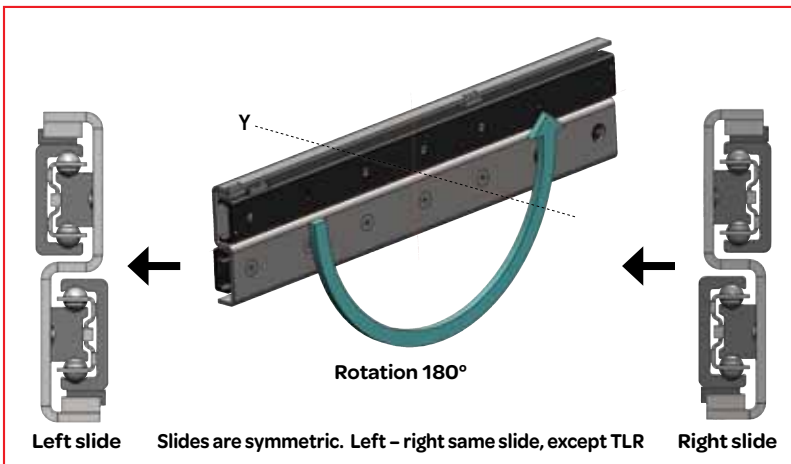


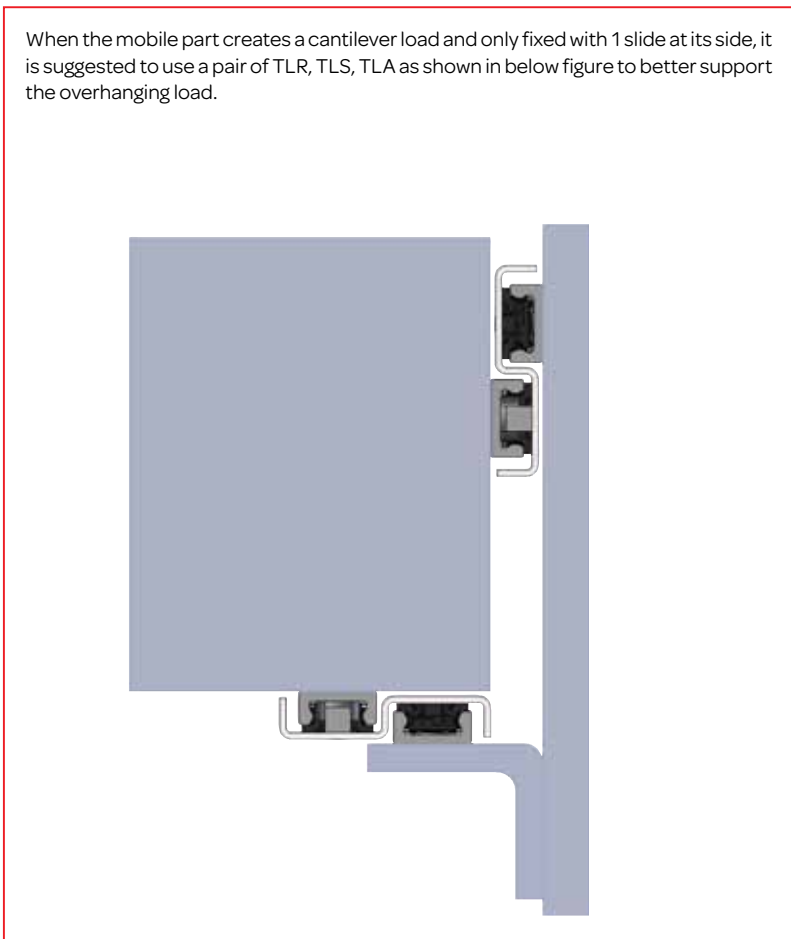
The slides can be mounted in different way, however in general as a configuration "drawer-slides" for horizontal complete extension of a mobile part, compared to a fixed structure.

Except for type TLR, which must be bought as Left-side TLRS and right-side TLRD, all other slides are symmetric, i.e. same version for both left and right side, just by rotating the slides 180degrees.

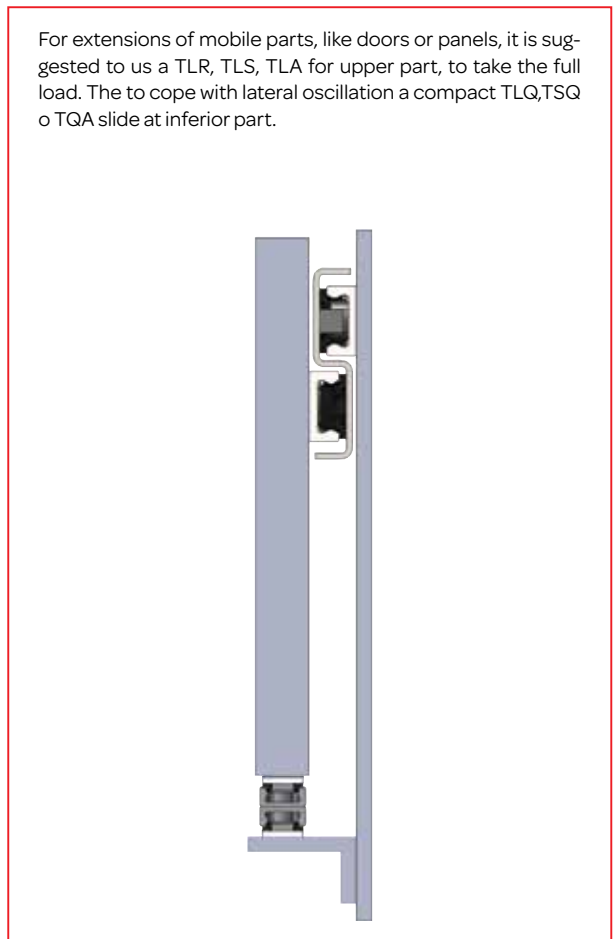
For all slides of series TLR, TLS, TLA with a vertical intermediate element, the mobile part must always be fixed to the lower rail. The upper rail is identified by the code marking at upper rail (TLR/TLS) or upper part (TLA).

