3.3. Calculating the Applied Load

The LM Guide is capable of receiving loads and moments in all directions that are generated due to the mounting orientation, alignment, gravity center position of a traveling object, thrust position and cutting resistance.

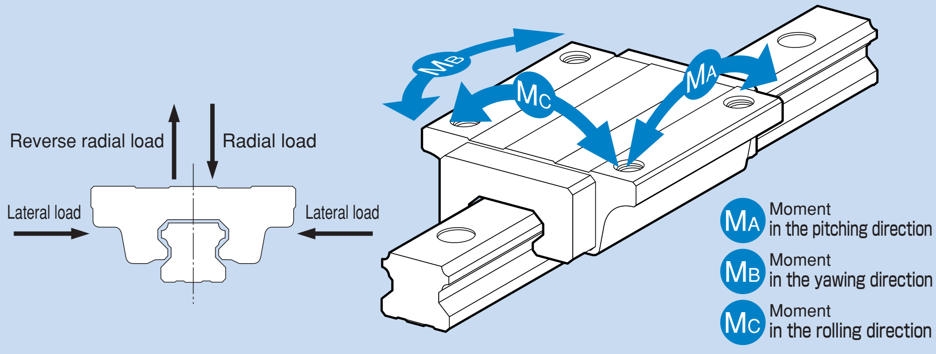
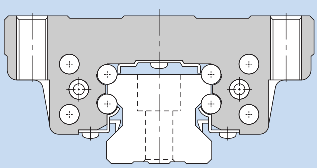
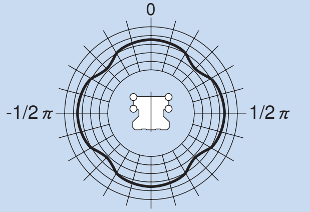
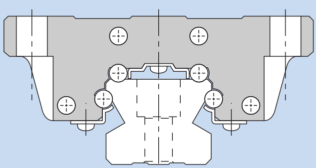
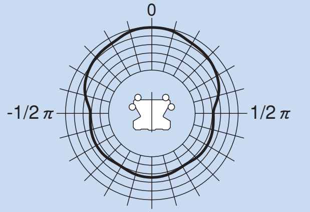


Fig. 1 Directions of Applied Loads on the LM Guide

3.3.1. Rated Load of an LM Guide® in Each Direction

The LM Guide is categorized into roughly two types: the 4-way equal-load type, which has the same rated load in the radial, reverse-radial and lateral directions, and the radial type, which has a large rated load in the radial direction. With the radial type LM Guide, the rated load in the radial direction is different from that in the reverse-radial and lateral directions. When such loads are applied, multiply the basic load rating in the "THK General Catalog - Product Specifications," provided separately, by the corresponding factor. Those factors are specified in the respective sections.

Rated Load in Each Direction

Type	Load distribution curve
4-way equal-load type 	
Radial type 	

3.3.2. Calculating an Applied Load

Single-Axis Use

●Moment Equivalence

When the installation space for the LM Guide is limited, you may have to use only one LM block, or two LM blocks closely contacting with each other. In such a setting, the load distribution is not uniform and, as a result, an excessive load is applied in localized areas (i.e., rail ends) as shown in Fig. 2. Continued use under such conditions may result in flaking in those areas, consequently shortening the service life. In such a case, calculate the actual load by multiplying the moment value by any one of the equivalent-moment factors specified in Tables 1 to 8.

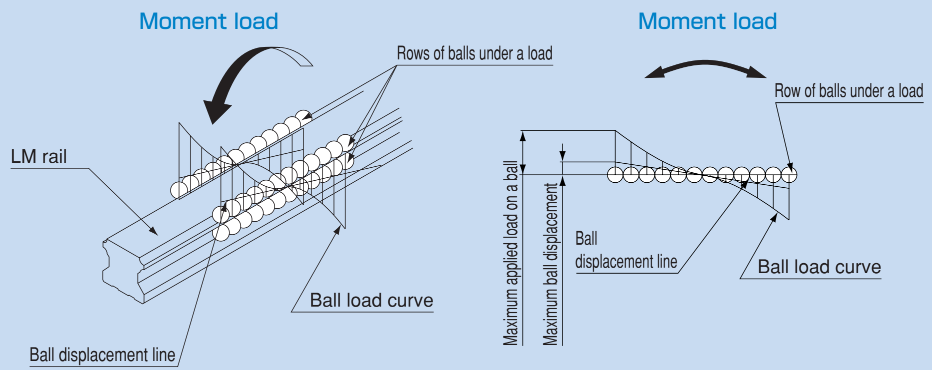


Fig. 2 Ball Load when a Moment is Applied

An equivalent-load equation applicable when a moment acts on an LM Guide is shown below.

$$P=K \cdot M$$

P : Equivalent load per LM Guide (N)
K : Equivalent moment factor
M : Load moment (N・mm)

●Equivalent Factor

Since the rated load is equivalent to the permissible moment, the equivalent factor to be multiplied when equalizing the M_A, M_B and M_C moments to the applied load per block is obtained by dividing the rated loads in the corresponding directions.

With those models other than 4-way equal-load types, however, the rated loads in the 4 directions differ from each other. Therefore, the equivalent factor values for the M_A and M_C moments also differ depending on whether the direction is radial or reverse-radial.

Equivalent factors for the M_A moment

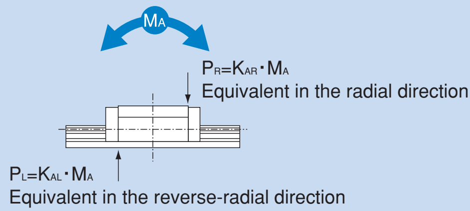


Fig. 3 Equivalent Factors for the M_A Moment

Equivalent factors for the M_A moment

- Equivalent factor in the radial direction $K_{AR}=\frac{C_0}{M_A}$
- Equivalent factor in the reverse-radial direction $K_{AL}=\frac{C_{0L}}{M_A}$

$$\frac{C_0}{K_{AR}\cdot M_A}=\frac{C_{0L}}{K_{AL}\cdot M_A}=1$$

Equivalent factors for the M_B moment

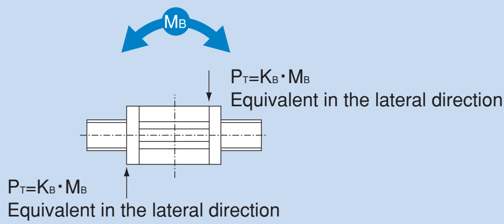


Fig. 4 Equivalent Factors for the M_B Moment

Equivalent factors for the M_B moment

- Equivalent factor in the lateral directions $K_B=\frac{C_{0T}}{M_B}$

$$\frac{C_{0T}}{K_B\cdot M_B}=1$$

Equivalent factors for the M_C moment

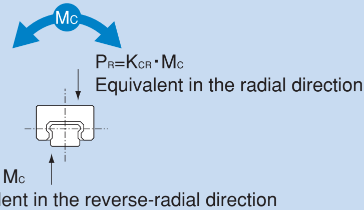


Fig. 5 Equivalent Factors for the M_C Moment

Equivalent factors for the M_C moment

- Equivalent factor in the radial direction $K_{CR}=\frac{C_0}{M_C}$
- Equivalent factor in the reverse-radial direction $K_{CL}=\frac{C_{0L}}{M_C}$

$$\frac{C_0}{K_{CR} \cdot M_C}=\frac{C_{0L}}{K_{CL} \cdot M_C}=1$$

C_0	: Basic load rating (radial direction)	(N)
C_{0L}	: Basic load rating (reverse-radial direction)	(N)
C_{0T}	: Basic load rating (lateral directions)	(N)
P_R	: Calculated load (radial direction)	(N)
P_L	: Calculated load (reverse-radial direction)	(N)
P_T	: Calculated load (lateral directions)	(N)

Table 1 Equivalent Factors (Models SSR, SNR and SNS)

