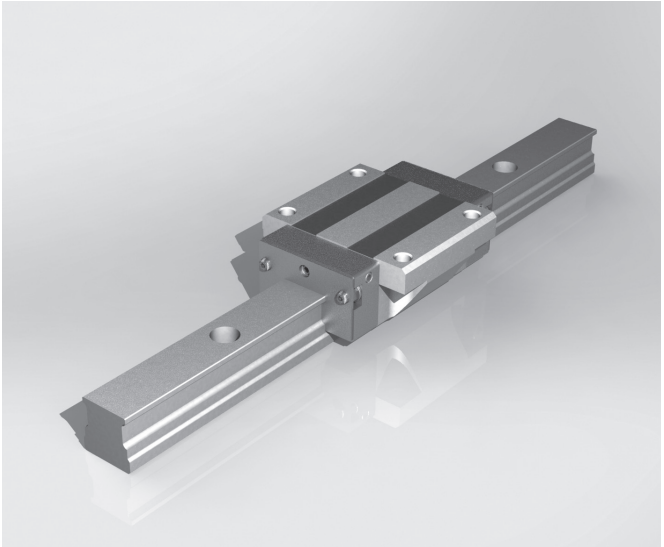
1 TBK LINEAR GUIDES

TBK linear guides are a high precision motion systems based on a recirculating ball technology that gives at the same time high rigidity and low friction features. TBK linear guides are small and light systems able to withstand high loads while meeting the accuracy requirements.

1.1 Main characteristics/features

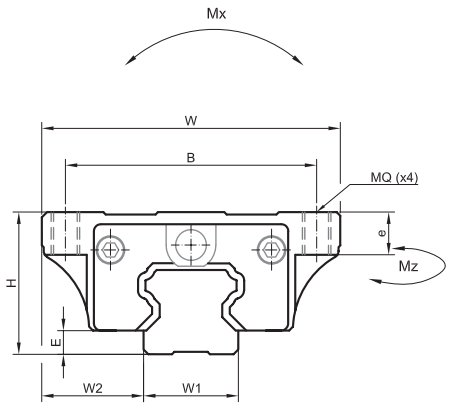
The main features of TBK linear guides are:

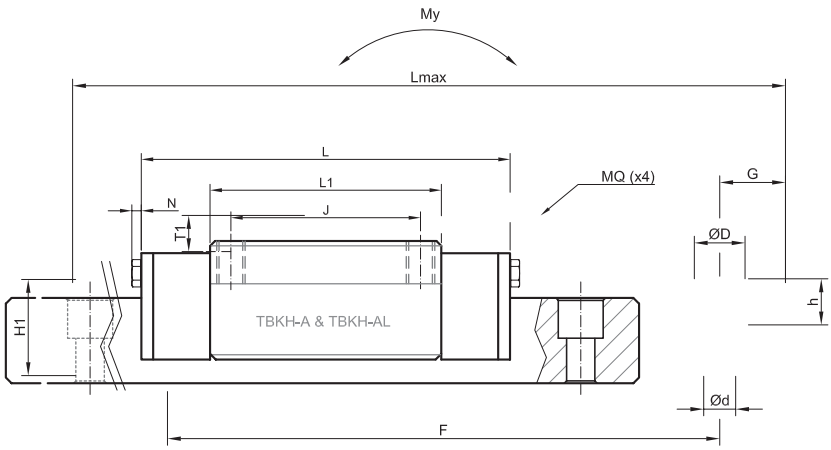
- High accuracy
- Dimensions follow the standard
- Smooth running with low friction
- Low noise at high speeds
- Low maintenance
- High rigidity
- Long life
- Easy installation
- Clean operation



1.2 Main dimensions (for components exchange)

The main dimensions to take into account when interchanging components are the ones listed below.





- **H:** Total Height
- **W:** Total Width
- **L:** Length of block
- **L1:** Block body length
- **BxJ:** Hole distribution dimensions
- **MQ:** Hole dimension and length in block
- **W1:** Rail width
- **F:** Pitch of the rail
- **dxDxh:** Hole diameter and size in the rail
- **G:** Distance from end of rail to first hole

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1.3 Choice of TBK linear guide system

For a proper selection of a TBK linear system it is recommended to follow the procedure described below:

1. Determine the desired accuracy according to the machine where the linear guide is going to be installed
2. Decide the maximum or minimum dimensions and the system shape
3. Determine the loading conditions
4. Determine the operating speed
5. Determine the environmental conditions
6. Pre-select the size and number of linear systems
7. Calculate the load applied to each system
8. Check the allowable axial load and the allowable tilting moment for the unit chosen and the corresponding safety factor
9. Check the rated life and compare it with the required life
10. Confirm that the clearance chosen is the one needed for the equipment

1.4 Accuracy Selection

The accuracy is one of the main parameters to be chosen depending on the application. In the table below different applications can be seen with the accuracy recommended for each one.