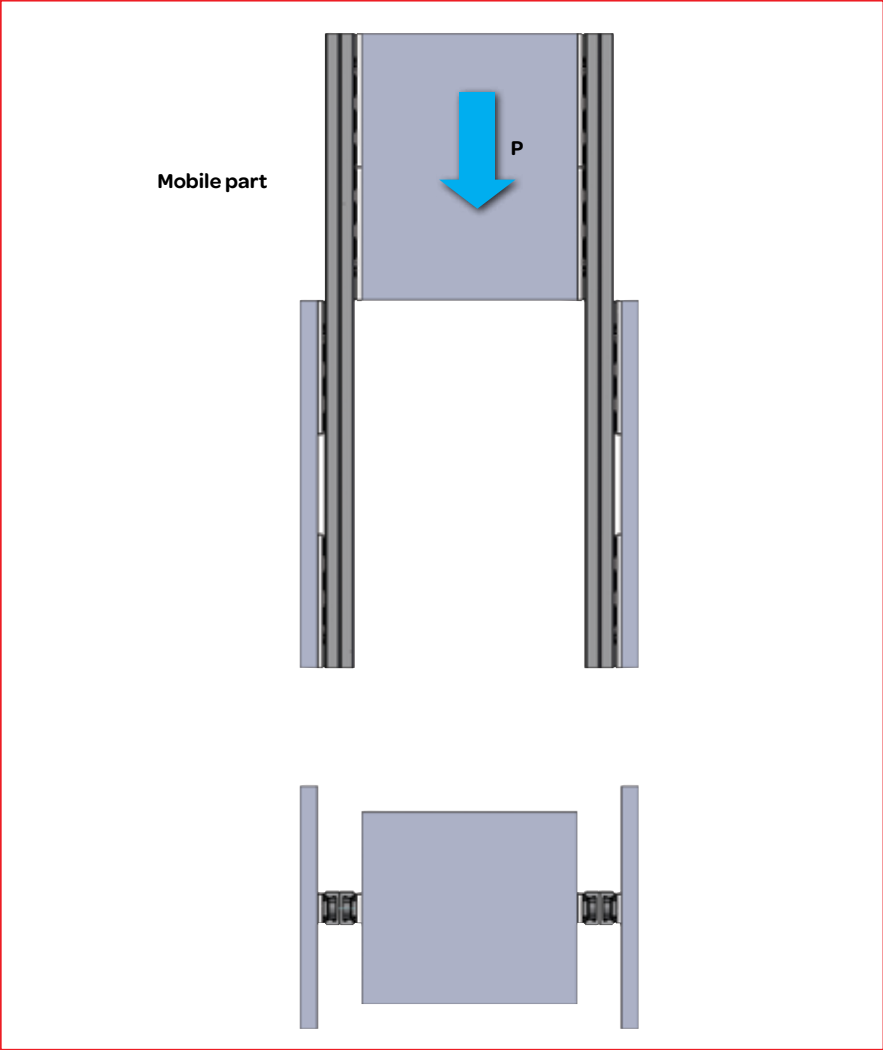


When the mobile part creates a cantilever load and only fixed with 1 slide at its side, it is suggested to use a pair of TLR, TLS, TLA as shown in below figure to better support the overhanging load.



For extensions of mobile parts, like doors or panels, it is suggested to use a TLR, TLS, TLA for upper part, to take the full load. To cope with lateral oscillation a compact TLQ, TSQ or TQA slide at inferior part.

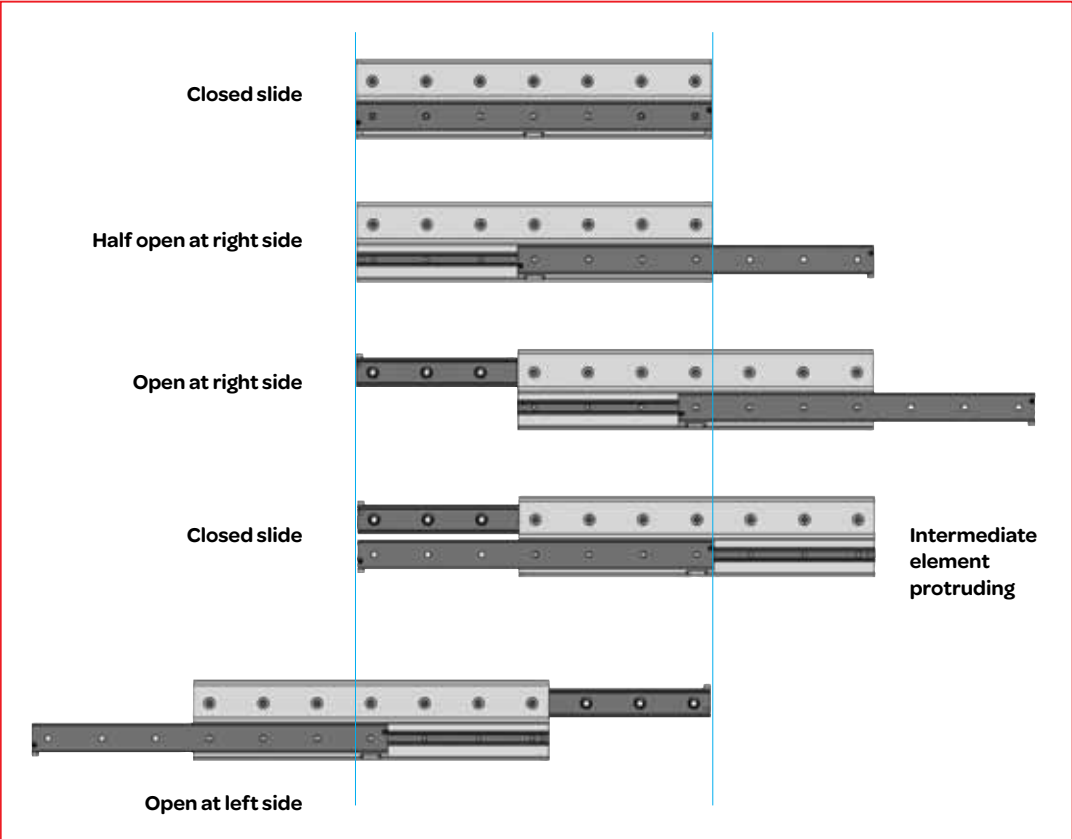




Vertical movement

For vertical movement is proposed TLQ or TQA slides, with compact dimensions. As the slides in such application generally do not take the load, but only some lateral oscillation, these slides are to be preferred.

For vertical movement are recommended roller slides, while ball-cage slides (TLS, TQS, SR) likely will have some ball-cage creeping-problem, as the ball-cage tends to move downwards by gravity, creating some minor binding, during upwards extension.

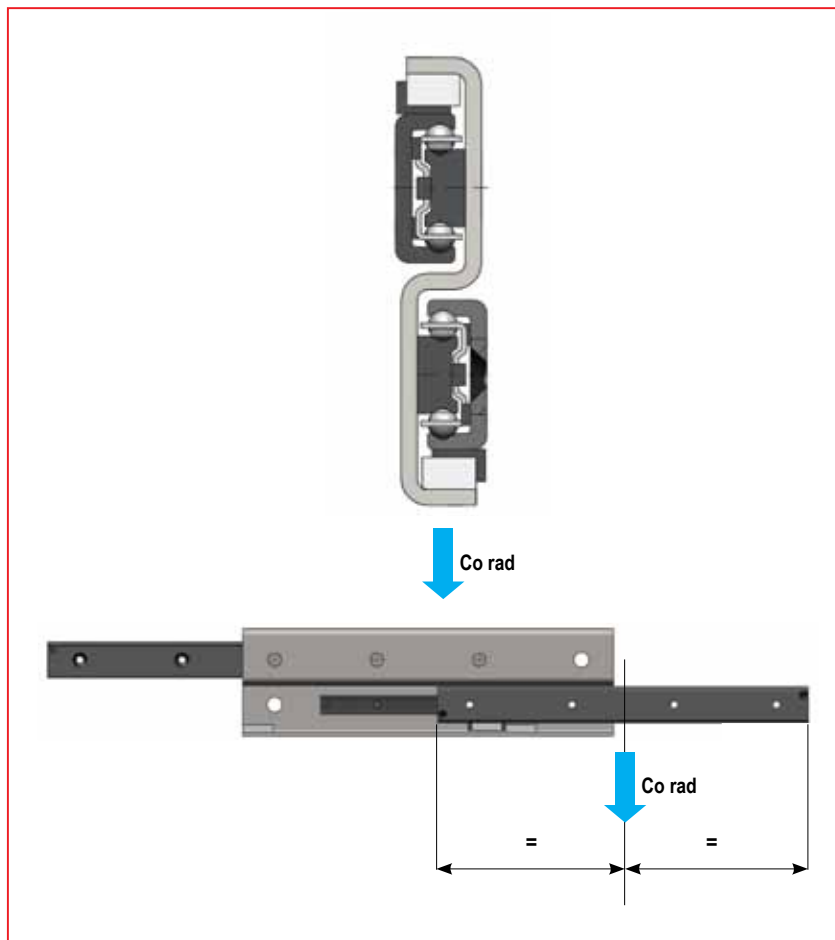


Double side movement

Slides for double side extension (TLS.D / TSQ) allow for extension of the mobile part to both left and right side, the stroke each side equals the length of the slide, less a small constant.

