A-Ⅱ Technical Description of NSK Linear Guides

A-Ⅱ-1 Accuracy

A-Ⅱ-1.1 Accuracy Standard

• Table Ⅱ-1•1, Figure Ⅱ-1•1 and Figure Ⅱ-1•2 show accuracy characteristics.

Table Ⅱ-1•1 Definition of accuracy

Characteristics	Definition (Figures Ⅱ-1•1, Ⅱ-1•2)
Mounting height *H*	Distance from A (rail bottom datum face) to C (ball slide top face)
Variation of *H*	Variation of *H* between assembled ball slides installed in the rails of a set of linear guide
Mounting width W_2 or W_3	Distance from B (rail side datum face) to D (ball slide side datum face). Applicable only to the reference linear guide.
Variation of W_2 or W_3	Difference of the width (W_2 or W_3) between the assembled ball slides which are installed in the same rail. Applicable only to the reference linear guide.
Running parallelism of ball slide, face C to face A	Variation of C (ball slide top face) to A (rail bottom datum face) when ball slide is moving.
Running parallelism of ball slide, face D to face B	Variation of D (ball slide side datum face) to B (rail side datum face) when a ball slide is moving.

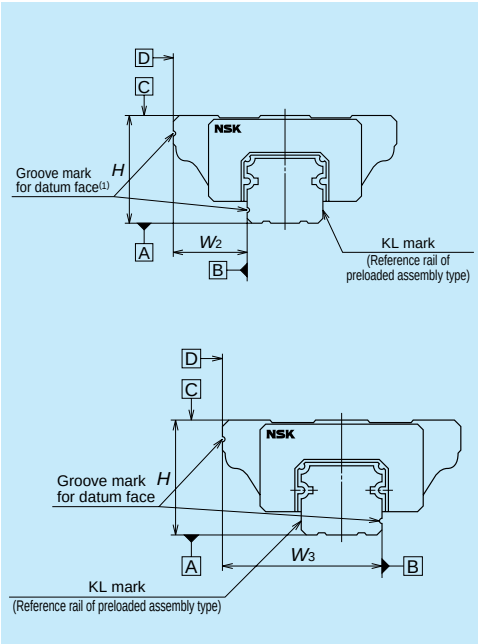


Fig. Ⅱ-1.1 Assembled accuracy (Height and width)

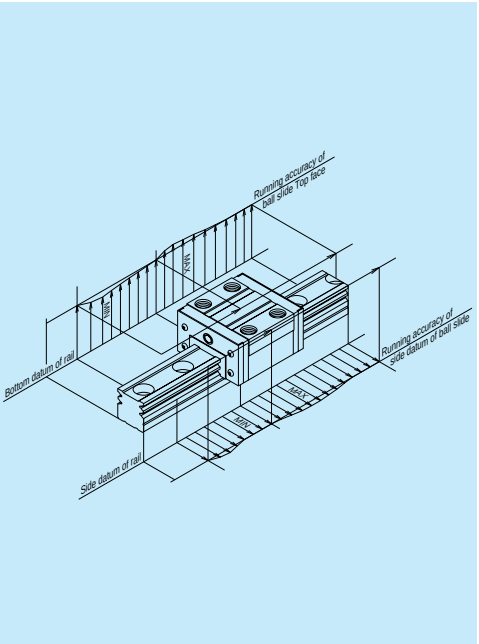


Fig. Ⅱ-1.2 Running parallelism of ball slide

Mounting width: W_2, W_3

• Mounting width differs depending on the arrangement of the datum faces of the rail and ball slide on the reference linear guide (indicated as KL on the rail). (Fig. Ⅱ-1•3 and Fig. Ⅱ-1•4)

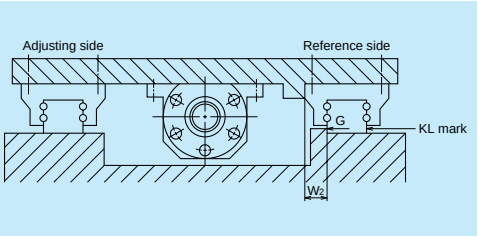


Fig. Ⅱ-1•3 Mounting width W_2

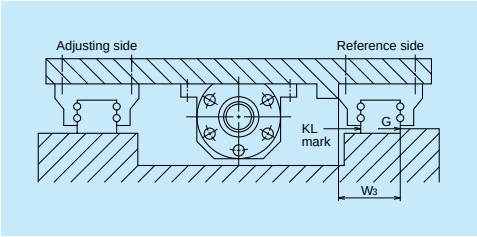


Fig. Ⅱ-1•4 Mounting width W_3

A-Ⅱ-1.2 Running Parallelism of Ball Slide

• Running parallelism of ball slide is common in all series. Specifications of all accuracy grades are shown in Table Ⅱ-1•2.

