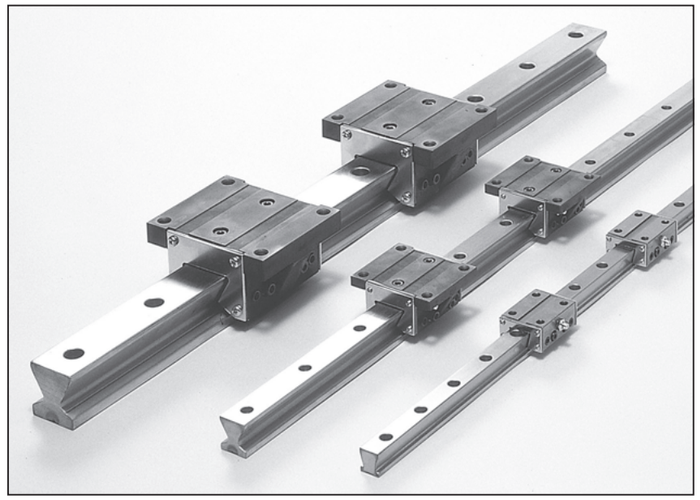
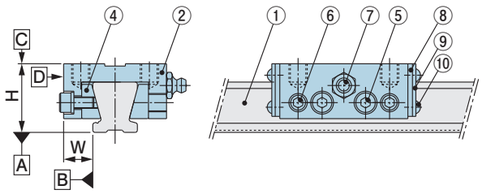
Oiles Slide Shifter S Type STC/STF GR



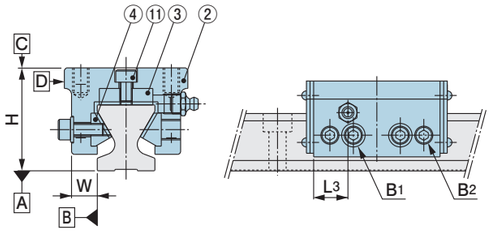
RoHS2 ELV

Component Parts・Accuracy

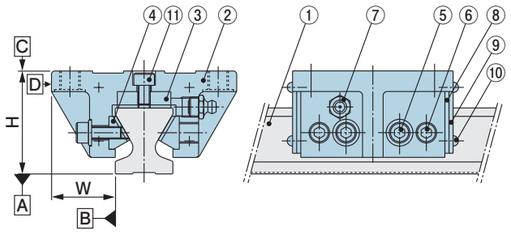
■ STC20



■ STC28



■ STF28,38,48 Flange type



Component Parts

No.	Name	Material
①	Guide rail	S45C+hard chrome-plated
②	Shift table	FCD450
③	Liner (Sliding material)	Oiles metal
④	Gib (Sliding material)	Oiles metal
⑤	Adjust pull bolt	Hex socket head cap bolt
⑥	Adjust push bolt	Hex socket head cap bolt
⑦	Grease nipple	A-PF1/8 (Screw mounting hole size Rp 1/8)
⑧	Seal	Polyurethane
⑨	Seal fixing plate	SPCC + rust proof
⑩	fixing screws	——
⑪	Liner fixing bolts	——

※About the shift table
・STC20 has Oiles metal joined to FCD450.
・STC28, STF28, 38 and 48 have been treated with a zinc phosphate coating for rustproofing (dyed black).

Accuracy

(Unit: mm)

Items	Accuracy
Running parallelism of side C with respect to side A	※0.03 or less/m (upright)
Running parallelism of side D with respect to side B	※0.05 or less/m (upright)
Tolerance of H dimension	$^{0}_{-0.1}$
Tolerance of W dimension	$^{-0.1}_{-0.3}$

※These are values obtained after installing and correcting the guide rails.

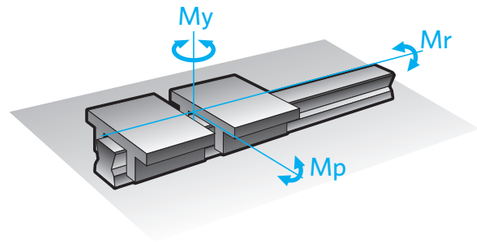
Service Range

Allowable load

- Static allowable load: Allowable load when a load is applied at a stationary condition or at quite low speed near stopping (not more than 0.0017 m/s [0.1 m/min.])
- Dynamic allowable load: Allowable load in the condition with sliding speed of 1.0 m/s {60 m/min} or less.
- Do not use STC20 in lateral or hanging position.

Allowable Moment

■ **2 tables on 1 rail**



Part No.	Type	Allowable load N {kgf} Table position Upright	Lateral	Hanging	Allowable moment N・m {kgf・m} Cases	Moment direction (when contact with the table) Mp	Mr	My
STC20	Static	10,800 {1,100}	——	——	1 rail 2 tables	49 { 5}	15 { 1.5}	44 { 4.5}
	Dynamic	3,430 { 350}	——	——				
STC28 STF28	Static	17,700 {1,800}	4,410 { 450}	3,920 { 400}	1 rail 2 tables	200 { 20}	20 { 2.0}	180 { 18}
	Dynamic	5,880 { 600}	1,470 { 150}	1,270 { 130}				
STF38	Static	31,400 {3,200}	7,850 { 800}	7,360 { 750}	1 rail 2 tables	320 { 33}	30 { 3.0}	290 { 30}
	Dynamic	10,800 {1,100}	2,650 { 270}	2,450 { 250}				
STF48	Static	44,100 {4,500}	13,700 {1,400}	11,800 {1,200}	1 rail 2 tables	490 { 50}	40 { 4.0}	440 { 45}
	Dynamic	14,700 {1,500}	4,410 { 450}	3,920 { 400}				

※The value of moment direction when 2 table in 1 rail is a reference value.
※Use the formula on page 337 to calculate the allowable load and determine whether it can be used.

Allowable Velocity

Lubrication conditions	Allowable max velocity	Remarks
Dry	0.5m/s {30m/min}	——
Periodical Inbrication	1.0m/s {60m/min}	Apply lubrication every 10 km of sliding

※Greasing is needed if the stroke is 1 meter or more or the allowable wear amount is small.

