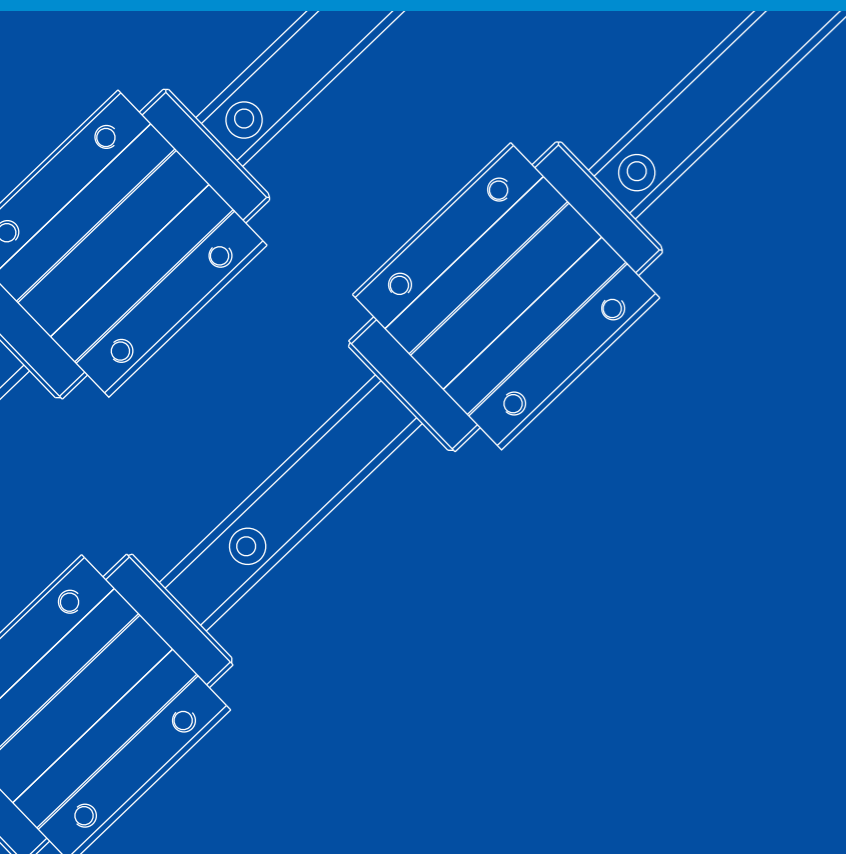




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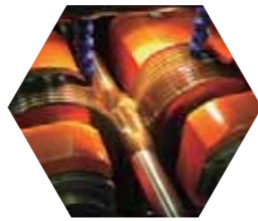
MINIATURE LINEAR GUIDE CATALOG



2013/04-2000

Note : The appearance and specification may be changed without prior notice only if the requirement improves performance.

LINEAR GUIDE



● 1986



Taiwan Ball Screw Industrial Co.,Ltd. ( *TBI* ) was established in Tucheng Industrial District, Taipei, Taiwan. We were also the first manufacturer who produces ground type of precise ball screws in Taiwan.

● 1988

TBI established Research & Development Department and finished constructing the factory in Taichung that focuses on innovative products and producing precise grinding ball screws.

● 2002



**COMTOP** was established and exported ball screws to world wide based on a professional and successful marketing sales system.

● 2010



( *TBI MOTION* ) has integrated the technology of *TBI* and the marketing strategy of **COMTOP** to develop *TBI MOTION* in a leading place of Linear Motion Industry. The main products are Ball Screws, Linear Guides, Ball Splines, Single Axis Robot, Linear Ball Bearing, Couplings, and Ball Screw Accessories... etc.



