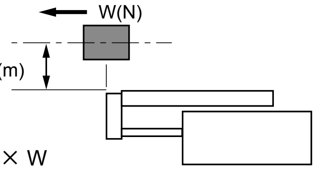
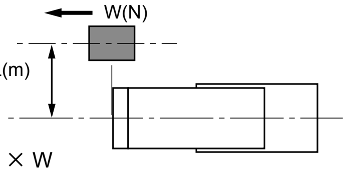
LCM
LCR
LCG
LCW
LCX
STM
STG
STS/STL
STR2
UCA2
ULK*
JSK/M2
JSG
JSC3/JSC4
USSD
UFCD
USC
UB
JSB3
LMB
LML
HCM
HCA
LBC
CAC4
UCAC2
CAC-N
UCAC-N
RCS2
RCC2
PCC
SHC
MCP
GLC
MFC
BBS
RRC
GRC
RV3*
NHS
HRL
LN
Hand
Chuk
MecHnd/Chuk
ShkAbs
FJ
FK
SpdContr
Ending

STEP 1

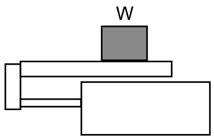
❶ Calculate the load and the moment of impact occurring at the stroke end in different directions.



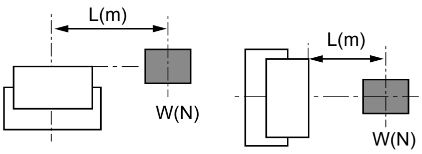
M1' = L × W



M3' = L × W



W' = W



M2' = L × W

Obtain an approximate G coefficient in [Table 1].

[Table 1] 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
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' x G = ☐ (N·m)

M2' = ☐ (N·m)

M3' x G = ☐ (N·m)

W' = ☐ (N)

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

= ☐ (J)

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

❷ 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_0 (from Table 3)

m_α : 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·m)	Radial moment M2'max (N·m)	Torsion moment M3'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 (E_0)

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	0.060	0.060	0.070	0.085	0.095	-	-	-	-	0.005	0.030
ø8	0.080	0.080	0.090	0.110	0.125	0.150	-	-	-	0.015	0.030
ø12	0.210	0.210	0.210	0.235	0.260	0.335	0.400	-	-	0.025	0.060
ø16	0.315	0.315	0.315	0.350	0.380	0.515	0.595	0.680	-	0.035	0.070
ø20	0.475	0.475	0.475	0.520	0.565	0.715	0.820	0.930	1.035	0.045	0.140
ø25	0.785	0.785	0.785	0.845	0.915	1.200	1.360	1.515	1.680	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.

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

α : Load factor

F_0 : Force (N) required to move the workpiece

F : Cylinder theoretical thrust (N) [Table 5]

For horizontal operation	For vertical operation
$F_0 = F_W$	$F_0 = W+F_W$
FW: W x 0.2 Note (N)	
W: Load (N)	

Note: Coefficient of friction

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

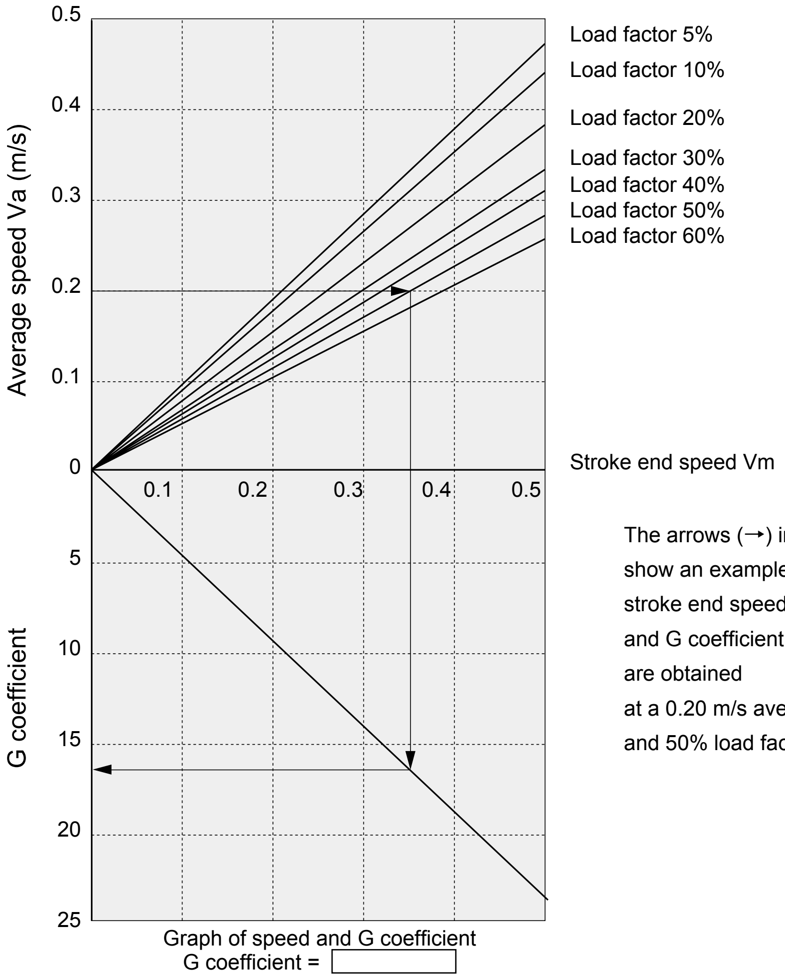
Bore size (mm)	Operating direction	Working pressure MPa 0.15	0.2	0.3	0.4	0.5	0.6	0.7
ø6	PUSH	8	11	17	23	28	34	40
	PULL	6	8	13	17	21	25	30
ø8	PUSH	15	20	30	40	50	60	70
	PULL	11	15	23	30	38	45	53
ø12	PUSH	34	45	68	90	113	136	158
	PULL	25	34	51	68	85	102	119
ø16	PUSH	60	80	121	161	201	241	281
	PULL	52	69	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] 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