As the movement of the 3 parts, i.e. the two rails and intermediate element is not synchronized, the intermediate element tends to protrude when closing the slide.

If this is a problem, synchronized slides can be offered, for which the intermediate element precisely follows the movement, as moved by a belt, fixed to upper and lower rail. See page 77.



The main factors for sizing the slides for a telescopic movement:

- The weight/forces of mobile part and their position compared to slides.
- Presence of dynamic forces / eventual abuse
- Max. acceptable flexion
- Max. acceptable extraction/closing force of mobile part
- Ambients, frequency, speed
- Expected lifetime

All load capacities Co_{rad} , are indicated per single slide and with the load perfectly centered. I.e an homogeneous load placed between 2 slides. Hereby the load P is acting as a radial point load, at half the extension and in the middle between the 2 slides. The load capacity for a pair is then :

$$P = 2 \cdot Co_{rad}$$

When sizing a telescopic application, it must be carefully evaluated if the load is centered. Also it must be considered if any external dynamic forces, or possible abuse could further increase the load forces acting on the slides.

In case the load isn't centered. i.e. load center Pe_1 more towards one of the slides, and/or more towards the tip of the load, the center weighted load must be calculated for the most slides = Pe_1 , to be inserted in formula on next page.

$$Pe_1 = \frac{(P \cdot a)}{(a + b)} \cdot fp$$

Where:

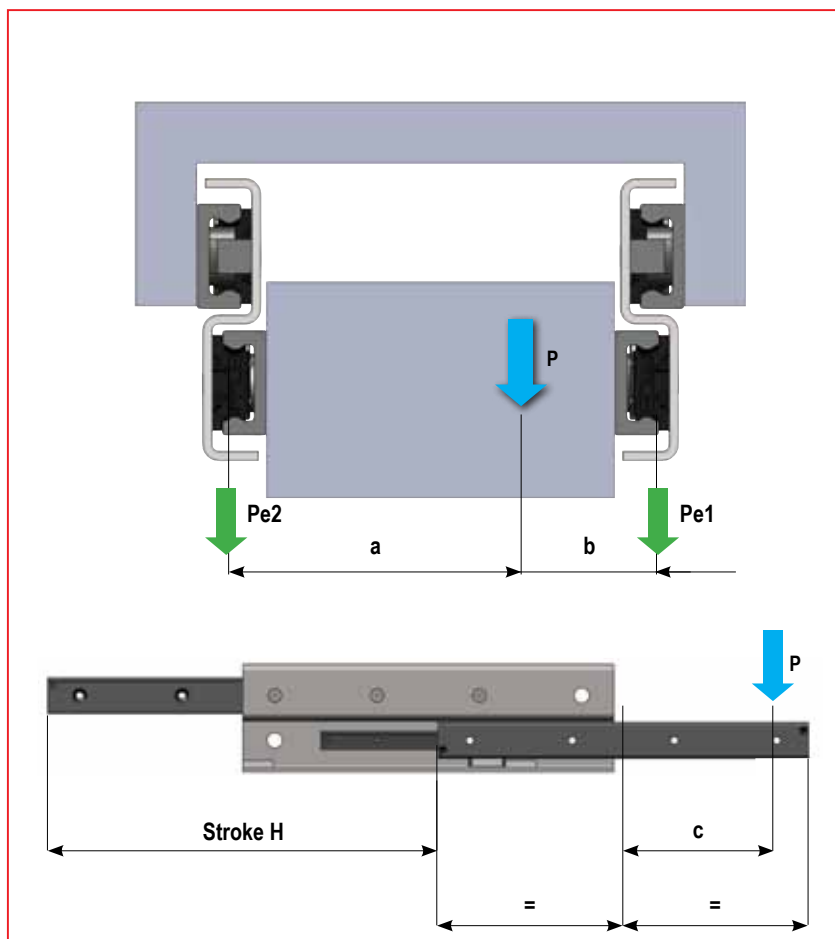
P = Weight/load of mobile part

a, b = distances from centered load to left/right slide

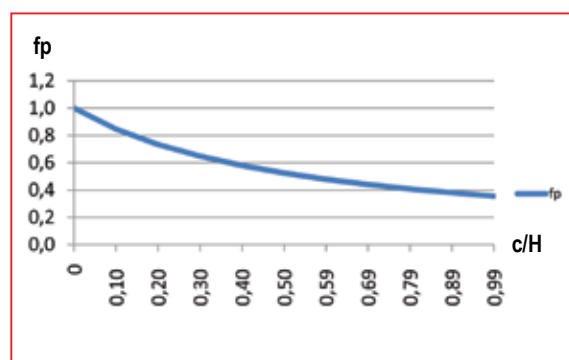
fp = load position coefficient, based on relation of "c" distance between actual load P and load Co_{rad} position, compared stroke H .

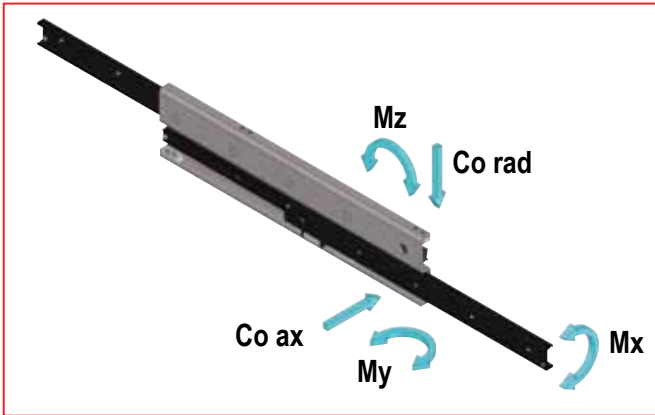
The coefficient fp is obtained from below diagram. as the ratio between "c/H".

When only 1 slide the formula is $Pe = P \cdot fp$



Capacity load reduction according to the position of the load P .





Where :

- Pe rad** = applied radial load
- Pe ax** = applied axial load
- Mex, Mey, Mez** = applied moments
- Co rad** = radial load capacity
- Co ax** = axial load capacity
- Mx, My, Mz** = moment capacities

SR and full telescopic slides TLQ, the calculation might also includes moments.

$$\left(\frac{Pe\ ax}{Co\ ax} + \frac{Pe\ rad}{Co\ rad} + \frac{M_{ex}}{M_x} + \frac{M_{ey}}{M_y} + \frac{M_{ez}}{M_z} \right) \leq \frac{1}{Z}$$

To assure a correct selection of the slides according to the slide's load capacity, it is assumed the known different forces acting on the slides, which then must be decomposed in : radial, axial or moment forces. Then again compared to load/moment capacities indicated for each single product in previous pages.

For the slides with intermediate element TLS, TLR, TLA the verification is mainly down to comparing the load capacity Co Rad. to Pe as calculated on previous page, including a safety factor Z.

$$Pe \leq Co\ rad \cdot Z$$

Where Z is the safety coefficient as per below table.

Safety coefficient - Z	Application conditions
1 - 1,5	Precise calculation of load/forces, precise assembly and rigid structures
1,5 - 2	Intermediate conditions
2 - 3,5	Roughly estimation of load/forces, not precise and not rigid structures

For slides TSQ and TQA might too include axial loads. The verification includes therefore both axial and radial loads.

