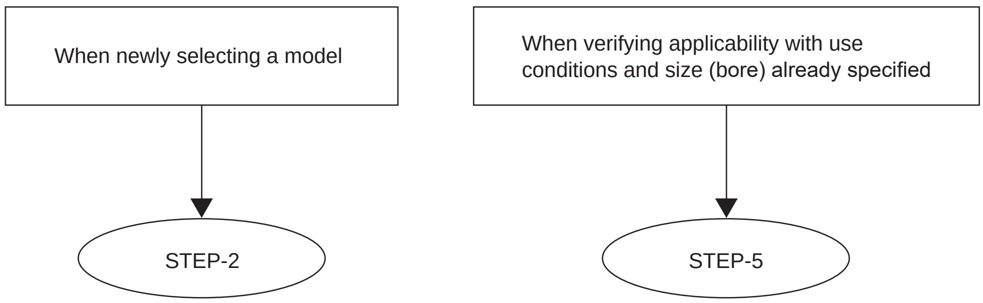
MRG2 Series selection guide

● As the selection conditions are different from those of general air cylinders, confirm whether the model is adequate or not according to selection guide.

STEP-1



STEP-2

● Confirming working conditions

1. Working pressure (P) ☐ (MPa)
2. Applied load (W) ☐ (N) (applied load = workpiece load + jig load)
3. Mounting orientation Horizontal / vertical (Refer to Fig. 1 below)
4. Stroke (L) ☐ (m)
5. Travel time (t) ☐ (S)
6. Average speed (Va) ☐ (m/s)

Formula for cylinder average speed Va

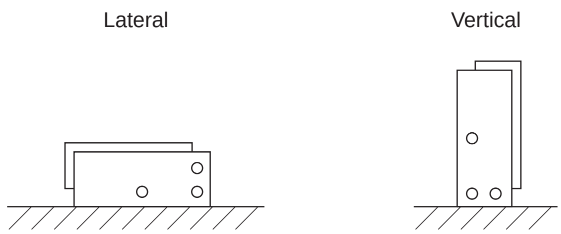
$$Va=\frac{L}{t}\ (m/s)$$

[Mounting orientation]

Operating direction Horizontal, vertical - up, vertical - down

Mounting direction Lateral, vertical (refer to Fig. 1)

Fig. 1



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

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

STEP-3

● Calculation of required thrust

Calculate the required thrust (F_N) of the cylinder.

1. For horizontal operation
   F_N=Wx0.2* = ☐ (N)
2. For vertical operation
   F_N=W = ☐ (N)

* This is the frictional resistance value of the guide, etc., when a load is placed on the slider. Consider separately when there is further external resistance.

STEP-4

● Selection of approximate size of cylinder

$$\text{Required thrust of cylinder } F_N \le \text{theoretical thrust} \times \frac{\mu}{100} \times \frac{\alpha}{100}$$

μ: Thrust efficiency (%) (refer to Fig. 2.)
α: Load factor (%) (refer to Fig. 2.)

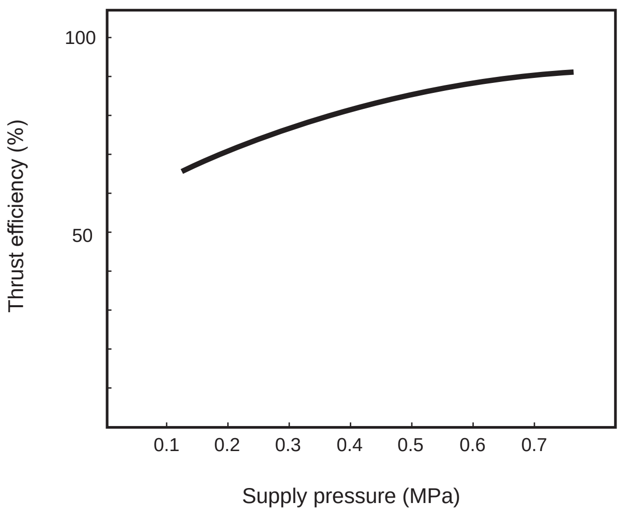
Select a cylinder size which satisfies this condition.

