
	8	
	9	
	10	
	11	
	12	

EnDat 2.1 encoder with sin/cos incremental signals, plug connector size con.23

Connection diagram	Pin	Connection
	1	Up sense
	2	
	3	
	4	0 V sense
	5	
	6	
	7	Up +
	8	Clock +
	9	Clock –
	10	0 V GND
	11	
	12	B + (Sin +)
	13	B – (Sin –)
	14	Data +
	15	A + (Cos +)
	16	A – (Cos –)
	17	Data –

Resolver, plug connector size con.23

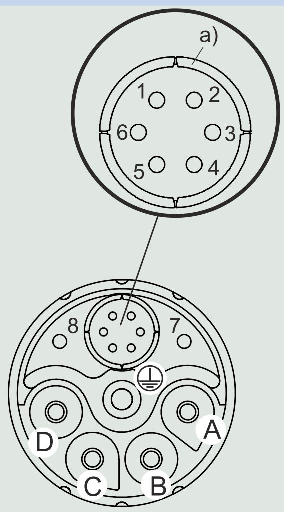
Connection diagram	Pin	Connection
	1	
	2	
	3	S4 Sin +
	4	S1 Cos −
	5	R2 Ref +
	6	
	7	S2 Sin −
	8	S3 Cos +
	9	R1 Ref −
	10	
	11	
	12	

15.2.6 Terminal assignment for plug connectors (One Cable Solution)

In the One Cable Solution design, the power and encoder lines are connected using a shared plug connector.

The temperature sensor of the motor is connected to the encoder internally. The measured values from the temperature sensor are transmitted via the log of the encoder.

Plug connector size con.23

Connection diagram	Pin	Connection
	A	1U1 (U phase)
	B	1V1 (V phase)
	C	1W1 (W phase)
	D	
	1	Up +
	2	0 V GND
	3	Data +
	4	Data −
	5	Clock +
	6	Clock −
	7	1BD2 (brake −)
	8	1BD1 (brake +)
	⏚	PE (grounding conductor)
a) Coaxial shield to which the shield of the encoder cores is connected		

15.3 Connection to Control Techniques drive controllers

This chapter contains the information for connecting STOBER synchronous servo motors to drive controllers of the above-named manufacturer which differs from connecting to STOBER drive controllers. You can find all other information about STOBER synchronous servo motors in the chapter EZ synchronous servo motors.

STOBER has taken the following measures to minimize the effort of commissioning STOBER motors connected to Control Techniques drive controllers and avoid errors during parameterization:

- The commutation offset of the motor was set so that calibration by the customer is not necessary.
- Parameter lists are available on request at systemsupport@stoeber.de.

15.3.1 Encoder

Encoders with EnDat 2.2 interface

Encoder model	Code	Measuring method	Recordable revolutions	Resolution	Position values per revolution	MTTF [years]	PFH [h]
EnDat 2.2 EQI 1131 Safety	S2	Inductive	4096	19 bit	524288	> 100	≤ 15 × 10^{-9}
EnDat 2.2 EQN 1135 Safety	S3	Optical	4096	23 bit	8388608	> 100	≤ 15 × 10^{-9}

Encoders with EnDat 2.1 interface

Encoder model	Code	Measuring method	Recordable revolutions	Resolution	Position values per revolution	Periods per revolution	MTTF [years]	PFH [h]
EnDat 2.1 EQN 1125	Q4	Optical	4096	13 bit	8192	Sin/cos 512	> 57	≤ 2 × 10^{-6}
EnDat 2.1 ECI 1118-G3	C2	Inductive	–	18 bit	262144	Sin/cos 16	> 100	≤ 6 × 10^{-7}
EnDat 2.1 EQI 1130-G3	Q2	Inductive	4096	18 bit	262144	Sin/cos 16	> 100	≤ 6 × 10^{-7}

Notes

- The encoder code is a part of the type designation of the motor.
- Safety = Safety-related position measuring system for use in safety-oriented applications.
- Multiple revolutions of the motor shaft can be recorded only using multi-turn encoders.

15.3.2 Resolver

In this chapter, you can find detailed technical data for the resolver that can be installed as an encoder in a STOBER motor.

Feature	Description
Code	R0
Number of poles	2
Input voltage U_{1eff}	7 V ± 5%
Input frequency f_1	10 kHz
Output voltage $U_{2,S1–S3}$	$K_{tr} \cdot U_{R1–R2} \cdot \cos \theta$
Output voltage $U_{2,S2–S4}$	$K_{tr} \cdot U_{R1–R2} \cdot \sin \theta$
Transformation ratio K_{tr}	0.5 ± 5%
Electrical fault	±10 arcmin
MTTF	> 100 years
PFH	≤ 10^{-9}

15.3.3 Possible combinations with drive controllers

The following table shows the possible combinations of STOBER synchronous servo motors with drive controllers from Control Techniques depending on the encoder model.

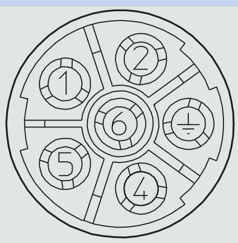
Drive controller		**Unidrive** EnDat 2.1/Resolver	**Digitax OCS** EnDat 2.2
Drive controller code		GE	HH
Connection plan ID		442555	443177
Encoder	**Encoder code**		
EnDat 2.2 EQI 1131 Safety	S2	–	EZ
EnDat 2.2 EQN 1135 Safety	S3	–	EZ
EnDat 2.1 EQN 1125	Q4	EZ	–
EnDat 2.1 ECI 1118-G3	C2	EZ	–
EnDat 2.1 EQI 1130-G3	Q2	EZ	–
Resolvers	R0	EZ	–

The encoder and drive controller codes are a part of the type designation of the motor.

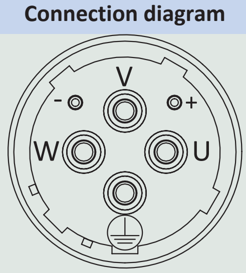
15.3.4 Terminal assignment of the power plug connector

The size and connection diagram of the power plug connector depend on the size of the motor.

Plug connector size con.23

Connection diagram	Pin	Connection
	1	1U1 (U phase)
	2	1V1 (V phase)
	4	1W1 (W phase)
	5	1BD1 (brake +)
	6	1BD2 (brake –)
	⏚	PE (grounding conductor)

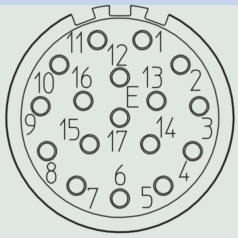
Plug connector size con.40

Connection diagram	Pin	Connection
	U	1U1 (U phase)
	V	1V1 (V phase)
	W	1W1 (W phase)
	+	1BD1 (brake +)
	–	1BD2 (brake –)
	⏚	PE (grounding conductor)

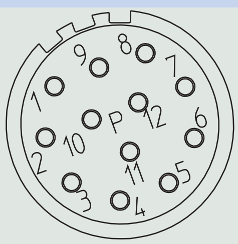
15.3.5 Terminal assignment of the encoder plug connector

The size and terminal assignment of the encoder plug connectors depend on the model of encoder installed and the size of the motor.

