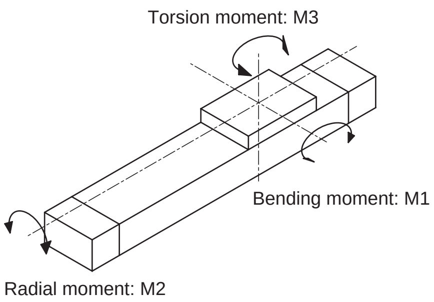
Rodless cylinder selection guide

[STEP1]

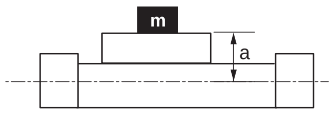
Moment actuates according to the cylinder mounting direction and the position of center of gravity of load.

- Types of moment caused by load



[Table 1] Value of a

Bore size	a(m) SRL3,SRL3-G,SRL3-Q,SRL3-GQ
ø12	0.023
ø16	0.025
ø20	0.028
ø25	0.036
ø32	0.039
ø40	0.045
ø50	0.054
ø63	0.060
ø80	0.081
ø100	0.089



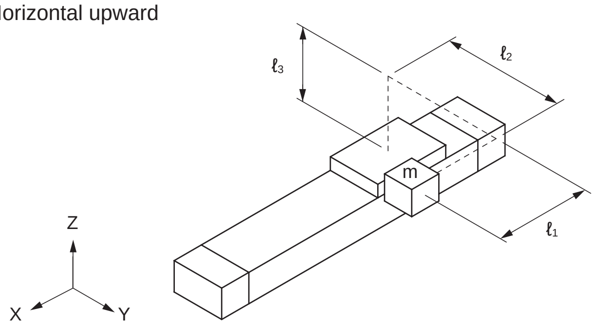
1 Obtain the static moment.

Unit: N·m

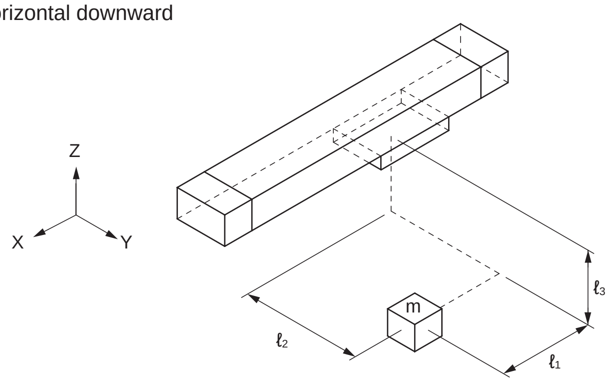
Mounting orientation		Horizontal upward	Horizontal downward	Horizontal lateral	Vertical
Vertical load W		mx9.8			-
Static moment	M1	Wxℓ_1	Wxℓ_1	-	Wx(ℓ_3+a)
	M2	Wxℓ_2	Wxℓ_2	Wx(ℓ_3+a)	-
	M3	-	-	Wxℓ_1	Wxℓ_2

m : Load weight [kg]
ℓ_1 : Length along the stroke direction from the center of table to the center of gravity of load [m]
ℓ_2 : Length in the width direction from the center of table to the center of gravity of load [m]
ℓ_3 : Length in the vertical direction from the center of table to the center of gravity of load [m]

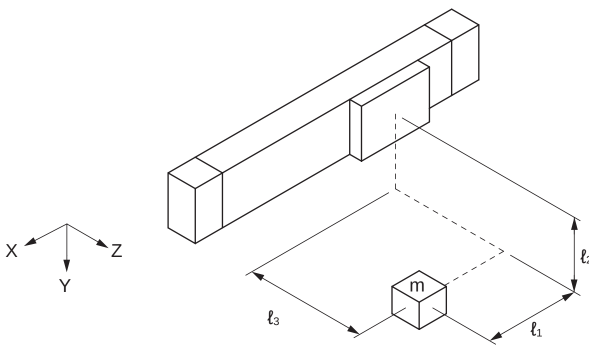
Horizontal upward



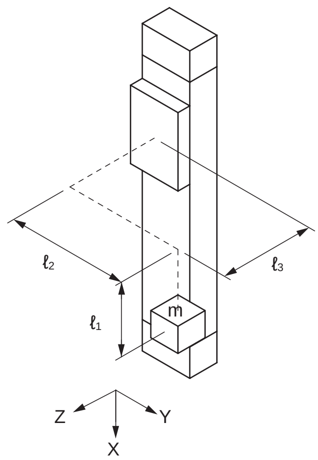
Horizontal downward



Horizontal lateral



Vertical



SCP*3
CMK2
CMA2
SCM
SCG
SCA2
SCS2
CKV2
CAV2/COVP/N2
SSD2
SSG
SSD
CAT
MDC2
MVC
SMG
MSD/MSDG
FC*
STK
SRL3
SRG3
SRM3
SRT3
MRL2
MRG2
SM-25
ShkAbs
FJ
FK
Spd Contr
Ending

2 Obtain the dynamic moment caused by the load inertia at the stroke end.

Unit: N·m

Mounting orientation		Horizontal upward	Horizontal downward	Vertical	Horizontal lateral
Dynamic moment	M1i	$Wx(\ell_3 + a)xG$			
	M2i	M2i dynamic moment is not generated.			
	M3i	$Wx\ell_2xG$			

Dynamic moment can be calculated with the formulas above regardless of the mounting direction.

Obtain an approximate G coefficient from Table 2.

[Table 2] $\text{Va (Average speed)} = \frac{\text{Travel distance}}{\text{Travel time}}$ (m/s)

Va (Average speed) (m/s)	Vm (stroke end speed) (m/s)	G Coefficient
0.3	to 0.65	9
0.6	to 1.00	15
0.9	to 1.30	23
1.2	to 2.00	40

G Coefficient = [ ]

3 Select an approximate bore size.

Select an approximate bore size.