Once having found Pe axial and radial the formula is :

$$\left(\frac{Pe\ ax}{Co\ ax} + \frac{Pe\ rad}{Co\ rad} \right) \leq \frac{1}{Z}$$

Lifetime calculation

Theoretical lifetime calculation

The theoretical life of the rollers and raceways of rail should be determined by the conventional formula as indicated below in km of running, however, should keep in mind that the value thus calculated must be taken with caution just for orientation, in fact, the real service life achieved can be very different from that calculated value, because the phenomena of wear and fatigue are caused by factors not easy to predetermine, for example:

- Inaccuracy in the estimation of the real loading condition
- Overloading for inaccuracies in assembling
- Vibration, shock and dynamic pulse stress
- Raceways status of lubrication
- Thermal excursions
- Environmental pollution and dust
- Damage mounting
- Stroke length and frequency of movement

$$L_{cy} = fa \cdot 50 \cdot \left(\frac{C}{P} \right)^3 \cdot \frac{1}{H} \cdot 10^6$$

Where :

- Pe rad** = applied radial load
- Pe ax** = applied axial load
- Mex, Mey, Mez** = applied moments
- Co rad** = radial load capacity
- Co ax** = axial load capacity
- Mx, My, Mz** = moment capacities

The correction factors **fa** applied to the theoretical calculation formula have the sole purpose of guiding the designer qualitatively on the influence in the lifetime estimation of the real application conditions without any pretense of precision. For more details please contact the Technical Service T RACE.

The slides TQA/X and TLA/X is expected to reach approx. 100.000 cycles, with a load of 70% of max load capacity.

Coefficient fa	Operating condistions
0,7-1	Correct load sizing, rigid structures, constantgood lubrication, clean ambient
0,3-0,7	Intermediate conditions
0,05-0,3	Approximative load sizing, unprecise non rigid structures, dusty not clear ambient

The actual lifetime very much depends on constant good lubrication of the raceways. Without good constant librucation and/or in very dusty ambients the actual lifetime expectations can be much reduced.

Calculation of load P to be used for Lifetime calculation

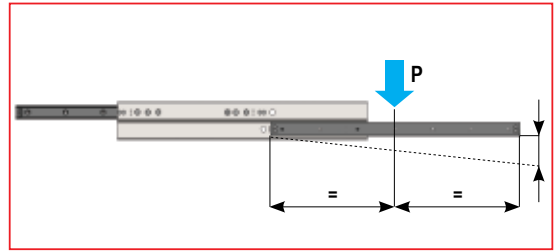
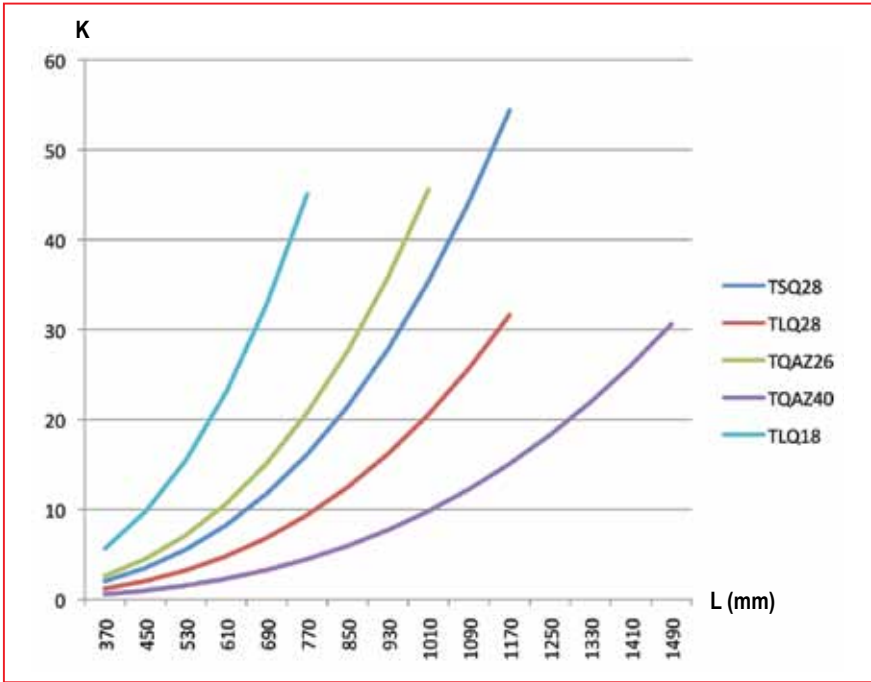
The load P to be used in below formular is referred to single slide, with load in the centre. If used in pair, load on each single slide must be calculated, see page 74 for further info.

The slides TSQ and TQA can be used with both radial and axial loads. In this case P, is substituted by Pe, to include axial load in the Lifetime formula.

$$Pe = Co\ rad \cdot \left(\frac{Pe\ rad}{Co\ rad} + \frac{Pe\ ax}{Co\ ax} \right)$$

The slides TLQ and SR might too include moments Mex, Mey and Mez, in addition to radial and axial loads. The formula in case of moments is

$$Pe = Co\ rad \cdot \left(\frac{Pe\ rad}{Co\ rad} + \frac{Pe\ ax}{Co\ ax} + \frac{M_{ex}}{M_x} + \frac{M_{ey}}{M_y} + \frac{M_{ez}}{M_z} \right)$$



The extended slides have a minor flexion “ f ” in function of applied load P and its own construction. What gives the strength of the slides, are merely the intermediate element’s shape. The slides with a long S-shape intermediate element TLS, TLR, TLA allow for much lower flexion, than the compact slides TSQ, TLQ, TQA, even though all base components are identical.

The flexion can be estimated as approximately:

$$f = \frac{(K \cdot P)}{1000} + X$$

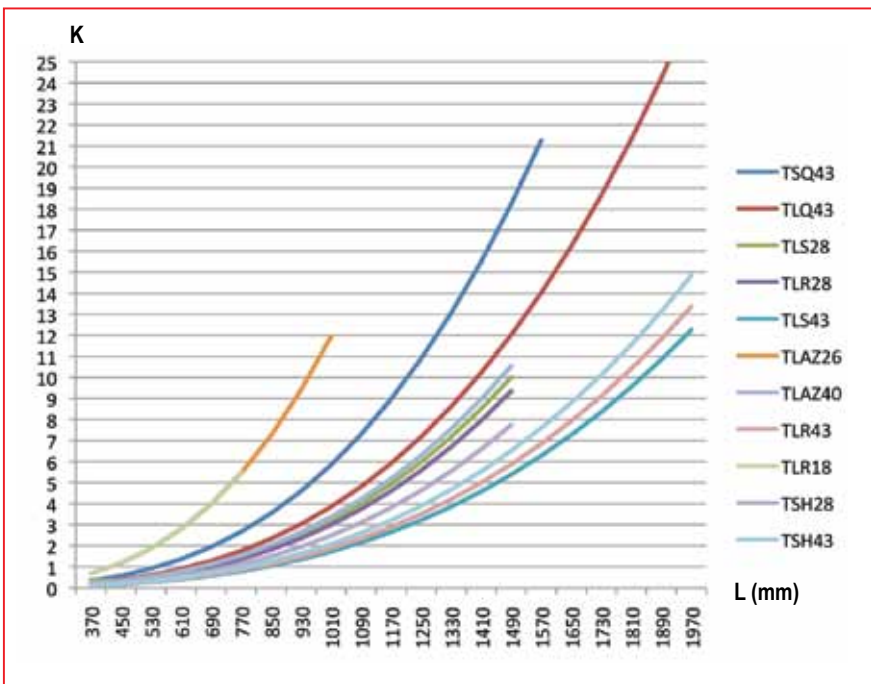
Where:

K = coefficient obtained from graph, in function of slide type and length.