EnDat 2.1 encoder with sin/cos incremental signals, plug connector size con.23

Connection diagram	Pin	Connection
	1	1TP1 (temperature sensor +)
	2	1TP2 (temperature sensor −)
	3	
	4	
	5	
	6	
	7	
	8	Clock +
	9	Clock −
	10	A + (Cos +)
	11	Data +
	12	Data −
	13	A − (Cos −)
	14	B + (Sin +)
	15	B − (Sin −)
	16	Up +
	17	0 V GND

Resolver, plug connector size con.23

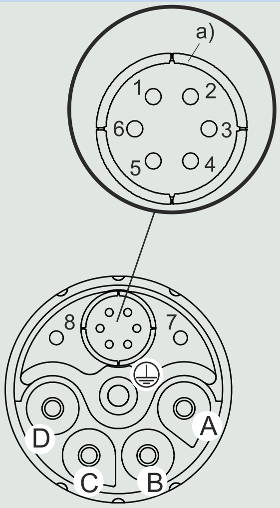
Connection diagram	Pin	Connection
	1	R2 Ref +
	2	R1 Ref −
	3	S3 Cos +
	4	S1 Cos −
	5	S4 Sin +
	6	S2 Sin −
	7	1TP1 (temperature sensor +)
	8	1TP2 (temperature sensor −)
	9	
	10	
	11	
	12	

15.3.6 Terminal assignment for plug connectors (One Cable Solution)

In the One Cable Solution design, the power and encoder lines are connected using a shared plug connector.

The temperature sensor of the motor is connected to the encoder internally. The measured values from the temperature sensor are transmitted via the log of the encoder.

Plug connector size con.23

Connection diagram	Pin	Connection
	A	1U1 (U phase)
	B	1V1 (V phase)
	C	1W1 (W phase)
	D	
	1	Up +
	2	0 V GND
	3	Data +
	4	Data –
	5	Clock +
	6	Clock –
	7	1BD2 (brake –)
	8	1BD1 (brake +)
	⏚	PE (grounding conductor)
a) Coaxial shield to which the shield of the encoder cores is connected		

15.4 Connection to Siemens drive controllers

This chapter contains the information for connecting STOBER synchronous servo motors to drive controllers of the above-named manufacturer which differs from connecting to STOBER drive controllers. You can find all other information about STOBER synchronous servo motors in the chapter EZ synchronous servo motors.

STOBER has taken the following measures to minimize the effort of commissioning STOBER motors connected to SINAMICS S120 drive controllers and avoid errors during parameterization:

- The commutation offset of the motor was set so that calibration by the customer is not necessary.
- Parameter lists are available on request at systemsupport@stoeber.de.

More information on commissioning EZ motors connected to SINAMICS S120 drive controllers can be found in the 443232_en document in the download area on the STOBER website.

15.4.1 Encoders

Encoders with EnDat 2.1 interface

Encoder model	Code	Measuring method	Recordable revolutions	Resolution	Position values per revolution	Periods per revolution	MTTF [years]	PFH [h]
EnDat 2.1 EQN 1125	Q4	Optical	4096	13 bit	8192	Sin/cos 512	> 57	$\leq 2 \times 10^{-6}$

Notes

- The encoder code is a part of the type designation of the motor.
- Multiple revolutions of the motor shaft can be recorded only using multi-turn encoders.

15.4.2 Resolver

In this chapter, you can find detailed technical data for the resolver that can be installed as an encoder in a STOBER motor.

Feature	Description
Code	R0
Number of poles	2
Input voltage U_{1eff}	7 V ± 5%
Input frequency f_1	10 kHz
Output voltage $U_{2,S1-S3}$	$K_{tr} \cdot U_{R1-R2} \cdot \cos \theta$
Output voltage $U_{2,S2-S4}$	$K_{tr} \cdot U_{R1-R2} \cdot \sin \theta$
Transformation ratio K_{tr}	0.5 ± 5%
Electrical fault	±10 arcmin
MTTF	> 100 years
PFH	$\leq 10^{-9}$

15.4.3 Possible combinations with drive controllers

The following table shows the possible combinations of STOBER synchronous servo motors with drive controllers from Siemens depending on the encoder model.

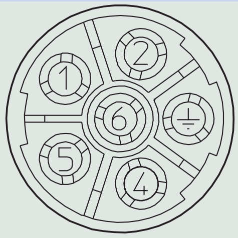
Drive controller		**SINAMICS S120** EnDat 2.1/resolver
Drive controller code		FJ
Connection plan ID		442315
Encoder	**Encoder code**	
EnDat 2.1 EQN 1125	Q4	EZ
Resolvers	R0	EZ

The encoder and drive controller codes are a part of the type designation of the motor.

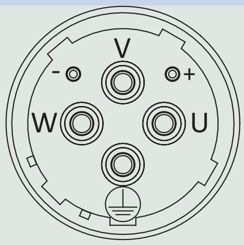
15.4.4 Connection assignment of the power plug connector

The size and connection diagram of the power plug connector depend on the size of the motor.

Plug connector size con.23

Connection diagram	Pin	Connection
	1	1U1 (U phase)
	2	1V1 (V phase)
	4	1BD1 (brake +)
	5	1BD2 (brake –)
	6	1W1 (W phase)
	⏚	PE (grounding conductor)

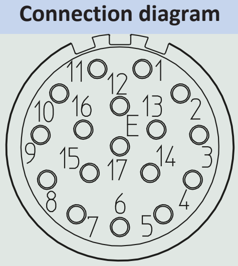
Plug connector size con.40

Connection diagram	Pin	Connection
	U	1U1 (U phase)
	V	1V1 (V phase)
	W	1W1 (W phase)
	+	1BD1 (brake +)
	–	1BD2 (brake –)
	⏚	PE (grounding conductor)

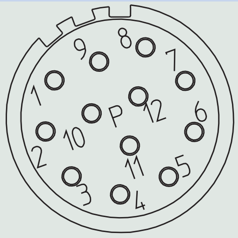
15.4.5 Connection assignment of the encoder plug connector

The size and terminal assignment of the encoder plug connectors depend on the model of encoder installed and the size of the motor.

