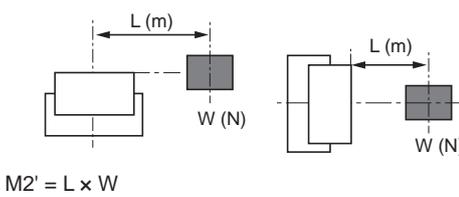
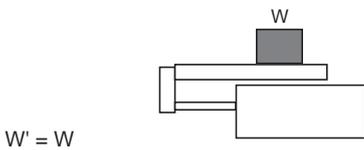
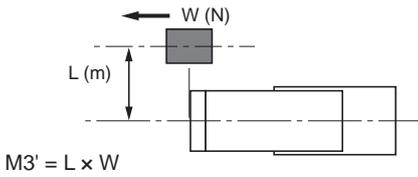
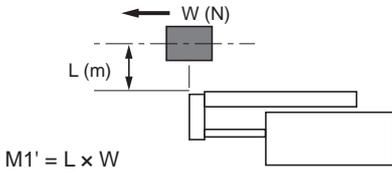


STEP-1

① Calculate the load and the moment of impact occurring at the stroke end in different directions.



Obtain an approximate G coefficient in Table 1.

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

V_a average speed (m/s)	V_m Stroke length 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)

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

= (J)

$(m \doteq \frac{W}{9.8})$

② 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

$W' \text{ max}$: Maximum allowable value of W' (from Table 2)

$M1' \text{ max}$: Maximum allowable value of $M1'$ (from Table 2)

$M2' \text{ max}$: Maximum allowable value of $M2'$ (from Table 2)

$M3' \text{ max}$: Maximum allowable value of $M3'$ (from Table 2)

$E \text{ max}$: Maximum allowable value of E_0 (from Table 3)

m_α : Table weight (from Table 4)

(Table 2) Allowable static load

Bore size	Stroke length (mm)	Vertical load $W' \text{ max}$ (N)	Bending moment $M1' \text{ max}$ (N·m)	Radial moment $M2' \text{ max}$ (N·m)	Twist moment $M3' \text{ max}$ (N·m)
ø6	10 to 30	140	1.7	4.0	1.7
	40 to 50	186	10.7	6.0	10.7
ø8	10 to 30	152	3.4	6.8	3.4
	40 to 75	230	13.8	10.3	13.8
ø12	10 to 50	220.8	5.7	15.2	5.7
	75 to 100		22.2	21.0	22.2
ø16	10 to 50	380.8	17.8	36.0	17.8
	75 to 125		37.3	40.0	37.3
ø20	10 to 50	548.8	31.1	60.3	31.1
	75 to 150		56.2	61.6	56.2
ø25	10 to 50	961.5	65.1	131.8	65.1
	75 to 150		127.5	132.0	127.5

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

(Table 3) LCG allowable absorbed energy value (E_0)

Bore size	Standard (J)	With Stroke adjusting stopper (J)
	ø6	0.025
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 length (mm)									P72/P73 Increment
	10	20	30	40	50	75	100	125	150	
ø6	0.060	0.060	0.070	0.085	0.095	-	-	-	-	0.005
ø8	0.080	0.080	0.090	0.110	0.125	0.150	-	-	-	0.015
ø12	0.210	0.210	0.210	0.235	0.260	0.335	0.400	-	-	0.025
ø16	0.315	0.315	0.315	0.350	0.380	0.515	0.595	0.680	-	0.035
ø20	0.475	0.475	0.475	0.520	0.565	0.715	0.820	0.930	1.035	0.045
ø25	0.785	0.785	0.785	0.845	0.915	1.200	1.360	1.515	1.680	0.075

STEP-2

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 : Theoretical cylinder thrust (N)
(Table 5)

(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

For horizontal operation	For vertical operation
$F_0 = F_w$	$F_0 = W + F_w$
FW: $W \times 0.2$ Note (N)	
W: Load (N)	

