Product Description

Outstanding features

Rexroth Feed Modules VKK are precise, ready-to-install linear motion systems that combine high performance with compact dimensions. They are especially suitable for handling tasks requiring high precision as well as high thrust and torque transfer capabilities. Because of their low moved mass, Feed Modules VKK are ideal for vertical motion in Z-axes.

Rexroth offers favorable price/performance ratios and fast delivery.

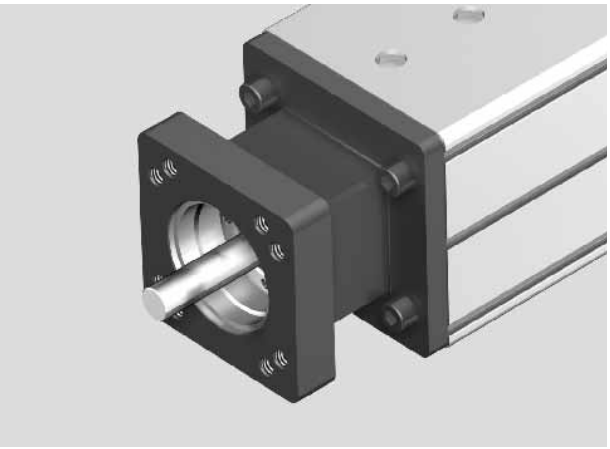
Structural design
- Extremely compact extruded aluminum profile (frame) with Ball Rail System in eLINE technology
- Precision Ball Screw Drive in tolerance grade 7 with zero-backlash nut system
- Fixed bearing end block made of aluminum with two-row, preloaded angular-contact thrust ball bearing

Attachments
- Maintenance-free digital AC servo drives with integrated brake and attached feedback, or stepping motors
- Motor mount and coupling or timing belt side drive for motor attachment
- Switches