EnDat 2.1 encoder with sin/cos incremental signals, plug connector size con.23

Connection diagram	Pin	Connection
	1	A + (Cos +)
	2	A – (Cos –)
	3	Data +
	4	
	5	Clock +
	6	
	7	0 V GND
	8	1TP1 (temperature sensor +)
	9	1TP2 (temperature sensor –)
	10	Up +
	11	B + (Sin +)
	12	B – (Sin –)
	13	Data –
	14	Clock –
	15	0 V sense
	16	Up sense
	17	

Resolver, plug connector size con.23

Connection diagram	Pin	Connection
	1	S4 Sin +
	2	S2 Sin −
	3	
	4	
	5	
	6	
	7	R1 Ref −
	8	1TP1 (temperature sensor +)
	9	1TP2 (temperature sensor −)
	10	R2 Ref +
	11	S3 Cos +
	12	S1 Cos −

15.5 Connection to Kollmorgen drive controllers

This chapter contains the information for connecting STOBER synchronous servo motors to drive controllers of the above-named manufacturer which differs from connecting to STOBER drive controllers. You can find all other information about STOBER synchronous servo motors in the chapter EZ synchronous servo motors.

STOBER has taken the following measures to minimize the effort of commissioning STOBER motors connected to Kollmorgen drive controllers and avoid errors during parameterization:

- The commutation offset of the motor was set so that calibration by the customer is not necessary.
- Parameter lists are available on request at systemsupport@stoeber.de.

More information on commissioning EZ motors connected to Kollmorgen drive controllers can be found in the 443236_en document in the download area on the STOBER website.

15.5.1 Encoders

Encoders with EnDat 2.2 interface

Encoder model	Code	Measuring method	Recordable revolutions	Resolution	Position values per revolution	MTTF [years]	PFH [h]
EnDat 2.2 EQI 1131 Safety	S2	Inductive	4096	19 bit	524288	> 100	≤ 15 × 10^{-9}

Encoders with EnDat 2.1 interface

Encoder model	Code	Measuring method	Recordable revolutions	Resolution	Position values per revolution	Periods per revolution	MTTF [years]	PFH [h]
EnDat 2.1 EQN 1125	Q4	Optical	4096	13 bit	8192	Sin/cos 512	> 57	≤ 2 × 10^{-6}

Notes

- The encoder code is a part of the type designation of the motor.
- Safety = Safety-related position measuring system for use in safety-oriented applications.
- Multiple revolutions of the motor shaft can be recorded only using multi-turn encoders.

15.5.2 Resolver

In this chapter, you can find detailed technical data for the resolver that can be installed as an encoder in a STOBER motor.

Feature	Description
Code	R0
Number of poles	2
Input voltage U_{1eff}	7 V ± 5%
Input frequency f_1	10 kHz
Output voltage $U_{2,S1–S3}$	$K_{tr} \cdot U_{R1–R2} \cdot \cos \theta$
Output voltage $U_{2,S2–S4}$	$K_{tr} \cdot U_{R1–R2} \cdot \sin \theta$
Transformation ratio K_{tr}	0.5 ± 5%
Electrical fault	±10 arcmin
MTTF	> 100 years
PFH	≤ 10^{-9}

15.5.3 Possible combinations with drive controllers

The following table shows the possible combinations of STOBER synchronous servo motors with drive controllers from Kollmorgen depending on the encoder model.

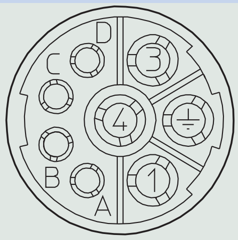
Drive controller		**Servostar S300-700** EnDat 2.2/EnDat 2.1/resolver
Drive controller code		FE
Connection plan ID		442311
Encoder	**Encoder code**	
EnDat 2.2 EQI 1131 Safety	S2	EZ
EnDat 2.1 EQN 1125	Q4	EZ
Resolvers	R0	EZ

The encoder and drive controller codes are a part of the type designation of the motor.

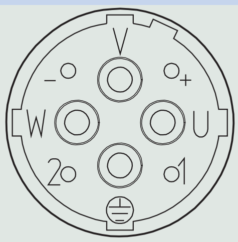
15.5.4 Connection assignment of the power plug connector

The size and connection diagram of the power plug connector depend on the size of the motor.

Plug connector size con.23

Connection diagram	Pin	Connection
	1	1U1 (U phase)
	3	1W1 (W phase)
	4	1V1 (V phase)
	A	1BD1 (brake +)
	B	1BD2 (brake –)
	C	
	D	
	⏚	PE (grounding conductor)

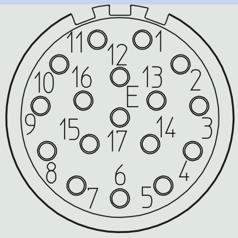
Plug connector size con.40

Connection diagram	Pin	Connection
	U	1U1 (U phase)
	V	1V1 (V phase)
	W	1W1 (W phase)
	+	1BD1 (brake +)
	–	1BD2 (brake –)
	1	
	2	
	⏚	PE (grounding conductor)

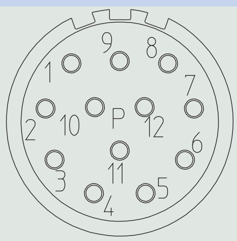
15.5.5 Connection assignment of the encoder plug connector

The size and terminal assignment of the encoder plug connectors depend on the model of encoder installed and the size of the motor.

EnDat 2.1 encoder with sin/cos incremental signals, plug connector size con.23

Connection diagram	Pin	Connection
	1	B – (Sin –)
	2	0 V GND
	3	A – (Cos –)
	4	Up +
	5	Data +
	6	
	7	1TP1 (temperature sensor +)
	8	Clock +
	9	B + (Sin +)
	10	0 V sense
	11	A + (Cos +)
	12	Up sense
	13	Data –
	14	1TP2 (temperature sensor -)
	15	Clock –
	16	
	17	

Resolver, plug connector size con.23

Connection diagram	Pin	Connection
	1	
	2	1TP1 (temperature sensor +)
	3	S4 Sin +
	4	S3 Cos +
	5	R2 Ref +
	6	1TP2 (temperature sensor -)
	7	S2 Sin –
	8	S1 Cos –
	9	R1 Ref –
	10	
	11	
	12	

15.6 Connection to Bosch drive controllers

This chapter contains the information for connecting STOBER synchronous servo motors to drive controllers of the above-named manufacturer which differs from connecting to STOBER drive controllers. You can find all other information about STOBER synchronous servo motors in the chapter EZ synchronous servo motors.

STOBER has taken the following measures to minimize the effort of commissioning STOBER motors connected to IndraDrive C/Cs drive controllers and avoid errors during parameterization:

- The commutation offset of the motor was set so that calibration by the customer is not necessary.
- Parameter lists are available on request at systemsupport@stoeber.de.

