1.1 SERVOMECH Linear actuators

SERVOMECH mechanical linear actuators are motorised mechanical cylinders able to transform the rotary motion of a motor into the linear motion of a push rod.

They are designed and manufactured for industrial applications, even the heaviest in terms of:

- applied load
- linear speed
- duty cycle
- environmental conditions.

They are able to work under push or pull load.

According to their configuration, they can be:

- statically self-locking - able to sustain static load keeping the same position when the motor is switched off;
- statically non self-locking - in this case the load must be sustained with a brake motor.

They operate at constant linear speed with and without load, with low noise level.

Their operation can be just a simple push-pull “ON-OFF” action or they can become real servo-mechanisms, able to work as controlled axes by means of accessories such as encoders or potentiometers for positioning control, motors with tacho-generator and servo drives.

Their installation is simple and not expensive since it requires just a front and rear hinging as for standard hydraulic and pneumatic cylinders.

Linear actuators can effectively replace pneumatic or hydraulic cylinders for several reasons:

- uniformity in push-pull motion
- accuracy in stopping position
- position holding under load (self-locking)
- energy consumption during operation only
- installation in difficult environments, only electrical control cables are required
- higher safety in load lifting (internal mechanical safety devices available)
- can be used in ambients with very low temperature without freezing risk
- can be used in ambients with very high temperature without fire risk.

SERVOMECH linear actuators have a wide application field. They are intended for industrial applications which require safe operation and/or linear motion control while moving, turning over or lifting a load.

The wide range of sizes, stroke lengths, motor types, linear speeds and available accessories enables to adapt these products for new applications, replace even complex mechanical solutions and hydraulic or pneumatic cylinders, improving the result in terms of performance and with economical advantages.

1.2 SERVOMECH linear actuators range

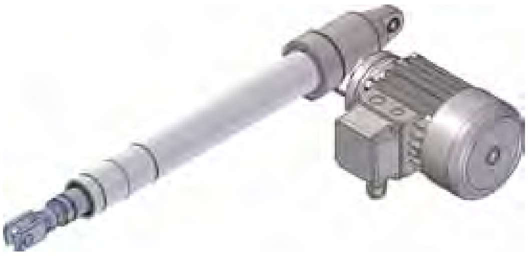
SERVOMECH linear actuators range consists of **5 actuator groups** determined by their different design, input drive and fixing type.

SERVOMECH Linear Actuators

1.2 SERVOMECH linear actuators range

Linear actuators **ATL Series**:
- input drive: worm gear drive
- linear drive: 1 or more starts acme screw

Linear actuators **BSA Series**:
- input drive: worm gear drive
- linear drive: ball screw



INPUT DRIVE

worm gear drive

LINEAR DRIVE

acme screw	ball screw
ATL Series	BSA Series
ATL 20, ATL 25, ATL 28, ATL 30, ATL 40	BSA 20, BSA 25, BSA 28, BSA 30, BSA 40
ATL 50, ATL 63, ATL 80	BSA 50, BSA 63, BSA 80
ATL 100, ATL 125	BSA 100, BSA 125
Linear speed: (1.4 ... 140) mm/s Max. force: 600 N ... 350 kN Standard stroke up to 800 mm, special stroke length on request	Linear speed: (2.3 ... 93) mm/s Max. force: 1 200 N ... 123 kN Standard stroke up to 800 mm, special stroke length on request

Input shaft axis at 90° with respect to actuator axis

Input:
- attachment for IEC electric motor
- solid shaft

Electric motor:
- AC 3-phase or 1-phase
- DC 24 V or 12 V

Stroke end switches:
- electric switches, activated by adjustable rings along the support rod
- magnetic reed switches, adjustable position along the outer tube
- proximity switches, fix position on outer tube
- cam-operated electric switches, fix position on outer tube

Positioning control:
- rotary encoder on the input shaft
- linear potentiometer mounted parallel to the push rod

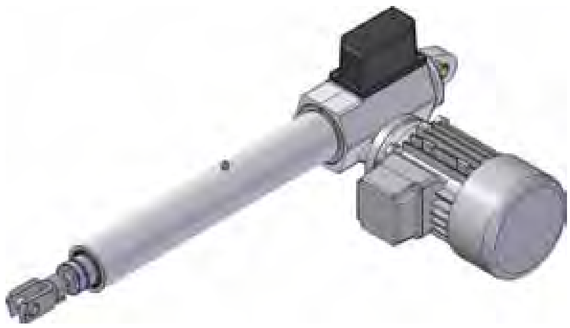
Wide range of accessories

It is possible to create drive systems consisting of two or more actuators whose input shafts are mechanically connected by transmission shafts.

1.2 SERVOMECH linear actuators range

Linear actuators **CLA Series**:
- input drive: worm gear drive
- linear drive: 1 or more starts acme screw

Linear actuators **CLB Series**:
- input drive: worm gear drive
- linear drive: ball screw



INPUT DRIVE	
worm gear drive	
LINEAR DRIVE	
acme screw	ball screw
CLA Series	CLB Series
CLA 30 CLA 40 CLA 50	CLB 30 CLB 40 CLB 50
Linear speed: (2 ... 56) mm/s Max. force: 2 500 N ... 25 kN Standard stroke up to 800 mm, special stroke length on request (more details on pages 108 ... 110)	Linear speed: (2.5 ... 60) mm/s Max. force: 3 300 N ... 25 kN Standard stroke up to 800 mm, special stroke length on request (more details on pages 108 ... 110)

Input shaft axis at 90° with respect to actuator axis

Input:
- attachment for IEC electric motor
- solid shaft

Electric motor:
- AC 3-phase or 1-phase

Stroke end switches:
- adjustable cam-operated electric switches

Positioning control:
- rotary potentiometer

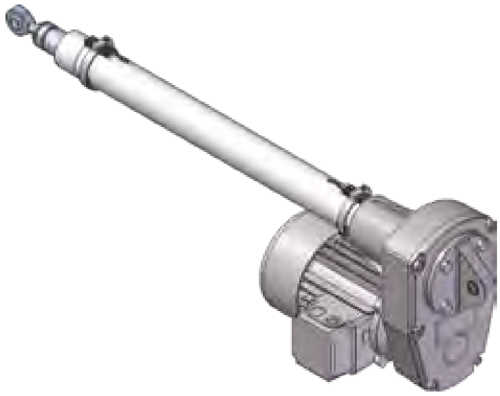
Wide range of accessories

It is possible to create drive systems consisting of two or more actuators whose input shafts are mechanically connected by transmission shafts.

1.2 SERVOMECH linear actuators range

Linear actuators **UBA Series**:
- input drive: timing belt transmission
- linear drive: ball screw

Linear actuators **UAL Series**:
- input drive: timing belt transmission
- linear drive: 1 or more starts acme screw



INPUT DRIVE	
timing belt transmission	
LINEAR DRIVE	
ball screw	acme screw
UBA Series	UAL Series
UBA 1 UBA 2 UBA 3 UBA 4 UBA 5	UAL 1 UAL 2 UAL 3 UAL 4 UAL 5
Linear speed: (40 ... 875) mm/s Max. force: (290 ... 10 650) N Standard stroke up to 800 mm, special stroke length on request	Linear speed: (23 ... 529) mm/s Max. force: (300 ... 10 400) N Standard stroke up to 800 mm, special stroke length on request

Motor axis parallel to actuator axis

Input:
- attachment for IEC electric motor

Electric motor:
- AC 3-phase or 1-phase **with brake**
- DC 24 V or 12 V **with brake**

Stroke end switches:
- magnetic reed switches, adjustable position along the outer tube
- proximity switches, fix position on outer tube

Positioning control:
- rotary encoder on the input axis
- linear potentiometer mounted parallel to the push rod

Wide range of accessories

1.2 SERVOMECH linear actuators range

Linear actuators **TMA Series**:
- input drive: worm gear drive
- linear drive: 1-start acme screw

INPUT DRIVE
worm gear drive

LINEAR DRIVE
acme screw

TMA Series
TMA 15
TMA 25
TMA 50
TMA 100
TMA 150
TMA 200

Linear speed: (0.12 ... 40) mm/s
Max. force: (2.6 ... 200) kN
Stroke up to 1 500 mm

Trunnion mounted housing fixed with pins or bronze bushes

Input shaft axis at 90° with respect to actuator axis

Input:
- attachment for IEC electric motor
- solid shaft

Electric motor:
- AC 3-phase

Stroke end switches:
- proximity switches, fix position on outer tube
- cam-operated electric switches, fix position on outer tube

Positioning control:
- rotary encoder on the input shaft

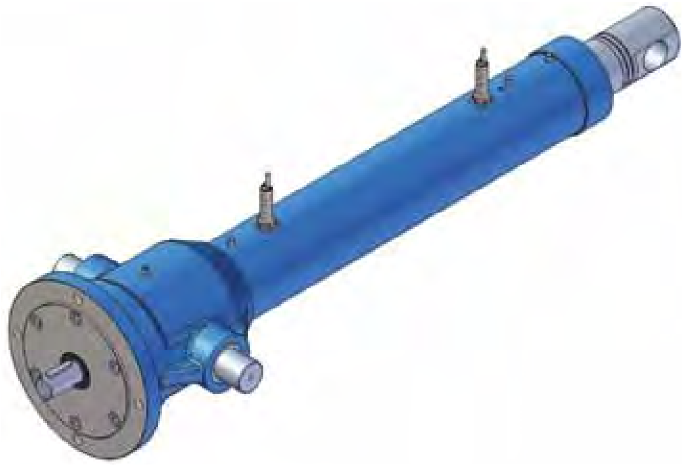
Wide range of accessories

It is possible to create drive systems consisting of two or more actuators whose input shafts are mechanically connected by transmission shafts.

1.2 SERVOMECH linear actuators range

Linear actuators **ILA Series**:

- linear drive: 1 or more starts acme screw (**ILA . A Series**)
- linear drive: ball screw (**ILA . B Series**)



INPUT DRIVE	
acme screw	ball screw
ILA . A Series	ILA . B Series
ILA 15 A ILA 25 A ILA 50 A ILA 100 A ILA 150 A ILA 200 A	ILA 15 B ILA 25 B ILA 50 B ILA 100 B ILA 150 B ILA 200 B
Max. force: (15 ... 200) kN Stroke up to 1 500 mm	Max. force: (15 ... 200) kN Stroke up to 1 500 mm

IN-LINE actuators

Housing mounting with pins

Input: shaft and flange as input drive attachment

Stroke end switches:

- proximity switches, fixed position on outer tube

Wide range of accessories

1.3 Linear actuator selection

THERMAL LIMIT

Linear actuators transform the rotary motion into a linear motion. This transformation involves a dissipation of energy in the form of heat. Therefore, to choose the right actuator for an application it is necessary to take into account the **APPLICATION DUTY CYCLE REQUIRED** and compare it with the **ACTUATOR DUTY CYCLE PERMISSIBLE.**

The **APPLICATION DUTY CYCLE REQUIRED** F_u [%] is the ratio expressed in percentage between the actual working time under load during the reference time period of 10 minutes and the reference period itself.

$$F_u\,[\%] = \frac{\text{Working time over 10 min}}{\text{10 min}} \times 100$$

The **ACTUATOR DUTY CYCLE PERMISSIBLE** F_i [%] is the maximum working time expressed in percentage that the actuator can perform during the reference time period of 10 minutes, under maximum rated load stated in this catalogue at ambient temperature 25°C, without risk of internal parts overheating.

Linear drive	F_i [%]
1-start acme screw	30
ball screw	100

For the proper operation of a linear actuator, the condition $F_u \leqslant F_i$ must be satisfied. Therefore, the real limit for the actuator working time is often the thermal limit and not its structural strength nor the motor power.

In order to make the right selection of an actuator we recommend following SELECTION PROCEDURE below.

LINEAR ACTUATOR SELECTION PROCEDURE

1. Identify the performances and technical specifications required by the application

- stroke
- linear speed
- dynamic load, pull - push, current stroke corresponding to the max. push load value
- static load, pull – push, current stroke corresponding to the max. push load value
- working cycle
- type of motor required

2. Determine the type of linear drive

Considering the STROKE, the LINEAR SPEED and the WORKING CYCLE, calculate the APPLICATION DUTY CYCLE REQUIRED F_u [%] over 10 min:

- with $F_u \leqslant 30$ %: select acme screw actuators
- with $F_u \geqslant 50$ %: select ball screw actuators
- with 30 % < F_u < 50 % there are 2 possibilities:
  - select ball screw linear actuators, as a precaution;
  - select acme screw linear actuators, previous accurate check of the permissible load for a duty cycle higher than 30 % (refer to diagram DUTY CYCLE F_i RELATED TO DYNAMIC LOAD AND SPEED on page 38).

Generally, ball screw actuators are more expensive than their equivalent with acme screw. On the other hand, the selection of acme screw actuators in case of F_u > 30 %, implies a reduced performance and it is necessary to select a larger size.

Ball screw actuators are not self-locking and require a brake motor to ensure static load holding. Furthermore, a brake motor is also necessary whenever a precise positioning and stopping repeatability are required, with both ball screw and acme screw actuators.

In any case, a brake motor is required for high linear speeds.

Therefore, in this condition the choice between ball screw or acme screw actuators is influenced not only by technical factors but also by economic reasons.

1.3 Linear actuator selection

3. Select the size as a 1st approximation

Referring to the force and the linear speed required by the application, use the 1st APPROXIMATION SELECTION DIAGRAMS, according to the linear drive type as determined in the previous step (see pages 17 ... 22), to select the actuator size.

4. Mechanical checks

4.1 Structural stability check

Referring to the max. push load and the stroke, check the structural stability – buckling resistance under push load - of the actuator selected in the previous step. This check should be carried out for push load and long strokes referring to diagrams on pages 23 ... 29.

4.2 Lifetime check

- Acme screw actuators
  The performances stated in this catalogue are the maximum permissible, considering duty cycle F_i = 30 % over a time period of 10 min and ambient temperature 25°C. Besides the load, the life-time is strongly influenced also by the linear speed, the ambient temperature and the duty cycle. For a more precise evaluation contact SERVOMECH.
- Ball screw actuators
  The performances stated in this catalogue are the maximum permissible with max. duty cycle 100%, ambient temperature 25°C and minimum lifetime L_{10h} = 1000 hours.

  For a different lifetime refer to the diagrams on pages 30 ... 38.

  The previously selected size can be confirmed, otherwise the next larger size shall be selected.

5. Determine the actuator ratio

According to the required motor type, the series and the size of the selected actuator, see the relative PERFORMANCE TABLE and find the RATIO which gives the required performance in terms of LOAD and SPEED. Choose the performance nearest to those required. If necessary, select the next size to fully satisfy the required performance.

6. Check the thermal limit

- For acme screw actuators and $F_u \leqslant$ 30 % only: according to the working cycle, considering the actual speed of the actuator, calculate the actual DUTY CYCLE F_u and verify that it is not higher than the DUTY CYCLE F_i permissible by the selected actuator ($F_u \leqslant F_i$). Otherwise, considering the difference F_u - F_i, decide if the selection can be confirmed or if the next bigger size should be chosen.
- For acme screw actuators and 30 % < F_u < 50 % only: refer to diagram DUTY CYCLE F_i RELATED TO DYNAMIC LOAD AND SPEED on page 38 and check the dynamic load permissible by the selected actuator.

7. Select accessories and/or options

7.1 Front attachment
7.2 Stroke end switches
7.3 Input version
7.4 Other accessories

8. Check actuator dimensions and fixing accessories

Refer to the dimensional tables to know the over-all dimensions of the actuator and relevant accessories and verify if they suit the application.

9. Complete the ordering code

Refer to the example shown at the end of the chapter regarding the selected actuator series.

1.3 Linear actuator selection

1

Example 1:

1. Application data

- stroke: 300 mm
- linear speed: 20 mm/s
- dynamic load: 4 500 N, push, constant along the entire stroke forward and backward
- static load: 4 500 N, push, applied in any position of the stroke
- working cycle: 5 complete travels (forward + backward) in 10 min
- motor: AC 3-phase electric motor
- application layout

2. Determination of the linear drive type

Calculation of the DUTY CYCLE F_u [%] over 10 min:

$$F_u = \frac{2 \times \text{STROKE}}{\text{LIN.SPEED}} \times \frac{\text{Nr. of cycles over ref. time period}}{\text{Ref. time period}} \times 100 = \frac{2 \times 300\ \text{mm}}{20\ \frac{\text{mm}}{\text{s}}} \times \frac{5}{10\ \text{min} \times 60\ \frac{\text{s}}{\text{min}}} \times 100 = 25\ \%$$

With $F_u \leqslant 30\ \%$, the correct selection is an acme screw actuator.

3. Size selection as a 1st approximation

Referring to the 1st APPROXIMATION SELECTION DIAGRAMS for acme screw actuators on pages 17 ... 20:
- considering the LINEAR SPEED of 20 mm/s select the ATL Series
- considering the MAX. DYNAMIC LOAD of 4500 N at LINEAR SPEED of 20 mm/s select the SIZE 30.

4.1 Check of structural stability

Referring to the diagram BUCKLING RESISTANCE UNDER PUSH LOAD for ATL Series on page 23, for PUSH LOAD of 4500 N and STROKE of 300 mm, selection of the actuator ATL 30 is CORRECT.

5. Determination of ratio

Referring to the ACME SCREW LINEAR ACTUATORS ATL SERIES WITH AC 3-PHASE MOTOR PERFORMANCES table on page 46, the performances of the actuator ATL 30 with RATIO RN2 and 3-PHASE 0.25 kW 2-pole MOTOR

LINEAR SPEED: 23 mm/s DYNAMIC LOAD: 5200 N

are sufficiently closed to the required performances.

6. Check of thermal limit

$F_u \leqslant 30\ \%$: considering the actual speed of the selected actuator, calculate the DUTY CYCLE F_u [%] over 10 min:

$$F_u = \frac{2 \times 300\ \text{mm}}{23\ \frac{\text{mm}}{\text{s}}} \times \frac{5}{10\ \text{min} \times 60\ \frac{\text{s}}{\text{min}}} \times 100 = 22\ \%$$

The calculated value is lower than the duty cycle permissible by the actuator (for acme screw actuators $F_i = 30\ \%$, see page 9), therefore the selection of actuator ATL 30 RN2 is CONFIRMED.

7. Accessories and/or options selection

Select the actuator fixing attachments (see pages 54 ... 57), the input version (see page 83), the stroke end switches (see pages 88 ... 92) and/or other accessories and/or options (see page 82 and pages 93 ... 96).

8. Check of actuator dimensions

Referring to actuator overall dimensions (see pages 54 ... 57, according to the selected stroke end switches), verify if the actuator dimensions fit to the application requirements.

9. Ordering code

Complete the ordering code of the selected actuator referring to the example on page 97.

