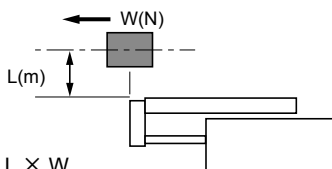
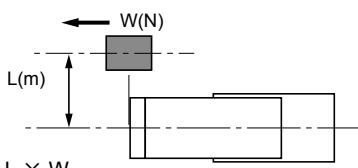


STEP 1

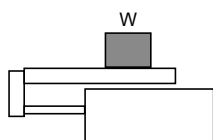
① Calculate the load and the moment of impact occurring at the stroke end in different directions.



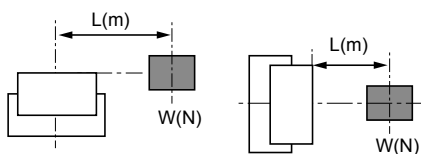
$$M1' = L \times W$$



$$M3' = L \times W$$



$$W' = W$$



$$M2' = L \times W$$

Obtain an approximate G coefficient in [Table 1].

[Table 1] V_a (average speed) = $\frac{\text{Travel distance}}{\text{Travel time}}$ (m/s)

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

G coefficient =

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

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

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

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

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

$$= \text{ } (J)$$

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

② Select a temporary bore size that satisfies the following formula.

$$M_T = \frac{M1' \times G}{M1'_{\max}} + \frac{M2'}{M2'_{\max}} + \frac{M3' \times G}{M3'_{\max}} + \frac{W'}{W'_{\max}} < 1$$

$$E' < E_{\max}$$

M_T : Resultant moment (must be smaller than 1)

G : G coefficient

$W'_{\max}$: Max. allowable value of W' (from Table 2)

$M1'_{\max}$: Max. allowable value of $M1'$ (from Table 2)

$M2'_{\max}$: Max. allowable value of $M2'$ (from Table 2)

$M3'_{\max}$: Max. allowable value of $M3'$ (from Table 2)

$E_{\max}$: Max. allowable value of E_o (from Table 3)

m_a : Table weight (from Table 4)

[Table 2] Allowable static load

Bore size	Stroke length (mm)	Vertical load $W'_{\max}(N)$	Bending moment $M1'_{\max}(N \cdot m)$	Radial moment $M2'_{\max}(N \cdot m)$	Torsion moment $M3'_{\max}(N \cdot m)$
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 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] LCR allowable absorbed energy (E_o)

Bore size	Standard (J)	With stroke adjusting stopper (J)	With shock absorber stopper (J)
ø6	0.025	0.0032	0.14
ø8	0.058	0.0032	0.25
ø12	0.112	0.014	0.25
ø16	0.176	0.043	0.65
ø20	0.314	0.055	1.3
ø25	0.314	0.14	1.3

[Table 4] Table weight

(Unit: kg)

Bore size	Stroke length (mm)									P72/P73 added	B/BL added
	10	20	30	40	50	75	100	125	150		
ø6	0.035	0.035	0.04	0.05	0.055	-	-	-	-	0.005	0.030
ø8	0.055	0.055	0.06	0.075	0.08	0.095	-	-	-	0.015	0.030
ø12	0.13	0.13	0.13	0.14	0.155	0.195	0.225	-	-	0.025	0.060
ø16	0.185	0.185	0.185	0.2	0.215	0.285	0.325	0.365	-	0.035	0.070
ø20	0.29	0.29	0.29	0.315	0.335	0.415	0.47	0.525	0.585	0.045	0.140
ø25	0.505	0.505	0.505	0.54	0.58	0.745	0.835	0.925	1.015	0.075	0.310

STEP 2

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

● Calculate the load factor.