More information on commissioning EZ motors connected to IndraDrive C/Cs drive controllers can be found in the 443235_en document in the download area on the STOBER website.

15.6.1 Encoders

Encoders with EnDat 2.1 interface

Encoder model	Code	Measuring method	Recordable revolutions	Resolution	Position values per revolution	Periods per revolution	MTTF [years]	PFH [h]
EnDat 2.1 EQN 1125	Q4	Optical	4096	13 bit	8192	Sin/cos 512	> 57	$\leq 2 \times 10^{-6}$
EnDat 2.1 ECI 1118-G3	C2	Inductive	–	18 bit	262144	Sin/cos 16	> 100	$\leq 6 \times 10^{-7}$
EnDat 2.1 EQI 1130-G3	Q2	Inductive	4096	18 bit	262144	Sin/cos 16	> 100	$\leq 6 \times 10^{-7}$

Encoders with HIPERFACE interface

Encoder model	Code	Measuring method	Recordable revolutions	Resolution	Position values per revolution	Periods per revolution	MTTF [years]	PFH [h]
SKM36	H1	Optical	4096	12 bit	4096	Sin/cos 128	> 100	$\leq 5.4 \times 10^{-7}$

Notes

- The encoder code is a part of the type designation of the motor.
- Multiple revolutions of the motor shaft can be recorded only using multi-turn encoders.

15.6.2 Possible combinations with drive controllers

The following table shows the possible combinations of STOBER synchronous servo motors with drive controllers from Bosch depending on the encoder model.

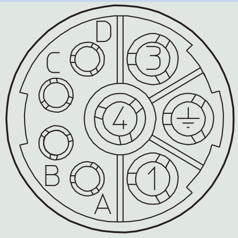
Drive controller		IndraDrive C/Cs EnDat 2.1/HIPERFACE
Drive controller code		FW
Connection plan ID		442445
Encoder	**Encoder code**	
EnDat 2.1 EQN 1125	Q4	EZ
EnDat 2.1 ECI 1118-G3	C2	EZ
EnDat 2.1 EQI 1130-G3	Q2	EZ
SKM36	H1	EZ

The encoder and drive controller codes are a part of the type designation of the motor.

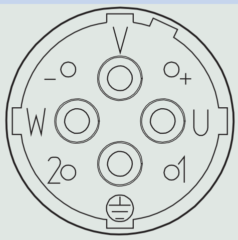
15.6.3 Connection assignment of the power plug connector

The size and connection diagram of the power plug connector depend on the size of the motor.

Plug connector size con.23

Connection diagram	Pin	Connection
	1	1U1 (U phase)
	3	1V1 (V phase)
	4	1W1 (W phase)
	A	1BD1 (brake +)
	B	1BD2 (brake –)
	C	1TP1 (temperature sensor +)
	D	1TP2 (temperature sensor –)
	⏚	PE (grounding conductor)

Plug connector size con.40

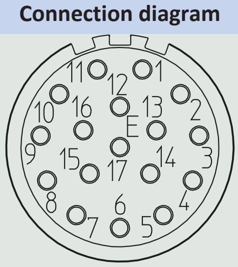
Connection diagram	Pin	Connection
	U	1U1 (U phase)
	V	1V1 (V phase)
	W	1W1 (W phase)
	+	1BD1 (brake +)
	–	1BD2 (brake –)
	1	1TP1 (temperature sensor +)
	2	1TP2 (temperature sensor –)
	⏚	PE (grounding conductor)

15.6.4 Connection assignment of the encoder plug connector

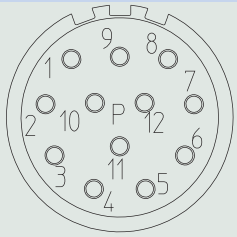
The size and terminal assignment of the encoder plug connectors depend on the model of encoder installed and the size of the motor.

EnDat 2.1 encoder with sin/cos incremental signals, plug connector size con.23

This terminal assignment only applies to the IndraDrive C/Cs drive controller.

Connection diagram	Pin	Connection
	1	Up sense
	2	
	3	
	4	0 V sense
	5	
	6	
	7	Up +
	8	Clock +
	9	Clock –
	10	0 V GND
	11	
	12	B + (Sin +)
	13	B – (Sin –)
	14	Data +
	15	A + (Cos +)
	16	A – (Cos –)
	17	Data –

HIPERFACE encoder, plug connector size con.23

Connection diagram	Pin	Connection
	1	Us
	2	0 V GND
	3	REFSIN
	4	REFCOS
	5	Data +
	6	Data −
	7	+ SIN
	8	+ COS
	9	
	10	
	11	
	12	

15.7 Connection to Beckhoff drive controllers

This chapter contains the information for connecting STOBER synchronous servo motors to drive controllers of the above-named manufacturer which differs from connecting to STOBER drive controllers. You can find all other information about STOBER synchronous servo motors in the chapter EZ synchronous servo motors.

STOBER has taken the following measures to minimize the effort of commissioning STOBER motors connected to AX5000 and AX8000 drive controllers and avoiding errors during parameterization:

- The commutation offset of the motor was set so that calibration by the customer is not necessary.
- Parameter lists are available on request at systemsupport@stoeber.de.

More information on commissioning EZ motors connected to Beckhoff drive controllers can be found in the 443185_en document in the download area on the STOBER website.

15.7.1 Encoders

Encoders with EnDat 2.2 interface

Encoder model	Code	Measuring method	Recordable revolutions	Resolution	Position values per revolution	MTTF [years]	PFH [h]
EnDat 2.2 EQI 1131 Safety	S2	Inductive	4096	19 bit	524288	> 100	$\leq 15 \times 10^{-9}$
EnDat 2.2 EQN 1135 Safety	S3	Optical	4096	23 bit	8388608	> 100	$\leq 15 \times 10^{-9}$

Encoders with EnDat 2.1 interface

Encoder model	Code	Measuring method	Recordable revolutions	Resolution	Position values per revolution	Periods per revolution	MTTF [years]	PFH [h]
EnDat 2.1 EQN 1125	Q4	Optical	4096	13 bit	8192	Sin/cos 512	> 57	$\leq 2 \times 10^{-6}$
EnDat 2.1 EQI 1130-G3	Q2	Inductive	4096	18 bit	262144	Sin/cos 16	> 100	$\leq 6 \times 10^{-7}$

Encoders with HIPERFACE DSL interface

Encoder model	Code	Measuring method	Recordable revolutions	Resolution	Position values per revolution	MTTF [years]	PFH [h]
EDM35	H6	Optical	4096	20 bit	1048576	> 100	$\leq 31 \times 10^{-9}$

Notes

- The encoder code is a part of the type designation of the motor.
- Safety = Safety-related position measuring system for use in safety-oriented applications.
- Multiple revolutions of the motor shaft can be recorded only using multi-turn encoders.