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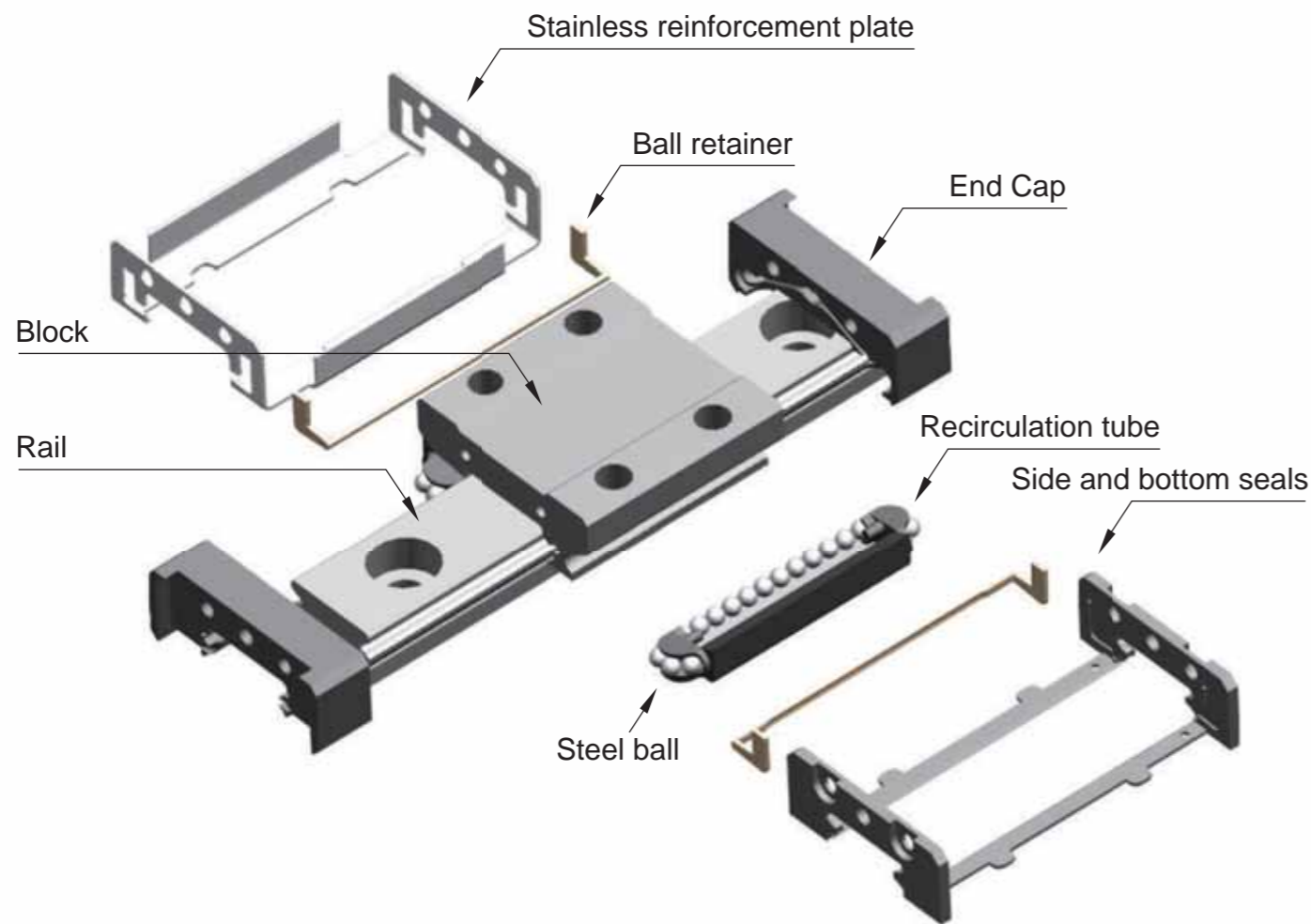
### 3. Miniature Linear guide

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### 1-1 TBI Motion miniature linear guide

#### 1-1-1 Introduction

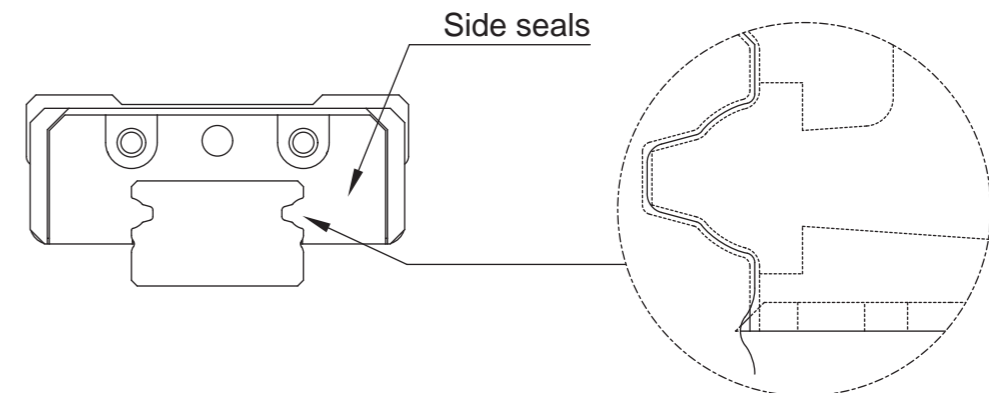


Recirculation system: End cap + Recirculation tube + ball retainer  
 Sealing system: Side + bottom system