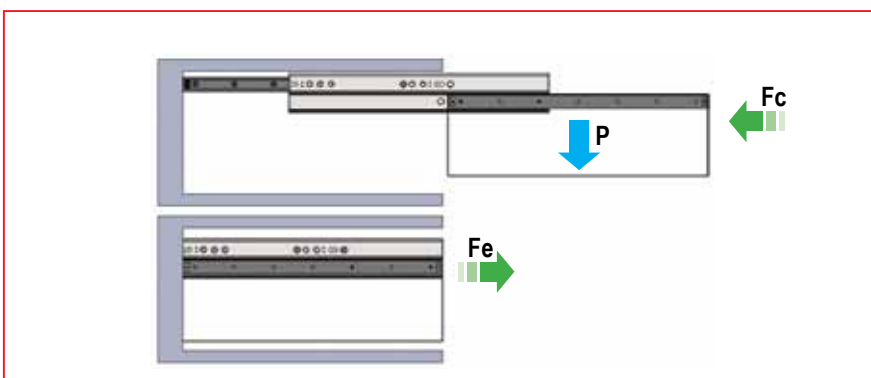
P = applied load in the central point of the single slides

X = external factors as : rigidity and precision of mobile structure and fixed structure

In case the load P was applied on two slides in an eccentric position, it is necessary to determine the equivalent component Pe for each slides (see page 74) and replace it to P in the formula.



Extension & closing forces



The required force Fe to extend the applied load, is determined by the friction of the slide’s rolling components and applied load Pe is:

$$F_e \approx 0,01 \cdot P \text{ (N)}$$

The required force Fc to close the applied load is

$$F_c = 0,01 \cdot P + \frac{f}{H} \cdot P \text{ (N)}$$

Where :

P = radial load applied on single rail

f = calculated flexion

H = stroke of slide

For applications with 2 slides, with even load the force is x 2. In addition there might be some additional “binding friction” from non precise assembly. For applications requiring lowest extension/closing forces is recommended roller slides series TLR and TLQ .

The speed of the slides is limited by strength of the stoppers, which move the intermediate element along with each opening/closing of the slides. The critical point is the impact, when stopper in rail hits the stopper in intermediate element. The stoppers are different among types of slides, but the same for all lengths of same slide. As the impact force, increase with the length of slides, based of same speed, as the weight of intermediate element increases propotional with the increased lengths, the max impact the stoppers can absorb is: $E_k = m \cdot v$

Where:

m = weight of element

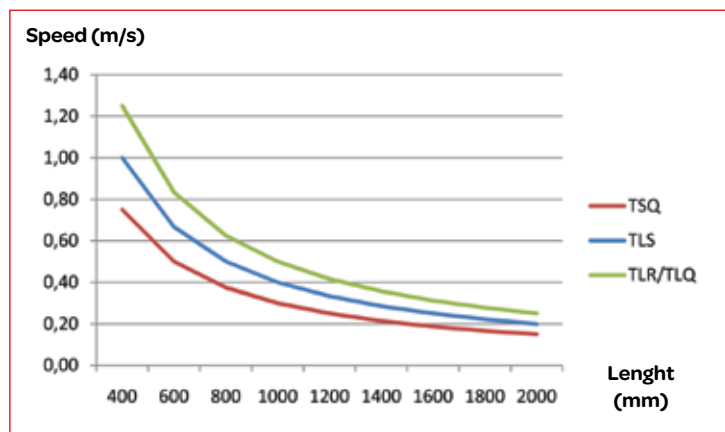
v = Speed of slide

Hereby short slides can operate at faster speeds than long slides.

The roller telescopic slides TLR, TLQ, TLA and TQA have strong impact stoppers, to provide the highest speed. The speed range is from 1m/s for the shorter slides to 0,2m for the longest slides. Besides highest speed, the roller telescopic slides are also the most silent and smooth moving slides due to the roller.

The strong ball-cage slides TLS offer a speed range of 0,8m/s for shorter slides to 0,2m/s for the longest slides.

The TSQ and SR slides are without any rubber inserts, just square pins, so metal against metal impact. The speed range is hereby lower; 0,6m/s for shorter slides to 0,1m/s for max. lengths.



Materials and treatments

The rails, except TLAZ-TLAX-TQAZ-TQAX slides are hardened steel profiles with T RACE NOX treatment, to provide a hardened surface, min 58HRC on all surfaces, an overall high corrosion resistance of the entire profile. The treatment provides unique long lasting telescopic slides, even for severe high frequency application and corrosive ambients. The T RACE NOX treatment is made in 3 steps :

- 1) High-depth nitriding hardening
- 2) Black oxidation
- 3) Impregnation in protective black mineral oil

The T RACE NOX treatment is done on the complete profile, leaving the rail a smooth matt black finish.

Materials	TLR	TLQ	TLRX	TLQX	TLS TSH	TSQ	TLSX TSHX	TSQX	TLAZ	TQAZ	TLAX	TQAX
Rails/ Profiles	Nitriding hardened steel, black (TRACE-NOX)				Nitriding hardened steel, black (TRACE-NOX)				Bright zinc plated steel		Stainless steel Inox AISI 304	
Intermediate element	Bright zinc plated steel	no	Stainless steel Inox AISI 304	no	Bright zinc plated steel	no	Stainless steel Inox AISI 304	no	Bright zinc plated steel	no	Stainless steel Inox AISI 304	no
Rotelle/ sfere	Core hardened 100Cr6 steel		Core hardened stainless steel Inox AISI 440C		Core hardened 100Cr6 steel		Core hardened stainless steel Inox AISI 440C		Core hardened 100Cr6 steel		Core hardened stainless steel Inox AISI 440C	
Rollers / balls	no				Bright zinc plated steel		Stainless steel Inox AISI 304					
Wipers	Polycarbonate elastomer				no				no	no	no	no
Lubricant sponge	Synthetic fibre with litium grease				no				no	no	no	no
Screws	Zinc plated steel		Stainless steel Inox		Zinc plated steel		Stainless steel Inox		Stainless steel Inox		Stainless steel Inox	
Element stoppers	Zinc plated steel - Nitrilic rubber		Zinc plated steel - Nitrilic rubber		Zinc plated steel - Nitrilic rubber	Stainless steel Inox	Zinc plated steel - Nitrilic rubber	Stainless steel Inox	Stainless steel Inox - Nitrilic rubber			
Roller seals	(Type 2RS) Neoprene				no				(Type 2Z) Zinc plated steel		(Type 2RS) Neoprene	
Inner bearing ball-cage	Polyamide				no				Zinc plated steel		Polyamide	

