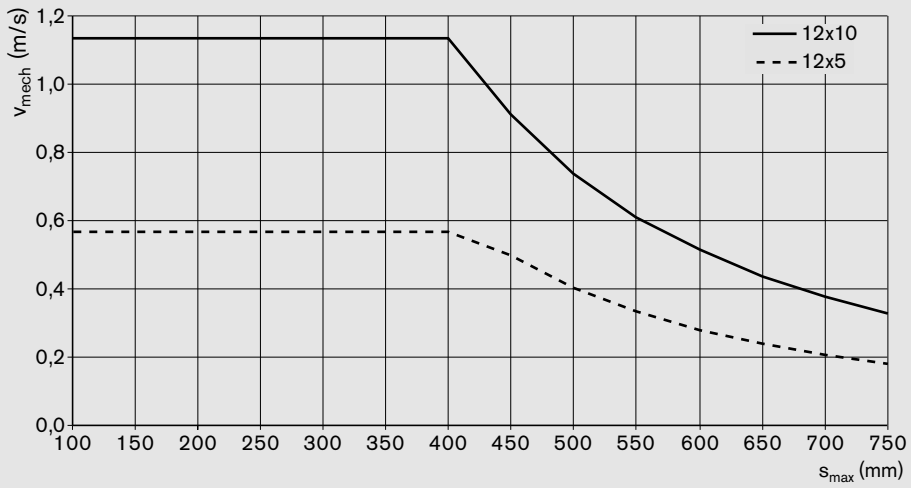
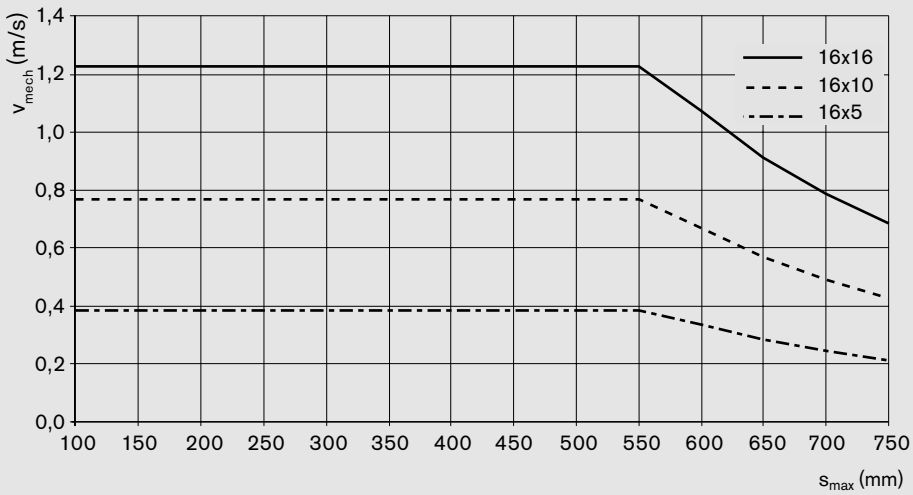
Permissible Speeds