### 1-2 TM Sealing system

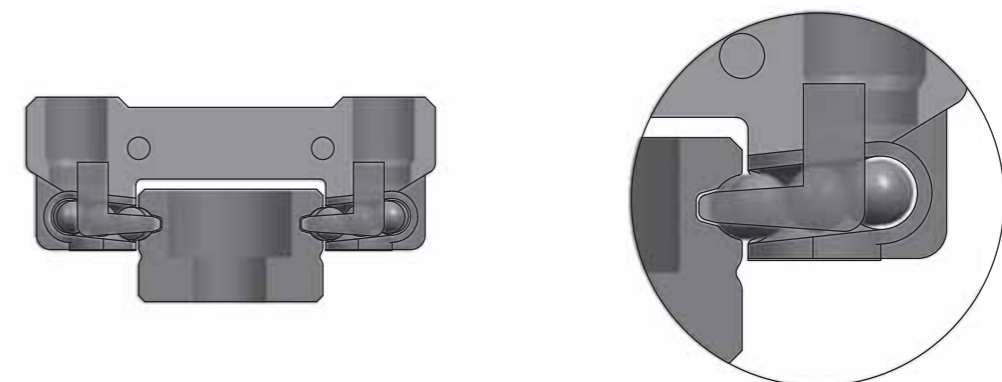
#### 1-2-1 Bottom sealing plate

The stainless bottom seal is the innovative new design of TBI Motion TM-N series. It prevents effectively the abnormal chips getting into the ball track from the bottom side of the slider and keep the good running performance and extend the life time of the slider because the friction is low by keeping some small backlash between the slider and rail.



#### 1-2-2 Design of recirculation track

The recirculation hole and track is composed of sealed plastic frame and end cap. By simplifying the structure of the slider, we can reduce the contact area and impact of steel balls and steel component. Therefore, we can lower the noise level effectively. The special design of oil tank inside the recirculation track extend the lubrication cycle longer than normal.



### 1-3 High tensile performance stainless steel reinforcement plate

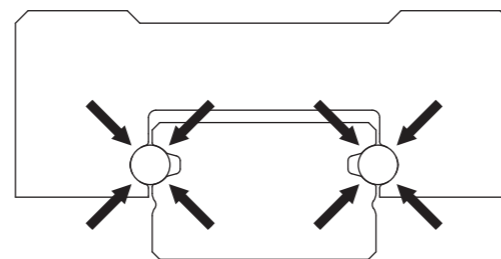
#### 1-3-1 TM-N (7M / 9M/W . 12M/W . 15M/W)

Dual fully covered stainless steel plates design delivers the best coverage for plastic on each ends. Stainless steel screws are used to strength the rigidity, protection with end cap in order to sustain higher operational speed  $V_{max}=5m/s$ ,  $a_{max}=300m/s^2$ , When linear block is equipped with reinforcement plates and anti-dust seal, it can also function as scraper.



#### 1-3-2 High loading and moment capacity performance

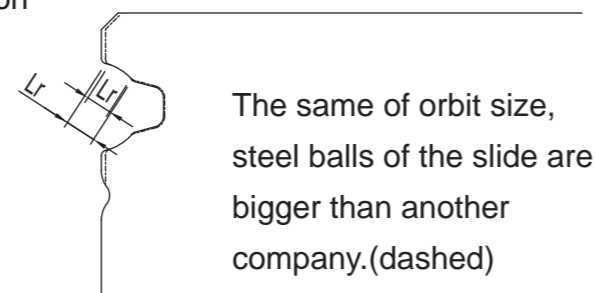
TM Miniature Linear Guide series uses two row re-circulating methods with Gothic 45° contact angle on the rail groove to achieve equal load capacity in four directions. Larger steel balls are used to enhance the loading and torsion resistance performance in limited space.



The Gothic 45 degrees four-direction load structure

#### 1-3-3 Anti-dust design

Standard end seal provide extreme protection from dust, metal scraps to maintain long service life and lower maintenance period. Unique low friction seal lips provide best smoothness and lower friction.



The same of orbit size, steel balls of the slide are bigger than another company.(dashed)

### 2-1 Accuracy

#### Accuracy

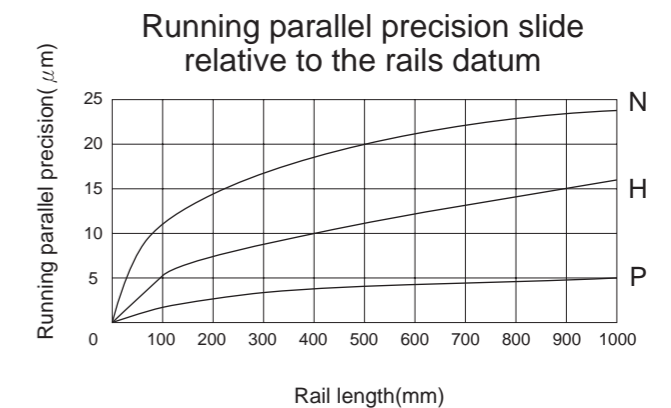
■ Accuracy level  
TM Miniature Linear Guide provide three accuracy grades for customer to choose.