1.3 Linear actuator selection

Example 2:

1. Application data

- stroke: 600 mm
- linear speed: 60 mm/s
- dynamic load: 900 N, push - pull, constant along the entire stroke forward and backward
- static load: 900 N, push, applied in any position of the stroke
- working cycle: 13 complete travels (forward + backward) in 10 min
- motor: DC 24 V **with brake**
- application layout

2. Determination of the linear drive type

Calculation of the DUTY CYCLE F_u [%] over 10 min:

$$F_u = \frac{2 \times \text{STROKE}}{\text{LIN.SPEED}} \times \frac{\text{Nr. of cycles over ref. time period}}{\text{Ref. time period}} \times 100 = \frac{2 \times 600\ \text{mm}}{60\ \frac{\text{mm}}{\text{s}}} \times \frac{13}{10\ \text{min} \times 60\ \frac{\text{s}}{\text{min}}} \times 100 = 43\,\%$$

With **30 % <** F_u **< 50 %**, both acme or ball screw actuator could be chosen. This example shows the selection of an acme screw actuator because the ball screw actuator, with F_i = **100 %**, satisfies the condition $F_u \leq F_i$.

3. Size selection as a 1st approximation

Referring to the 1st APPROXIMATION SELECTION DIAGRAMS for acme screw actuators on pages 17 ... 20:
- considering the LINEAR SPEED of 60 mm/s select the **ATL Series**
- considering the MAX. DYNAMIC LOAD of 900 N at LINEAR SPEED of 60 mm/s select the SIZE **20**.

4.1 Check of structural stability

Referring to the diagram BUCKLING RESISTANCE UNDER PUSH LOAD for **ATL Series** on page 23, for PUSH LOAD of 900 N and STROKE of 600 mm selection of the actuator **ATL 20** is CORRECT.

5. Determination of ratio

Referring to the ACME SCREW LINEAR ACTUATORS ATL SERIES WITH DC MOTOR PERFORMANCES table on page 49, the performances of the actuator **ATL 20** with RATIO **RV2** and DC MOTOR 24 V **100 W 3000 rpm**

LINEAR SPEED: 64 mm/s DYNAMIC LOAD: 920 N

are sufficiently closed to the required performances.

6. Check of thermal limit

30 % < F_u **< 50 %**: referring to the diagram DUTY CYCLE F_i RELATED TO DYNAMIC LOAD AND SPEED on page 38, the max. dynamic load permissible with condition $F_i = F_u$ = 43 % is:

0.7 × 920 = 640 N

The calculated value is lower than the dynamic load required by the application, therefore the selection of the actuator ATL 20 RV2 is NOT CORRECT.

5.bis Determination of ratio

Back to the ACME SCREW LINEAR ACTUATORS ATL SERIES WITH DC MOTOR PERFORMANCES table on page 49, select the actuator **next larger size**, **ATL 25** with RATIO **RV2** and with DC MOTOR 24 V **150 W 3000 rpm** with performances

LINEAR SPEED: 64 mm/s DYNAMIC LOAD: 1330 N

which are sufficiently closed to the required performances.

1.3 Linear actuator selection

Example 2 (continuation):

6.bis Check of thermal limit

30 % < F_u < 50 %: referring to the diagram DUTY CYCLE F_i RELATED TO DYNAMIC LOAD AND SPEED on page 38, the max. dynamic load permissible with condition $F_i = F_u$ = 43 % is:

0.7 × 1330 = 930 N

The resulting value is higher than the dynamic load required by the application, therefore the selection of the actuator ATL 25 RV2 is CORRECT.

Considering now the actual speed of the selected actuator, the DUTY CYCLE F_u [%] over 10 min is

$$F_u = \frac{2 \times 600\ \text{mm}}{64\,\frac{\text{mm}}{\text{s}}} \times \frac{13}{10\ \text{min} \times 60\,\frac{\text{s}}{\text{min}}} \times 100 = 41\,\%$$

Being this value remained within the limits 30 % < F_u < 50 %, the selection of the actuator ATL 25 RV2 is CONFIRMED.

7. Accessories and/or options selection

Select the actuator fixing attachments (see pages 58 ... 61), the input version (see page 83), the stroke end switches (see pages 88 ... 92) and/or other accessories and/or options (see page 82 and pages 93 ... 96).

8. Check of actuator dimensions

Referring to actuator overall dimensions (see pages 58 ... 61, according to the selected stroke end switches), verify if the actuator dimensions fit to the application requirements.

9. Ordering code

Complete the ordering code of the selected actuator referring to the example on page 97.

NOTE: Due to the quite high linear speed, it is necessary to use a brake-motor.

1.3 Linear actuator selection

Example 3:

1. **Application data**
   - stroke: 500 mm
   - linear speed: 125 mm/s
   - dynamic load: 1 800 N, push - pull, constant along the entire stroke forward and backward
   - static load: not present
   - working cycle: 50 complete travels (forward + backward) in 10 min
   - required lifetime: 3 000 hours of work under load
   - motor: AC 3-phase **with brake**
   - application layout

2. **Determination of the linear drive type**

   Calculation of the DUTY CYCLE F_u [%] over 10 min:

$$F_u = \frac{2 \times \text{STROKE}}{\text{LIN.SPEED}} \times \frac{\text{Nr. of cycles over ref. time period}}{\text{Ref. time period}} \times 100 = \frac{2 \times 500\ \text{mm}}{125 \frac{\text{mm}}{\text{s}}} \times \frac{50}{10\ \text{min} \times 60 \frac{\text{s}}{\text{min}}} \times 100 = 67\ \%$$

   With F_u = 67 %, the correct selection is a ball screw actuator.

3. **Size selection as a 1st approximation**

   Referring to the 1st APPROXIMATION SELECTION DIAGRAMS for ball screw actuators on pages 21 ... 22:
   - considering the LINEAR SPEED of 125 mm/s select the UBA Series
   - considering the MAX. DYNAMIC LOAD of 1800 N at LINEAR SPEED of 125 mm/s select the SIZE 2.

4.1 Check of structural stability

Referring to the diagram BUCKLING RESISTANCE UNDER PUSH LOAD for UBA Series on page 26, for PUSH LOAD of 1800 N and STROKE of 500 mm, selection of the actuator UBA 2 is CORRECT.

4.2 Lifetime check

Referring to the diagram BALL screw LIFETIME for ball screw BS 16×5 on page 33, the lifetime of this ball screw with load 1800 N and linear speed 125 mm/s is lower than required 3000 hours, therefore the actuator UBA 2 is NOT CORRECT for the application.

4.2 bis Lifetime check

Select the next larger actuator size: UBA 3. Referring to the diagram BALL screw LIFETIME for ball screw BS 20×5 on page 34, the lifetime of this ball screw with load 1800 N and linear speed 125 mm/s is higher than required 3000 hours, therefore the actuator UBA 3 is CORRECT for the application.

5. **Determination of ratio**

   Referring to the BALL SCREW LINEAR ACTUATORS UBA SERIES WITH AC 3-PHASE MOTOR PERFORMANCES table on page 130, the performances of the actuator ATL 20 with RATIO RN1 and with 3-PHASE MOTOR 0.55 kW 2-pole

   LINEAR SPEED: 115 mm/s DYNAMIC LOAD: 2750 N

   are sufficiently closed to the required performances.

7. **Accessories and/or options selection**

   Select the actuator fixing attachments (see pages 136 ... 137) and/or other accessories and/or options (see pages 146 and 151).

8. **Check of actuator dimensions**

   Referring to actuator overall dimensions (see pages 136 ... 137, according to the selected stroke end switches), verify if the actuator dimensions fit to the application requirements.

9. **Ordering code**

   Complete the ordering code of the selected actuator referring to the example on page 152.
   NOTE: Due to the high linear speed, it is necessary to use a brake-motor.

1.3 Linear actuator selection

Example 4:

1. Application data

- stroke: 1 200 mm
- linear speed: 0.4 mm/s
- dynamic load: 50 kN, push, constant along the entire stroke forward and backward
- static load: 95 kN, push, applied in any position of the stroke
- working cycle: 1 (one) travel of 8 mm every 5 min
- motor: AC 3-phase
- application layout

2. Determination of the linear drive type

Calculation of the DUTY CYCLE F_u [%] over 10 min:

$$F_u = \frac{2 \times \text{STROKE}}{\text{LIN.SPEED}} \times \frac{\text{Nr. of cycles over ref. time period}}{\text{Ref. time period}} \times 100 = \frac{2 \times 8\ \text{mm}}{0.4\ \frac{\text{mm}}{\text{s}}} \times \frac{1}{2 \times 5\ \text{min} \times 60\ \frac{\text{s}}{\text{min}}} \times 100 = 6.7\ \%$$

With $F_u \leqslant 30\ \%$, the correct selection is an acme screw actuator.

3. Size selection as a 1st approximation

Referring to the 1st APPROXIMATION SELECTION DIAGRAMS for acme screw actuators on pages 17 ... 20:
- considering the LINEAR SPEED of 0.4 mm/s select the TMA Series
- considering the MAX. DYNAMIC LOAD of 50 kN at LINEAR SPEED of 0.4 mm/s select the SIZE 50

4.1 Check of structural stability

Referring to the diagram BUCKLING RESISTANCE UNDER PUSH LOAD for TMA Series on page 27, for PUSH LOAD of 95 kN is higher than the max. load permissible by the actuator TMA 50, therefore the selection is NOT CORRECT for the application.

4.1 bis Check of structural stability

Select the next larger size: TMA 100. Referring to the diagram BUCKLING RESISTANCE UNDER PUSH LOAD for TMA Series on page 27, for PUSH LOAD of 95 kN at STROKE of 1200 mm the selection of the actuator TMA 100 is CORRECT.

5. Determination of ratio

Referring to the ACME SCREW LINEAR ACTUATORS TMA SERIES PERFORMANCES table on page 161, the performances of the actuator TMA 100 with RATIO RL1, with INPUT GEAR DRIVE I 40 R20 and 3-PHASE MOTOR 0.37 kW 4-pole

LINEAR SPEED: 0.38 mm/s DYNAMIC LOAD: 100 kN

are sufficiently closed to the required performances.

6. Check of thermal limit

In case of a DUTY CYCLE F_u [%] over 10 min value low as in this example, the check of the thermal limit can be omitted.

7. Accessories and/or options selection

Select the actuator configuration (see pages 162 ... 163), the actuator fixing attachments (see pages 164 ... 171) and/or other accessories and/or options (see pages 177 ... 178).

8. Check of actuator dimensions

Referring to actuator overall dimensions (see pages 164 ... 171 according to the selected configuration) verify if the actuator dimensions fit to the application requirements.

9. Ordering code

Complete the ordering code of the selected actuator referring to the example on page 180.

1.3 Linear actuator selection

Example 5:

1. Application data
   - stroke: 600 mm
   - linear speed: 400 mm/s
   - dynamic load: 4 500 N, push - pull, constant along the entire stroke forward and backward
   - static load: not present
   - working cycle: continuous work
   - motor: servo-motor, in line with the actuator linear drive
   - required lifetime: 3 000 hours of work under 4 500 N load
   - application layout

2. Determination of the linear drive type

   Considering the **continuous** working cycle (F_u = 100 %), select a ball screw actuator.

3. Size selection

   Referring to the diagram concerning the BALL SCREW LIFETIME RELATED TO LOAD AND LINEAR SPEED (see pages 33 ... 38), considering the MAX. DYNAMIC LOAD of 4500 N, the LINEAR SPEED of 400 mm/s and the required LIFETIME of 3000 hours, select the BALL SCREW BS 32×10 and therefore linear actuator ILA 25 B.

4.1 Check of structural stability

   Referring to the diagram BUCKLING RESISTANCE UNDER PUSH LOAD for ILA . B Series on page 29, with PUSH LOAD 4500 N and STROKE 600 mm the selection of the actuator ILA 25 B is CORRECT.

7. Accessories and/or options selection

   Select the actuator fixing attachments (see pages 192 ... 193), specify the input dimensions (see pages 192 ... 193) and/or other accessories and/or options (see pages 194 ... 195).

8. Check of actuator dimensions

   Referring to actuator overall dimensions (see pages 192 ... 193), verify if the actuator dimensions fit to the application requirements .

9. Ordering code

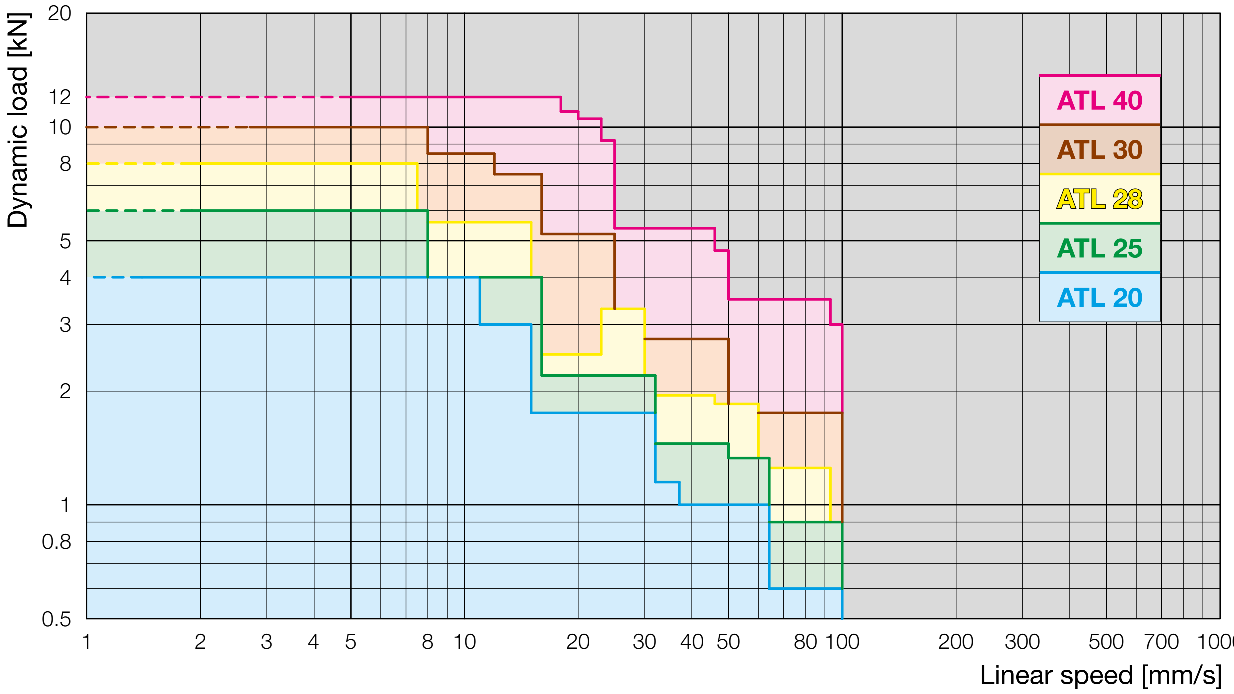
   Complete the ordering code of the selected actuator referring to the example on page 196.

1

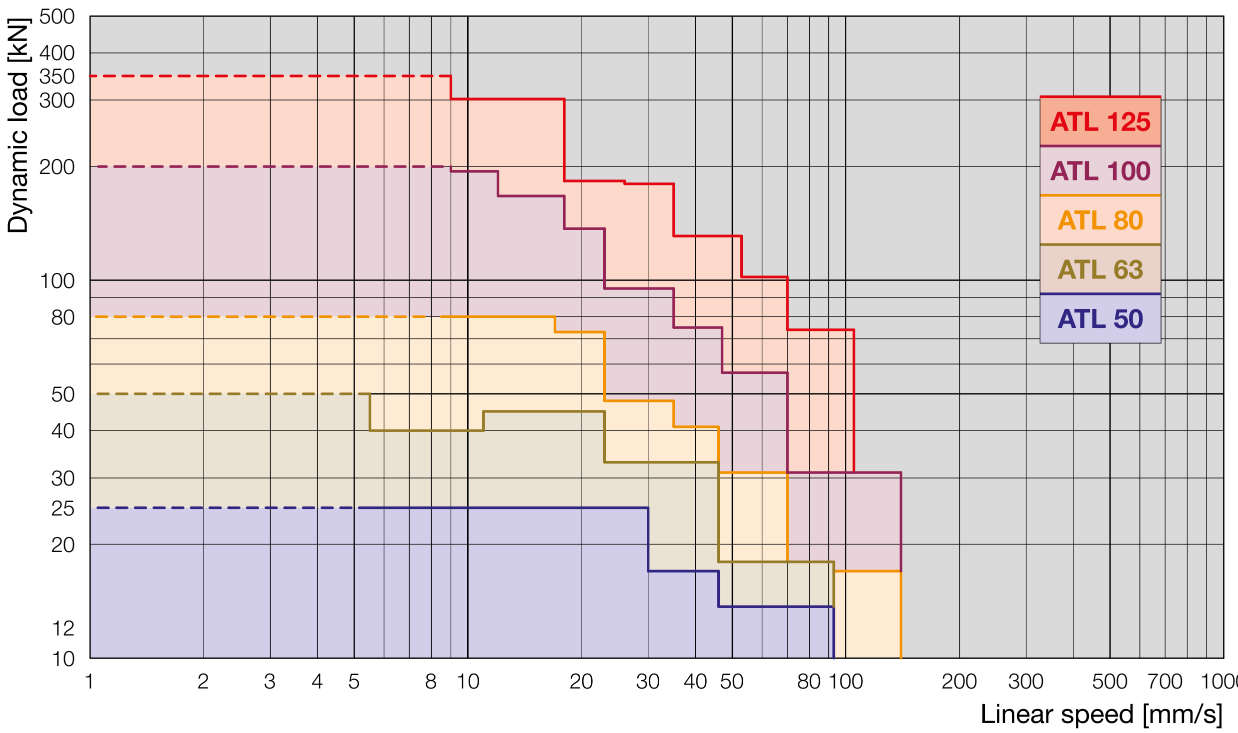
1.4 1st approximation selection diagrams