Model No.	Equivalent factor							
	K_{AR1}	K_{AL1}	K_{AR2}	K_{AL2}	K_{B1}	K_{B2}	K_{CR}	K_{CL}
SSR 15XW(TB)	2.08×10^{-1}	1.04×10^{-1}	3.75×10^{-2}	1.87×10^{-2}	1.46×10^{-1}	2.59×10^{-2}	1.71×10^{-1}	8.57×10^{-2}
SSR 15XV	3.19×10^{-1}	1.60×10^{-1}	5.03×10^{-2}	2.51×10^{-2}	2.20×10^{-1}	3.41×10^{-2}	1.71×10^{-1}	8.57×10^{-2}
SSR 20XW(TB)	1.69×10^{-1}	8.46×10^{-2}	3.23×10^{-2}	1.62×10^{-2}	1.19×10^{-1}	2.25×10^{-2}	1.29×10^{-1}	6.44×10^{-2}
SSR 20XV	2.75×10^{-1}	1.37×10^{-1}	4.28×10^{-2}	2.14×10^{-2}	1.89×10^{-1}	2.89×10^{-2}	1.29×10^{-1}	6.44×10^{-2}
SSR 25XW(TB)	1.41×10^{-1}	7.05×10^{-2}	2.56×10^{-2}	1.28×10^{-2}	9.86×10^{-2}	1.77×10^{-2}	1.10×10^{-1}	5.51×10^{-2}
SSR 25XV	2.15×10^{-1}	1.08×10^{-1}	3.40×10^{-2}	1.70×10^{-2}	1.48×10^{-1}	2.31×10^{-2}	1.10×10^{-1}	5.51×10^{-2}
SSR 30XW	1.18×10^{-1}	5.91×10^{-2}	2.19×10^{-2}	1.10×10^{-2}	8.26×10^{-2}	1.52×10^{-2}	9.22×10^{-2}	4.61×10^{-2}
SSR 35XW	1.01×10^{-1}	5.03×10^{-2}	1.92×10^{-2}	9.60×10^{-3}	7.04×10^{-2}	1.33×10^{-2}	7.64×10^{-2}	3.82×10^{-2}
SNR 25	1.16×10^{-1}	7.41×10^{-2}	2.18×10^{-2}	1.40×10^{-2}	7.02×10^{-2}	1.33×10^{-2}	9.09×10^{-2}	5.82×10^{-2}
SNR 25L	8.79×10^{-2}	5.62×10^{-2}	1.82×10^{-2}	1.16×10^{-2}	5.41×10^{-2}	1.13×10^{-2}	9.09×10^{-2}	5.82×10^{-2}
SNR 30	1.02×10^{-1}	6.51×10^{-2}	1.86×10^{-2}	1.19×10^{-2}	6.16×10^{-2}	1.13×10^{-2}	8.11×10^{-2}	5.19×10^{-2}
SNR 30L	7.60×10^{-2}	4.87×10^{-2}	1.55×10^{-2}	9.93×10^{-3}	4.68×10^{-2}	9.58×10^{-3}	8.11×10^{-2}	5.19×10^{-2}
SNR 35	8.92×10^{-2}	5.71×10^{-2}	1.67×10^{-2}	1.07×10^{-2}	5.40×10^{-2}	1.01×10^{-2}	6.73×10^{-2}	4.31×10^{-2}
SNR 35L	7.01×10^{-2}	4.48×10^{-2}	1.37×10^{-2}	8.79×10^{-3}	4.27×10^{-2}	8.41×10^{-3}	6.73×10^{-2}	4.31×10^{-2}
SNR 45	6.55×10^{-2}	4.19×10^{-2}	1.35×10^{-2}	8.62×10^{-3}	4.03×10^{-2}	8.32×10^{-3}	5.10×10^{-2}	3.27×10^{-2}
SNR 45L	5.32×10^{-2}	3.41×10^{-2}	1.10×10^{-2}	7.01×10^{-3}	3.26×10^{-2}	6.73×10^{-3}	5.10×10^{-2}	3.27×10^{-2}
SNR 55	5.85×10^{-2}	3.74×10^{-2}	1.13×10^{-2}	7.24×10^{-3}	3.56×10^{-2}	6.92×10^{-3}	4.36×10^{-2}	2.79×10^{-2}
SNR 55L	4.55×10^{-2}	2.91×10^{-2}	9.36×10^{-3}	5.99×10^{-3}	2.79×10^{-2}	5.75×10^{-3}	4.36×10^{-2}	2.79×10^{-2}
SNR 65	5.07×10^{-2}	3.25×10^{-2}	9.92×10^{-3}	6.35×10^{-3}	3.09×10^{-2}	6.06×10^{-3}	3.70×10^{-2}	2.37×10^{-2}
SNR 65L	3.58×10^{-2}	2.29×10^{-2}	7.67×10^{-3}	4.91×10^{-3}	2.21×10^{-2}	4.75×10^{-3}	3.70×10^{-2}	2.37×10^{-2}
SNS 25	1.12×10^{-1}	9.42×10^{-2}	2.11×10^{-2}	1.78×10^{-2}	1.02×10^{-1}	1.91×10^{-2}	9.41×10^{-2}	7.90×10^{-2}
SNS 25L	8.52×10^{-2}	7.16×10^{-2}	1.77×10^{-2}	1.48×10^{-2}	7.73×10^{-2}	1.60×10^{-2}	9.41×10^{-2}	7.90×10^{-2}
SNS 30	9.86×10^{-2}	8.28×10^{-2}	1.80×10^{-2}	1.51×10^{-2}	8.93×10^{-2}	1.63×10^{-2}	8.42×10^{-2}	7.07×10^{-2}
SNS 30L	7.37×10^{-2}	6.19×10^{-2}	1.50×10^{-2}	1.26×10^{-2}	6.68×10^{-2}	1.36×10^{-2}	8.42×10^{-2}	7.07×10^{-2}
SNS 35	8.64×10^{-2}	7.26×10^{-2}	1.61×10^{-2}	1.36×10^{-2}	7.83×10^{-2}	1.46×10^{-2}	7.01×10^{-2}	5.89×10^{-2}
SNS 35L	6.80×10^{-2}	5.71×10^{-2}	1.33×10^{-2}	1.12×10^{-2}	6.17×10^{-2}	1.21×10^{-2}	7.01×10^{-2}	5.89×10^{-2}
SNS 45	6.34×10^{-2}	5.33×10^{-2}	1.30×10^{-2}	1.10×10^{-2}	5.75×10^{-2}	1.18×10^{-2}	5.27×10^{-2}	4.43×10^{-2}
SNS 45L	5.17×10^{-2}	4.34×10^{-2}	1.06×10^{-2}	8.94×10^{-3}	4.69×10^{-2}	9.64×10^{-3}	5.27×10^{-2}	4.43×10^{-2}
SNS 55	5.67×10^{-2}	4.76×10^{-2}	1.10×10^{-2}	9.22×10^{-3}	5.14×10^{-2}	9.94×10^{-3}	4.52×10^{-2}	3.80×10^{-2}
SNS 55L	4.42×10^{-2}	3.72×10^{-2}	9.09×10^{-3}	7.64×10^{-3}	4.01×10^{-2}	8.24×10^{-3}	4.52×10^{-2}	3.80×10^{-2}
SNS 65	4.92×10^{-2}	4.13×10^{-2}	9.62×10^{-3}	8.08×10^{-3}	4.46×10^{-2}	8.71×10^{-3}	3.82×10^{-2}	3.21×10^{-2}
SNS 65L	3.47×10^{-2}	2.92×10^{-2}	7.45×10^{-3}	6.26×10^{-3}	3.15×10^{-2}	6.75×10^{-3}	3.82×10^{-2}	3.21×10^{-2}

K_{AR1} : Equivalent factor in the M_A radial direction when one LM block is used

K_{AL1} : Equivalent factor in the M_A reverse-radial direction when one LM block is used

K_{AR2} : Equivalent factor in the M_A radial direction when two LM blocks are used in close contact with each other

K_{AL2} : Equivalent factor in the M_A reverse-radial direction when two LM blocks are used in close contact with each other

K_{B1} : M_B Equivalent factor when one LM block is used

K_{B2} : M_B Equivalent factor when two LM blocks are used in close contact with each other

K_{CR} : Equivalent factor in the M_C radial direction

K_{CL} : Equivalent factor in the M_C reverse-radial direction

Table 2 Equivalent Factors (Models SHS, SHW and SRS)

Model No.	Equivalent factor K_{AR1} K_{AL1}	Equivalent factor K_{AR2} K_{AL2}	Equivalent factor K_{B1}	Equivalent factor K_{B2}	Equivalent factor K_{CR} K_{CL}
SHS 15	1.38×10^{-1}	2.69×10^{-2}	1.38×10^{-1}	2.69×10^{-2}	1.50×10^{-1}
SHS 15L	1.07×10^{-1}	2.22×10^{-2}	1.07×10^{-1}	2.22×10^{-2}	1.50×10^{-1}
SHS 20	1.15×10^{-1}	2.18×10^{-2}	1.15×10^{-1}	2.18×10^{-2}	1.06×10^{-1}
SHS 20L	8.85×10^{-2}	1.79×10^{-2}	8.85×10^{-2}	1.79×10^{-2}	1.06×10^{-1}
SHS 25	9.25×10^{-2}	1.90×10^{-2}	9.25×10^{-2}	1.90×10^{-2}	9.29×10^{-2}
SHS 25L	7.62×10^{-2}	1.62×10^{-2}	7.62×10^{-2}	1.62×10^{-2}	9.29×10^{-2}
SHS 30	8.47×10^{-2}	1.63×10^{-2}	8.47×10^{-2}	1.63×10^{-2}	7.69×10^{-2}
SHS 30L	6.52×10^{-2}	1.34×10^{-2}	6.52×10^{-2}	1.34×10^{-2}	7.69×10^{-2}
SHS 35	6.95×10^{-2}	1.43×10^{-2}	6.95×10^{-2}	1.43×10^{-2}	6.29×10^{-2}
SHS 35L	5.43×10^{-2}	1.16×10^{-2}	5.43×10^{-2}	1.16×10^{-2}	6.29×10^{-2}
SHS 45	6.13×10^{-2}	1.24×10^{-2}	6.13×10^{-2}	1.24×10^{-2}	4.69×10^{-2}
SHS 45L	4.79×10^{-2}	1.02×10^{-2}	4.79×10^{-2}	1.02×10^{-2}	4.69×10^{-2}
SHS 55	4.97×10^{-2}	1.02×10^{-2}	4.97×10^{-2}	1.02×10^{-2}	4.02×10^{-2}
SHS 55L	3.88×10^{-2}	8.30×10^{-3}	3.88×10^{-2}	8.30×10^{-3}	4.02×10^{-2}
SHS 65	3.87×10^{-2}	7.91×10^{-3}	3.87×10^{-2}	7.91×10^{-3}	3.40×10^{-2}
SHS 65L	3.06×10^{-2}	6.51×10^{-3}	3.06×10^{-2}	6.51×10^{-3}	3.40×10^{-2}
SHW 12	2.48×10^{-1}	4.69×10^{-2}	2.48×10^{-1}	4.69×10^{-2}	1.40×10^{-1}
SHW 12L	1.70×10^{-1}	3.52×10^{-2}	1.70×10^{-1}	3.52×10^{-2}	1.40×10^{-1}
SHW 14	1.92×10^{-1}	3.80×10^{-2}	1.92×10^{-1}	3.80×10^{-2}	9.93×10^{-2}
SHW 17	1.72×10^{-1}	3.41×10^{-2}	1.72×10^{-1}	3.41×10^{-2}	6.21×10^{-2}
SHW 21	1.59×10^{-1}	2.95×10^{-2}	1.59×10^{-1}	2.95×10^{-2}	5.57×10^{-2}
SHW 27	1.21×10^{-1}	2.39×10^{-2}	1.21×10^{-1}	2.39×10^{-2}	4.99×10^{-2}
SHW 35	8.15×10^{-2}	1.64×10^{-2}	8.15×10^{-2}	1.64×10^{-2}	3.02×10^{-2}
SHW 50	6.22×10^{-2}	1.24×10^{-2}	6.22×10^{-2}	1.24×10^{-2}	2.30×10^{-2}
SRS 9	2.95×10^{-1}	5.26×10^{-2}	3.04×10^{-1}	5.40×10^{-2}	2.17×10^{-1}
SRS 9W	2.37×10^{-1}	4.25×10^{-2}	2.44×10^{-1}	4.37×10^{-2}	1.06×10^{-1}
SRS 12	2.94×10^{-1}	4.50×10^{-2}	2.94×10^{-1}	4.50×10^{-2}	1.53×10^{-1}
SRS 12W	2.00×10^{-1}	3.69×10^{-2}	2.00×10^{-1}	3.69×10^{-2}	7.97×10^{-2}
SRS 15	2.17×10^{-1}	3.69×10^{-2}	2.17×10^{-1}	3.69×10^{-2}	1.41×10^{-1}
SRS 15W	1.67×10^{-1}	2.94×10^{-2}	1.67×10^{-1}	2.94×10^{-2}	4.83×10^{-2}
SRS 20	1.80×10^{-1}	3.30×10^{-2}	1.86×10^{-1}	3.41×10^{-2}	9.34×10^{-2}
SRS 25	1.14×10^{-1}	2.17×10^{-2}	1.14×10^{-1}	2.17×10^{-2}	8.13×10^{-2}

