Selecting a Screw Jack or Lifting Equipment – Procedure

Page 2 Observe design information

i

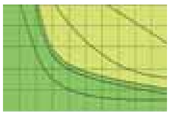
Page 5 Parameters according to Checklist Pages 1 to 5

S version
Standing spindle

R version
Rotating spindle

S version:

Preselect screw jack size
acc. to diagram on screw jack Pages
Stat. / dyn. load (Section 4 - Catalogue 2008)

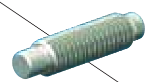


Tension load

Compression load

Page 10 Buckling calculation

Min. spindle diameter
(possibly select larger screw jack and check again)



R version:

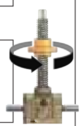
Preselect screw jack size
acc. to diagram on screw jack Pages
Stat. / dyn. load (Section 4 - Catalogue 2008)

Compression load

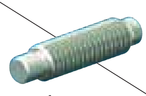
Tension load

Page 10 Buckling calculation

Page 11 Critical whirling speed

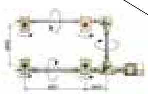


Min. spindle diameter
(possibly select larger screw jack and check again)



Page 12 Required drive torque per screw jack

Page 14 System layout



Page 14 Select motor

Page 16
Check max.
power torque
(possibly select larger screw jack and check again)

Define system components
See Section 7 - Catalogue 2008

Page 17 Determine lengths
(spindle, protective tube)

Page 21 Order code

INFO:
Please always confirm the application parameters, load, speed, duty etc. so we can confirm the correct components have been selected.

Construction Advice

Design and specification

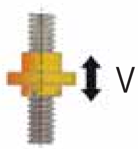
The customer confirm selection and dimensioning because we are not familiar with the design criteria such as installation location and type of application. We can provide support during selection and layout on request and make a proposal with subassemblies drawing and calculation based on your application parameters. You can then examine and approve this drawing with parts lists. These then serve as basis for production and pre-assembly and assist your employees during assembly and fitting. We guarantee the quality of the machine elements as described in the catalogue. The gearboxes are designed for industrial use with loads and operating periods as specified in the catalogue.

Please contact our project technicians for demands going beyond these specifications. We generally deliver according to our current Terms of Sales and Delivery (Section 10 - Catalogue 2008).

Lifting speed

$$\text{Lifting speed } v = \frac{\text{Spindle pitch } P}{\text{Gear reduction } i} \times \text{motor speed } n$$

m/min



Several options are available to influence the lifting speed:

Faster:
- Double-pitch screw (not generally in stock): Doubles the speed (attention: max. input torque, not self-locking - brake required!)
- Larger spindle diameter for R version (spindle from next larger size): Bigger pitch / higher lifting speed depending on gearbox size
- Ball screw spindle: Various pitch options available (attention: not self-locking, brake required!)
- Frequency converter: Serves to increase the motor speed to above 1500. This variant is only usable for movements without load or with light loads.

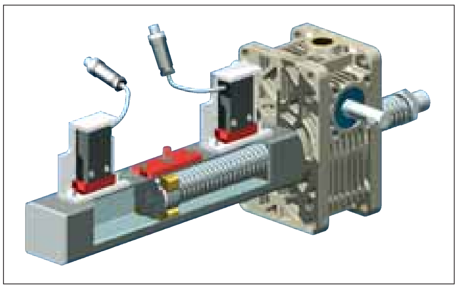
Slower:
- Motors with more poles/lower speed (6, 8, 10 or 12 poles)
- Frequency converter (attention: a suitable cooler for the motor is required for slow operation below 25 Hz, e.g.: external fan)
- Geared motor (attention: maximum input torque)
- Bevel gearbox with gear reduction (only possible for certain applications)

Temperature and operating period

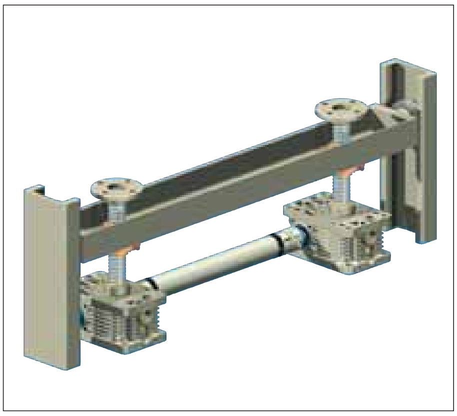
Screw jacks are generally not designed for continuous operation. Refer to the diagram on the Gearbox Pages (Section 4 - Catalogue 2008) for the maximum #operating periods (ED).
These are reference values but various according to usage conditions.
In borderline cases, select a larger screw jack or contact our project technicians.
Operating temperatures should not exceed 80°C (higher on request).

Rotation protection

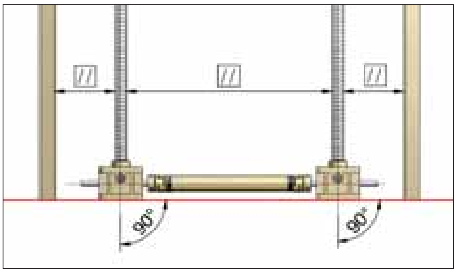
On the Version S with standing spindle, the spindle is free running within the gear (worm wheel). The spindle must be protected against rotation – otherwise it would rotate due to the friction in the worm wheel. This can be achieved by fixing the spindle to an external guidance system or by using our rotation protection (VS) (in a protective tube).



Parallelism and angularity

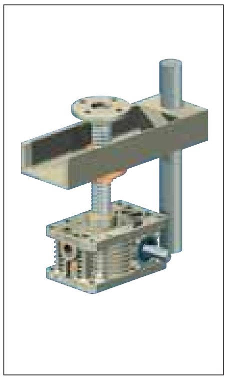


Pay attention to the parallelism and angularity of mounting surfaces, gears, nuts and guides to each other. The same applies for exact alignment of gears, pedestal bearings, connecting shafts and motors to each other.



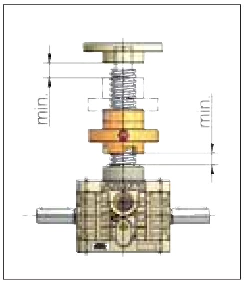
Guides

Guide bush play in the screw jack gearbox can be between 0.2 mm and 0.6 mm depending on the size. This is just a secondary support and does not replace a linear guide system to support side forces.

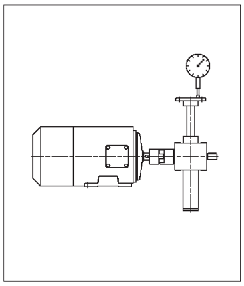


Construction Advice

Safety distance
Safety distances between moving and stationary components must be maintained otherwise there is the risk of the screw jack reaching the blocked position (see Gearbox Data Sheets).



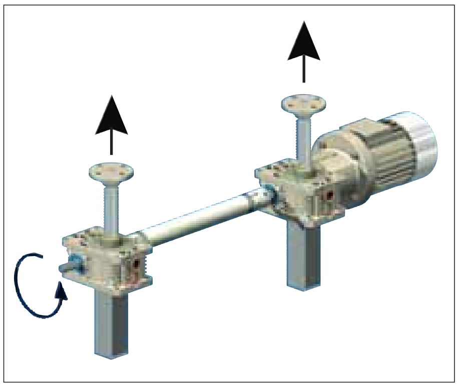
Accuracy
The repeat accuracy of the gearbox can be up to 0.05 mm when moving to the same position again under the same load conditions. This requires measures on the drive side, e.g. a rotary voltage braked motor in connection with a frequency converter, a rotary pulse encoder or a servo motor with encoder, etc.



The pitch accuracy for trapezoid spindles is 0.2 mm over 300 mm spindle length, and 0.05 mm for ball screw spindles over 300 mm spindle length.

Under alternating load, axial play on trapezoid threads can be up to 0.4 mm and 0.08 mm on ball screws (when new). Rotation play on a new drive shaft is approx. 3° to 5°.

Direction of rotation and movement

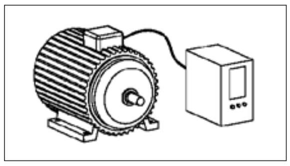


Check the rotation direction of the equipment and record this in the drawing or select one of our standard system layouts (Section 4 - Catalogue 2008). With T bevel gearboxes, the direction of rotation can be changed by simply turning the gearbox around.

Self-locking / overrun
Screw jacks with a single pitch trapezoid thread spindles have a limited self-locking capability which cannot always be relied upon, especially with impact loads or vibrations (brake recommended).

The overrun after the motor has been switched off varies depending on the application. To minimize overrun, we recommend using a brake motor or a spring-compression brake FDB. A braked motor is essential for double pitch spindles or ball screw drives because these are not self-locking.

Drive
To achieve smooth startup and brake ramps, we recommend using a frequency converter. This lengthens the service life of the equipment and minimizes starting noise.



Trial run!
Trial runs without load and under normal operating conditions including load (according to your design parameters) are necessary to ensure reliable operation. These on-site trial runs are necessary to achieve system alignement and to eliminate any factors which may affect operation.

Spare parts
To protect against production downtimes caused by long operating periods or high loads, we recommend storing a set of screw jacks (including spindles, system components and with assembly drawings) at your location or at your customer's location.

Stage engineering
We deliver lifting equipment according to the current regulations on stage design.

Land, air and water vehicles
Our machine elements used in any land, sea or air vehicles are generally excluded from our extended warranty terms. Individual conditions can be agreed with our management.

Environmental conditions
Please specify any ambient conditions outside normal industrial environmental conditions (Checklists).

Construction Advice

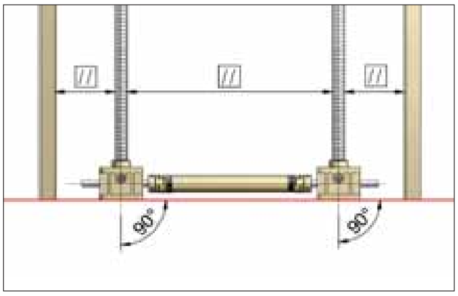
Lubrication

Adequate lubrication is essential for the service life of a screw jack. Ensure adequate lubrication of spindles, gearboxes and rotation protection. The red lubrication strip for the rotation protection can be mounted in alternative positions to meet your requirements (please specify).
Please also refer to our lubricator and our Assembly, Operating and Maintenance Instructions (Section 8 - Catalogue 2008).

