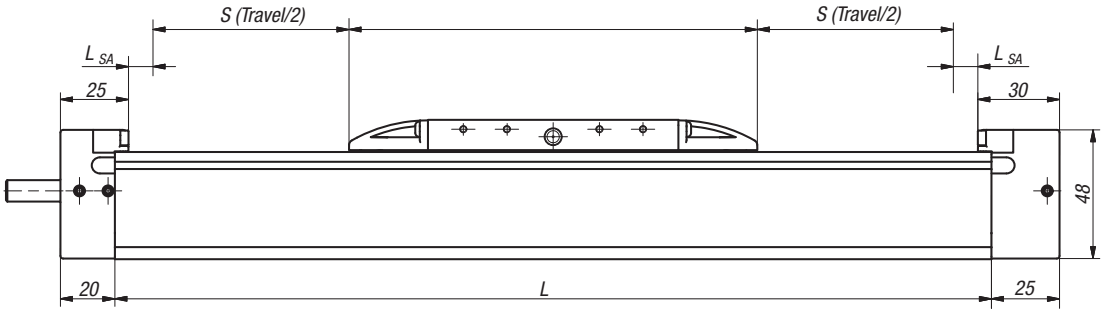
Technical information about linear actuators with ball screws 20331

Length calculation of the linear actuators

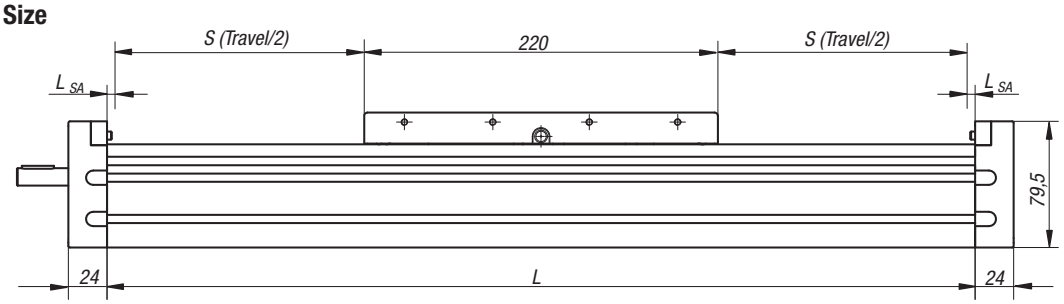
Size



SA	LSA
0	6
2	23
4	40

L = Strav + 150mm + 2 * LSA + 10mm + 2 * travel reserve
Ltotal = L + 45mm

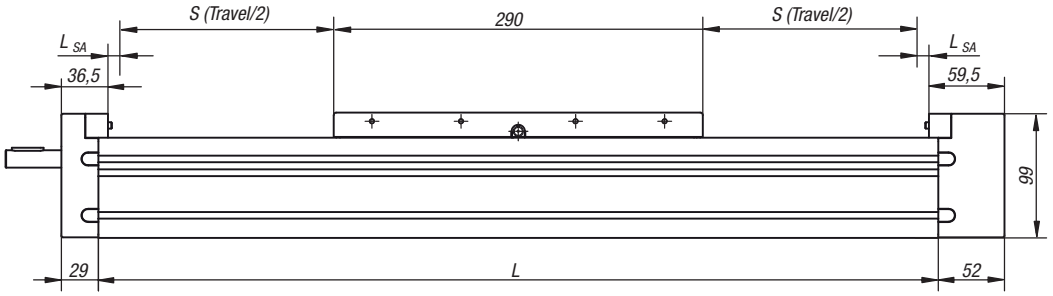
Size



SA	LSA
0	5
2	31
4	62

L = Strav + 220mm + 2 * LSA + 2 * travel reserve
Ltotal = L + 48mm

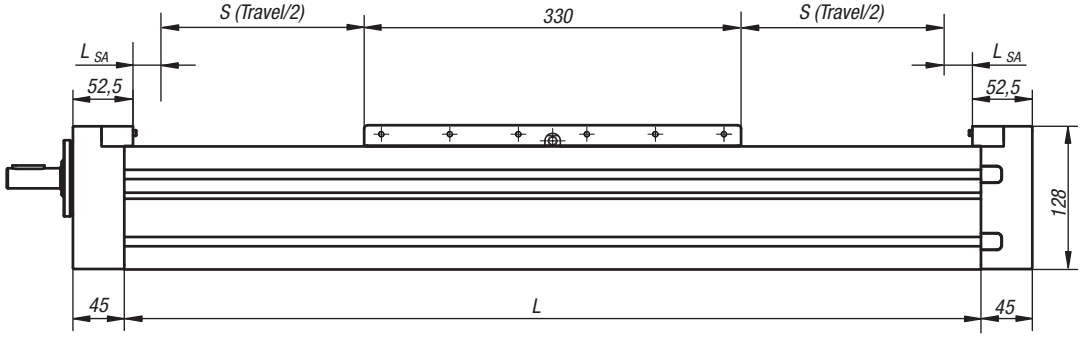
Size



SA	LSA
0	6
2	28,5
4	59,5
6	90,5
8	121,5
10	152,5

L = Strav + 290mm + 2 * LSA + 15mm + 2 * travel reserve
Ltotal = L + 81mm

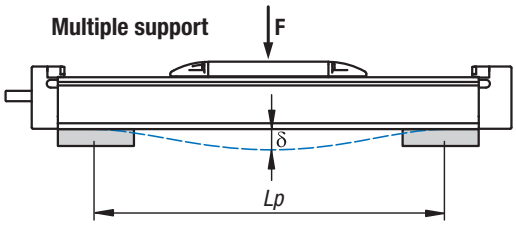