However, applicable accuracy grades differ by series. Please refer to "**Table Ⅰ-3.1 Accuracy grade and applicable series**" on page A20.

Table Ⅱ-1•2 Running parallelism of ball slide

Unit: μm

	Preloaded assembly (Non-interchangeable)					Interchangeable type
Rail over all length (mm)	Ultra precision P3	Super precision P4	High precision P5	Precision grade P6	Normal grade PN	Normal grade PC
~50	2	2	2	6	12	12
50~80	2	2	3	7	13	13
80~125	2	2	3.5	8	14	14
125~200	2	2	4	9	15	15
200~250	2	2.5	5	10	17	17
250~315	2	2.5	5	11	17	17
315~400	2	3	6	11	18	18
400~500	2	3	6	12	19	19
500~630	2	3.5	7	13	20	20
630~800	2	4.5	8	14	22	22
800~1000	2.5	5	9	16	23	23
1000~1250	3	6	10	17	25	25
1250~1600	4	7	11	19	27	27
1600~2000	4.5	8	13	21	29	29
2000~2500	5	10	15	22	31	31
2500~3150	6	11	17	25	33	33
3150~4000	9	16	23	30	38	38

A-Ⅱ-1.3 Accuracy Standard in Each Series

LH, LS, LA, LY, LW Series

Table Ⅱ-1.3 shows accuracy standards of the preloaded assembly in LH, LS, LA, LY and LW Series. Table Ⅱ-1.4 shows accuracy standards of LH Series interchangeable type. Table Ⅱ-1•5 shows accuracy standards of LS and LW Series interchangeable type.

Table Ⅱ-1•3 Tolerance of preloaded assembly in LH, LS, LA, LY and LW Series Unit: μm

Characteristic \ Accuracy grade	Ultra precision P3	Super precision P4	High precision P5	Precision grade P6	Normal grade PN
Mounting height *H* Variation of *H* (all ball slides installed in rails for a set of linear guides)	±10 3	±10 5	±20 7	±40 15	±80 25
Mounting width W_2 or W_3 Variation of W_2 or W_3 (all ball slides on the reference linear guide)	±15 3	±15 7	±25 10	±50 20	±100 30
Running parallelism of ball slide, face C to face A Running parallelism of ball slide, face D to face B	Refer to Table Ⅱ-1•2, Figure Ⅱ-1•5 and Figure Ⅱ-1•6				

Table Ⅱ-1•4 Tolerance of interchangeable type in LH Series • Normal grade (PC) Unit: μm

	Characteristic \ Model No.	LH20	LH25, 30, 35	LH45, 55, 65
Interchangeable type with clearance	Mounting height *H* Variation of *H*	±30 60	±35 70	±45 90
	Mounting width W_2 or W_3 Variation of width W_2 or W_3	±40 80	±40 80	±50 100
	Running parallelism of ball slide, face C to face A Running parallelism of ball slide, face D to face B	Refer to Table Ⅰ-1•2, Figure Ⅰ-3•1, Figure Ⅰ-3•2		
Interchangeable type with preload	Mounting height *H* Variation of *H*	±30 60		
	Mounting width W_2 or W_3 Variation of W_2 or W_3 (W_2 or W_3)	±40 80		±50 100
	Running parallelism of ball slide, face C to face A running parallelism, face C to face B	Refer to Table Ⅱ-1•2, Figure Ⅱ-1•5 and Figure Ⅱ-1•6		

Table Ⅱ-1.5 Tolerance of interchangeable type in LS and LW Series • Normal grade (PC) Unit: μm

Characteristic \ Model No.	LS15, 20, 25, 30, 35 LW17, 21, 27, 35, 50
Mounting height *H* Variation of *H*	±30 60
Mounting width W_2 or W_3 Variation of width W_2 or W_3	±30 60
Running parallelism of ball slide, face C to face A Running parallelism of ball slide, face D to face B	Refer to Table Ⅱ-1•2, Figure Ⅱ-1•5 and Figure Ⅱ1•6