Accuracy ( $\mu m$ )	tabulation		
	Precision P	High H	Normal N
Tolerance of Height H	$\pm 10$	$\pm 20$	$\pm 40$
Variation of height with different block on same spot of the rail	$\Delta H$ 7	15	25
Tolerance of width $W_2$	$\pm 15$	$\pm 25$	$\pm 40$
Variation with width on different block on same spot of the rail	$\Delta W_2$ 10	20	30

#### Operational speed

The extreme operational speed for TM-N can reach  $V_{max}=3m/s$ ,  $a_{max}=250m/s^2$  ( $40/ms^2$  before preload).

The maximum acceleration of TM-N can reach  $V_{max} > 5m/s$ ,  $a_{max}=300m/s^2$  ( $60/ms^2$  before preload).



## 2-2 Preload

- Preload  
TM Miniature Linear Guide offers three preloading level which are ZF, Z0, Z1. A proper preloading will enhance performance on stiffness, precision, and torsion resistance; however an un proper preloading will lower service life and increase friction.

Table

Preload grade	Pressure	Preload(μm)				Applications
		7	9	12	15	
ZF	Zero Preload	+4~0	+4~0	+5~0	+6~0	Running smoothly
Z0	Slight Clearance	+2~0	+2~0	+2~0	+3~0	Precision applications, Running smoothly
Z1	Light Preload	0~3	0~4	0~5	0~6	High steel, Precision applications, Running smoothly

- Permissible Operational Temperature

The TM Miniature Linear Guide is sufficient to operate between -40 ~ + 80 .  
For sudden temperature rise the temperature can reach up to +100 .

## 2-3 Lubrication

### Effect of lubrication

When a linear guide is well lubricated, the contact point between rail and rolling steel balls will be separated by 1 micro meter. Therefore, a good lubrication provides:

- Lower friction
- Prevent from corrosion
- Lowering the ware
- Prevent from overheating to increase service life

### Note need to pay attention when apply lubrication

- Rail and block must be prelubricated before any operation. Avoid any pollutants.
- The block should running back and forth when applying lubrication
- Manual and auto lubrication can be applied on the rail with miniature linear guide.
- TBI linear block provide seal through hole design in order for the steel balls to carry oil when circulating.
- The surface of rail should always maintain a thin layer of lubrication.
- Re-lubrication should be applied before deform or decay of the lubrication.
- Contact TBI service window when lubrication is perform in clean room, acidic environment.
- When linear guide is not mounted on horizontal, lubrication should take mounting methods into consideration.
- If travel stroke is two times shorter than length of block or 15 larger, lubrication period should repeat more frequent.

### Grease lubrication

When grease is applied, lithium soap grease with viscosity between ISO VG32-100 is suggested.

### Oil lubrication

DIN51517 CPL, CGLP or DIN51524-HLP is suggested when operation temperature between 0C~+70C, ISO VG32-100 is suggested. (ISO VG10 is recommended when running under low temperature)

## 2-4 Lubrication notions

### Lubrication notions

- Re-lubrication should be applied before deform or decay of the lubrication.
- Refer to the table 1 for the thickness of primarily lubrication. When using liquid form lubrication, the amount of lubrication should be applied till full.
- Re-lubrication should be applied when operation temperature remain, block should also running back and forth when applying lubrication.

Table1

Model	Lubrication amount (cc)	Model	Lubrication amount (cc)
7MN	0.3	9WN	0.4
7ML	0.4	9WL	0.6
9MN	0.4	12WN	0.9
9ML	0.6	12WL	1.3
12MN	0.9	15WN	1.4
12ML	1.3	15WL	2.0
15MN	1.4		
15ML	2.0		

### Relubrication period

- Relubrication period varies from working environment, loading and side load. Relubrication period should under cautious monitoring.
- Relubrication period should be no less than a year.
- Water coolant should not apply on rail.
- Lubrication can be injected through both ends on oil hole. Injection can be purchased from TBI.
- Lubrication should be 1/2 of thickness of primarily lubrication.
- Lubrication period would be maintaining periodical than one time maintenance.

- Relubrication should be applied when operation remains.
- Minium stroke should maintain four times than the block length.

## 2-5 Types of lubrication

### Grease

When a linear guide is well lubricated, the contact point between rail and rolling steel balls will be separated by 1 micro meter. Therefore, a good lubrication increases the life of linear guide.

### Clean room lubrication

Suitable for low dust environment.