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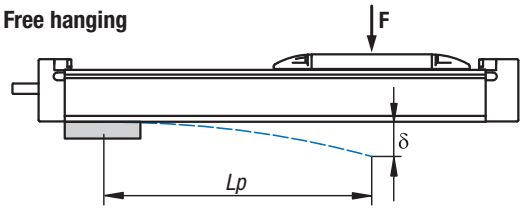


SA	LSA
0	6
2	28,5
4	59,5
6	90,5
8	121,5
10	152,5

L = Strav + 330mm + 2 * LSA + 15mm + 2 * travel reserve
Ltotal = L + 90mm

Deflection of the mechanical linear actuator

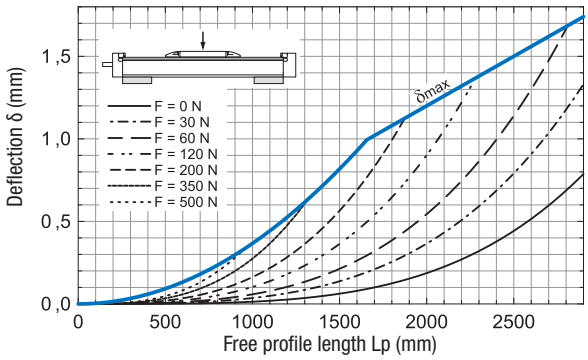


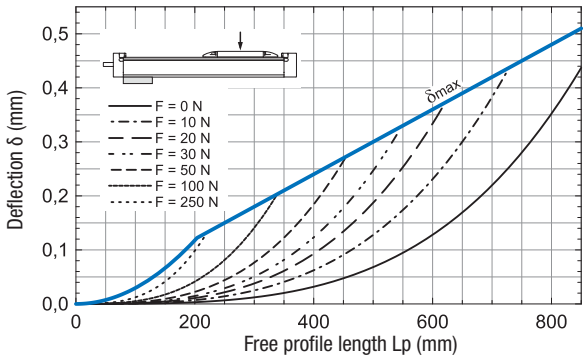


δ Maximum deflection of the linear actuator [mm]
δ Maximum permissible deflection of the linear actuator [mm]
F Force [N]
Lp Free profile length [mm]

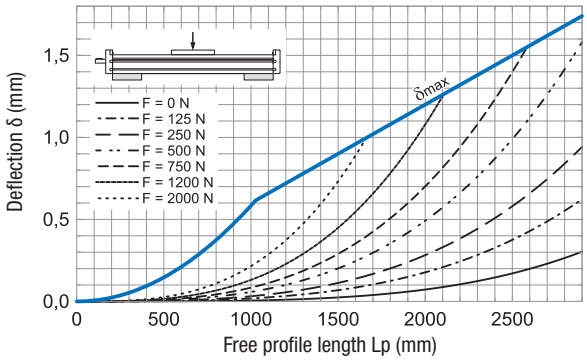
If the maximum deflection exceeds the permissible deflection, additional supports are required