Table 1. Theoretical thrust value

(N)

Bore size (mm)	Working pressure MPa					
	0.2	0.3	0.4	0.5	0.6	0.7
ø10	-	24	31	39	47	55
ø16	40	60	80	101	121	141
ø25	98	147	196	245	295	344

Fig. 2 Thrust efficiency μ



Load factor α: For general use, the value within the range in Table 2 is desirable.

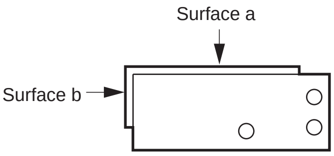
Table 2. Load factor guidelines

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

STEP-5

● Calculate the vertical load and value for each moment

Calculate the vertical loads (W1, W2) and the moments (M1, M2, M3) depending on the load cylinder mounting status.



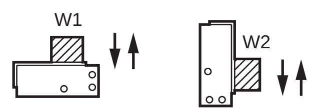
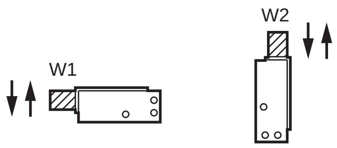
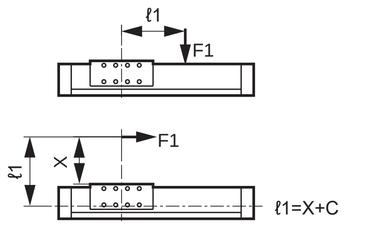
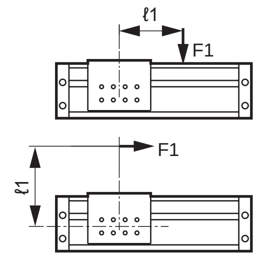
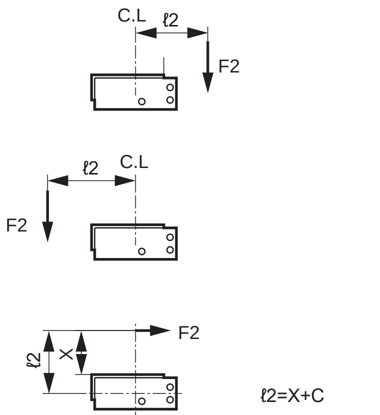
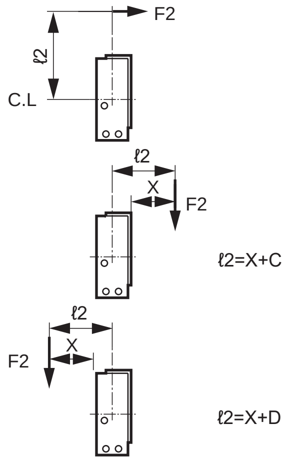
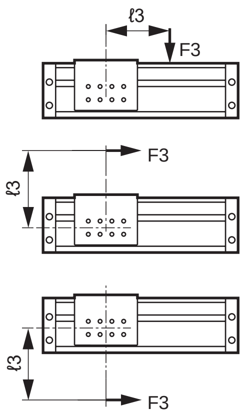
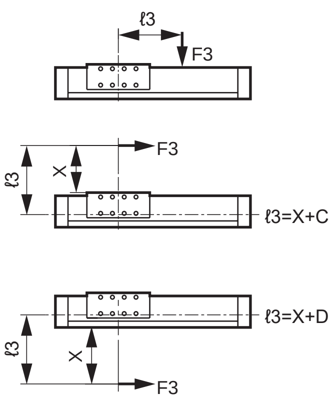
	Mounting on surface a	Mounting on surface b	Calculation results
Vertical load W1 W2			W1= ☐ W2= ☐
Bending moment M1=F1xℓ1	 X is the distance from the surface of the slider to the working point of the force		M1= ☐
Radial moment M2=F2xℓ2	 C.L indicates the center point between the set screws on surface a		M2= ☐
Torsion moment M3=F3xℓ3			M3= ☐

Table 3. Values of each parameter

(m)