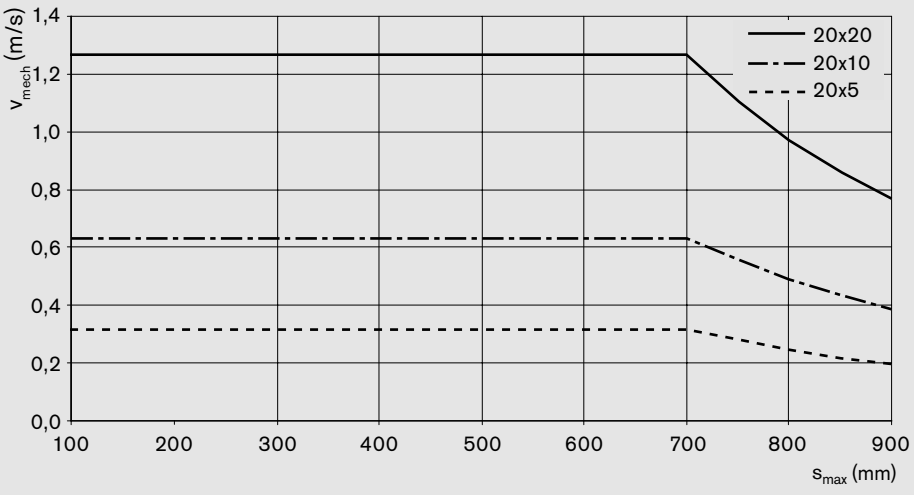
EMC 32



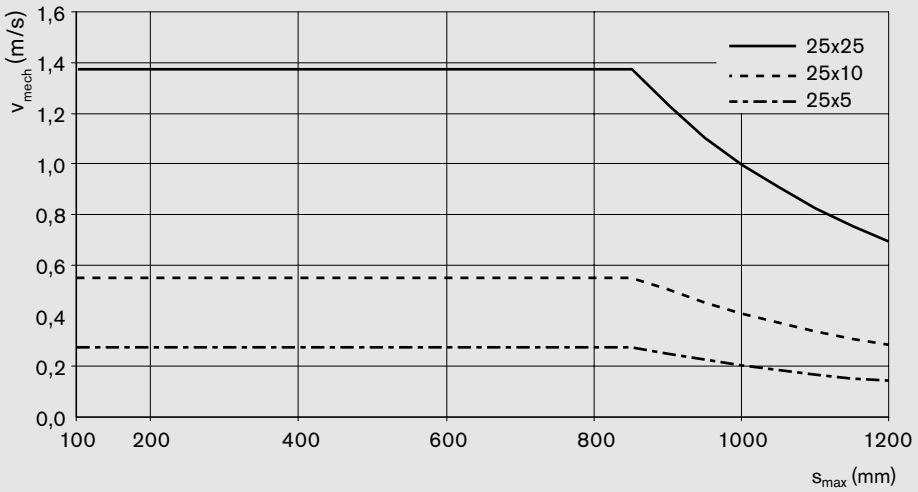
EMC 40



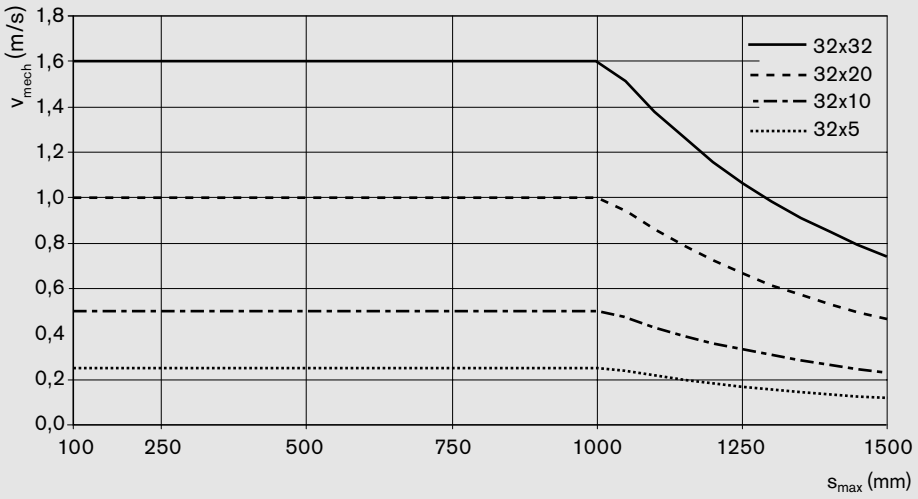
EMC 50



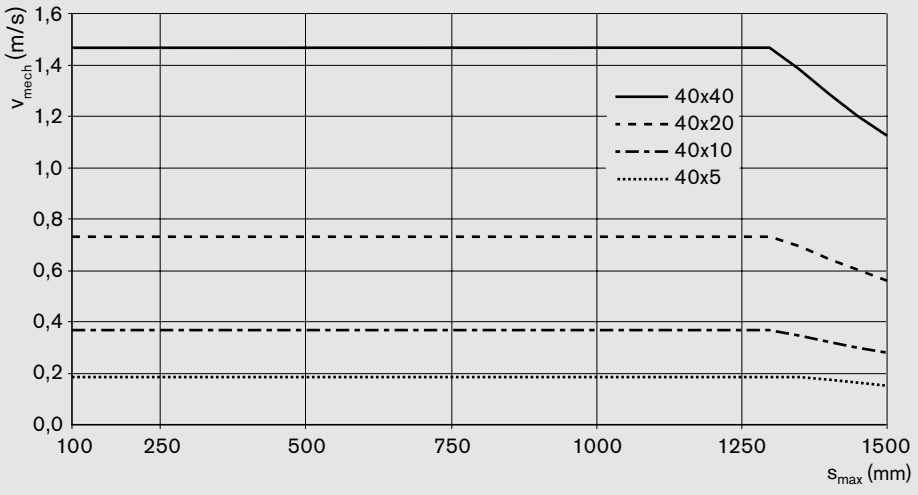
EMC 63



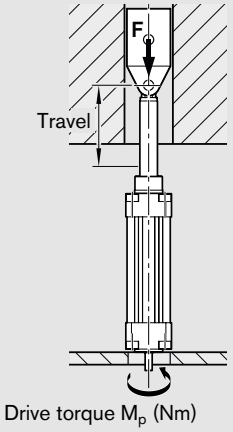
EMC 80



EMC 100



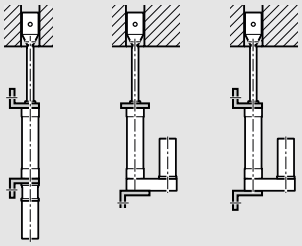
Permissible Drive Torque M_P



The attainable torques may vary according to the EMC version and the type of mounting.