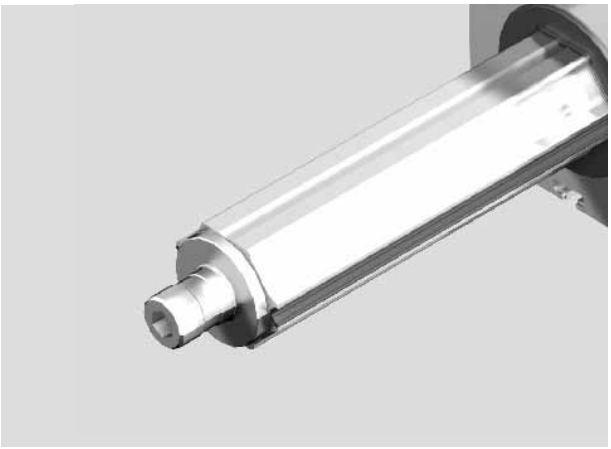
Drive controllers and control systems

Further highlights

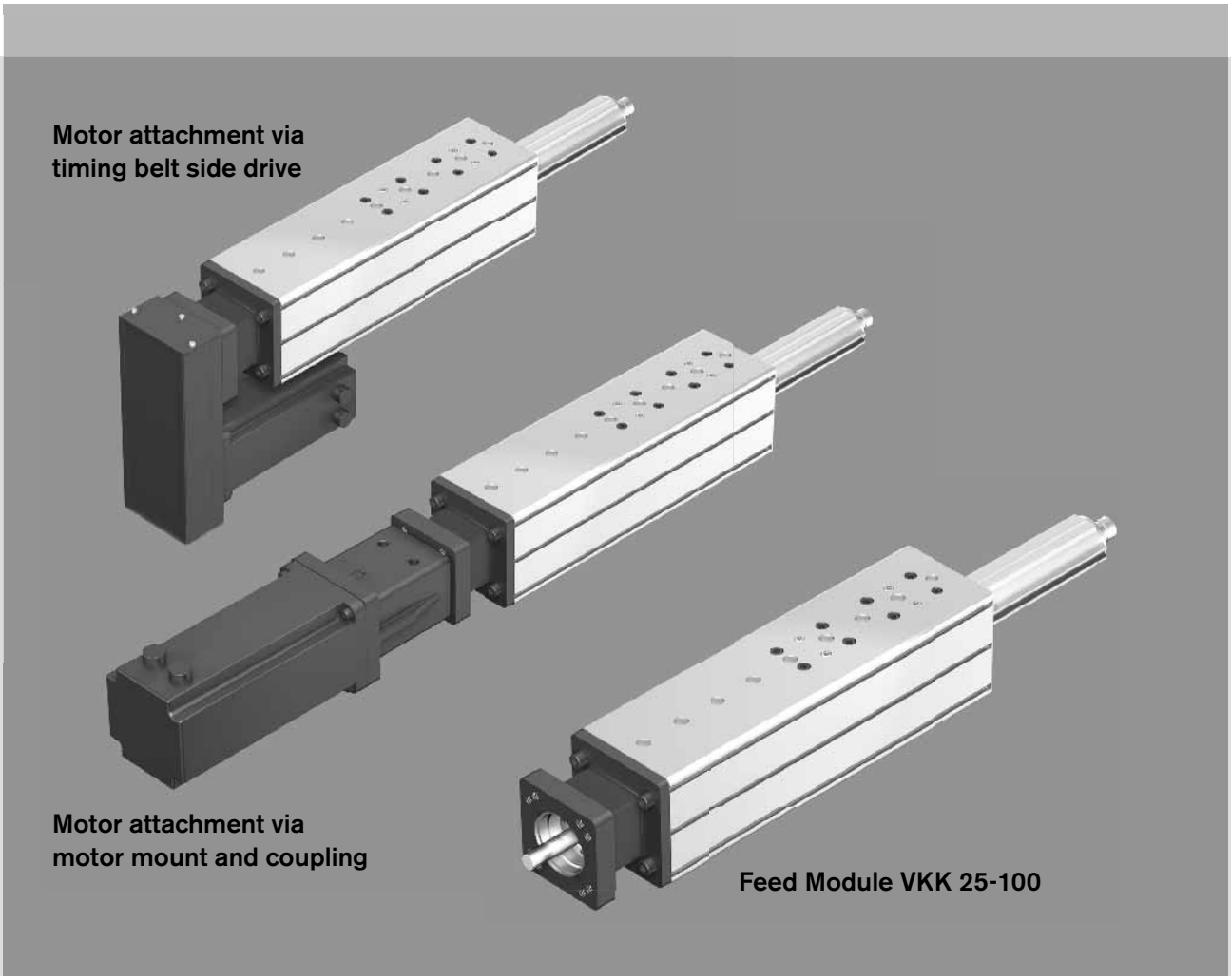
- Optimal travel performance, high load capacities and high rigidity due to integrated, zero-clearance ball rail system
- Especially compact design due to integrated ball screw drive
- Ball screw drive with zero-backlash nut system assures high positioning accuracy and repeatability
- Low-cost maintenance provided by one-point lubrication (grease) of the ball rail system and the ball screw drive
- Easy motor attachment due to locating feature and fastening threads
- Enclosed guideway
- Switches can be positioned anywhere along the travel range
- Switch activation without switching cam
- Easy installation of various attachments
- Fully compatible with the camoLINE system
- Positive-locking connection technology with centering rings

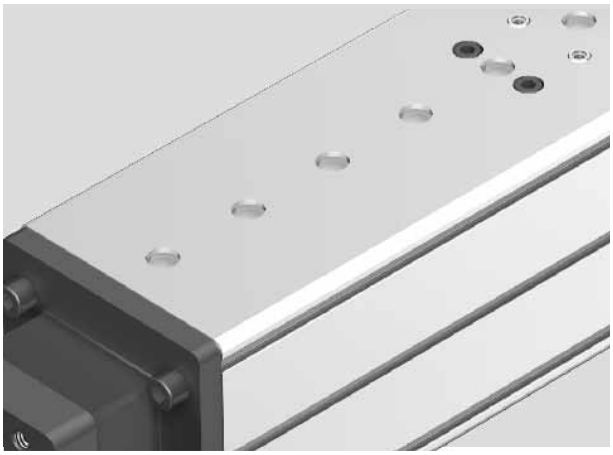


End block with threads and locating feature for motor attachment

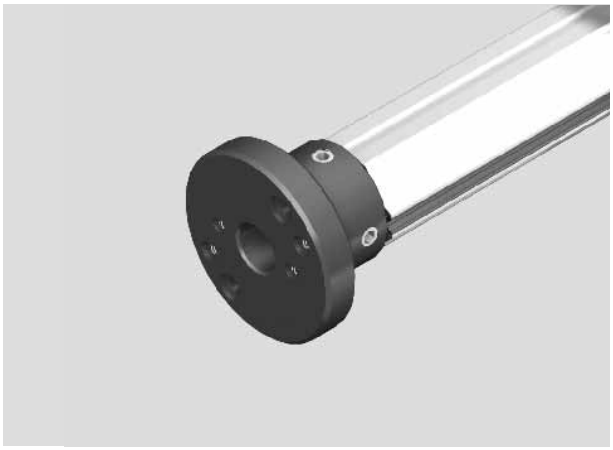


Thrust rod with mounting interface for standard flange





Centering holes for positive-locking connections with good repeatability to simplify installation
(camoLINE Cartesian Motion building system)



Thrust rod with standard flange for a variety of attachments

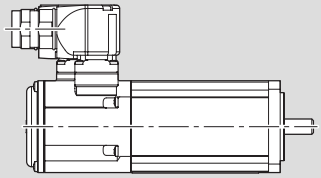
Product Overview

Motor selection based on drive controllers and control system

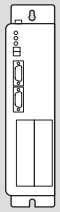
Several motor-controller combinations are available in order to provide the most cost-effective solution for every customer application.
When sizing the drive unit, always consider the motor-controller combination.

Refer to the “Controllers, Electrical Accessories” catalogs for more information about motors and control systems.