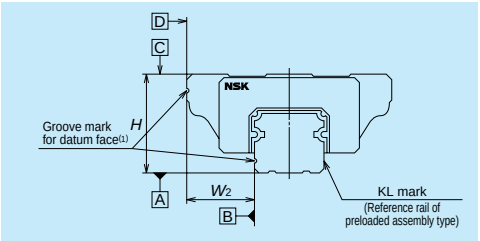


Fig Ⅱ-1•5 Mounting width (W_2)

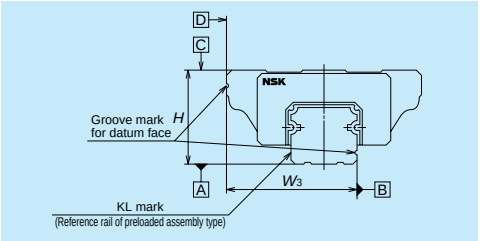


Fig Ⅱ-1•6 Mounting width (W_3)

LE, LU Series

Table Ⅱ-1•6 shows tolerance of preloaded assembly in LE and LU Series. Table Ⅱ-1•7 shows tolerance of LE and LU Series intercahngeable type.

Table Ⅱ-1•6 Tolerance of preloaded assembly in LE and LU Series Unit: μm

Characteristic \ Accuracy grade	Super precision P4	High precision P5	Precision grade P6	Normal grade PN
Mounting height *H* Variation of *H* (all ball slides installed in rails for a set of linear guides)	±10 5	±15 7	±20 15	±40 25
Mounting width W_2 or W_3 Variation of W_2 or W_3 (all ball slides on the reference linear guide)	±15 7	±20 10	±30 20	±50 30
Running parallelism of ball slide, face C to face A Running parallelism of ball slide, face D to face B	Refer to Table Ⅱ-1•2, Figure Ⅱ-3•7 and Figure Ⅱ-1•8			

Table Ⅱ-1•7 Tolerance of interchangeable type in LE and LU Series Normal grade (PC) Unit: μm

Characteristic \ Model No.	LU09, 12, 15 LE09, 12, 15
Mounting height *H* Variation of *H*	±20 40
Mounting width W_2 or W_3 Variation of width W_2 or W_3	±20 40
Running parallelism of ball slide, face C to face A Running parallelism of ball slide, face D to face B	Refer to Table Ⅰ-1•2, Fig. Ⅱ-3•7 and Fig. Ⅱ-1•8

Indication of idatum face in LE and LU Series is different from other series. Refer to Table Ⅱ-1•8.

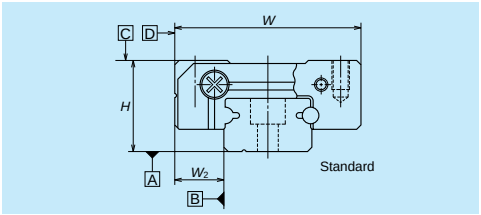


Fig. Ⅱ-1•7 Mounting width (W_2)

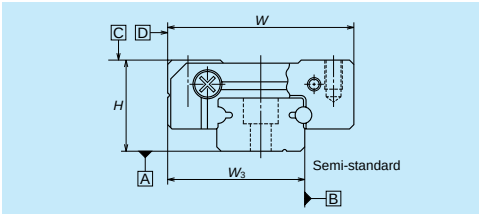
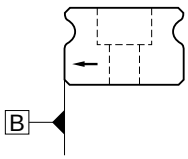
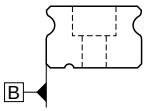
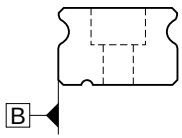
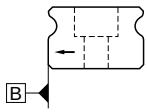


Fig. Ⅱ-1•8 Mounting width (W_3)

Table Ⅱ-1.8 Indication of rail datum face in LE and LU Series

Material \ Model No.	LU05,07, 09 LE05, 07, 09, 12	LU12, 15	LE15 LE09,12 (with a ball retainer)
Special high carbon steel			
Stainless steel			

LL Series

Table Ⅱ-1•9 shows tolerance of LL Series.