K_{AR1} : Equivalent factor in the M_A radial direction when one LM block is used
K_{AL1} : Equivalent factor in the M_A reverse-radial direction when one LM block is used
K_{AR2} : Equivalent factor in the M_A radial direction when two LM blocks are used in close contact with each other
K_{AL2} : Equivalent factor in the M_A reverse-radial direction when two LM blocks are used in close contact with each other
K_{B1} : M_B Equivalent factor when one LM block is used
K_{B2} : M_B Equivalent factor when two LM blocks are used in close contact with each other
K_{CR} : Equivalent factor in the M_C radial direction
K_{CL} : Equivalent factor in the M_C reverse-radial direction

Table 3 Equivalent Factors (Models SRG, SRN and SR)

Model No.	Equivalent factor							
	K_{AR1}	K_{AL1}	K_{AR2}	K_{AL2}	K_{B1}	K_{B2}	K_{CR}	K_{CL}
SRG 25	8.96×10^{-2}		1.55×10^{-2}		8.96×10^{-2}	1.55×10^{-2}	7.23×10^{-2}	
SRG 25L	6.99×10^{-2}		1.31×10^{-2}		6.99×10^{-2}	1.31×10^{-2}	7.23×10^{-2}	
SRG 30	8.06×10^{-2}		1.33×10^{-2}		8.06×10^{-2}	1.33×10^{-2}	5.61×10^{-2}	
SRG 30L	6.12×10^{-2}		1.11×10^{-2}		6.12×10^{-2}	1.11×10^{-2}	5.61×10^{-2}	
SRG 35	7.14×10^{-2}		1.18×10^{-2}		7.14×10^{-2}	1.18×10^{-2}	4.98×10^{-2}	
SRG 35L	5.26×10^{-2}		9.67×10^{-3}		5.26×10^{-2}	9.67×10^{-3}	4.98×10^{-2}	
SRG 45	5.49×10^{-2}		9.58×10^{-3}		5.49×10^{-2}	9.58×10^{-3}	3.85×10^{-2}	
SRG 45L	4.18×10^{-2}		7.93×10^{-3}		4.18×10^{-2}	7.93×10^{-3}	3.85×10^{-2}	
SRG 55	4.56×10^{-2}		8.04×10^{-3}		4.56×10^{-2}	8.04×10^{-3}	3.25×10^{-2}	
SRG 55L	3.37×10^{-2}		6.42×10^{-3}		3.37×10^{-2}	6.42×10^{-3}	3.25×10^{-2}	
SRG 65L	2.63×10^{-2}		4.97×10^{-3}		2.63×10^{-2}	4.97×10^{-3}	2.70×10^{-2}	
SRN 35	7.14×10^{-2}		1.18×10^{-2}		7.14×10^{-2}	1.18×10^{-2}	4.98×10^{-2}	
SRN 35L	5.26×10^{-2}		9.67×10^{-3}		5.26×10^{-2}	9.67×10^{-3}	4.98×10^{-2}	
SRN 45	5.49×10^{-2}		9.58×10^{-3}		5.49×10^{-2}	9.58×10^{-3}	3.85×10^{-2}	
SRN 45L	4.18×10^{-2}		7.93×10^{-3}		4.18×10^{-2}	7.93×10^{-3}	3.85×10^{-2}	
SRN 55	4.56×10^{-2}		8.04×10^{-3}		4.56×10^{-2}	8.04×10^{-3}	3.25×10^{-2}	
SRN 55L	3.37×10^{-2}		6.42×10^{-3}		3.37×10^{-2}	6.42×10^{-3}	3.25×10^{-2}	
SRN 65L	2.63×10^{-2}		4.97×10^{-3}		2.63×10^{-2}	4.97×10^{-3}	2.70×10^{-2}	
SR 15W(TB)	2.09×10^{-1}	1.04×10^{-1}	3.74×10^{-2}	1.87×10^{-2}	1.46×10^{-1}	2.58×10^{-2}	1.70×10^{-1}	8.48×10^{-2}
SR 15V(SB)	3.40×10^{-1}	1.70×10^{-1}	4.94×10^{-2}	2.47×10^{-2}	2.35×10^{-1}	3.32×10^{-2}	1.70×10^{-1}	8.48×10^{-2}
SR 20W(TB)	1.72×10^{-1}	8.61×10^{-2}	3.24×10^{-2}	1.62×10^{-2}	1.21×10^{-1}	2.25×10^{-2}	1.30×10^{-1}	6.49×10^{-2}
SR 20V(SB)	2.72×10^{-1}	1.36×10^{-1}	4.33×10^{-2}	2.16×10^{-2}	1.88×10^{-1}	2.94×10^{-2}	1.30×10^{-1}	6.49×10^{-2}
SR 25W(TB)	1.38×10^{-1}	6.89×10^{-2}	2.59×10^{-2}	1.30×10^{-2}	9.67×10^{-2}	1.80×10^{-2}	1.11×10^{-1}	5.55×10^{-2}
SR 25V(SB)	2.17×10^{-1}	1.09×10^{-1}	3.46×10^{-2}	1.73×10^{-2}	1.51×10^{-1}	2.35×10^{-2}	1.11×10^{-1}	5.55×10^{-2}
SR 30W(TB)	1.15×10^{-1}	5.74×10^{-2}	2.22×10^{-2}	1.11×10^{-2}	8.06×10^{-2}	1.55×10^{-2}	9.22×10^{-2}	4.61×10^{-2}
SR 30V(SB)	1.99×10^{-1}	9.93×10^{-2}	2.99×10^{-2}	1.49×10^{-2}	1.37×10^{-1}	2.02×10^{-2}	9.22×10^{-2}	4.61×10^{-2}
SR 35W(TB)	1.04×10^{-1}	5.21×10^{-2}	1.92×10^{-2}	9.61×10^{-3}	7.31×10^{-2}	1.33×10^{-2}	7.64×10^{-2}	3.82×10^{-2}
SR 35V(SB)	1.70×10^{-1}	8.51×10^{-2}	2.61×10^{-2}	1.31×10^{-2}	1.17×10^{-1}	1.77×10^{-2}	7.64×10^{-2}	3.82×10^{-2}
SR 45W(TB)	9.12×10^{-2}	4.56×10^{-2}	1.69×10^{-2}	8.47×10^{-3}	6.39×10^{-2}	1.17×10^{-2}	5.71×10^{-2}	2.85×10^{-2}
SR 55W(TB)	6.89×10^{-2}	3.44×10^{-2}	1.39×10^{-2}	6.93×10^{-3}	4.84×10^{-2}	9.66×10^{-3}	5.46×10^{-2}	2.73×10^{-2}

K_{AR1} : Equivalent factor in the M_A radial direction when one LM block is used
K_{AL1} : Equivalent factor in the M_A reverse-radial direction when one LM block is used
K_{AR2} : Equivalent factor in the M_A radial direction when two LM blocks are used in close contact with each other
K_{AL2} : Equivalent factor in the M_A reverse-radial direction when two LM blocks are used in close contact with each other
K_{B1} : M_B Equivalent factor when one LM block is used
K_{B2} : M_B Equivalent factor when two LM blocks are used in close contact with each other
K_{CR} : Equivalent factor in the M_C radial direction
K_{CL} : Equivalent factor in the M_C reverse-radial direction

Table 4 Equivalent Factors (Models NR and NRS)

