SCPD3	
SCM	
SSD2	
MDC2	
SMG	
LCM	
LCR	
LCG	
LCX	
STM	
STG	
STR2	
MRL2	
GRC	
Cylinder switch	
MN3E MN4E	
4GA/B	
M4GA/B	
MN4GA/B	
F.R (module unit)	
Clean F.R	
Precision R	
Press gauge Diff. press gauge	
Electro-pneumatic R	
Speed controller	
Auxiliary valve	
Fitting/ tube	
Clean air unit	
Pressure sensor	
Flow rate sensor	
Valve for air blow	
Ending	

STEP-1

❶ Calculate the load and the moment of impact occurring at the stroke end in different directions.

$M1' = L \times W$

$M3' = L \times W$

$W' = W$

$M2' = L \times W$
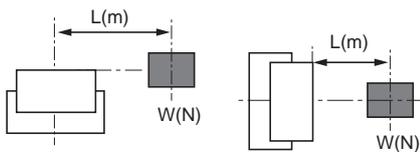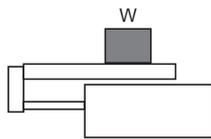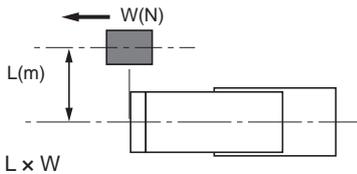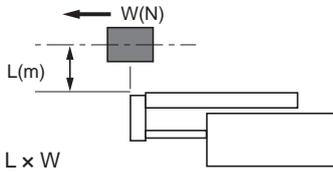
Obtain an approximate G coefficient in (Table 1).

(Table 1) Va (average speed) = $\dfrac{\text{Distance traveled}}{\text{Time traveled}}$ (m/s)

Va average speed (m/s)	Vm Stroke end speed (m/s)	G coefficient
up to 0.07	up to 0.1	5
up to 0.2	up to 0.3	14
up to 0.27	up to 0.4	19
up to 0.35	up to 0.5	24

G coefficient = [　　　]

$M1' \times G$ = [　　　] (N·m)

$M2'$ = [　　　] (N·m)

$M3' \times G$ = [　　　] (N·m)

W' = [　　　] (N)

$E' = \dfrac{1}{2} \times (m + m_\alpha) \times Vm^2$

= [　　　] (J)

$(m \fallingdotseq \dfrac{W}{9.8})$

❷ Select a temporary bore size that satisfies the following formula.

$$M'_T = \frac{M1' \times G}{M1'\text{max}} + \frac{M2'}{M2'\text{max}} + \frac{M3' \times G}{M3'\text{max}} + \frac{W'}{W'\text{max}} < 1$$

$E' < E\,\text{max}$

M'T	: Resultant moment (must be smaller than 1)
G	: G coefficient
W'max	: Maximum allowable value of W' (from Table 2)
M1'max	: Maximum allowable value of M1' (from Table 2)
M2'max	: Maximum allowable value of M2' (from Table 2)
M3'max	: Maximum allowable value of M3' (from Table 2)
Emax	: Maximum allowable value of Eo (from Table 3)
mα	: Table weight (from Table 4)

(Table 2) Allowable static load

Bore size	Stroke (mm)	Vertical load W'max (N)	Bending moment M1'max (N·m)	Radial moment M2'max (N·m)	Twist moment M3'max (N·m)
ø6	10 to 30	140	1.7	3.5	1.7
	40 to 50	186	10.7	5.6	10.7
ø8	10 to 30	140	1.7	3.5	1.7
	40 to 75	186	10.7	5.6	10.7
ø12	10 to 50	220.8	5.7	9.8	5.7
	75 to 100		22.2		22.2
ø16	10 to 50	380.8	17.8	19.2	17.8
	75 to 125		37.3		37.3
ø20	10 to 50	548.8	31.1	37.6	31.1
	75 to 150		56.2		56.2
ø25	10 to 50	961.5	65.1	116.3	65.1
	75 to 150		127.5		127.5

Note: When attaching a load to the end plate, even if selecting long stroke (ø6, 8: 40 or more, ø12 or more: 75 or more), calculate the allowable values with short stroke (ø6, 8: 30 or less, ø12 or more: 50 or less).