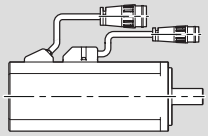
Digital AC servo motors MSK



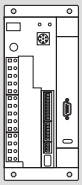
Digital controllers
IndraDrive



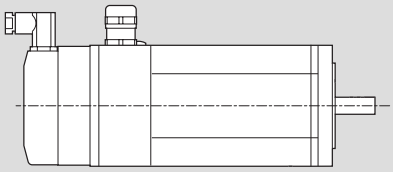
Digital AC servo motors MSM



Digital controllers
ECODRIVE Cs

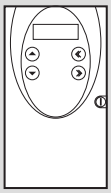


3-phase stepping motors

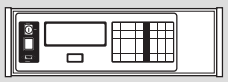


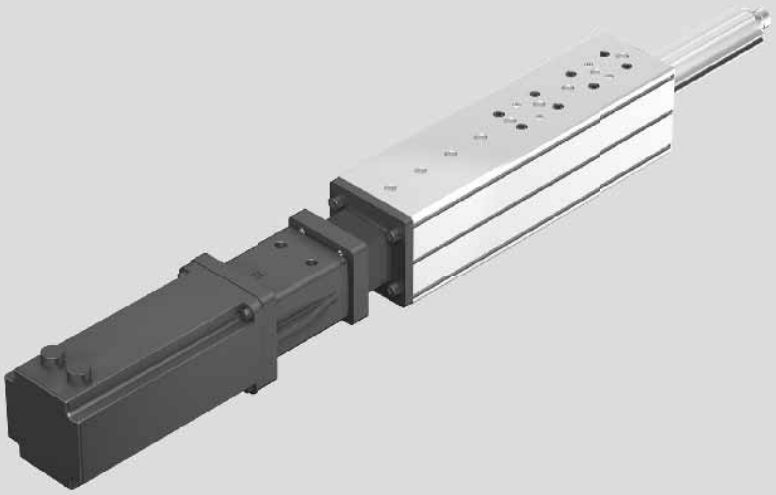
Power electronics

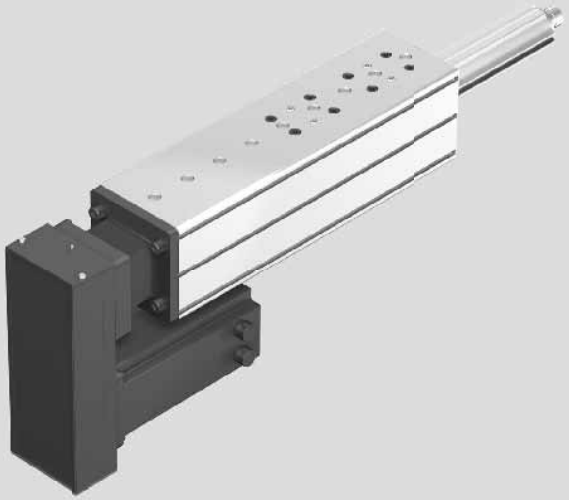
SD326
SD328



Profi Step
control unit







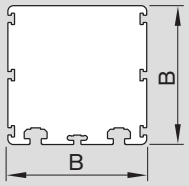
Feed Modules VKK are available as complete solutions with motor and controller.

Product Overview

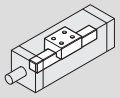
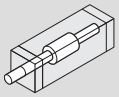
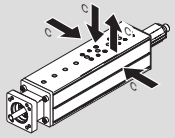
Type designation (size)

Feed Modules VKK are identified by the type designation and size.

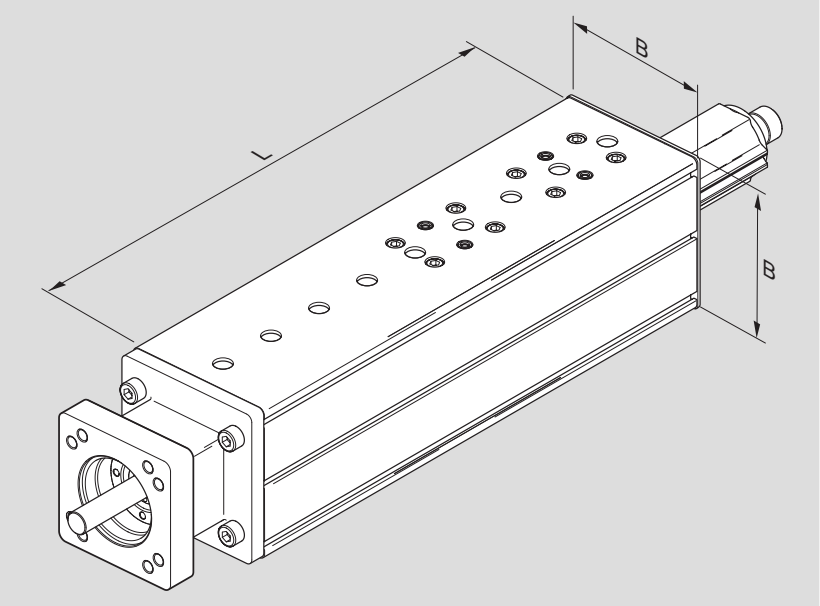
Description		Type			Size
	Example: Feed Module	**V**	**K**	**K**	**25-100**
System	Feed Module **(V)**				
Guideway	Integrated Ball Rail System **(K)**				
Drive unit	Ball Screw **(K)**				
Frame size	Width of frame (mm) Example: B = 100 mm				