Model No.	Equivalent factor							
	K_{AR1}	K_{AL1}	K_{AR2}	K_{AL2}	K_{B1}	K_{B2}	K_{CR}	K_{CL}
NR 25X	1.10×10^{-1}	7.78×10^{-2}	2.19×10^{-2}	1.55×10^{-2}	8.11×10^{-2}	1.63×10^{-2}	9.26×10^{-2}	6.58×10^{-2}
NR 25XL	8.91×10^{-2}	6.33×10^{-2}	1.79×10^{-2}	1.27×10^{-2}	6.55×10^{-2}	1.33×10^{-2}	9.26×10^{-2}	6.58×10^{-2}
NR 30	9.66×10^{-2}	6.86×10^{-2}	1.84×10^{-2}	1.31×10^{-2}	7.05×10^{-2}	1.35×10^{-2}	8.28×10^{-2}	5.88×10^{-2}
NR 30L	7.43×10^{-2}	5.27×10^{-2}	1.52×10^{-2}	1.08×10^{-2}	5.47×10^{-2}	1.13×10^{-2}	8.28×10^{-2}	5.88×10^{-2}
NR 35	8.82×10^{-2}	6.26×10^{-2}	1.64×10^{-2}	1.16×10^{-2}	6.42×10^{-2}	1.20×10^{-2}	6.92×10^{-2}	4.91×10^{-2}
NR 35L	6.67×10^{-2}	4.74×10^{-2}	1.35×10^{-2}	9.61×10^{-3}	4.90×10^{-2}	1.00×10^{-2}	6.92×10^{-2}	4.91×10^{-2}
NR 45	6.84×10^{-2}	4.86×10^{-2}	1.30×10^{-2}	9.23×10^{-3}	5.00×10^{-2}	9.58×10^{-3}	5.19×10^{-2}	3.68×10^{-2}
NR 45L	5.11×10^{-2}	3.62×10^{-2}	1.08×10^{-2}	7.66×10^{-3}	3.79×10^{-2}	8.07×10^{-3}	5.19×10^{-2}	3.68×10^{-2}
NR 55	5.75×10^{-2}	4.08×10^{-2}	1.11×10^{-2}	7.90×10^{-3}	4.21×10^{-2}	8.21×10^{-3}	4.44×10^{-2}	3.15×10^{-2}
NR 55L	4.53×10^{-2}	3.22×10^{-2}	9.16×10^{-3}	6.51×10^{-3}	3.34×10^{-2}	6.79×10^{-3}	4.44×10^{-2}	3.15×10^{-2}
NR 65	4.97×10^{-2}	3.53×10^{-2}	9.74×10^{-3}	6.91×10^{-3}	3.64×10^{-2}	7.18×10^{-3}	3.75×10^{-2}	2.66×10^{-2}
NR 65L	3.56×10^{-2}	2.53×10^{-2}	7.51×10^{-3}	5.33×10^{-3}	2.65×10^{-2}	5.61×10^{-3}	3.75×10^{-2}	2.66×10^{-2}
NR 75	4.21×10^{-2}	2.99×10^{-2}	8.31×10^{-3}	5.90×10^{-3}	3.08×10^{-2}	6.13×10^{-3}	3.16×10^{-2}	2.24×10^{-2}
NR 75L	3.14×10^{-2}	2.23×10^{-2}	6.74×10^{-3}	4.78×10^{-3}	2.33×10^{-2}	5.04×10^{-3}	3.16×10^{-2}	2.24×10^{-2}
NR 85	3.70×10^{-2}	2.62×10^{-2}	7.31×10^{-3}	5.19×10^{-3}	2.71×10^{-2}	5.40×10^{-3}	2.80×10^{-2}	1.99×10^{-2}
NR 85L	2.80×10^{-2}	1.99×10^{-2}	6.07×10^{-3}	4.31×10^{-3}	2.08×10^{-2}	4.55×10^{-3}	2.80×10^{-2}	1.99×10^{-2}
NR 100	3.05×10^{-2}	2.17×10^{-2}	6.20×10^{-3}	4.41×10^{-3}	2.26×10^{-2}	4.63×10^{-3}	2.38×10^{-2}	1.69×10^{-2}
NR 100L	2.74×10^{-2}	1.95×10^{-2}	5.46×10^{-3}	3.87×10^{-3}	2.00×10^{-2}	4.00×10^{-3}	2.38×10^{-2}	1.69×10^{-2}
NRS 25X	1.05×10^{-1}		2.11×10^{-2}		1.05×10^{-1}	2.11×10^{-2}	9.41×10^{-2}	
NRS 25XL	8.60×10^{-2}		1.73×10^{-2}		8.60×10^{-2}	1.73×10^{-2}	9.41×10^{-2}	
NRS 30	9.30×10^{-2}		1.77×10^{-2}		9.30×10^{-2}	1.77×10^{-2}	8.44×10^{-2}	
NRS 30L	7.17×10^{-2}		1.47×10^{-2}		7.17×10^{-2}	1.47×10^{-2}	8.44×10^{-2}	
NRS 35	8.47×10^{-2}		1.57×10^{-2}		8.47×10^{-2}	1.57×10^{-2}	7.08×10^{-2}	
NRS 35L	6.44×10^{-2}		1.31×10^{-2}		6.44×10^{-2}	1.31×10^{-2}	7.08×10^{-2}	
NRS 45	6.58×10^{-2}		1.25×10^{-2}		6.58×10^{-2}	1.25×10^{-2}	5.26×10^{-2}	
NRS 45L	4.92×10^{-2}		1.04×10^{-2}		4.92×10^{-2}	1.04×10^{-2}	5.26×10^{-2}	
NRS 55	5.54×10^{-2}		1.07×10^{-2}		5.54×10^{-2}	1.07×10^{-2}	4.52×10^{-2}	
NRS 55L	4.38×10^{-2}		8.85×10^{-3}		4.38×10^{-2}	8.85×10^{-3}	4.52×10^{-2}	
NRS 65	4.79×10^{-2}		9.38×10^{-3}		4.79×10^{-2}	9.38×10^{-3}	3.81×10^{-2}	
NRS 65L	3.43×10^{-2}		7.25×10^{-3}		3.43×10^{-2}	7.25×10^{-3}	3.81×10^{-2}	
NRS 75	4.05×10^{-2}		8.01×10^{-3}		4.05×10^{-2}	8.01×10^{-3}	3.20×10^{-2}	
NRS 75L	3.03×10^{-2}		6.50×10^{-3}		3.03×10^{-2}	6.50×10^{-3}	3.20×10^{-2}	
NRS 85	3.56×10^{-2}		7.05×10^{-3}		3.56×10^{-2}	7.05×10^{-3}	2.83×10^{-2}	
NRS 85L	2.70×10^{-2}		5.87×10^{-3}		2.70×10^{-2}	5.87×10^{-3}	2.83×10^{-2}	
NRS 100	2.93×10^{-2}		5.97×10^{-3}		2.93×10^{-2}	5.97×10^{-3}	2.41×10^{-2}	
NRS 100L	2.65×10^{-2}		5.27×10^{-3}		2.65×10^{-2}	5.27×10^{-3}	2.41×10^{-2}	

K_{AR1} : Equivalent factor in the M_A radial direction when one LM block is used
K_{AL1} : Equivalent factor in the M_A reverse-radial direction when one LM block is used
K_{AR2} : Equivalent factor in the M_A radial direction when two LM blocks are used in close contact with each other
K_{AL2} : Equivalent factor in the M_A reverse-radial direction when two LM blocks are used in close contact with each other
K_{B1} : M_B Equivalent factor when one LM block is used
K_{B2} : M_B Equivalent factor when two LM blocks are used in close contact with each other
K_{CR} : Equivalent factor in the M_C radial direction
K_{CL} : Equivalent factor in the M_C reverse-radial direction

Table 5 Equivalent Factors (Models HSR, JR and CSR)

Model No.	Equivalent factor				
	K_{AR1} K_{AL1}	K_{AR2} K_{AL2}	K_{B1}	K_{B2}	K_{CR} K_{CL}
HSR 8	4.39×10^{-1}	6.75×10^{-2}	4.39×10^{-1}	6.75×10^{-2}	2.97×10^{-1}
HSR 10	3.09×10^{-1}	5.33×10^{-2}	3.09×10^{-1}	5.33×10^{-2}	2.35×10^{-1}
HSR 12	2.08×10^{-1}	3.74×10^{-2}	2.08×10^{-1}	3.74×10^{-2}	1.91×10^{-1}
HSR 15	1.68×10^{-1}	2.95×10^{-2}	1.68×10^{-1}	2.95×10^{-2}	1.60×10^{-1}
HSR 20	1.25×10^{-1}	2.28×10^{-2}	1.25×10^{-1}	2.28×10^{-2}	1.18×10^{-1}
HSR 20L	9.83×10^{-2}	1.91×10^{-2}	9.83×10^{-2}	1.91×10^{-2}	1.18×10^{-1}
HSR 25	1.12×10^{-1}	2.01×10^{-2}	1.12×10^{-1}	2.01×10^{-2}	1.00×10^{-1}
HSR 25L	8.66×10^{-2}	1.68×10^{-2}	8.66×10^{-2}	1.68×10^{-2}	1.00×10^{-1}
HSR 30	8.93×10^{-2}	1.73×10^{-2}	8.93×10^{-2}	1.73×10^{-2}	8.31×10^{-2}
HSR 30L	7.02×10^{-2}	1.43×10^{-2}	7.02×10^{-2}	1.43×10^{-2}	8.31×10^{-2}
HSR 35	7.81×10^{-2}	1.55×10^{-2}	7.81×10^{-2}	1.55×10^{-2}	6.74×10^{-2}
HSR 35L	6.15×10^{-2}	1.28×10^{-2}	6.15×10^{-2}	1.28×10^{-2}	6.74×10^{-2}
HSR 45	6.71×10^{-2}	1.21×10^{-2}	6.71×10^{-2}	1.21×10^{-2}	5.22×10^{-2}
HSR 45L	5.20×10^{-2}	1.00×10^{-2}	5.20×10^{-2}	1.00×10^{-2}	5.22×10^{-2}
HSR 55	5.59×10^{-2}	1.03×10^{-2}	5.59×10^{-2}	1.03×10^{-2}	4.27×10^{-2}
HSR 55L	4.33×10^{-2}	8.56×10^{-3}	4.33×10^{-2}	8.56×10^{-3}	4.27×10^{-2}
HSR 65	4.47×10^{-2}	9.13×10^{-3}	4.47×10^{-2}	9.13×10^{-3}	3.69×10^{-2}
HSR 65L	3.28×10^{-2}	7.06×10^{-3}	3.28×10^{-2}	7.06×10^{-3}	3.69×10^{-2}
HSR 85	3.73×10^{-2}	6.80×10^{-3}	3.73×10^{-2}	6.80×10^{-3}	2.79×10^{-2}
HSR 85L	2.89×10^{-2}	5.68×10^{-3}	2.89×10^{-2}	5.68×10^{-3}	2.79×10^{-2}
HSR 100	2.60×10^{-2}	5.15×10^{-3}	2.60×10^{-2}	5.15×10^{-3}	2.25×10^{-2}
HSR 120	2.36×10^{-2}	4.72×10^{-3}	2.36×10^{-2}	4.72×10^{-3}	1.97×10^{-2}
HSR 150	2.17×10^{-2}	4.35×10^{-3}	2.17×10^{-2}	4.35×10^{-3}	1.61×10^{-2}
HSR 15M2A	1.65×10^{-1}	2.89×10^{-2}	1.65×10^{-1}	2.89×10^{-2}	1.86×10^{-1}
HSR 20M2A	1.23×10^{-1}	2.23×10^{-2}	1.23×10^{-1}	2.23×10^{-2}	1.34×10^{-1}
HSR 25M2A	1.10×10^{-1}	1.98×10^{-2}	1.10×10^{-1}	1.98×10^{-2}	1.14×10^{-1}
JR 25	1.12×10^{-1}	2.01×10^{-2}	1.12×10^{-1}	2.01×10^{-2}	1.00×10^{-1}
JR 35	7.81×10^{-2}	1.55×10^{-2}	7.81×10^{-2}	1.55×10^{-2}	6.74×10^{-2}
JR 45	6.71×10^{-2}	1.21×10^{-2}	6.71×10^{-2}	1.21×10^{-2}	5.22×10^{-2}
JR 55	5.59×10^{-2}	1.03×10^{-2}	5.59×10^{-2}	1.03×10^{-2}	4.27×10^{-2}
CSR 15	1.68×10^{-1}	2.95×10^{-2}	1.68×10^{-1}	2.95×10^{-2}	1.60×10^{-1}
CSR 20S	1.25×10^{-1}	2.28×10^{-2}	1.25×10^{-1}	2.28×10^{-2}	1.18×10^{-1}
CSR 20	9.83×10^{-2}	1.91×10^{-2}	9.83×10^{-2}	1.91×10^{-2}	1.18×10^{-1}
CSR 25S	1.12×10^{-1}	2.01×10^{-2}	1.12×10^{-1}	2.01×10^{-2}	1.00×10^{-1}
CSR 25	8.66×10^{-2}	1.68×10^{-2}	8.66×10^{-2}	1.68×10^{-2}	1.00×10^{-1}
CSR 30S	8.93×10^{-2}	1.73×10^{-2}	8.93×10^{-2}	1.73×10^{-2}	8.31×10^{-2}
CSR 30	7.02×10^{-2}	1.43×10^{-2}	7.02×10^{-2}	1.43×10^{-2}	8.31×10^{-2}
CSR 35	6.15×10^{-2}	1.28×10^{-2}	6.15×10^{-2}	1.28×10^{-2}	6.74×10^{-2}
CSR 45	5.20×10^{-2}	1.00×10^{-2}	5.20×10^{-2}	1.00×10^{-2}	5.22×10^{-2}