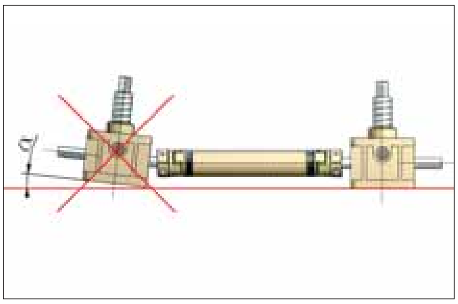
Assembly, Operating and Maintenance Instructions
Please refer to our Assembly, Operating and Maintenance Instructions (Section 8 - Catalogue 2008) during the design phase.

Design advice for plant engineers:
Hardly any assembly problems arise when using screw jacks in mechanical engineering because the surfaces being processed are machined. In plant engineering however, frequent geometric faults may occur in welded frames despite accurate working in steel construction. The interaction between different components can also cause alignment issues. Therefore the following must be considered:

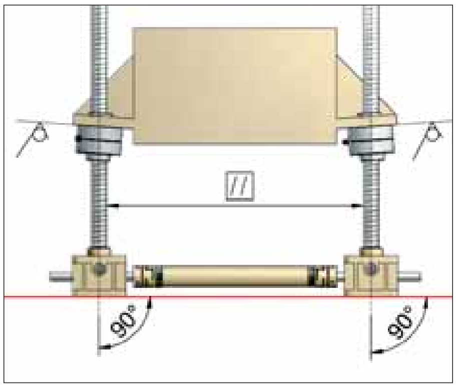
Parallelism / angularity:

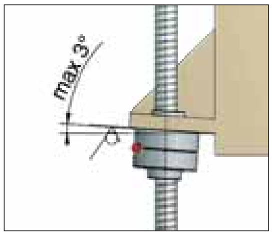


Spindles and guides must be parallel to each other otherwise the equipment can seize up during operation. All mounting surfaces for the gearboxes must be exactly at right angles to the guides otherwise interference can occur.
This accelerates wear and/or severe damage can occur. Squeaking noises can also occur on R versions.



The mounting surfaces for the nuts should also be at right angles. ZIMM has developed the self-aligning nut PM (see Section 7 - Catalogue 2008) to save time and costs here.



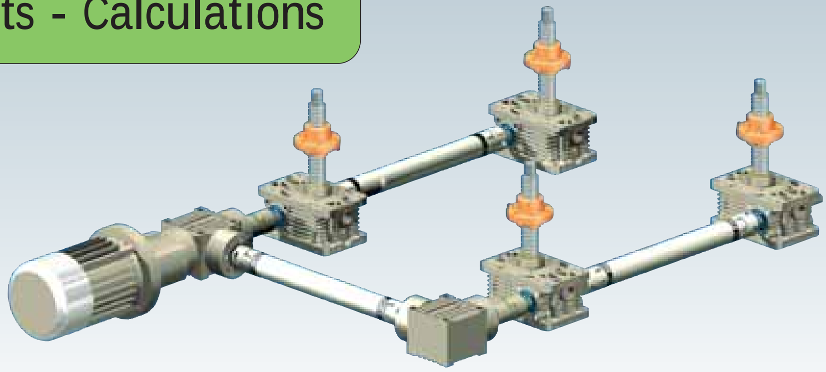


Additional features where alignment may be a problem are the integrated pivot bushings in the gearbox or the hinged bearing plate KAR (see Section 7 - Catalogue 2008).

For plant engineering:
We supply massive standard linear guides including rollers. Stability, long service life, avoidance of geometric errors and absorption of side forces are decisive arguments for using these guides.

You can find further information on our homepage at www.zimm.at

Printing errors, mistakes regarding dimensions etc., as well as technical changes and improvements are excepted. Valid re the drawings which are have been checked and approved by both partners in accordance with the order acknowledgement.



Checklists - Page 1 - Parameters

Company:	________	Date:	________
Address:	________	Phone:	________
Contact:	________	Fax:	________
Dept.:	________	E-mail:	________

Fast and efficient:
Copy
Select
Fax / E-mail

1 Lifting force in kN, max.
- Per gearbox ____ kN Per system ____ kN
- Under tension ____ kN Under compression ____ kN
- Load: static ____ kN Dynamic ____ kN
- Fitting posn.: ☐ vertical ☐ horizontal ☐ pivotal
- Conditions: ☐ smooth ☐ impact load ☐ vibrations

2 Lift / travel ____ mm

3 Lifting speed
☐ Type N = 1.5 m/min ☐ Type L = 0.375 m/min
☐ Customer requirement ____ m/min (many variants possible)

4 Operating period, operating cycle
____ lifts per day ____ lifts per hour hours per day: ☐ 8 ☐ 16 ☐ 24
____ % operating period (ED) relative to 10 min,
For ED > 10 % per 10 min, please specify cycle (e.g.: 5s up, 5s pause, 5s down, 30s pause)

5 Type S or R: ☐ S standing spindle ☐ R rotating spindle

6 Standard layout No. ____ Measure MA1 ____ MA2 ____ MA3 ____ MA4 ____ MA5 ____
See standard layouts, Checklist Page 8 and 9 (for multiple systems)

7 Component list ☐ YES ☐ NO See Checklist Page 6 or 7!

8 Motor: ☐ Rotary voltage motor AC ☐ Brake motor AC ☐ ________ ☐ Manual operation
☐ Spring-compression brake ☐ Incremental encoder ☐ Linear measuring system ☐ Limit switches (S version)

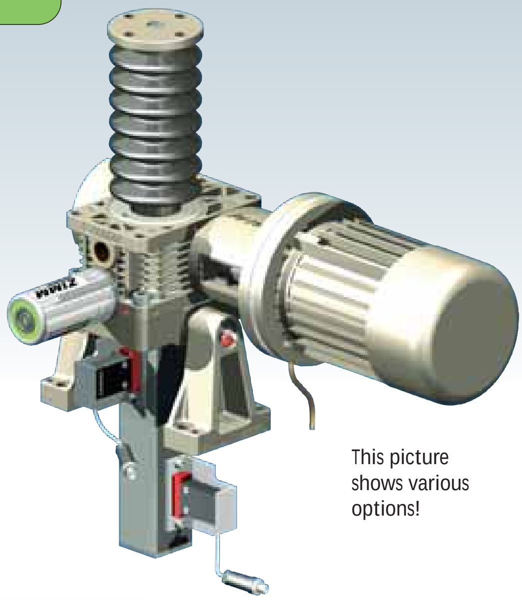
9 Application purpose / function description / branch

Description:

Operating conditions: ☐ Dry ☐ Humid ☐ Dusty ☐ Chips ☐ ________
Ambient temperature: Min. ____ °C Max. ____ °C

10 Quantity: ____ pcs. ☐ Prototype first

11 Schedule: Quotation: ____ Delivery: ____

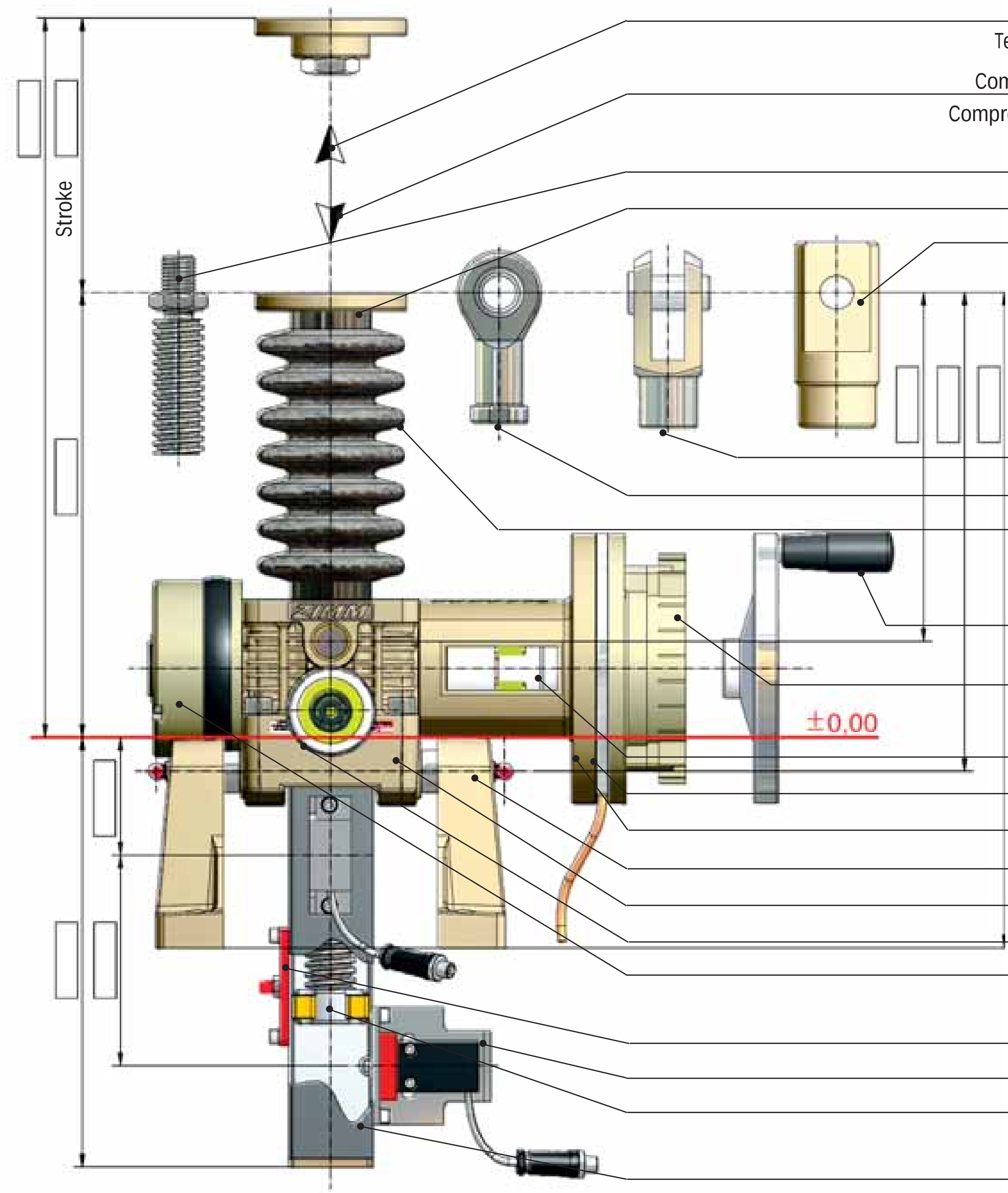


This picture shows various options!