### Lubrication

General usage, ISO V32-68.

Special Oil needs by *TBI MOTION*



Lubricant	Classification	Item
Grease	Lithium-based grease (JS No.2) Urea-base grease (JS No.2)	* 4FB Grease (TBI MOTION) Albania Grease No.2 (Showa Shell Sekiyu) Daphne Eponex Grease No.2 (Idemitsu Kosan) or equivalent.
No dust	Special synthetic oil	Kluber-NCA52 Multemp -or equivalent. NSK-LGU THK-AFE
Oil	Sliding surface oil or turbine oil ISOVG32~68	Super Multi 32 to 68 (Idemitsu Kosan) Vactra No.2S (Mobile Oil) DT Oil (Mobile Oil) Tonner Oil (Showa Shell Sekiyu) or equivalent

Feeding Should be performed every 100km of travel under normal usage conditions to prevent incomplete lubrication by exhausted lubrication.

## 2-6 Friction

### Friction

The TR Miniature Linear Guide series have low friction characteristics , with a stable and minor starting friction.

Friction		End Seal under lubrication		
$F = \mu \cdot N$ _____(1)	N Load(kgf)	TM Model	Friction with End Seal under lubrication(Nmax) (Under lubrication)	
			M	W
		7	0.1	
	F Friction(kgf)	9	0.1	0.8
		12	0.4	1.0
		15	1.0	1.0

TR Miniature Linear Guide series friction Factor is  $\mu=0.002\sim0.003$  approximately

### Sealing system

- Collision between the balls during operation.
- Collision between the balls during the return path.
- Of the balls in the Gothic arch load zone.
- Resistance from the churning of the lubrication in the runner block.
- Ball run crowding out resistance lubricant arising.
- Interfered objects.

## 2-7 Load capacity and rating life

### Static load rating $C_0$

The static load align the acting direction ; under this loading , the maximum calculated stress at the rolling elements and the raceway by:

a curvature radius 0.52 is 4200 MPa

a curvature radius 0.6 is 4600 MPa

Note: at this contact point under such stress , a permanent total deformation is generated corresponding to about 0.0001 times of the rolling element diameter.

(The above is according to ISO 14728-2)

### Static load safety factor calculation

$S_0 = C_0 / P_0$ _____(11)	Operation condition	$S_0$
$S_0 = M_0 / M$ _____(12)	Normal operation	1~2
$P_0 = F_{max}$ _____(13)	Load with vibration or impact	2~3
$M_0 = M_{max}$ _____(14)	High accuracy and smooth running	3

### Static Load $P_0$ and moment $M_0$

Permissible static load the applying static load of the miniature linear guide is limited as follows:

- The static load the miniature linear guide.
- The permissible load of the fixing screws.
- The permissible load of the related parts of the mechanism.
- The static load safety factor required for application.

The equivalent static load and static moment are the largest load and moment , refer to formulas (13) and (14).

### Static load safety factor $S_0$

Under the static load safety factor , the linear guide system demonstrates a reliable operation and running accuracy as required in application. The static load safety factor  $S_0$  is calculated by the formulas (11) and (12).

$S_0$  static load safety factor.

$C_0$  basic static load in action direction kgf

$P_0$  equivalent static load in action direction kgf

$M_0$  basic static torque in action direction kgf · m

$M$  equivalent static torque in action direction kgf · m

## 2-7-1 Dynamic load rating C100B

When the dynamic loads are applied normal to the lead zones with constant magnitude and direction , theoretically ; the rating life of the linear guide can reach 100km of travel distance.(The above is according to ISO 14728-1)

### Rating life calculation

$$C_{50B} = 1.26 \cdot C_{100B} \quad \text{--- (2)}$$

$$C_{100B} = 0.79 \cdot C_{50B} \quad \text{--- (3)}$$

$$L = \left( \frac{C_{100B}}{P} \right)^3 \cdot 10^5 \quad \text{--- (4)}$$

$$L_h = \frac{L}{2 \cdot s \cdot n \cdot 60} = \frac{L}{V_m} \cdot \left( \frac{C_{100B}}{P} \right)^3 \quad \text{--- (5)}$$

L = Rating life for travel distance 100km (m)

L<sub>h</sub> = Rating life (h)

C<sub>100B</sub> = Dynamic load rating(N)

P = Equivalent load(N)

s = Length of stroke(m)

n = Stroke repetition (min<sup>-1</sup>)

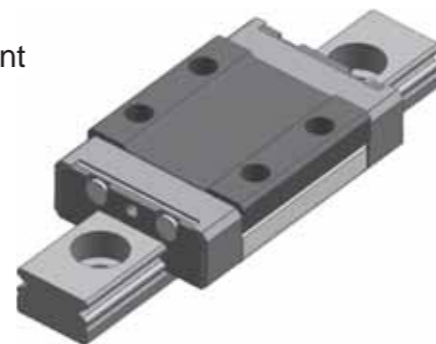
V<sub>m</sub> = Average speed (m/min)

### Rating Life L

And individual Linear Guide or a batch of identical Linear Guide under the same running conditions , using common materials with normal manufacturing quality and operation conditions can reach a 90% survival rate at the calculated life.