Table Ⅱ-1•9 Tolerance of LL Series
Normal grade (PN)

Unit: μm

Characteristic \ Model No.	LL15
Mounting height	±20
Running parallelism, face C to face A	20
Running parallelism, face D to face B	(See Fig. Ⅱ-1•9)

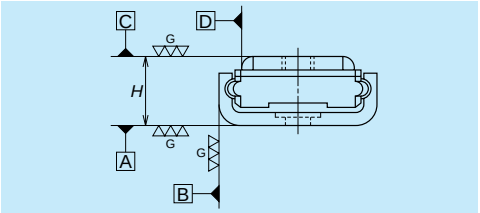


Fig. Ⅱ-1•9 Standard LL

A-Ⅱ-2 Preload and Rigidity

A-Ⅱ-2.1 Preload and rigidity

- In NSK linear guides, slight size changes of balls, which are going to be inserted in the ball slide, controls clearance and amount of preload.
- In NSK linear guide, rigidity is further increased and elastic deformation is reduced by applying preload.
- In general, a load range in which the preload is effective becomes about 2.8 times of the preload (Fig. Ⅱ-2•1).
- Fig. Ⅱ-2•2 shows the relationship of ball slide deformation by external vertical load and preload. LY35 is used as a case.
- The following show the definition of linear guide rigidity.

1) Radial rigidity: Rigidity of vertical and lateral directions -- up/down and right/left (Fig. Ⅱ-2•3).
2) Moment rigidity: Three moment directions -- pitching, rolling, and yawing (Fig. Ⅱ-2•4).

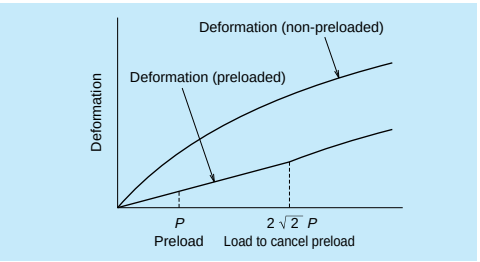


Fig. Ⅱ-2•1 Elastic deformation

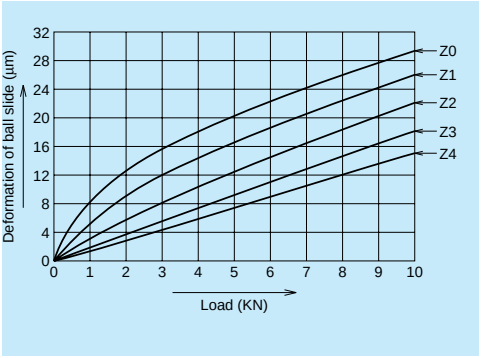


Fig. Ⅱ-2•2 Rigidity of LY35, downward direction load (example)

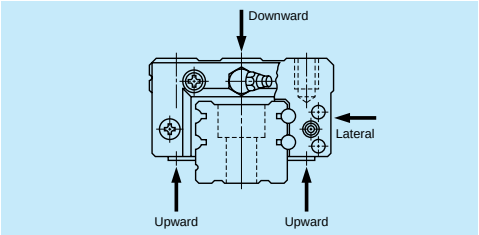


Fig. Ⅱ-2•3 Radial rigidity

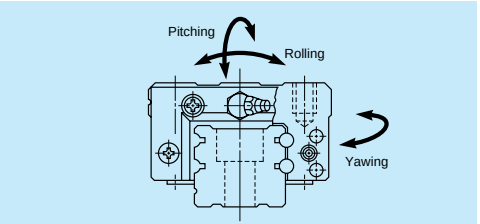


Fig. Ⅱ-2•4 Moment rigidity

- Since two rails and four ball slides are used in general as a pair, considering only the radial rigidity is sufficient.
- However, in cases as shown in Fig. Ⅱ-2•5, Fig. Ⅱ-2•6 and Fig. Ⅱ-2•7, it is necessary to take into account the moment rigidity in addition to the radial rigidity.

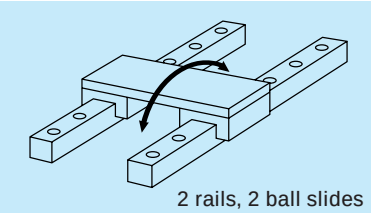


Fig. Ⅱ-2•5 Pitching direction

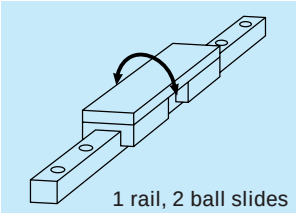


Fig. Ⅱ-2•6 Rolling direction

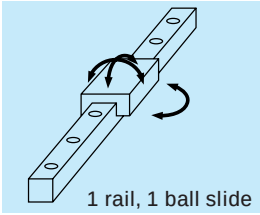


Fig. Ⅱ-2•7 All directions

A-Ⅱ-2.2 Preload and Rigidity of Each Series

LH Series (Preloaded assembly)

Table Ⅱ-2•1 shows preload and rigidity of preloaded assembly of LH Series.