Overview of types with load capacities

Type	System	Guideway	Drive unit	Size	Load capacities
					 C (N)
VKK	Feed Module	Ball rail system	Ball screw drive	**15-70**	8120
				25-100	26000

Dimensions



Standard lengths L

Feed Module		VKK 15-70	VKK 25-100	Stroke
B	**mm**	70	100	
L	**mm**	280	360	80
		320	400	120
		400	480	200
		520	600	320
		600	680	400

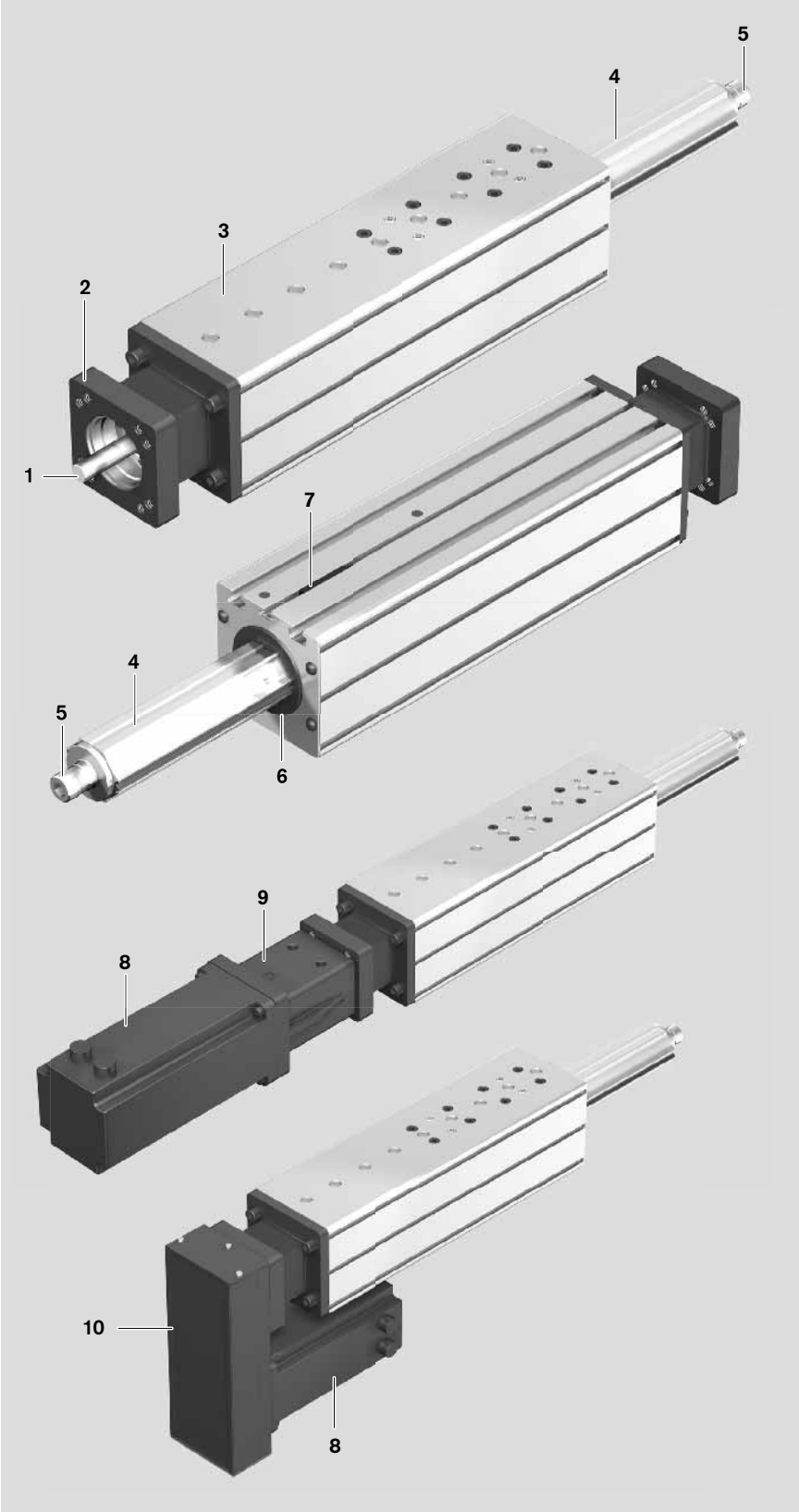
Structural Design

Feed Module VKK

1 Ball screw with zero-backlash cylindrical single nut
2 Fixed bearing end block
3 Frame
4 Thrust rod
5 Mounting interface for standard flange
6 End seal