related to linear speed, dynamic load and THERMAL LIMIT

Acme screw linear actuators
ATL Series, size 20 ... 40



Acme screw linear actuators
ATL Series, size 50 ... 125



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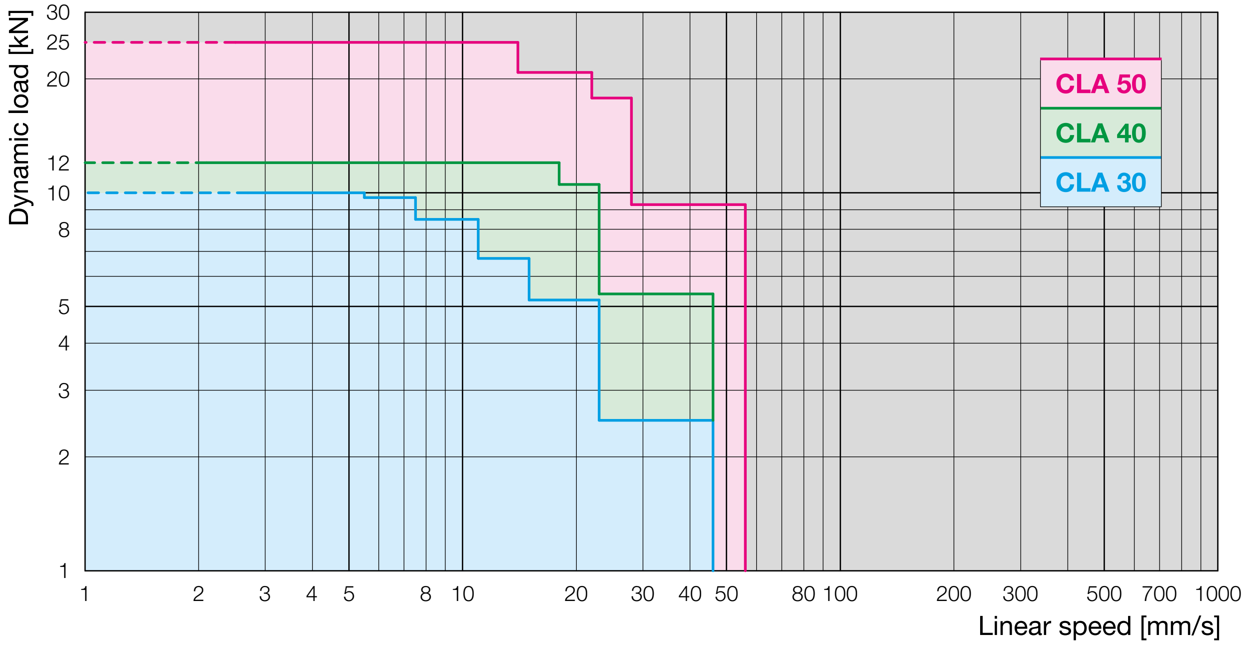
1.4 1st approximation selection diagrams

related to linear speed, dynamic load and THERMAL LIMIT

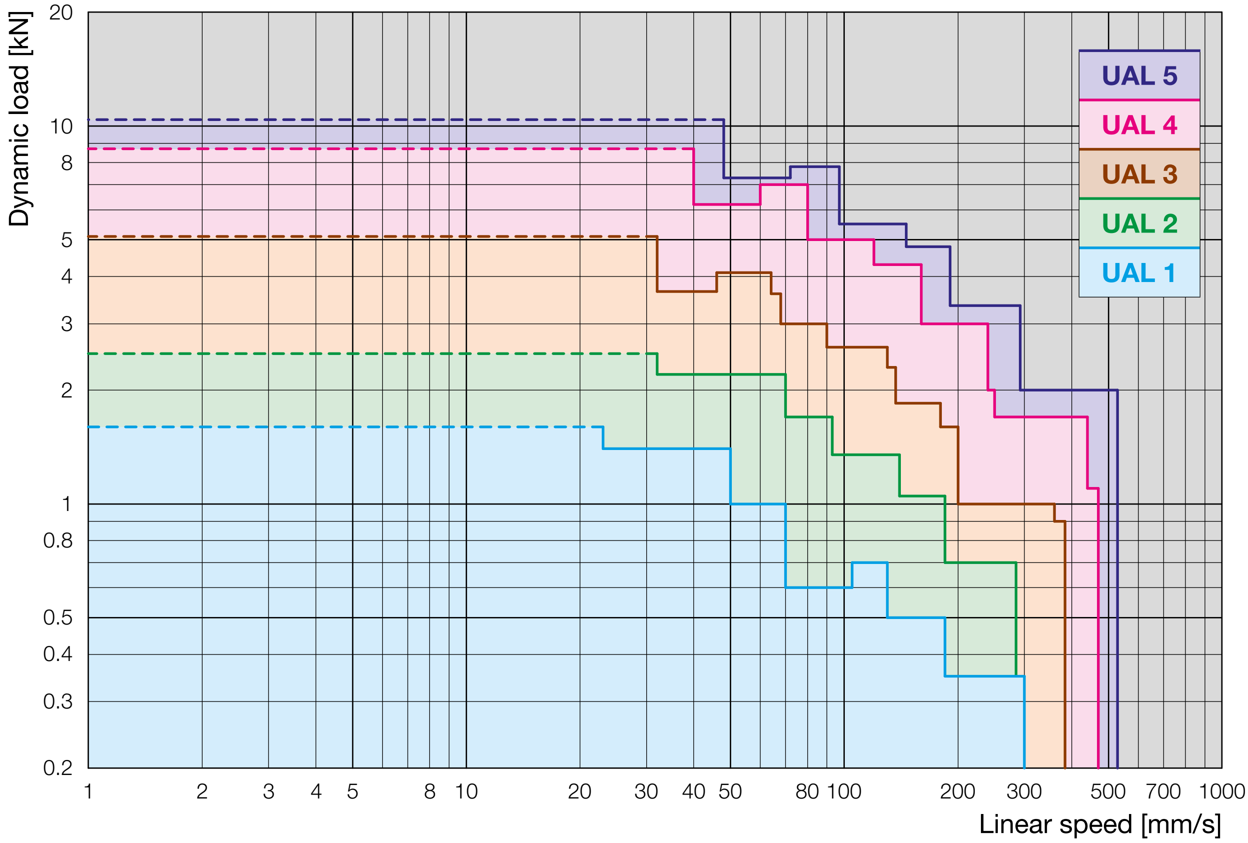
Acme screw linear actuators

CLA Series



Acme screw linear actuators

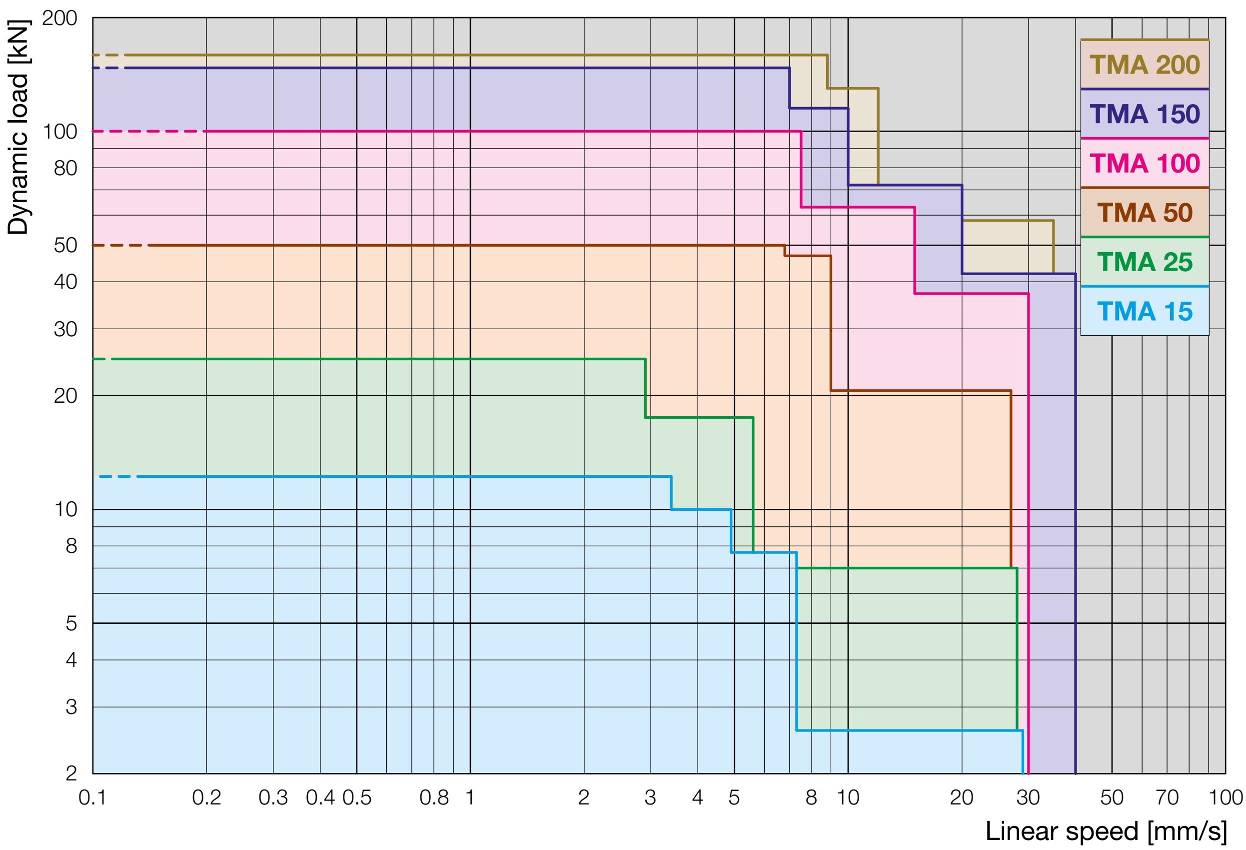
UAL Series



1.4 1st approximation selection diagrams

related to linear speed, dynamic load and THERMAL LIMIT

Acme screw linear actuators
TMA Series



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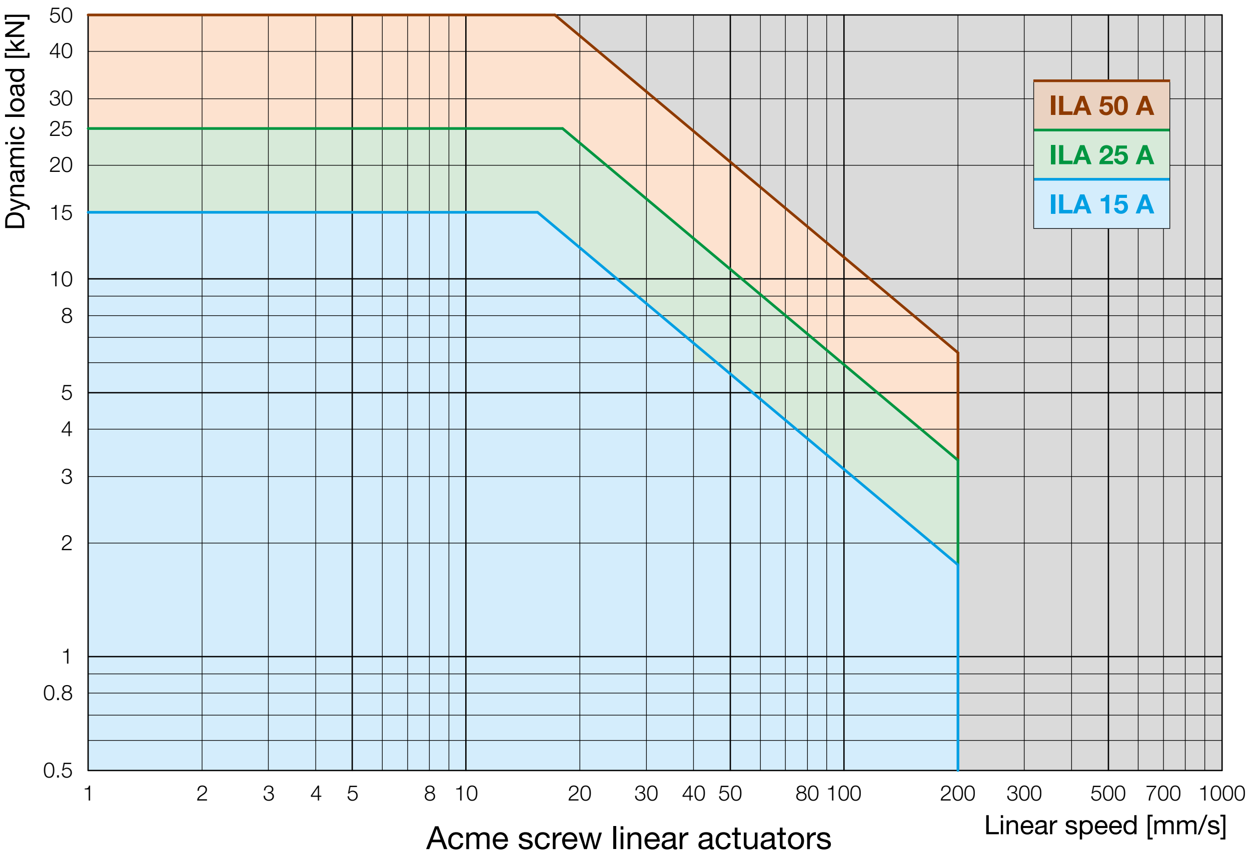
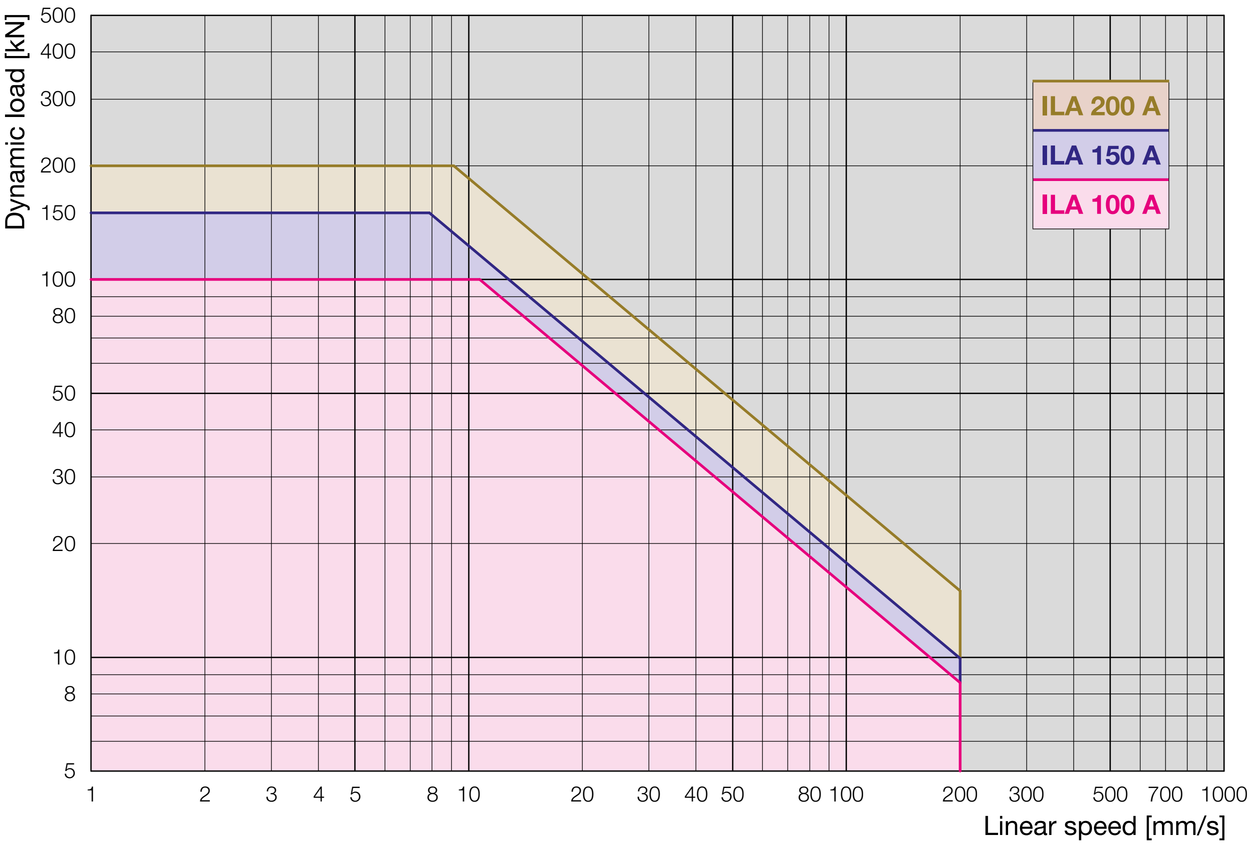
1.4 1st approximation selection diagrams

related to linear speed, dynamic load and THERMAL LIMIT

Acme screw linear actuators
ILA 15 A ... ILA 50 A



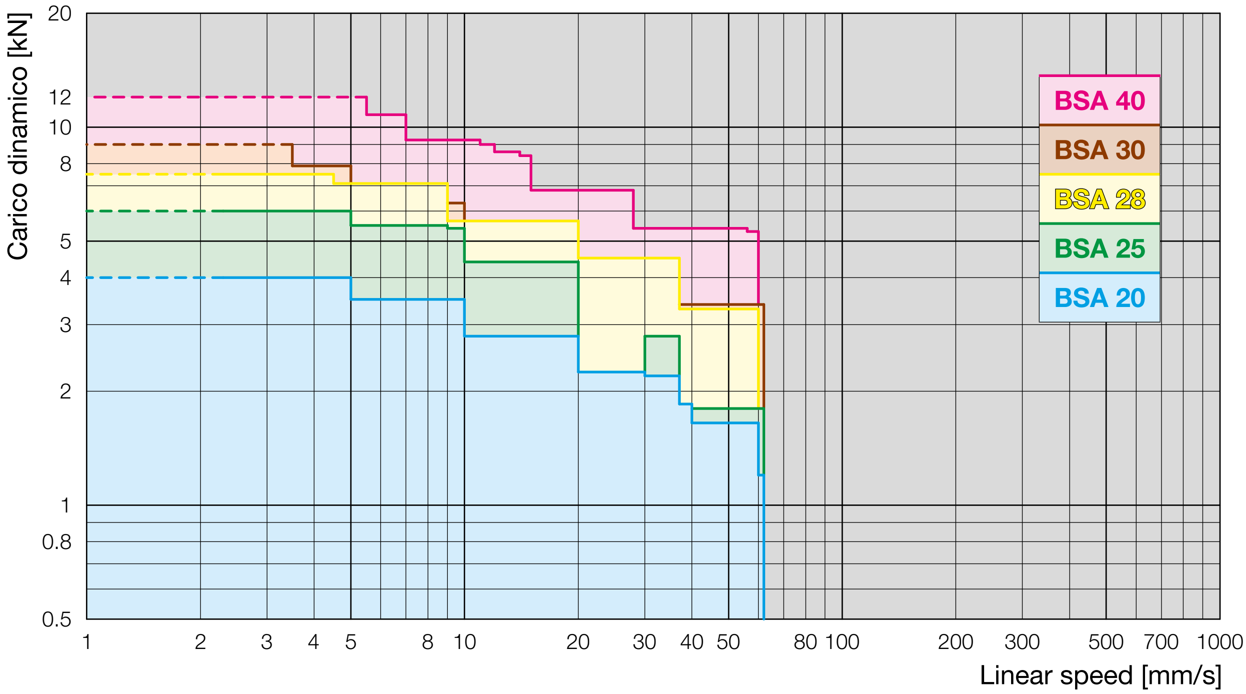
Acme screw linear actuators
ILA 100 A ... ILA 200 A