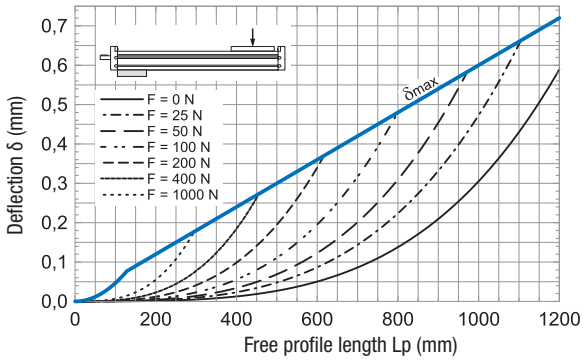
Size



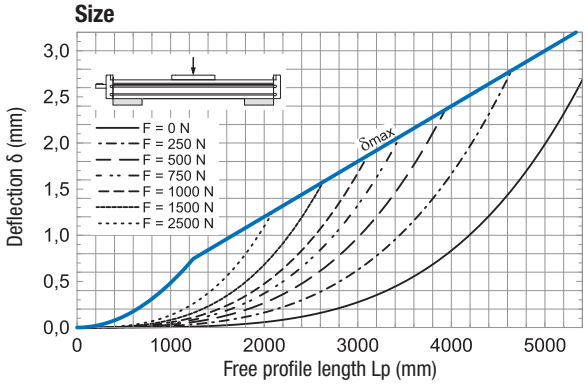


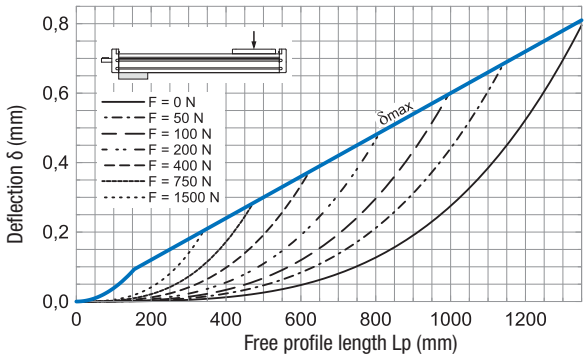
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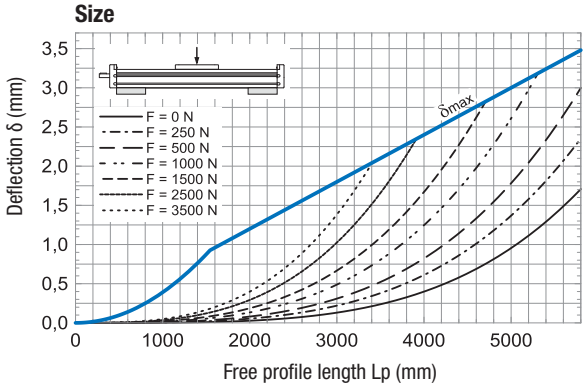


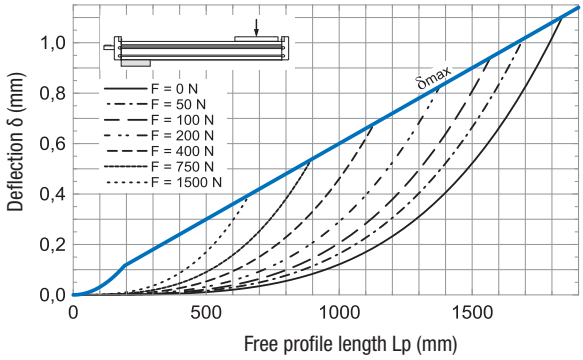
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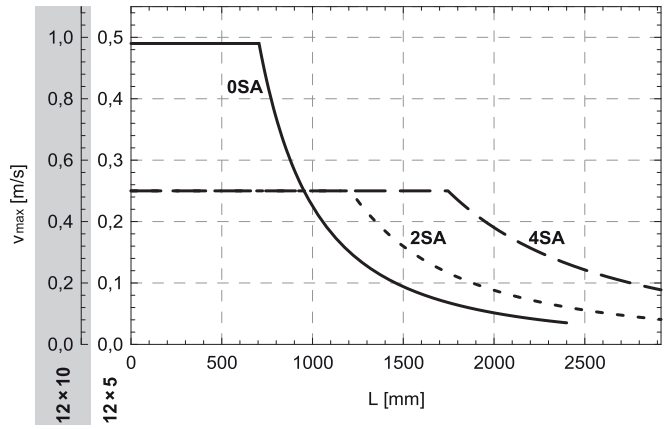
Size





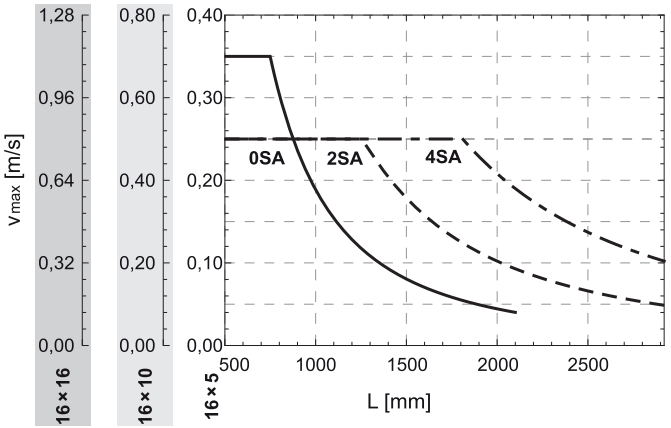
Maximum speed as a function of the profile length