Bore size (mm)	C	D
ø10	0.016	0.012
ø16	0.020	0.014
ø25	0.026	0.020

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

STEP-6

● Confirmation of the vertical load and the composite value for each moment

Divide each load with the max. allowable values listed in Table 4 and confirm that the total value thereof is 1.0 or less.

$$\frac{W1\ (\text{or } W2)}{W1\ (\text{or } W2)\ max} + \frac{M1}{M1max} + \frac{M2}{M2max} + \frac{M3}{M3max} \leq 1.0$$

When the total value is greater than 1.0

1. Review the load → STEP-2
2. Use a cylinder with wider bore size, etc., for revision. → Increase cylinder bore size STEP-5

Table 4. Max. allowable values of vertical load and moments

Bore size (mm)	W1max(N)	W2max(N)	M1max (N·m)	M2max (N·m)	M3max (N·m)
ø10	44	35	2.2	1.2	2.2
ø16	103	91	7.4	3.2	7.4
ø25	176	176	18.3	7.3	18.3

STEP-7

● Confirmation of kinetic energy

Calculate the kinetic energy from load weight m (kg) and speed V (m/s) to confirm that the value is within the range of the specifications of the shock absorber. If the kinetic energy exceeds the specifications, increase the cylinder size or install an external shock absorber.

(1) Formula for kinetic energy calculation

$$E_1 = \frac{1}{2} \times m \times V^2 = \square\ (J)$$

$$m = \frac{W}{9.8} = \square\ (kg)$$

$$V = \frac{L}{t} \times \left\{1 + 1.5 \times \frac{\alpha}{100}\right\} = \square\ (m/s)$$

$$\alpha = \frac{F_N}{\text{Cylinder theoretical thrust} \times \frac{\mu}{100}} \times 100 = \square\ (\%)$$

E_1	: Kinetic energy	(J)
m	: Load weight	(kg)
V	: Speed	(m/s)
W	: Applied load	(N)
L	: Cylinder stroke	(m)
t	: Operating time	(s)
α	: Cylinder load factor	(%)
F_N	: Required thrust	(N)
μ	: Thrust efficiency	(%)

(2) Shock absorber

The shock absorber used with MRG2 is shown in Table 5.

Table 5. Shock absorber specifications

Model	MRG2-10	MRG2-16	MRG2-25
Shock absorber model No.	MRG2-10-C (NCK-00-0.3 used)	MRG2-16-C (NCK-00-0.7 used)	MRG2-25-C (NCK-00-1.2 used)
Max. absorbed energy (J) *1	2.1	5.3	8.7
Stroke (mm) *1	5	7	8.5
Absorbed energy per hour (kJ/hour)	6.3	12.6	21.6
Max. operating frequency (cycle/min)	35	30	30

*1) As a stopper cap is used to stop the piston before the stroke end, the energy and stroke are both smaller than standard products.

● Confirmation of allowable colliding energy of shock absorber

Calculate colliding object equivalent weight Me and colliding energy E with the formula listed in the table below and confirm that Me and E are less than or equal to the allowable values listed in Fig. 4 and Table 5. Also confirm that the repetition frequency is less than or equal to the allowable value according to Table 5.