Table Ⅱ-2•1 Preload and rigidity of preloaded assembly of LH Series

	Model No.	Preload N [kgf]		Rigidity N/μm [kgf/μm]			
				Vertical directions		Lateral direction	
		Slight preload Z1	Medium preload Z3	Slight preload Z1	Medium preload Z3	Slight preload Z1	Medium preload Z3
High load type	LH20 AN,EL,FL	147 [15]	835 [85]	186 [19]	335 [34]	137 [14]	245 [25]
	LH25 AN,EL,FL	196 [20]	1270 [130]	206 [21]	380 [39]	147 [15]	284 [29]
	LH30 AN	245 [25]	1570 [160]	216 [22]	400 [41]	157 [16]	294 [30]
	LH30 EL,FL	294 [30]	1770 [180]	265 [27]	480 [49]	186 [19]	355 [36]
	LH35 AN,EL,FL	390 [40]	2350 [240]	305 [31]	560 [57]	216 [22]	390 [40]
	LH45 AN,EL,FL	635 [65]	3900 [400]	400 [41]	745 [76]	284 [29]	540 [55]
	LH55 AN,EL,FL	980 [100]	5900 [600]	490 [50]	910 [93]	345 [35]	645 [66]
	LH65 AN,EL,FL	1470 [150]	8900 [910]	580 [59]	1070 [109]	400 [41]	755 [77]
Super high load type	LH20 BN,GL,HL	196 [20]	1080 [110]	265 [27]	480 [49]	196 [20]	355 [36]
	LH25 BN,GL,HL	245 [25]	1570 [160]	294 [30]	560 [57]	216 [22]	400 [41]
	LH30 BN,GL,HL	390 [40]	2260 [230]	360 [37]	665 [68]	265 [27]	480 [49]
	LH35 BN,GL,HL	490 [50]	2940 [300]	430 [44]	795 [81]	305 [31]	570 [58]
	LH45 BN,GL,HL	785 [80]	4800 [490]	520 [53]	960 [98]	370 [38]	695 [71]
	LH55 BN,GL,HL	1180 [120]	7050 [720]	635 [65]	1170 [119]	440 [45]	835 [85]
	LH65 BN,GL,HL	1860 [190]	11300 [1150]	805 [82]	1480 [151]	550 [56]	1040 [106]
	LH85 BN,GL,HL	2840 [290]	16800 [1710]	1020 [104]	1870 [191]	695 [71]	1300 [133]

Clearance for fine clearance Z0 is 0 ~ 3μm. Therefore, preload is zero.

LH Series (interchangeable type)

Table Ⅱ-2•2 shows clearance and preload of interchangeable in LH Series.

Table Ⅱ-2•2 Clearance and preload of interchangeable type in LH Series

Unit: μm

Model No.	Fine clearance	Slight preload
	ZT	ZZ
LH20	–5〜15	–5〜0
LH25		–5〜0
LH30		–7〜0
LH35		–7〜0
LH45		–7〜0
LH55		–9〜0
LH65		–9〜0

Negative sign indicates preload volume.

LS Series (Preloaded assembly)

Table Ⅱ-2•3 shows preload and rigidity o of LS Series.

Table Ⅱ-2•3 Preload and rigidity of preloaded assembly in LS Series

	Model No.	Preload N [kgf]		Rigidity N/μm [kgf/μm]			
				Vertical directions		Lateral direction	
		Slight preload Z1	Medium preload Z3	Slight preload Z1	Medium preload Z3	Slight preload Z1	Medium preload Z3
High load type	LS15 AL,EL,FL	69 [7]	390 [40]	127 [13]	226 [23]	88 [9]	167 [17]
	LS20 AL,EL,FL	88 [9]	540 [55]	147 [15]	284 [29]	108 [11]	206 [21]
	LS25 AL,EL,FL	147 [15]	880 [90]	206 [21]	370 [38]	147 [15]	275 [28]
	LS30 AL,EL,FL	245 [25]	1370 [140]	255 [26]	460 [47]	186 [19]	345 [35]
	LS35 AL,EL,FL	345 [35]	1960 [200]	305 [31]	550 [56]	216 [22]	400 [41]
Medium load type	LS15 CL,JL,KL	49 [5]	294 [30]	78 [8]	147 [15]	59 [6]	108 [11]
	LS20 CL,JL,KL	69 [7]	390 [40]	108 [11]	186 [19]	78 [8]	137 [14]
	LS25 CL,JL,KL	98 [10]	635 [65]	127 [13]	235 [24]	88 [9]	177 [18]
	LS30 CL,JL,KL	147 [15]	980 [100]	147 [15]	275 [28]	108 [11]	206 [21]
	LS35 CL,JL,KL	245 [25]	1370 [140]	186 [19]	335 [34]	137 [14]	245 [25]