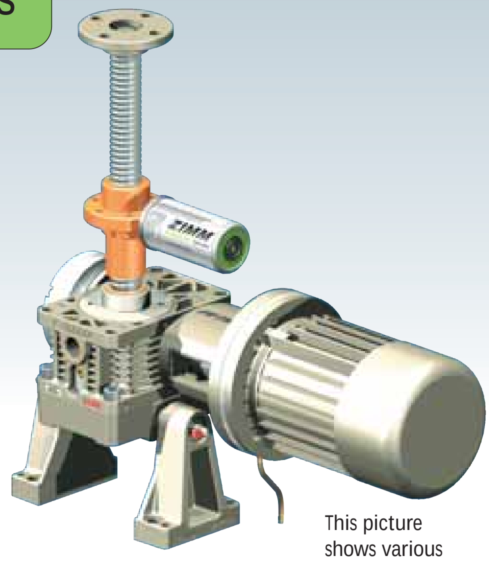
Checklists - Page 2 - Component List S

Type:
- [ ] SN (standing spindle, normal speed)
- [ ] SL (standing spindle, low speed)

Variants:
- [ ] Tr trapezoidal screw
- [ ] SIFA safety nut
  - [ ] with SIFA control
- [ ] KGT ball screw



- Tension load (kN), static [ ]
- Tension load (kN), dynamic [ ]
- Compression load (kN), static [ ]
- Compression load (kN), dynamic [ ]
- Standard spindle end [ ]
- Fixing flange BF [ ]
- Pivot bearing head SLK [ ]
- Forked head GK [ ]
- Rod end KGK [ ]
- Bellows FB [ ]
- Spiral spring SF [ ]
- Handwheel HR [ ]
- Motor with brake [ ]
- Motor without brake [ ]
- Coupling KUZ [ ]
- Rotary pulse encoder DIG [ ]
- Motor flange MF [ ]
- Pivot bracket LB [ ]
- Hinged bearing plate KAR [ ]
- Lubricator Z-LUB [ ]
- Spring-compression brake FDB [ ]
- Protective cap SK [ ]
- Lubrication strip SL [ ]
- 2x limit switch set ESSET [ ]
- Rotation protection VS [ ]
- Escape protection AS [ ]
- Protective tube SRO [ ]

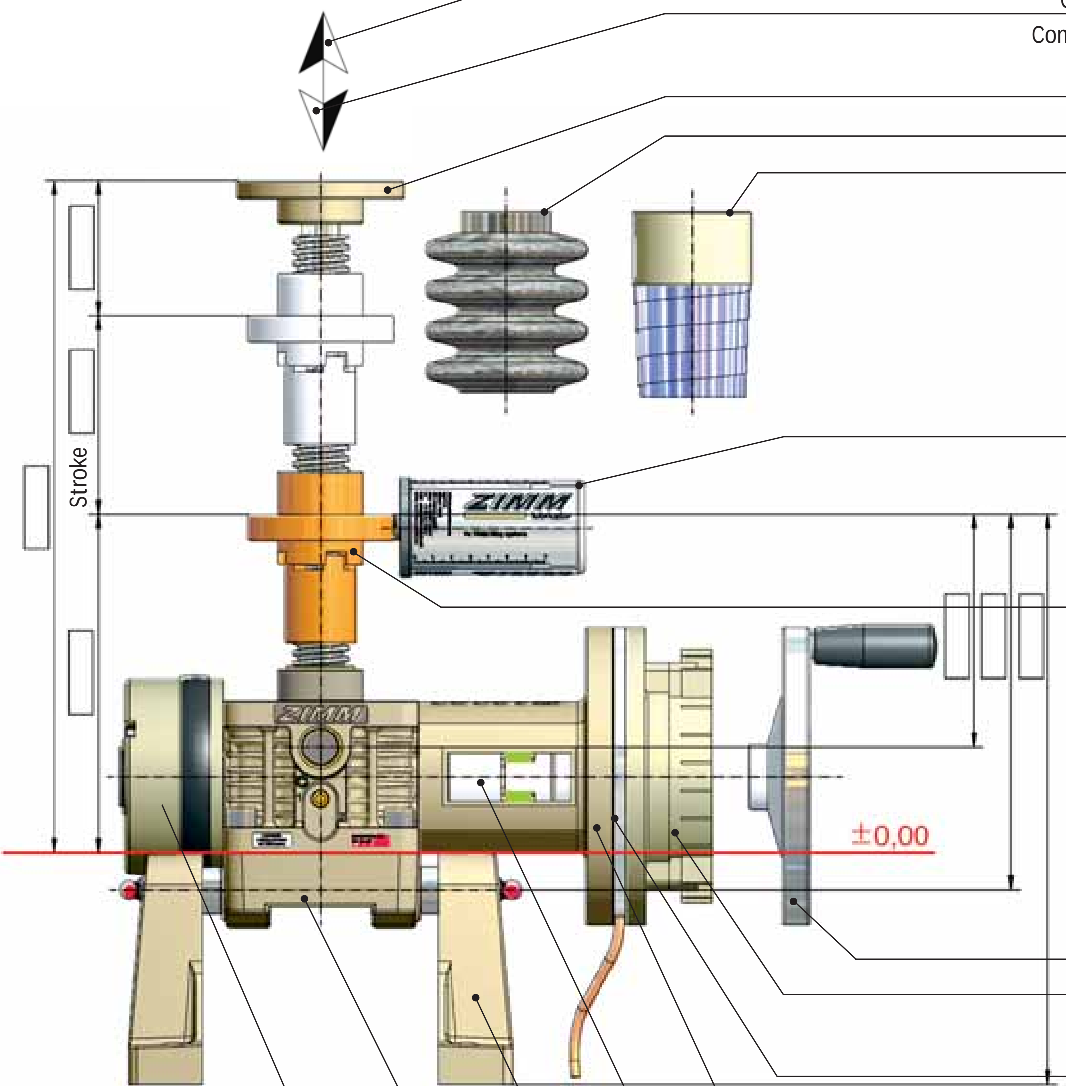


This picture shows various options!

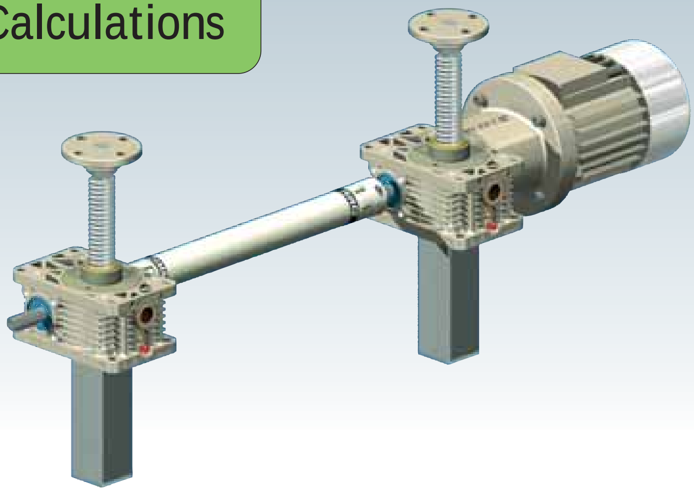
Checklists - Page 3 - Component List R

Type:
- ☐ RN (rotating spindle, normal speed)
- ☐ RL (rotating spindle, low speed)

Variants:
- ☐ Tr trapezoidal screw
- ☐ SIFA safety nut
  - ☐ with SIFA control
- ☐ KGT ball screw

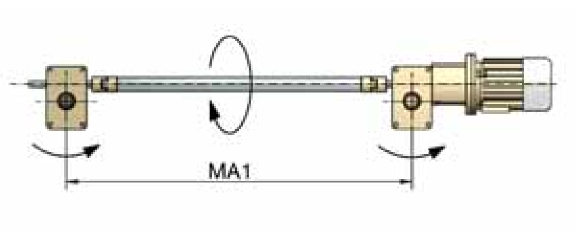


- Tension load (kN), static ☐
- Tension load (kN), dynamic ☐
- Compression load (kN), static ☐
- Compression load (kN), dynamic ☐
- Opposed bearing plate GLP ☐
- Bellows FB ☐
- Spiral spring cover SF ☐
- Lubricator Z-LUB ☐
- Cardan adapter DMA ☐
- Duplex nut DM ☐
- Trapezoid flange nut FM ☐
- KGT flange nut KGT-F ☐
- Self-aligning nut PM ☐
- Greaseless nut FFDM ☐
- Driving flange TRMFL ☐
- Safety nut SIFA ☐
- Wear control SIFA control ☐
- Handwheel HR ☐
- Motor with brake ☐
- Motor without brake ☐
- Rotary pulse encoder DIG ☐
- Motor flange MF ☐
- Coupling KUZ ☐
- Pivot bracket LB ☐
- Hinged bearing plate KAR ☐
- Spring-compression brake FDB ☐
- Protective cap SK ☐