### Calculation of rating life

Formulas (4) and (5) can be used when the equivalent dynamic load and the average speed are constant.



## 2-7-2 Equivalent dynamic load and speed

If the load and speed are not constant , each actual load and speed must be taken into account and both will influence the life.

### Equivalent dynamic load

If there is a change in load only , the equivalent dynamic load can be calculated according to formula(6).

### Equivalent speed

If there is a change in speed only , the equivalent speed can be calculated by formula(7). If there is a change in both of load and speed , the equivalent dynamic load can be calculated

### Equivalent load and speed calculation

$$P = \sqrt[3]{\frac{Q_1 \cdot F_1^3 + Q_2 \cdot F_2^3 + \dots + Q_n \cdot F_n^3}{100}} \quad \text{--- (6)}$$

$$\bar{v} = \frac{Q_1 \cdot V_1 + Q_2 \cdot V_2 + \dots + Q_n \cdot V_n}{100} \quad \text{--- (7)}$$

$$P = \sqrt[3]{\frac{Q_1 \cdot V_1 \cdot F_1^3 + Q_2 \cdot V_2 \cdot F_2^3 + \dots + Q_n \cdot V_n \cdot F_n^3}{100 \bar{v}}} \quad \text{--- (8)}$$

$$P = |F_x| + |F_y| \quad \text{--- (9)}$$

$$P = |F| + |M| \cdot \frac{C_0}{M_0} \quad \text{--- (10)}$$

P = Equivalent dynamic load (N)

q = Percentage of stroke (h)

F<sub>1</sub> = Discrete load steps (N)

$\bar{v}$  = Average of speed (min)

v = Discrete speed steps (m)

F = External dynamic load N

F<sub>Y</sub> = External dynamic load, vertical N

F<sub>X</sub> = External dynamic load, horizontal N

C<sub>0</sub> = Static load rating N

M = Static torque Nm

M<sub>0</sub> = Static torque in direction of action Nm



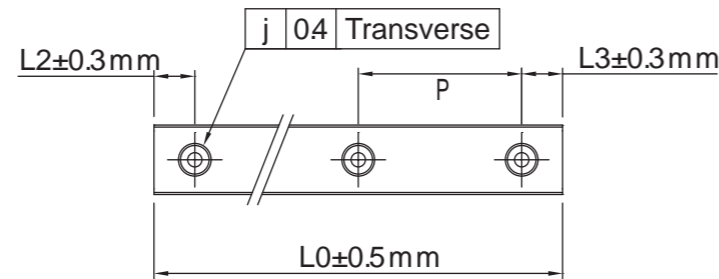
2-7-3 Combined dynamic load

If the Linear Guide takes on load from an arbitrary angle, its equivalent dynamic load rating is calculated using formula (9).

If both load and moment act on the Linear Guide, the equivalent dynamic load can be calculated by the formula (10). According to ISO 14728-1, the equivalent load (P) shall not exceed 1/2C.

P 0.5C

P C0, Reliable life calculated.