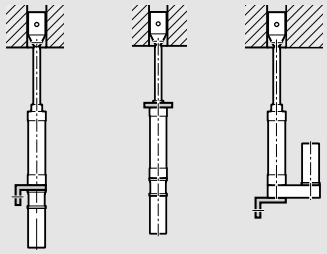
Case I

Fixed mounting to head and end cap (flange or foot mounting).



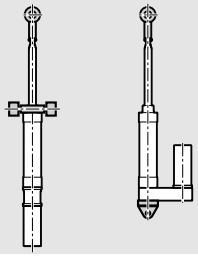
Case II

Fixed mounting to head cap or end cap (flange or foot mounting).

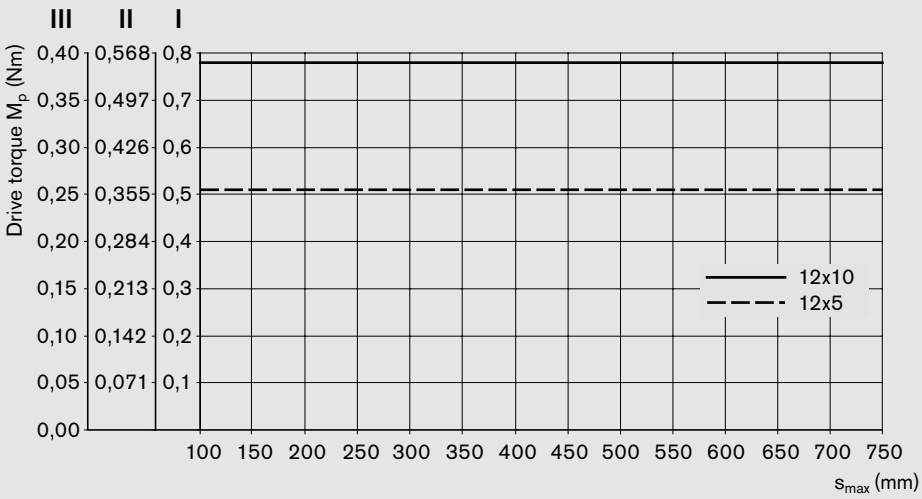


Case III

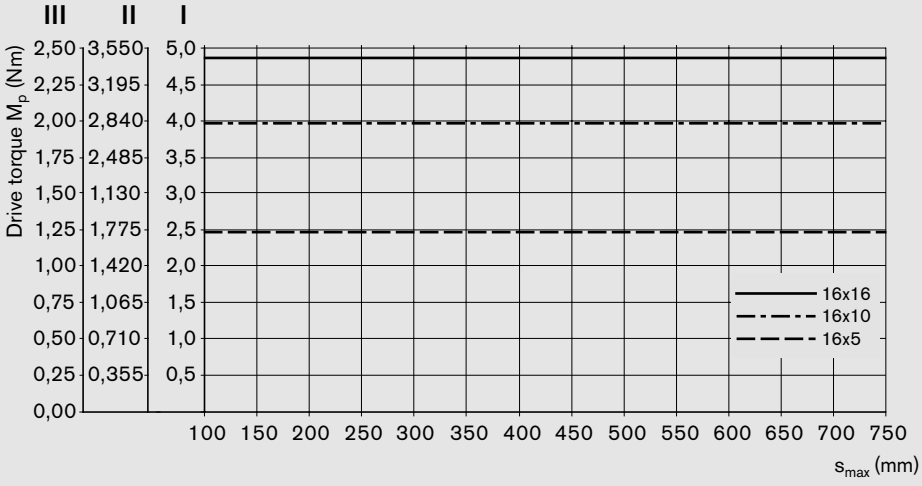
All types of articulated mounting. Pivotable or swivel mountings.