Attachments

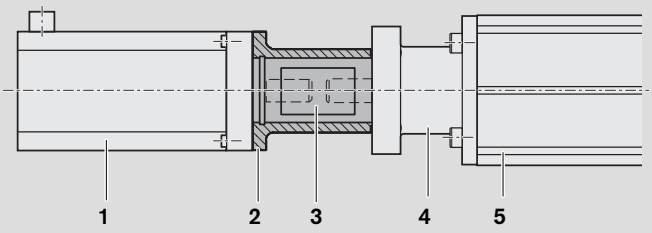
7 Magnetic field sensor
8 Motor
9 Motor mount and coupling
10 Timing belt side drive



Motor mount and coupling

A motor can be attached to all Feed Modules by means of a motor mount and coupling.

The motor mount serves to fasten the motor to the Feed Module and acts as a closed housing for the coupling. The motor's drive torque is transmitted backlash-free through the coupling to the Feed Module's screw shaft.



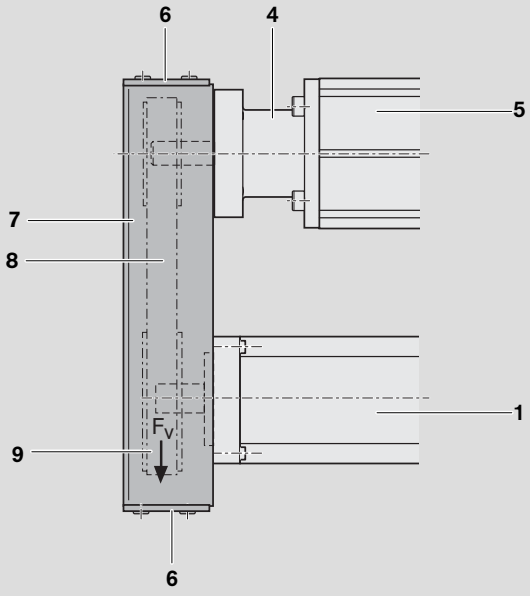
Timing belt side drive

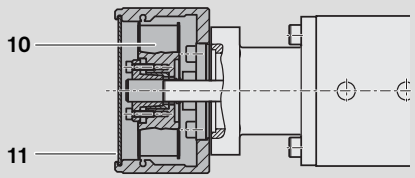
All Feed Modules offer the option of attaching the motor via a side drive with timing belt.
This results in a shorter overall length compared to a motor attachment via motor mount and coupling.
The compact, closed housing protects the belt and secures the motor. Various gear ratios are also available:

- i = 1 : 1
- i = 1 : 1.5
- i = 1 : 2

The timing belt side drive can be mounted in four different directions:

- below, above (RV01 and RV02)
- left, right (RV03 and RV04)

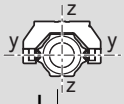




1 Motor
2 Motor mount
3 Coupling
4 Fixed bearing end block
5 Feed Module
6 End cover
7 Extruded, anodized aluminum profile
8 Toothed belt
9 Pre-tensioning of the toothed belt: apply pretensioning force F_v to motor (F_v will be indicated on delivery)
10 Belt pulleys
11 Cover plate

Technical Data

Load capacities and moments

Feed Module	Ball screw	Dynamic load capacity C			Dynamic moments		Planar moment of inertia Thrust rod 		Maximum stroke	Moved mass of system
	d_0 x P	Guide-way (N)	Ball screw (N)	Fixed bearing (N)	M_t (Nm)	M_L (Nm)	I_y (cm^4)	I_z (cm^4)	H_{max} (mm)	m_b (kg)
VKK 15-70	16 x 5	8 120	12 300	13 400	160	280	5.7	6.7	400	1.3
	16 x 10		9 600							
	16 x 16		6 300							
VKK 25-100	20 x 5	26 000	14 300	17 900	670	1 300	12.9	16.2	400	2.5
	25 x 10		15 700							
	20 x 20		13 300							

Maximum permissible loads

Feed Module	Maximum permissible forces		Maximum permissible moments	
	$F_{z\,max}$ (N)	$F_{y\,max}$ (N)	$M_{t\,max}$ (Nm)	$M_{L\,max}$ (Nm)
VKK 15-70	3 250	3 250	55	110
VKK 25-100	10 400	10 400	100	360

Acceptable loads
(recommended from experience)

As far as the desired service life is concerned, loads of up to approximately 20% of the dynamic load and moment values (C, M_t, M_L) have proved acceptable.

The following limits should not be exceeded:
- maximum permissible loads
- permissible drive torque
- permissible travel speed

Note on dynamic load capacities and moments

Determination of the dynamic load capacities and moments is based on a travel life of 100,000 m. Often only 50,000 m are actually stipulated.

For comparison:
Multiply values C, M_t and M_L from the table by 1.26.

Permissible drive torque M_{perm}
Requirement:
No radial load on ball screw shaft

Consider the rated torque of the coupling used!