Size

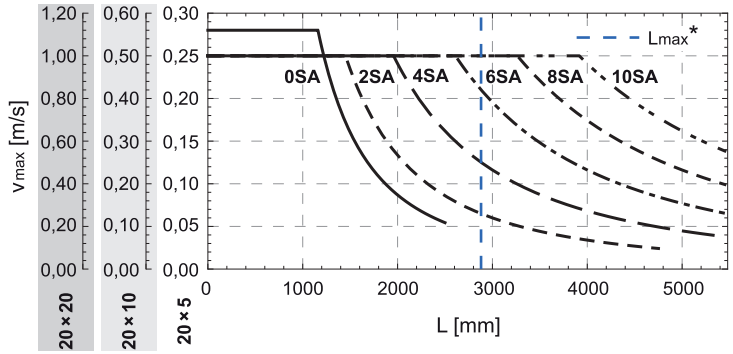


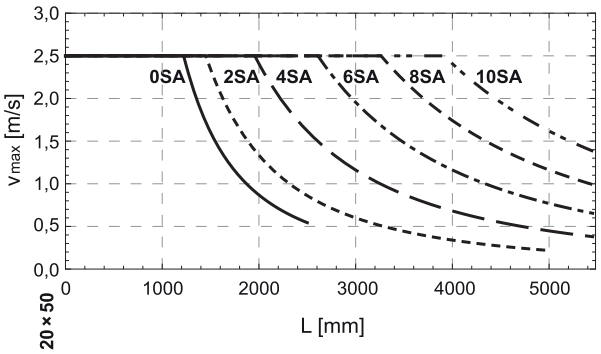
SA = Number of spindle supports

Size

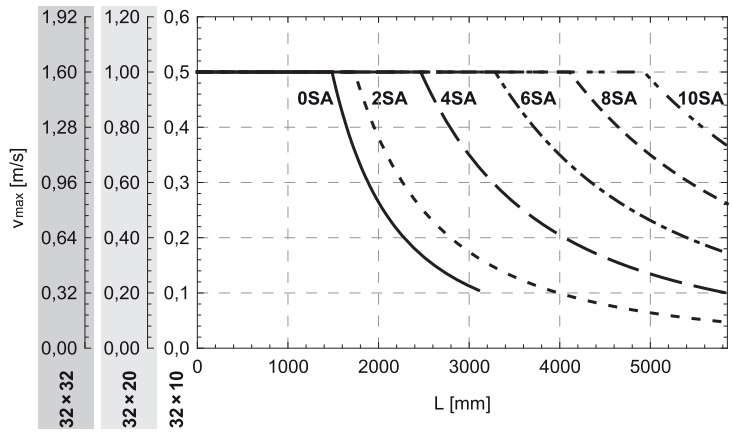


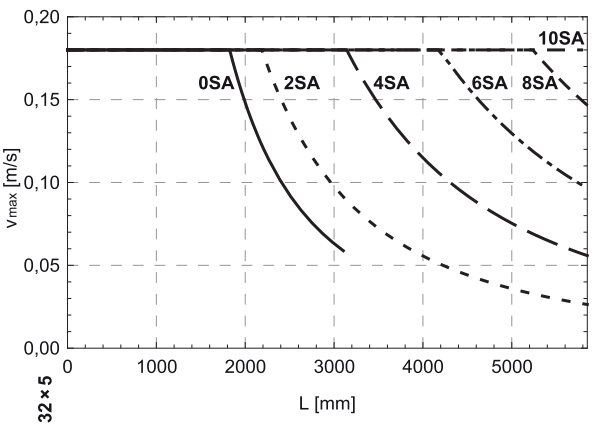
Size





Size





Spindle supports

In applications with long travel distances and high travel speeds, the critical spindle speed is quickly reached, so that appropriate support is required to prevent the spindle from swinging. Travelling spindle supports can be attached to the spindle axles. This enables long travel at full speed.