15.7.2 Possible combinations with drive controllers

The following table shows the possible combinations of STOBER synchronous servo motors with drive controllers from Beckhoff depending on the encoder model.

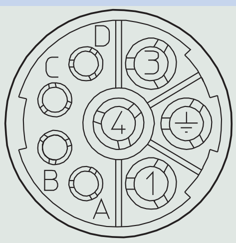
Drive controller		AX5000 8-pin[6] EnDat 2.1	AX8000/5000 OCS 9-pin[7] HIPERFACE DSL	AX5000 9-pin[8] EnDat 2.1	AX8000 9-pin[9] EnDat 2.2
Drive controller code		FM	HK	HN	HO
Connection plan ID		442318	443393	443451	443452
Encoder	**Encoder code**				
EnDat 2.2 EQI 1131 Safety	S2				EZ
EnDat 2.2 EQN 1135 Safety	S3				EZ
EnDat 2.1 EQN 1125	Q4	EZ		EZ	
EnDat 2.1 EQI 1130-G3	Q2			EZ	
EDM35	H6		EZ		

The encoder and drive controller codes are a part of the type designation of the motor.

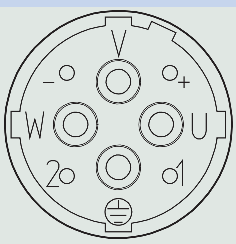
15.7.3 Terminal assignment of 8-pin power plug connector

The size and connection diagram of the power plug connector depend on the size of the motor.

Plug connector size con.23

Connection diagram	Pin	Connection
	1	1U1 (U phase)
	3	1W1 (W phase)
	4	1V1 (V phase)
	A	1BD1 (brake +)
	B	1BD2 (brake –)
	C	1TP1 (temperature sensor +)
	D	1TP2 (temperature sensor –)
	⏚	PE (grounding conductor)

Plug connector size con.40

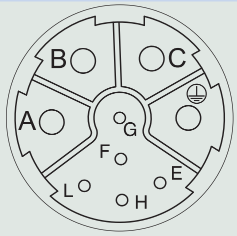
Connection diagram	Pin	Connection
	U	1U1 (U phase)
	V	1V1 (V phase)
	W	1W1 (W phase)
	+	1BD1 (brake +)
	–	1BD2 (brake –)
	1	1TP1 (temperature sensor +)
	2	1TP2 (temperature sensor –)
	⏚	PE (grounding conductor)

[6] Design of the power connector
[7] Design of the power connector
[8] Design of the power connector
[9] Design of the power connector

15.7.4 Terminal assignment of 9-pin power plug connector

The size and connection diagram of the power plug connector depend on the size of the motor.

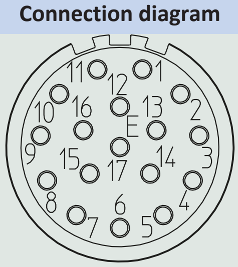
Plug connector size con.23

Connection diagram	Pin	Connection
	A	1U1 (U phase)
	B	1V1 (V phase)
	C	1W1 (W phase)
	E	1TP2 (temperature sensor -)
	F	
	G	1BD1 (brake +)
	H	1TP1 (temperature sensor +)
	L	1BD2 (brake –)
	⏚	PE (grounding conductor)

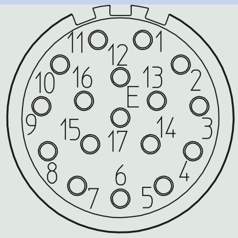
15.7.5 Connection assignment of the encoder plug connector

The size and terminal assignment of the encoder plug connectors depend on the type of encoder installed and the size of the motor.

EnDat 2.2 digital encoder, plug connector size con.23

Connection diagram	Pin	Connection
	1	
	2	0 V GND
	3	
	4	Up +
	5	Data +
	6	
	7	
	8	Clock +
	9	
	10	0 V sense
	11	
	12	Up sense
	13	Data –
	14	
	15	Clock –
	16	
	17	

EnDat 2.1 encoder with sin/cos incremental signals, plug connector size con.23

Connection diagram	Pin	Connection
	1	B − (Sin −)
	2	0 V GND
	3	A − (Cos −)
	4	Up +
	5	Data +
	6	
	7	
	8	Clock +
	9	B + (Sin +)
	10	0 V sense
	11	A + (Cos +)
	12	Up sense
	13	Data −
	14	
	15	Clock −
	16	
	17	

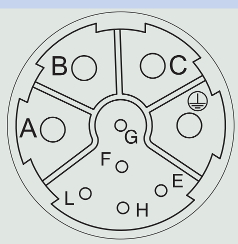
15.7.6 Terminal assignment for plug connectors (One Cable Solution)

In the One Cable Solution design, the power and encoder lines are connected using a shared plug connector.

The size of the plug connector depends on the size of the motor.

The temperature sensor of the motor is connected to the encoder internally. The measured values from the temperature sensor are transmitted via the log of the encoder.

Plug connector size con.23

Connection diagram	Pin	Connection
	A	1U1 (U phase)
	B	1V1 (V phase)
	C	1W1 (W phase)
	E	DSL− (L)
	F	DSL shield
	G	1BD1
	H	DSL+ (H)
	L	1BD2
	⏚	PE (grounding conductor)

15.8 Connection to Allen-Bradley drive controllers

This chapter contains the information for connecting STOBER synchronous servo motors to drive controllers of the above-named manufacturer which differs from connecting to STOBER drive controllers. You can find all other information about STOBER synchronous servo motors in the chapter EZ synchronous servo motors.

The STOBER EZ geared motors can be parameterized to Kinetix 5500/5700/6500 drive controllers fully automatically. EZ motors without an attached gearbox and other STOBER series are excluded.

STOBER has taken the following measures to minimize the effort of commissioning STOBER motors connected to Allen-Bradley drive controllers and avoid errors during parameterization:

- The commutation offset of the motor was set so that calibration by the customer is not necessary.
- The electronic nameplate of the motor was designed to be compatible with the Kinetix 5500/5700/6500.
- STOBER tests the motor connected to Allen-Bradley drive controllers before delivery to the customer.
- Parameter lists are available on request at systemsupport@stoeber.de.

More information on commissioning EZ motors connected to Allen-Bradley drive controllers can be found in the 443244_en document in the download area on the STOBER website.

15.8.1 Encoders

Information

The safety functionality of the encoders cannot be used in combination with Allen-Bradley drive controllers because, for applications with safety functionality, Allen-Bradley only permits its own motors.