3-1 Order Information

Customized Requirement

X: Rail with Special Machining B: Black Oxidation O: Hard Chrome Plating

P: Phosphating N: Nickle Plating D: Raydent K: Tapped-hole Rail

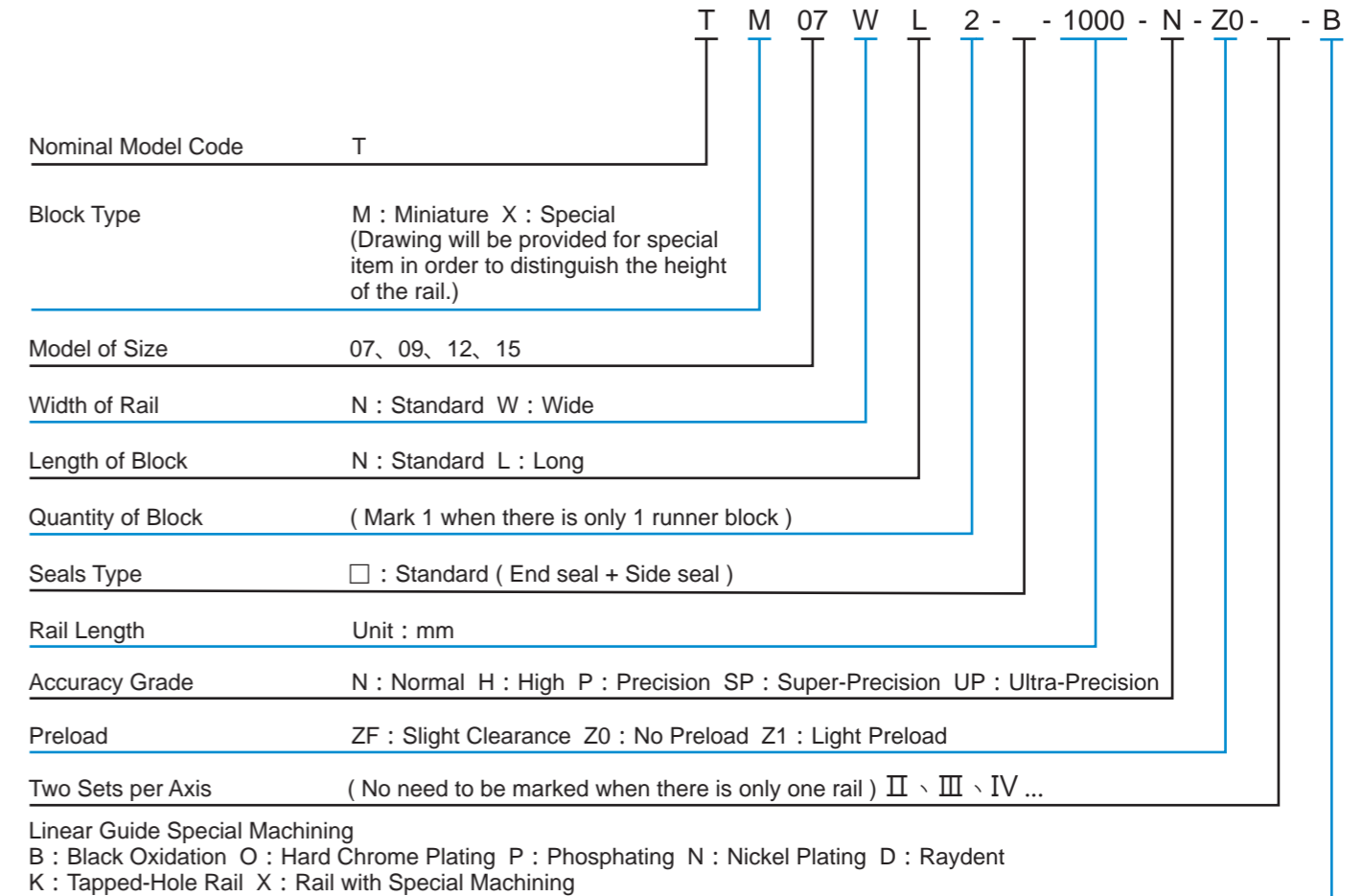
Please contact TBI MOTION for special requirement.

Standard Type

Size	Size			
	7 M	9 M	12 M	15 M
Standard Length of One Rail.(mm)	40	55	70	70
	55	75	90	110
	70	95	120	150
	85	115	145	190
	100	135	170	230
	130	155	195	270
		175	220	310
		195	245	350
		275	270	390
		375	320	430
		370	470	
		470	550	
		570	670	
			870	
Pitch(mm)	15	20	25	40
L2,L3 min	3	4	4	4
L2,L3 max	10	20	20	35
Lmax	1000	1000	1000	1000