Weight and moving mass

Size	Ball screw spindle DxT	Number SA nSA	Linear actuator weight kg	Moved mass kg
40	12x5	0	1,2 + 0,0028 * S Strav + 0,47	0,47 + 0,47
		2	1,3 + 0,0028 * S Strav + 0,47	0,50 + 0,47
		4	1,4 + 0,0028 * S Strav + 0,47	0,53 + 0,47
	12x10	0	1,2 + 0,0028 * S Strav + 0,47	0,47 + 0,47
		2	1,3 + 0,0028 * S Strav + 0,47	0,50 + 0,47
		4	1,4 + 0,0028 * S Strav + 0,47	0,53 + 0,47
65	16x5	0	4,0 + 0,0073 * S Strav + 1,5	1,50 + 1,50
		2	4,5 + 0,0073 * S Strav + 1,5	1,58 + 1,50
		4	5,0 + 0,0073 * S Strav + 1,5	1,66 + 1,50
	16x10	0	4,0 + 0,0073 * S Strav + 1,5	1,50 + 1,50
		2	4,5 + 0,0073 * S Strav + 1,5	1,58 + 1,50
		4	5,0 + 0,0073 * S Strav + 1,5	1,66 + 1,50
	16x16	0	4,0 + 0,0073 * S Strav + 1,5	1,50 + 1,50
		2	4,5 + 0,0073 * S Strav + 1,5	1,58 + 1,50
		4	5,0 + 0,0073 * S Strav + 1,5	1,66 + 1,50
80	20x5	0	8,2 + 0,0114 * S Strav + 3,0	3,00 + 3,00
		2	8,9 + 0,0114 * S Strav + 3,0	3,07 + 3,00
		4 / 6 / 8 / 10	9,7 + 0,4 (nSA - 4) + 0,0114 * S Strav + 3,0	3,21 + 0,035 * (nSA - 4) +3,00
	20x10	0	8,2 + 0,0114 * S Strav + 3,0	3,00 + 3,00
		2	8,9 + 0,0114 * S Strav + 3,0	3,07 + 3,00
		4 / 6 / 8 / 10	9,7 + 0,4 (nSA - 4) + 0,0114 * S Strav + 3,0	3,21 + 0,035 * (nSA - 4) +3,00
	20x20	0	8,2 + 0,0114 * S Strav + 3,0	3,00 + 3,00
		2	8,9 + 0,0114 * S Strav + 3,0	3,07 + 3,00
		4 / 6 / 8 / 10	9,7 + 0,4 (nSA - 4) + 0,0114 * S Strav + 3,0	3,21 + 0,035 * (nSA - 4) +3,00
	20x50	0	8,2 + 0,0114 * S Strav + 3,0	3,00 + 3,00
		2	8,9 + 0,0114 * S Strav + 3,0	3,07 + 3,00
		4 / 6 / 8 / 10	9,7 + 0,4 (nSA - 4) + 0,0114 * S Strav + 3,0	3,21 + 0,035 * (nSA - 4) +3,00
110	32x5	0	17,3 + 0,0216 * S Strav + 4,9	4,90 + 4,90
		2	17,7 + 0,0216 * S Strav + 4,9	5,03 + 4,90
		4 / 6 / 8 / 10	19,3 + 0,8 (nSA - 4) + 0,0216 * S Strav + 4,9	3,21 + 0,035 * (nSA - 4) +3,00
	32x10	0	17,3 + 0,0216 * S Strav + 4,9	4,90 + 4,90
		2	17,7 + 0,0216 * S Strav + 4,9	5,03 + 4,90
		4 / 6 / 8 / 10	19,3 + 0,8 (nSA - 4) + 0,0216 * S Strav + 4,9	3,21 + 0,035 * (nSA - 4) +3,00
	32x20	0	17,3 + 0,0216 * S Strav + 4,9	4,90 + 4,90
		2	17,7 + 0,0216 * S Strav + 4,9	5,03 + 4,90
		4 / 6 / 8 / 10	19,3 + 0,8 (nSA - 4) + 0,0216 * S Strav + 4,9	3,21 + 0,035 * (nSA - 4) +3,00
	32x32	0	17,3 + 0,0216 * S Strav + 4,9	4,90 + 4,90
		2	17,7 + 0,0216 * S Strav + 4,9	5,03 + 4,90
		4 / 6 / 8 / 10	19,3 + 0,8 (nSA - 4) + 0,0216 * S Strav + 4,9	3,21 + 0,035 * (nSA - 4) +3,00

SA = Number of spindle supports

The specified values apply to travel up to 500 mm.

* The idling torque increases with longer travel.