Seal Friction Fs

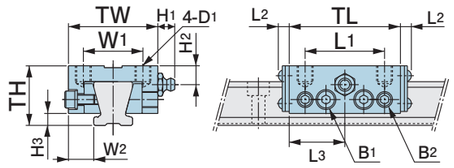
Part No.	STC20	STC28	STF28	STF38	STF48
Fs	9.8N {1.0kgf}	12N {1.2kgf}	12N {1.2kgf}	15N {1.5kgf}	18N {1.8kgf}

STC/STF GR Oiles Slide Shifter S Type

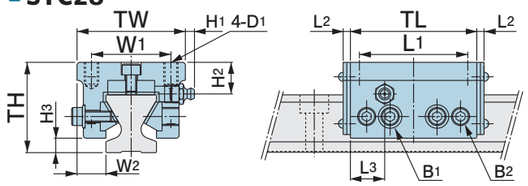
RoHS2 ELV

Shift Tables

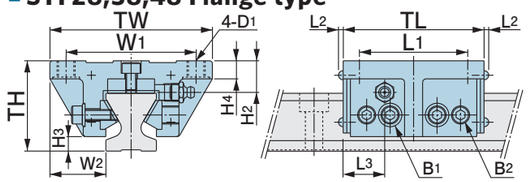
■ STC20



■ STC28



■ STF28,38,48 Flange type



●Product Identification

Flange type

Specify by **STC** ☐ **Part No.** Specify by **STF** ☐ **Part No.**

(e.g.) When the Flange type rail width is 28mm. ▶ **STF28**

Part No.	TH	TW	TL	W1	W2	L1	L2	L3	D1	H1	H2	H3	H4	B1	B2	Weight kg
STC20	30	45	56	30	12.75	40	5.5	28	M8	8.5	9.5	6	—	M5×10	M8×8	0.32
STC28	50	60	70	44	16	50	6	19	M8	5	17.5	8	—	M6×16	M10×10	0.90
STF28	50	90	78	72	31	60	2.0	23	M10	—	17.5	8	10	M6×16	M10×10	0.94
STF38	65	110	100	90	36	80	2.6	25	M10	—	25	10	15	M8×18	M12×12	2.30
STF48	82	140	120	116	46	95	3.9	30	M12	—	30	11	20	M8×22	M12×15	4.95

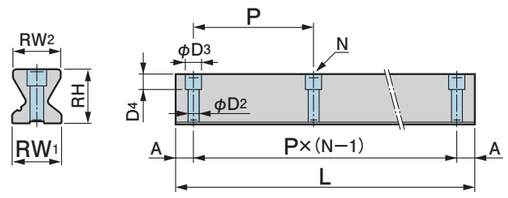
※H1 value is a reference value.

Guide Rails

●Product Identification

Specify by **GR** **Width** **-** **Length** **Part No.**

(e.g.) When the width is 28mm and the length is 1000mm. ▶ **GR28-1000**



※Use hex socket head bolts for installation.
※The maximum length of a single rail is 2000 mm. Connect rails if a 2000 mm or longer rail is needed.
※Bolt hole cap (plastic) is available. Refer to page 295 for the detail.

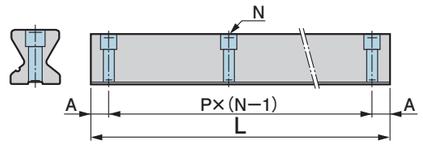
Part No.	RW1	RW2	RH	L	A	Number of holes N	P	φD2	φD3	D4	Attach bolts	Weight kg
GR20-300	19.5	19.5	22	300	25	6	50	6.6	11	7	M6×30	0.8
GR20-500	19.5	19.5	22	500	25	10	50	6.6	11	7	M6×30	1.4
GR20-1000	19.5	19.5	22	1000	25	20	50	6.6	11	7	M6×30	2.8
GR20-1500	19.5	19.5	22	1500	25	30	50	6.6	11	7	M6×30	4.2
GR20-2000	19.5	19.5	22	2000	25	40	50	6.6	11	7	M6×30	5.6
GR28-300	28	28	32	300	30	4	80	6.6	11	7	M6×40	1.5
GR28-400	28	28	32	400	40	5	80	6.6	11	7	M6×40	2.0
GR28-600	28	28	32	600	20	8	80	6.6	11	7	M6×40	3.0
GR28-1000	28	28	32	1000	20	13	80	6.6	11	7	M6×40	5.0
GR28-1500	28	28	32	1500	30	19	80	6.6	11	7	M6×40	7.5
GR28-2000	28	28	32	2000	40	25	80	6.6	11	7	M6×40	10.0
GR38-400	38	38	42	400	42.5	4	105	9	14.2	12	M8×45	3.7
GR38-600	38	38	42	600	37.5	6	105	9	14.2	12	M8×45	5.6
GR38-900	38	38	42	900	30	9	105	9	14.2	12	M8×45	8.4
GR38-1200	38	38	42	1200	22.5	12	105	9	14.2	12	M8×45	11.2
GR38-1500	38	38	42	1500	15	15	105	9	14.2	12	M8×45	14.0
GR38-2000	38	38	42	2000	55	19	105	9	14.2	12	M8×45	18.5
GR48-600	48	48	52	600	37.5	6	105	11	17.5	15	M10×60	9.2
GR48-900	48	48	52	900	30	9	105	11	17.5	15	M10×60	13.8
GR48-1200	48	48	52	1200	22.5	12	105	11	17.5	15	M10×60	18.4
GR48-1500	48	48	52	1500	15	15	105	11	17.5	15	M10×60	23.0
GR48-2000	48	48	52	2000	55	19	105	11	17.5	15	M10×60	30.5

Custom-made Guide Rails

●Product Identification

Specify by **GR** **Width** **-** **Length** **Part No.**

(e.g.) When the widit is 20mm and the length is 450mm. ▶ **GR20-450**



(Unit: mm)

L	GR20	P=50	GR28	P=80	GR38	P=105	GR48	P=105
	A	N	A	N	A	N	A	N
100	25	2	—	—	—	—	—	—
150	25	3	35	2	—	—	—	—
200	25	4	20	3	47.5	2	47.5	2
250	25	5	45	3	20	3	20	3
300	25	6	30	4	45	3	45	3
350	25	7	15	5	17.5	4	17.5	4
400	25	8	40	5	42.5	4	42.5	4
450	25	9	25	6	15	5	15	5
500	25	10	10	7	40	5	40	5
550	25	11	35	7	12.5	6	12.5	6
600	25	12	20	8	37.5	6	37.5	6
650	25	13	45	8	62.5	6	62.5	6
700	25	14	30	9	35	7	35	7
750	25	15	15	10	60	7	60	7
800	25	16	40	10	32.5	8	32.5	8
850	25	17	25	11	57.5	8	57.5	8
900	25	18	10	12	30	9	30	9
950	25	19	35	12	55	9	55	9
1000	25	20	20	13	27.5	10	27.5	10
1050	25	21	45	13	52.5	10	52.5	10
1100	25	22	30	14	25	11	25	11
1150	25	23	15	15	50	11	50	11
1200	25	24	40	15	22.5	12	22.5	12
1250	25	25	25	16	47.5	12	47.5	12
1300	25	26	10	17	20	13	20	13
1350	25	27	35	17	45	13	45	13
1400	25	28	20	18	17.5	14	17.5	14
1450	25	29	45	18	42.5	14	42.5	14
1500	25	30	30	19	15	15	15	15
1550	25	31	15	20	40	15	40	15
1600	25	32	40	20	12.5	16	12.5	16
1650	25	33	25	21	37.5	16	37.5	16
1700	25	34	10	22	10	17	10	17
1750	25	35	35	22	35	17	35	17
1800	25	36	20	23	60	17	60	17
1850	25	37	45	23	32.5	18	32.5	18
1900	25	38	30	24	—	—	—	—
1950	25	39	15	25	30	19	30	19
2000	25	40	40	25	55	19	55	19