M1 + M1i	= [ ]	(N·m)	→(ø)
M2	= [ ]	(N·m)	→(ø)
M3 + M3i	= [ ]	(N·m)	→(ø)
W	= [ ]	(N)	→(ø)
$E_0 = \frac{1}{2} x\ m\ x\ Vm^2$	= [ ]	(J)	→(ø)

Select a temporary max. bore size.

ø [ ]

[Table 3] Allowable value

Item / Bore size (mm)		Wmax (N)	M1max (N·m)	M2max (N·m)	M3max (N·m)
SRL3	ø12	30	1.5	0.6	0.6
	ø16	140	5	1	1
	ø20	200	10	1.5	3
	ø25	360	17	5	10
	ø32	620	36	10	21
	ø40	970	77	23	26
	ø50	1470	154	32	42
	ø63	2320	275	52	76
	ø80	3500	460	70	100
	ø100	5000	750	95	130
SRL3-G	ø12	30	1.5	0.6	0.4
	ø16	140	5	1	0.6
	ø20	200	10	1.5	1
	ø25	360	17	5	2
	ø32	620	36	10	4
	ø40	810	41	18	5
	ø50	1440	76	32	9
	ø63	1630	98	51	12
	ø80	3500	351	70	37
	ø100	4130	386	95	42

[Table 4] Allowable absorbed energy value of SRL3 (Eo)

Bore size (mm)	Integrated air cushion (J)	Shock absorber (J)	Model No.
ø12	0.03	2.4	NCK-00-0.3-C
ø16	0.22	2.4	NCK-00-0.3-C
ø20	0.59	5.7	NCK-00-0.7-C
ø25	1.40	10.0	NCK-00-1.2
ø32	2.57	18.0	NCK-00-2.6
ø40	4.27	50.0	NCK-00-7
ø50	9.13	86.0	NCK-00-12
ø63	17.4	86.0	NCK-00-12
ø80	33.0	143.0	NCK-00-20
ø100	57.0	143.0	NCK-00-20

4 Obtain the resultant moment at the stroke end (M_T).
(Confirm that the bore size selected in **3** satisfies the formula below.)

$$M_T = \frac{M1+M1_i}{M1max} + \frac{M2}{M2max} + \frac{M3+M3i}{M3max} + \frac{W}{Wmax} < 1$$

M : Resultant moment (must be smaller than 1)
Wmax : Max. allowable value of W (from Table 3)
M1max : Max. allowable value of M1 (from Table 3)
M2max : Max. allowable value of M2 (from Table 3)
M3max : Max. allowable value of M3 (from Table 3)

- If M_T is much more than 1, change the selection condition.
- If M_T is slightly more than 1, improving the accuracy in STEP 2 may make the value 1 or less. Perform STEP 2 to see the result.

[STEP2]

Next, obtain a more accurate load factor, effective thrust, stroke end speed and resultant moment.

● Calculate the load factor.

$$\alpha = \frac{F_0}{F} \times 100[\%]$$

α : Load factor
F_0 : Force (N) required to move the workpiece
F : Effective thrust of the cylinder (N) (Fig. 1 to 4)

For horizontal operation	For vertical operation
$F_0 = F_W + F_1 + F_2 + F_3 + F_L$	$F_0 = W + F_1 + F_2 + F_3 + F_L$

Fw : Wx0.2(N)
F_2 : $M_2 \times C_2$ Note (N)
F_L : Other kinds of resistance (e.g., guide resistance) (N)
F_1 : $M_1 \times C_1$ Note (N)
F_3 : $M_3 \times C_3$ Note (N)
W : Load (N)

Note: Coefficient to correct the increase of friction caused when moment is applied

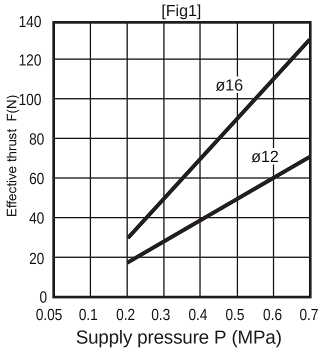
[Table 5] Moment friction coefficients 1/m

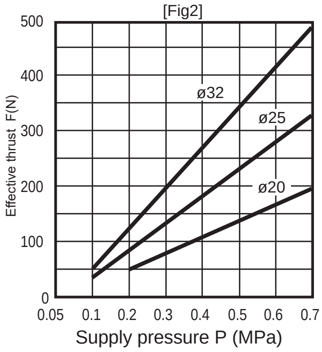
Bore size (mm)	C_1	C_2	C_3
ø12 or equiv.	8	27	8
ø16 or equiv.	7	24	7
ø20 or equiv.	6	21	6
ø25 or equiv.	5	16	5
ø32 or equiv.	4	13	4
ø40 or equiv.	4	11	4
ø50 or equiv.	4	9	4
ø63 or equiv.	3	8	3
ø80 or equiv.	3	7	3
ø100 or equiv.	3	6	3

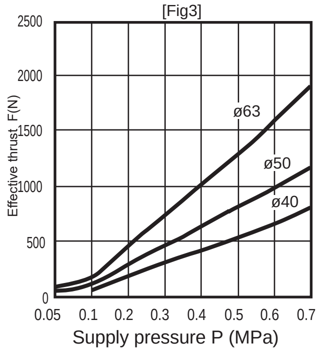
[Table 6] Load factor guidelines

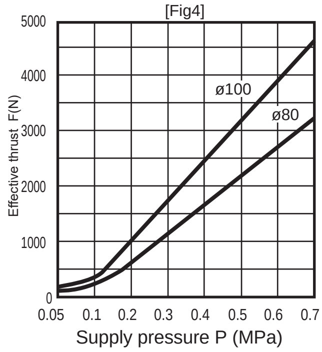
Working pressure (MPa)	Load factor (%)
0.2 to 0.3	α ≤ 40
0.3 to 0.6	α ≤ 50
0.6 to 0.7	α ≤ 60

● Graph for obtaining effective thrust

[Fig1]


[Fig2]