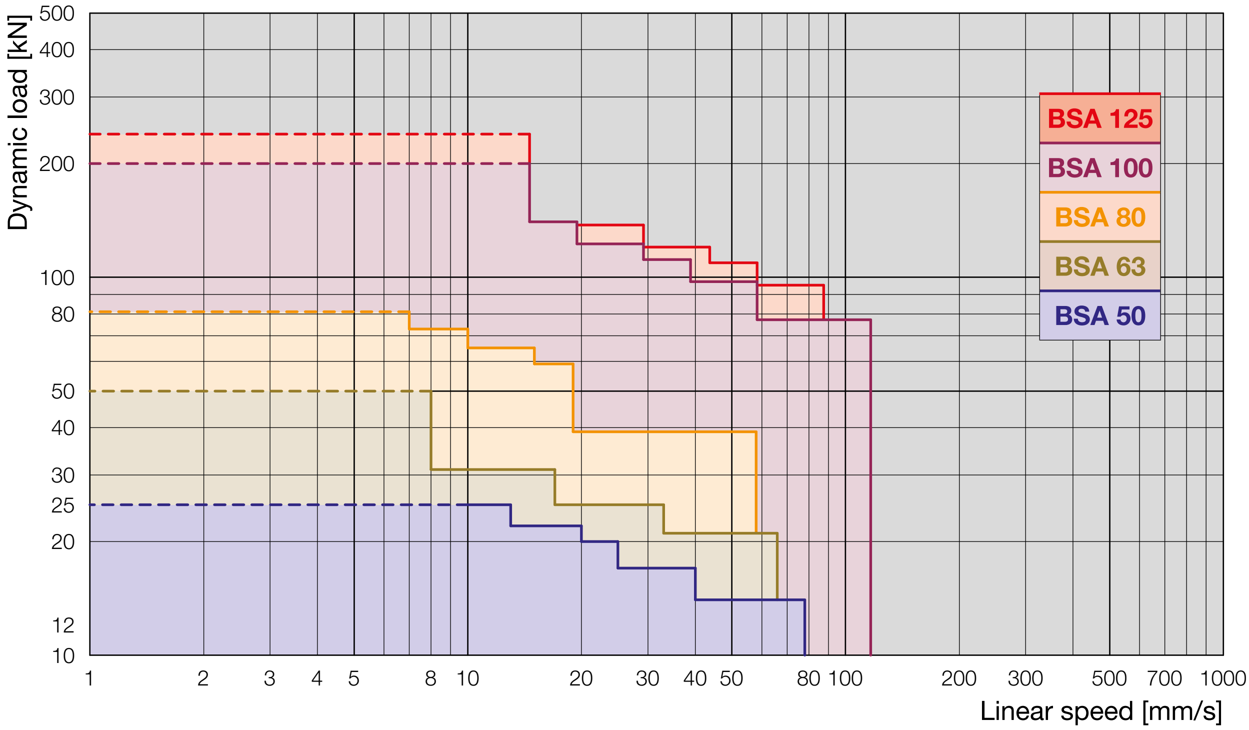
1.4 1st approximation selection diagrams

related to linear speed, dynamic load and ball screw laod capacity

Ball screw linear actuators
BSA Series, size 20 ... 40



Ball screw linear actuators
BSA Series, size 50 ... 125



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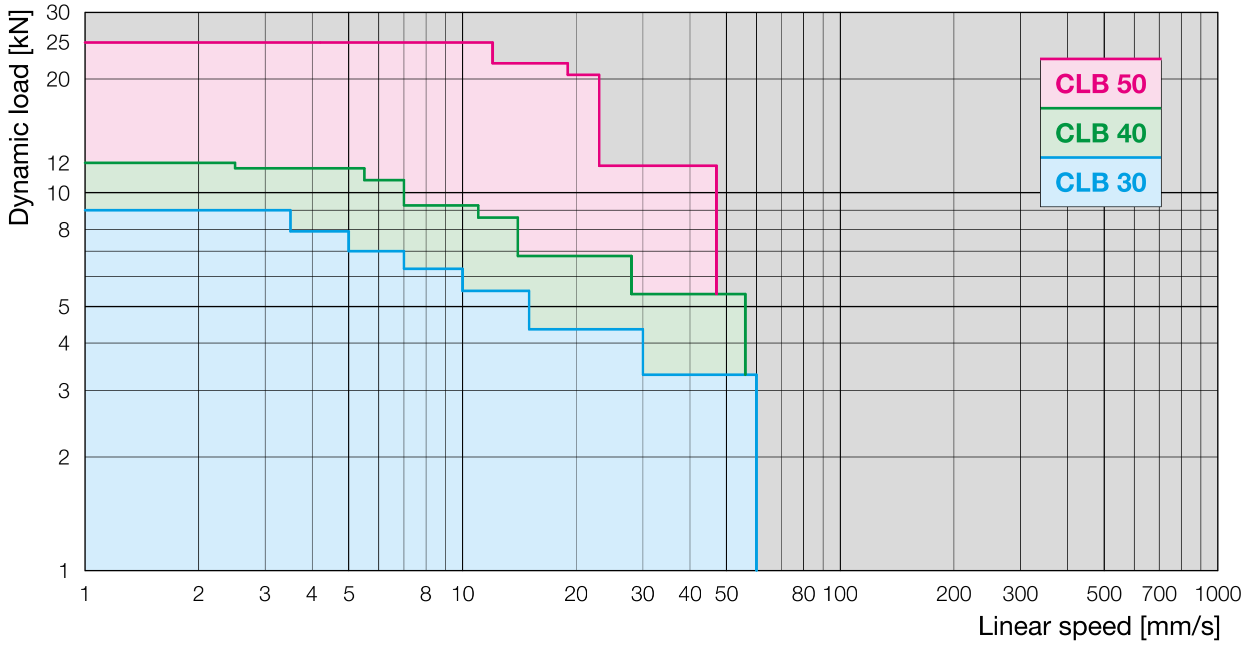
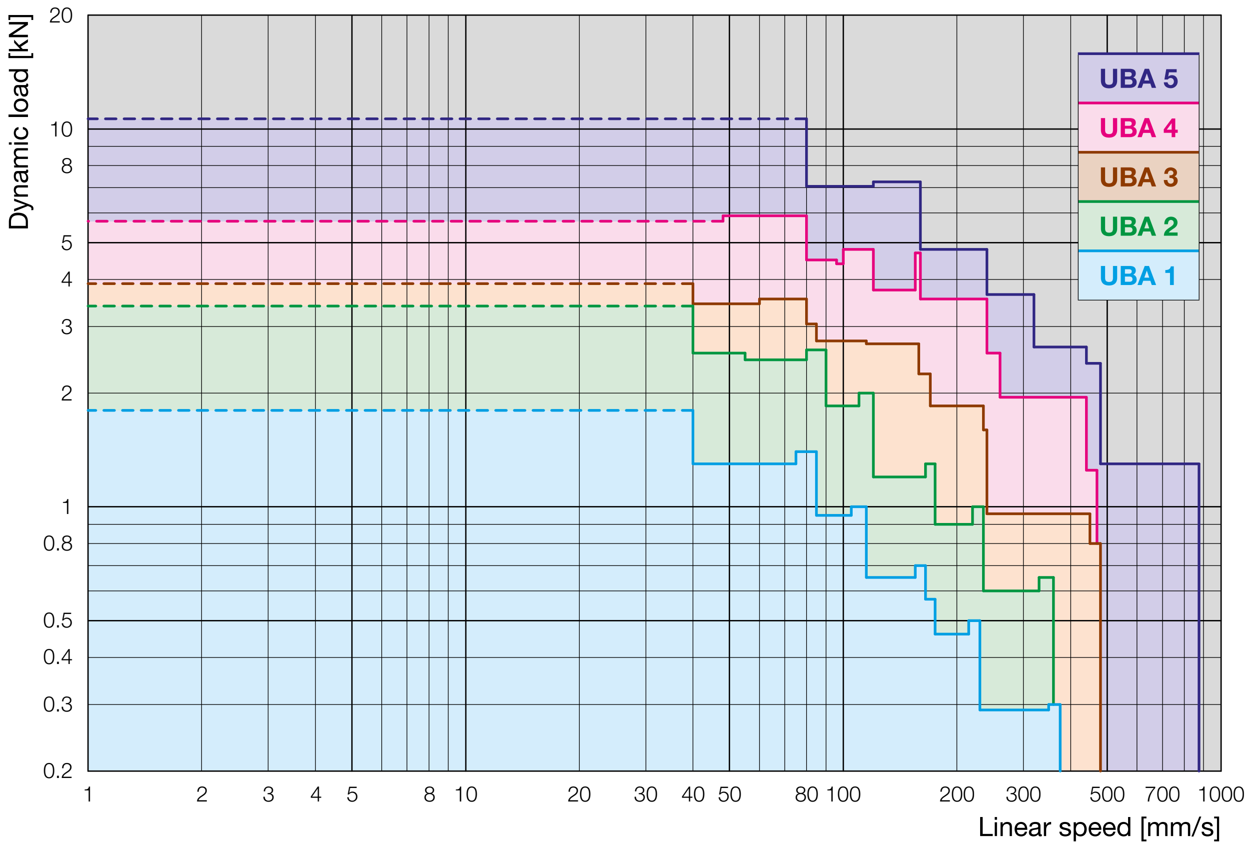
1.4 1st approximation selection diagrams

related to linear speed, dynamic load and ball screw laod capacity

Ball screw linear actuators
CLB Series



Ball screw linear actuators
UBA Series



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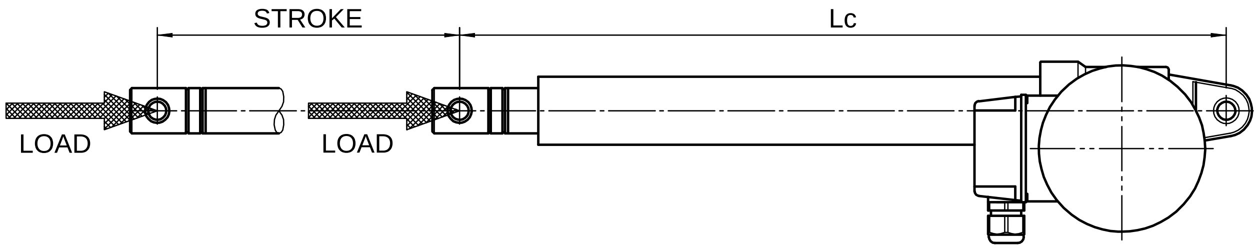
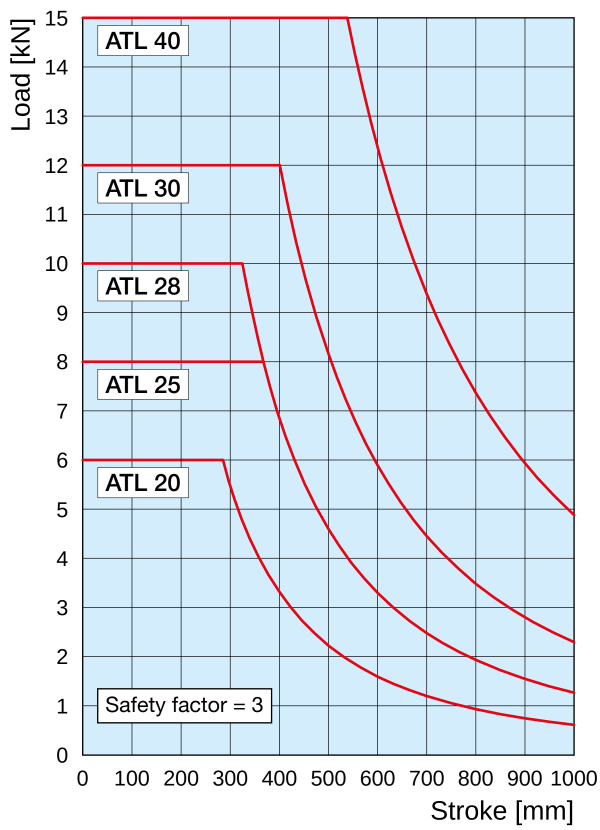
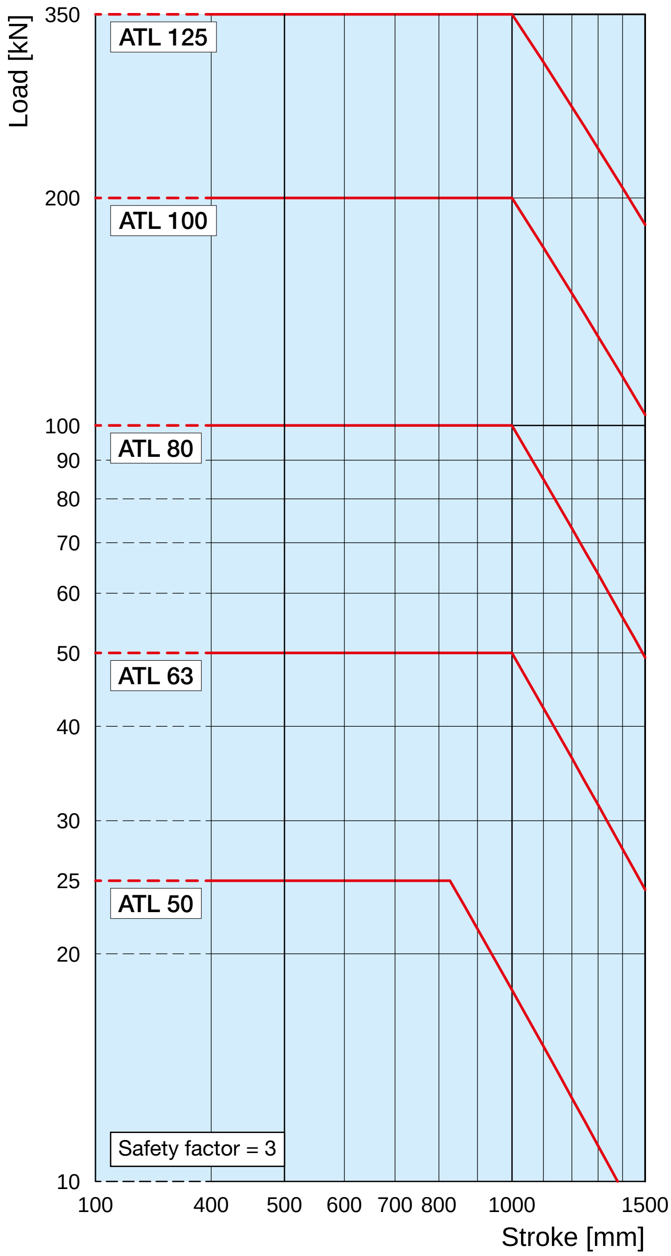
1.5 Buckling resistance under push load - Euler III diagrams

Acme screw linear actuators **ATL Series**







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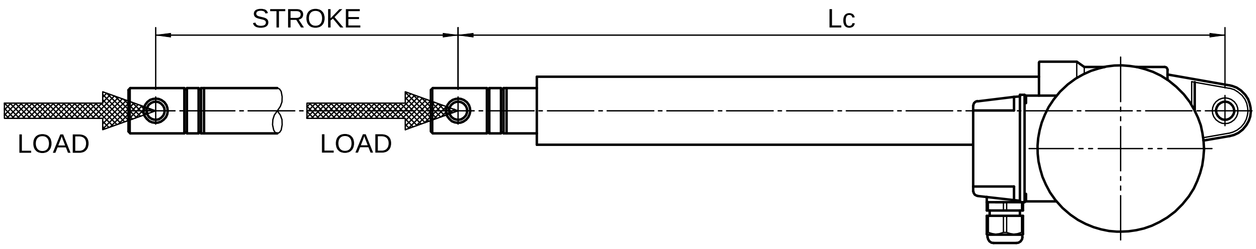
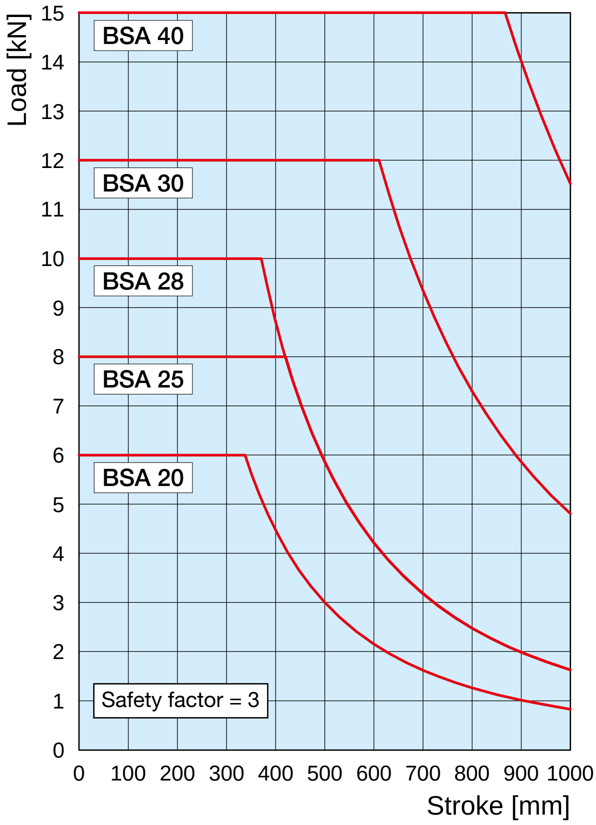
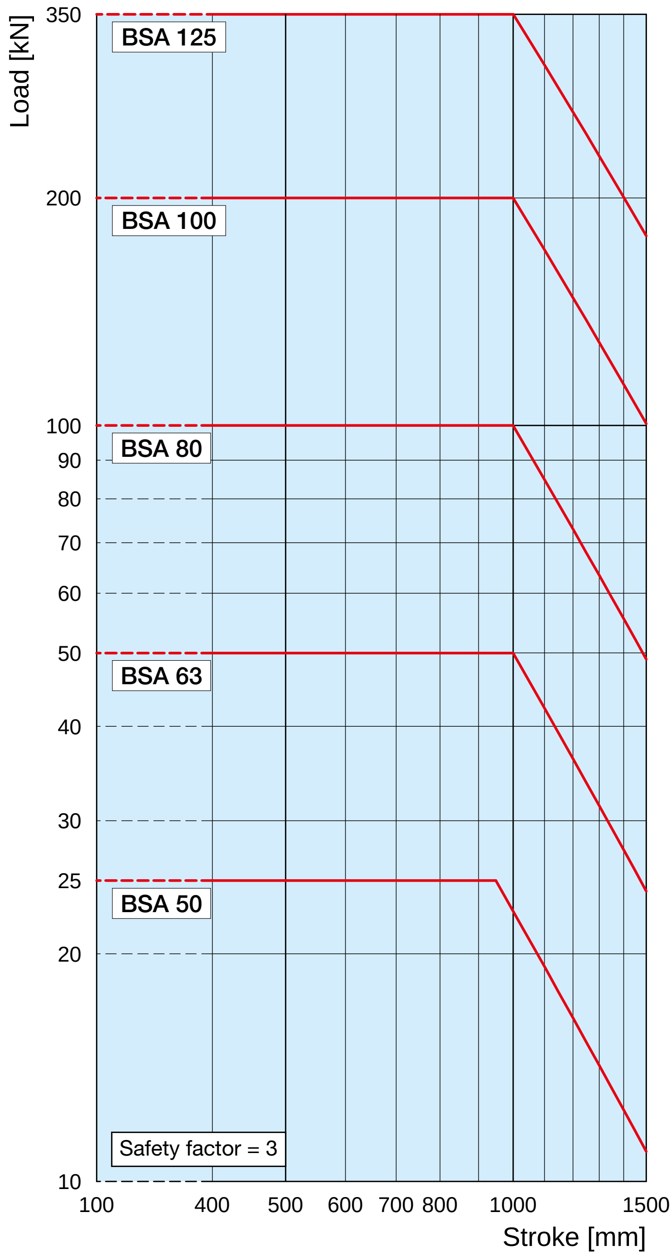
1.5 Buckling resistance under push load - Euler III diagrams