Clearance for fine clearance Z0 is 0 ~3μm. Therefore, preload is zero.
However, Z0 of PN grade is 0 ~15μm.

LS Series (Interchangeable type)

Table Ⅱ-2•4 shows clearance of interchangeable type of LS Series.

Table Ⅱ-2•4 Preload and clearance of interchangeable type of LS Series Unit: μm

Model No.	Fine clearance	Slight preload
	ZT	ZZ
LS15	–4〜15	–4〜0
LS20	–4〜15	–4〜0
LS25	–5〜15	–5〜0
LS30	–5〜15	–5〜0
LS35	–5〜15	–6〜0

Negative sign indicates preload volume.

LA Series

Table Ⅱ-2•5 shows preload and rigidity of LA Series.
LA Series has two types of preload Z3 (medium preload) and Z4 (heavy preload).

Table Ⅱ-2•5 Preload and rigidity of LA Series

	Model No.	Preload N [kgf]		Rigidity N/μm [kgf/μm]	
		Medium preload Z3	Heavy preload Z4	Medium preload Z3	Heavy preload Z4
High load type	LA30 AN, EL, FL	2450 [250]	3140 [320]	705 [72]	835 [85]
	LA35 AL, AN, EL, FL	3450 [350]	4300 [440]	825 [84]	970 [99]
	LA45 AL, AN, EL, FL	5050 [515]	6350 [650]	1100 [112]	1240 [126]
	LA55 AL, AN, EL, FL	8100 [825]	10200 [1040]	1400 [143]	1540 [157]
	LA65 AN, EL, FL	13800 [1410]	18800 [1920]	1730 [176]	2030 [207]
Super high load type	LA30 BN, GL, HL	3250 [330]	4050 [415]	1000 [102]	1180 [120]
	LA35 BL, BN, GL, HL	4450 [455]	5650 [575]	1200 [122]	1400 [143]
	LA45 BL, BN, GL, HL	6150 [630]	7750 [790]	1450 [148]	1640 [167]
	LA55 BL, BN, GL, HL	9550 [975]	12100 [1230]	1840 [188]	2020 [206]
	LA65 BN, GL, HL	18000 [1840]	24400 [2490]	2450 [250]	2840 [290]

LY Series

Table Ⅱ-2•6 shows preload and rigidity of LY Series.