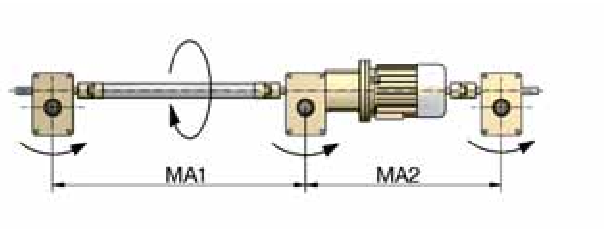


Checklists - Page 4 - System-Layouts

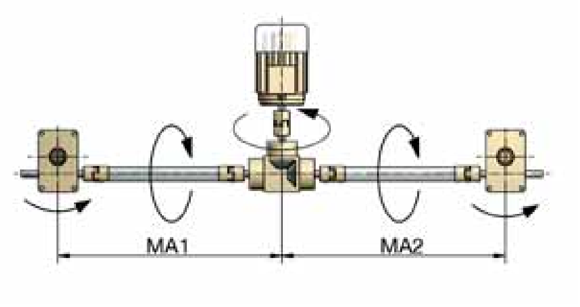
A



B



C



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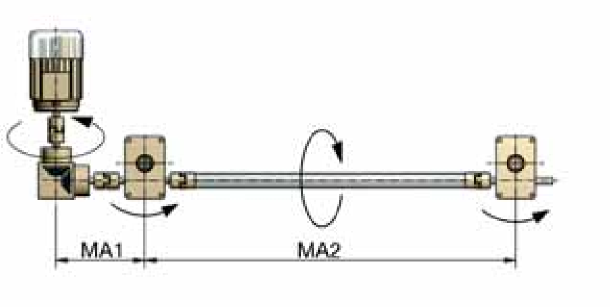
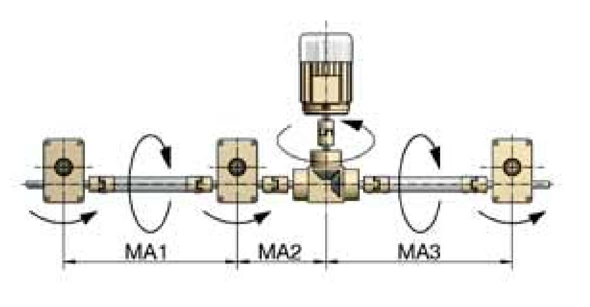
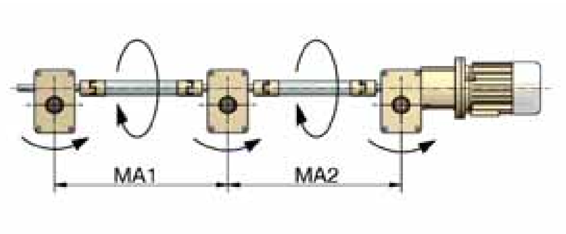


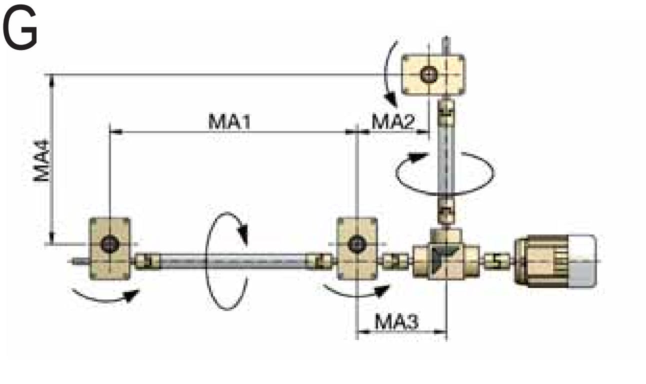
E



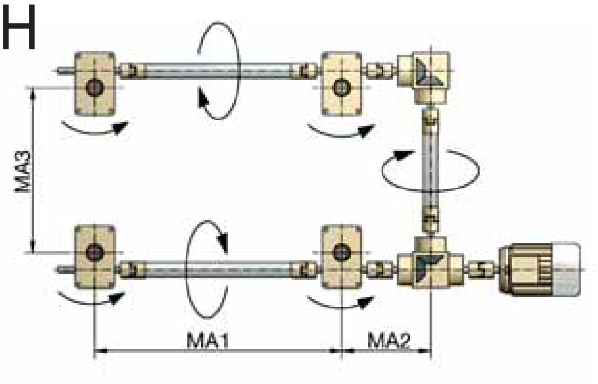
F



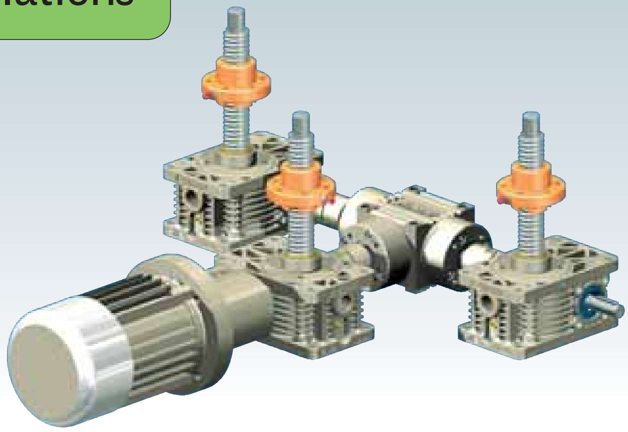
G



H

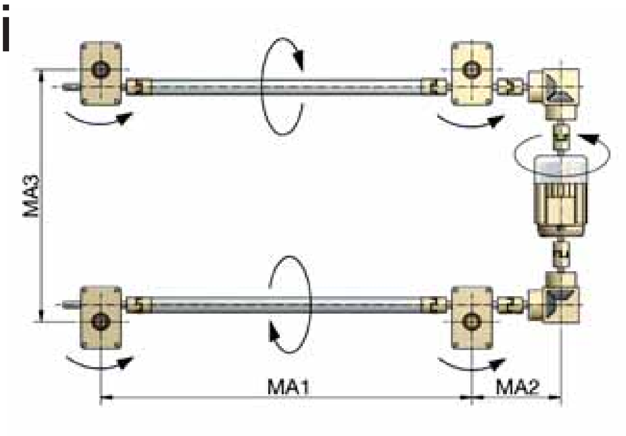


The most common arrangements are shown. Be certain to check the rotation direction should your design deviate!

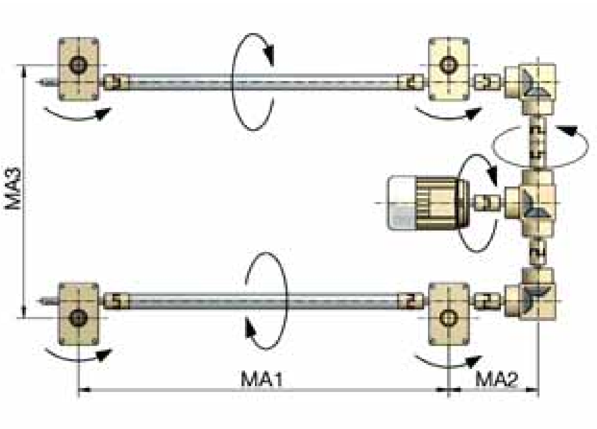


Checklists - Page 5 - System-Layouts

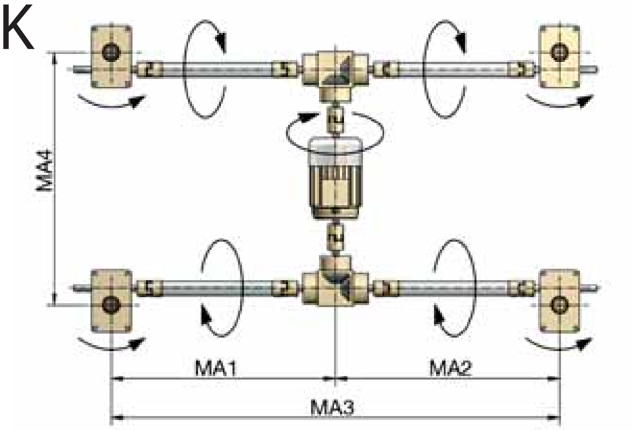
i



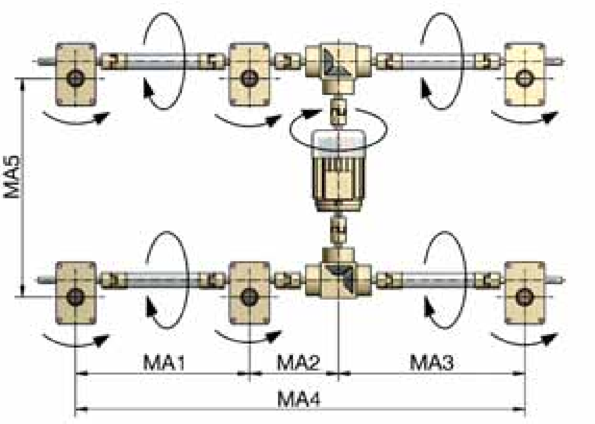
J



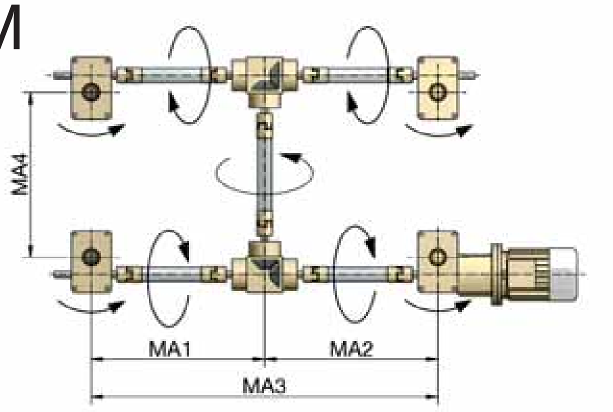
K



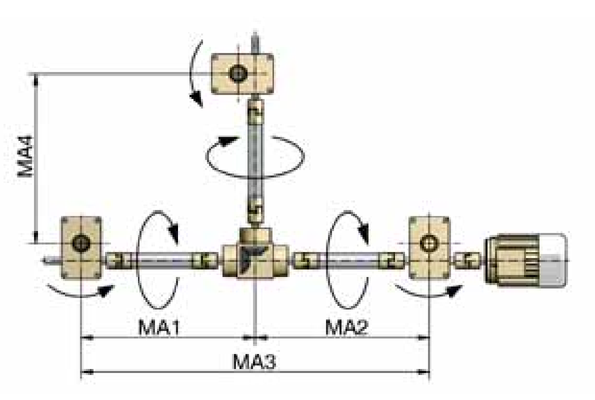
L



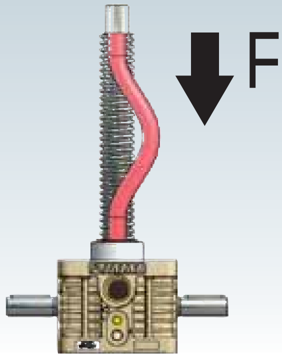
M



N



The most common arrangements are shown. Be certain to check the rotation direction should your design deviate!