Table 6 Equivalent Factors (Models HRW, GSR and HR)

Model No.	Equivalent factor							
	K_{AR1}	K_{AL1}	K_{AR2}	K_{AL2}	K_{B1}	K_{B2}	K_{CR}	K_{CL}
HRW 12	2.72×10^{-1}		5.16×10^{-2}		5.47×10^{-1}	1.04×10^{-1}	1.40×10^{-1}	
HRW 14	2.28×10^{-1}		4.16×10^{-2}		4.54×10^{-1}	8.28×10^{-2}	1.01×10^{-1}	
HRW 17	1.95×10^{-1}		3.33×10^{-2}		1.95×10^{-1}	3.33×10^{-2}	6.32×10^{-2}	
HRW 21	1.64×10^{-1}		2.89×10^{-2}		1.64×10^{-1}	2.89×10^{-2}	5.92×10^{-2}	
HRW 27	1.30×10^{-1}		2.33×10^{-2}		1.30×10^{-1}	2.33×10^{-2}	5.12×10^{-2}	
HRW 35	8.66×10^{-2}		1.59×10^{-2}		8.66×10^{-2}	1.59×10^{-2}	3.06×10^{-2}	
HRW 50	6.50×10^{-2}		1.21×10^{-2}		6.50×10^{-2}	1.21×10^{-2}	2.35×10^{-2}	
HRW 60	5.77×10^{-2}		8.24×10^{-3}		5.77×10^{-2}	8.24×10^{-3}	1.77×10^{-2}	
GSR 15T	1.61×10^{-1}	1.44×10^{-1}	2.88×10^{-2}	2.59×10^{-2}	1.68×10^{-1}	3.01×10^{-2}	—	—
GSR 15V	2.21×10^{-1}	1.99×10^{-1}	3.54×10^{-2}	3.18×10^{-2}	2.30×10^{-1}	3.68×10^{-2}	—	—
GSR 20T	1.28×10^{-1}	1.16×10^{-1}	2.34×10^{-2}	2.10×10^{-2}	1.34×10^{-1}	2.44×10^{-2}	—	—
GSR 20V	1.77×10^{-1}	1.59×10^{-1}	2.87×10^{-2}	2.58×10^{-2}	1.84×10^{-1}	2.99×10^{-2}	—	—
GSR 25T	1.07×10^{-1}	9.63×10^{-2}	1.97×10^{-2}	1.77×10^{-2}	1.12×10^{-1}	2.06×10^{-2}	—	—
GSR 25V	1.47×10^{-1}	1.33×10^{-1}	2.42×10^{-2}	2.18×10^{-2}	1.53×10^{-1}	2.52×10^{-2}	—	—
GSR 30T	9.17×10^{-2}	8.26×10^{-2}	1.68×10^{-2}	1.51×10^{-2}	9.59×10^{-2}	1.76×10^{-2}	—	—
GSR 35T	8.03×10^{-2}	7.22×10^{-2}	1.48×10^{-2}	1.33×10^{-2}	8.39×10^{-2}	1.55×10^{-2}	—	—
HR 918	2.65×10^{-1}	2.65×10^{-1}	—	—	2.65×10^{-1}	—	—	—
HR 1123	2.08×10^{-1}	2.08×10^{-1}	—	—	2.08×10^{-1}	—	—	—
HR 1530	1.56×10^{-1}	1.56×10^{-1}	—	—	1.56×10^{-1}	—	—	—
HR 2042	1.11×10^{-1}	1.11×10^{-1}	—	—	1.11×10^{-1}	—	—	—
HR 2042T	8.64×10^{-2}	8.64×10^{-2}	—	—	8.64×10^{-2}	—	—	—
HR 2555	7.79×10^{-2}	7.79×10^{-2}	—	—	7.79×10^{-2}	—	—	—
HR 2555T	6.13×10^{-2}	6.13×10^{-2}	—	—	6.13×10^{-2}	—	—	—
HR 3065	6.92×10^{-2}	6.92×10^{-2}	—	—	6.92×10^{-2}	—	—	—
HR 3065T	5.45×10^{-2}	5.45×10^{-2}	—	—	5.45×10^{-2}	—	—	—
HR 3575	6.23×10^{-2}	6.23×10^{-2}	—	—	6.23×10^{-2}	—	—	—
HR 3575T	4.90×10^{-2}	4.90×10^{-2}	—	—	4.90×10^{-2}	—	—	—
HR 4085	5.19×10^{-2}	5.19×10^{-2}	—	—	5.19×10^{-2}	—	—	—
HR 4085T	4.09×10^{-2}	4.09×10^{-2}	—	—	4.09×10^{-2}	—	—	—
HR 50105	4.15×10^{-2}	4.15×10^{-2}	—	—	4.15×10^{-2}	—	—	—
HR 50105T	3.27×10^{-2}	3.27×10^{-2}	—	—	3.27×10^{-2}	—	—	—
HR 60125	2.88×10^{-2}	2.88×10^{-2}	—	—	2.88×10^{-2}	—	—	—

K_{AR1} : Equivalent factor in the M_A radial direction when one LM block is used
K_{AL1} : Equivalent factor in the M_A reverse-radial direction when one LM block is used
K_{AR2} : Equivalent factor in the M_A radial direction when two LM blocks are used in close contact with each other
K_{AL2} : Equivalent factor in the M_A reverse-radial direction when two LM blocks are used in close contact with each other
K_{B1} : M_B Equivalent factor when one LM block is used
K_{B2} : M_B Equivalent factor when two LM blocks are used in close contact with each other
K_{CR} : Equivalent factor in the M_C radial direction
K_{CL} : Equivalent factor in the M_C reverse-radial direction

Table 7 Equivalent Factors (Model RSR)