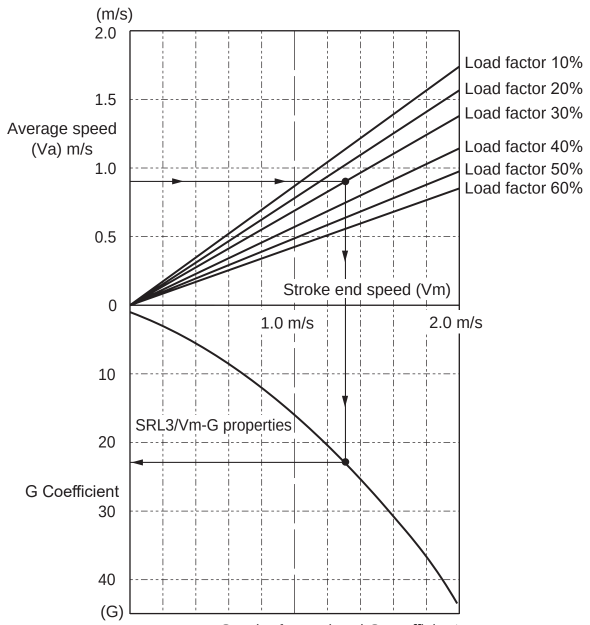
[Fig3]


[Fig4]


[STEP3]

In [Fig. 1], obtain the stroke end speed (Vm) and G coefficient from the average speed (Va) and load factor obtained in STEP 2.

● Graph of speed and G coefficient [Fig. 1]



Graph of speed and G coefficient

G Coefficient =

● The arrow (→) in the figure is the formula for obtaining

- Stroke end speed : 1.3 m/s
- G Coefficient : 22.5

at

- Average speed : 0.9 m/s
- Load factor : 30 %

[STEP4]

● Calculate the resultant moment (M_T) using the G coefficient obtained in STEP 3.

M1 + M1i = (N·m)

M2 = (N·m)

M3 + M3i = (N·m)

W = (N)

$$M_T = \frac{M1+M1_i}{M1max} + \frac{M2}{M2max} + \frac{M3+M3i}{M3max} + \frac{W}{Wmax}$$

$M_T \leq 1$

↓

Bore size is decided. (* Refer to [Table 3] in STEP 1)

↓

Confirm cushion capacity

Unit: N·m

Mounting orientation		Horizontal upward	Horizontal downward	Vertical	Horizontal lateral
Dynamic moment	M1i	Wx(ℓ₃ + a)xG			
	M2i	M2i dynamic moment is not generated.			
	M3i	Wxℓ₂xG			

Although the formulas are the same as those in STEP 1, use the G coefficient obtained in STEP 3 for calculation.

[STEP5]

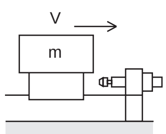
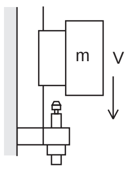
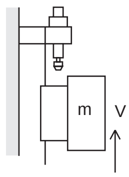
● Confirming cushion capacity

$$E=\frac{1}{2}\times m\times Vm^2$$

E : Kinetic energy at workpiece end (J)
m : Load weight (kg)
Vm : Speed of the piston entering the cushion (m/s)

Checking the allowable absorbed energy of shock absorber
Calculate the colliding energy E and the colliding object equivalent weight Me from the formula in the table below. Confirm that Me is within the allowable values shown in Figure 2. As well, check that it is within the allowable values shown in Table 7.
Note that the allowable colliding object equivalent weight Me and allowable colliding energy E change depending on the colliding speed.

● The allowable absorbed energy changes depending on the colliding speed. Keep it within 1/3 of the max. energy absorption in Table 7 at 2000 mm/s colliding speed, and within 1/2 at 1000 mm/s colliding speed.

	Horizontal movement	Vertical down	Vertical up
Applications			
Colliding object equivalent weight Me (kg)	$Me=\frac{2xE}{V^2}$	$Me=\frac{2xE}{V^2}$	$Me=\frac{2xE}{V^2}$
Energy E (J)	$E=\frac{mV^2}{2}+F\cdot St$	$E=\frac{mV^2}{2}+(F+mg)\cdot St$	$E=\frac{mV^2}{2}+(F-mg)\cdot St$

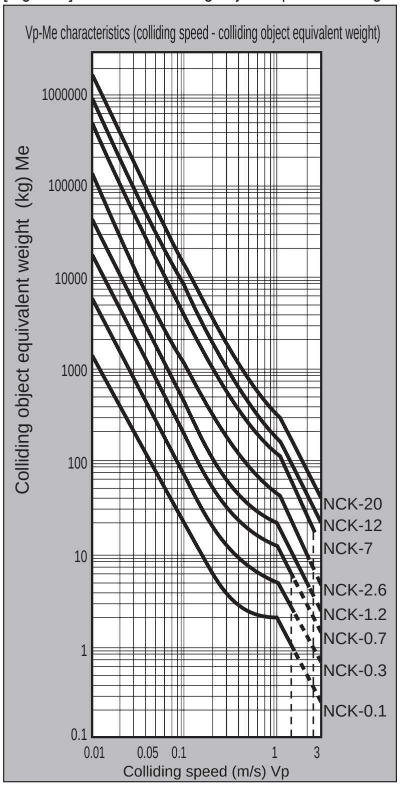
● Code

E	: Colliding energy	J
Me	: Colliding object equivalent weight	kg
m	: Workpiece weight	kg
F	: Cylinder thrust	N
V	: Colliding speed (m/s)	
St	: Shock absorber stroke (m)	
g	: Gravity acceleration 9.8 (m/s^2)	

[Table 7] Allowable absorbed energy value of SRL3 (Eo)

Bore size (mm)	Integrated air cushion (J)	Shock absorber (J)	Model No.
ø12	0.03	2.4	NCK-00-0.3-C
ø16	0.22	2.4	NCK-00-0.3-C
ø20	0.59	5.7	NCK-00-0.7-C
ø25	1.40	10.0	NCK-00-1.2
ø32	2.57	18.0	NCK-00-2.6
ø40	4.27	50.0	NCK-00-7
ø50	9.13	86.0	NCK-00-12
ø63	17.4	86.0	NCK-00-12
ø80	33.0	143.0	NCK-00-20
ø100	57.0	143.0	NCK-00-20

[Figure 2] Allowable colliding object equivalent weight



[STEP6]

● The bore size determined from the cushion performance is øA. (Bore size determined in STEP 5)

● The bore size determined from the load conditions is øB. (Bore size determined in STEP 4)

øA ≥ øB → Select øA.
or
→ øB should be used with an external damper.