Ball screw linear actuators **BSA Series**

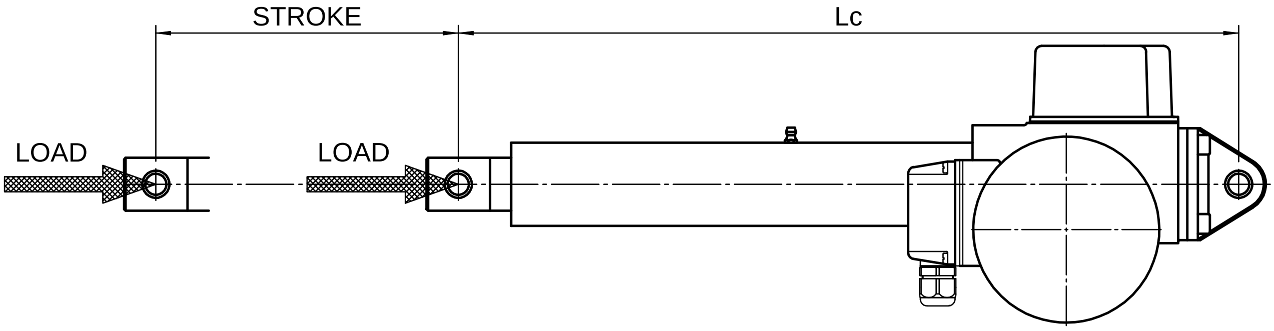


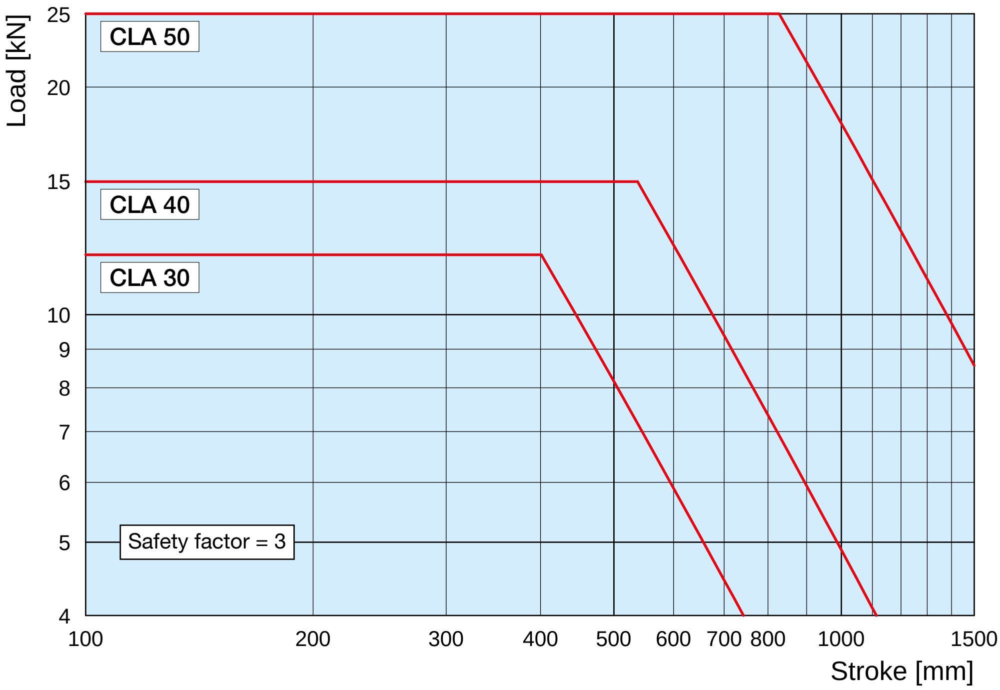


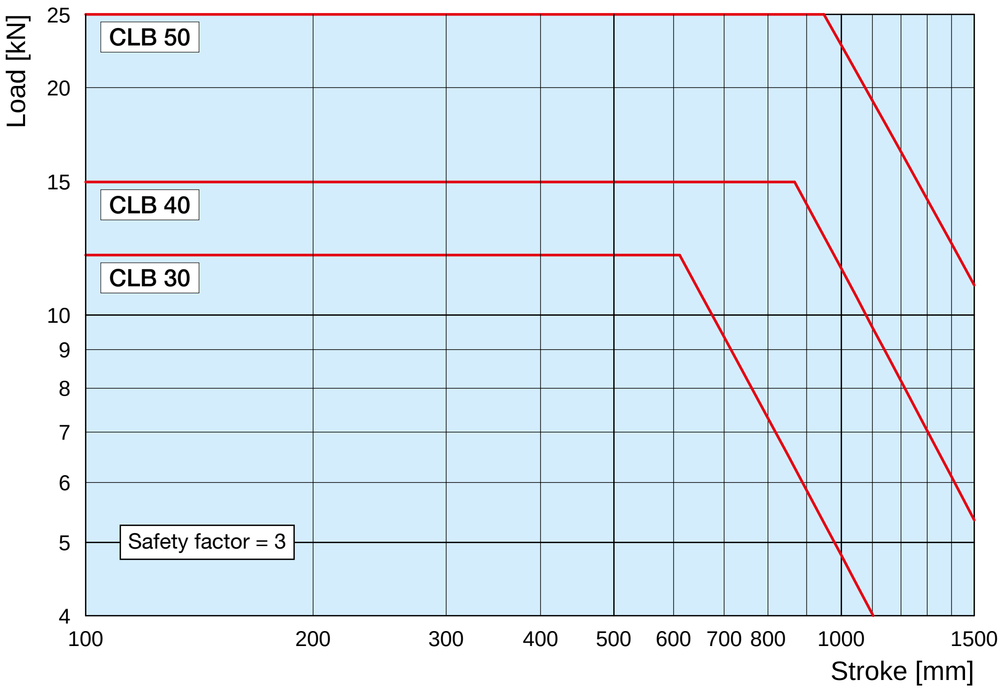


1.5 Buckling resistance under push load - Euler III diagrams

Acme screw linear actuators **CLA Series**
Ball screw linear actuators **CLB Series**







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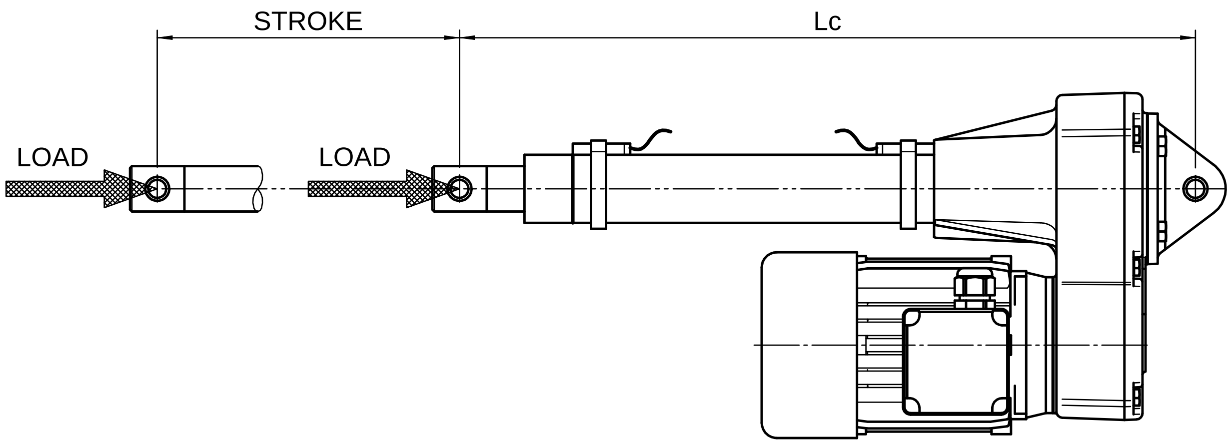
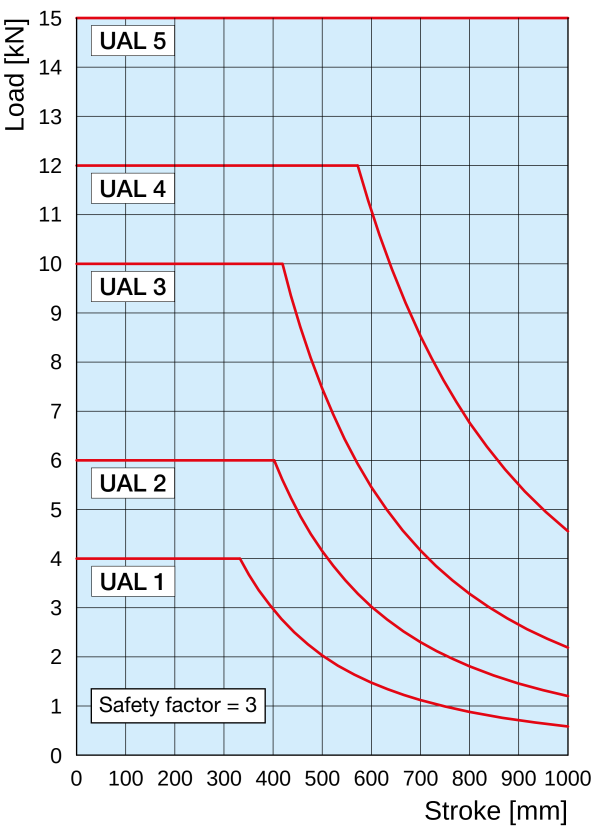
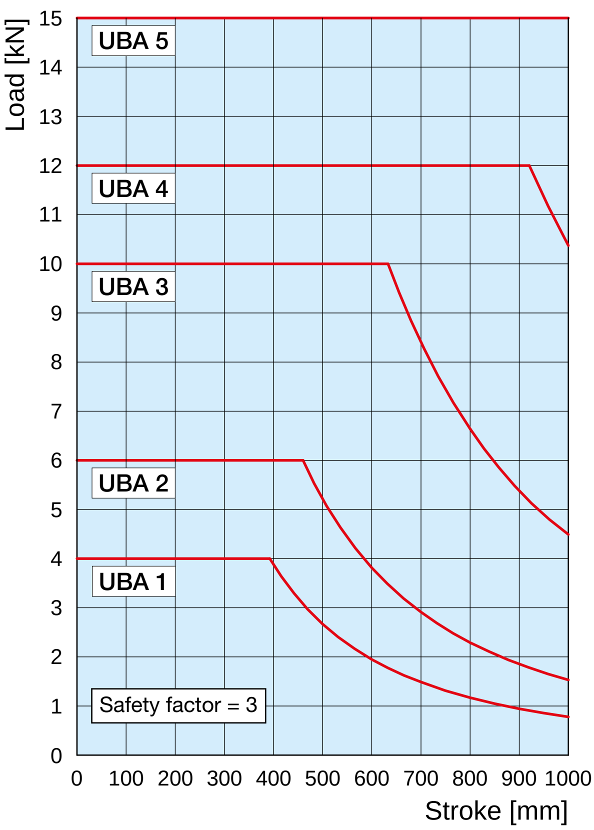
1.5 Buckling resistance under push load - Euler III diagrams

Acme screw linear actuators **UAL Series**
Ball screw linear actuators **UBA Series**

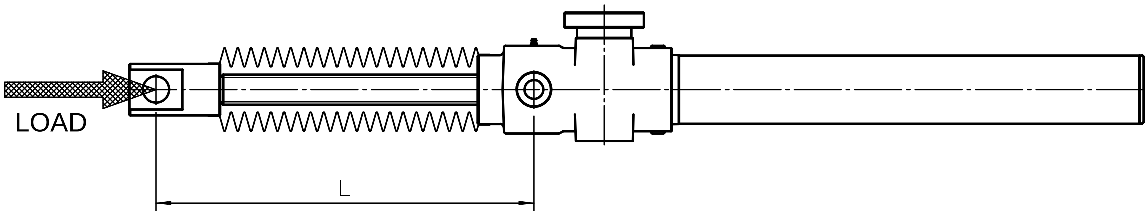


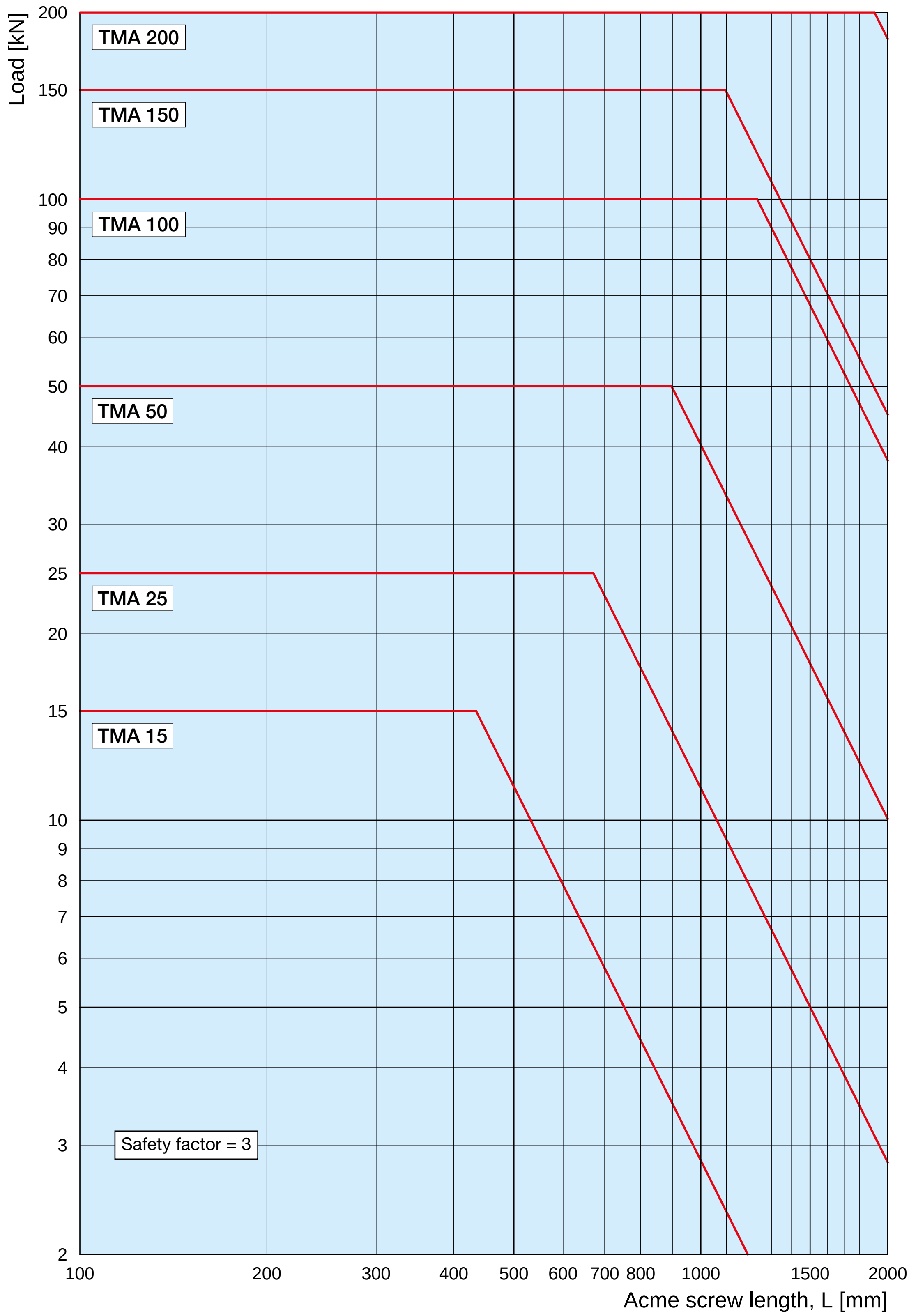




1.5 Buckling resistance under push load - Euler II diagrams

Acme screw linear actuators **TMA Series**





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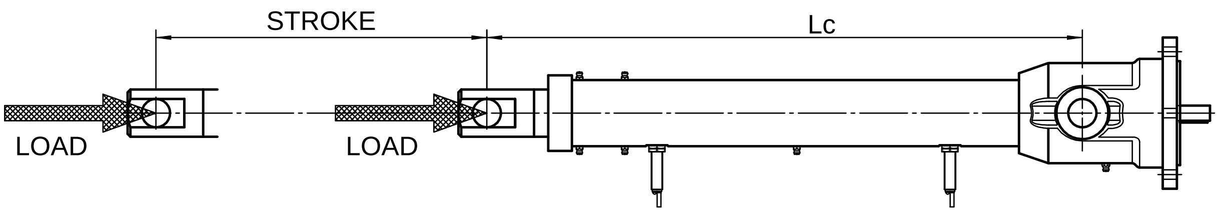
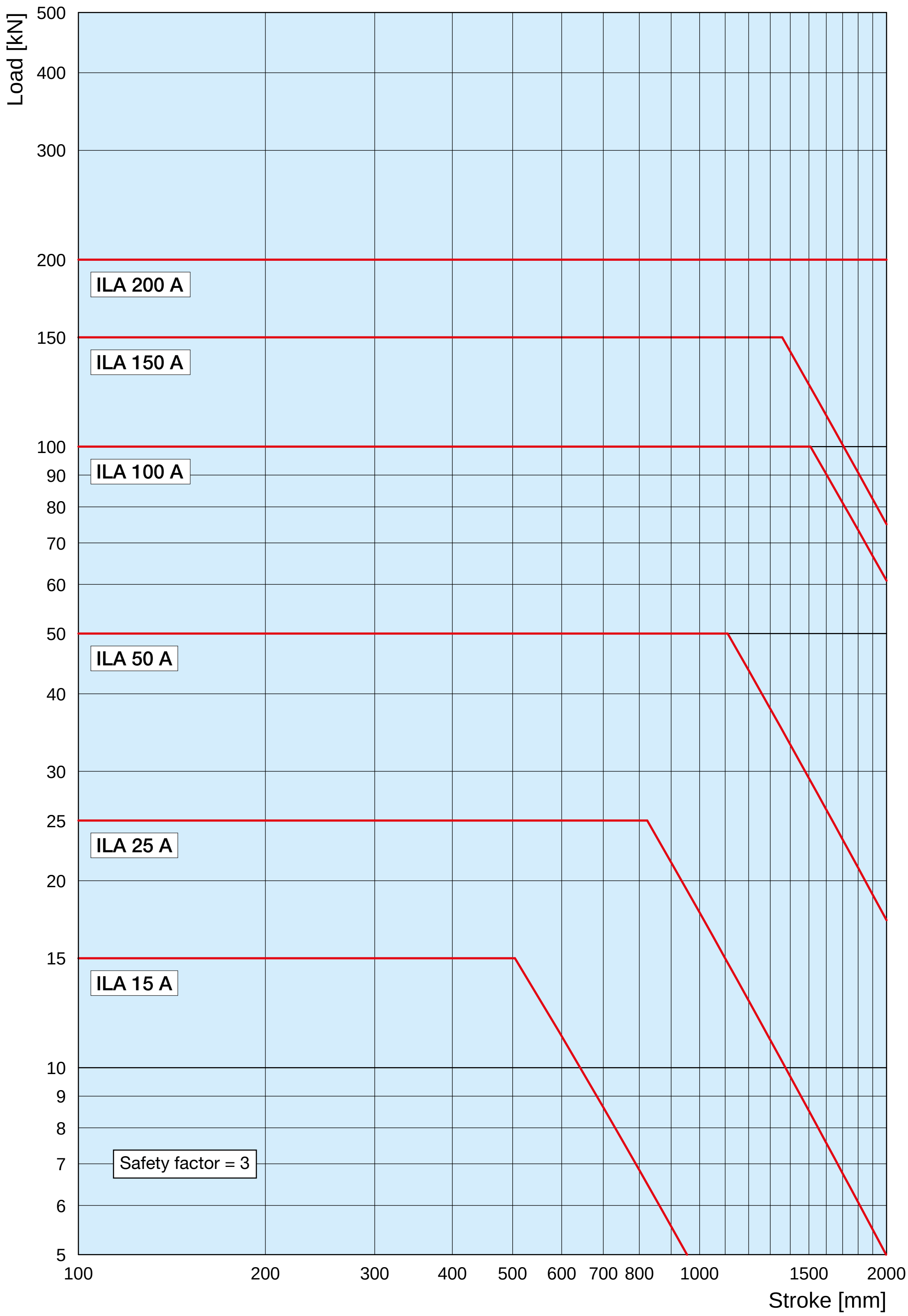
1.5 Buckling resistance under push load - Euler III diagrams