●Select the number of mounting holes of the longer rail shown above if the required length is shorter than the listed L. For dimensions not shown above, select the special-dimension guide rail that accommodates the necessary dimension in the above table and find the value of A (end dimension) from its P (mounting pitch) and N (number of mounting holes) using the following expression. The dimensions of both ends must be the same.

$$A=\frac{L-\{P\times(N-1)\}}{2}$$

Expression if A is less than 10 mm

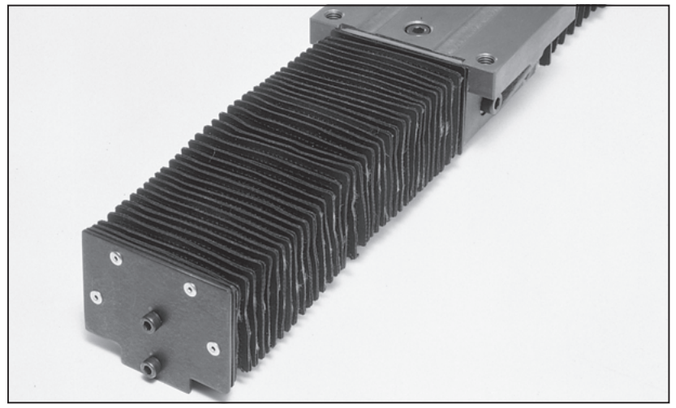
$$A=\frac{L-\{P\times(N-2)\}}{2}$$

Calculation example (GR20-1090)
Select the special-dimension guide rail 1100 mm (P = 50, N = 22) from above if the necessary guide rail dimension is 1090 mm.

The end dimension $A=\frac{1090-\{50\times(22-1)\}}{2}=20$

The end dimension = 20 mm and the number of mounting holes = 22 are found.

Optional Parts Applicable to S and SE Types



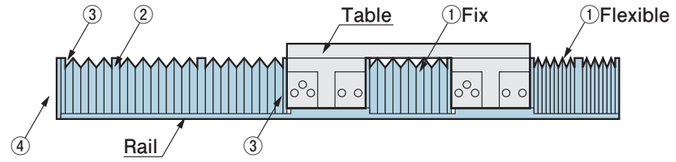
Bellows exclusive for slide shifters

The S and SE types incorporate Oiles bearings on the sliding surfaces and have superior foreign matter resistance. It is recommended to use the exclusive bellows if higher resistance is required. A heat-resistant bellows is also available.

Caps for covering up bolt holes on guide rails

Exclusive caps for preventing dust, etc. from entering the bolt holes for mounting the guide rail are available.

Component Parts for Bellows Exclusive for Slide Shifters

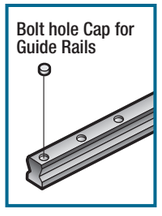


No.	Name	Material
①	Flexible bellows	Neoprene rubber + nylon cloth
	Fix bellows	
	Heat-resistant flexible bellows	GENTEX® + PTFE
	Heat-resistant fix bellows	
②	Slide Plate	PVC
③	Clamp Plate	SPCC
④	End Plate	SPCC

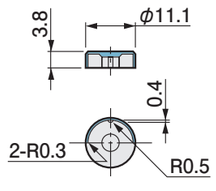
※Determine the positions of the bolts for fixing the rail at both ends when using the 38J or 48J as shown below.

Bolt hole Cap for Guide Rails

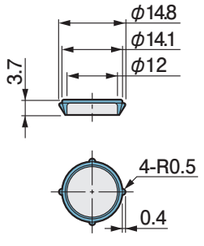
Exclusive bolt hole cap (plastic) is available to keep out the dust from bolt holes.



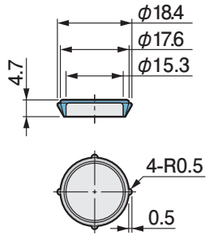
■ **CP-6** (for M6)



■ **CP-8** (for M8)



■ **CP-10** (for M10)



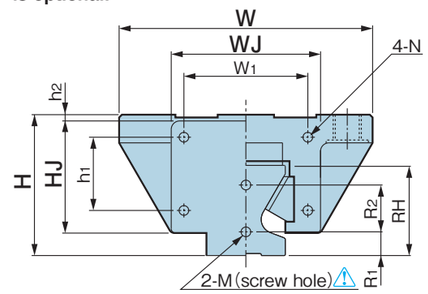
Part No.	Bolt Size	Rails
CP-6	M6	GR20、28、GRE20、28
CP-8	M8	GR38
CP-10	M10	GR48

※Press fit the cap with a plastic hammer.
※Fit CP-6 in the clearance between the rail and the bolt, and twist it to tie up.

Product Identification for Exclusive Bellows for Slide Shifters

⚠CAUTION

■ Mounting screw hole on the guide rail for bellows is optional.



● End plate of 20J sticks out 8mm from the table surface.

■ Flexible Bellows

28J - A - 100 - T
Part No.
- Put T for heat-resistant bellows
- Shortened length of bellows (Lmin)
- Bellows expansion ratio A or B

■ Fix Bellows

28JK - 140 - T
Part No.
- Put T for heat-resistant bellows
- Length of fixed bellows

Part No.	W×H	Bellows size WJ×HJ	Expansion ratio A	Stroke	Expansion ratio B	Stroke	h1	h2	W1	RH	R1	R2	N	M	Applicable tables
20J	45×30	52×32	5	under 1100	3.5	1100 or more	14	凸8	37	22	6	10	M3×10	M4×8	STC20 STE20
28J	90×50	60×40	5	under 1100	3.5	1100 or more	26	凹1	44	32	8	18	M3×10	M4×8	STC28 STF28 STE28 STFE28
38J	110×65	80×52	7	under 1300	5.5	1300 or more	36	凹1	58	42	10	24	M4×12	M5×10	STF38
48J	140×82	101×67	10	under 1300	7.5	1300 or more	50	凹3	74	52	12	30	M6×12	M6×10	STF48

Calculating formula

■ Length of Bellows
(L min=Shortened length, L max=Expanded length)

In case of expansion ratio A

$$L\,min=\frac{S}{A-1},\ L\,max=L\,min\times A$$

In case of expansion ratio B

$$L\,min=\frac{S}{B-1},\ L\,max=L\,min\times B$$

■ Total length of guide rail when using bellows

Using bellows at both ends

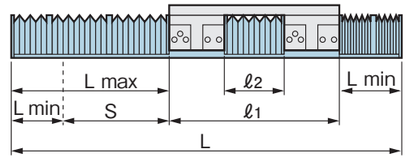
$$L=(L\,min\times 2)+S+\ell_1$$

Using bellows at one end

$$L=L\,min+S+\ell_1$$

In case of standard guid rails, L min dimension needs to be adjusted.

$$L\,min=\frac{L-S-\ell_1}{2}$$



S: Stroke
A, B: Expansion ratio of bellows
L max: Expanded length of bellows
L min: Shortened length of bellows
ℓ_1: Table length
ℓ_2: Fix bellows length
L: Rail length