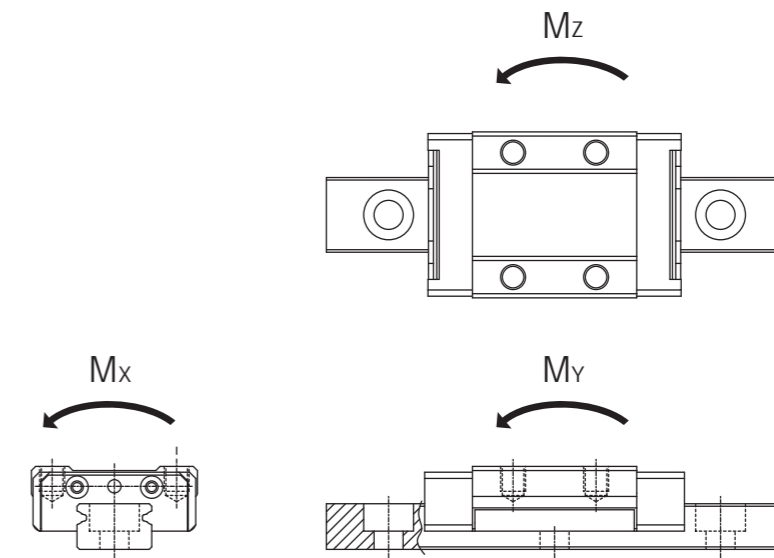
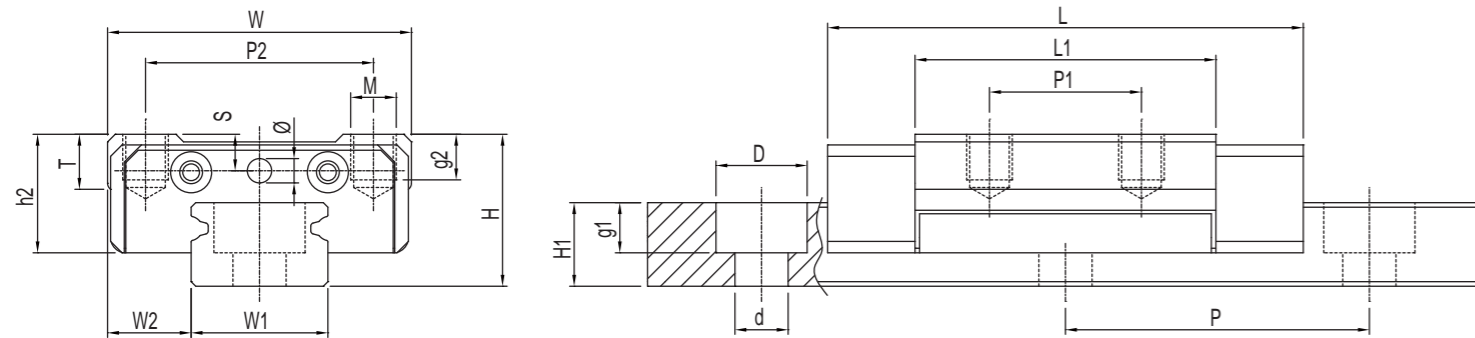
3-2 Model Number of TM Series

Perform joint treatment when required lengths exceed Lmax. Please contact TBI MOTION for detailed information.



PS : Linear guide sets are available. If blocks and rails need to be sent separately, returning rails will be provided.

## TM-N Specification



Model No.	Assembly (mm)		Block(mm)						Rail(mm)										
	H	W2	W1	H1	P	D	d	g1	W	L	L1	h2	P1	P2	M	g2	T	$\phi$	S
TM07NN	8	5	7	4.7	15	4.2	2.4	2.3	17	23	12.3	6.5	8	12	M2	2	2.25	1.3	1.5
TM07NL	8	5	7	4.7	15	4.2	2.4	2.3	17	31	20.3	6.5	13	12	M2	2	2.25	1.3	1.5
TM09NN	10	5.5	9	5.5	20	6	3.5	3.3	20	30.5	19.8	7.8	10	15	M3	3	3.62	1.3	2.4
TM09NL	10	5.5	9	5.5	20	6	3.5	3.3	20	40.8	30.1	7.8	16	15	M3	3	3.62	1.3	2.4
TM12NN	13	7.5	12	7.5	25	6	3.5	4.5	27	35	20.6	10	15	20	M3	3.5	4.54	1.3	3
TM12NL	13	7.5	12	7.5	25	6	3.5	4.5	27	47.5	33.1	10	20	20	M3	3.5	4.54	1.3	3
TM15NN	16	8.5	15	9.5	40	6	3.5	4.5	32	43	27	12	20	25	M3	5	5.86	1.3	3.3
TM15NL	16	8.5	15	9.5	40	6	3.5	4.5	32	60	44	12	25	25	M3	5	5.86	1.3	3.3

Model No.	Rating Load (kgf)		Static permissible moment of load					Weight	
			Mx(kgf-mm)		My(kgf-mm)		Mz(kgf-mm)		Block (kg)
	C	Co	Single Block	Single Block	Double Block	Single Block	Double Block		
TM07NN	144	204	745	232	3,234	232	3,234	0.005	0.21
TM07NL	220	374	1,367	849	7,261	849	7,261	0.009	
TM09NN	220	374	1,713	849	7,117	849	7,117	0.013	0.32
TM09NL	299	579	2,648	2,099	14,174	2,099	14,174	0.020	
TM12NN	381	536	3,269	1,094	12,391	1,094	12,391	0.024	0.61
TM12NL	555	919	5,604	3,437	26,857	3,437	26,857	0.039	
TM15NN	581	834	6,336	2,316	23,096	2,316	23,096	0.048	1
TM15NL	860	1,459	11,088	7,527	52,908	7,527	52,908	0.080	