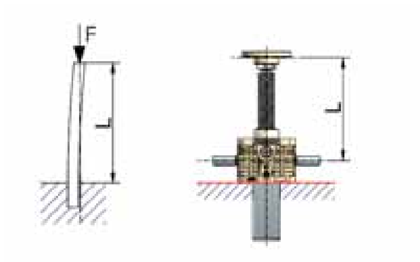
Example:

F = 45,000N/gearbox
L = 1320 mm
v = 3

Explanation:
I = moment of area 2nd level in mm^4
F = max. load/gearbox in N
L = free spindle length in mm
E = elasticity modulus for steel (210,000N/mm^2)
v = safety factor (normally 3)
d = minimum core diameter of spindle

Critical Buckling Force of the Spindle

Euler 1



Unguided

Formula:

$$I = \frac{F \times v \times (L \times 2)^2}{\pi^2 \times E} \quad \text{then} \quad d = \sqrt[4]{\frac{I \times 64}{\pi}}$$

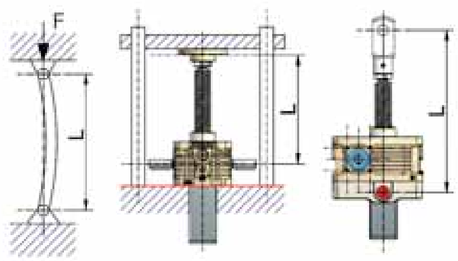
Example:

$$I = \frac{45{,}000\text{ N} \times 3 \times (1{,}320\text{ mm} \times 2)^2}{\pi^2 \times 210{,}000\text{ N/mm}^2} = \frac{9.40896^{11}\text{ mm}^4}{2{,}072{,}616.924} = 453{,}965.22\text{ mm}^4$$

$$d = \sqrt[4]{\frac{453{,}965.22\text{ mm}^4 \times 64}{\pi}}$$

= 55.15 mm minimum core diameter
= Z-250 (spindle core Ø = 59.6 mm)

Euler 2



S version
Guided

Pivot drive

Formula:

$$I = \frac{F \times v \times L^2}{\pi^2 \times E} \quad \text{then} \quad d = \sqrt[4]{\frac{I \times 64}{\pi}}$$

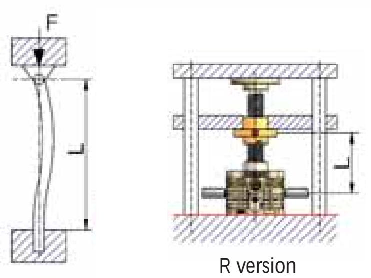
Example:

$$I = \frac{45{,}000\text{ N} \times 3 \times (1{,}320\text{ mm})^2}{\pi^2 \times 210{,}000\text{ N/mm}^2} = \frac{2.35224^{11}\text{ mm}^4}{2{,}072{,}616.924} = 113{,}491.305\text{ mm}^4$$

$$d = \sqrt[4]{\frac{113{,}491.305\text{ mm}^4 \times 64}{\pi}}$$

= 38.99 mm minimum core diameter
= Z-100 (spindle core Ø = 43.6 mm)

Euler 3



R version
Guided

Formula:

$$I = \frac{F \times v \times (L \times 0.7)^2}{\pi^2 \times E} \quad \text{then} \quad d = \sqrt[4]{\frac{I \times 64}{\pi}}$$

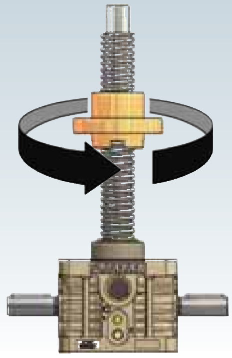
Example:

$$I = \frac{45{,}000\text{ N} \times 3 \times (1{,}320\text{ mm} \times 0.7)^2}{\pi^2 \times 210{,}000\text{ N/mm}^2} = \frac{1.15259^{12}\text{ mm}^4}{2{,}072{,}616.924} = 55{,}610.7396\text{ mm}^4$$

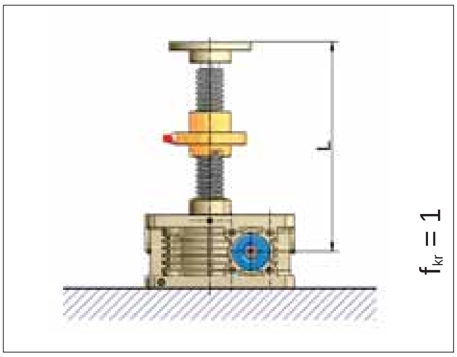
$$d = \sqrt[4]{\frac{55{,}610.739\text{ mm}^4 \times 64}{\pi}}$$

= 32.62 mm minimum core diameter
= Z-50/Tr50 (spindle core Ø = 39.8 mm)

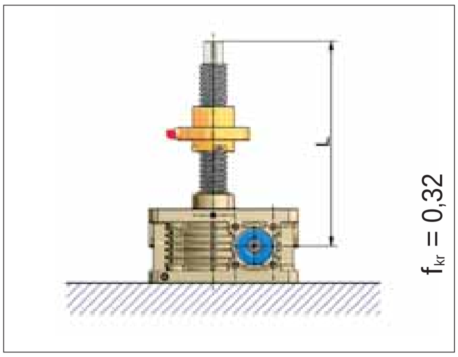
	Z-2	Z-5	Z-10	Z-25	Z-35/50	Z-50/Tr50	Z-100	Z-150	Z-250	Z-350	Z-500	Z-750	Z-1000
Trapezoid thread Tr	16x4	18x4	20x4	30x6	40x7	50x8	55x9	60x9	80x16	100x16	120x16	140x20	160x20
Core Ø in mm (minimum)	10.9	12.9	14.9	22.1	31.0	39.8	43.6	48.6	59.6	80.6	99.6	115.0	135.0
Ball screw KGT Ø mm	16	16	25	32	40	-	50	63	80	-	-	-	-
Core Ø in mm (minimum)	12.9	12.9	21.5	27.3	34.1	-	44.1	57.1	72.4	-	-	-	-



Critical Whirling Speed for R Gearboxes



With end mounting
(preferred solution)



Without end mounting
(avoid when possible)

Maximum allowable spindle speed

$n_{zul} = 0.8 \times n_{kr} \times f_{kr}$

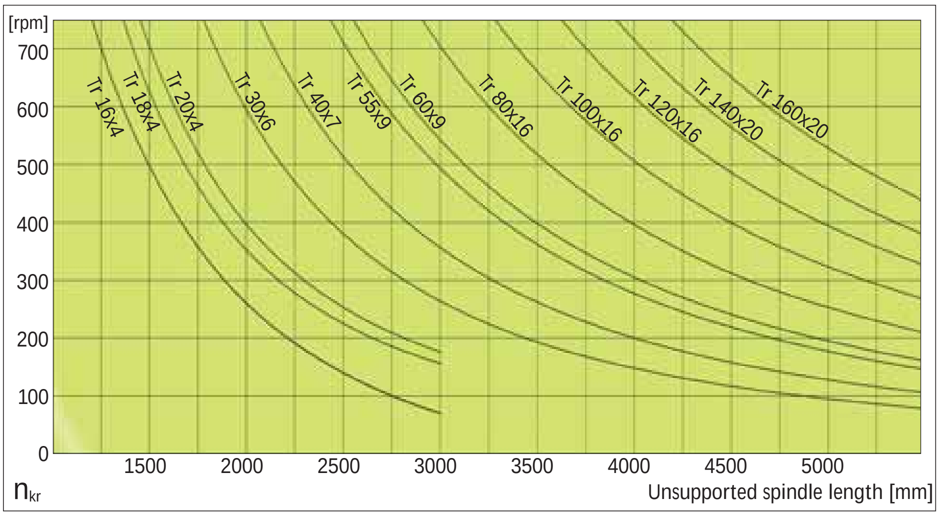
n_{zul} Maximum allowable spindle speed (rpm)

n_{kr} Theoretical critical spindle speed (rpm) that leads to resonance vibrations (see diagram)

f_{kr} Correction factor that considers the type of spindle mounting

! The operating speed must not exceed 80% of the maximum speed

$$\text{Spindle speed} = \frac{\text{Input speed}}{i_{Gearbox}}$$



The maximum allowable spindle speed must be calculated for R version gearboxes (with rotating spindle) with long, thin spindles. To do this, read out the theoretical critical speed n_{kr} from the diagram. Also consider the additional lengths for spindle bellows etc. when calculating the unsupported spindle lengths. Now use the formula together with the correction factor for the spindle mounting to calculate the maximum allowable spindle speed.

If the calculated maximum spindle speed is lower than the required speed, select a larger spindle or a double pitch spindle with half the speed. This must then be checked. You have the option to use a "stronger spindle" on the R version (spindle of next larger gearbox).

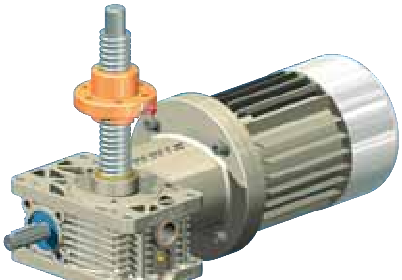
Bear in mind that a larger diameter spindle demands a higher drive torque.

Attention:
Long, thin spindles can squeak even though the bending critical speed is maintained! Therefore calculate with sufficient safety margins.

Determining the Drive Torque of [M_G] One Screw Jack

The following specifications serve to calculate the required drive torque. In order to facilitate calculation of the drive torque, we have determined multiplication factors from this formula and included these in the technical data for the respective versions.

M_G	Required drive torque [Nm] for a gearbox
F	Lifting load (dynamic) [kN]
$\eta_{Gearbox}$	Screw jack efficiency (without spindle)
$\eta_{Spindle}$	Spindle efficiency
P	Spindle pitch [mm]
i	Screw jack ratio
M_L	Idling torque [Nm]
P_M	Motor drive capacity



Formula:

1) Drive torque: $M_G = \dfrac{F\,[kN] \cdot P\,[mm]}{2 \cdot \pi \cdot \eta_{Gearbox} \cdot \eta_{Spindle} \cdot i} + M_L\,[Nm]$

2) Motor capacity: $P_M[kW] = \dfrac{M_G\,[Nm] \cdot n\,[min^{-1}]}{9550}$

3) We recommend multiplying the calculated value by a safety factor of 1.3 to 1.5 (up to 2 for small systems).

!

Example:

Z-25-SN
F = 12 kN (lifting load, dynamic)
$\eta_{Gearbox} = 0.87$ $\eta_{Spindle} = 0.375$
P = 6 i = 6

1) $M_G = \dfrac{12\ kN \cdot 6\ mm}{2 \cdot \pi \cdot 0.87 \cdot 0.375 \cdot 6} + 0.36\ Nm = 6.21\ Nm$

2) $P_M = \dfrac{6.21\ Nm \cdot 1500\ min^{-1}}{9550} = 0.975\ kW$

3) Example: 0.975 kW · 1.5 = 1.462 kW ⟶ Motor 1.5 kW

For gearboxes with single pitch trapezoid thread spindles, it is also possible to just multiply the load by the factor stated on the corresponding gearbox page (Section 4 - Catalogue 2008).