Calculation example

Expression of calculating the bellows length is $L\,min=\frac{S}{A-1}$

$$L\,min=\frac{400}{5-1}=100mm$$

Required rail length $L_1=(L\,min\times 2)+S+\ell_1$

$$L_1=(100\times 2)+400+300=900mm$$

Bellows length L min when using standard rail length L2 (1000mm)

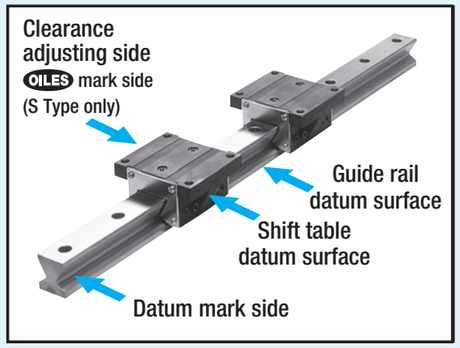
$$L\,min=(1000-400-300)/2=150mm$$

STF28
Stroke: S=400mm
Expansion ratio: A=5
Table length: ℓ_1=300mm
Fix bellows length: ℓ_2=140mm
Required rail length: L_1
Standard rail length: L_2=1000mm

Installation and Adjusting Methods of S and SE Types

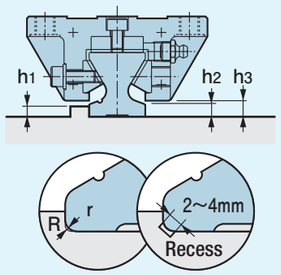
- The clearance between the shift table and guide rail of the S type need be adjusted.
- The shift table of the SE type has an automatic clearance adjustment function.

■ Installation Datum Surface



The guide rail and shift table have their own datum surface for correct installation.
The datum surface of the guide rail is the datum mark side (side B). That of the shift table is the opposite side (side D) to the OILES mark.
※Side B and D refer to the datum mark on page 287.

- Stage machining of installation datum part and corner dimensions



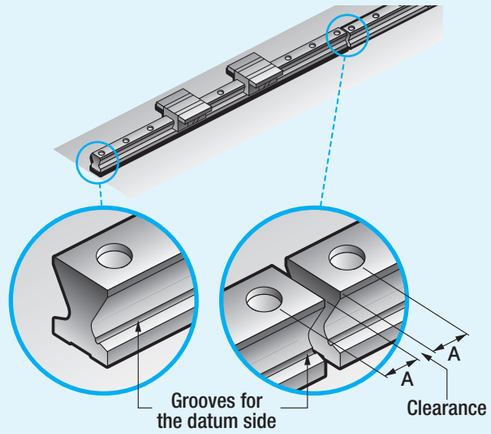
(Unit: mm)

Part No.	h1	h2	h3	r	R mating corner
GR20·GRE20	3~4	4	6	R1	R0.5 or less or recess
GR28·GRE28	4~6	6	8	R1.5	R1 or less or recess
GR38	5~8	8	10	R1.5	Ditto
GR48	5~8	10	11	R2	R1.5 or less or recess

■ Connecting Guide Rails

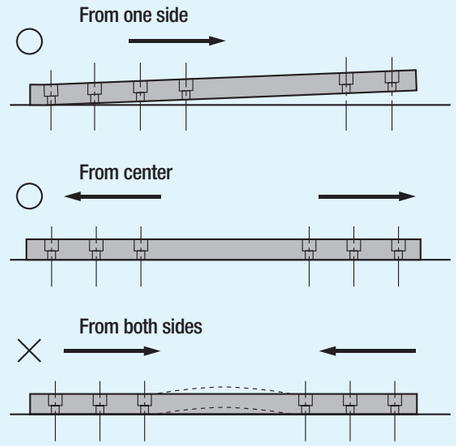
- Joining guide rails

Fix the guide rails with the grooves with the datum marks on the same side.
The distance A between the mounting hole and end face is machined with a minus tolerance and accordingly the joint has a clearance. However, the clearance causes no bad influences.



■ Cautions

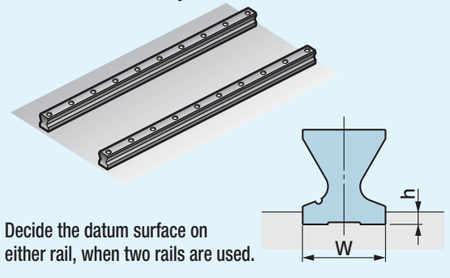
Tighten the bolts of the rail from one side or from the center to the right and left in sequence.



○: Correct ×: Wrong

■ Installation of Guide Rails

It is recommended that the guide rail be corrected before installation. The product alone has a bend of not more than 0.2 mm/m, which also applies to both the S and SE types. When it is installed on a base, the bend is corrected below 0.03 mm/m. After correction, adjust bend of the S type rail by means of clearance adjustment of the shift table. The SE type has an automatic clearance adjustment function and adjusts clearance automatically.

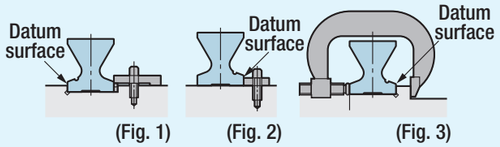


Decide the datum surface on either rail, when two rails are used.

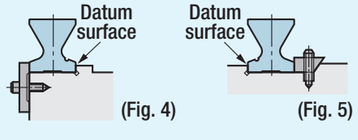
Part No.	W	h
GR20 · GRE20	19.5 +0.08 +0.05	2~3
GR28 · GRE28	28 +0.08 +0.05	3~4
GR38	38 +0.08 +0.05	4~5
GR48	48 +0.08 +0.05	4~5

■ Guide Rail Installation Adjustment Example

①Make a groove along the guide rail axis. Press the rail against the datum surface strongly to correct it. When two rails are used, parallelism is secured easily if grooves are made simultaneously.
②Alternative procedures are as shown below: Make the widths of the installation grooves roughly, insert drill rods and rails into the grooves, and fix the rails while pressing the drill rods. (See Fig. 1.)
③Other procedures as shown below: Install a rigid plate on a planar base, and install the rail to fit this plate. (See Fig. 2.)
④Make stages on the mating base with a planer or milling machine, press the datum surface of the rail against the machined surface with a vice or bolts and auxiliary plate, and fix the rail. (See Figs. 3, 4 and 5.)

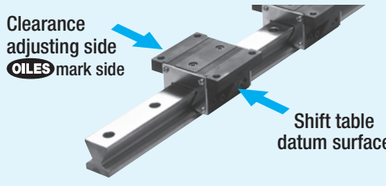


(Fig. 1) (Fig. 2) (Fig. 3)



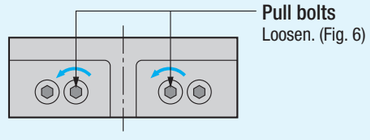
(Fig. 4) (Fig. 5)

■ Clearance Adjusting Method (S Type)

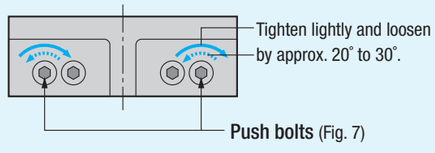


Recommended tightening torque	
STC20	1.47N · m {15kgf · cm}
STC28 · STF28	1.96N · m {20kgf · cm}
STF38	2.45N · m {25kgf · cm}
STF48	2.94N · m {30kgf · cm}

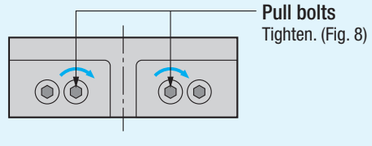
①Loosen the pull bolts on the side with OILES mark (on the grease nipple side) sufficiently. (See Fig. 6.)