Moment of inertia and idling torque

Size	Ball screw spindle DxT	Number SA nSA	Moment of inertia 10-5 kg m²	Idle torque* Nm
40	12x5	0	0,48 + 0,0012 * S Strav + 0,03	0,08 + 0,08
		2	0,53 + 0,0012 * S Strav + 0,03	0,09 + 0,08
		4	0,57 + 0,0012 * S Strav + 0,03	0,10 + 0,08
	12x10	0	0,57 + 0,0012 * S Strav + 0,12	0,09 + 0,09
		2	0,62 + 0,0012 * S Strav + 0,12	0,11 + 0,09
		4	0,67 + 0,0012 * S Strav + 0,12	0,14 + 0,09
65	16x5	0	1,6 + 0,0052 + S Strav + 0,09	0,14 + 0,14
		2	1,9 + 0,0052 + S Strav + 0,09	0,16 + 0,14
		4	2,2 + 0,0052 + S Strav + 0,09	0,18 + 0,14
	16x10	0	1,9 + 0,0052 + S Strav + 0,38	0,15 + 0,15
		2	2,2 + 0,0052 + S Strav + 0,38	0,19 + 0,15
		4	2,5 + 0,0052 + S Strav + 0,38	0,22 + 0,15
	16x16	0	2,5 + 0,0052 + S Strav + 0,97	0,20 + 0,20
		2	2,8 + 0,0052 + S Strav + 0,97	0,26 + 0,20
		4	3,2 + 0,0052 + S Strav + 0,97	0,31 + 0,20
80	20x5	0	5,6 + 0,0127 * S Strav + 0,19	0,23 + 0,23
		2	6,2 + 0,0127 * S Strav + 0,19	0,26 + 0,23
		4 / 6 / 8 / 10	7,0 + 0,4 * (nSA - 4) + 0,0127 * S Strav + 0,19	0,31 + 0,015 * (nSA - 4) + 0,23
	20x10	0	6,2 + 0,0127 * S Strav + 0,76	0,25 + 0,25
		2	6,8 + 0,0127 * S Strav + 0,76	0,30 + 0,25
		4 / 6 / 8 / 10	7,6 + 0,4 * (nSA - 4) + 0,0127 * S Strav + 0,76	0,41 + 0,025 * (nSA - 4) + 0,25
	20x20	0	8,5 + 0,0127 * S Strav + 3,04	0,25 + 0,25
		2	9,1 + 0,0127 * S Strav + 3,04	0,30 + 0,25
		4 / 6 / 8 / 10	10,1 + 0,5 * (nSA - 4) + 0,0127 * S Strav + 3,04	0,62 + 0,055 * (nSA - 4) + 0,30
	20x50	0	24,4 + 0,0127 * S Strav + 19,00	0,70 + 0,70
		2	25,5 + 0,0127 * S Strav + 19,00	0,97 + 0,70
		4 / 6 / 8 / 10	27,1 + 0,6 * (nSA - 4) + 0,0127 * S Strav + 19,00	1,50 + 0,135 * (nSA - 4) + 0,70
110	32x5	0	34,6 + 0,0690 * S Strav + 0,31	0,60 + 0,60
		2	35,1 + 0,0690 * S Strav + 0,31	0,67 + 0,60
		4 / 6 / 8 / 10	39,4 + 2,2 * (nSA - 4) + 0,0690 * S Strav + 0,31	0,81 + 0,035 * (nSA - 4) + 0,60
	32x10	0	35,5 + 0,0690 * S Strav + 1,24	0,70 + 0,70
		2	36,1 + 0,0690 * S Strav + 1,24	0,84 + 0,70
		4 / 6 / 8 / 10	40,4 + 2,2 * (nSA - 4) + 0,0690 * S Strav + 1,24	1,12 + 0,070 * (nSA - 4) + 0,70
	32x20	0	39,3 + 0,0690 * S Strav + 4,96	0,70 + 0,70
		2	39,9 + 0,0690 * S Strav + 4,96	0,84 + 0,70
		4 / 6 / 8 / 10	44,4 + 2,2 * (nSA - 4) + 0,0690 * S Strav + 4,96	1,60 + 0,140 * (nSA - 4) + 0,75
	32x32	0	47,0 + 0,0690 * S Strav + 12,71	0,80 + 0,80
		2	47,8 + 0,0690 * S Strav + 12,71	1,25 + 0,80
		4 / 6 / 8 / 10	52,8 + 2,3 * (nSA - 4) + 0,0690 * S Strav + 12,71	2,16 + 0,225 * (nSA - 4) + 0,80

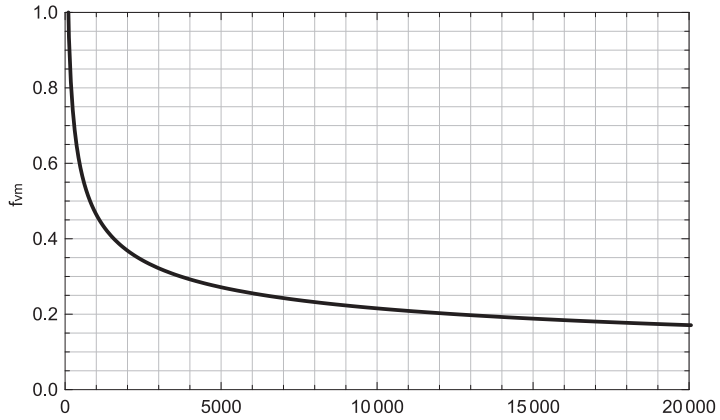
SA = Number of spindle supports

The specified values apply to travel up to 500 mm.