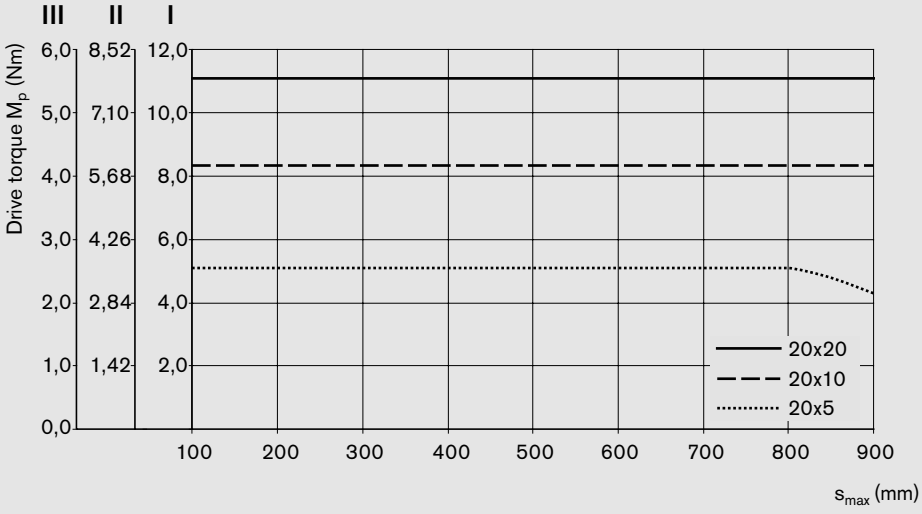
EMC 32



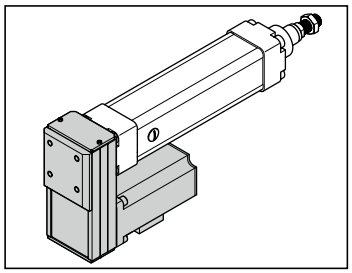
EMC 40



EMC 50



Motor attachment with timing belt side drive:



For motor attachment with timing belt side drive (SD), **the drive torque at the EMC journal** may be limited depending on the version:

EMC	Type	Ball screw lead P (mm)						
	RV	5	10	16	20	25	32	40
32	A	–	–					
	B	–	–					
40	A	–	3.2	3.2				
	B	–	–	–				
50	A	–	–		8.2			
	B	–	–		–			
63	A	–	18.5			18.5		
	B	–	22			23.5		
80	A	–	24		24		24	
	B	–	28		38		42	
100	A	–	–		55			55
	B	–	–		80			80

When comparing the chart and table, the permissible drive torque is always the lower of the two values.

Example:

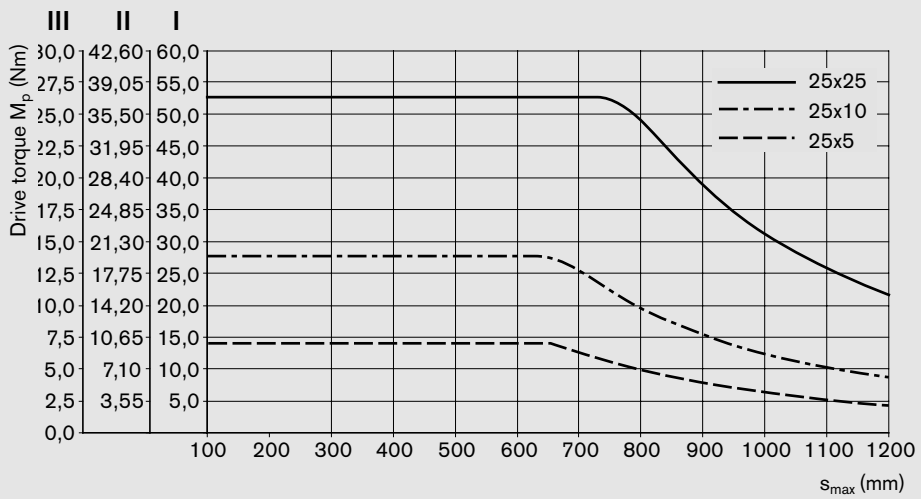
EMC 100, ball screw 40x20, s_{max} = 700 mm,

motor attachment with timing belt side drive
Type B:

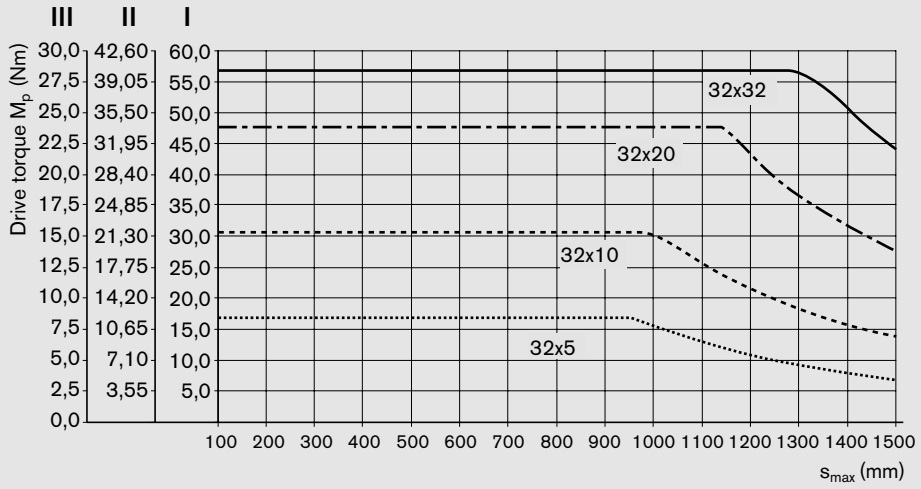
- From chart M_p = 102 Nm
- From table M_p = 80 Nm