②Tighten the push bolts lightly, check the clearance zero condition, press reversely by approximately 20 to 30°, and return the bolts. (See Fig. 7.)
For fine adjustment, retry adjustment in the order of Fig. 7 and Fig. 8. Clearance is increased or decreased by adjusting the degree of loosing the bolts shown in Fig. 7.



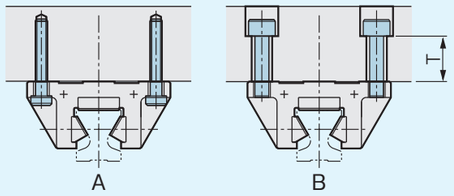
③Tighten the pull bolts. Clearance becomes 0.03 to 0.05 mm. (Fig. 8.)
NOTE: Tighten the pull bolts until the spring washers collapse. However, do not tighten them more strongly.



Installation and Adjusting Methods of S and SE Types

■ Installation of Shift Tables

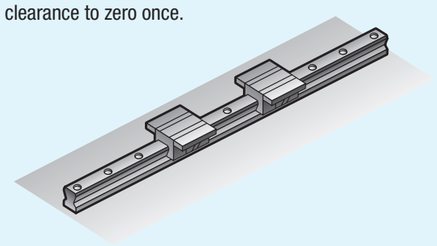
The shift table fixing bolts may be used in two ways as shown below. The recommended bolt diameters and lengths are as shown below.



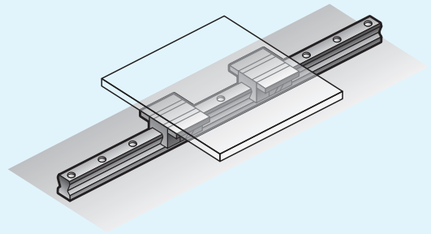
Part No.	A	B
STE20 · STC20	——	M8× (T+ 5)
STE28 · STC28	——	M8× (T+ 8)
STFE28 · STF28	M8×20	M10× (T+ 8)
STF38	M8×25	M10× (T+12)
STF48	M10×30	M12× (T+16)

■ Installing Several Shift Tables on a Single-axis Rail (S Type)

①Insert the shift tables in the guide rail and adjust the clearance to zero once.

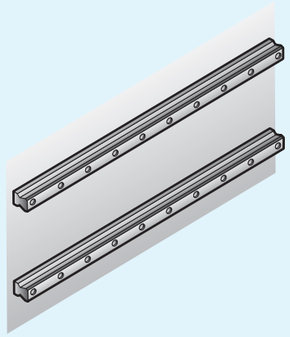


②Fasten the mating plate to the shift tables finally, adjust the linear accuracy, and adjust the clearance.

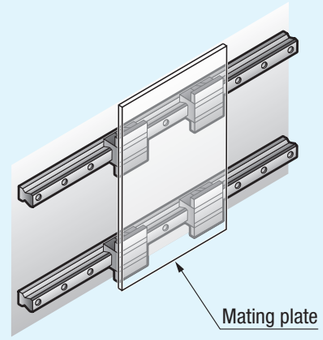


■ Installing Several Shift Tables on Dual-axis Rails Topsy-turvy, Laterally, or Vertically (S Type)

①Make sure that two rails are in parallel. (0.2 mm or less)



②Insert the shift tables with adjusted clearance into the guide rails.

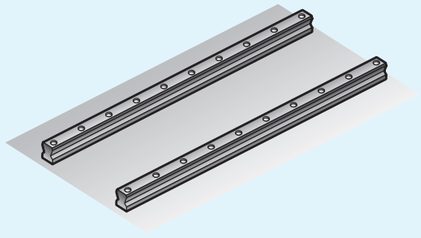


③Fix the mating plate to the shift tables temporarily, make sure that the tables move smoothly, and fix the mating plate finally.

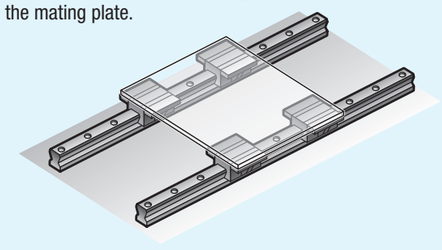
④Recheck parallelism and clearance of the rails if movement is not smooth.
If large moment loads are applied, the resistance increases.

■ Installing Several Shift Tables on Dual-axis Rails (S Type)

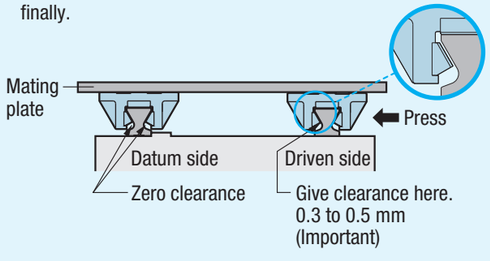
①Make sure that two rails are in parallel. (0.2 mm or less)



②Insert the shift tables into the guide rails with the clearance adjusting sides (OILES marks) outward. Put the mating plate.

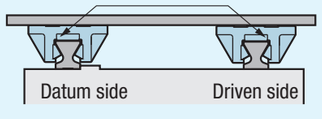


③Zero the clearance of the datum-side shift tables. Set the clearance of the driven shift tables to 0.3 to 0.5 mm, press the shift tables against the rails in the direction of the arrow, and fix the shift tables to the mating plate finally.



④Adjust the clearance on the datum-side shift tables.

Both outer clearances are the same as the amount of clearance adjustment, which depends on the parallelism of the guide rails.



■ Other Instructions

①Use knock pins for both the guide rails and shift tables if vibrations or large impact loads are applied to them. The fixing holes of the guide rails may be used at intervals of several holes for the knock pins.

②It is recommended that a mating plate with high parallelism should be used. If sufficient parallelism cannot be secured for reasons of machining, carry out adjustment with shims so that the guide rails and shift table are in good contact.