Model No.	Equivalent factor							
	K_{AR1}	K_{AL1}	K_{AR2}	K_{AL2}	K_{B1}	K_{B2}	K_{CR}	K_{CL}
RSR 3M	9.20×10^{-1}		1.27×10^{-1}		9.20×10^{-1}	1.27×10^{-1}	6.06×10^{-1}	
RSR 3N	6.06×10^{-1}		1.01×10^{-1}		6.06×10^{-1}	1.01×10^{-1}	6.06×10^{-1}	
RSR 3W	7.03×10^{-1}		1.06×10^{-1}		7.03×10^{-1}	1.06×10^{-1}	3.17×10^{-1}	
RSR 3WN	4.76×10^{-1}		8.27×10^{-2}		4.76×10^{-1}	8.27×10^{-2}	3.17×10^{-1}	
RSR 5M	6.67×10^{-1}		9.06×10^{-2}		6.67×10^{-1}	9.06×10^{-2}	3.85×10^{-1}	
RSR 5N	5.21×10^{-1}		8.00×10^{-2}		5.21×10^{-1}	8.00×10^{-2}	3.85×10^{-1}	
RSR 5W	4.85×10^{-1}		7.28×10^{-2}		4.85×10^{-1}	7.28×10^{-2}	1.96×10^{-1}	
RSR 5WN	3.44×10^{-1}		5.93×10^{-2}		3.44×10^{-1}	5.93×10^{-2}	1.96×10^{-1}	
RSR 7M	4.66×10^{-1}		6.57×10^{-2}		4.66×10^{-1}	6.57×10^{-2}	2.74×10^{-1}	
RSR 7Z	4.66×10^{-1}		6.60×10^{-2}		4.66×10^{-1}	6.60×10^{-2}	2.74×10^{-1}	
RSR 7N	2.88×10^{-1}		5.01×10^{-2}		2.88×10^{-1}	5.01×10^{-2}	2.74×10^{-1}	
RSR 7W	3.07×10^{-1}		5.30×10^{-2}		3.07×10^{-1}	5.30×10^{-2}	1.40×10^{-1}	
RSR 7WZ	3.30×10^{-1}		5.12×10^{-2}		3.30×10^{-1}	5.12×10^{-2}	1.40×10^{-1}	
RSR 7WN	2.18×10^{-1}		4.13×10^{-2}		2.18×10^{-1}	4.13×10^{-2}	1.40×10^{-1}	
RSR 9K	3.06×10^{-1}		5.19×10^{-2}		3.06×10^{-1}	5.19×10^{-2}	2.15×10^{-1}	
RSR 9Z	3.06×10^{-1}		5.23×10^{-2}		3.06×10^{-1}	5.23×10^{-2}	2.15×10^{-1}	
RSR 9N	2.15×10^{-1}		4.08×10^{-2}		2.15×10^{-1}	4.08×10^{-2}	2.15×10^{-1}	
RSR 9WV	2.44×10^{-1}		4.22×10^{-2}		2.44×10^{-1}	4.22×10^{-2}	1.09×10^{-1}	
RSR 9WZ	2.44×10^{-1}		4.22×10^{-2}		2.44×10^{-1}	4.22×10^{-2}	1.09×10^{-1}	
RSR 9WN	1.73×10^{-1}		3.32×10^{-2}		1.73×10^{-1}	4.22×10^{-2}	1.09×10^{-1}	
RSR 12V	3.52×10^{-1}	2.46×10^{-1}	5.37×10^{-2}	3.76×10^{-2}	2.81×10^{-1}	4.21×10^{-2}	2.09×10^{-1}	1.46×10^{-1}
RSR 12Z	3.52×10^{-1}	2.46×10^{-1}	5.37×10^{-2}	3.76×10^{-2}	2.81×10^{-1}	4.21×10^{-2}	2.09×10^{-1}	1.46×10^{-1}
RSR 12N	2.30×10^{-1}	1.61×10^{-1}	4.08×10^{-2}	2.85×10^{-2}	1.85×10^{-1}	3.25×10^{-2}	2.09×10^{-1}	1.46×10^{-1}
RSR 12WV	2.47×10^{-1}	1.73×10^{-1}	4.38×10^{-2}	3.07×10^{-2}	1.99×10^{-1}	3.49×10^{-2}	1.02×10^{-1}	7.15×10^{-2}
RSR 12WZ	2.47×10^{-1}	1.73×10^{-1}	4.38×10^{-2}	3.07×10^{-2}	1.99×10^{-1}	3.49×10^{-2}	1.02×10^{-1}	7.15×10^{-2}
RSR 12WN	1.71×10^{-1}	1.20×10^{-1}	3.36×10^{-2}	2.35×10^{-2}	1.38×10^{-1}	2.70×10^{-2}	1.02×10^{-1}	7.15×10^{-2}
RSR 15V	2.77×10^{-1}	1.94×10^{-1}	4.38×10^{-2}	3.07×10^{-2}	2.21×10^{-1}	3.45×10^{-2}	1.69×10^{-1}	1.18×10^{-1}
RSR 15Z	2.77×10^{-1}	1.94×10^{-1}	4.38×10^{-2}	3.07×10^{-2}	2.21×10^{-1}	3.45×10^{-2}	1.69×10^{-1}	1.18×10^{-1}
RSR 15N	1.70×10^{-1}	1.19×10^{-1}	3.24×10^{-2}	2.27×10^{-2}	1.37×10^{-1}	2.59×10^{-2}	1.69×10^{-1}	1.18×10^{-1}
RSR 15WV	1.95×10^{-1}	1.36×10^{-1}	3.52×10^{-2}	2.46×10^{-2}	1.56×10^{-1}	2.80×10^{-2}	5.83×10^{-2}	4.08×10^{-2}
RSR 15WZ	1.95×10^{-1}	1.36×10^{-1}	3.52×10^{-2}	2.46×10^{-2}	1.56×10^{-1}	2.80×10^{-2}	5.83×10^{-2}	4.08×10^{-2}
RSR 15WN	1.34×10^{-1}	9.41×10^{-2}	2.68×10^{-2}	1.88×10^{-2}	1.09×10^{-1}	2.16×10^{-2}	5.82×10^{-2}	4.08×10^{-2}
RSR 20V	1.68×10^{-1}	1.18×10^{-1}	2.92×10^{-2}	2.04×10^{-2}	1.35×10^{-1}	2.32×10^{-2}	1.30×10^{-1}	9.13×10^{-2}
RSR 20N	1.20×10^{-1}	8.39×10^{-2}	2.30×10^{-2}	1.61×10^{-2}	9.68×10^{-2}	1.84×10^{-2}	1.30×10^{-1}	9.13×10^{-2}

K_{AR1} : Equivalent factor in the M_A radial direction when one LM block is used

K_{AL1} : Equivalent factor in the M_A reverse-radial direction when one LM block is used

K_{AR2} : Equivalent factor in the M_A radial direction when two LM blocks are used in close contact with each other

K_{AL2} : Equivalent factor in the M_A reverse-radial direction when two LM blocks are used in close contact with each other

K_{B1} : M_B Equivalent factor when one LM block is used

K_{B2} : M_B Equivalent factor when two LM blocks are used in close contact with each other

K_{CR} : Equivalent factor in the M_C radial direction

K_{CL} : Equivalent factor in the M_C reverse-radial direction

Table 8 Equivalent Factors (Model RSH, MX and NSR)

Model No.	Equivalent factor							
	K_{AR1}	K_{AL1}	K_{AR2}	K_{AL2}	K_{B1}	K_{B2}	K_{CR}	K_{CL}
RSH 7Z	4.66×10^{-1}		6.60×10^{-2}		4.66×10^{-1}	6.60×10^{-2}	2.74×10^{-1}	
RSH 7WZ	3.30×10^{-1}		5.12×10^{-2}		3.30×10^{-1}	5.12×10^{-2}	1.40×10^{-1}	
RSH 9Z	3.06×10^{-1}		5.23×10^{-2}		3.06×10^{-1}	5.23×10^{-2}	2.15×10^{-1}	
RSH 9WZ	2.44×10^{-1}		4.22×10^{-2}		2.44×10^{-1}	4.22×10^{-2}	1.09×10^{-1}	
RSH 12Z	3.52×10^{-1}	2.46×10^{-1}	5.37×10^{-2}	3.76×10^{-2}	2.81×10^{-1}	4.21×10^{-2}	2.09×10^{-1}	1.46×10^{-1}
RSH 12WZ	2.47×10^{-1}	1.73×10^{-1}	4.38×10^{-2}	3.07×10^{-2}	1.99×10^{-1}	3.49×10^{-2}	1.02×10^{-1}	7.15×10^{-2}
RSH 15Z	2.77×10^{-1}	1.94×10^{-1}	4.38×10^{-2}	3.07×10^{-2}	2.21×10^{-1}	3.45×10^{-2}	1.69×10^{-1}	1.18×10^{-1}
RSH 15WZ	1.95×10^{-1}	1.36×10^{-1}	3.52×10^{-2}	2.46×10^{-2}	1.56×10^{-1}	2.80×10^{-2}	5.83×10^{-2}	4.08×10^{-2}
MX 5	4.27×10^{-1}		7.01×10^{-2}		4.27×10^{-1}	7.01×10^{-2}	3.85×10^{-2}	
MX 7W	2.18×10^{-1}		4.13×10^{-1}		2.18×10^{-1}	4.13×10^{-1}	1.40×10^{-1}	
NSR 20TBC	2.29×10^{-1}		2.68×10^{-2}		2.29×10^{-1}	2.68×10^{-2}	–	–
NSR 25TBC	2.01×10^{-1}		2.27×10^{-2}		2.01×10^{-1}	2.27×10^{-2}	–	–
NSR 30TBC	1.85×10^{-1}		1.93×10^{-2}		1.85×10^{-1}	1.93×10^{-2}	–	–
NSR 40TBC	1.39×10^{-1}		1.60×10^{-2}		1.39×10^{-1}	1.60×10^{-2}	–	–
NSR 50TBC	1.24×10^{-1}		1.42×10^{-2}		1.24×10^{-1}	1.42×10^{-2}	–	–
NSR 70TBC	9.99×10^{-2}		1.15×10^{-2}		9.99×10^{-2}	1.15×10^{-2}	–	–

K_{AR1} : Equivalent factor in the M_A radial direction when one LM block is used
K_{AL1} : Equivalent factor in the M_A reverse-radial direction when one LM block is used
K_{AR2} : Equivalent factor in the M_A radial direction when two LM blocks are used in close contact with each other
K_{AL2} : Equivalent factor in the M_A reverse-radial direction when two LM blocks are used in close contact with each other
K_{B1} : M_B Equivalent factor when one LM block is used
K_{B2} : M_B Equivalent factor when two LM blocks are used in close contact with each other
K_{CR} : Equivalent factor in the M_C radial direction
K_{CL} : Equivalent factor in the M_C reverse-radial direction

[Example of calculation]

When one LM block is used

Model No.: SSR20XV1

Gravitational acceleration g=9.8 (m/s²)
Mass m=10 (kg)
ℓ_1=200 (mm)
ℓ_2=100 (mm)

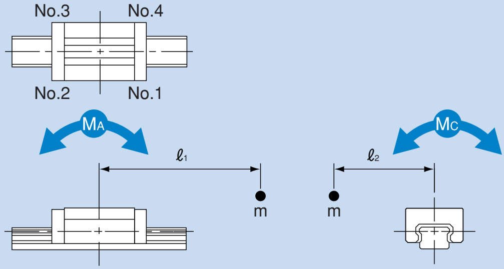


Fig. 6 One LM Block is Used

No.1 $P_1=mg+K_{AR1}\cdot mg\cdot \ell_1+K_{CR}\cdot mg\cdot \ell_2=98+0.275\times98\times200+0.129\times98\times100=6752$ (N)

No.2 $P_2=mg-K_{AL1}\cdot mg\cdot \ell_1+K_{CR}\cdot mg\cdot \ell_2=98-0.137\times98\times200+0.129\times98\times100=-1323$ (N)

No.3 $P_3=mg-K_{AL1}\cdot mg\cdot \ell_1-K_{CL}\cdot mg\cdot \ell_2=98-0.137\times98\times200-0.0644\times98\times100=-3218$ (N)