		Accuracy grade				
	Application	**N**	**H**	**P**	**SP**	**UP**
MC Machine tools	Machining Center			●	●	
	Lathe			●	●	
	Milling Machine			●	●	
	Boring Machine			●	●	●
	Jig Borer				●	●
	Grinding Machine			●	●	●
	Electro-discharge Machine (EDM)		●	●		
	Punching press machine		●	●		
	Laser cutting machine	●	●	●		
	Wood Working Machine	●	●	●		
	NC Drilling Machine		●	●		
	Milling Center		●	●		
	Packaging machine	●				
	ATC	●				
	Wire cut machine		●	●		
	Grinding wheel machine			●	●	

		Accuracy grade				
	Application	**N**	**H**	**P**	**SP**	**UP**
Robot industrial	Orthogonal type	●	●			
	Multi-joint type	●	●			
Semiconductor Machine	Wire Bonder		●	●		
	Prober			●	●	
	Inserter Machine	●	●			
	PBC driller	●	●	●		
MC Machine tools	Injection Molding Machine	●	●			
	Measuring Machine		●	●	●	
	Business machine	●	●			
	Transporting Machine	●	●			
	X-Y table	●	●	●		
	Painting Machine	●	●			
	Welding Machine	●	●			
	Medical equipment	●	●			
	Digitizer	●	●	●		
	Test equipment		●	●	●	

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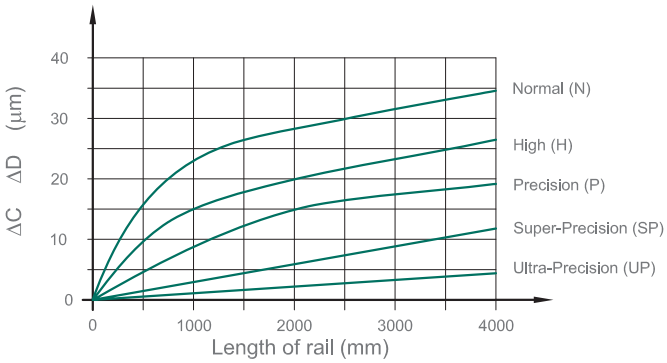
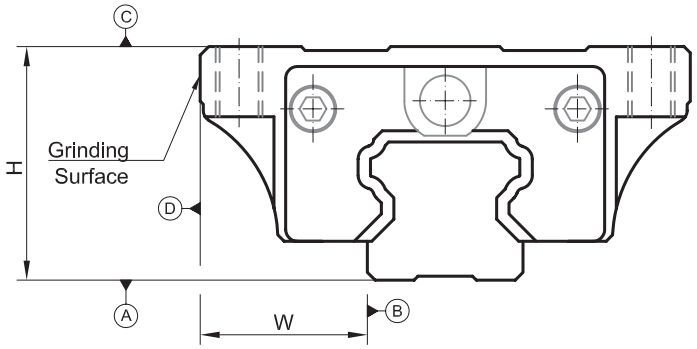
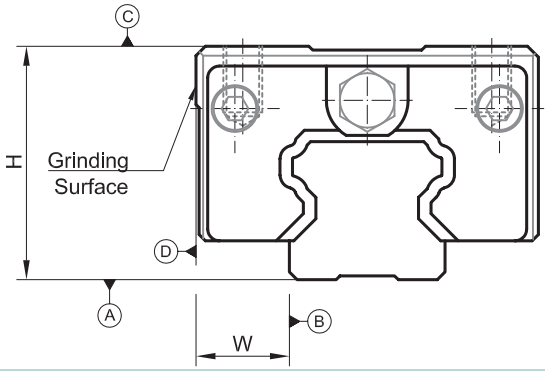
	GRADE				
	Normal (N)	**High (H)**	**Precision (P)**	**Super-precision (SP)**	**Ultra-Precision (UP)**
Tolerance of height (H)	±0,1	±0,04	0 -0,04	0 -0,02	0 -0,01
Tolerance of width (W)	±0,1	±0,04	0 -0,04	0 -0,02	0 -0,01
Difference of heights (DH)	0,03	0,02	0,01	0,005	0,003
Difference of widths (DW)	0,03	0,02	0,01	0,005	0,003

The parallelism of the block surface C with respect of surface A is shown in the following graph as ΔC.