Table Ⅱ-2•6 Preload and rigidity of LY Series

	Model No.	Preload N [kgf]				Rigidity N/μm [kgf/μm]			
		Slight preload Z1	Light preload Z2	Medium preload Z3	Heavy preload Z4	Slight preload Z1	Light preload Z2	Medium preload Z3	Heavy preload Z4
High load type	LY15 AL,AN,EL,FL	59 [6]	147 [15]	294 [30]	– –	98 [10]	137 [14]	167 [17]	– –
	LY20 AL, EL,FL	98 [10]	245 [25]	490 [50]	– –	127 [13]	167 [17]	216 [22]	– –
	LY25 AL,AN,EL,FL	147 [15]	440 [45]	835 [85]	1180 [120]	167 [17]	284 [29]	390 [40]	460 [47]
	LY30 AL,AN,EL,FL	245 [25]	635 [65]	1270 [130]	1770 [180]	196 [20]	325 [33]	480 [49]	580 [59]
	LY35 AL,AN,EL,FL	345 [35]	880 [90]	1770 [180]	2450 [250]	245 [25]	360 [37]	580 [59]	655 [67]
	LY45 AL,AN,EL,FL	490 [50]	1270 [130]	2550 [260]	3600 [370]	315 [32]	500 [51]	735 [75]	860 [88]
	LY55 AL,AN,EL,FL	785 [80]	1960 [200]	3900 [400]	5600 [570]	370 [38]	600 [61]	880 [90]	1020 [104]
	LY65 AN,EL,FL	1670 [170]	4200 [430]	8450 [860]	11800 [1200]	560 [57]	910 [93]	1340 [137]	1560 [159]
Super high load type	LY20 BL, GL,HL	98 [10]	294 [30]	590 [60]	– –	147 [15]	216 [22]	275 [28]	– –
	LY25 BL,BN,GL,HL	196 [20]	540 [55]	1080 [110]	1570 [160]	226 [23]	360 [37]	540 [55]	645 [66]
	LY30 BL,BN,GL,HL	294 [30]	785 [80]	1570 [160]	2160 [220]	245 [25]	400 [41]	610 [62]	695 [71]
	LY35 BL,BN,GL,HL	440 [45]	1080 [110]	2160 [220]	2940 [300]	305 [31]	450 [46]	685 [70]	805 [82]
	LY45 BL,BN,GL,HL	635 [65]	1570 [160]	3150 [320]	4400 [450]	400 [41]	625 [64]	940 [96]	1100 [112]
	LY55 BL,BN,GL,HL	980 [100]	2450 [250]	5000 [510]	6950 [710]	470 [48]	755 [77]	1140 [116]	1340 [137]
	LY65 BN,GL,HL	2260 [230]	5600 [570]	11300 [1150]	15700 [1600]	805 [82]	1280 [131]	1920 [196]	2230 [227]

Clearance for fine clearance Z0 is 0 ~ 3μm. Therefore, preload is zero.

LW Series (Preloaded assembly)

Table Ⅱ-2•7 shows preload and rigidity of preloaded assembly of LW Series.
Rigidities are for the median of the preload range.

Table Ⅱ-2•7 Preload and rigidity of LW Series

Model No.	Preload N [kgf]		Rigidity N/μm [kgf/μm]	
	Slight preload Z1	Medium preload Z3	Slight preload Z1	Medium preload Z3
LW17 EL	0〜245 [0〜25]	– –	156 [16]	– –
LW21 EL	0〜294 [0〜30]	– –	181 [18]	– –
LW27 EL	0〜390 [0〜40]	– –	226 [23]	– –
LW35 EL	0〜490 [0〜50]	785 [80]	295 [30]	440 [45]
LW50 EL	0〜590 [0〜60]	1470 [150]	345 [35]	600 [61]

Clearance of fine clearance Z0 is 0 ~3μm. Therefore, preload is zero.
However, Z0 of PN Grade is 3 ~15μm.

LW Series (Interchangeable type)

Table Ⅱ-2•8 shows in LW Series.

Table Ⅱ-2•8 Clearance of interchangeable type in LW Series

Unit: μm

Model No.	Fine clearance
	ZT
LW17	–3〜15
LW21	–3〜15
LW27	–4〜15
LW35	–5〜15
LW50	–5〜15

LE Series (Preloaded assembly)

Table Ⅱ-2•9 shows preload and rigidity of preloaded assembly of LE Series. Rigidities are for the median of the preload range.

Table Ⅱ-2•9 Preload and rigidity of LE Series

	Model No.	Preload N [kgf]	Rigidity N/μm [kgf/μm]
		Slight preload Z1	Slight preload Z1
High load type	LE05 AL	0~22 [0~2.3]	36 [3.5]
	LE07 TL	0~29 [0~3]	46 [4.5]
	LE09 AL,TL LE09 AR,TR	0~37 [0~3.8]	61 [6]
	LE12 AL LE12 AR	0~40 [0~4.1]	63 [6.5]
	LE15 AL,AR	0~49 [0~5]	66 [6.5]
Medium load type	LE05 CL	0~19 [0~1.9]	29 [3]
	LE07 SL	0~20 [0~2]	28 [3]
	LE09 CL,SL	0~20 [0~2]	33 [3.5]
	LE12 CL	0~23 [0~2.3]	36 [3.5]
	LE15 CL	0~29 [0~3]	44 [4.5]
Super high load type	LE07 UL	0~43 [0~4.4]	71 [7]
	LE09 BL,UL	0~49 [0~5]	86 [9]
	LE12 BL	0~59 [0~6]	97 [10]
	LE15 BL	0~78 [0~8]	114 [12]

Clearance of fine clearance Z0 is 0 ~3μm. Therefore, preload is zero.
However, Z0 of PN grade is 3 ~10μm.