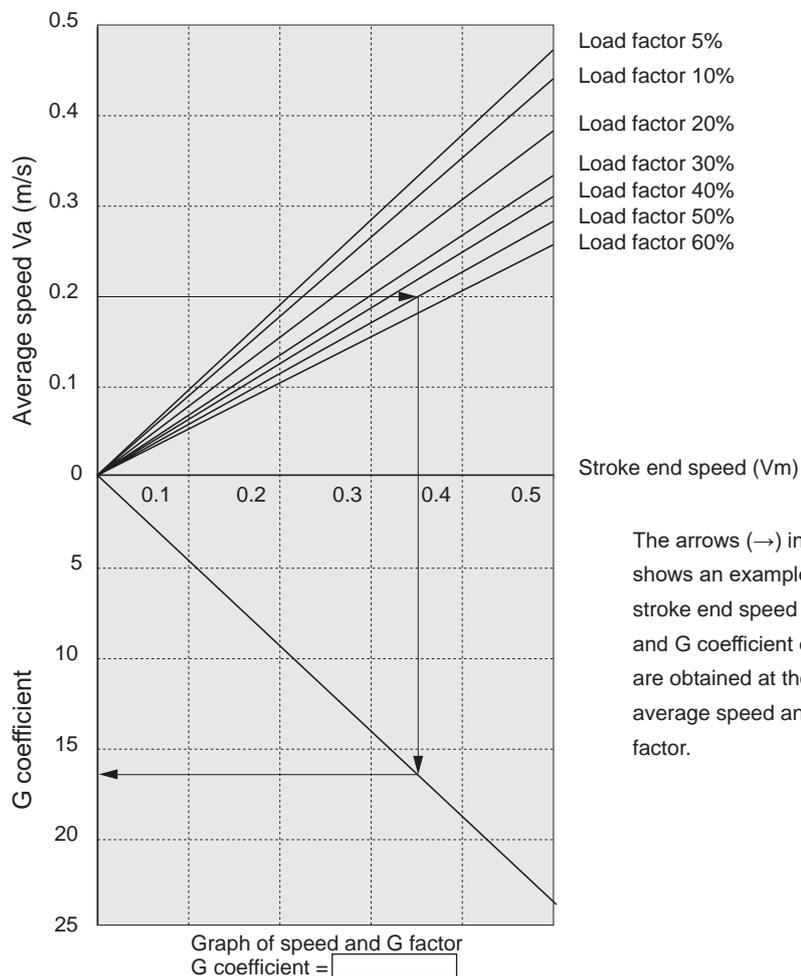
Note: Coefficient of friction

(Table 6) Load factor guidelines

Working pressure MPa	Load factor (%)
0.2 to 0.3	$\alpha \leq 40$
0.3 to 0.6	$\alpha \leq 50$
0.6 to 0.7	$\alpha \leq 60$

STEP-3

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



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.

- 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-4

Calculate the resultant moment (M_T) from the G factor and stroke end speed (V_m) obtained in STEP-3.

$$M1' \times G = \text{[] (N}\cdot\text{m)}$$

$$M2' = \text{[] (N}\cdot\text{m)}$$

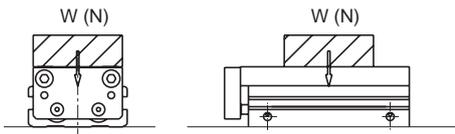
$$M3' \times G = \text{[] (N}\cdot\text{m)}$$

$$W' = \text{[] (N)}$$

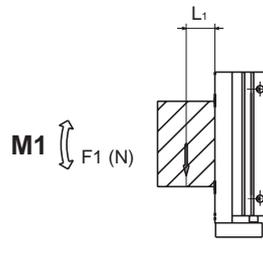
$$M_T = \frac{M1' \times G}{M1' \text{ max}} + \frac{M2'}{M2' \text{ max}} + \frac{M3' \times G}{M3' \text{ max}} + \frac{W'}{W' \text{ max}} = \text{[]}$$

Obtain M_T (resultant moment during movement). (Note that it differs from what you obtained in STEP-1.)

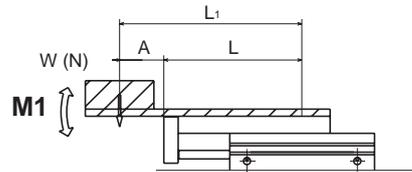
● Vertical load: W (N)



● Bending moment: $M1$ (N·m)



$$M1 = F1 \times L1$$

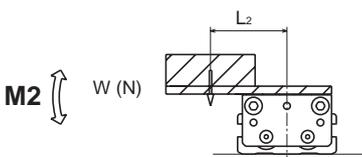


$$M1 = W \times L1$$

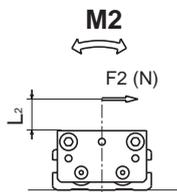
$$L1 = A + L$$

L is a value in the table below.

● Radial moment: $M2$ (N·m)

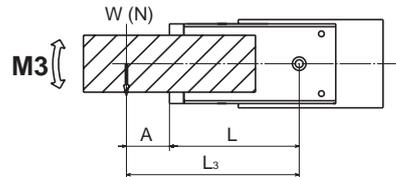


$$M2 = W \times L2$$



$$M2 = F2 \times L2$$

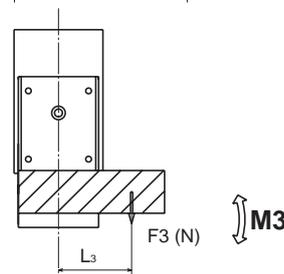
● Twist moment: $M3$ (N·m)



$$M3 = W \times L3$$

$$L3 = A + L$$

L is a value in the table below.



$$M3 = F3 \times L3$$

L value

Unit (m)