Encoders with EnDat 2.2 interface

Encoder model	Code	Measuring method	Recordable revolutions	Resolution	Position values per revolution	MTTF [years]	PFH [h]
EnDat 2.2 EQN 1135 Safety	S3	Optical	4096	23 bit	8388608	> 100	≤ 15 × 10^{-9}

Encoders with HIPERFACE DSL interface

Encoder model	Code	Measuring method	Recordable revolutions	Resolution	Position values per revolution	MTTF [years]	PFH [h]
EDM35	H6	Optical	4096	20 bit	1048576	> 100	≤ 31 × 10^{-9}

Notes

- The encoder code is a part of the type designation of the motor.
- Safety = Safety-related position measuring system for use in safety-oriented applications.
- Multiple revolutions of the motor shaft can be recorded only using multi-turn encoders.

15.8.2 Possible combinations with drive controllers

The following table shows the possible combinations of STOBER motors and geared motors with drive controllers from Allen-Bradley depending on the encoder model.

Information

The safety functionality of the encoders cannot be used in combination with Allen-Bradley drive controllers because, for applications with safety functionality, Allen-Bradley only permits its own motors.

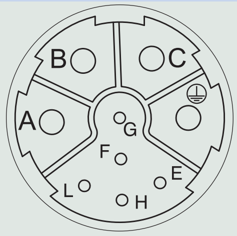
Drive controller		**KINETIX 5500 OCS** HIPERFACE DSL	**KINETIX 5700 OCS** HIPERFACE DSL	**KINETIX 5700** EnDat 2.2	**KINETIX 6500** EnDat 2.2
Drive controller code		HB	GD	HA	GC
Connection plan ID		443169	442449	443096	442448
Encoder	**Encoder code**				
EnDat 2.2 EQN 1135 Safety	S3	–	–	EZ	EZ
EDM35	H6	EZ	EZ	–	–

The encoder and drive controller codes are a part of the type designation of the motor.

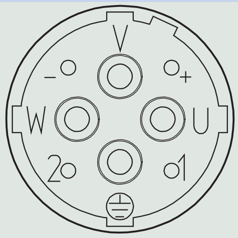
15.8.3 Terminal assignment of the power plug connector

The size and connection diagram of the power plug connector depend on the size of the motor.

Plug connector size con.23

Connection diagram	Pin	Connection
	A	1U1 (U phase)
	B	1V1 (V phase)
	C	1W1 (W phase)
	F	MBRK + (1BD1)
	G	MBRK – (1BD2)
	E	
	H	
	L	
	⏚	PE (grounding conductor)

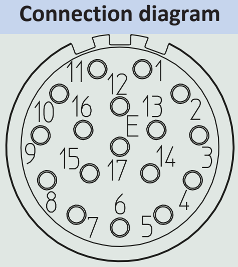
Plug connector size con.40

Connection diagram	Pin	Connection
	U	1U1 (U phase)
	V	1V1 (V phase)
	W	1W1 (W phase)
	+	MBRK + (1BD1)
	–	MBRK – (1BD2)
	1	
	2	
	⏚	PE (grounding conductor)

15.8.4 Terminal assignment of the encoder plug connector

The size and terminal assignment of the encoder plug connectors depend on the model of encoder installed and the size of the motor.

EnDat 2.2 digital encoder, plug connector size con.23

Connection diagram	Pin	Connection
	1	
	2	
	3	
	4	
	5	DATA +
	6	DATA –
	7	CLK + (Clock +)
	8	CLK – (Clock –)
	9	EPWR_5V (Up +)
	10	ECOM (0 V)
	11	
	12	
	13	TS + (1TP1)
	14	TS – (1TP2)
	15	
	16	
	17	

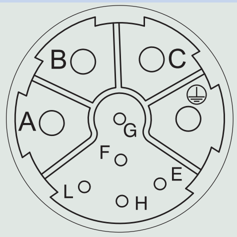
15.8.5 Terminal assignment for plug connectors (One Cable Solution)

In the One Cable Solution design, the power and encoder lines are connected using a shared plug connector.

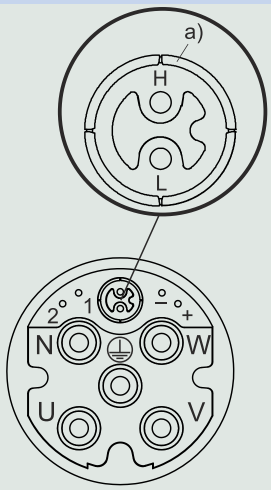
The size of the plug connector depends on the size of the motor.

The temperature sensor of the motor is connected to the encoder internally. The measured values from the temperature sensor are transmitted via the log of the encoder.

Plug connector size con.23

Connection diagram	Pin	Connection
	A	1U1 (U phase)
	B	1V1 (V phase)
	C	1W1 (W phase)
	E	DATA + (DSL +)
	F	MBRK + (1BD1)
	G	MBRK – (1BD2)
	H	DATA – (DSL –)
	L	
	⏚	PE (grounding conductor)

Plug connector size con.40

Connection diagram	Pin	Connection
	U	1U1 (U phase)
	V	1V1 (V phase)
	W	1W1 (W phase)
	N	
	+	
	–	
	1	MBRK + (1BD1)
	2	MBRK – (1BD2)
	H	DATA – (DSL –)
	L	DATA + (DSL +)
	⏚	PE (grounding conductor)
a) Coaxial shield to which the DSL shield is connected		