Gearbox efficiency $\eta_{Gearbox}$ (without spindle)

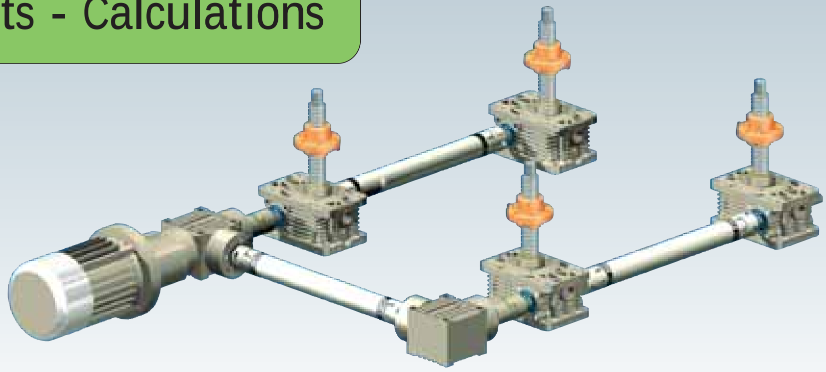
i	rpm	Z-2	Z-5	Z-10	Z-25	Z-35	Z-50	Z-100	Z-150	Z-250	Z-350	Z-500	Z-750	Z-1000
N	3000	0.87	0.81	0.83	0.87	-	-	-	-	-	-	-	-	-
N	1500	0.87	0.82	0.84	0.87	0.87	0.87	0.88	0.89	0.91	0.91	0.93	-	-
N	1000	0.86	0.82	0.82	0.86	0.87	0.86	0.87	0.89	0.90	0.91	0.92	0.88	0.90
N	750	0.86	0.82	0.84	0.85	0.86	0.85	0.87	0.88	0.90	0.91	0.92	0.88	0.90
N	500	0.85	0.82	0.84	0.83	0.85	0.84	0.85	0.87	0.89	0.90	0.92	0.87	0.89
N	100	0.74	0.77	0.79	0.78	0.78	0.78	0.78	0.80	0.83	0.86	0.87	0.81	0.84
L	3000	0.78	0.74	0.78	0.76	-	-	-	-	-	-	-	-	-
L	1500	0.77	0.70	0.74	0.72	0.64	0.66	0.67	0.67	0.78	0.79	0.77	-	-
L	1000	0.75	0.67	0.72	0.70	0.64	0.66	0.65	0.66	0.77	0.78	0.76	0.67	0.76
L	750	0.74	0.65	0.70	0.68	0.64	0.66	0.65	0.65	0.76	0.78	0.75	0.66	0.76
L	500	0.71	0.62	0.67	0.65	0.63	0.65	0.65	0.63	0.75	0.77	0.73	0.65	0.75
L	100	0.54	0.53	0.59	0.54	0.52	0.55	0.57	0.53	0.65	0.67	0.61	0.58	0.66

Spindle efficiency $\eta_{Spindle}$

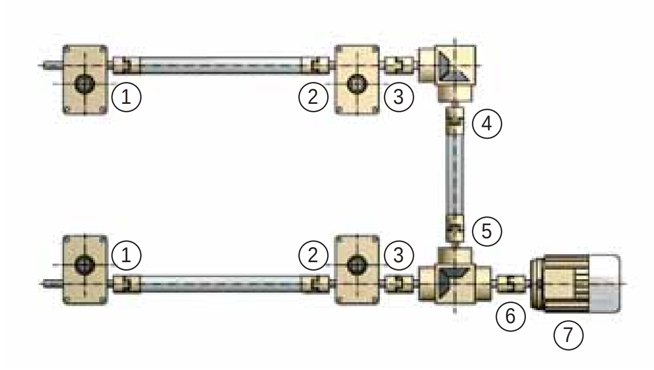
Tr spindle, single pitch	16x4	18x4	20x4	30x6	40x7	50x8	55x9	60x9	80x16	100x16	120x16	140x20	160x20	Ball screw spindle
Efficiency	0.453	0.420	0.391	0.391	0.357	0.335	0.340	0.320	0.391	0.335	0.293	0.308	0.278	0.9
Tr spindle, double pitch	16x8P4	18x8P4	20x8P4	30x12P6	40x14P7	50x16P8	55x18P9	60x18P9	80x32P16	100x32P16	120x32P16	140x40P20	160x40P20	Ball screw spindle
Efficiency	0.623	0.591	0.563	0.563	0.526	0.502	0.508	0.484	0.563	0.502	0.453	0.471	0.436	0.9

Idling torque M_L of gearbox [Nm] (without spindle, at 20°C)

Z	2	5	10	25	35	50	100	150	250	350	500	750	1000
N	0.08	0.10	0.26	0.36	0.56	0.76	1.68	1.90	2.64	3.24	3.96	7.28	9.70
L	0.06	0.08	0.16	0.26	0.40	0.54	1.02	1.20	1.94	2.20	2.84	4.42	5.90



Drive Torque for Gearboxes - exact calculation



The efficiency of connecting shafts (η 0.95) and bevel gearboxes (η 0.90) are included in the following example calculation.

Gearbox formula:

Drive torque: $M_G = \dfrac{F\,[kN] \cdot P\,[mm]}{2 \cdot \pi \cdot \eta_{Gearbox} \cdot \eta_{Spindle} \cdot i} + M_L\,[Nm]$

Efficiency:

Connecting shafts: η 0.95
Bevel gearboxes: η 0.90

Example:

1) $M_G = \dfrac{12\ kN \cdot 6\ mm}{2 \cdot \pi \cdot 0.87 \cdot 0.375 \cdot 6} + 0.36\ Nm = 6.21\ Nm$

Z-25-SN
F = 12 kN (lifting load, dynamic per gearbox)
$\eta_{Gearbox} = 0.87$ $\eta_{Spindle} = 0.375$
P = 6 i = 6

2) $\dfrac{6.21\ Nm}{0.95} = 6.53\ Nm$

(Connecting shaft efficiency)

3) 6.21 Nm + 6.53 Nm = 12.74 Nm

12.74 Nm · 1.5 = 19.11 Nm
--> This means KSZ-25-L is OK (see Section 6 - Catalogue 2008)

4) $\dfrac{12.74\ Nm}{0.9} = 14.15\ Nm$

(Bevel gearbox efficiency)

5) $\dfrac{14.15\ Nm}{0.95} = 14.9\ Nm$

6) (12.74 Nm + 14.9 Nm)/0.9 = 30.71 Nm

7) 30.71 Nm · 1.5 = 46 Nm

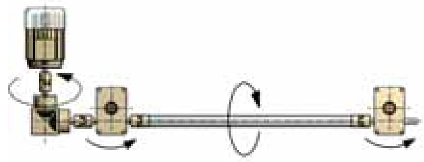
46 Nm --> we need KSZ-50-L
(see Section 6 - Catalogue 2008)

We recommend multiplying the calculated value by a safety factor of 1.3 to 1.5 (up to 2 for small systems). !

Motor selection: 132M-P4-7.5 kW (50 Nm)
--> see Section 7 - Catalogue 2008 for motors

An approximated calculation is shown on the next page.

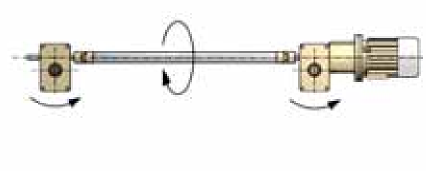
Drive Torque for Gearboxes - Approximated Calculation



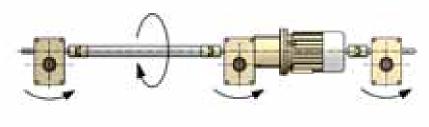
$M_R = M_G \times 2.25$

Determination
The drive torque required for a lifting system is the sum of the torques for the single screw jacks and increases due to friction losses on transfer components such as couplings, connecting shafts, bevel gearboxes etc.

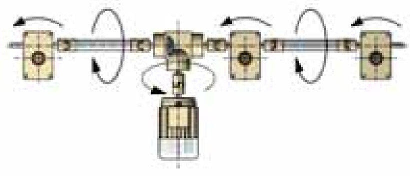
To simplify the calculation, the following factors are used to determine the drive torque for the most common system layouts.



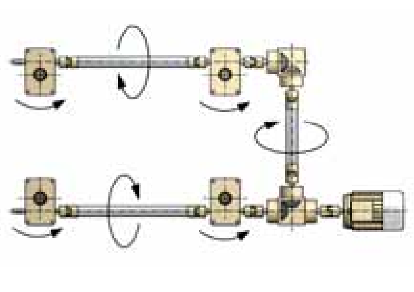
$M_R = M_G \times 2.1$



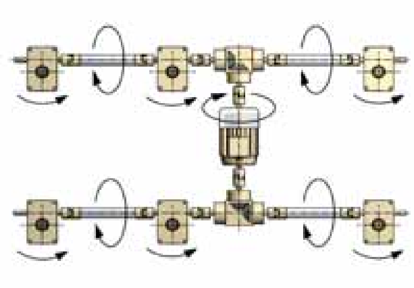
$M_R = M_G \times 3.1$



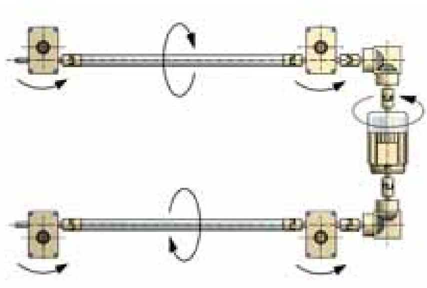
$M_R = M_G \times 3.35$



$M_R = M_G \times 4.6$



$M_R = M_G \times 6.8$

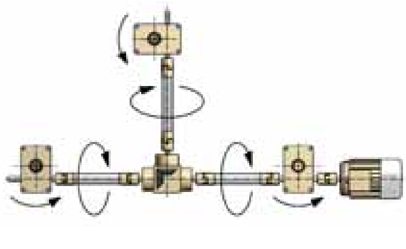


$M_R = M_G \times 4.4$

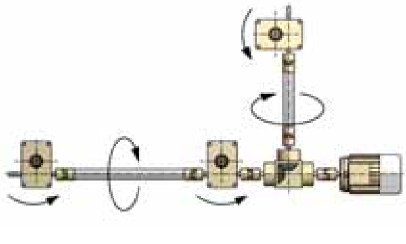
M_R – overall drive torque for the complete system