Bore size	Stroke length									P72/P73 Increment
	10	20	30	40	50	75	100	125	150	
ø6	0.039	0.0415	0.049	0.0615	0.069	-	-	-	-	0.012
ø8	0.0395	0.042	0.0495	0.0615	0.069	0.088	-	-	-	0.020
ø12	0.053	0.0555	0.058	0.0655	0.073	0.096	0.115	-	-	0.020
ø16	0.0555	0.058	0.0605	0.068	0.0755	0.1025	0.1215	0.140	-	0.020
ø20	0.0635	0.066	0.0685	0.076	0.0835	0.108	0.127	0.1455	0.1645	0.025
ø25	0.0695	0.072	0.0745	0.082	0.0895	0.1185	0.1375	0.156	0.175	0.025

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

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

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

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

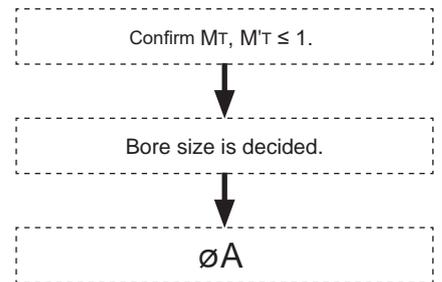
$$M_T = \frac{M1}{M1 \text{ max}} + \frac{M2}{M2 \text{ max}} + \frac{M3}{M3 \text{ max}} + \frac{W}{W \text{ max}} = \boxed{}$$

M_T : Synthesis of moment
 $W \text{ max}$: Maximum allowable value of W (from Table 7)
 $M1 \text{ max}$: Maximum allowable value of $M1$ (from Table 7)
 $M2 \text{ max}$: Maximum allowable value of $M2$ (from Table 7)
 $M3 \text{ max}$: Maximum allowable value of $M3$ (from Table 7)
 $E \text{ max}$: Maximum allowable value of E_0 (from Table 3)

(Table 7) Allowable moving load

Bore size	Stroke length (mm)	Vertical load W_{max} (N)	Bending moment $M1_{\text{max}}$ (N·m)	Radial moment $M2_{\text{max}}$ (N·m)	Twist moment $M3_{\text{max}}$ (N·m)
ø6	10 to 30	14	0.17	0.40	0.17
	40 to 50	15.5	0.89	0.50	0.89
ø8	10 to 30	15.2	0.34	0.68	0.34
	40 to 75	19.2	1.1	0.86	1.1
ø12	10 to 50	27.6	0.71	1.9	0.71
	75 to 100		2.2	2.1	2.2
ø16	10 to 50	47.6	1.9	4.0	1.9
	75 to 125		4.6	5.0	4.6
ø20	10 to 50	68.6	3.4	6.7	3.4
	75 to 150		7.0	7.7	7.0
ø25	10 to 50	128.2	7.6	15.5	7.6
	75 to 150		17.0	17.6	17.0

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

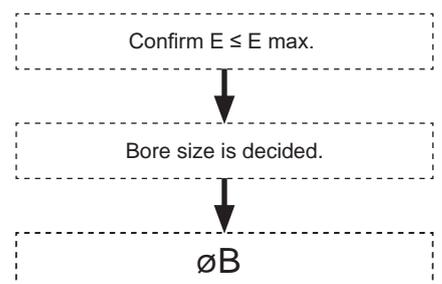


STEP-5

Confirming the allowable absorbed energy

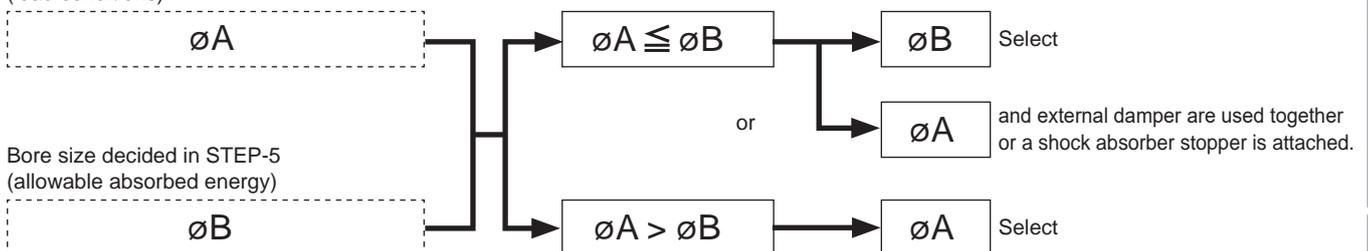
$$E = \frac{1}{2} \times (m + m_{\alpha}) \times Vm^2$$

E : Kinetic energy at workpiece end (J)
 m : Load weight (kg) ($m \doteq \frac{W \text{ (N)}}{9.8}$)
 m_{α} : Table weight (from Table 4)
 Vm : Stroke end speed (m/s)
 $E \text{ max}$: Maximum allowable value of E_0 (from Table 3)



STEP-6

Bore size decided in STEP-4 (load conditions)



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

- 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