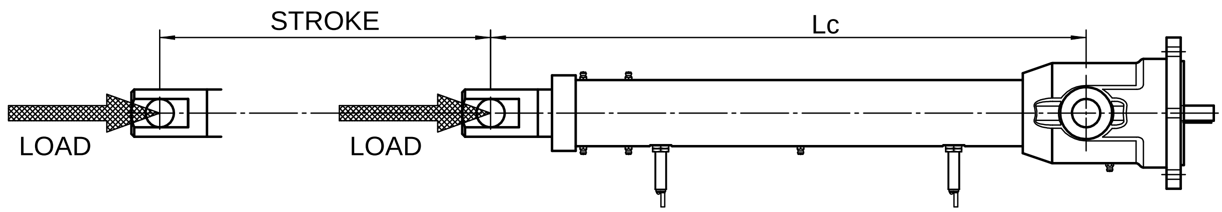
Acme screw linear actuators **ILA . A Series**

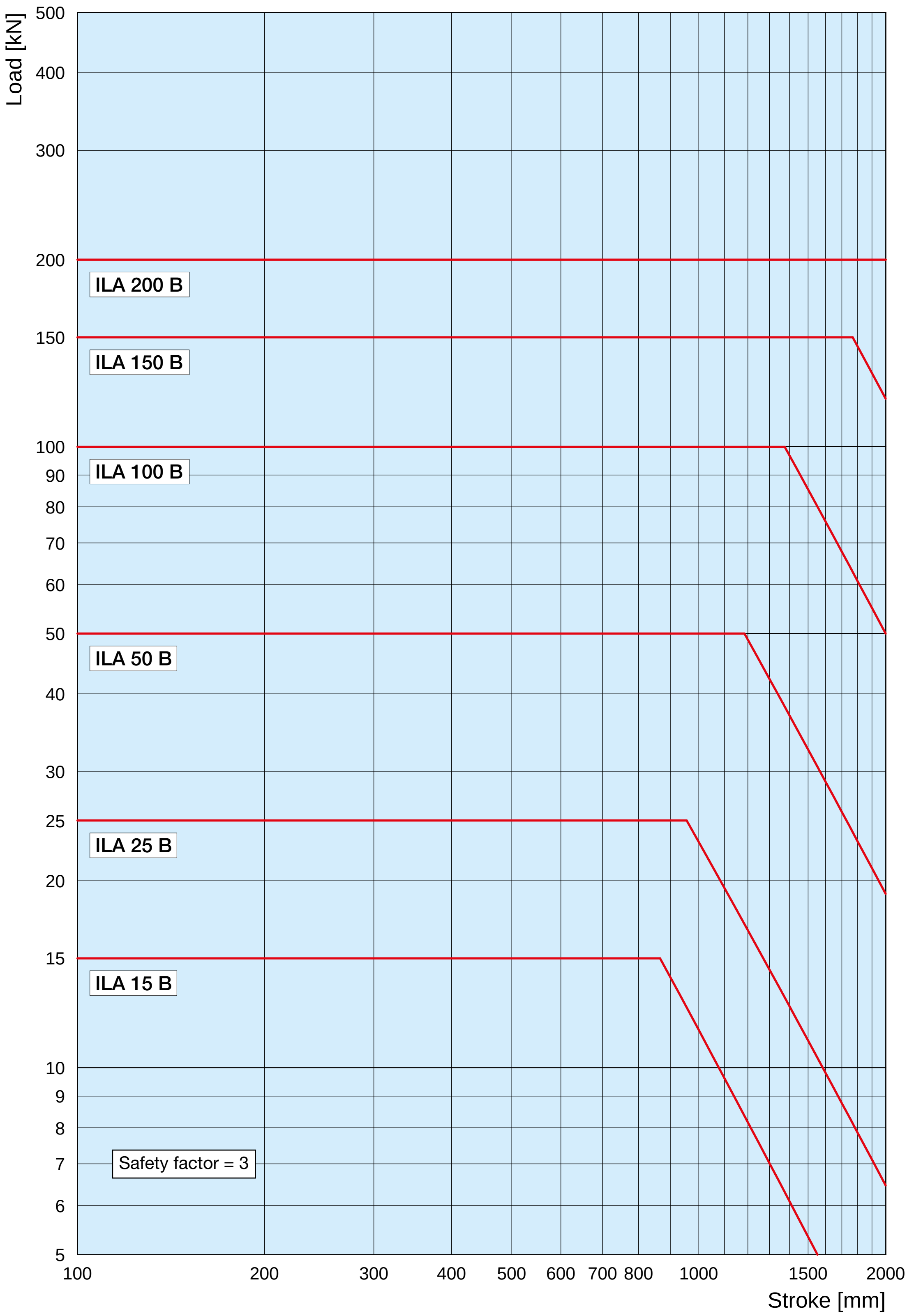




1.5 Buckling resistance under push load - Euler III diagrams

Ball screw linear actuators **ILA . B Series**





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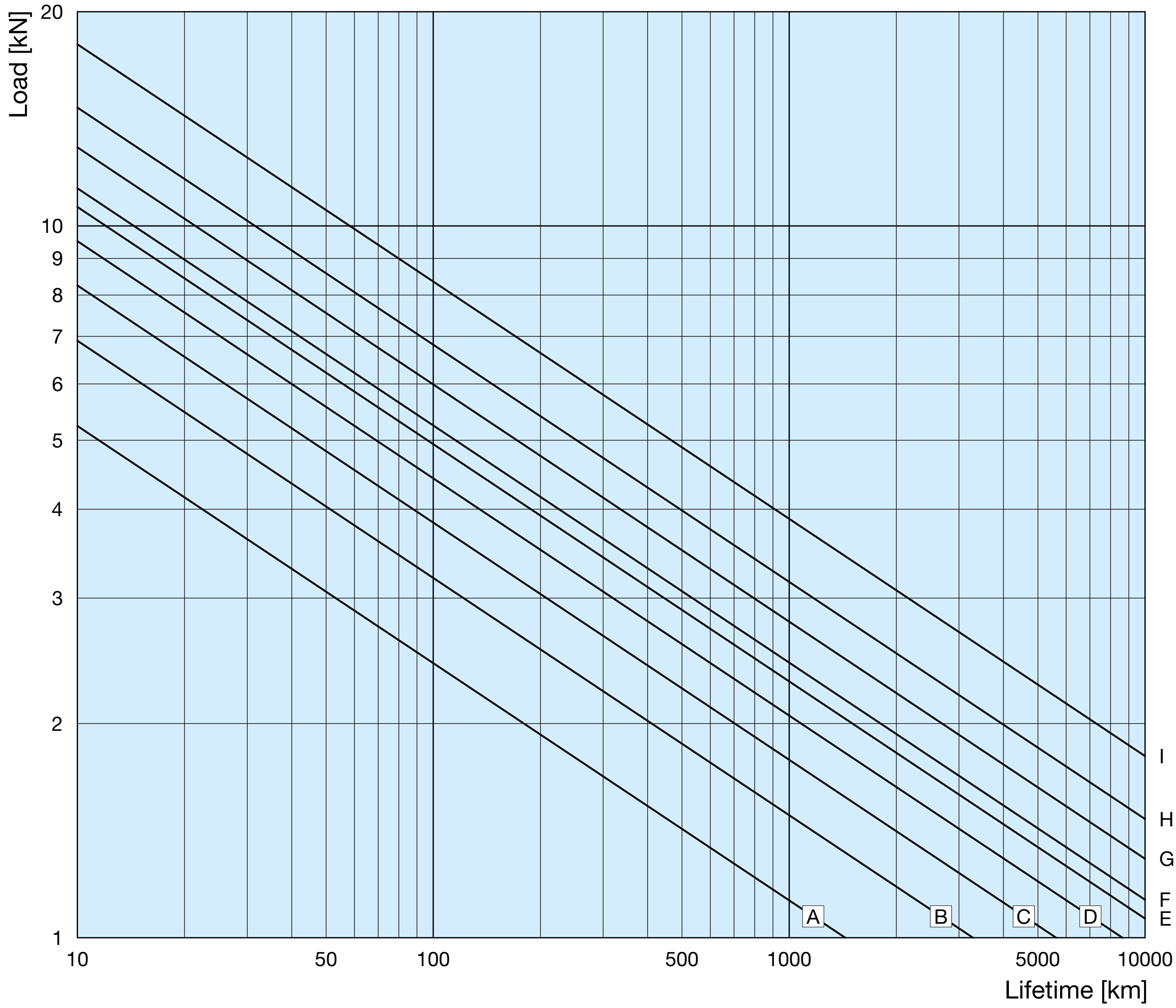
1.6 Ball screw lifetime – performed stroke related to load



BALL SCREW	ball [mm]	n° of circuits	C_a [kN]	C_{0a} [kN]	CURVE
BS 14×5	3.175	2	6.6	8.6	A
BS 14×10	3.175	2	6.9	9.3	B
BS 16×5	3.175	3	10.4	15.6	C
BS 16×5	3.175	4	13.4	20.9	E
BS 16×10	3.175	3	11.3	18	F
BS 20×5	3.175	3	12	21.2	D
BS 20×10	3.175	3	12.9	23.5	G
BS 25×6	3.969	3	17.4	30.5	H
BS 25×10	3.969	3	18	33	I

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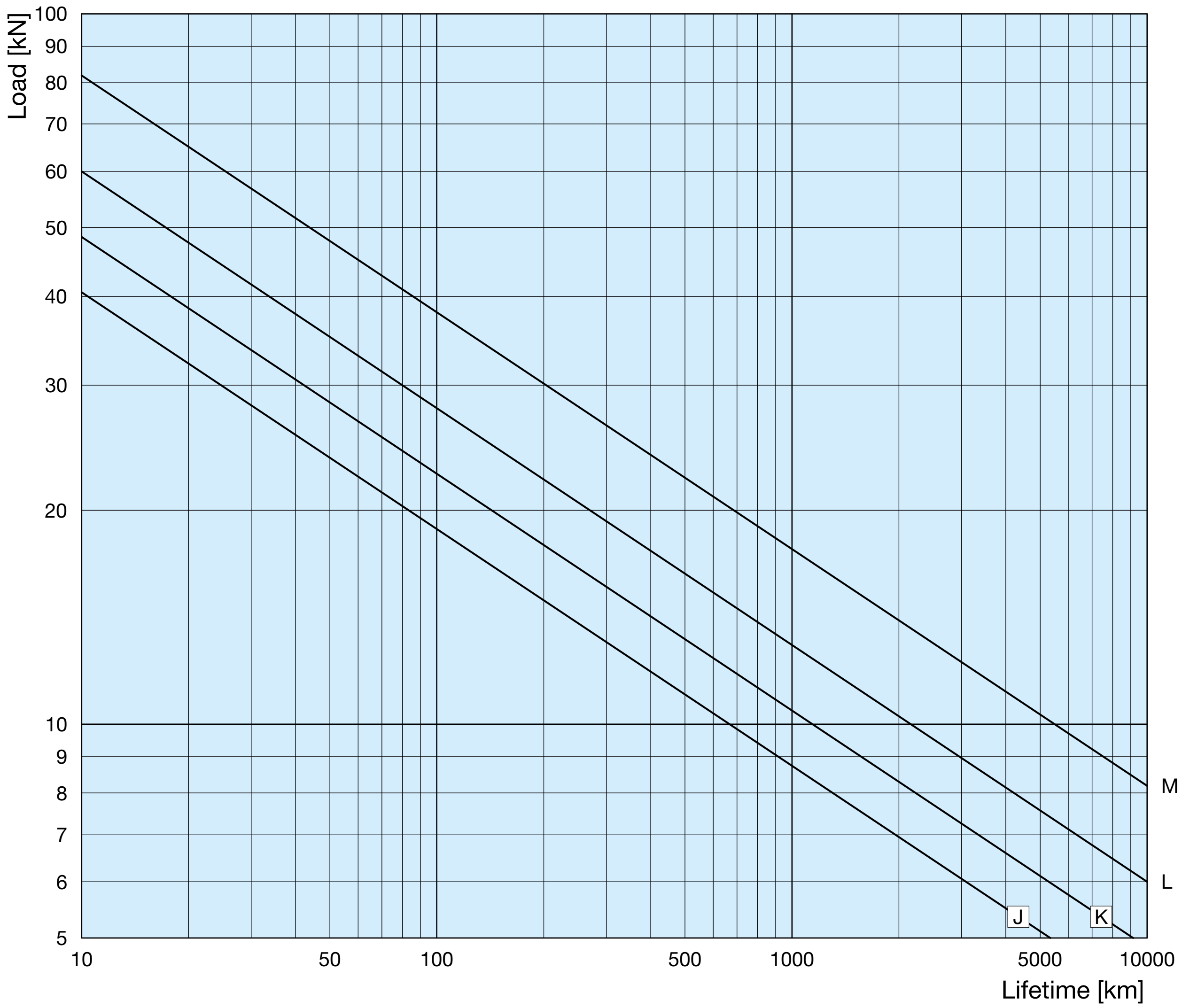
1.6 Ball screw lifetime – performed stroke related to load



BALL SCREW	ball [mm]	n° of circuits	C_a [kN]	C_{0a} [kN]	CURVE
BS 32×10	6.35	4	41.8	73	J
BS 32×20	6.35	3	32.2	53	J
BS 40×10	6.35	5	60	123	L
BS 40×20	6.35	3	38.5	74	K
BS 50×10	6.35	5	83	188	M
BS 50×20	6.35	4	65	140	M