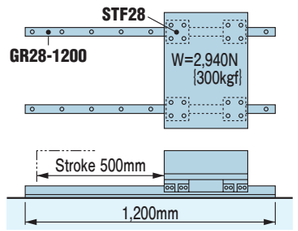
Durability Test Data / To Prevent Malfunctioning

Durability Test Data

S Type

<Testing conditions>
Type: STF28 four shift tables
GR28-1200 dual-axis
Load: 2,940N {300kgf}
Velocity: 0.33m/s {20m/min}
Stroke: 500mm
Sliding distance: 1,000km

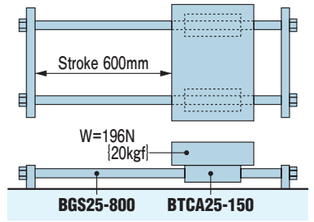
<Result>
Wear amount on liner: 0.025mm
on rail: 0.005mm
Coefficient of friction: 0.08～0.14
Temperature of friction: 32～42℃



BA Type

<Testing conditions>
Type: BTCA25-150 one shift table
BGS25-800 dual-axis
Load: 196N {20kgf}
Velocity: 0.50m/s {30m/min}
Stroke: 600mm
Sliding distance: 1,000km

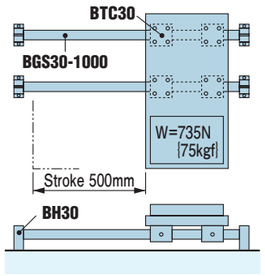
<Result>
Wear amount on bushing: 0.055mm
on shaft: 0.008mm
Coefficient of friction: 0.20～0.28



BC Type

<Testing conditions>
Type: BTC30 four shift tables
BGS30-1000 dual-axis
Load: 735N {75kgf}
Moment: 323N·m {33kgf·m}
Velocity: 0.25m/s {15m/min}
Stroke: 500mm
Sliding distance: 300km (300000 cycles)

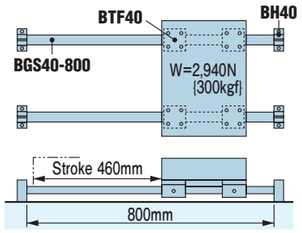
<Result>
Wear amount on bushing: 0.032mm
on shaft: 0.006mm
Coefficient of friction: 0.12～0.30



BF Type

<Testing conditions>
Type: BTF40 four shift tables
BGS40-800 dual-axis
Load: 2,940N {300kgf}
Velocity: 0.42m/s {25m/min}
Stroke: 460mm
Sliding distance: 1,000km

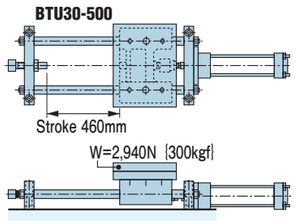
<Result>
Wear amount on bushing: 0.035mm
on shaft: 0.008mm
Coefficient of friction: 0.10～0.25
Temperature of friction: 42～85℃



BTU Type

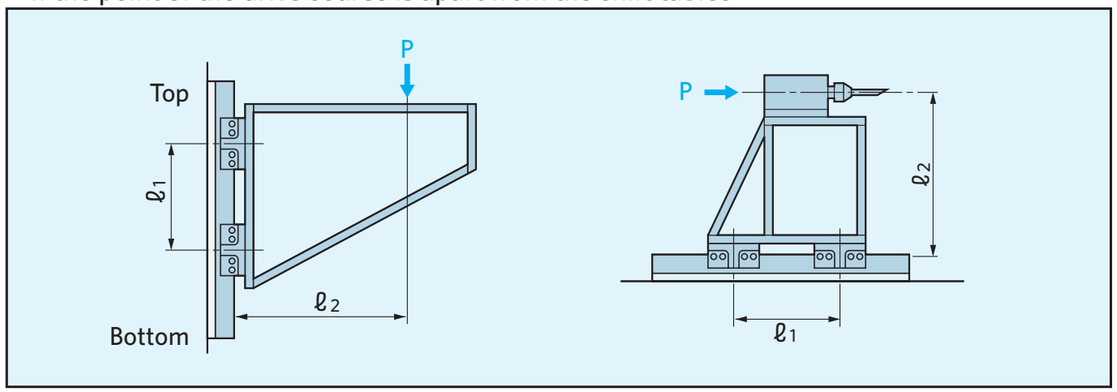
<Testing conditions>
Type: BTU30-500
Load: 2,940N {300kgf}
Velocity: 0.42m/s {25m/min}
Stroke: 460mm
Sliding distance: 730 (800000 cycles)

<Result>
Wear amount on bushing: 0.023mm
on shaft: 0.012mm
Coefficient of friction: 0.16～0.20



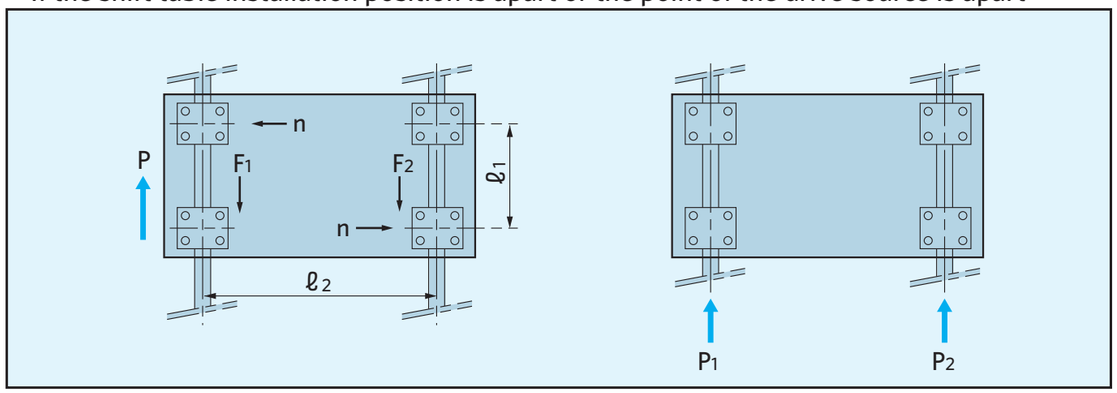
To Prevent Malfunctioning

■ If the point of the drive source is apart from the shift tables



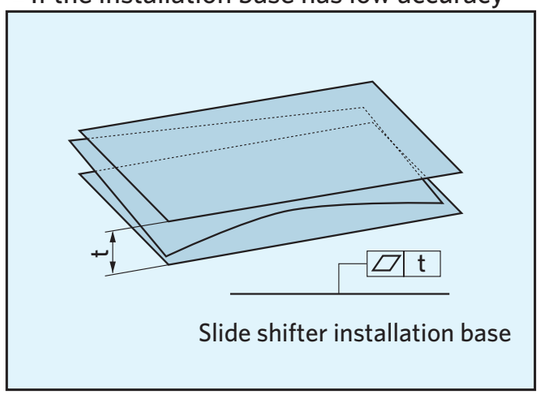
If the position of drive source P is apart from the rail surface by ℓ_2, of ℓ_2/ℓ_1 exceeds 1.67 when the coefficient of friction μ is 0.3, resulting in malfunctioning. Take the allowable moment load into consideration and reduce ℓ_2/ℓ_1 below 1.5.