No.4 $P_4=mg+K_{AR1}\cdot mg\cdot \ell_1-K_{CL}\cdot mg\cdot \ell_2=98+0.275\times98\times200-0.0644\times98\times100=4857$ (N)

When two LM blocks are used in close contact with each other

Model No.: SNS30R2

Gravitational acceleration g=9.8 (m/s²)
Mass m=5 (kg)
ℓ_1=200 (mm)
ℓ_2=150 (mm)

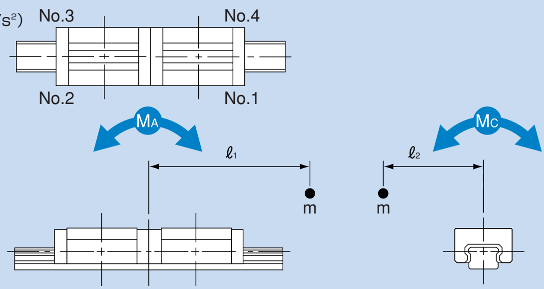


Fig. 7 Two LM Blocks are Used in Close Contact with Each Other

No.1 $P_1=\frac{mg}{2}+K_{AR2}\cdot mg\cdot \ell_1+K_{CR}\cdot\frac{mg\cdot \ell_2}{2}=\frac{49}{2}+0.018\times49\times200+0.0842\times\frac{49\times150}{2}=510.3$ (N)

No.2 $P_2=\frac{mg}{2}-K_{AL2}\cdot mg\cdot \ell_1+K_{CR}\cdot\frac{mg\cdot \ell_2}{2}=\frac{49}{2}-0.0151\times49\times200+0.0842\times\frac{49\times150}{2}=186$ (N)

No.3 $P_3=\frac{mg}{2}-K_{AL2}\cdot mg\cdot \ell_1-K_{CL}\cdot\frac{mg\cdot \ell_2}{2}=\frac{49}{2}-0.0151\times49\times200-0.0707\times\frac{49\times150}{2}=-383.3$ (N)

No.4 $P_4=\frac{mg}{2}+K_{AR2}\cdot mg\cdot \ell_1-K_{CL}\cdot\frac{mg\cdot \ell_2}{2}=\frac{49}{2}+0.018\times49\times200-0.0707\times\frac{49\times150}{2}=-58.9$ (N)

Note 1: Since an LM Guide used in vertical installation received only a moment load is applied, there is no need to apply a load force (mg).
Note 2: In some models, rated loads differ depending on the direction of the applied load. With such a model, calculate an equivalent load in the direction of the smallest rated load.

Double-axis Use

●Setting the Service Conditions

Set the service conditions needed to calculate the LM system's applied load and service life in hours.
The service conditions consist of the following items.

① Mass : m (kg)
② Direction of the working load
③ Position of the working point (e.g., center of gravity) : ℓ_2, ℓ_3, h_1 (mm)
④ Thrust position : ℓ_4, h_2 (mm)
⑤ LM system arrangement : ℓ_0, ℓ_1 (mm)
(No. of units and axes)
⑥ Speed diagram
Speed : V (mm/s)
Time constant : t_n (s)
Acceleration : α_n (mm/s²)

$$\left(\alpha_n = \frac{V}{t_n}\right)$$

⑦ Duty cycle
No. of reciprocations per minute : N_1 (min⁻¹)
⑧ Stroke length : ℓ_s (mm)
⑨ Average Speed : V_m (m/s)
⑩ Required service life in hours : L_h (h)

Gravitational acceleration $g=9.8$ (m/s²)

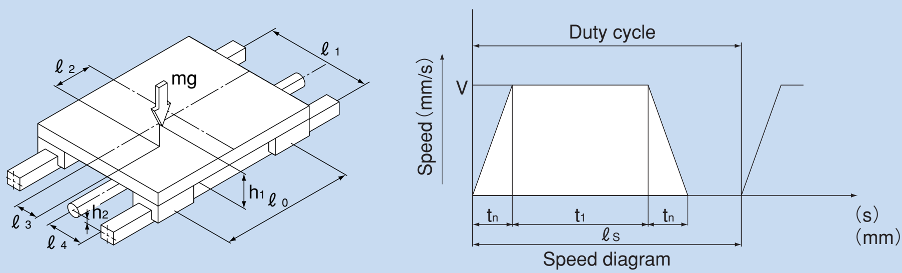


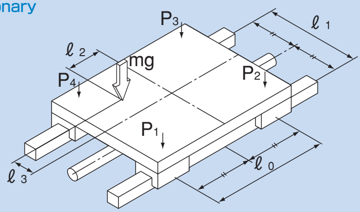
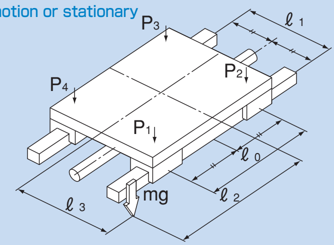
Fig. 8 Service Conditions

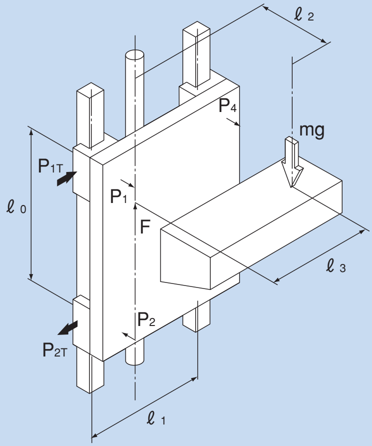
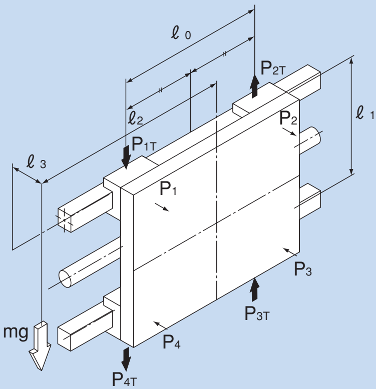
●Applied Load Equation

The load applied to the LM Guide varies with the external force, such as the position of the gravity center of an object, thrust position, inertia generated from acceleration/deceleration during start or stop, and cutting force.
In selecting an LM Guide, it is necessary to obtain the value of the applied load while taking into account these conditions.

Calculate the load applied to the LM Guide in each of the examples 1 to 10 shown below.

m	:Mass	(kg)
ℓ_n	:Distance	(mm)
F_n	:External force	(N)
P_n	:Applied load (radial/reverse-radial direction)	(N)
P_{nT}	:Applied load (lateral directions)	(N)
g	:Gravitational acceleration (g=9.8m/s²)	(m/s²)
V	:Speed	(m/s)
t_n	:Time constant	(s)
α_n	:Acceleration $(\alpha_n = \frac{V}{t_n})$	(m/s²)

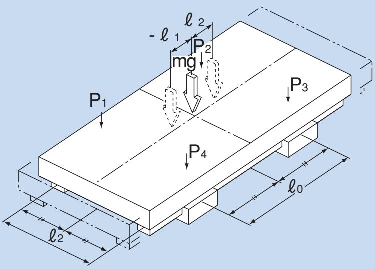
Example	Service conditions	Applied load equation
1	Horizontal mount (with the block traveling) Uniform motion or stationary 	$P_1 = \frac{mg}{4} + \frac{mg\cdot\ell_2}{2\cdot\ell_0} - \frac{mg\cdot\ell_3}{2\cdot\ell_1}$ $P_2 = \frac{mg}{4} - \frac{mg\cdot\ell_2}{2\cdot\ell_0} - \frac{mg\cdot\ell_3}{2\cdot\ell}$ $P_3 = \frac{mg}{4} - \frac{mg\cdot\ell_2}{2\cdot\ell_0} + \frac{mg\cdot\ell_3}{2\cdot\ell_1}$ $P_4 = \frac{mg}{4} + \frac{mg\cdot\ell_2}{2\cdot\ell_0} + \frac{mg\cdot\ell_3}{2\cdot\ell_1}$
2	Horizontal mount, overhung (with the block traveling) Uniform motion or stationary 	$P_1 = \frac{mg}{4} + \frac{mg\cdot\ell_2}{2\cdot\ell_0} + \frac{mg\cdot\ell_3}{2\cdot\ell_1}$ $P_2 = \frac{mg}{4} - \frac{mg\cdot\ell_2}{2\cdot\ell_0} + \frac{mg\cdot\ell_3}{2\cdot\ell_1}$ $P_3 = \frac{mg}{4} - \frac{mg\cdot\ell_2}{2\cdot\ell_0} - \frac{mg\cdot\ell_3}{2\cdot\ell_1}$ $P_4 = \frac{mg}{4} + \frac{mg\cdot\ell_2}{2\cdot\ell_0} - \frac{mg\cdot\ell_3}{2\cdot\ell_1}$

Example	Service conditions	Applied load equation
3	Vertical mount Uniform motion or stationary  E.g.: Vertical axis of industrial robot, automatic coating machine, lifter	$P_1 \sim P_4 = \dfrac{mg\cdot\ell_2}{2\cdot\ell_0}$ $P_{1T} \sim P_{4T} = \dfrac{mg\cdot\ell_3}{2\cdot\ell_0}$
4	Wall mount Uniform motion or stationary  E.g.: Travel axis of cross-rail loader	$P_1 \sim P_4 = \dfrac{mg\cdot\ell_3}{2\cdot\ell_1}$ $P_{1T} = P_{4T} = \dfrac{mg}{4} + \dfrac{mg\cdot\ell_2}{2\cdot\ell_0}$ $P_{2T} = P_{3T} = \dfrac{mg}{4} - \dfrac{mg\cdot\ell_2}{2\cdot\ell_0}$