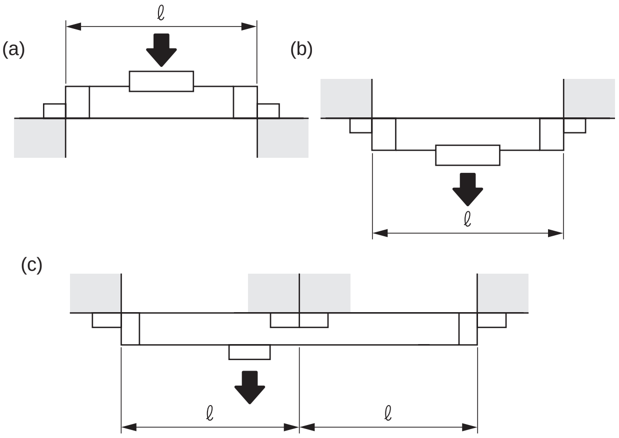
øA < øB → Select øB.

SRL3 Series

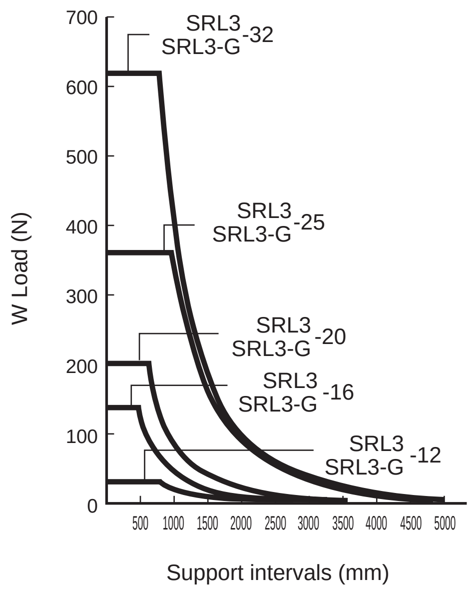
Selection guide

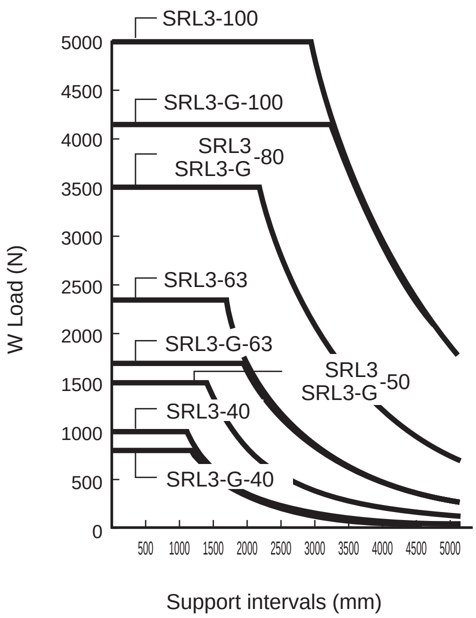
1 Limits of vertical load

- If the stroke is long, the cylinder tube sags with its self weight and load. In this case, use an intermediate support bracket to keep the support interval in the figure below within the value of the graph.
  (The intermediate support bracket is an auxiliary bracket for reducing sag. It is not a fixing bracket.)

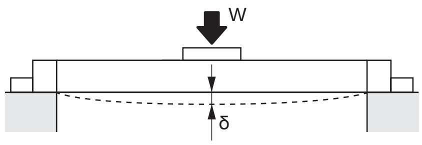


- Allowable load for the supporting methods (a), (b) and (c) above

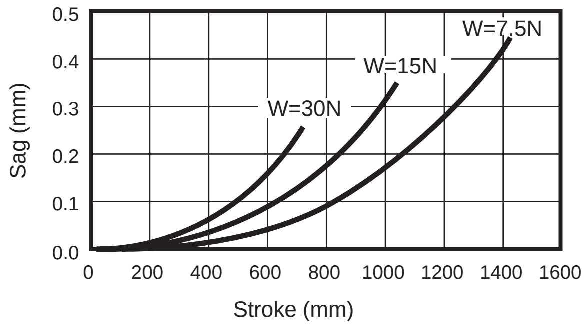




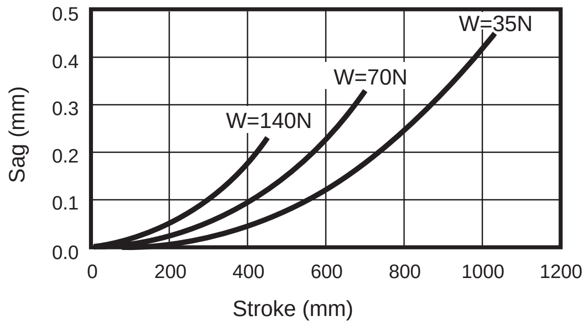
2 Sag of cylinder tube δ



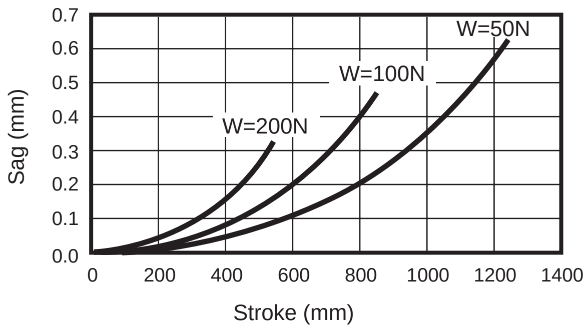
- SRL3-12, SRL3-G-12 (ø12 or equiv.)