● Code

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

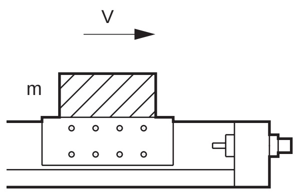
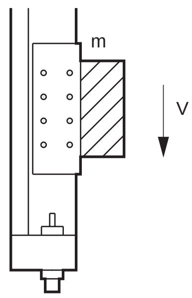
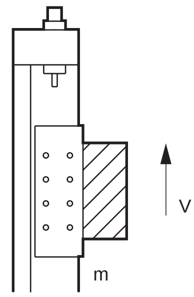
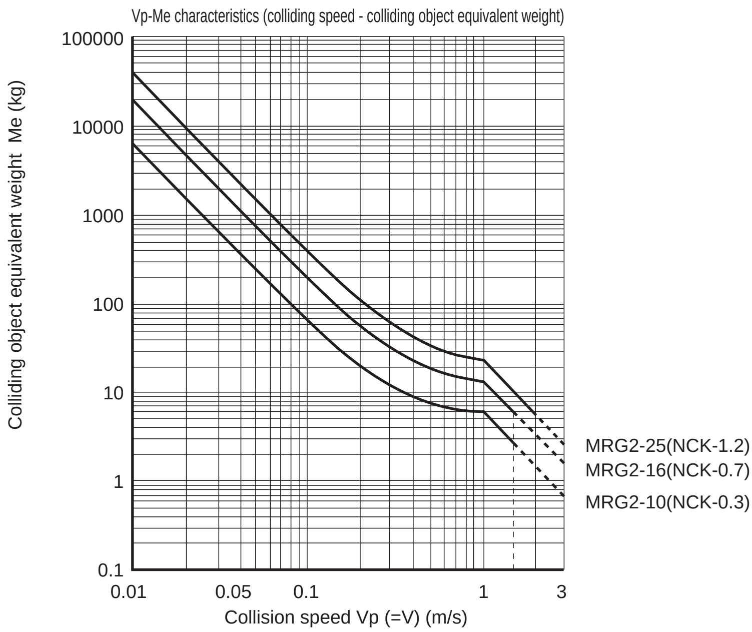
	Horizontal movement	Vertical down	Vertical up
Applications			
Colliding object equivalent weight Me (kg)	$Me=m+\frac{2F\cdot St}{V^2}$	$Me=m+\frac{2\cdot St\,(F+mg)}{V^2}$	$Me=m+\frac{2\cdot St\,(F-mg)}{V^2}$
Energy E (J)	$E=\frac{mV^2}{2}+F\cdot St$	$E=\frac{mV^2}{2}+(F+mg)\cdot St$	$E=\frac{mV^2}{2}+(F-mg)\cdot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

Fig. 4



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

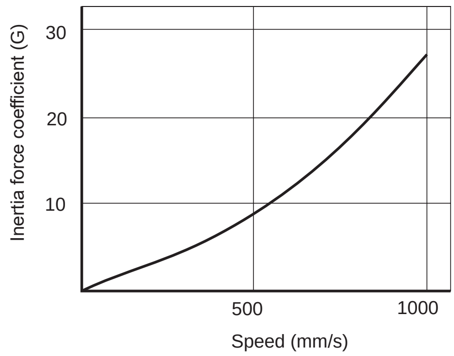
STEP-8

● Confirmation of inertia load

Inertia force functioning due to the load will operate at the end of the stroke.
Confirm whether this force is within the allowable range.

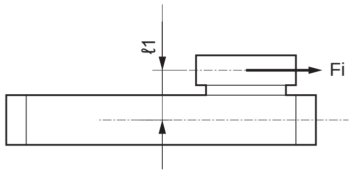
(1) Calculate inertia force Fi according to speed V and the inertia force coefficient shown in Fig. 5.
Fi=9.8xmxG(N)
m: Load weight (kg)
G: Inertia force coefficient

Fig. 5. Inertia force coefficient

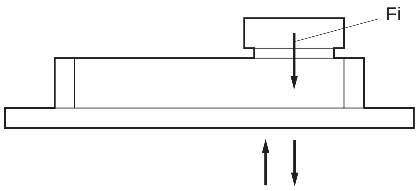


(2) Calculate the moment and load that is generated due to the inertia force.
(Example)

M1i=Fixℓ1



W1i=Fi



When vertically moving the entire cylinder

(3) Add the load and moment generated by static load and inertial force, divide each load with the allowable values listed in Table 4 and confirm that the total values thereof are 1.0 or less.

W1g=W1+W1i
W2g=W2+W2i

M1g=M1+M1i
M2g=M2+M2i
M3g=M3+M3i

$$\frac{\text{W1g (or W2g)}}{\text{W1 (or W2) max}} + \frac{\text{M1g}}{\text{M1 max}} + \frac{\text{M2g}}{\text{M2 max}} + \frac{\text{M3g}}{\text{M3 max}} \leq 1.0$$