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

α : Load factor

F_o : Force (N) required to move the workpiece

F : Cylinder theoretical 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

[Table 6] Load factor guidelines

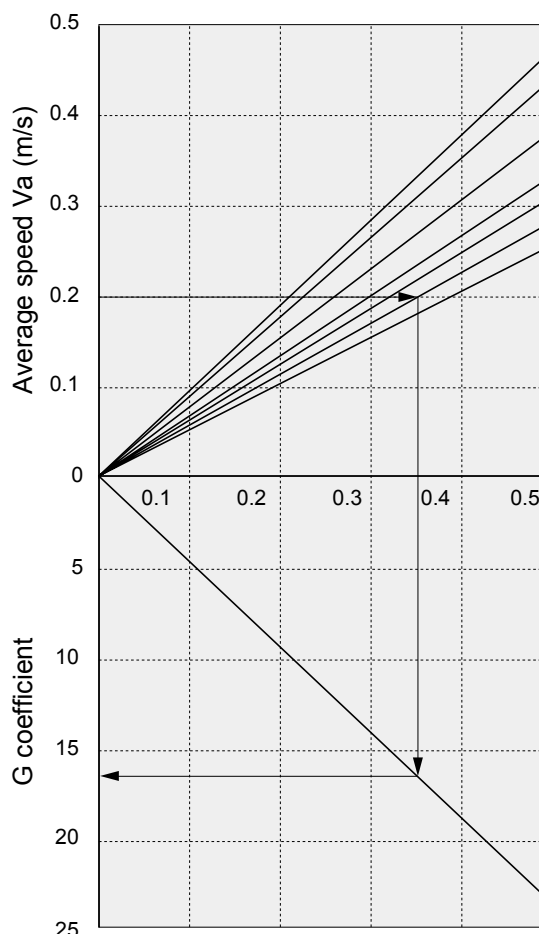
Working pressure MPa	Load factor (%)
0.2 to 0.3	$\alpha \leq 40$
0.3 to 0.6	$\alpha \leq 50$
0.6 to 0.7	$\alpha \leq 60$

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

Note: Coefficient of friction

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.



Graph of speed and G coefficient
G coefficient =

Load factor 5%
Load factor 10%

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

Stroke end speed V_m

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

LCM
LCR
LCG
LCW
LCX
STM
STG
STS/STL
STR2
UCA2
ULK*
JSK/M2
JSG
JSC3/JSC4
USSD
UFCD
USC
UB
JSB3
LMB
LML
HCM
HCA
LBC
CAC4
UCAC2
CAC-N
UCAC-N
RCS2
RCC2
PCC
SHC
MCP
GLC
MFC
BBS
RRC
GRC
RV3*
NHS
HRL
LN
Hand
Chuk
MechHnd/Chuk
ShkAbs
FJ
FK
SpdContr
Ending

STEP 4

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

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

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

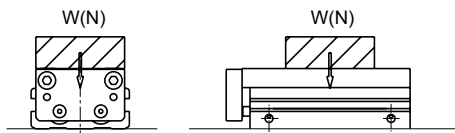
$$M3' \times G = \text{ } (N \cdot m)$$

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

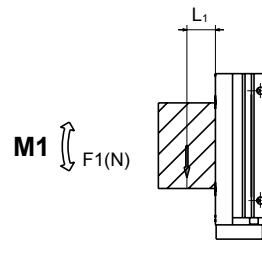
$$M_T = \frac{M1' \times G}{M1'_{\max}} + \frac{M2'}{M2'_{\max}} + \frac{M3' \times G}{M3'_{\max}} + \frac{W'}{W'_{\max}} = \text{ }$$

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

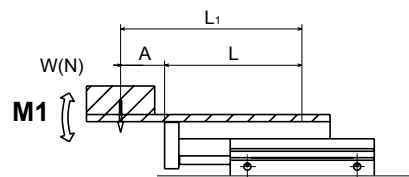
● Vertical load: W (N)



● Bending moment: $M1$ (N·m)