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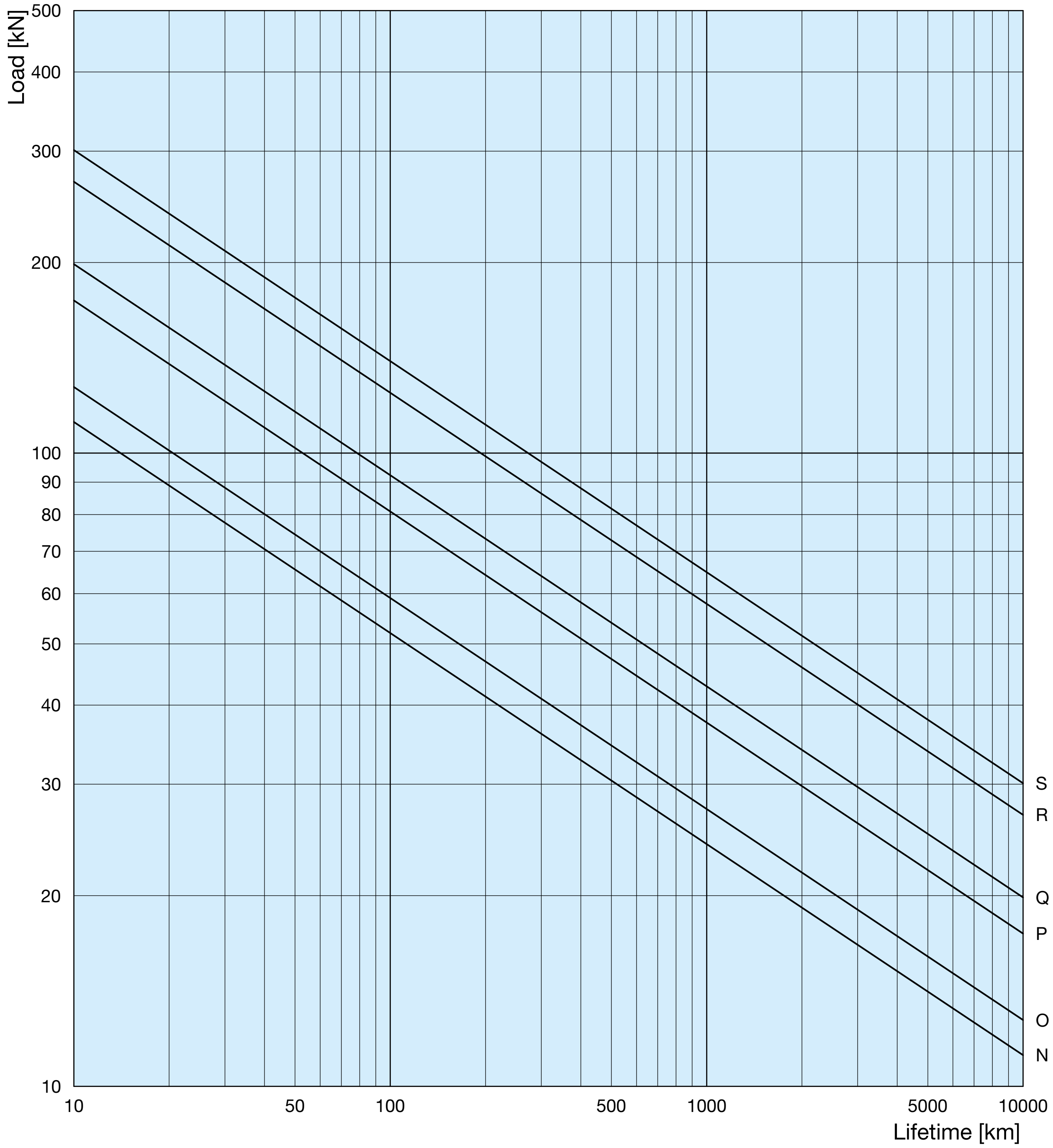
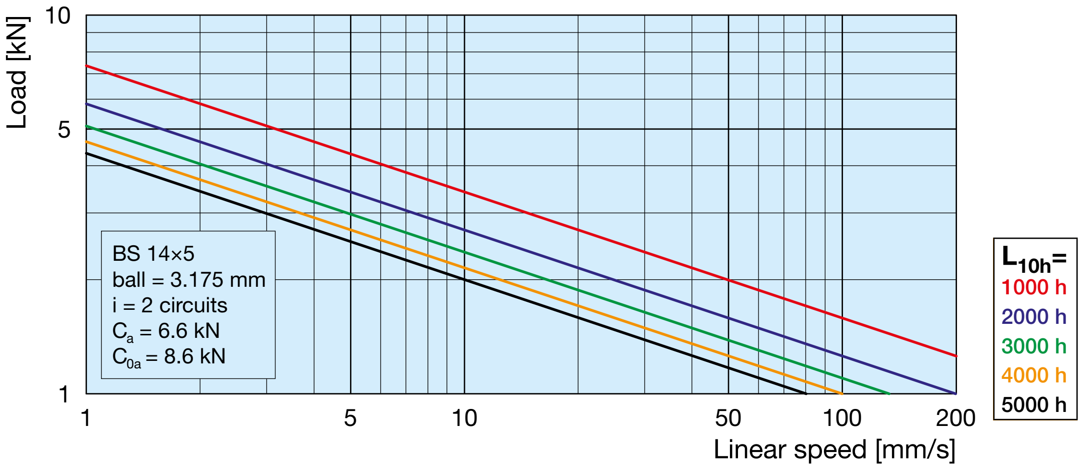
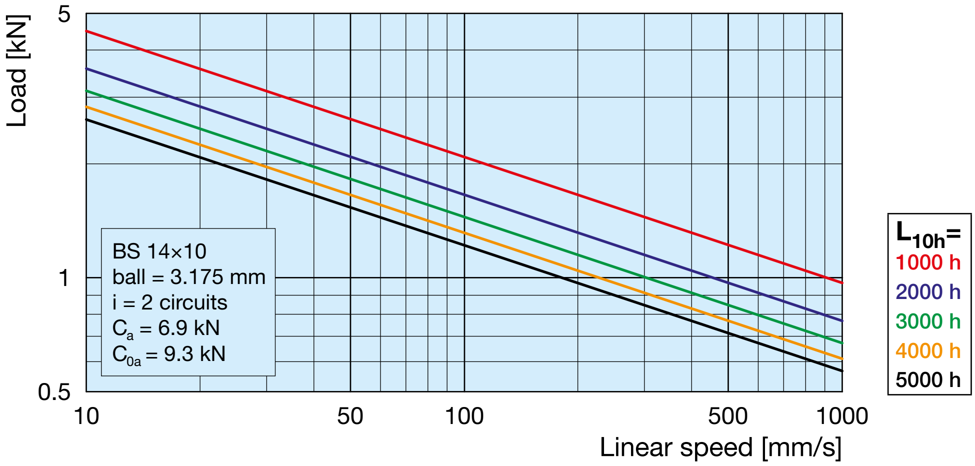
1.6 Ball screw lifetime – performed stroke related to load

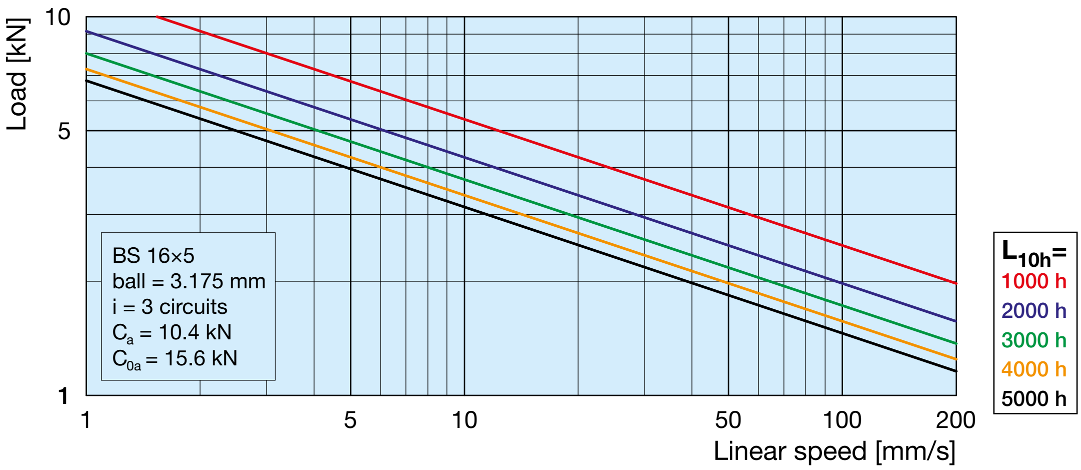


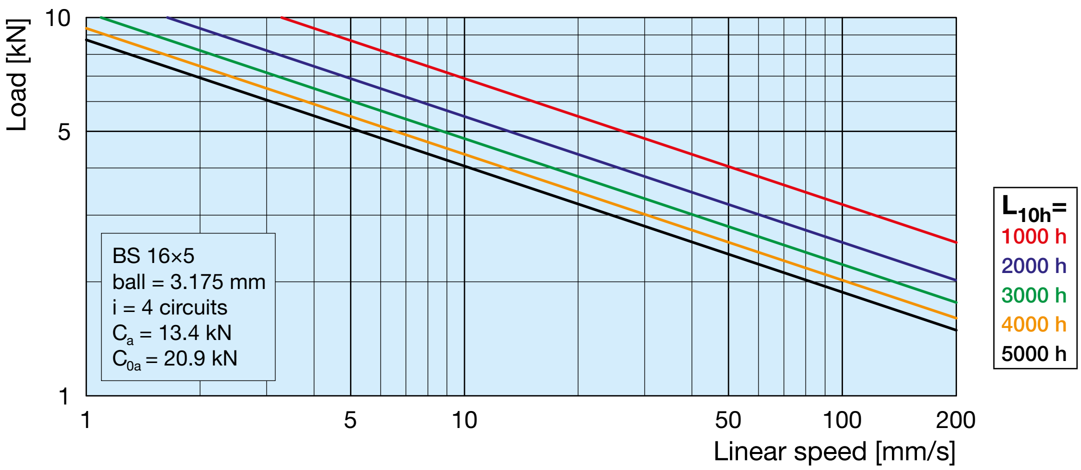
BALL SCREW	ball [mm]	n° of circuits	C_a [kN]	C_{0a} [kN]	CURVE
BS 63×10	7.144	6	112	313	N
BS 63×20	9.525	4	101	220	O
BS 80×16	9.525	5	149	393	P
BS 80×20	12.7	4	213	516	R
BS 100×16	9.525	5	170	523	Q
BS 100×20	12.7	4	239	687	S

1.7 Ball screw lifetime related to load and linear speed

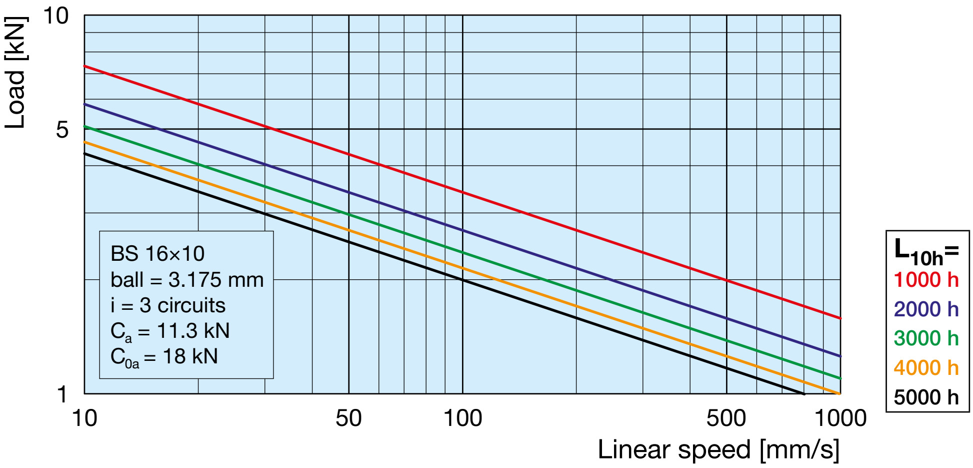


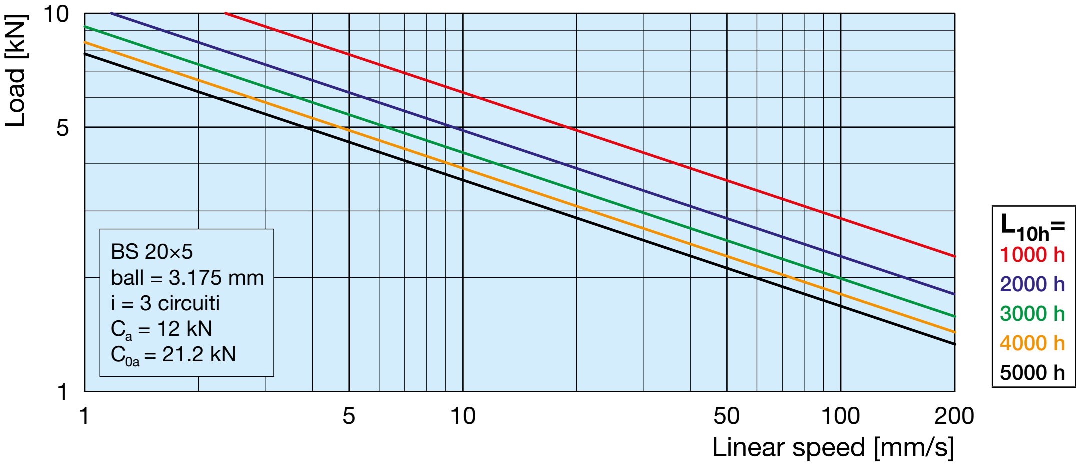


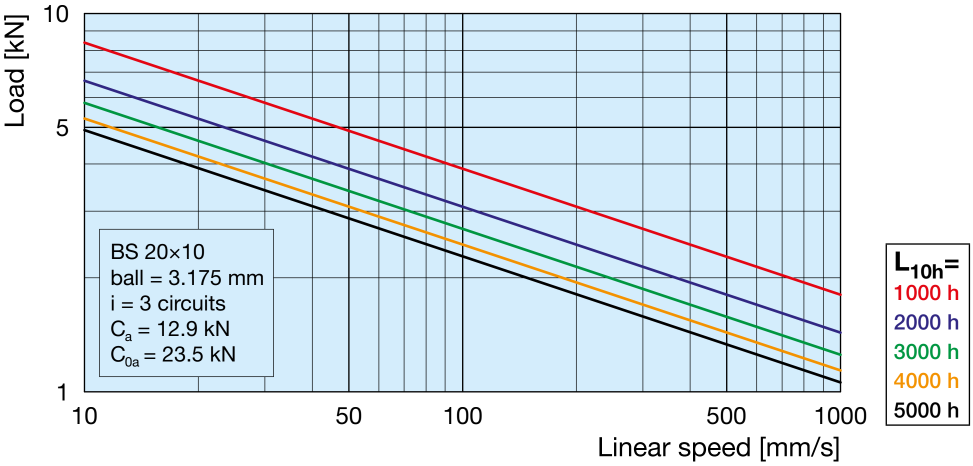




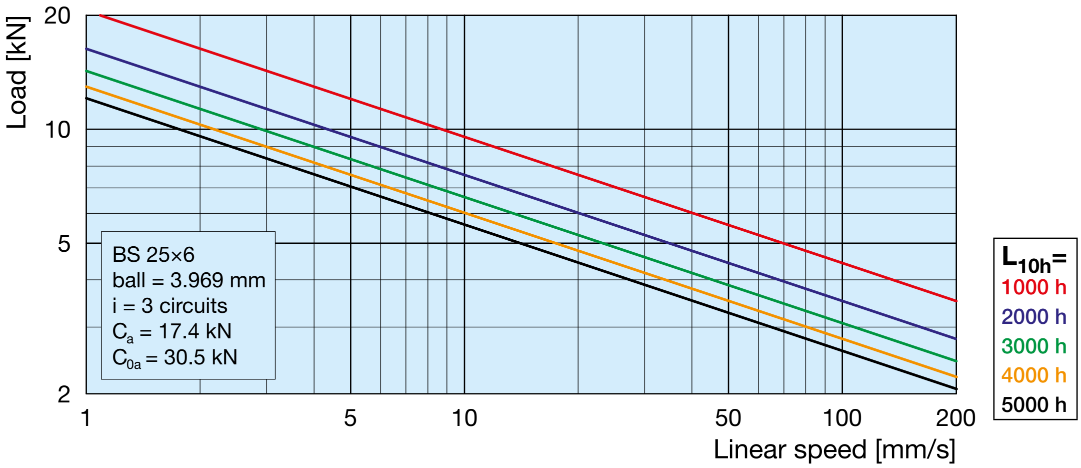
1.7 Ball screw lifetime related to load and linear speed