! permissible drive torque at EMC journal: M_p = 80 Nm

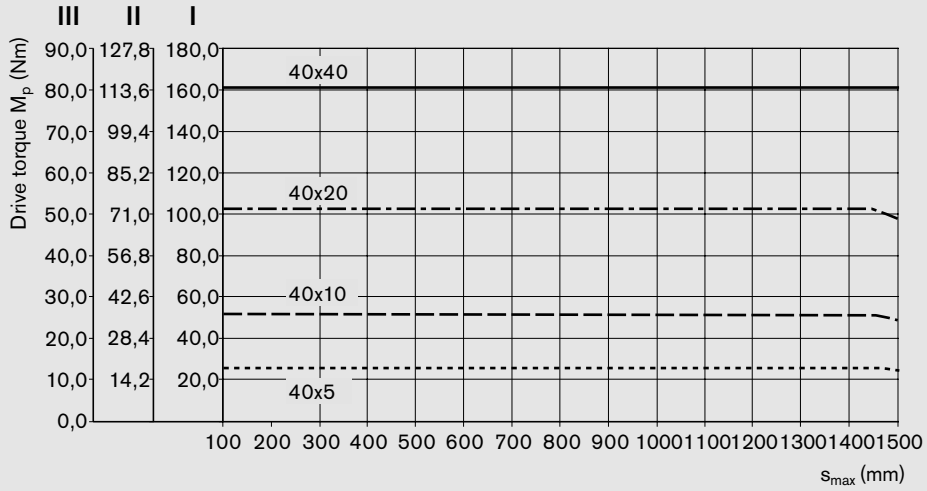
EMC 63



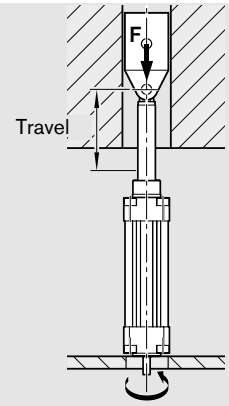
EMC 80



EMC 100



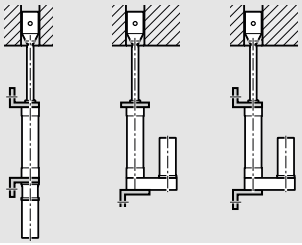
Maximum Axial Loading of Mechanical Cylinder System F_{max}



The attainable forces may vary according to the type of mounting.

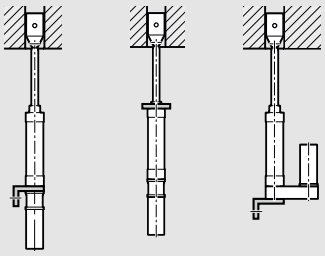
Case I

Fixed mounting to head and end cap (flange or foot mounting).



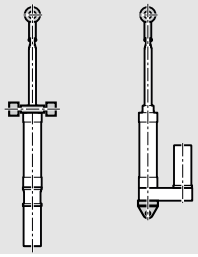
Case II

Fixed mounting to head cap or end cap (flange or foot mounting).