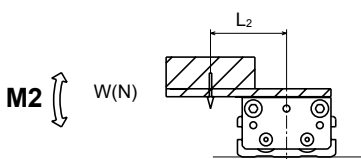
$$M1 = F1 \times L1$$



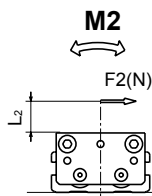
$$M1 = W \times L1$$

$L1 = A + L$
L is value in table below

● Radial moment: $M2$ (N·m)

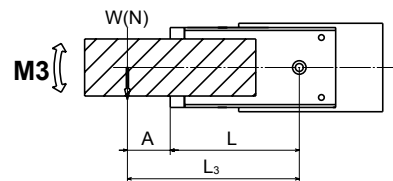


$$M2 = W \times L2$$



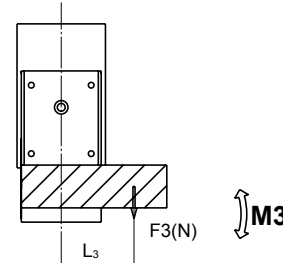
$$M2 = F2 \times L2$$

● Torsion moment: $M3$ (N·m)



$$M3 = W \times L3$$

$L3 = A + L$
L is value in table below



$$M3 = F3 \times L3$$

L value

Unit (m)

Bore size	Stroke length									P72/P73 added	B/BL added
	10	20	30	40	50	75	100	125	150		
ø6	0.048	0.048	0.058	0.073	0.083	-	-	-	-	0.012	0.0165
ø8	0.048	0.048	0.058	0.072	0.082	0.107	-	-	-	0.020	0.0145
ø12	0.067	0.067	0.067	0.077	0.087	0.117	0.142	-	-	0.020	0.018
ø16	0.071	0.071	0.071	0.081	0.091	0.124	0.149	0.174	-	0.020	0.019
ø20	0.081	0.081	0.081	0.091	0.101	0.126	0.151	0.176	0.201	0.025	0.020
ø25	0.085	0.085	0.085	0.095	0.105	0.14	0.165	0.19	0.215	0.025	0.023

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

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

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

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

$$M_T = \frac{M1}{M1_{\max}} + \frac{M2}{M2_{\max}} + \frac{M3}{M3_{\max}} + \frac{W}{W_{\max}} = \text{ }$$

M_T : Synthesis of moment

$W_{\max}$: Max. allowable value of W (from Table 7)

$M1_{\max}$: Max. allowable value of M1 (from Table 7)

$M2_{\max}$: Max. allowable value of M2 (from Table 7)

$M3_{\max}$: Max. allowable value of M3 (from Table 7)

$E_{\max}$: Max. allowable value of E_o (from Table 3)

[Table 7] Allowable running load

Bore size	Stroke length (mm)	Vertical load $W_{\max}$ (N)	Bending moment $M1_{\max}$ (N·m)	Radial moment $M2_{\max}$ (N·m)	Torsion moment $M3_{\max}$ (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 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 allowable absorbed energy

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

E : Kinetic energy at workpiece end (J)

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

m_a : Table weight (from Table 4)

V_m : Stroke end speed (m/s)

$E_{\max}$: Max. allowable value of E_o (from Table 3)

Confirm $E \leq E_{\max}$.

Bore size is decided.

øB

STEP 6

Bore size decided in STEP 4
(load conditions)

øA

øA < øB

øB

Select.

or

øA

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

Bore size decided in STEP 5
(allowable absorbed energy)

øB

øA > øB

øA

Select.

Selection confirmation graph of shock absorber stopper

1. This is a simplified confirmation graph for shock absorber stoppers. The area inside the graph is the usable range.
Select a bore size for shock absorber mounting within the usable range.
2. Simplified selection graph lists the pneumatic pressure value used for the cylinder at 0.5 MPa.
3. The absorbed energy of the shock absorber varies depending on the temperature. The simplified confirmation graph lists the value at room temperature.
4. Colliding object weight is the sum of load weight m and table weight m_a .