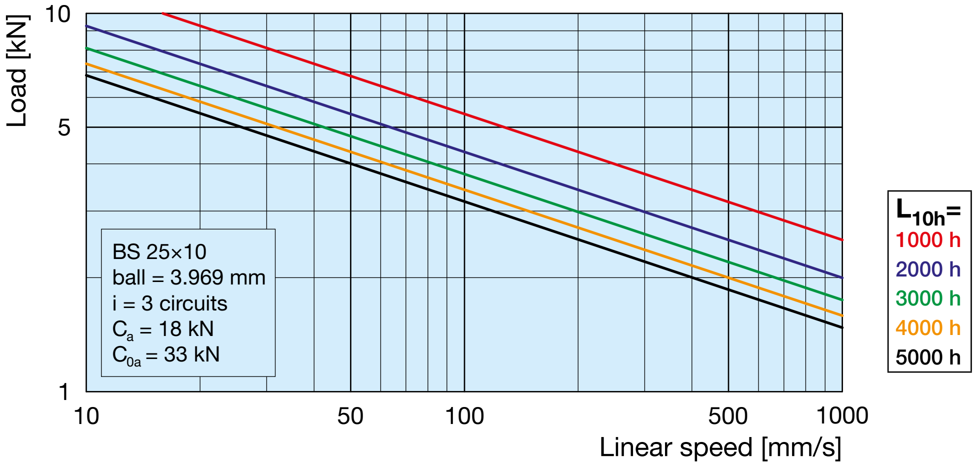


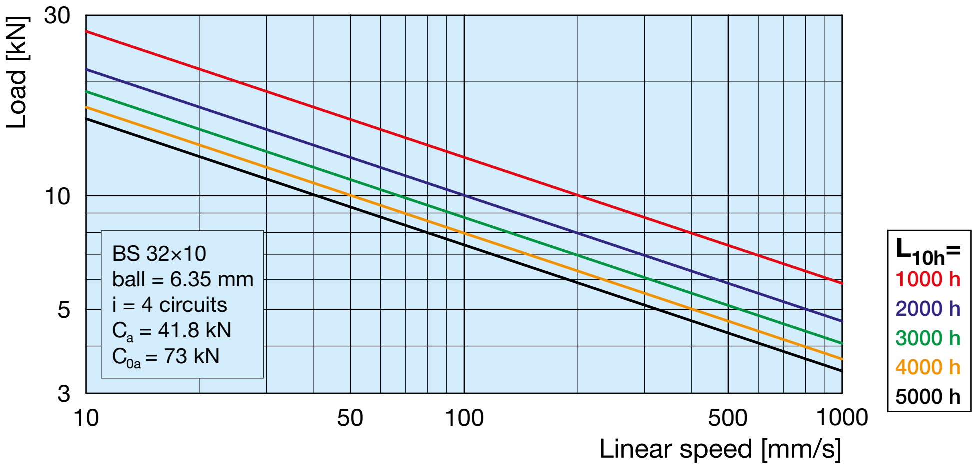


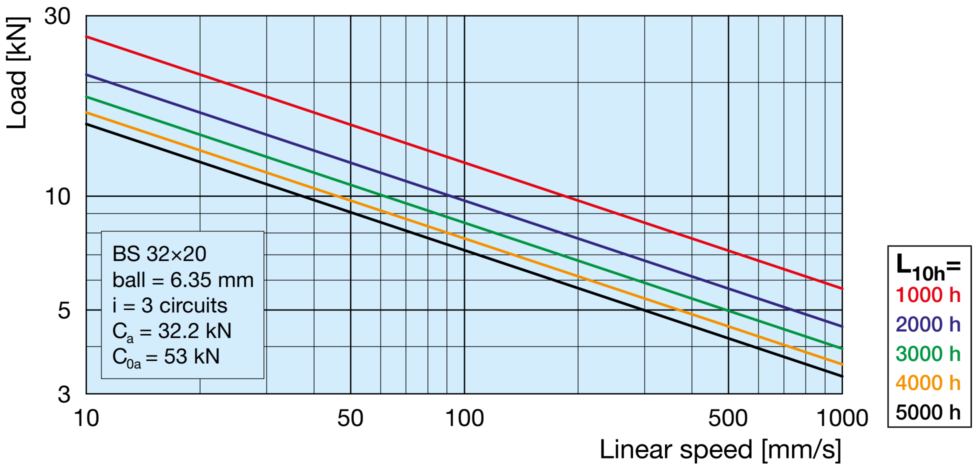


1.7 Ball screw lifetime related to load and linear speed

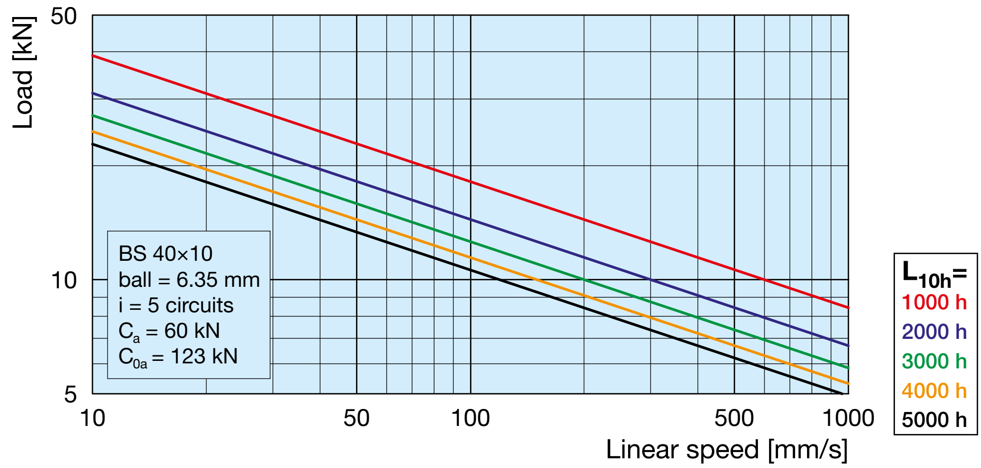


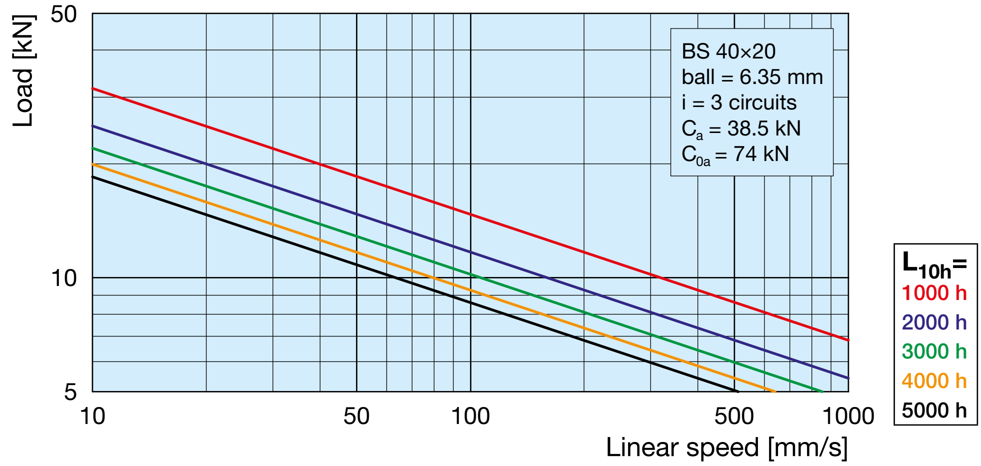


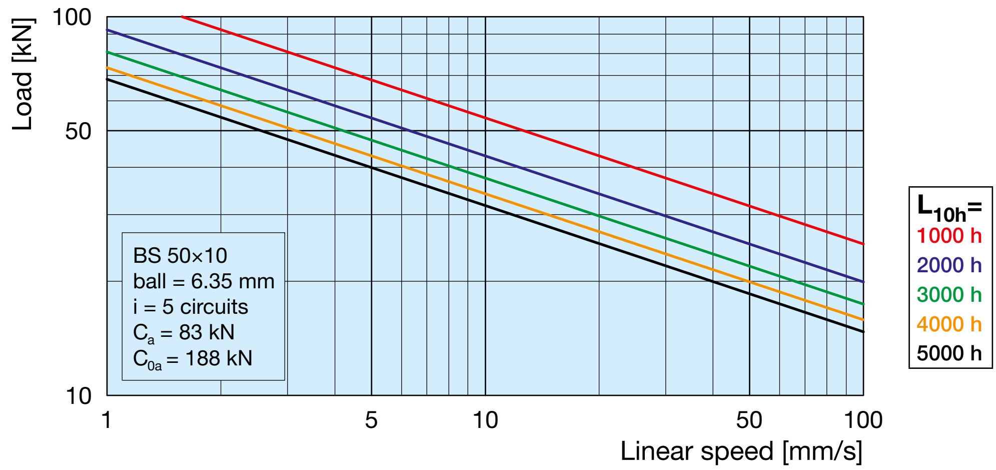


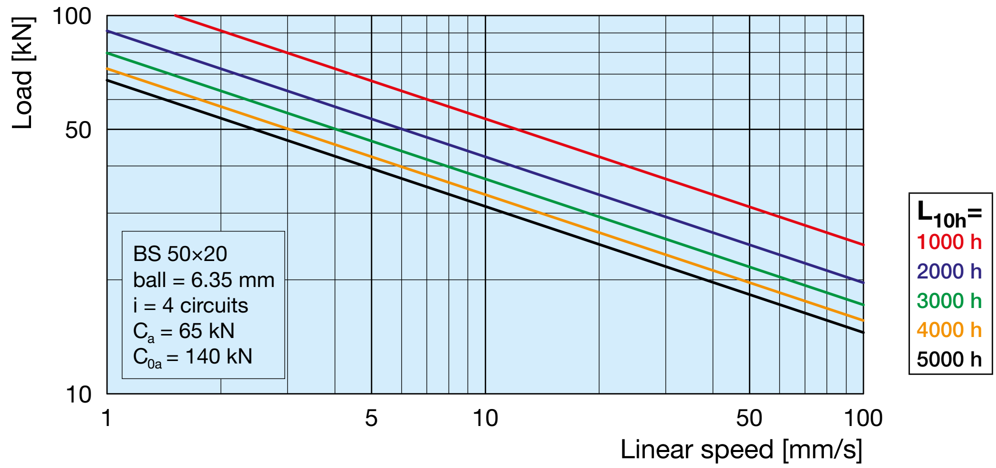


1.7 Ball screw lifetime related to load and linear speed

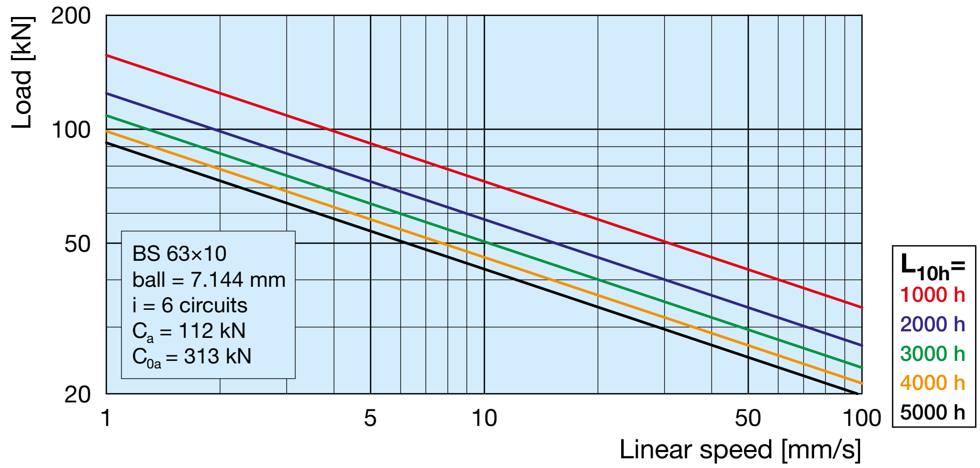


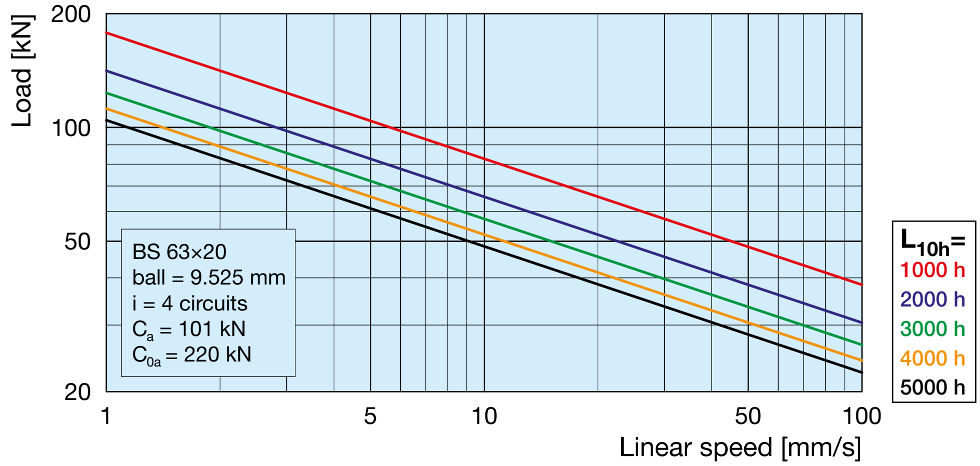


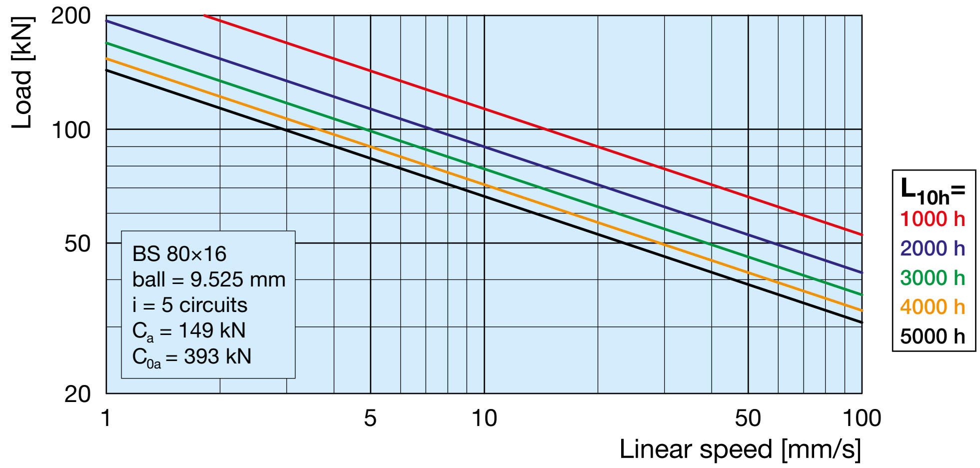


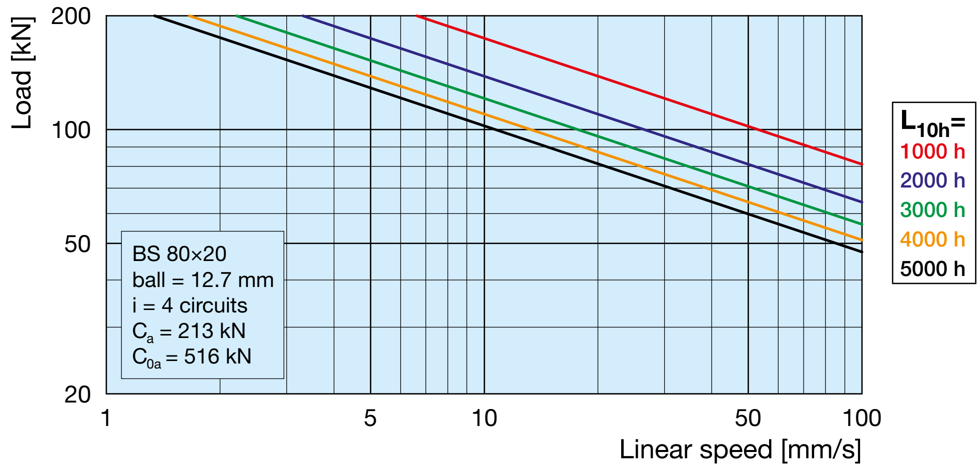


1.7 Ball screw lifetime related to load and linear speed

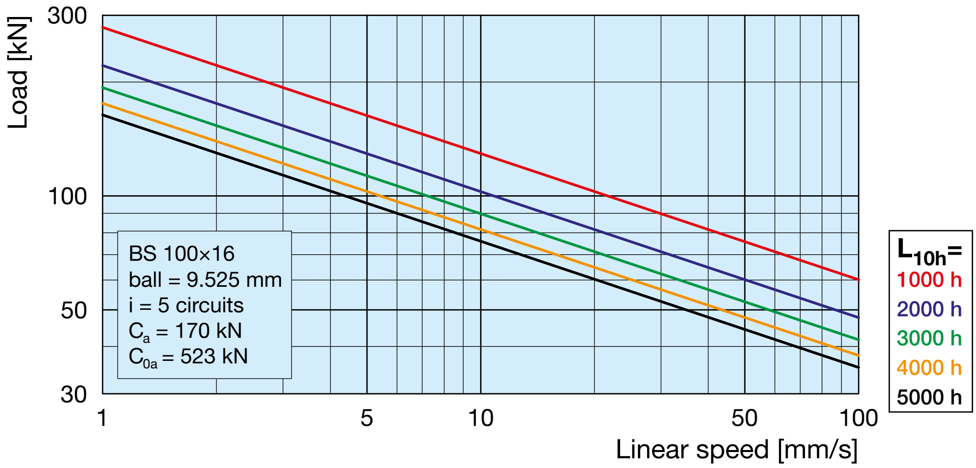


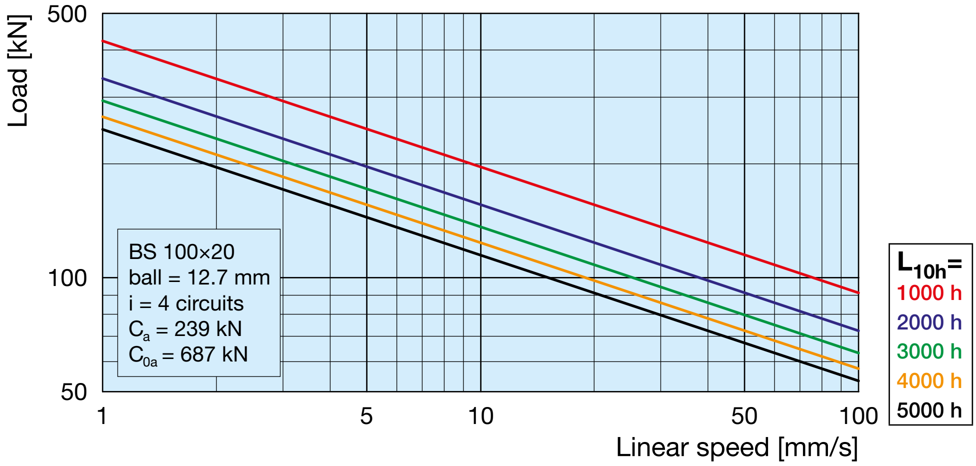




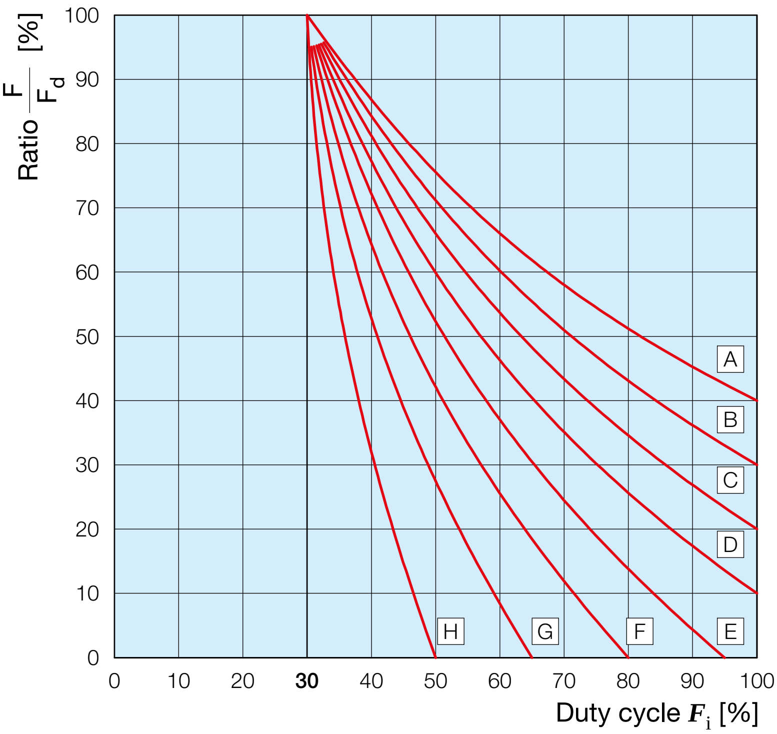


1.7 Ball screw lifetime related to load and linear speed





1.8 Actuator duty cycle permissible F_i related to dynamic load and speed



CURVE	Reference linear speed [mm/s]
A	5
B	10
C	25
D	50
E	75
F	100
G	200
H	400

F - dynamic load required by the application
F_d - dynamic load stated in the actuator PERFORMANCE TABLE

1.9 Self-locking conditions

A linear actuator is self-locking when:

- it is not running and, even when a push or pull load is applied on the push rod, it does not start running before the electric motor is switched on (statically self-locking);
- it is running and, after the electric motor is switched off it stops, even when a push or pull load is applied on the push rod (dynamically self-locking).

Self-locking or non self-locking conditions are defined for the following 4 different situations:

1) **Statically self-locking**: not running actuator, conditions without load vibrations; when applying a push or pull load (up to the maximum load permissible) the actuator does not start moving.
   This self-locking condition occurs whenever the self-locking coefficient[1] is lower than 0.35.

2) **Dynamically self-locking**:
   2.1) Actuator in motion, the load direction is opposite to its running direction: by switching the motor off, the actuator stops (self-lock).
   This self-locking condition occurs whenever the self-locking coefficient[1] is lower than 0.30.
   2.2) Actuator in motion, its running direction and the load applied has got the same direction: by switching the motor off, the actuator stop is not guaranteed. The actuator stops only if its self-locking coefficient[1] is lower than 0.25 and in any case not always in the same position.
   In the above condition the use of a brake-motor is recommended to stop the actuator under load and to lock it on that position, avoiding an unexpected start in case of vibrations or load shocks.

3) **Uncertain locking**: with self-locking coefficient[1] between 0.35 and 0.55, the actuators are in an uncertain locking condition. The self-locking condition depends on the load entity and on the system inertia.
   The use of a brake motor is recommended to ensure a self-locking condition. If necessary, contact SERVOMECH for a technical evaluation of the application.

4) **Non self-locking**: with self-locking coefficient[1] higher than 0.55 the actuators are never self-locking.
   Note that even non self-locking actuators require a minimal push or pull force to start moving. The evaluation of this force value shall be done with SERVOMECH Engineering Dpt.

SELF-LOCKING	UNCERTAIN LOCKING	NON SELF-LOCKING
0 – 0.35	0.35 – 0.55	0.55 – 1

[1] Values of the self-locking coefficient are stated in the relevant PERFORMANCES TABLES.