LE Series (Interchangeable type)

Table Ⅱ-2•10 shows clearance of interchangeable type of LE Series.

Table Ⅱ-2•10 Clearance of interchangeable type of LE Series

Unit: μm

Model No.	Fine clearance
	ZT
LE09	0~15
LE12	
LE15	

LU Series (Preloaded assembly)

Table Ⅱ-2•11 shows preload and rigidity of preloaded assembly of LU Series.
Rigidities are for the median of the preload range.

Table Ⅱ-2•11 Preload and rigidity of LU Series

	Model No.	Preload N [kgf]	Rigidity N/μm [kgf/μm]
		Slight preload Z1	Slight preload Z1
High load type	LU05 TL	0~3.5 [0~0.34]	15 [1.5]
	LU07 AL	0~8 [0~0.8]	22 [2]
	LU09 AL,TL	0~12 [0~1.2]	26 [2.5]
	LU09 AR,TR	0~10 [0~1.0]	30 [3.5]
	LU12 AL,TL	0~17 [0~1.7]	33 [3.5]
	LU12 AR,TR	0~17 [0~1.7]	33 [3.5]
	LU15 AL	0~33 [0~3.4]	45 [4.5]
Super high load type	LU09 BL,UL	0~17 [0~1.7]	43 [4.5]
	LU12 BL,UL	0~25 [0~2.5]	52 [5]
	LU15 BL	0~51 [0~5.2]	75 [7.5]

Clearance of fine clearance Z0 is 0 ~3μm. Therefore, preload is zero.
However, Z0 of PN grade is 3 ~10μm.

LU Series (Interchangeable type)

Table Ⅱ-2•12 shows clearance of interchangeable type of LU Series

Table Ⅱ-2•12 Clearance of interchangeable type of LU Series

Unit: μm

Model No.	Fine clearance
	ZT
LU09	0~15
LU12	
LU15	

LL Series

Table Ⅱ-2•13 shows clearance of LL Series

Table Ⅱ-2•13 Radial clearance

Unit: μm

Model No.	Clearance
LL15	0~10

A-Ⅱ-2.3 Calculating Friction Force by Preload

- Dynamic friction force per one ball slide of the linear guide can be calculated from preload vlue.
- The followings is a simple calculation to obtain the criterion of dynamic friction force.
  For slight preload ZZ of interchangeable type with preload , use preload volume of slight preload Z1 of preloaded assembly.

$F = iP$

F: Dynamic friction force(N)
P: Preload (N)
i: Contact coefficient

Use the following contact coefficient values (i).
LH/LS, LW Series : 0.004
LA Series : 0.012
LY, LE, LU Series : 0.026

- The starting friction force when the ball slide begins to move depends on lubrication condition. Roughly estimate it at 1.5 to 2 times of the dynamic friction obtained by the above method.

Calculation example

In case of LH35AN - Z3
i = 0.004
P = 2350 (N) (from Table Ⅱ-2•1)
$F = iP$
= 0.004 x 2350 = 9.4 (N)
Therefore, the criteria of the dynamic friction force of LH35AN - Z3 is 9.4 N.

For seal friction, refer to "**A-Ⅱ-5 Dust Proof of Linear Guide**."

A-Ⅱ-3 Rating Life

A-Ⅱ-3.1 Rating Life and Basic Load Rating

(1) Life

Although used in appropriate conditions, the linear guide deteriorates after a certain period of operation, and eventually becomes unusable. In broad definition, the period until the linear guide becomes unusable is called "life." There are "fatigue life " caused by flaking, and "life of accuracy deterioration" which is caused by wear.

(2) Rating fatigue life

When the linear guide runs under load, the balls and the rolling contact surface of the grooves are exposed to repetitive load. This brings about fatigue to the material, and generates flaking. Flaking is scale-like damage to the surface of the ball groove.

Total running distance until first appearance of flaking is called "fatigue life." This is "life" in the narrow sense. Fatigue life varies significantly even in linear guides produced in the same lot, and even when they are operated under the same conditions. This is attributable to the inherent variation of the fatigue of the material itself.

"Rating fatigue life" is the total running distance which allows 90% of the group of linear guides of the same reference number to run without causing flaking when they are independently run under the same conditions. Rating fatigue life is sometimes indicated by total operating hours when the linear guides run at a certain speed.