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17 Appendix

Table of contents

17.1 Formula symbols

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

Symbol	Unit	Explanation
a^*	m/s^2	Acceleration
a_{NOT*}	m/s^2	Emergency off acceleration
a_{th}	–	Parameter for calculating $K_{mot,th}$
a_{thEL}	–	Parameters for calculating $K_{mot,th}$ (dependent on the mounting position)
B_{10}	–	Number of cycles after which 10% of components have failed
B_{10D}	–	Number of cycles until 10% of components have failed dangerously
C_{lin}	N/µm	Linear total spring rigidity in relation to gearbox output at F_{f2acc}
C_{linE}	N/µm	Linear total spring rigidity in relation to gearbox output at F_{f2acc}, pinion position E
d_0	mm	Pitch circle diameter
ΔJ_B	$kgcm^2$	Additive mass moment of inertia of a motor with brake
Δm_B	kg	Additive weight of a motor with brake
Δs	mm	Linear backlash resulting from the backlash of the gearbox
Δs_{red}	mm	Reduced linear backlash resulting from the backlash of the gearbox
Δs_{redI}	mm	Reduced linear backlash resulting from the backlash of the gearbox (backlash class I)
Δs_{redII}	mm	Reduced linear backlash resulting from the backlash of the gearbox (backlash class II)
ED_{10}	%	Duty cycle based on 10 minutes
F_{ax}	N	Permitted axial force on the output
F_{ax*}	N	Actual axial force on the output
F_{ax100}	N	Permitted axial force on the output for $n_{m*} \leq 100$ rpm
$fB_{KHß}$	–	Load distribution operating factor (takes into account uneven load distribution across the tooth width)
fB_{lub}	–	Lubrication operating factor
fB_{op}	–	Operating mode operating factor
fB_t	–	Runtime operating factor
fB_T	–	Temperature operating factor
fB_{ZB}	–	Operating factor for cyclic operation
F_f	kN	Permitted feed force
$F_{f,max}$	kN	Maximum permitted feed force
$\lvert F_{f2} \rvert$	kN	Absolute value of feed force at output
F_{f2}	kN	Feed force on gearbox output at n_1 = 500 rpm
$F_{f2,0}$	kN	Standstill feed force at gearbox output at n_1 = 500 rpm
$F_{f2,1*} - F_{f2,4*}$	kN	Existing feed force in the respective time segment (1 to 4)
$F_{f2,n*}$	kN	Existing feed force in the nth time segment
F_{f2acc}	kN	Permitted acceleration feed force at the gearbox output
F_{f2acc*}	N	Actual acceleration feed force at the gearbox output
F_{f2accE}	kN	Permitted acceleration feed force at the gearbox output, pinion position E
F_{f2accS}	kN	Permitted acceleration feed force at the gearbox output, pinion position S
F_{f2eq}	kN	Equivalent feed force at the gearbox output
F_{f2eq*}	kN	Actual equivalent feed force at the gearbox output
F_{f2NOT}	kN	Emergency off feed force of the gearbox at the gearbox output for a maximum of 1000 load changes
		Without consideration of the maximum torque of the motor
F_{f2NOT*}	kN	Actual emergency off feed force at the gearbox output
$F_{f2NOT,E}$	kN	Emergency off feed force of the gearbox at the gearbox output for a maximum of 1000 load changes, pinion position E
F_{fNOT}	kN	Emergency off feed force for a maximum of 1000 load changes
F_{L*}	N	Existing load force
F_p	µm	Total pitch error
F_{rad}	N	Permitted radial force on the output
F_{rad*}	N	Actual radial force on the output
F_{rad100}	N	Permitted radial force on the output for $n_{m*} \leq 100$ rpm

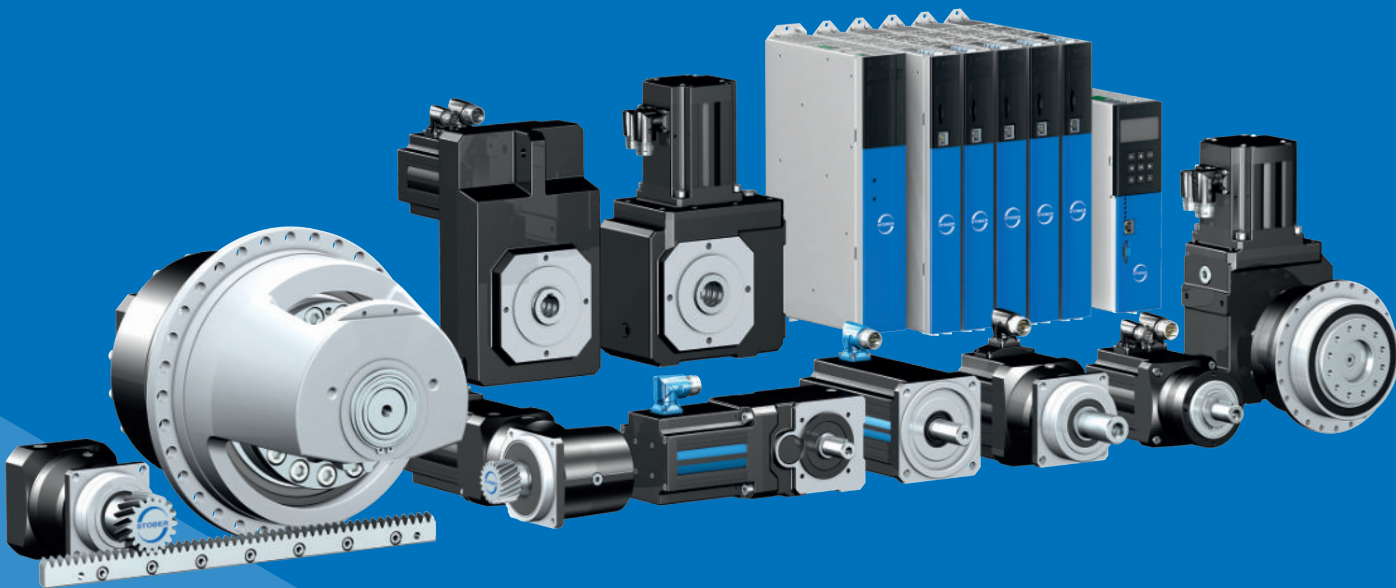
Symbol	Unit	Explanation
F_{sv}	kN	Transmittable feed force of the screw connection
$F_{svLA125}$	kN	Transmittable feed force of the screw connection with 125 mm hole spacing
$F_{svLA125PIN}$	kN	Transmittable feed force of the screw connection with 125 mm hole spacing, pinned
$F_{svLA62.5}$	kN	Transmittable feed force of the screw connection with 62.5 mm hole spacing
$F_{svLA62,5PIN}$	kN	Transmittable feed force of the screw connection with 62.5 mm hole spacing, pinned
F_{svNOT}	kN	Transmittable emergency off feed force of the screw connection for a maximum of 1000 load changes
H	m	Installation altitude above sea level
i	–	Gear ratio
I_0	A	Stall current
I_{max}	A	Maximum current
I_N	A	Nominal current
$I_{N,B}$	A	Nominal current of the brake at 20 °C
$I_{N,F}$	A	Nominal current of the forced ventilation unit
J_{Bstop}	$kgcm^2$	Reference mass moment of inertia when braking from full speed: $J_{Bstop} = J_{dyn} \times 2$
J_{dyn}	$kgcm^2$	Mass moment of inertia of a motor in dynamic operation
J_{tot}	kgm^2	Total mass moment of inertia (based on the motor shaft)
K_{EM}	V/1000 rpm	Voltage constant: peak value of the induced voltage between the phases U, V, W of the motor at operating temperature at a speed of 1000 rpm
K_H	–	Derating factor for installation altitude
K_{M0}	Nm/A	Torque constant: ratio of the stall torque and frictional torque to the stall current; $K_{M0} = (M_0 + M_R) / I_0$ (tolerance ±10%)
$K_{M,N}$	Nm/A	Torque constant: ratio of the nominal torque M_N to the nominal current I_N; $K_{M,N} = M_N / I_N$ (tolerance ±10%)
$K_{mot,th}$	–	Factor for determining the thermal limit torque
K_{ϑ}	–	Derating factor for surrounding temperature
l	mm	Length of the output shaft
L_{pA}	dB(A)	Sound pressure level of gearbox at n_{1N} = 2000 rpm
L_{U-V}	mH	Winding inductance of a motor between two phases (determined in a resonant circuit)
LW	-	Load change: A load change (LW) corresponds to an acceleration and a deceleration.
m*	kg	Mass to be accelerated
M	Nm	Torque
M_0	Nm	Stall torque: The continuous torque the motor is able to deliver at a speed of 10 rpm (tolerance ±5%)
$M_{1*} – M_{4*}$	Nm	Actual torque of the motor in the respective time segment (1 to 4)
$M_{2.1*} – M_{2.4*}$	Nm	Actual torque in the respective time segment (1 to 4)
$M_{2,n*}$	Nm	Actual torque in the n-th time segment
M_{2acc}	Nm	Maximum permitted acceleration torque on the gearbox output
M_{2accE}	Nm	Maximum permitted acceleration torque at the gearbox output, pinion position E
M_{2eff*}	Nm	Actual effective torque on the gearbox output
M_{2th}	Nm	Thermal limit torque on the gearbox output
M_{Bdyn}	Nm	Dynamic braking torque at 100 °C
M_{Bstat}	Nm	Static braking torque of the motor brake at 100 °C
m_{dyn}	kg	Weight of a motor in dynamic operation
M_{eff*}	Nm	Actual effective torque of the motor
m_F	kg	Weight of the forced ventilation unit
M_k	Nm	Permitted tilting torque on the output
M_{k*}	Nm	Actual tilting torque on the output
M_{k100}	Nm	Permitted tilting torque on the output for $n_{m*} \leq$ 100 rpm
M_L	Nm	Load torque
M_{lim}	Nm	Torque limit without field weakening
M_{limF}	Nm	Torque curve of the motor with forced ventilation in continuous operation