Permissible travel speed v
Consider the motor speed!

Feed Module	Ball screw d_0 x P	M_{perm} (Nm)	M_{perm} with keyway (Nm)	Travel speed v (m/s)
VKK 15-70	16 x 5	2.2	2.2	0.4
	16 x 10	3.7	3.2	0.8
	16 x 16	4.7	3.2	1.2
VKK 25-100	20 x 5	10.8	10.8	0.3
	25 x 10	12.3	11.3	0.6
	20 x 20	25.5	11.3	1.2

Modulus of elasticity E

$E = 70{,}000\ N/mm^2$

Weight of Feed Module without motor

VKK 15-70: 2.8 kg + 0.0075 (kg/mm) · stroke (mm)
VKK 25-100: 7.2 kg + 0.0143 (kg/mm) · stroke (mm)

Specifications of timing belt side drive for motor attachment via timing belt side drive

Motor		MSM 030 C				MSM 040B			
Frictional torque M_{RRV} (Nm)		0.35				0.4			
		Permissible torque up to length L = … at		Reduced mass moment of inertia at		Permissible torque up to length L = … at		Reduced mass moment of inertia at	
Gear ratio		i = 1	i = 1.5	i = 1	i = 1.5	i = 1	i = 1.5	i = 1	i = 1.5
Feed Module	Ball screw d_0 x P	M_{Rv} (Nm)	M_{Rv} (Nm)	J_{Rv} (10^{-6} kgm²)	J_{Rv} (10^{-6} kgm²)	M_{Rv} (Nm)	M_{Rv} (Nm)	J_{Rv} (10^{-6} kgm²)	J_{Rv} (10^{-6} kgm²)
VKK 15-70	16 x 5	2.2	1.5	40	13	–	–	–	–
	16 x 10	3.0	2.5			–	–		
	16 x 16	3.0	2.5			–	–		
VKK 25-100	20 x 5	–	–	–	–	7.1	4.7	240	84
	20 x 20	–	–			7.1	4.7		
	25 x 10	–	–			7.1	4.7		

Motor		MSK 030 C				MSK 050 C			
Frictional torque M_{RRV} (Nm)		0.35				0.45			
		Permissible torque up to length L = … at		Reduced mass moment of inertia at		Permissible torque up to length L = … at		Reduced mass moment of inertia at	
Gear ratio		i = 1	i = 1.5	i = 1	i = 1.5	i = 1	i = 2	i = 1	i = 2
Feed Module	Ball screw d_0 x P	M_{Rv} (Nm)	M_{Rv} (Nm)	J_{Rv} (10^{-6} kgm²)	J_{Rv} (10^{-6} kgm²)	M_{Rv} Nm	M_{Rv} Nm	J_{Rv} 10^{-6} kgm²	J_{Rv} 10^{-6} kgm²
VKK 15-70	16 x 5	2.2	1.5	37	14	–	–	–	–
	16 x 10	3.0	2.5			–	–		
	16 x 16	3.0	2.7			–	–		
VKK 25-100	20 x 5	–	–	–	–	10.8	5.4	1 420	230
	20 x 20	–	–			15.0	7.5		
	25 x 10	–	–			12.3	6.2		

M_{RRv} = frictional torque of timing belt side drive at motor journal (Nm)
M_{Rv} = permissible torque for system with timing belt side drive at motor journal (Nm); observe max. motor torque M_{Mmax}
J_{Rv} = reduced mass moment of inertia of timing belt side drive (kgm²)
i = timing belt side drive reduction

Constants k_1, k_2, k_3 Frictional torque M_R

Feed Module	Ball screw d_0 x P	Constants k_1	k_2	k_3	Frictional torque M_R (Nm)
VKK 15-70	16 x 5	4.035	0.032	0.633	0.33
	16 x 10	4.350	0.039	2.533	0.34
	16 x 16	4.958	0.047	6.485	0.37
VKK 25-100	20 x 5	39.342	0.086	0.633	0.52
	20 x 20	44.273	0.244	10.132	0.67
	25 x 10	46.551	0.122	2.533	0.69

Coupling data

The couplings with the specifications shown in the table are used with Feed Modules VKK with standard servo motors.

Feed Module	Motor attachment	Coupling data Rated torque M_K (Nm)	Mass moment of inertia J_k (10^{-6} kgm²)	Weight (kg)
VKK 15-70	MSM 030C	19	60	0.26
	MSM 040B			
	MSK 030C			
	MSK 040C			
	VRDM 3910			
	VRDM 3913			
VKK 25-100	MSM 040 B	19	64	0.27
	MSK 050C	50	200	0.7
	VRDM 31117			