* The idling torque increases with longer travel.

Linear rails service life:

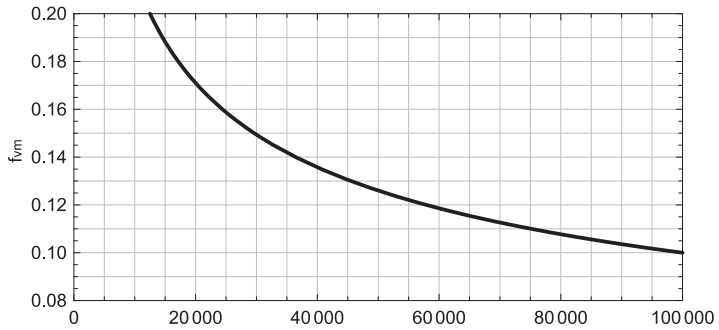
Comparison factor of the average load fvm as a function of the service life Lkm



$$f_v = \frac{|F_y|}{C_{dyn}} + \frac{|F_z|}{C_{dyn}} + \frac{|M_x|}{M_{x\,dyn}} + \frac{|M_y|}{M_{y\,dyn}} + \frac{|M_z|}{M_{z\,dyn}}$$

fv Load comparison factor
Cdyn Dynamic load rating
Mx dyn Dynamic torque around the X axis Nm
My dyn Dynamic torque around the Y axis Nm
Mz dyn Dynamic torque around the Z axis Nm
Fy Acting force in Y axis N
Fz Acting force in Z axis N
Mx Effective torque around the X axis Nm
My Effective torque around the Y axis Nm
Mz Effective torque around the Z axis Nm

More detailed view:



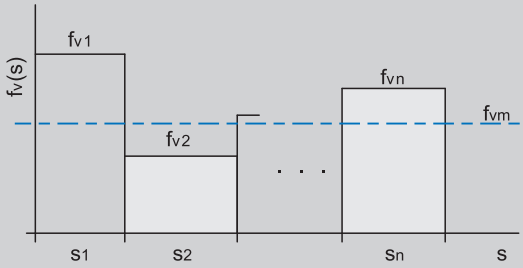
The diagrams show the theoretical service life of the linear actuators when the comparison factor of the average load fvm is taken into account.

Calculation of the mean load comparison factor fvm:

$$f_{vm} = \sqrt[3]{\frac{f_{v1}^3 \times s1 + f_{v2}^3 \times s2 + \ldots + f_{vn}^3 \times sn}{s1 + s2 + \ldots + sn}}$$

fvm Mean load comparison factor
fv i i-te load comparison factor of a given load mode fv (s), i ε [1,2...,n]
si i-te travel of a given load mode fv (s), i ε [1,2...,n]

Load mode fv (s)



Calculation of the service life:

$$L_{km} = \left(\frac{1}{f_{vm}}\right)^3 \cdot 10^2$$

Lkm Service life (km)

Safety factor fs:

$$f_s = \frac{1}{f_{vm}}$$

fs Safety factor

The safety factor depends on the application and its required safety. We recommend a minimum safety factor fs = 5.0.

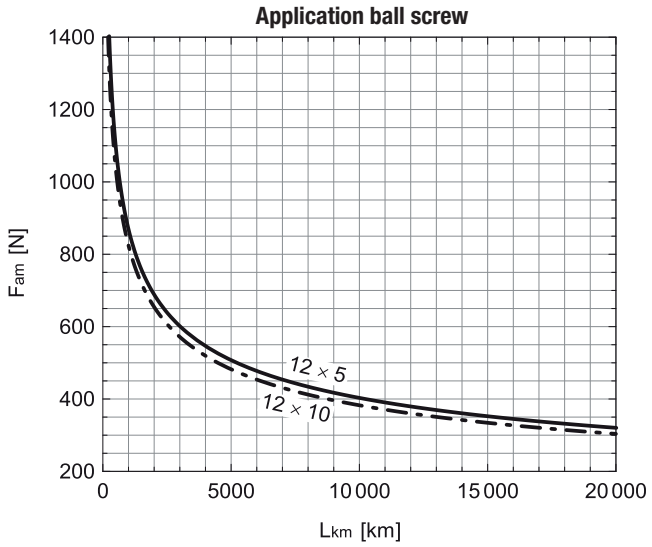
Permissible load factor fp for linear guide