ADDITIONAL EXTERNAL STOPPERS

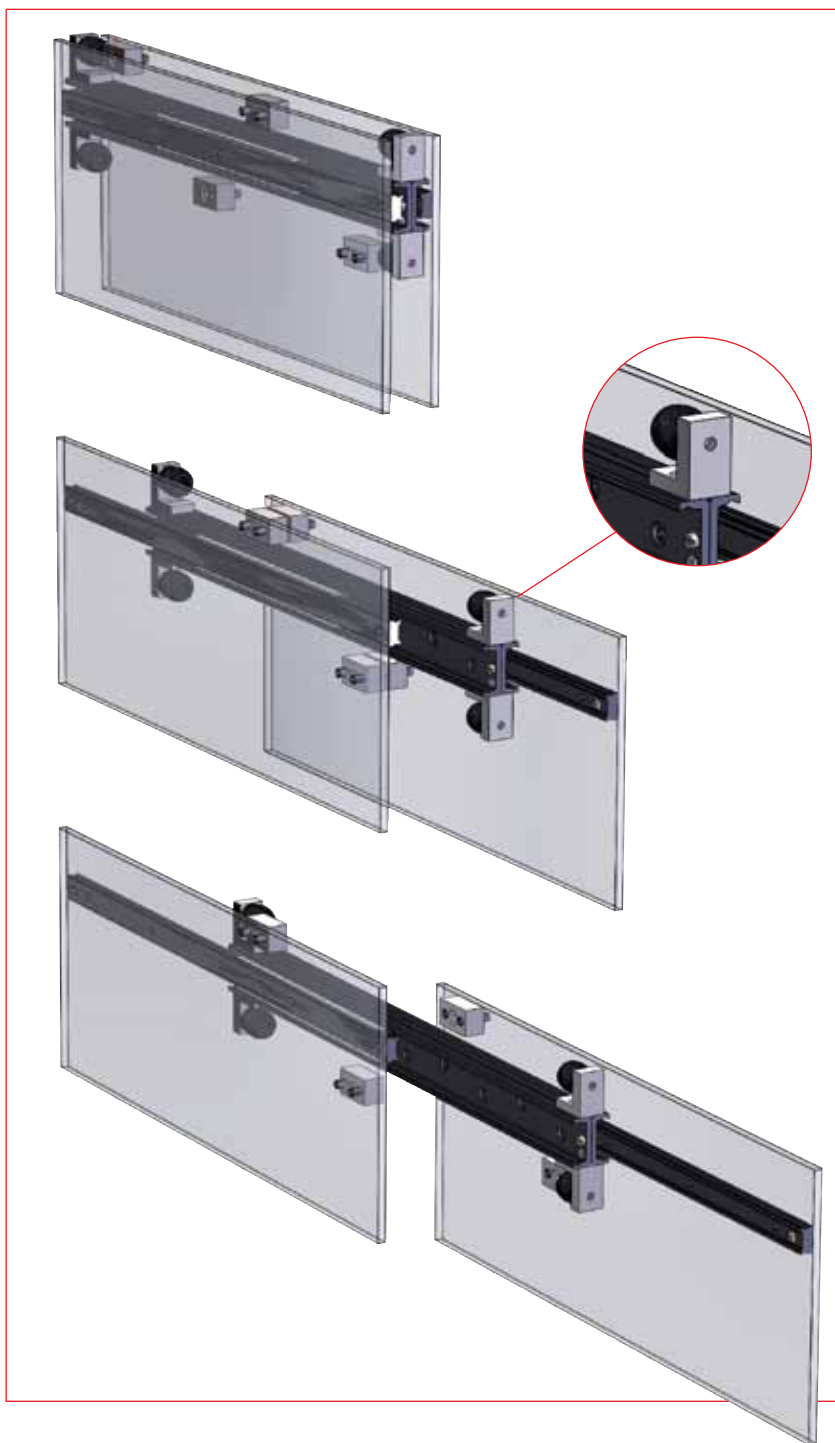
The use of telescopic slides require strong external movement end-stoppers, as the incorporated stoppers in all T RACE's sliders are solely designed to drag along the intermediate element, during opening/closing of the slides.

The dimensioning of external stoppers, depends on the total weight of mobile part and the speed of which it is being moved. T RACE's additional 8 end-stoppers provide an easy solution for good movement end-stoppers, which also are fast to install. The solution is based on 8 parts fixed, for which 4 are fixed to the intermediate element and remaining 4 installed on fixed and mobile structure. The shape of the strong rubber also provides a high damping property.

The advantages are :

- 1) The end-stopper system assures full stroke of the slide, unlike stopping system installed after on mobile and fixed structure. Such non-TRACE solutions tend to reduce full stroke with 30-60mm .
- 2) The end-stopper system provides a smooth and silent stopping at the reach of full extraction and closing, eliminating any metallic sound. at in impact.

For further technical data and dimensions, please contact T RACE's Technical dept.



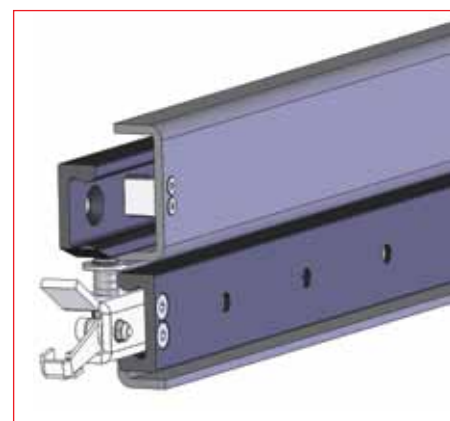
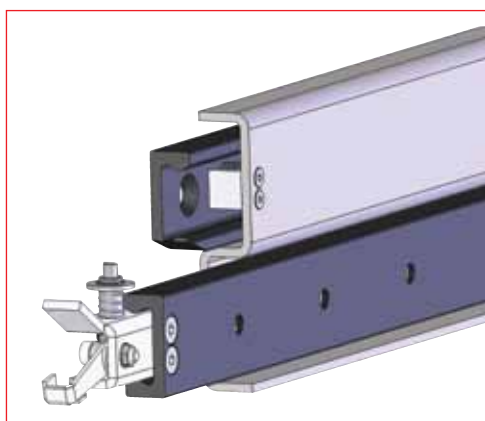
BLOCKING DEVICE FOR CLOSED POSITION

The telescopic slides TLS and TLR can include strong blocking device for closed position.

When closing, the mechanism fixed at mobile part, forces the robust spring-loaded pin to enter the upper rail, fixed to structure, to hereby assure a strong and safe blocking of the mobile part.

To release the blocking, the handle is manually pressed down.

For further data and dimensions, please contact T RACE's Technical dept.



SYNCHRONISATION OF THE INTERMEDIATE ELEMENT

The standard slides TLR, TLS, TSQ e TLQ can be provided as synchronised slides. The synchronization is obtained by mounting of pulleys and a strong belt fixed to standard slides. Hereby the slide will open/close, just by acting on the intermediate element.