Technical Data

Rigidity of thrust rod Feed Module VKK 15-70

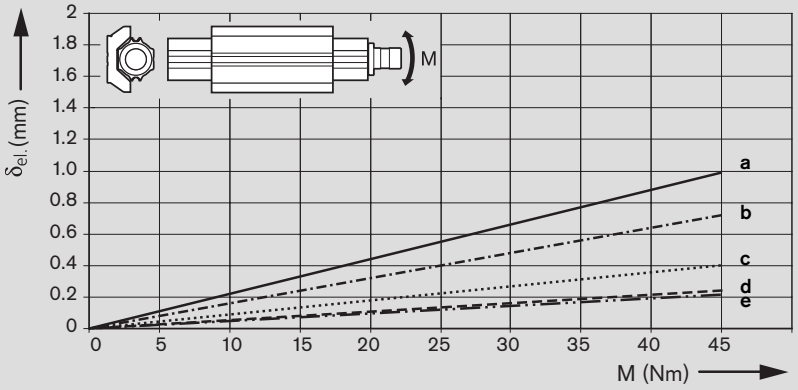
Measured values

Key to graph

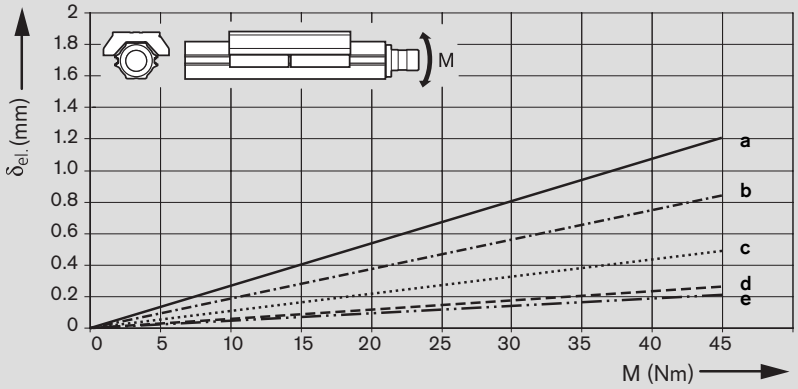
a Stroke = 400 mm
b Stroke = 320 mm
c Stroke = 200 mm
d Stroke = 120 mm
e Stroke = 80 mm

δ_{el} = elastic deflection (mm)
M = torque (Nm)

Rigidity in y-direction



Rigidity in z-direction



Rigidity of thrust rod Feed Module VKK 25-100

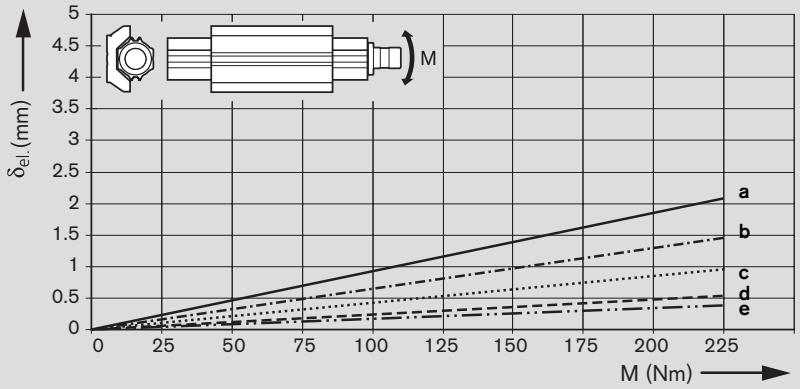
Measured values

Key to graph

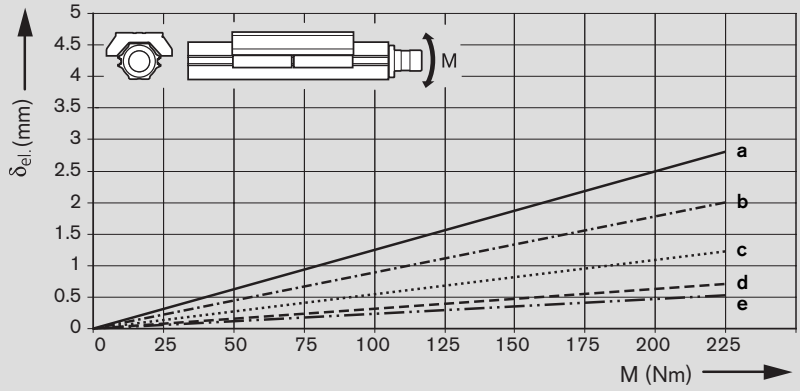
a Stroke = 400 mm
b Stroke = 320 mm
c Stroke = 200 mm
d Stroke = 120 mm
e Stroke = 80 mm

δ_{el} = elastic deflection (mm)
M = torque (Nm)