■ If the shift table installation position is apart or the point of the drive source is apart

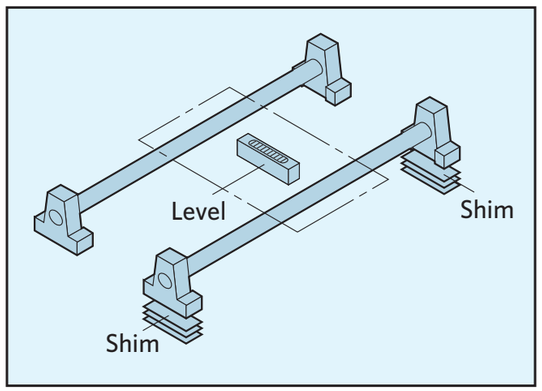


If the ℓ_2/ℓ_1 ratio of dual-axis parallel rails is large, the couple of the drive source P and resistance F_1 and F_2 becomes large and the slide shifter works improperly. Reduce ℓ_2/ℓ_1 below 3. As the point of the drive source becomes apart from the center, the condition becomes worse. Synchronize the drive source with P_1 and P_2 if ℓ_2/ℓ_1 is inevitably larger than 3 for reasons of the structure.

■ If the installation base has low accuracy



Do not select the S type if the parallelism t exceeds 0.3.



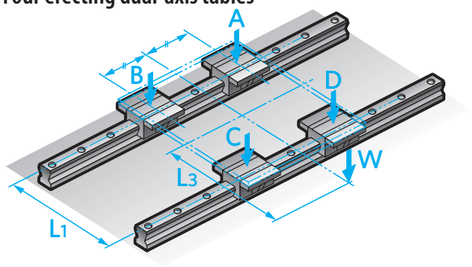
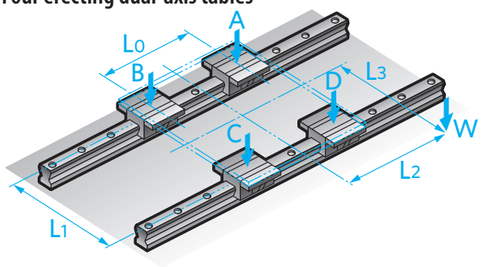
Select the B type if the parallelism t exceeds 0.3. Insert shims under the shaft holders to adjust them.
After adjustment, check the parallelism with a level, straight edge, clearance gauge, etc.

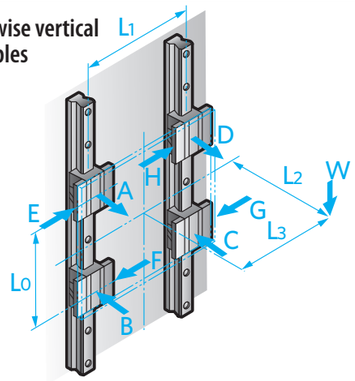
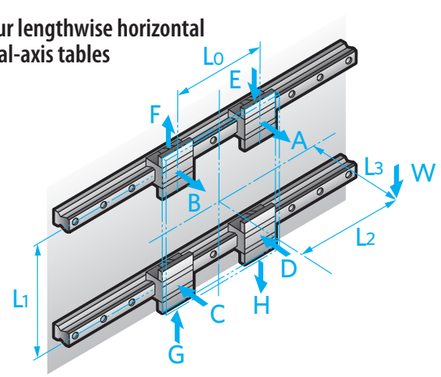
Setting Driving Force And Calculating Service Life

Setting Driving Force

The driving forces differ with the shift table installation conditions and types of the slide shifters. The typical load conditions and examples of calculating the driving forces are shown below. Take note of them. When setting the driving force, find the load applied to each table first using the formula shown below, and select a proper table in the allowable load table of each series. Then, calculate the driving force from the found load using the formula shown below.

Formula for calculating loads and driving forces

Application form	■ Four erecting dual-axis tables 	■ Four erecting dual-axis tables 
Load calculation Formula	A=W/4−W/2×L3/L1 B=W/4−W/2×L3/L1 C=W/4+W/2×L3/L1 D=W/4+W/2×L3/L1	A=W/4+W/2×L2/L0−W/2×L3/L1 B=W/4−W/2×L2/L0−W/2×L3/L1 C=W/4−W/2×L2/L0+W/2×L3/L1 D=W/4+W/2×L2/L0+W/2×L3/L1
Driving force calculation Formula	Driving force = *F*, safety ratio = S (standard value: 1.5 to 2.5) *F* = (μ1|A|+μ2|B|+μ3|C|+μ4|D|+nFs) × S The obtained value is a practical driving force. This formula applies to the case where the driving force position is at the table center.	

Application form	■ Four lengthwise vertical dual-axis tables 	■ Four lengthwise horizontal dual-axis tables 
Load calculation Formula	B Type / S Type A=B=C=D=W/2×L2/L0 E=F=G=H=W/2×L3/L1	B Type / S Type A=B=C=D=W/2×L3/L1 E=H=W/4+W/2×L2/L0 F=G=−W/4+W/2×L2/L0
Driving force calculation Formula	Driving force = *F*, safety ratio = S (standard value: 1.5 to 2.5) *F* = (μ1|A|+μ2|B|+μ3|C|+μ4|D|+nFs+ (※nMs) +μ1|E|+μ2|F|+μ3|G|+μ4|H|) × S Add the (*nMs) value when the metal scraper is used. The obtained value is a practical driving force. ±W (weight) is added to the value of the lengthwise vertical tables. This formula applies to the case where the driving force position is at the table center.	

A to H: Load applied to each table
n: Number of tables
Fs: Seal friction (S Type)/Operating resistance (SE Type)
Ms: Metal scraper friction
See the description for the values of Fs and Ms.

μ=Coefficient of friction(μ1 and μ2 are coefficient of frictions of the tables.)

Type	S Type			Others
Installation condition	Erecting	Lateral	Hanging	
Coefficient of friction μ	0.15	0.17	0.30	0.15

※Do not use the STC20 or SE type in the lateral or hanging condition.

Calculating Service Life

⚠CAUTION

All Oiles slide shifter series employ Oiles bearings and work without the need for lubrication, in principle. If they are lubricated, foreign matter may be removed and the durability is improved further. The service life of the Oiles slide shifters depends on the speed, environmental conditions, etc. Take the condition shown below into consideration and find the service life using the service life calculation formula. It will be the basis of design.

Service life calculation formula (N: Number of durability test cycles)

$$N = a \times K \times \frac{1}{2S} \times \frac{Wa}{Wi} \times \frac{fc}{fw \times fv \times fe \times f\ell}$$

- a = allowable wear amount [mm]
  Determine the amount of wear allowed to ensure the accuracy in the machine in use.
  * BTCA and BTSA: 0.15 mm or less

- K = coefficient of friction
  The slide shifters use various types of Oiles bearings. The coefficient of friction is set according to their performances and using conditions.

Series	BTCA and BTSA	Other series
Coefficient of friction K	1.2×10^{7}	5×10^{6}

- S = stroke [m]

- Wa = allowable load [N {kgf}]
  See the Parts List.

- Wi = load [N {kgf}]
  Select the severest one (i.e., value nearest the allowable load) at the load applied to each table calculated with the load calculating formula.

- fc = contact factor
  When several shift tables are used, it is difficult to obtain uniform load distribution due to influences of the installation surface accuracy. This factor is determined by taking the contact conditions of the shift tables into consideration.