Example	Service conditions	Applied load equation

5

With the LM rails movable
Horizontal mount



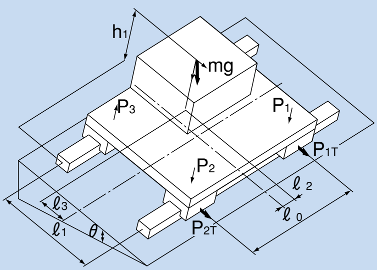
E.g.: XY table,
sliding fork

$$P_1 \sim P_4\,(\max) = \frac{mg}{4} + \frac{mg\cdot\ell_1}{2\cdot\ell_0}$$

$$P_1 \sim P_4\,(\min) = \frac{mg}{4} - \frac{mg\cdot\ell_1}{2\cdot\ell_0}$$

6

Laterally tilt mount



E.g.: NC lathe
Carriage

$$P_1 = +\frac{mg\cdot\cos\theta}{4} + \frac{mg\cdot\cos\theta\cdot\ell_2}{2\cdot\ell_0} - \frac{mg\cdot\cos\theta\cdot\ell_3}{2\cdot\ell_1} + \frac{mg\cdot\sin\theta\cdot h_1}{2\cdot\ell_1}$$

$$P_{1T} = \frac{mg\cdot\sin\theta}{4} + \frac{mg\cdot\sin\theta\cdot\ell_2}{2\cdot\ell_0}$$

$$P_2 = +\frac{mg\cdot\cos\theta}{4} - \frac{mg\cdot\cos\theta\cdot\ell_2}{2\cdot\ell_0} - \frac{mg\cdot\cos\theta\cdot\ell_3}{2\cdot\ell_1} + \frac{mg\cdot\sin\theta\cdot h_1}{2\cdot\ell_1}$$

$$P_{2T} = \frac{mg\cdot\sin\theta}{4} - \frac{mg\cdot\sin\theta\cdot\ell_2}{2\cdot\ell_0}$$

$$P_3 = +\frac{mg\cdot\cos\theta}{4} - \frac{mg\cdot\cos\theta\cdot\ell_2}{2\cdot\ell_0} + \frac{mg\cdot\cos\theta\cdot\ell_3}{2\cdot\ell_1} - \frac{mg\cdot\sin\theta\cdot h_1}{2\cdot\ell_1}$$

$$P_{3T} = \frac{mg\cdot\sin\theta}{4} - \frac{mg\cdot\sin\theta\cdot\ell_2}{2\cdot\ell_0}$$

$$P_4 = +\frac{mg\cdot\cos\theta}{4} + \frac{mg\cdot\cos\theta\cdot\ell_2}{2\cdot\ell_0} + \frac{mg\cdot\cos\theta\cdot\ell_3}{2\cdot\ell_1} - \frac{mg\cdot\sin\theta\cdot h_1}{2\cdot\ell_1}$$

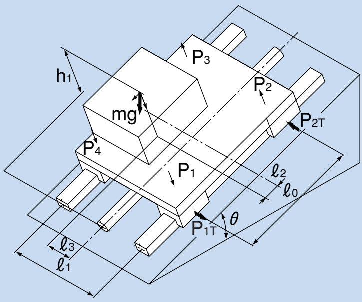
$$P_{4T} = \frac{mg\cdot\sin\theta}{4} + \frac{mg\cdot\sin\theta\cdot\ell_2}{2\cdot\ell_0}$$

Example	Service conditions	Applied load equation

7

Service conditions

Longitudinally tilt mount



E.g.: NC lathe
Tool rest

Applied load equation

$$P_1 = +\frac{mg\cdot\cos\theta}{4} + \frac{mg\cdot\cos\theta\cdot\ell_2}{2\cdot\ell_0} - \frac{mg\cdot\cos\theta\cdot\ell_3}{2\cdot\ell_1} + \frac{mg\cdot\sin\theta\cdot h_1}{2\cdot\ell_0}$$

$$P_{1T} = +\frac{mg\cdot\sin\theta\cdot\ell_3}{2\cdot\ell_0}$$

$$P_2 = +\frac{mg\cdot\cos\theta}{4} - \frac{mg\cdot\cos\theta\ \ell_2}{2\cdot\ell_0} - \frac{mg\cdot\cos\theta\cdot\ell_3}{2\cdot\ell_1} - \frac{mg\cdot\sin\theta\cdot h_1}{2\cdot\ell_0}$$

$$P_{2T} = -\frac{mg\cdot\sin\theta\cdot\ell_3}{2\cdot\ell_0}$$

$$P_3 = +\frac{mg\cdot\cos\theta}{4} - \frac{mg\cdot\cos\theta\cdot\ell_2}{2\cdot\ell_0} + \frac{mg\cdot\cos\theta\cdot\ell_3}{2\cdot\ell_1} - \frac{mg\cdot\sin\theta\cdot h_1}{2\cdot\ell_0}$$

$$P_{3T} = -\frac{mg\cdot\sin\theta\cdot\ell_3}{2\cdot\ell_0}$$

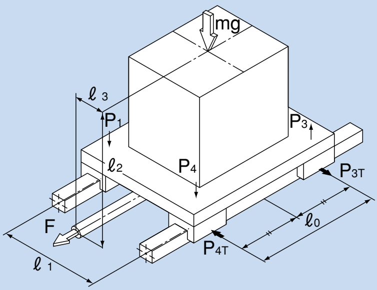
$$P_4 = +\frac{mg\cdot\cos\theta}{4} + \frac{mg\cdot\cos\theta\cdot\ell_2}{2\cdot\ell_0} + \frac{mg\cdot\cos\theta\cdot\ell_3}{2\cdot\ell_1} + \frac{mg\cdot\sin\theta\cdot h_1}{2\cdot\ell_0}$$

$$P_{4T} = +\frac{mg\cdot\sin\theta\cdot\ell_3}{2\cdot\ell_0}$$

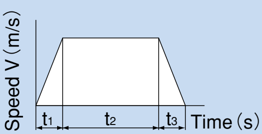
8

Service conditions

Horizontal mount
with inertia



$$\alpha_n = \frac{V}{t_n}$$



Speed diagram

E.g.: Conveyance truck

Applied load equation

During acceleration

$$P_1 = P_4 = \frac{mg}{4} - \frac{m\cdot\alpha_1\cdot\ell_2}{2\cdot\ell_0}$$

$$P_2 = P_3 = \frac{mg}{4} + \frac{m\cdot\alpha_1\cdot\ell_2}{2\cdot\ell_0}$$

$$P_{1T} \sim P_{4T} = \frac{m\cdot\alpha_1\cdot\ell_3}{2\cdot\ell_0}$$

During uniform motion

$$P_1 \sim P_4 = \frac{mg}{4}$$

During deceleration

$$P_1 = P_4 = \frac{mg}{4} + \frac{m\cdot\alpha_3\cdot\ell_2}{2\cdot\ell_0}$$

$$P_2 = P_3 = \frac{mg}{4} - \frac{m\cdot\alpha_3\cdot\ell_2}{2\cdot\ell_0}$$

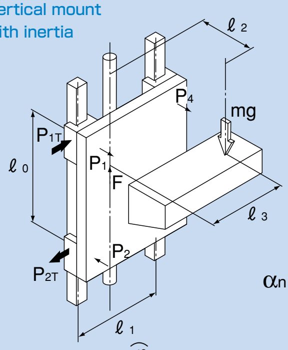
$$P_{1T} \sim P_{4T} = \frac{m\cdot\alpha_3\cdot\ell_3}{2\cdot\ell_0}$$

Example	Service conditions	Applied load equation
9	Vertical mount with inertia (see figure below)	During acceleration (see equations below)

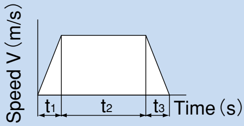
Example 9

Service conditions

Vertical mount with inertia



$$\alpha_n = \frac{V}{t_n}$$



Speed diagram

E.g.: Conveyance elevator

Applied load equation

During acceleration

$$P_1 \sim P_4 = \frac{m \cdot (g + \alpha_1) \cdot \ell_2}{2 \cdot \ell_0}$$

$$P_{1T} \sim P_{4T} = \frac{m \cdot (g + \alpha_1) \cdot \ell_3}{2 \cdot \ell_0}$$

During uniform motion

$$P_1 \sim P_4 = \frac{mg \cdot \ell_2}{2 \cdot \ell_0}$$

$$P_{1T} \sim P_{4T} = \frac{mg \cdot \ell_3}{2 \cdot \ell_0}$$

During deceleration

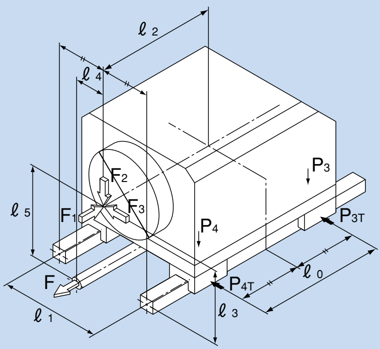
$$P_1 \sim P_4 = \frac{m \cdot (g - \alpha_3) \cdot \ell_2}{2 \cdot \ell_0}$$

$$P_{1T} \sim P_{4T} = \frac{m \cdot (g - \alpha_3) \cdot \ell_3}{2 \cdot \ell_0}$$

Example 10

Service conditions

Horizontal mount with external force



E.g.: Drill unit
Milling machine
Lathe
Machining center and other cutting machine

Applied load equation

Under force F_1

$$P_1 \sim P_4 = \frac{F_1 \cdot \ell_5}{2 \cdot \ell_0}$$

$$P_{1T} \sim P_{4T} = \frac{F_1 \cdot \ell_4}{2 \cdot \ell_0}$$

Under force F_2

$$P_1 = P_4 = \frac{F_2}{4} + \frac{F_2 \cdot \ell_2}{2 \cdot \ell_0}$$

$$P_2 = P_3 = \frac{F_2}{4} - \frac{F_2 \cdot \ell_2}{2 \cdot \ell_0}$$

Under force F_3

$$P_1 \sim P_4 = \frac{F_3 \cdot \ell_3}{2 \cdot \ell_1}$$

$$P_{1T} = P_{4T} = \frac{F_3}{4} + \frac{F_3 \cdot \ell_2}{2 \cdot \ell_0}$$

$$P_{2T} = P_{3T} = \frac{F_3}{4} - \frac{F_3 \cdot \ell_2}{2 \cdot \ell_0}$$