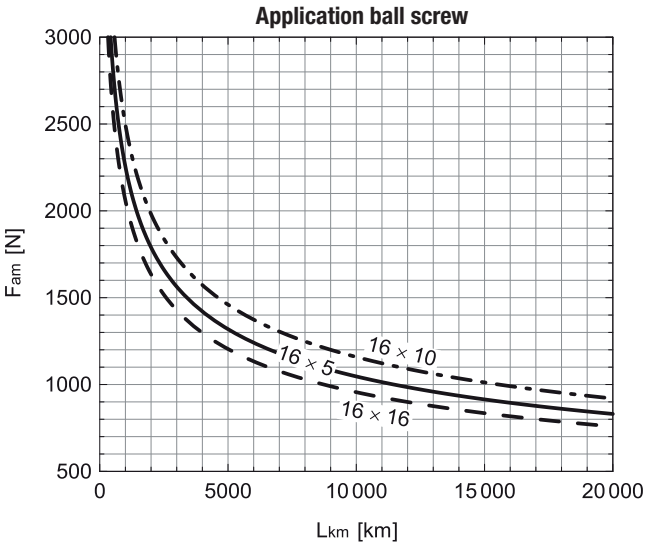
$$f_p = \frac{|F_y|}{F_{py}} + \frac{|F_z|}{F_{pz}} + \frac{|M_x|}{M_{px}} + \frac{|M_y|}{M_{py}} + \frac{|M_z|}{M_{pz}} \leq 1$$

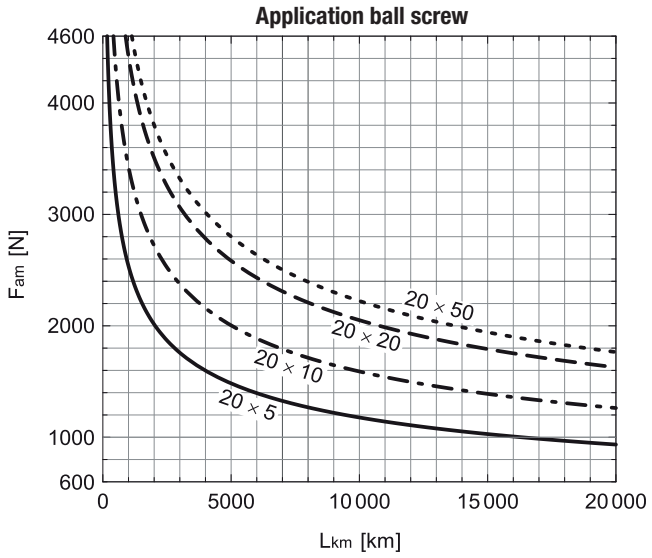
fp Permissible load factor
Fpy Max. permissible force in Y axis N
Fpz Max. permissible force in Z axis N
Mpx Max. permissible torque around the X axis Nm
Mpy Max. permissible torque around the Y axis Nm
Mpz Max. permissible torque around the Z axis Nm

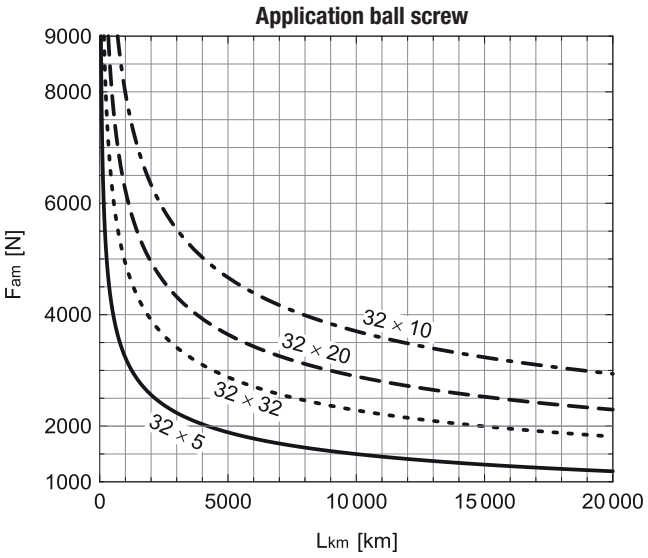
Ball screw service life

Applied average axial force Fam as a function of service life Lkm









The diagrams show the theoretical service life for the ball screw when the average axial force Fam is taken into account.

Calculation of the mean axial force Fam

$$Fam = \sqrt[3]{\frac{|Fa1|^3 \times s1 + |Fa2|^3 \times s2 + \ldots + |Fan|^3 \times sn}{s1 + s2 + \ldots + sn}}$$

Fam mean axial force
Fa i i-te axial force of a given load mode Fa (s), i ε [1,2,...,n]
si i-te travel of a given load mode Fa (s), i ε [1,2,...,n]

Load mode Fa (s)