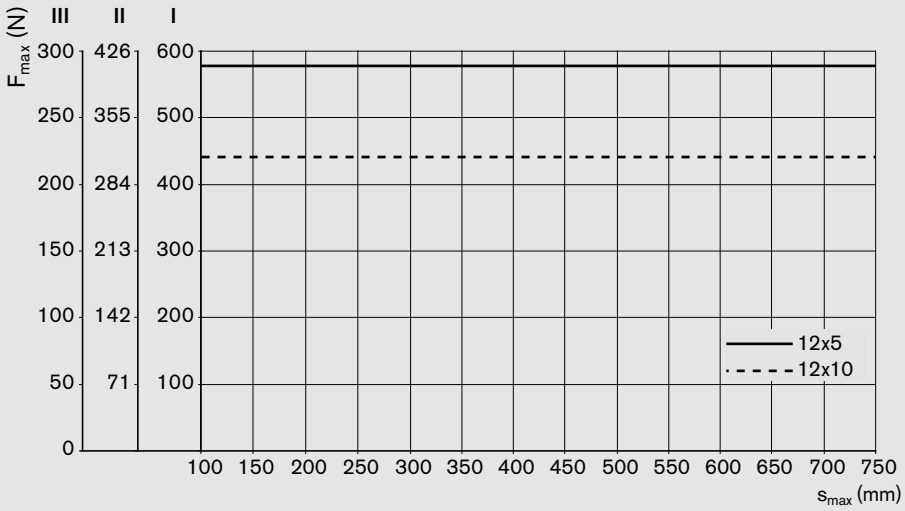


Case III

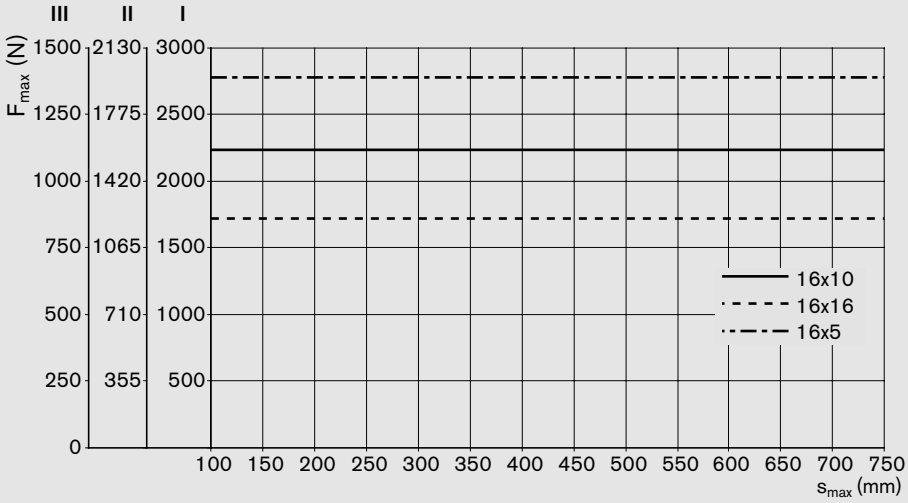
All types of articulated mounting. Pivotable or swivel mountings.