Symbol	Unit	Explanation
M_{limFW}	Nm	Torque limit with field weakening (applies to operation on STOBER drive controllers only)
M_{limK}	Nm	Torque curve of the motor with convection cooling in continuous operation
M_{max}	Nm	Maximum torque: the maximum permitted torque the motor is able to deliver over a short period (when accelerating or decelerating) (tolerance ±10%)
M_{max*}	Nm	Actual maximum torque
m_n	mm	Normal module
M_{n*}	Nm	Actual torque of the motor in the n-th time segment
M_N	Nm	Nominal torque: the maximum torque of a motor in S1 mode at nominal speed n_N (tolerance ±5%)
M_{Nred}	Nm	Reduced nominal torque of the motor
M_{op}	Nm	Torque of motor at the operating point from the motor characteristic curve at n_{1m*}
M_R	Nm	Frictional torque (of the bearings and seals) of a motor at winding temperature $\Delta\vartheta$ = 100 K
n	rpm	Speed
n_{1m*}	rpm	Actual average input speed
n_{1max*}	rpm	Actual maximum input speed
n_{1maxDB}	min^{-1}	Maximum permitted input speed of the gearbox in continuous operation
n_{1maxZB}	min^{-1}	Maximum permitted input speed of the gearbox in cyclic operation
N_{Bstop}	–	Permitted number of braking processes from full speed (n = 3000 rpm) with J_{Bstop} (M_L = 0). The following applies if the values of n and J_{Bstop} differ: $N_{Bstop} = W_{B,Rlim} / W_{B,R/B}$.
n_{m*}	rpm	Actual average motor speed
$n_{m,1*} – n_{m,4*}$	rpm	Actual average speed of the motor in the respective time segment (1 to 4)
$n_{m,n*}$	rpm	Actual average speed of the motor in the n-th time segment
n_N	rpm	Nominal speed: The speed for which the nominal torque M_N is specified
P_N	kW	Nominal power: the power the motor is able to deliver long term in S1 mode at the nominal point (tolerance ±5 %)
$P_{N,F}$	W	Nominal output of the forced ventilation unit
q_{vF}	m^3/h	Delivery capacity of the forced ventilation unit in open air
R_{U-V}	Ω	Winding resistance of a motor between two phases at a winding temperature of 20 °C
S	–	Service factor: Quotient of the nominal torque from the gearbox and the motor without consideration for thermal limiting performance. Represents a value for the reserve of the geared motor.
t	s	Time
$t_{1*} – t_{4*}$	s	Duration of the respective time segment (1 to 4)
$t_{1*} – t_{n*}$	s	Duration of the respective time segment
t_{11B}	ms	Response delay: time from when the current is turned off until the torque increases
t_{1B}	ms	Linking time: time from when the current is turned off until the nominal braking torque is reached
t_{2B}	ms	Disengagement time: time from when the current is turned on until the torque begins to drop
t_{dec}	ms	Stop time
T_{el}	ms	Electrical time constant: ratio of the winding inductance to the winding resistance of a motor: $T_{el} = L_{U-V} / R_{U-V}$
ϑ_{amb}	°C	Surrounding temperature
t_{n*}	s	Duration of the n-th time segment
U	V	Voltage
$U_{N,B}$	V	Nominal voltage of brake
$U_{N,F}$	V	Nominal voltage of the forced ventilation unit
$\lvert v_{f2} \rvert$	m/s	Absolute value of feed velocity
v_{f2}	m/s	Feed velocity at gearbox output
v_{f2m*}	m/s	Actual average feed velocity
$v_{f2m,1*} – v_{f2m,4*}$	m/s	Actual average feed velocity in the respective time segment (1 to 4)
$v_{f2m,n*}$	m/s	Actual average feed velocity in the nth time segment

Symbol	Unit	Explanation
$v_{f2maxDB}$	m/s	Maximum feed velocity at the gearbox output at n_{1maxDB}
$v_{f2maxDBEL1,2}$	m/s	Maximum feed velocity at gearbox output at n_{1maxDB} mounting position EL1, EL2
$v_{f2maxDBEL3,4,5,6}$	m/s	Maximum feed velocity at gearbox output at n_{1maxDB} mounting position EL3, EL4, EL5, EL6
$v_{f2maxZB}$	m/s	Maximum feed velocity at the gearbox output at n_{1maxZB}
$W_{B,R/B}$	J	Work done by friction for braking
$W_{B,Rlim}$	kJ	Work done by friction until wear limit is reached
$W_{B,Rmax/h}$	kJ/h	Maximum permitted work done by friction per hour with individual braking
x	mm	Profile offset factor
x_2	mm	Distance of the shaft shoulder to the force application point
$x_{B,N}$	mm	Nominal air gap of brake
y_2	mm	Distance of the shaft axis to the axial force application point
z	–	Number of teeth
z_2	mm	Distance of the shaft shoulder to the middle of the output bearing
z_{pin}	–	Number of pinion teeth

17.2 Sales terms and delivery conditions

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



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