(Table 3) Allowable absorbed energy value of LCR (Eo)

Bore size	Standard (J)	With stroke adjusting stopper (J)
ø6	0.025	0.0032
ø8	0.058	0.0032
ø12	0.112	0.014
ø16	0.176	0.043
ø20	0.314	0.055
ø25	0.314	0.14

(Table 4) Table weight　(Unit: kg)

Bore size	Stroke (mm)									P72/P73 Increment
	10	20	30	40	50	75	100	125	150	
ø6	0.035	0.035	0.04	0.05	0.055	-	-	-	-	0.005
ø8	0.055	0.055	0.06	0.075	0.08	0.095	-	-	-	0.015
ø12	0.13	0.13	0.13	0.14	0.155	0.195	0.225	-	-	0.025
ø16	0.185	0.185	0.185	0.2	0.215	0.285	0.325	0.365	-	0.035
ø20	0.29	0.29	0.29	0.315	0.335	0.415	0.47	0.525	0.585	0.045
ø25	0.505	0.505	0.505	0.54	0.58	0.745	0.835	0.925	1.015	0.075

CKD

STEP-2

Obtain a more accurate load factor, effectiveness thrust, stroke end speed and resultant moment.

● Calculate the load factor.

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

α : Load factor

Fo : Force (N) required to move the workpiece

F : Theoretical cylinder thrust (N) (Table 5)

For horizontal operation	For vertical operation
Fo = Fw	Fo = W + Fw
FW : W × 0.2 Note (N)	
W : Load (N)	

Note : Coefficient of friction

(Table 5) Theoretical thrust table   (Unit: N)

Bore size (mm)	Operating direction	Working pressure MPa						
		0.15	0.2	0.3	0.4	0.5	0.6	0.7
ø6	PUSH	8	11	17	23	28	34	40
	PULL	6	8	13	17	21	25	30
ø8	PUSH	15	20	30	40	50	60	70
	PULL	11	15	23	30	38	45	53
ø12	PUSH	34	45	68	90	113	136	158
	PULL	25	34	51	68	85	102	119
ø16	PUSH	60	80	121	161	201	241	281
	PULL	52	69	104	138	173	207	242
ø20	PUSH	94	126	188	251	314	377	440
	PULL	79	106	158	211	264	317	369
ø25	PUSH	147	196	295	393	491	589	687
	PULL	124	165	247	330	412	495	577

(Table 6) Rough indication of load factor

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

STEP-3

Obtain the stroke end speed (Vm) and G coefficient from the average speed (Va) and load factor obtained in STEP-2.

Load factor 10%
Load factor 20%
Load factor 30%
Load factor 40%
Load factor 50%
Load factor 60%

Stroke end speed Vm

The arrows (→) in the figure shows an example that the stroke end speed of 0.35 m/s and G coefficient of 16.8 are obtained at the 0.20 m/s average speed and 50% load factor.

Average speed Va (m/s)
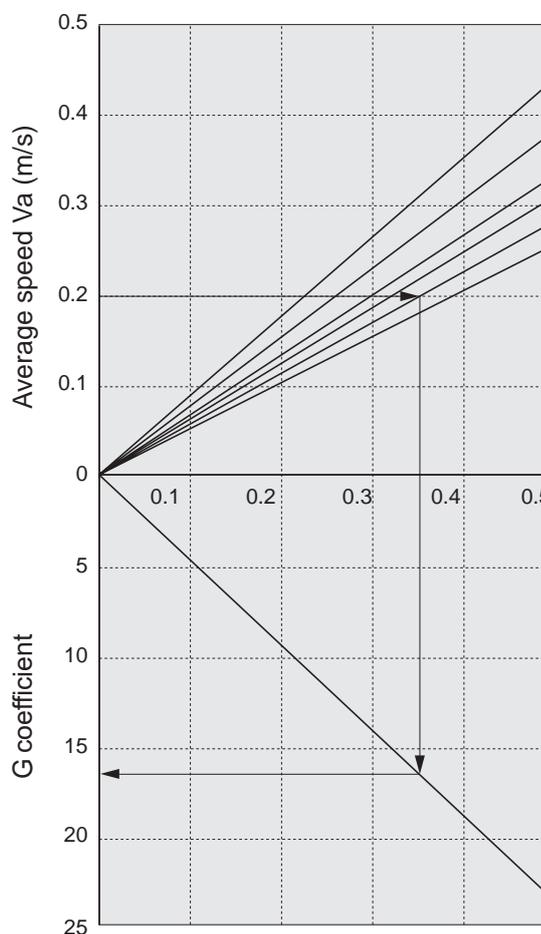
G coefficient

Graph of speed and G coefficient
G coefficient = ☐

STEP-4

Calculate the resultant moment (M$_T$) from the G factor and stroke end speed (Vm) obtained at STEP-3.