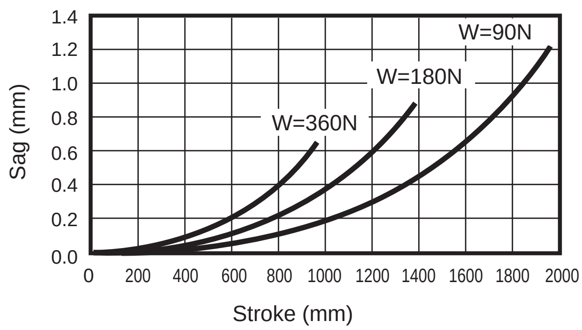
- SRL3-16, SRL3-G-16 (ø16 or equiv.)



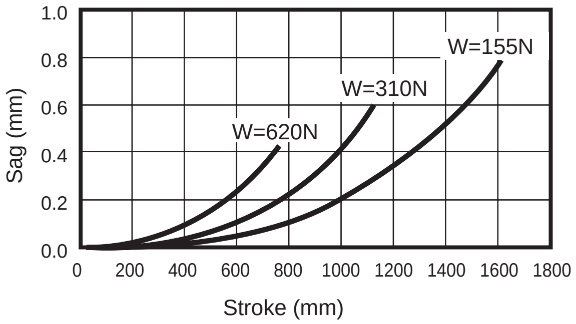
- SRL3-20, SRL3-G-20 (ø20 or equiv.)



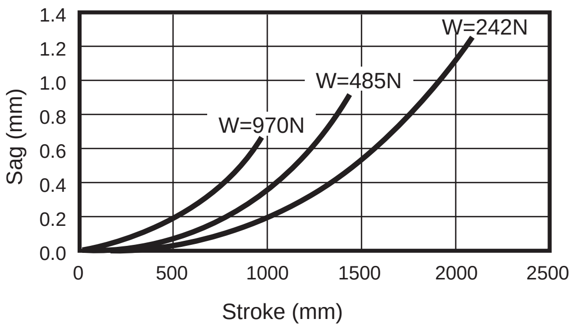
- SRL3-25, SRL3-G-25 (ø25 or equiv.)



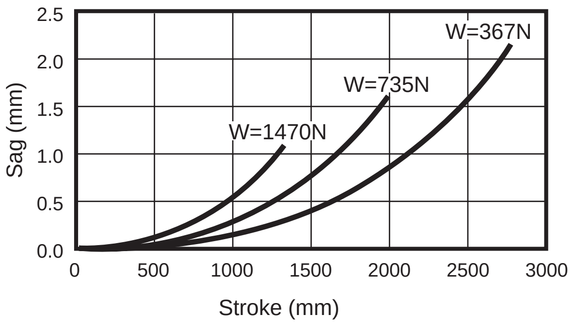
● SRL3-32, SRL3-G-32 (ø32 or equiv.)



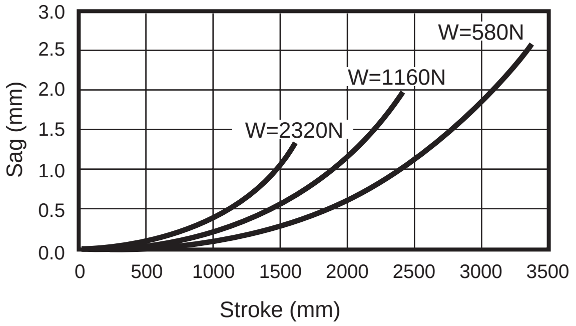
● SRL3-40, SRL3-G-40 (ø40 or equiv.)



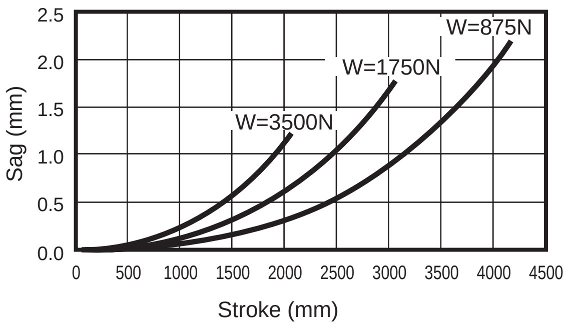
● SRL3-50, SRL3-G-50 (ø50 or equiv.)



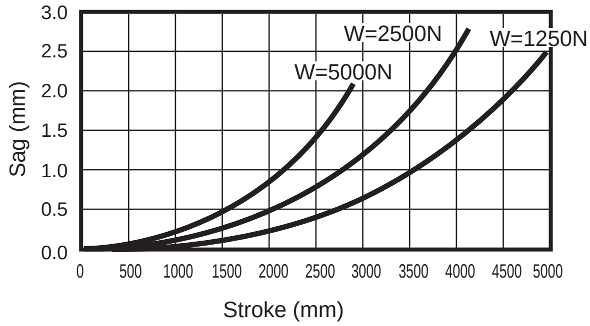
● SRL3-63, SRL3-G-63 (ø63 or equiv.)



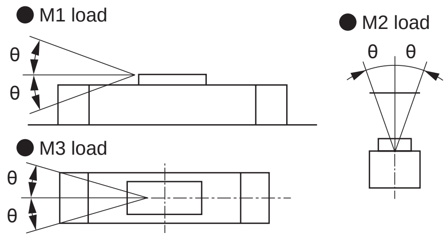
● SRL3-80, SRL3-G-80 (ø80 or equiv.)



● SRL3-100, SRL3-G-100 (ø100 or equiv.)