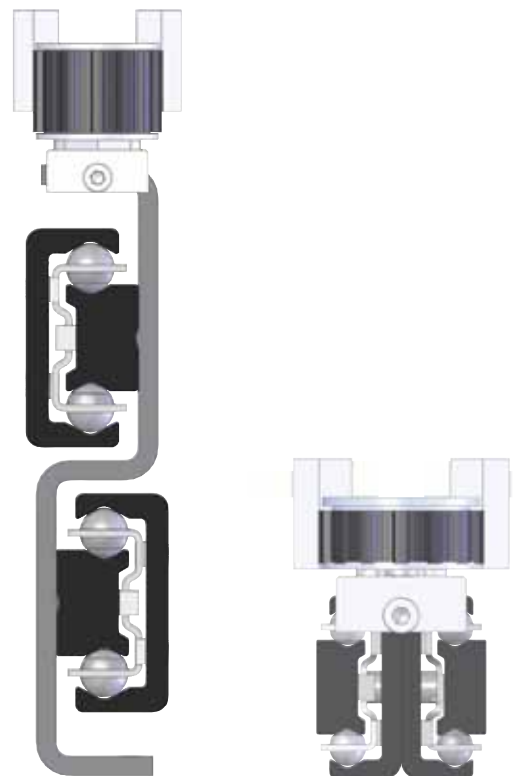
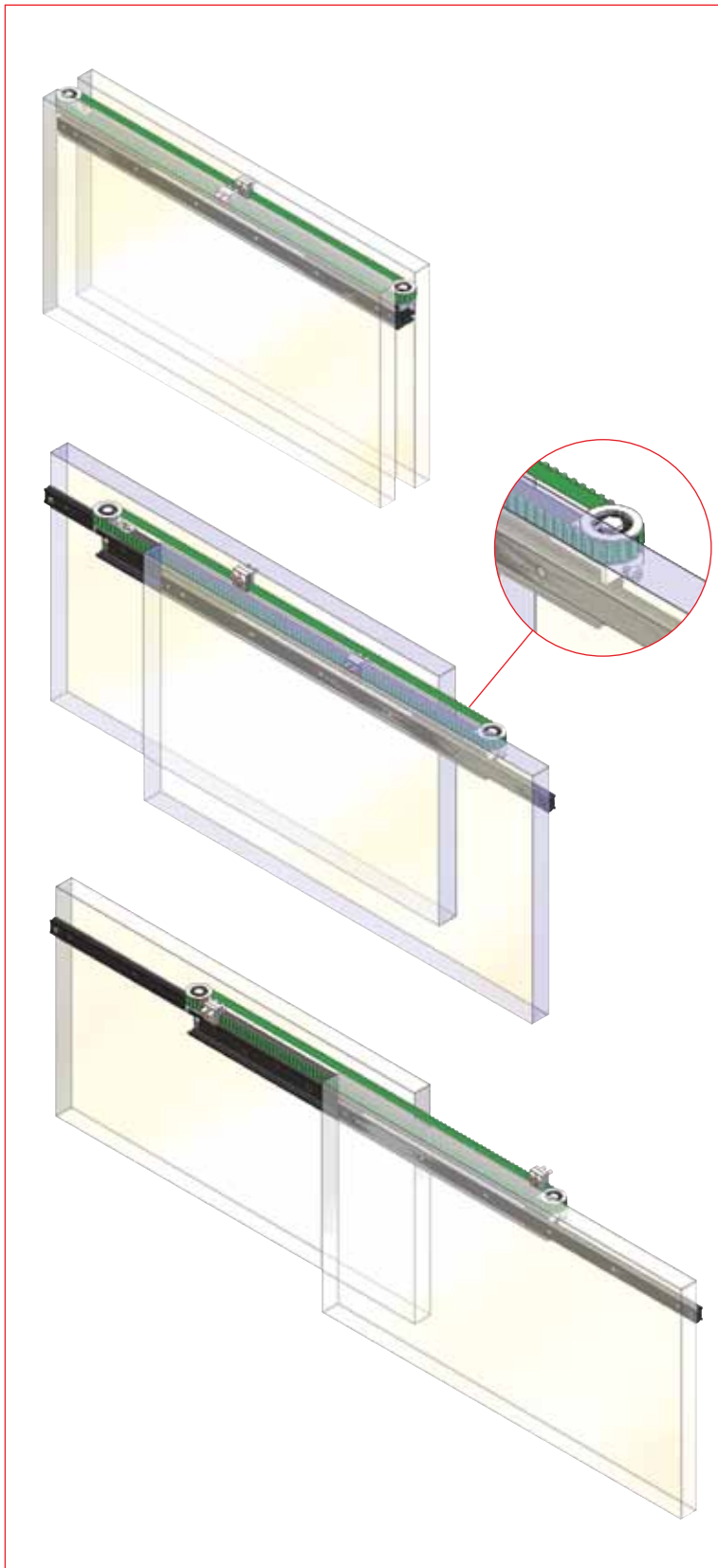
The advantages of this synchronization feature are :

- 1) Solve the problem of protruding element for double stroke applications with TSQ and TLS..D slides. See page 71.
- 2) Synchronized slides can reach max. speed 100% higher than standard version, as no impacts with intermediate element, ref. Page 76.
- 3) Very silent movement.
- 4) Possible to implement in high frequency telescopic applications, or automation at high speed.

Alternatively it is also possible to provide synchronized telescopic slides with "Rack & Pinion" movement.

Based on customized intermediate elements, like below, telescopic slides with much higher load capacities can be obtained.

Also slides with high rigidity in all directions for severe load conditions or applications demanding minimal flexion.