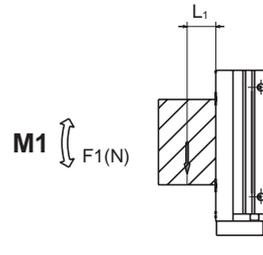M1' × G $\quad$ = ☐ (N·m)

M2' $\quad$ = ☐ (N·m)

M3' × G $\quad$ = ☐ (N·m)

W' $\quad$ = ☐ (N)

$$M'_T = \frac{M1' \times G}{M1'max} + \frac{M2'}{M2'max} + \frac{M3' \times G}{M3'max} + \frac{W'}{W'max} = \boxed{}$$

Obtain M$_T$ (resultant moment during movement). (Note that it differs from what you obtain in STEP-1.)
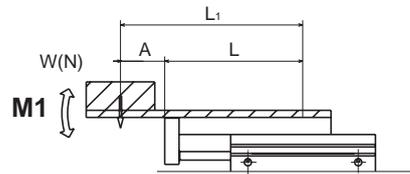
● Vertical load: W (N)
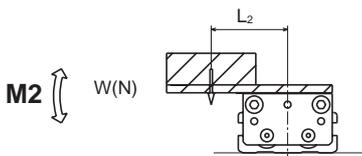
W(N) $\qquad$ W(N)
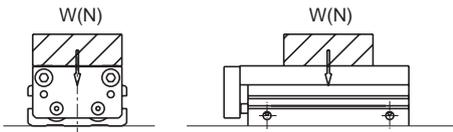
● Bending moment: M1 (N·m)

M1 $\quad$ F1(N)

M1 = F1 × L$_1$

M1 $\quad$ W(N) $\quad$ A $\quad$ L

M1 = W × L$_1$
L$_1$ = A + L
L is a value in
the table below.

● Radial moment: M2 (N·m)

M2 $\quad$ W(N)

M2 = W × L$_2$

M2

F2(N)
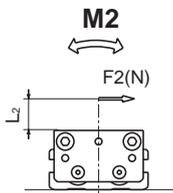
M2 = F2 × L$_2$

● Twist moment: M3 (N·m)

M3 $\quad$ W(N) $\quad$ A $\quad$ L $\quad$ L$_3$
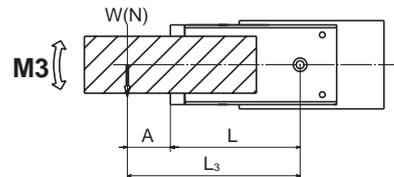
M3 = W × L$_3$
L$_3$ = A + L
L is a value in
the table below.
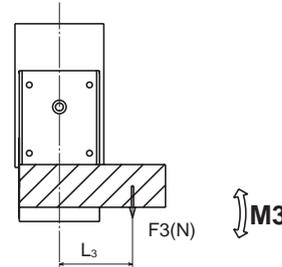
M3 = F3 × L$_3$

F3(N) **M3**

L$_3$

L value $\hfill$ Unit (m)

Bore size	Stroke									P72/P73
	10	20	30	40	50	75	100	125	150	Increment
ø6	0.048	0.048	0.058	0.073	0.083	-	-	-	-	0.012
ø8	0.048	0.048	0.058	0.072	0.082	0.107	-	-	-	0.020
ø12	0.067	0.067	0.067	0.077	0.087	0.117	0.142	-	-	0.020
ø16	0.071	0.071	0.071	0.081	0.091	0.124	0.149	0.174	-	0.020
ø20	0.081	0.081	0.081	0.091	0.101	0.126	0.151	0.176	0.201	0.025
ø25	0.085	0.085	0.085	0.095	0.105	0.14	0.165	0.19	0.215	0.025

$M1 = M1 \quad = \boxed{} \ (N \cdot m)$

$M2 = M2 \quad = \boxed{} \ (N \cdot m)$

$M3 = M3 \quad = \boxed{} \ (N \cdot m)$

$W = W \quad = \boxed{} \ (N)$

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

MT   : Synthesis of moment

Wmax: Maximum allowable value of W (from Table 7)

M1max: Maximum allowable value of M1 (from Table 7)
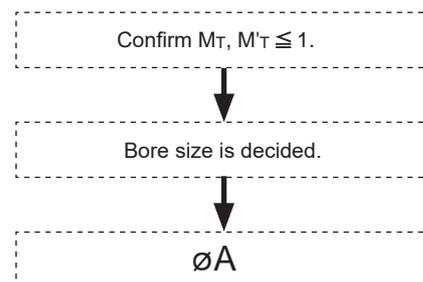
M2max: Maximum allowable value of M2 (from Table 7)