The parallelism of the block surface D with respect of surface B is shown in the following graph as ΔD.







1.5 Calculation

All the linear guides are always submitted to rated loads and tilting moments. To prevent the possible deformation or vibrations when using a linear guide a maximum allowable load is given.

The basic static load rating C0 refers to the static load that results in the maximum allowable stress at the center of the contact surface between the rolling elements and the rolling surface.

The basic dynamic load rating C represents the allowable load that could withstand the system for a certain distance travelled (50.000m). This value is determined statistically and is defined as the distance that 90% of the linear systems are able to travel before flaking.

When high rigidity and high precision are required for the application it is recommended to use a preloaded linear system. All the previous values can experience some changes when a preload force is applied. The load capacity of the linear systems varies according to the table below.

Grade	Symbol	Preload Force
Clearance	ZF	0
No Preload	Z0	0
Light Preload	Z1	0.02C
Middle Preload	Z2	0.05C
High Preload	Z3	0.07C

1.5.1 Contact factor (cf)

When two or more blocks are mounted together in the same rail it's difficult to know the axial load and tilting moment applied to each block. To avoid these hard calculations a contact factor is considered depending on the number of blocks which are going to be mounted together.

Number of blocks in close contact	Contact factor (cf)
Normal operation	1
2	0.81
3	0.72
4	0.66
5	0.61

1.5.2 Static load calculation / Safety factor (sf)

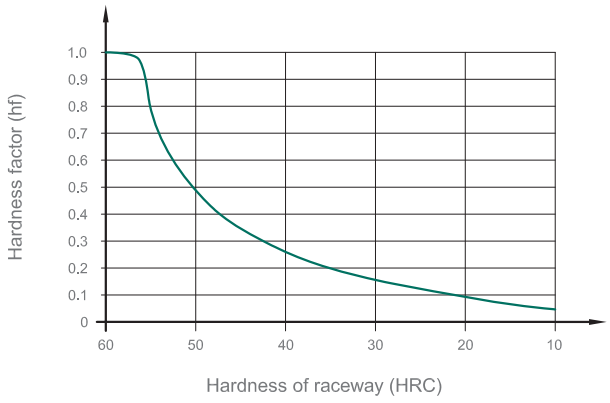
To ensure that the system chosen is the proper one for the application considered, the following calculations have to be performed to find the safety factor with which the system will work.

Depending on the operation conditions a minimum safety factor has to be reached according to the table below.

Operating condition	Load condition	Minimum sf
Normally static	Small impact and deflection	1.0 ~ 1.3
	Impact or twisting load applied	2.0 ~ 3.0
Normally moving	Small impact or small twisting load applied	1.0 ~ 1.5
	Impact or twisting load applied	2.5 ~ 5.0

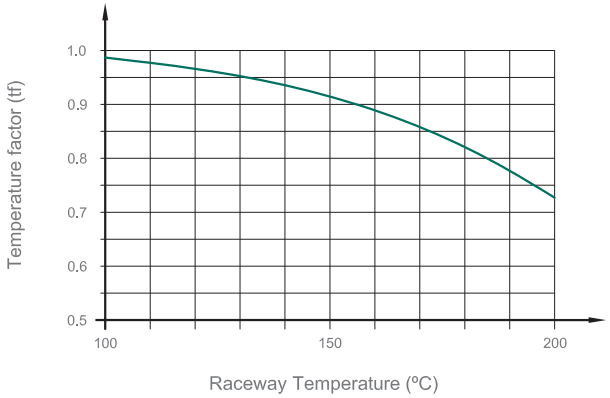
1.5.3 Hardness factor (hf)

The hardness of the guide rail is an important value to take into account because it plays an important role in determining the rated load. For values below the 58HRC the rated load should be multiplied by the corresponding hardness factor according to the graph.



1.5.4 Temperature factor (tf)

The temperature at which the linear system will be exposed may also influence on the allowable rated load. For temperatures above the 100ºC the life of the system is shortened, so a temperature coefficient has to be considered following the table.



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1.5.5 Load factor (wf)

Some other operation conditions like speed, impacts or vibrations have to be considered when calculating the load applied to each system. For an easier calculation these conditions are represented by a load factor shown in the table below.