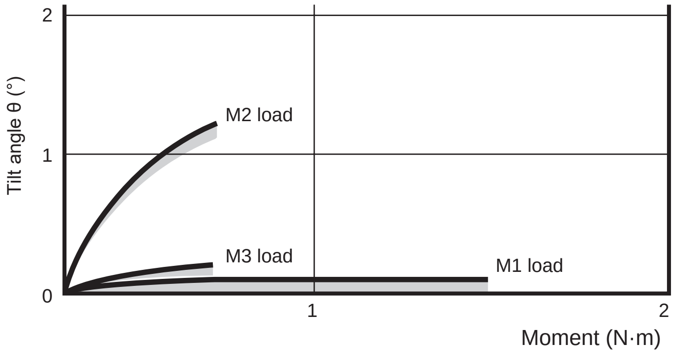


3 Inclination θ of table



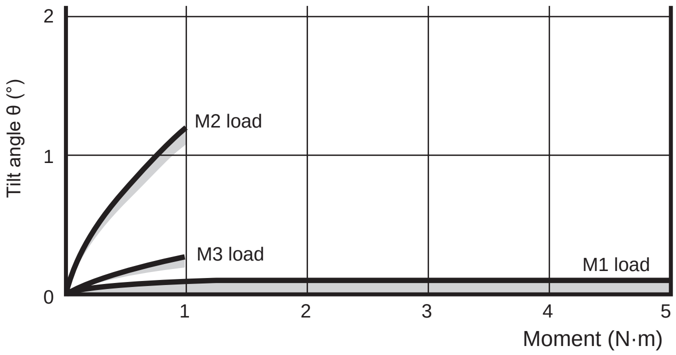
● SRL3-12 (ø12 or equiv.)

: Varies within this range.



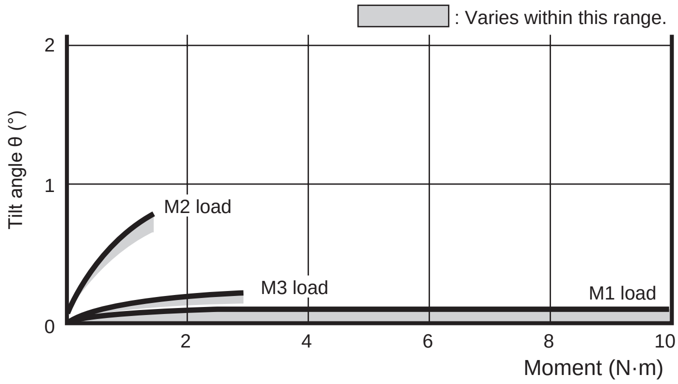
● SRL3-16 (ø16 or equiv.)

: Varies within this range.



● SRL3-20 (ø20 or equiv.)

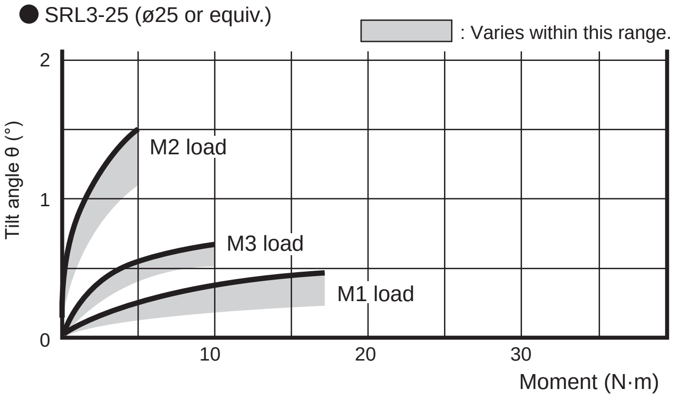
: Varies within this range.



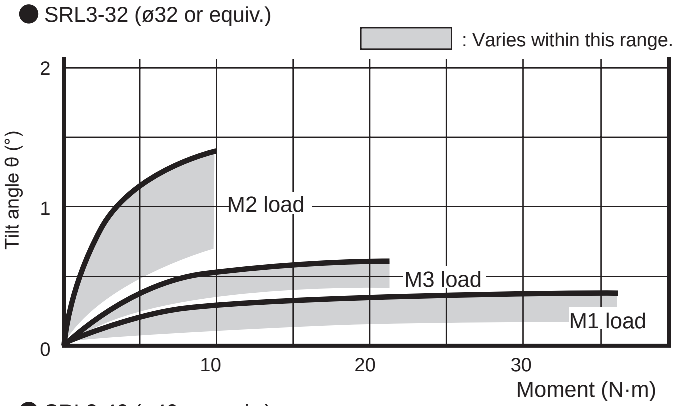
SRL3 Series

Selection guide

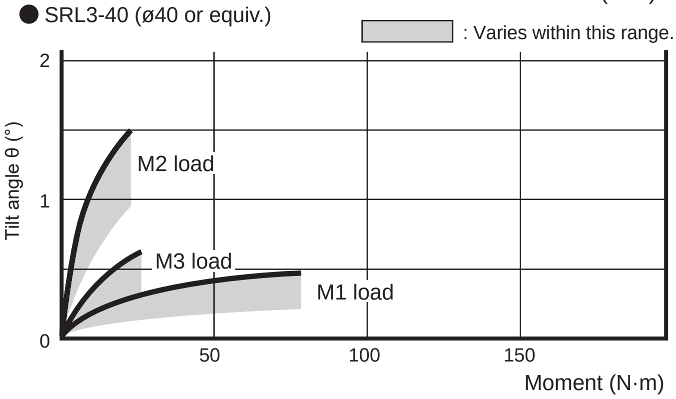
● SRL3-25 (ø25 or equiv.)



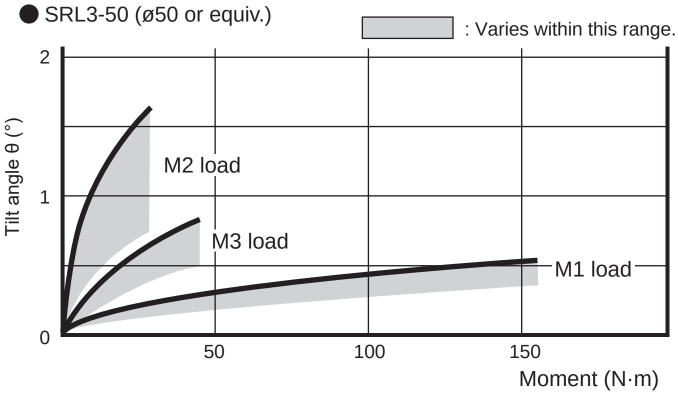
● SRL3-32 (ø32 or equiv.)