STEP 3

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



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.

Graph of speed and G coefficient
G coefficient =

STEP 4

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

M1' x G = ☐ (N·m)

M2' = ☐ (N·m)

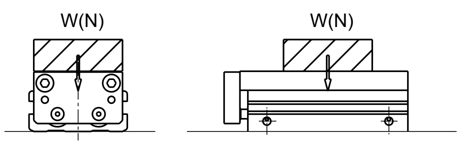
M3' x G = ☐ (N·m)

W' = ☐ (N)

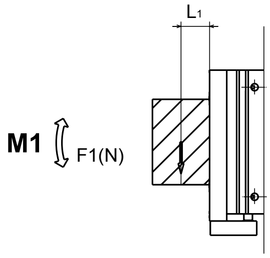
$$M'_T = \frac{M1' \times G}{M1'max} + \frac{M2'}{M2'max} + \frac{M3' \times G}{M3'max} + \frac{W'}{W'max} = \square$$

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

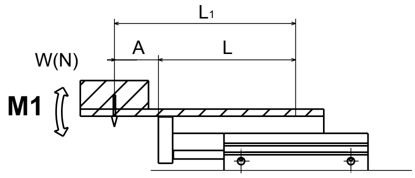
● Vertical load: W (N)



● Bending moment: M1 (N·m)

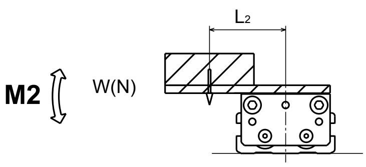


M1=F1 × L_1

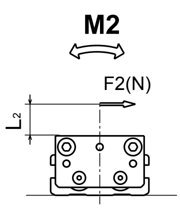


M1=W × L_1
L_1=A+L
L is value in table below

● Radial moment: M2 (N·m)

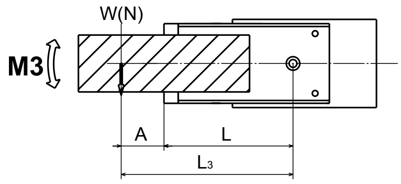


M2=W × L_2

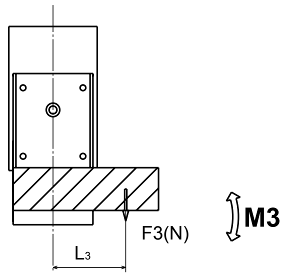


M2=F2 × L_2

● Torsion moment: M3 (N·m)



M3=W × L_3
L_3=A+L
L is value in table below



M3=F3 × L_3

L value

Unit (m)

Bore size	Stroke length									P72/P73	B/BL
	10	20	30	40	50	75	100	125	150	added	added
ø6	0.039	0.0415	0.049	0.0615	0.069	-	-	-	-	0.012	0.0165
ø8	0.0395	0.042	0.0495	0.0615	0.069	0.088	-	-	-	0.020	0.0145
ø12	0.053	0.0555	0.058	0.0655	0.073	0.096	0.115	-	-	0.020	0.018
ø16	0.0555	0.058	0.0605	0.068	0.0755	0.1025	0.1215	0.140	-	0.020	0.019
ø20	0.0635	0.066	0.0685	0.076	0.0835	0.108	0.127	0.1455	0.1645	0.025	0.020
ø25	0.0695	0.072	0.0745	0.082	0.0895	0.1185	0.1375	0.156	0.175	0.025	0.023

M1=M1 = ☐ (N·m)

M2=M2 = ☐ (N·m)

M3=M3 = ☐ (N·m)

W=W = ☐ (N)

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

M_T : Synthesis of moment

Wmax : Max. allowable value of W (from Table 7)

M1max : Max. allowable value of M1 (from Table 7)

M2max : Max. allowable value of M2 (from Table 7)

M3max : Max. allowable value of M3 (from Table 7)

E max : Max. allowable value of E_0 (from Table 3)

[Table 7] Allowable running load

Bore size	Stroke length (mm)	Vertical load Wmax (N)	Bending moment M1max (N·m)	Radial moment M2max (N·m)	Torsion moment M3max (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).

Confirm M_T, $M'_T \leq 1$.

↓

Bore size is decided.

↓

øA

STEP 5

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

m_α : Table weight (from Table 4)

Vm : Stroke end speed (m/s)

E max : Max. allowable value of E_0 (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 Select.
  - or → øA and external damper are used together or a shock absorber stopper is attached.
- 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 ma.