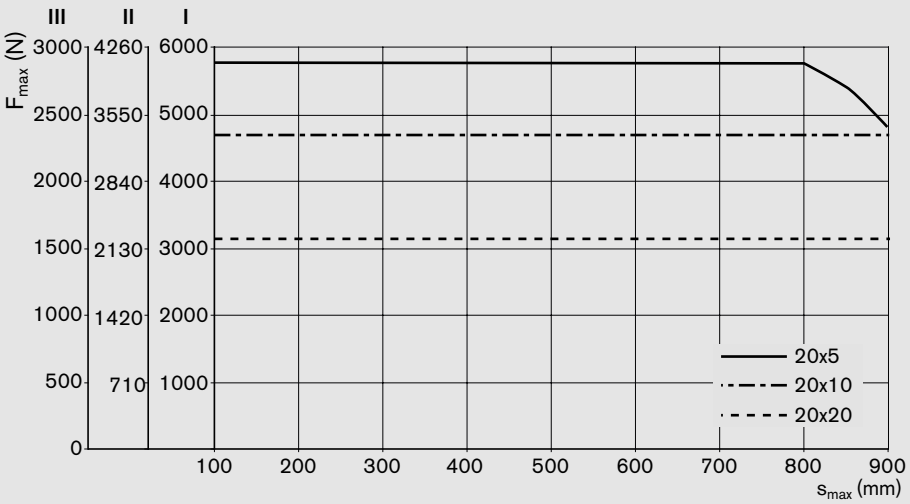
EMC 32



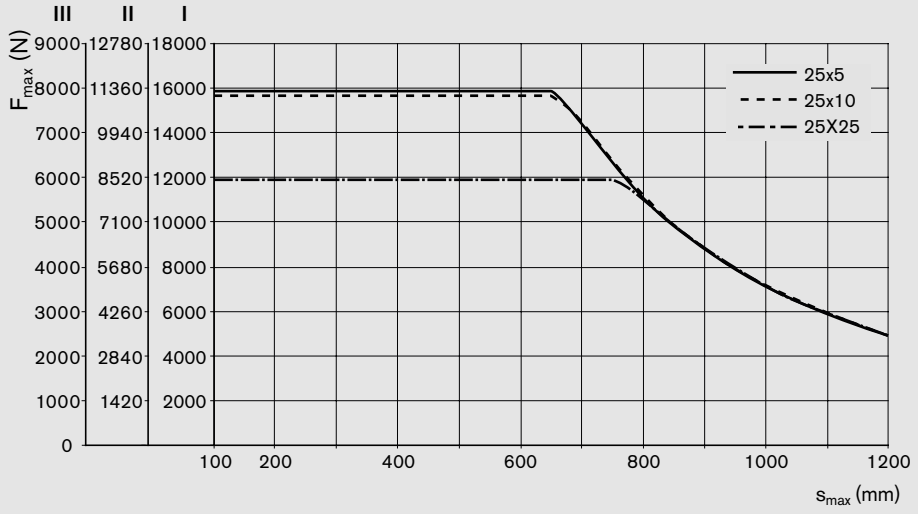
EMC 40



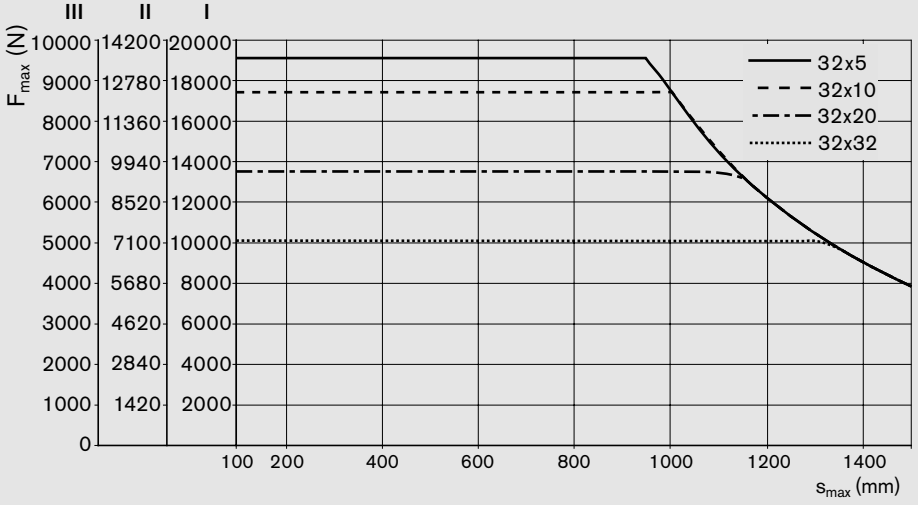
EMC 50



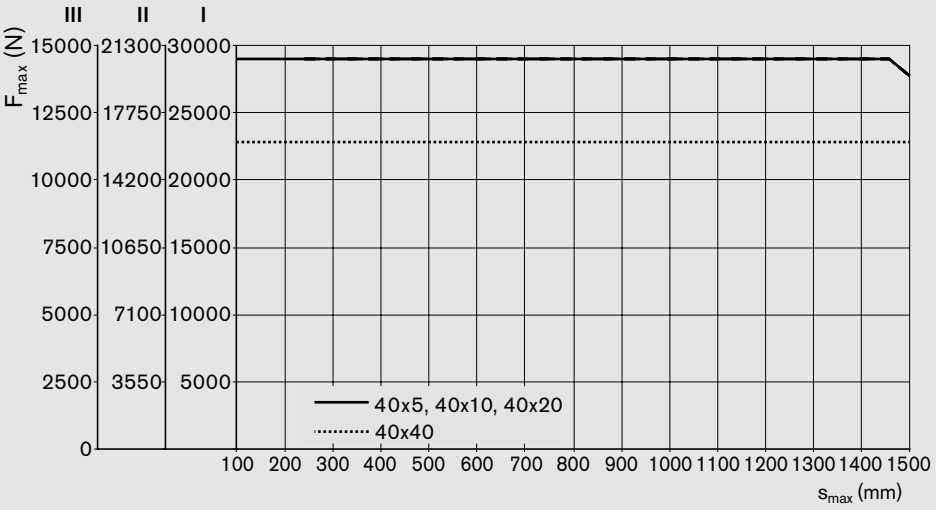
EMC 63



EMC 80



EMC 100



Calculations

After pre-selection of the mechanical cylinder system, the mounting elements and the cylinder/motor combination, the calculations can now be performed.
The actual loads must be smaller than the maximum permissible loads for the mechanical cylinder system and the mounting elements.

Average speed and average load

Where the operating conditions (speed and load) vary, the service life must be calculated using the average values for $\mathbf{F_{m,\,ax}}$ and $\mathbf{n_m}$.

– where the speed fluctuates, the average speed $\mathbf{n_m}$ is calculated as follows

$$n_m = \frac{q_1}{100} \cdot n_1 + \frac{q_2}{100} \cdot n_2 + \ldots + \frac{q_n}{100} \cdot n_n$$

– where the load fluctuates and the speed is constant, the equivalent dynamic axial load $\mathbf{F_{m,\,ax}}$ is calculated as follows

$$F_{m,\,ax} = \sqrt[3]{F_1^3 \cdot \frac{q_1}{100} + F_2^3 \cdot \frac{q_2}{100} + \ldots + F_n^3 \cdot \frac{q_n}{100}}$$

– where both the load and speed fluctuate, the equivalent dynamic axial load $\mathbf{F_{m,\,ax}}$ is calculated as follows

$$F_{m,\,ax} = \sqrt[3]{F_1^3 \cdot \frac{n_1}{n_m} \cdot \frac{q_1}{100} + F_2^3 \cdot \frac{n_2}{n_m} \cdot \frac{q_2}{100} + \ldots + F_n^3 \cdot \frac{n_n}{n_m} \cdot \frac{q_n}{100}}$$