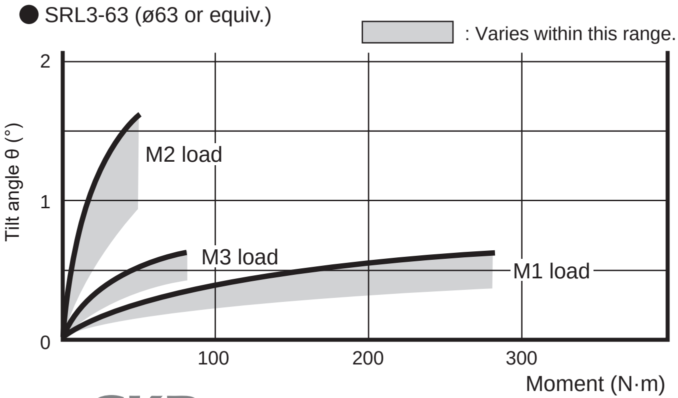
● SRL3-40 (ø40 or equiv.)



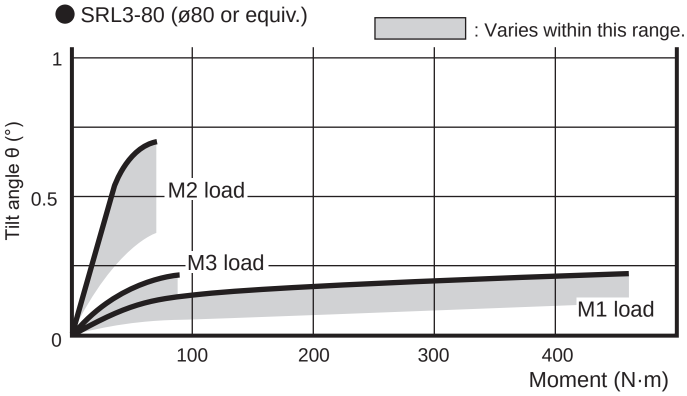
● SRL3-50 (ø50 or equiv.)



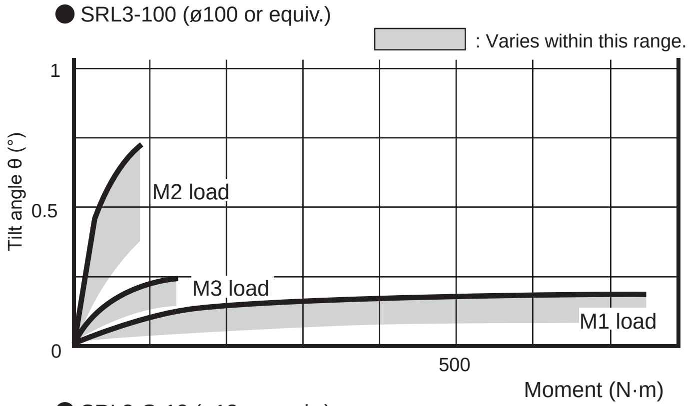
● SRL3-63 (ø63 or equiv.)



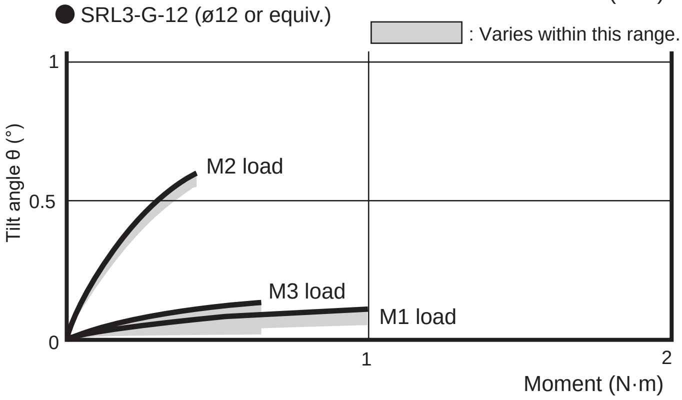
● SRL3-80 (ø80 or equiv.)



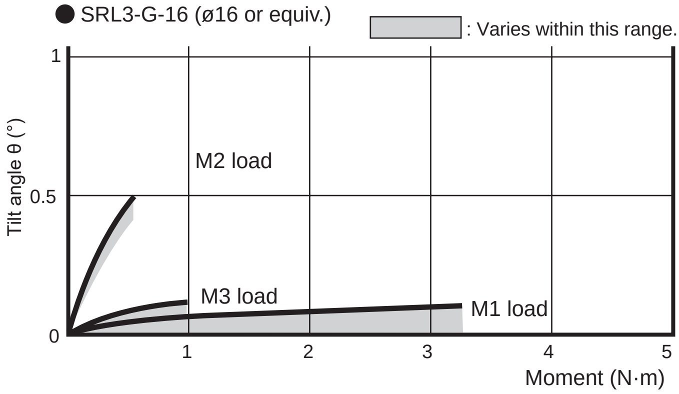
● SRL3-100 (ø100 or equiv.)



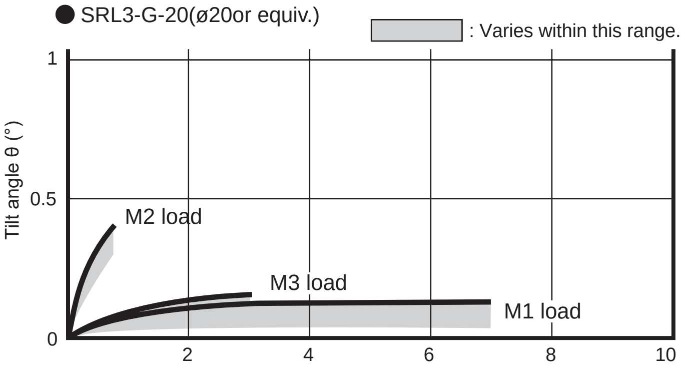
● SRL3-G-12 (ø12 or equiv.)