M_G - drive torque for one single screw jack

M_A – starting torque max. 1.5 x M_R

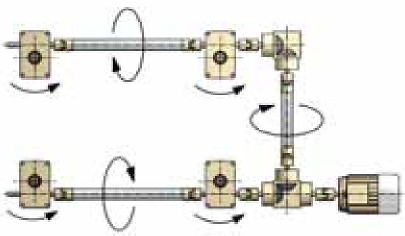


$M_R = M_G \times 3.34$



$M_R = M_G \times 3.27$

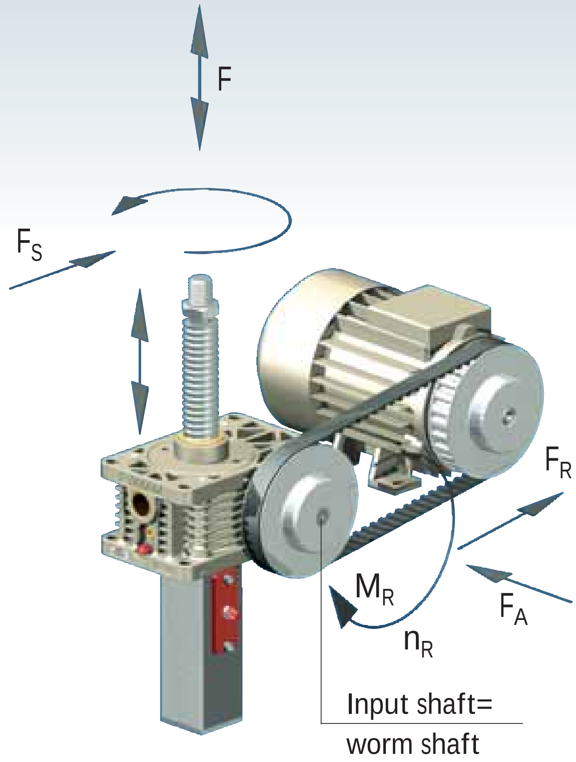
Example (example page 11, 12 kN per gearbox)



$M_R = M_G \times 4.6 = 6.21 \text{ Nm} \times 4.6 = 28.57 \text{ Nm}$
$\longrightarrow$ x safety 1.5 = 42.86 Nm

Attention:
We recommend multiplying the calculated value by a safety factor of 1.3 to 1.5 (up to 2 for small systems). The values specified are valid for even load distribution across all gearboxes!

Maximum Forces / Torques



Load definitions

- F - Lifting load tension and/or compression
- F_S - Side forces on the spindle
- v_H - Lifting speed of the spindle (or nut on R versions)
- F_A - Axial load of the input shaft
- F_R - Radial load of the input shaft
- M_R - Input torque
- n_R - Input speed

Please examine the information on the following technical pages before making your choice of the appropriate screw jack. A full specification can only be given with full application data and relevant information.
In case of doubt, please contact our project technicians.

Side forces on the lifting screw

The Table on the right shows the maximum allowable side forces. Side forces should generally be supported by linear slides. The guide bushing in the gearbox only functions as a secondary guide. The maximum side forces actually effective must be below the Table value!

Attention: Only static allowed

Maximal side force F_S [N] (only static) — Extended spindle length in mm

Z	100	200	300	400	500	600	700	800	900	1000	1200	1500	2000	2500	3000
5	360	160	100	70	55	45	38	32	28	25	20	18	12	–	–
10	600	280	180	130	100	80	70	60	50	47	40	30	20	15	–
25	900	470	300	240	180	150	130	110	100	90	70	60	45	35	30
35	1300	700	450	360	270	220	190	160	150	130	100	90	60	50	40
50	3000	2000	1300	900	700	600	500	420	380	330	280	230	160	130	100
100	5000	4000	3000	2300	1800	1500	1300	1100	950	850	700	600	400	350	250
150	5500	5000	3900	2800	2300	1800	1500	1300	1200	1000	850	750	500	400	350
250	9000	9000	6500	4900	3800	3000	2500	2200	2000	1900	1450	1250	900	760	660
350	15000	13000	12000	10000	8800	7000	6000	5500	4800	4300	3500	3000	2000	1600	1400
500	29000	29000	29000	29000	29000	24000	20000	17000	15000	14000	12000	9000	7000	5600	4900
750	34800	34800	34800	34800	34800	28800	24000	20400	18000	16800	14400	10800	8400	6720	5880
1000	46000	46000	39000	36000	32000	30000	25000	29000	25000	23500	20000	17000	12000	10000	8000

Maximum input torque

The values shown should not be exceeded to attain the optimal service life. Higher values for lower operating hours are possible. Please provide full data.

Maximum input torque M_R [Nm] — Max. drive-through torque, worm shaft [Nm]

i	rpm	Z-5	Z-10	Z-25	Z-35	Z-50	Z-50/Tr50	Z-100	Z-150	Z-250	Z-350	Z-500	Z-750	Z-1000
N	3000	4.0	11.0	17.0	-	-	-	-	-	-	-	-	-	-
N	1500	4.7	13.5	18	19.8	31.5	31.5	53.4	75.1	152	-	-	-	-
N	1000	5.6	14	22	20.8	36.8	36.8	60.8	77.1	152	265	408	480	680
N	500	6.1	16.7	28	24.8	46.5	46.5	75.3	95	160	350	500	640	960
L	3000	1.4	5.7	8.5	-	-	-	-	-	-	-	-	-	-
L	1500	1.5	7.5	10	9	10.4	10.4	13.5	20.7	41.4	-	-	-	-
L	1000	1.8	8.7	11	9.7	14.9	14.9	15.4	23.7	47.4	100	170	210	450
L	500	2.2	10.7	14	11.1	19.2	19.2	18.9	29.4	63.5	112	220	240	580
Drive-through		39	57	108	130	260	260	540	540	770	1800	1940	4570	4570

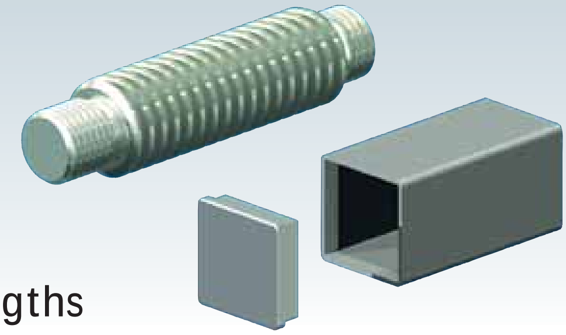
- Bear in mind that the starting torque is approx. 1.5 times the operating torque
- Limit values are mechanical - consider thermic factors depending on operating period

Radial load on the input shaft

The radial forces in the adjacent Table should not be exceeded when using chain or belt drives.

Maximum radial load of the input shaft F_R [N]

	Z-5	Z-10	Z-25	Z-35	Z-50	Z-100	Z-150	Z-250	Z-350	Z-500	Z-750	Z-1000
F_R max.	110	190	260	260	420	650	670	1100	1400	2600	3000	3400



Calculating Spindle and Protective Tube Lengths

Fitting lenght
The following Tables serve to calculate the required spindle and protective tube extension lengths yourself. This lets you quickly calculate the fitting dimensions of your screw jack.

Basic principle
The spindle (and the protective tube on the S version) are extended depending on the version and system components used. These dimensions are minimum requirements. For special fitting situations, please provide a drawing or contact our project technicians.

Stroke + basic length (+ various extensions for variants/system components)

Example S:

Z-25-SN, stroke: 250 mm
Bellows Z-25-FB-300 (ZD=70 mm)
Fixing flange BF (therefore bellows without fixing ring)
Rotation protection VS
Limit switch ESSET

Spindle length Tr:

250	+	180	+	44	+	45	=	519 mm
Stroke		Basic length		Bellows (70-26=44) Section 7 - Catalogue 2008		Limit switch + rotation protection		Spindle length

Protective tube length SRO:

250	+	53	+	72	=	377
Stroke		Basic length		Limit switch + Rotation protection		Protective tube length

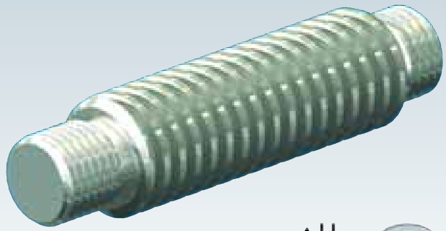
Example R:

Z-25-RN, stroke 250 mm
Spindle with journal (opposed bearing plate GLP)
Bellows Z-25-FB-300 (ZD=70 mm) below and above
Duplex nut DM

Spindle length Tr:

250	+	139	+	60	+	55	+	50	=	554 mm
Stroke		Basic length		Bellows, gearbox side (70-10=60)		2nd bellows (70-15=55)		Duplex nut		Spindle length

Length calculation for connecting shafts can be found in Section 7 - Catalogue 2008.