Impacts and vibrations	Speed (v)	Measured vibration (G)	wf
Without external Impacts or Vibrations	At low speed v < 15m/min	G ≤ 0.5	1.0 ~ 1.5
Without significant Impacts or Vibrations	At medium speed 15 < v < 60m/min	0.5 < G ≤ 1.0	1.5 ~ 2.0
With external Impacts or Vibrations	At high speed v > 60m/min	1.0 < G ≤ 2.0	2.0 ~ 3.5

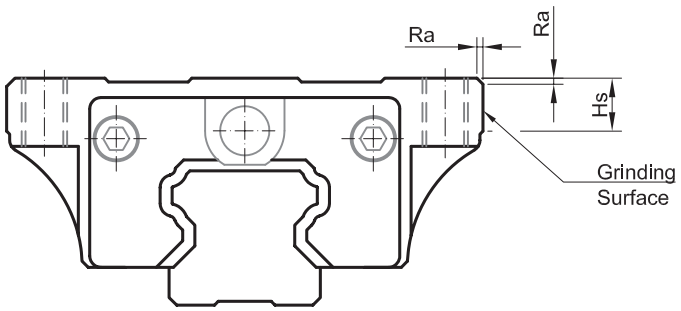
1.5.6 Dynamic load calculation / Nominal Life

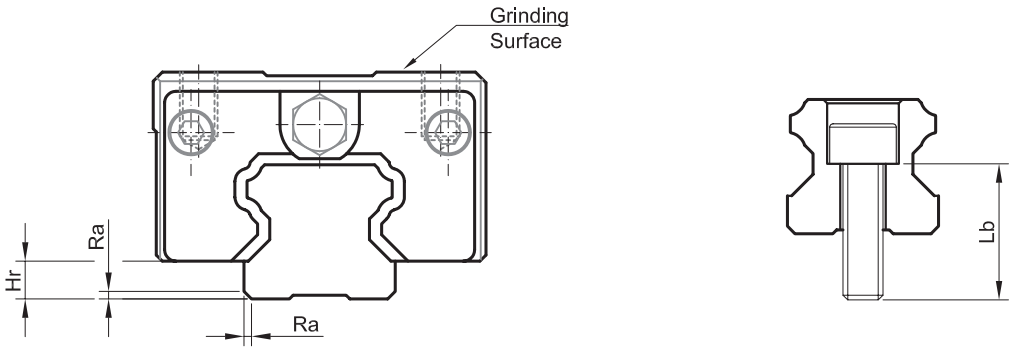
From all the factors chosen in the previous sections and the following formula the rated life of the linear system can be calculated in kilometers that can be traveled before faking.

$$L\,(km) = 50 \cdot \left(\frac{Hf \cdot Tf \cdot cf}{Lf} \cdot \frac{C}{P} \right)^3$$

1.6 Assembly recommendations

	TBK-15	TBK-20	TBK-25	TBK-30	TBK-35	TBK-45	TBK-50
Maximum fillet (Ra)	0.8	0.8	1.2	1.2	1.2	1.6	1.6
Maximum Height rail shoulder (Hr)	4	4.5	6	8	8.5	12	13
Maximum height block shoulder (Hs)	5	6	7	8	9	11	12
Rail Bolt length suggestion (Lb)	M4x16	M5x20	M6x25	M8x30	M8x30	M12x40	M14x45





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1.7 Ordering References

Block

TBK	Serie	Size	Type	Precision	Preload
	H: International Standard **S:** Low assembly	*15* *20* *25* *30* *35* *45* *55*	**A:** With flange **AL:** Long type with flange **B:** Without flange **BL:** Long type without flange **BS:** Short type without flange	**N:** Normal **H:** High **P:** Precision **SP:** Super-precision **UP:** Ultra-precision	**ZF:** Clearance **Z0:** No preload **Z1:** Light preload **Z2:** Middle preload **Z3:** Heavy preload

Rail

TBKR	Size	Lenght	Hole	Join Rail Track
	15 *20* *25* *30* *35* *45* *55*	*From 200...4000 mm. (1 mm. steps)*	**D0:** Standard hole (Standard hole distance. The distance of the first and last attachment holes is produced equidistantly) **F0:** Standard hole (Standard hole distance. The distance of the first and last attachment holes is not produced equidistantly). **D4:** Blind hole (Standard hole distance. The distance of the first and last attachment holes is produced equidistantly) **F4:** Blind hole (Standard hole distance. The distance of the first and last attachment holes is not produced equidistantly)	**A:** Yes **O:** No