● SRL3-G-16 (ø16 or equiv.)

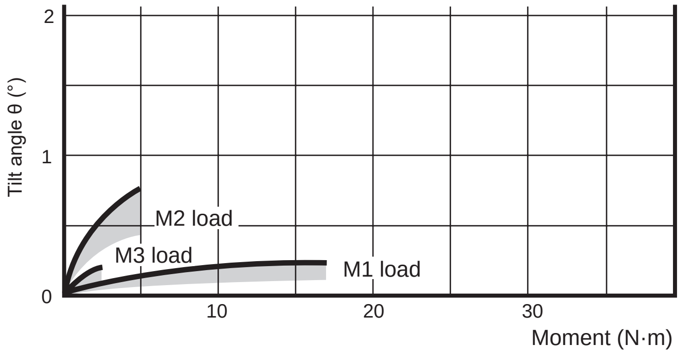


● SRL3-G-20(ø20or equiv.)



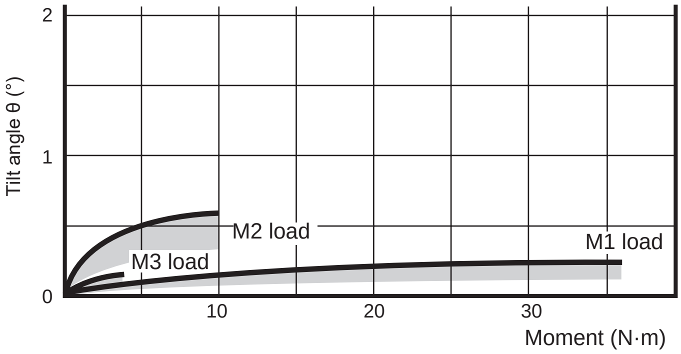
● SRL3-G-25 (ø25 or equiv.)

: Varies within this range.



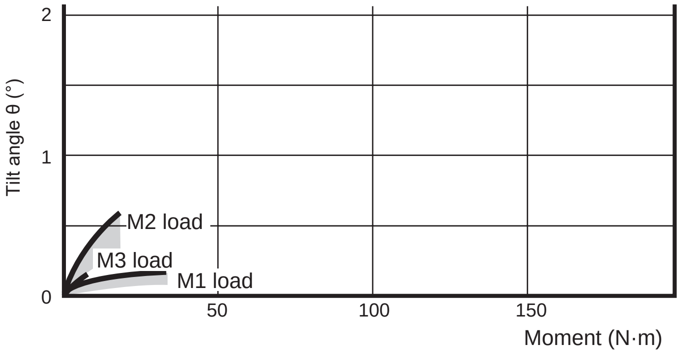
● SRL3-G-32 (ø32 or equiv.)

: Varies within this range.



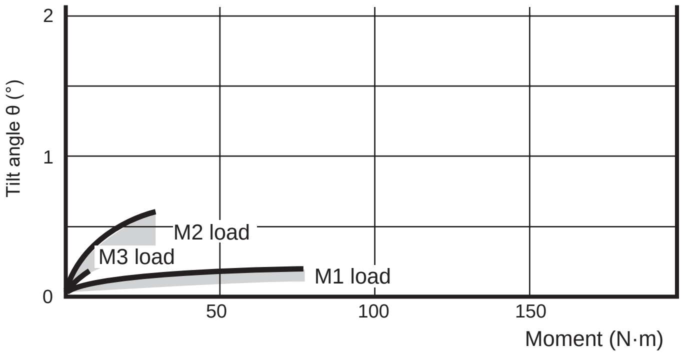
● SRL3-G-40 (ø40 or equiv.)

: Varies within this range.



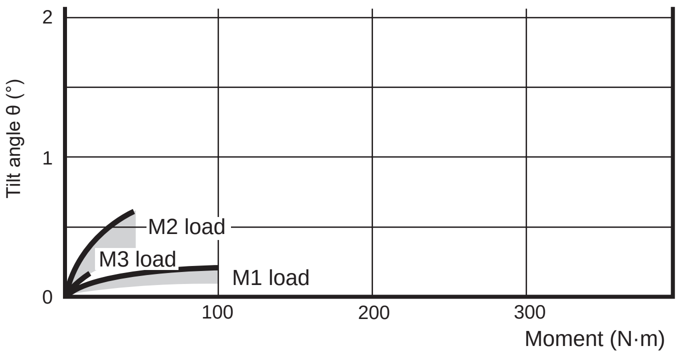
● SRL3-G-50 (ø50 or equiv.)

: Varies within this range.



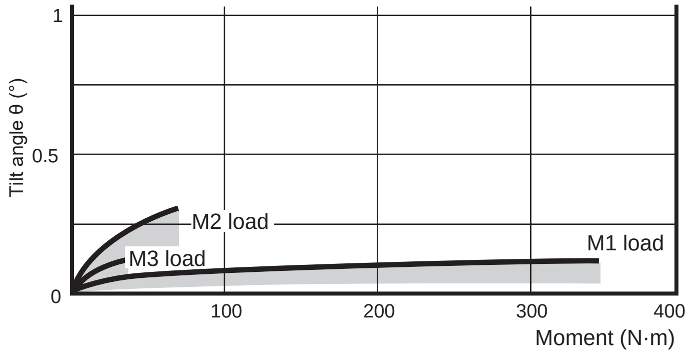
● SRL3-G-63 (ø63 or equiv.)

: Varies within this range.



● SRL3-G-80 (ø80 or equiv.)

: Varies within this range.



● SRL3-G-100 (ø100 or equiv.)

: Varies within this range.