Length Calculation, Standing Version S - Spindle

S

Spindle extension for S version below gearbox (protective tube side)

Z-2 to Z-150:	Z-2	Z-5	Z-10	Z-25	Z-35	Z-50	Z-50/Tr50	Z-100	Z-150
Tr basic length	118	139	161	180	219	240	263	338	342
Escape/rotation protection AS/VS	15	15	20	20	30	30	30	30	30
Limit switch ES[2)]	43	43	45	45	59	55	55	45	45
ES[2)] and hinged bearing plate KAR	65	64	65	69	-	-	-	-	-

Spindle extension for S version above gearbox

Z-2 to Z-150:	Z-2	Z-5	Z-10	Z-25	Z-35	Z-50	Z-50/Tr50	Z-100	Z-150
Bellows with bellow ring (GK/KGK)[1)]	ZD-1	ZD-2	ZD+1	ZD+5	ZD+10	ZD+10	ZD+8	ZD-2	ZD-2
Bellows without bellow ring (BF/SLK)[1)]	ZD-18	ZD-22	ZD-24	ZD-26	ZD-36	ZD-36	ZD-40	ZD-50	ZD-22
Bellows and KAR with FBR (GK/KGK)[1)]	ZD+32	ZD+31	ZD+28	ZD+46	-	-	-	-	-
Bellows and KAR without FBR (BF/SLK)[1)]	ZD+15	ZD+11	ZD+3	ZD+15	-	-	-	-	-

Spindle extension for S version below gearbox (protective tube side)

Z-250 to Z-1000:	Z-250	Z-350	Z-500	Z-750	Z-1000
Tr basic length	370	424	552	619	643
Escape protection AS	30	35	40	40	40
Limit switch ES[2)]	37	42	40	40	40
ES[2)] and hinged bearing plate KAR	-	-	-	-	-

Spindle extension for S version above gearbox

Z-250 to Z-1000:	Z-250	Z-350	Z-500	Z-750	Z-1000
Bellows with bellow ring (GK/KGK)[1)]	ZD-2	ZD-2	-	-	-
Bellows without bellow ring (BF/SLK)[1)]	ZD-22	ZD-22	-	-	-
Spindle side "F" (down)	11	-	-	-	-

Safety distances are already included in basic lengths!
(Tr spindle: 10 mm up to Z-50, 20 mm for Z-100 to Z-500, 40 mm for Z-750 and Z-1000)

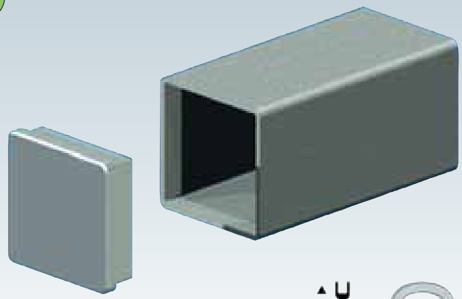
1) The value will be added to or subtracted from the ZD dimension of the bellows depending on the sign and the result then added to the spindle length.

2) Limit switches ES are always in combination with rotation protection VS (VS is included in the extension), with escape protection AS as from Z-250.

Spindle extension for spiral spring cover SF:
The extension for spiral spring covers varies according to the fitting and therefore this variant must be calculated from a drawing. We would be pleased to make this drawing for you.

Abbreviations:

AS	Escape protection	KAR	Hinged bearing plate
BF	Fixing flange	KGK	Rod end
ES	Limit switch	SLK	Pivot bearing head
FBR	Bellows connecting ring	ZD	Compression dimension
GK	Forked head		



Length Calculation, Standing Version S - Protective Tube SRO

S

Protective tube extension for S version

Z-2 to Z-150:	Z-2	Z-5	Z-10	Z-25	Z-35	Z-50	Z-50/Tr50	Z-100	Z-150
Tr basic length[1]	47	46	49	53	57	62	62	82	87
Escape/rotation protection AS/VS	15	15	20	20	30	30	30	30	30
Limit switch ES[3]	70	73	72	72	86	82	82	62	62
ES[3] and hinged bearing plate KAR	92	94	92	96	-	-	-	-	-

Attention: Minimum stroke with limit switch ES[2]:

Z-2 to Z-150:	Z-2	Z-5	Z-10	Z-25	Z-35	Z-50	Z-50/Tr50	Z-100	Z-150
Min. stroke with limit switch ES	53	50	51	51	41	42	42	42	42
Min. stroke with ES and lubrication strip SL	123	120	121	121	111	112	112	112	112

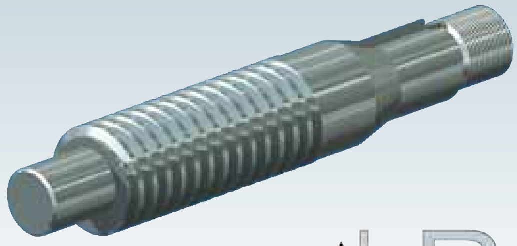
Protective tube extension for S version

Z-250 to Z-1000:	Z-250	Z-350	Z-500	Z-750	Z-1000
Tr basic length[1]	87	97	151	152	152
Escape protection AS	30	35	40	40	40
Limit switch ES[3]	46	51	40	40	40
ES[3] and hinged bearing plate KAR	-	-	-	-	-

Attention: Minimum stroke with limit switch ES[2]:

Z-250 to Z-1000:	Z-250	Z-350	Z-500	Z-750	Z-1000
Min. stroke with limit switch ES	47	42	46	46	46
Min. stroke with ES and lubrication strip SL	117	112	116	116	116

1) Basic length of protective tube without cap - add another 5 mm to the overall length of the protective tube to include the cap thickness.
2) If a shorter stroke than specified is required, fit the limit switches and the lubrication strip on two different sides (fitting location)!
3) Limit switches ES are always in combination with rotation protection VS (VS is included in the extension), with escape protection AS as from Z-250.



Length Calculation, Rotating Version R - Spindle

Z-2 to Z-150:	Z-2	Z-5	Z-10	Z-25	Z-35	Z-50	Z-100	Z-150
Tr basic length without journal	78	86	102	114	132	148	222	250
Tr basic length with journal (= standard for opposed bearing plate GLP)	90	101	122	139	162	178	267	305
Tr basic length strengthened with journal[1]	93	106	127	144	177	193	277	325
KGT basic length without journal	16x05 130	16x05 138	25x05 154	32x05 179	40x05 199	40x05 215	50x10 317	63x10 370
	16x10 163	16x10 171	25x10 187	32x10 203	40x10 213	40x10 229	50x20 357	63x20 440
			25x25 237	32x20 244	40x20 252	40x20 268		
			25x50 390	32x40 279	40x40 317	40x40 333		
KGT basic length without journal[1,2]		25x05 138	32x05 167	40x05 181	50x10 247	50x10 263	63x10 342	80x10 370
		25x10 171	32x10 191	40x10 195	50x20 287	50x20 303	63x20 412	80x20-4EP 450
		25x25 221	32x20 232	40x20 234				80x20-5EP 465
		25x50 374	32x40 267	40x40 299				
KGT basic length with journal	16x05 142	16x05 153	25x05 174	32x05 204	40x05 229	40x05 245	50x10 362	63x10 425
	16x10 175	16x10 186	25x10 207	32x10 228	40x10 243	40x10 259	50x20 402	63x20 495
			25x25 257	32x20 269	40x20 282	40x20 298		
			25x50 410	32x40 304	40x40 347	40x40 363		
KGT basic length with journal[1,2]		25x05 158	32x05 192	40x05 211	50x10 292	50x10 308	63x10 397	80x10 445
		25x10 191	32x10 216	40x10 225	50x20 332	50x20 348	63x20 467	80x20-4EP 525
		25x25 241	32x20 257	40x20 264				80x20-5EP 540
		25x50 394	32x40 292	40x40 329				
Flange nut FM	35	35	44	46	66	66	-	90
Duplex nut DM	45	45	45	50	70	70	90	115
Self-aligning nut PM	-	78	83	95	129	129	190	210
Greaseless duplex nut FFDM	-	53	53	59	85	85	-	-
DM + safety nut SIFA	70	70	84	95	133	133	173	211
PM + safety nut SIFA	-	123	128	158	212	212	300	330
1. Bellows[3]	ZD-10	ZD-12	ZD-12	ZD-10	ZD-12	ZD-12	ZD-22	ZD-22
2. Bellows[3]	ZD-10	ZD-10	ZD-14	ZD-15	ZD-15	ZD-15	ZD-20	ZD-30
KAR[4] spindle-side + 1st Bellows[3]	ZD+23	ZD+21	ZD+15	ZD+31	-	-	-	-

Z-250 to Z-1000:	Z-250	Z-350	Z-500	Z-750	Z-1000
Tr basic length without journal	265	288	366	417	438
Tr basic length with journal (= standard for opposed bearing plate GLP)	340	388	486	537	613
Tr basic length strengthened with journal[1]	365	408	486	592	-
KGT basic length without journal	80x10 385	-	-	-	-
	80x20-4EP 465	-	-	-	-
	80x20-5EP 480	-	-	-	-
	-	-	-	-	-
KGT basic length with journal	80x10 460	-	-	-	-
	80x20-4EP 540	-	-	-	-
	80x20-5EP 555	-	-	-	-
	-	-	-	-	-
Duplex nut DM	140	160	180	220	320
Self-aligning nut PM	224	275	-	-	-
DM + safety nut SIFA	250	270	303	365	500
1. Bellows[3]	ZD-22	ZD-22	-	-	-
2. Bellows[3]	ZD-40	ZD-60	-	-	-

Safety distances are already included in basic lengths (twice: 1x above and 1x below)!
(Tr spindle: 10 mm up to Z-50, 20 mm for Z-100 to Z-500, 40 mm for Z-750 and Z-1000)

1) When using a larger diameter spindle, select the components for the next size gearbox (Z-10 strengthened has a spindle Tr 30x6 which means component Z-25 - this is then the calculated spindle extension for size 25).
2) The basic length for KGT spindles includes the KGT nut length and the safety clearance acc. to the ZIMM Catalogue.
3) The value will be added to or subtracted from the ZD dimension of the bellows depending on the sign and the result then added to the spindle length.
4) KAR is the hinged bearing plate

Spindle extension for spiral spring cover:
The extension with a spiral spring cover depends on the fitting, therefore this variant must be calculated using a drawing. We would be pleased to make this drawing for you.

Order Code

Z-Series ZIMM	Size	Version	Ratio	Thread version	Spindle Ø / pitch	Number of threads, material	Stroke	List of system components
Z							H	– – – –
Z	2 5 10 25 35 50 100 150 250 350 500 750 1000	S Standing version R Rotating version	N Normal e.g. i = 4:1 L Low e.g. i = 16:1	Tr Trapezoid spindle (not specified = Tr) Tr/SIFA Tr with safety nut SIFA +CONTROL Wear control KGT Ball screw drive	Tr 1804 2004 ... KGT 1605 1610 ...	1 1-pitch (not specified = 1-pitch) 2 * 2-pitch I INOX (stainless steel) LH * left-handed	Stroke H + stroke in mm	List of system components (sequence not important) —> Section 7 - Catalogue 2008

*) Deliverable but not stock item, delivery time on request

Size, Version S or R, Ratio N or L, Thread version, Spindle diameter, Spindle pitch, Number of starts, Stroke, List of system components (sequence not important)

Order example: Z - 10 - SN - Tr - 2004 - 1 - H 300 - FB390 - VS - BF