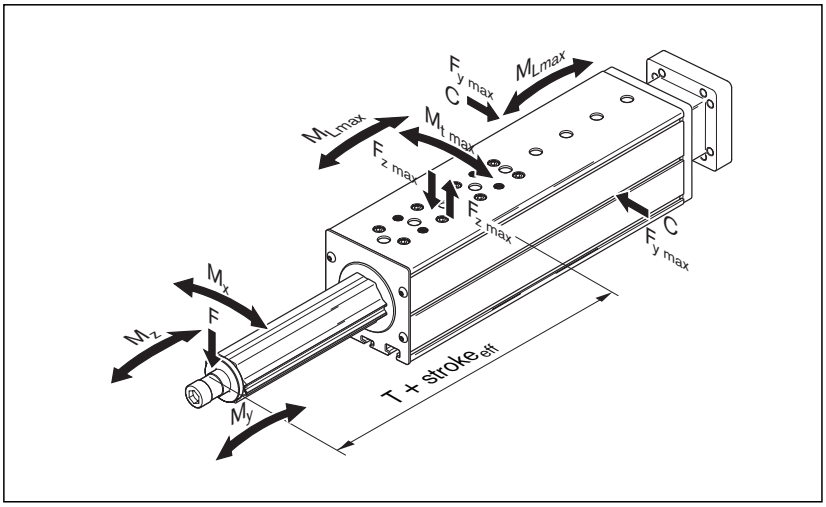
Rigidity in y-direction



Rigidity in z-direction



Calculations



$(T + stroke_{eff})$ = center-to-center distance between runner block and mounting interface

$T_{VKK15-70}$ = 124 mm

$T_{VKK25-100}$ = 166.5 mm

Combined equivalent load on bearing for guideway

(1) $$F_{comb} = |F_y| + |F_z| + C \cdot \frac{|M_x|}{M_t} + C \cdot \frac{|M_y|}{M_L} + C \cdot \frac{|M_z|}{M_L}$$

F_{comb}	=	combined equivalent load on bearing	(N)
F_y	=	force in y-direction	(N)
F_z	=	force in z-direction	(N)
M_x	=	moment about the x-axis	(Nm)
M_y	=	moment about the y-axis	(Nm)
M_z	=	moment about the z-axis	(Nm)
C	=	dynamic load capacity	(N)
M_t	=	dynamic torsional moment load capacity	(Nm)
M_L	=	dynamic longitudinal moment load capacity	(Nm)

Nominal life of guideway

(2) $$L = \left(\frac{C}{F_{comb}}\right)^3 \cdot 10^5 \text{ m}$$

L	=	nominal life	(m)
C	=	dynamic load capacity	(N)
F_{comb}	=	combined equivalent load on bearing	(N)

Nominal life of guideway in operating hours

(3) $$L_h = \frac{L}{3600 \cdot v_m}$$

L	=	nominal life	(m)
L_h	=	nominal life	(h)
v_m	=	average speed	(m/s)

Frictional torque

Motor attachment via motor mount and coupling:

(4) $$M_R = M_{RS}$$

Motor attachment via timing belt side drive:

(5) $$M_R = \frac{M_{RS}}{i} + M_{RRv}$$

M_R	=	frictional torque at motor journal	(Nm)
M_{RS}	=	frictional torque of system	(Nm)
M_{RRv}	=	frictional torque of timing belt side drive at motor journal	(Nm)
i	=	gear ratio	

Calculations

Mass moment of inertia

Condition for handling:
$6 \cdot J_M \geq J_{fr}$

Condition for processing:
$1.5 \cdot J_M > J_{fr}$

Motor attachment via motor mount and coupling:

$$J_{fr} = J_S + J_K + J_{Br}$$

$$J_S = (k_1 + k_2 \cdot L + k_3 \cdot m_{fr}) \cdot 10^{-6}$$

$$J_{tot} = J_{fr} + J_M = J_S + J_K + J_{Br} + J_M$$

Motor attachment via timing belt side drive:

$$J_{fr} = \frac{J_S}{i^2} + J_{Rv} + J_{Br}$$

$$J_S = (k_1 + k_2 \cdot L + k_3 \cdot m_{fr}) \cdot 10^{-6}$$

$$J_{tot} = J_{fr} + J_M = \frac{J_S}{i^2} + J_{Rv} + J_{Br} + J_M$$

J_M	=	mass moment of inertia of motor	(kgm^2)
J_{fr}	=	mass moment of inertia of external load	(kgm^2)
J_S	=	mass moment of inertia of system with external load	(kgm^2)
J_K	=	mass moment of inertia of coupling	(kgm^2)
J_{Br}	=	mass moment of inertia of motor brake	(kgm^2)
J_{tot}	=	total mass moment of inertia	(kgm^2)
J_{Rv}	=	reduced mass moment of inertia of timing belt side drive at motor journal	(kgm^2)
m_{fr}	=	external load	(kg)
i	=	gear ratio	
L	=	length of Feed Module	(mm)
$k_1 ... k_3$	=	constants, see “Constants” table	

Rotary speed

When attaching a gear motor, also include the gear mass moment of inertia and gear reduction in the calculation.

$$n_1 = \frac{i \cdot v \cdot 1000}{P}$$

Conditions:
$n_1 < n_{max}$
$v < v_{perm}$

n_1	=	rotary speed	(min^{-1})
n_{max}	=	maximum usable motor speed	(min^{-1})
P	=	screw lead	(mm)
i	=	gear ratio	
v	=	travel speed (must be $\leq v_{perm}$ from “Permissible speed” chart)	(m/min)