Number of tables per axis	One	Two	Three	Four
Contact factor fc	1.0	0.75 to 0.85	0.65 to 0.75	0.6 to 0.65

- fw = load factor
  This factor is used for compensation of the load conditions, since it is difficult to grasp the actual vibrations, impacts, etc. produced in machines.

Impact fluctuating loads	None	Yes
Load factor fw	1.0	2.0 to 3.0

- fv = velocity factor
  This factor is used for compensation of the speed conditions.

(Unit: m/sec.)

Velocity condition	0.0017 or less	0.0017 to 0.05	0.05 to 0.5	0.5 to 1
Velocity factor fv	0.25 to 0.3	0.3 to 1.0	1.0 to 2.0	2.0 to 4.0

- fe = environmental factor
  This factor is used for compensation of the ambient temperature and influences of foreign matter.

Ambient temperature	60˚C or less		60 to 100˚C	
Foreign matter	None	Yes	None	Yes
Environmental factor fe	1.0 to 2.0	3.0 to 6.0	3.0 to 6.0	6.0 to 12.0

※Lubrication is needed if the temperature is 100˚C or more.

- fl = lubrication factor
  Lubrication enhances the effect in high-speed operation or foreign matter need to be removed.

Running distance and lubrication	No lubrication	Lubrication every 10 km	Lubrication every 1 km
Lubrication factor fℓ	1.0 to 1.5	0.3 to 0.5	0.2 to 0.3

※Use the BTCA and BTSA in the self-lubricating conditions.

Calculation Examples of Four Erecting Dual-Axis Tables (S Type)

Load Calculation, Driving Force Calculation and Service Life Calculation

Use conditions and required service life

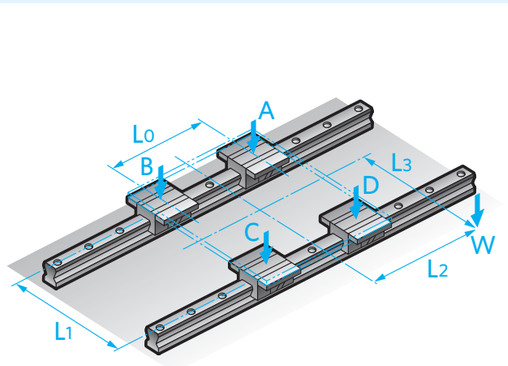
N=1 million cycles	W=100kgf	fc =0.75, single-axis, two units	fe=1.0, 60˚C or less, no foreign matter
a=0.1mm	K=5×10⁶	fw=1.0, no impact load	fℓ=1.0, no lubrication
S=0.25m	L_0=L_1=L_2=L_3=200mm	fv =1.0, 0.05m/s	

① Calculating loads applied to tables

A=W/4+W/2×L_2/L_0−W/2×L_3/L_1
B=W/4−W/2×L_2/L_0−W/2×L_3/L_1
C=W/4−W/2×L_2/L_0+W/2×L_3/L_1
D=W/4+W/2×L_2/L_0+W/2×L_3/L_1

Use the load calculating formula shown above and find the load to be applied to each table from the use conditions.

W = load = 100 kgf
L_0、L_1、L_2、L_3 = distance between load application point and each table
Find A, B, C and D (load to be applied to each table) from L_0 = L_1 = L_2 = L_3 = 200 mm.
A=100/4+100/2×200/200−100/2×200/200=25
B=100/4−100/2×200/200−100/2×200/200=−75
C=100/4−100/2×200/200+100/2×200/200=25
D=100/4+100/2×200/200+100/2×200/200=125
Select the proper shift tables so that the values of A, B, C and D are within the ranges of values in the allowable load table shown in the description.
A = 25 kg (erecting)
B = -75 kg (hanging) ※See the hanging values for negative values.
C = 25 kg (erecting)
D = 125 kg (erecting)
As a result, the STF28 is selected from the allowable load table.



Allowable load with simple load (Unit: N {kgf})

Part No.	Load type	Installation condition		
		Erecting	Lateral	Hanging
STC20	Allowable static load	10,800 {1,100}	——	——
	Allowable dynamic load	3,430 { 350}	——	——
STC28・STF28	Allowable static load	17,700 {1,800}	4,410 { 450}	3,920 { 400}
	Allowable dynamic load	5,880 { 600}	1,470 { 150}	1,270 { 130}
STF38	Allowable static load	31,400 {3,200}	7,850 { 800}	7,360 { 750}
	Allowable dynamic load	10,800 {1,100}	2,650 { 270}	2,450 { 250}
STF48	Allowable static load	44,100 {4,500}	13,700 {1,400}	11,800 {1,200}
	Allowable dynamic load	14,700 {1,500}	4,410 { 450}	3,920 { 400}

- Allowable static load: Allowable load when it is born in the stationary condition or at quite low speed near stopping (not more than 0.0017 m/s [0.1 m/min.])
- Allowable dynamic load: Allowable load in the condition with sliding speed of 1.0 m/s [60 m/min] or less.
- Do not use the STC20 in the lateral or hanging condition.

② Calculating driving force

F=(μ_1|A|+μ_2|B|+μ_3|C|+μ_4|D|+nFs+nMs)×S

Find the driving force from the use conditions using the above formula.

Type	S Type		
Installation condition	Erecting	Lateral	Hanging
Coefficient of friction μ	0.15	0.17	0.30

※Do not use the STC20 in the lateral or hanging condition.

F = driving force
S = safety factor (2 in this example)
μ^1, μ^2, μ^3, μ^4 = coefficient of friction of each table
μ^1 = 0.15 (erecting)
μ^2 = 0.30 (hanging)
μ^3 = 0.15 (erecting)
μ^4 = 0.15 (erecting)
A, B, C and D = load applied to each table
A = 25 kgf
B = -75 kgf
C = 25 kgf
D = 125 kgf
n = number of tables = 4
Fs = seal friction = 1.2 kgf
The value of F is obtained as shown below:
F = (0.15 × 25 + 0.3 × 75 + 0.15 × 25 + 0.15 × 125 + 4 × 1.2) × 2 ≒ 107 kgf

③ Calculating service life

N = a×K×(1/2S)×(Wa/Wi)×fc/(fw×fv×fe×fℓ)

Find the service life from the use conditions using the above formula.

N = service life = required service life (1 million cycles)
a = allowable wear amount = 0.1 mm
K = coefficient of friction = 5 x 10^6
S = stroke = 0.25 m
Wa = allowable load = 130 kgf (Hanging STF28)
Wi = applied load = 75 kgf (Value closest to the allowable load: Select the severest one among the loads found with the load calculating formula.)
fc = contact factor = 0.75 (Two single-axis units)
fw = load factor = 1.0 (No impact load)
fv = velocity factor = 1.0 (0.05 m/s)
fe = environmental factor=1.0 (60˚C or less, no foreign matter)
fl = lubrication factor = 1.0 (No lubrication)
The value of N is found as shown below:
N = 0.1 × 5 × 10^6 × 1 × (2 × 0.25) × (130/75) × 0.75/ (1.0 × 1.0 × 1.0 × 1.0) = 1,300,000
The required service life of 1 million cycles is satisfied.