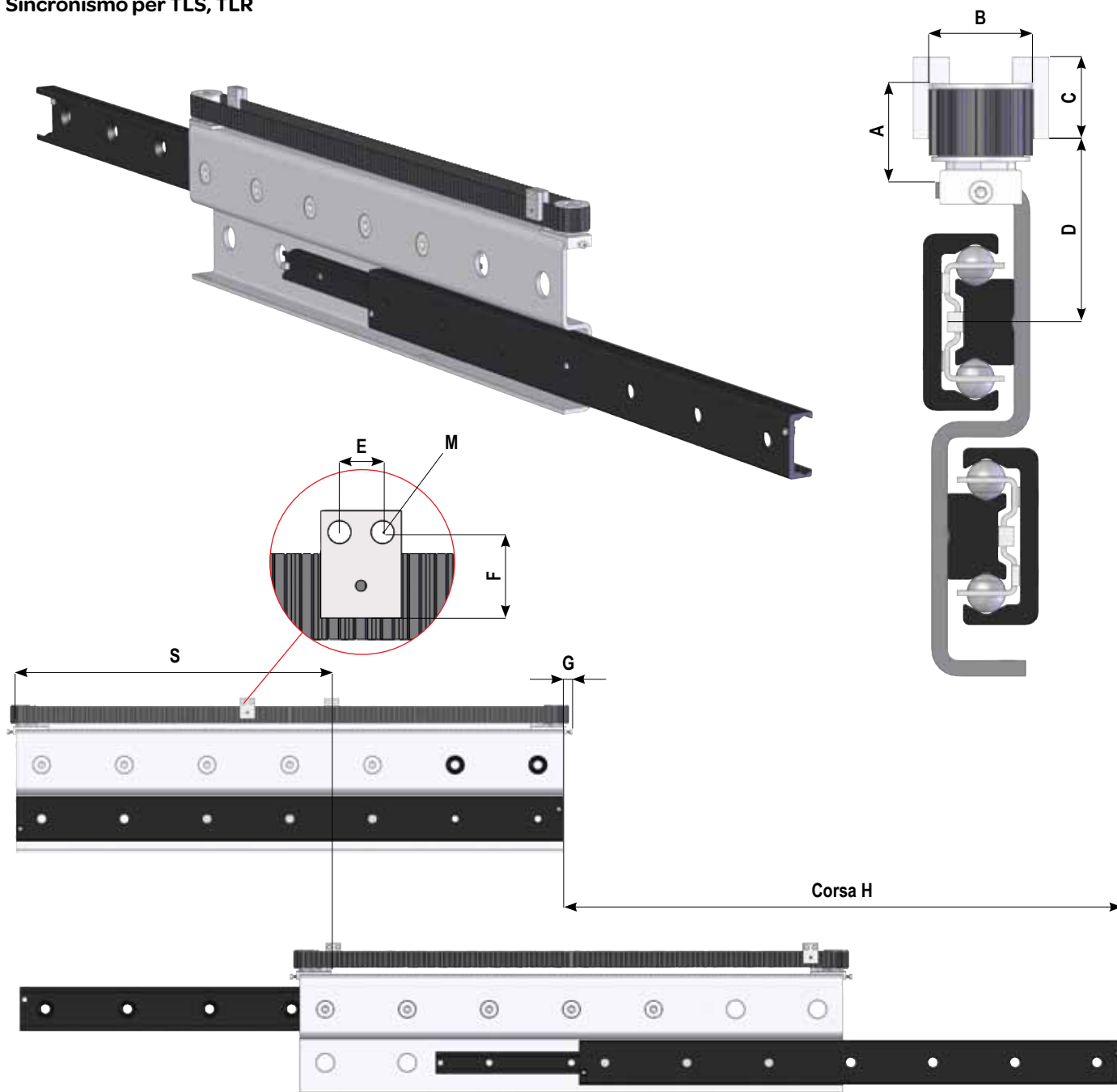


DESCRIPTION OF THE SYNCHRONISATION SYSTEM

The synchronisation system is composed of a pair of pulleys placed at the end of the telescopic slide connected by a pre-tensioned belt closed in a loop with two blocks gripping the belt placed on each of the two longitudinal sides of the belt. The two blocks must be fixed respectively on the fixed part and the movable part between which is interposed the telescopic slide. The system can be placed above or below the telescopic slide according to the availability of space occupied in the vertical plane as shown in table, while it is still contained horizontally in the thickness of the telescopic slide. To mount the system, in addition to the normal fixing holes of the guide, fixing holes must be arranged for lock gripper belt to be placed in the position shown in the table.

The pulleys are mounted on an adjustable slide that enables the adjusting of the preload of the belt according to the needs. The system must be ordered with the telescopic slide as desired. Even though the synchronization system is an additional device to add to the standard telescopic slide its application requires the

Sincronismo per TLS, TLR



Code	A	B	C	D	E	F	G	M	S	Stroke	Width of the belt AT5
TLS43SY	24	26	24	40,4	8	20	10	Hole for screw M4	L/2+40	H	16
TLR.43SY				38,4					L/2		
TLS43DSY				40,4					L/2		

execution of some specific holes on the intermediate beam of the telescopic slide. The device of synchronism, when it is used with a double-stroke telescopic slide, reduces the nominal stroke H listed in the catalog as shown in the table below.

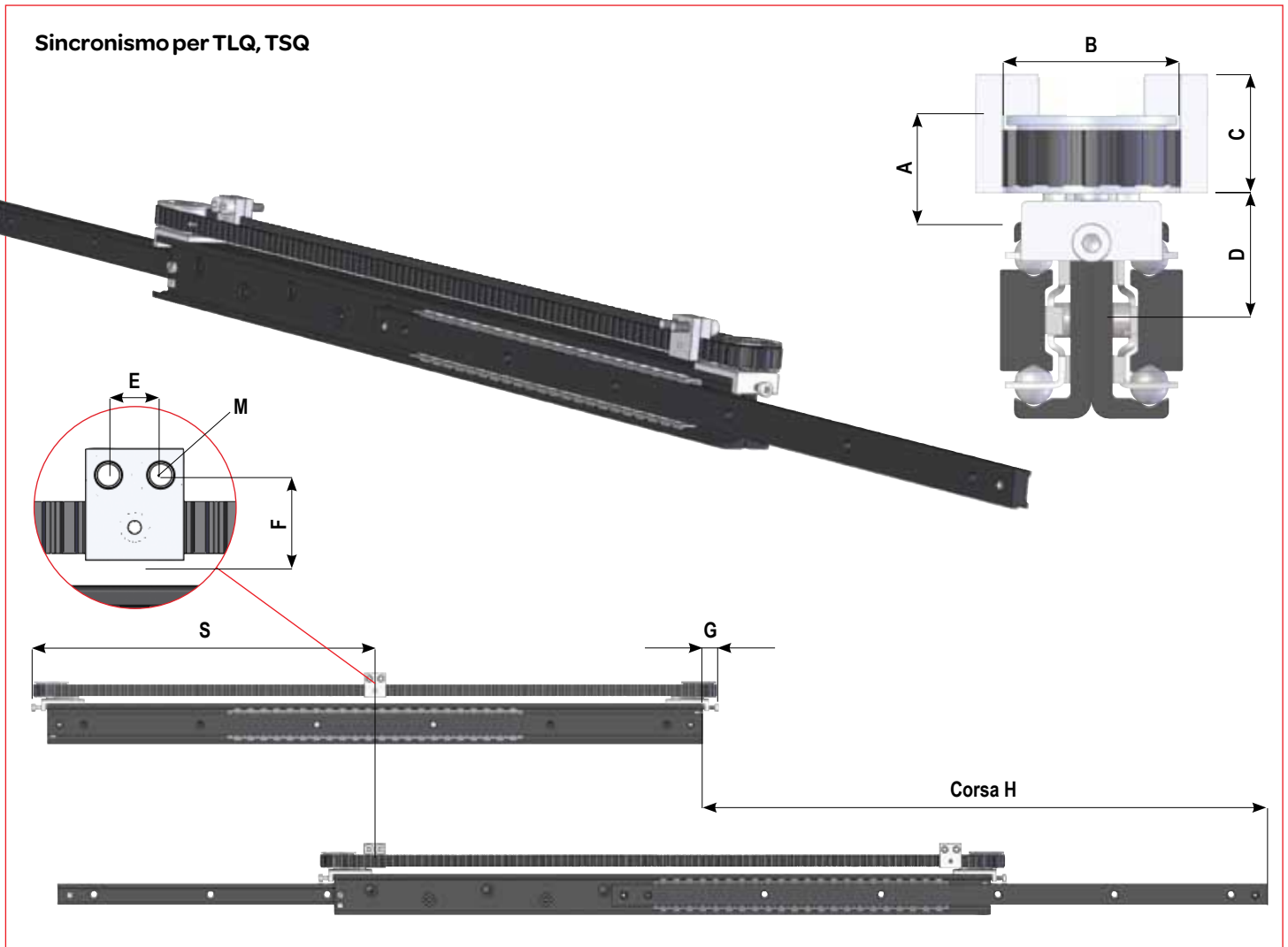
The synchronization system does not have the function of limit stop of the movement of extraction and closing of the application, so it is necessary to provide adequate appropriate external stoppers sized as a function of the weight and speed of the moving part.

The ordering of the rail with synchronism is obtained by adding the suffix SY to the code of the standard guide.

Example:

- Standard Guide **TLS43-1650**

- with synchronism **TLS43SY-1650**



Code	A	B	C	D	E	F	G	M	S	Stroke	Width of the belt AT5
TSQ..28.SY (single stroke)	15	26	17	18	8	13	10	Hole for screw M4	L/2+35	H	8
TSQ..28.SY (double stroke)									L/2	L-70	
TLQ..28SY	24	26	24	27,9	8	20	10	Hole for screw M4	L/2+35	H	16
TSQ..43.SY (single stroke)									L/2+40	H	
TSQ..43.SY (double stroke)									L/2	L-80	
TLQ..43SY									L/2+40	H	

Operating temperature

The limitation of operating temperature is mainly based on a few plastic/rubber components.

The slides **TLS, TLQ, TSQR, TLR, TLA** and **TQA** may operation in a temperature range from -20 to +110°C.

The slides SR and TSQ which are without any plastic/rubber components may function properly even with temperature of 300°C as non property alteration of the nitriding hardened steel. Too possible with TLS slides, when removing the rubber stoppers, and used for slow speed applications.