$F_{m,\,ax}$ = equivalent dynamic axial load (N)
n_m = average rotary speed (min^{-1})
q = discrete time step for phases 1 ... n (%)

Nominal life

Service life in revolutions L

$$L = \left(\frac{C}{F_{m,\,ax}}\right)^3 \cdot 10^6 \Rightarrow C = F_{m,\,ax} \cdot \sqrt[3]{\frac{L}{10^6}} \Rightarrow F_{m,\,ax} = \frac{C}{\sqrt[3]{\frac{L}{10^6}}}$$

C = dynamic load capacity (N)
$F_{m,\,ax}$ = equivalent dynamic axial load (N)

Service life in hours L_h

$$L_h = \frac{L}{n_m \cdot 60}$$

L_h = service life (h)
L = service life (revolutions) (–)
n_m = average rotary speed (min^{-1})

$$\text{Machine operating hours} = L_h \cdot \frac{\text{Machine duty cycle}}{\text{Screw duty cycle}}$$

Drive torque and drive power

Drive torque M_p
Conversion of rotary to linear motion:

$$M_p = \frac{F \cdot P}{2000 \cdot \pi \cdot \eta}$$

F = operating load (N)
M_p = drive torque (Nm)
P = lead (mm)
η = mechanical efficiency (≈ 0.9)

The dynamic drag torque must be taken into account for preloaded ball nut units.

Drive power P_a

$$P_a = \frac{M_p \cdot n}{9550}$$

M_p = drive torque (Nm)
n = rotary speed (min^{-1})
P_a = drive power (kW)

Frictional torque M_R

for motor attachment via motor mount and coupling:

$$M_R = M_{RS}$$

for motor attachment via timing belt side: drive:

$$M_R = \frac{M_{RS}}{i} + M_{R\,sd}$$

Mass moment of inertia J_s

of the EMC referred to the drive journal

$$J_s = (k_{J\,fix} + k_{J\,var} \cdot s_{max}) \cdot 10^{-6}$$

Mass moment of inertia J_{ex}

of the mechanical system referred to the motor journal

Motor attachment via motor mount and coupling

$$J_{ex} = J_s + J_t + J_c$$

Motor attachment via timing belt side drive

$$J_{ex} = \frac{J_s + J_t}{i^2} + J_{sd}$$

Translatory mass moment of inertia of external load J_t

referred to the drive journal

$$J_t = m_{ex} \cdot k_{J\,m} \cdot 10^{-6}$$

Mass moment of inertia J_{dc}

of the drive train referred to the motor journal

$$J_{dc} = J_{ex} + J_{br}$$

Mass moment of inertia ratio V

$$V = \frac{J_{dc}}{J_m}$$

Application area	V
Handling	≤ 6.0
Processing	≤ 1.5

Total mass moment of inertia J_{tot}

referred to the motor journal

$$J_{tot} = J_{dc} + J_m$$

Maximum permissible rotary speed n_{mech}

of mechanical system

$$n_{mech} = \frac{v_{mech} \cdot i \cdot 1000 \cdot 60}{P}$$

$$n_{mech} < n_{m\,max}$$

Effective stroke

Effective stroke = s_{max} – 2 x excess travel

i = gear ratio
J_s = mass moment of inertia of EMC (without external load) (kgm^2)
$k_{J\,fix}$ = constant for fixed-length portion of mass moment of inertia (10^6 kgm^2)
$k_{J\,var}$ = constant for variable-length portion of mass moment of inertia (10^9 kgm)
M_R = frictional torque at motor journal (Nm)
M_{RS} = frictional torque of the system (Nm)
$M_{R\,sd}$ = frictional torque of timing belt side drive at motor journal (Nm)
s_{max} = maximum travel (mm)
J_{br} = mass moment of inertia, motor brake (kgm^2)
J_c = mass moment of inertia, coupling (kgm^2)
J_{dc} = mass moment of inertia, drive train (kgm^2)
J_{ex} = mass moment of inertia of mechanical system (kgm^2)
J_m = mass moment of inertia, motor (kgm^2)
J_s = mass moment of inertia of EMC (without external load) (kgm^2)
J_{sd} = mass moment of inertia of timing belt side drive at motor journal (kgm^2)
J_t = translatory mass moment of inertia of external load referred to the drive journal (kgm^2)
J_{tot} = total mass moment of inertia (kgm^2)
i = gear ratio of timing belt side drive (–)
$k_{J\,m}$ = constant for mass-specific portion of mass moment of inertia (10^6 m^2)
m_{ex} = moved external load (kg)
$n_{m\,max}$ = maximum permissible rotary speed of motor with controller (min^{-1})
n_{mech} = maximum permissible rotary speed of mechanical system (min^{-1})
P = screw lead (mm)
V = ratio of mass moments of inertia of drive train and motor (–)
v_{mech} = maximum permissible linear speed of mechanical system (m/s)