M3max: Maximum allowable value of M3 (from Table 7)

E max: Maximum allowable value of Eo (from Table 3)

(Table 7) Allowable moving load

Bore size	Stroke (mm)	Vertical load Wmax (N)	Bending moment M1max (N·m)	Radial moment M2max (N·m)	Twist moment M3max (N·m)
ø6	10 to 30	14	0.17	0.35	0.17
	40 to 50	15.5	0.89	0.47	0.89
ø8	10 to 30	14	0.17	0.35	0.17
	40 to 75	15.5	0.89	0.47	0.89
ø12	10 to 50	27.6	0.71	1.2	0.71
	75 to 100		2.2		2.2
ø16	10 to 50	47.6	1.9	2.4	1.9
	75 to 125		4.6		4.6
ø20	10 to 50	68.6	3.4	4.7	3.4
	75 to 150		7.0		7.0
ø25	10 to 50	128.2	7.6	15.5	7.6
	75 to 150		17.0		17.0

Note: When attaching a load to the end plate, even if selecting long stroke (ø6, 8: 40 or more, ø12 or more: 75 or more), calculate the allowable values with short stroke (ø6, 8: 30 or less, ø12 or more: 50 or less).

Confirm M_T, M'_T ≦ 1.

↓

Bore size is decided.

↓

øA

STEP-5

Check of the allowable absorbed energy

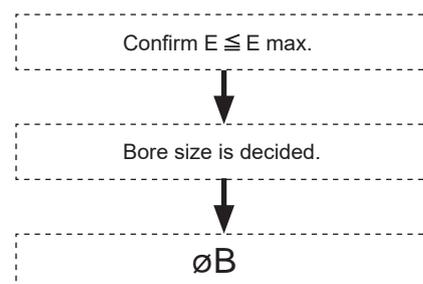$$E = \frac{1}{2} \times (m + m_\alpha) \times Vm^2$$

E   : Kinetic energy at workpiece end (J)

m   : Load weight (kg) ($m \fallingdotseq \frac{W (N)}{9.8}$)

m_α : Table weight (from Table 4)
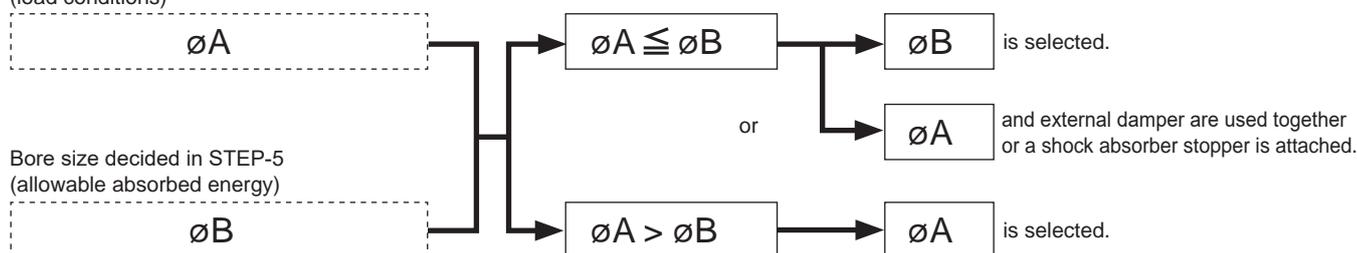
Vm   : Stroke end speed (m/s)

E max : Maximum allowable value of Eo (from Table 3)

Confirm E ≦ E max.

↓

Bore size is decided.

↓

øB

STEP-6

Bore size decided in STEP-4 (load conditions)

øA

Bore size decided in STEP-5 (allowable absorbed energy)

øB

øA ≦ øB → øB is selected.

or → øA and external damper are used together or a shock absorber stopper is attached.

øA > øB → øA is selected.

SCPD3
SCM
SSD2
MDC2
SMG
LCM
LCR
LCG
LCX
STM
STG
STR2
MRL2
GRC
Cylinder Switch
MN3E MN4E
4GA/B
M4GA/B
MN4GA/B
F.R.(module unit)
Clean F.R
Precision R
Press gauge Diff. press gauge
Electro-pneumatic R
Speed controller
Auxiliary valve
Fitting/ tube
Clean air unit
Pressure sensor
Flow rate sensor
Valve for air blow
Ending