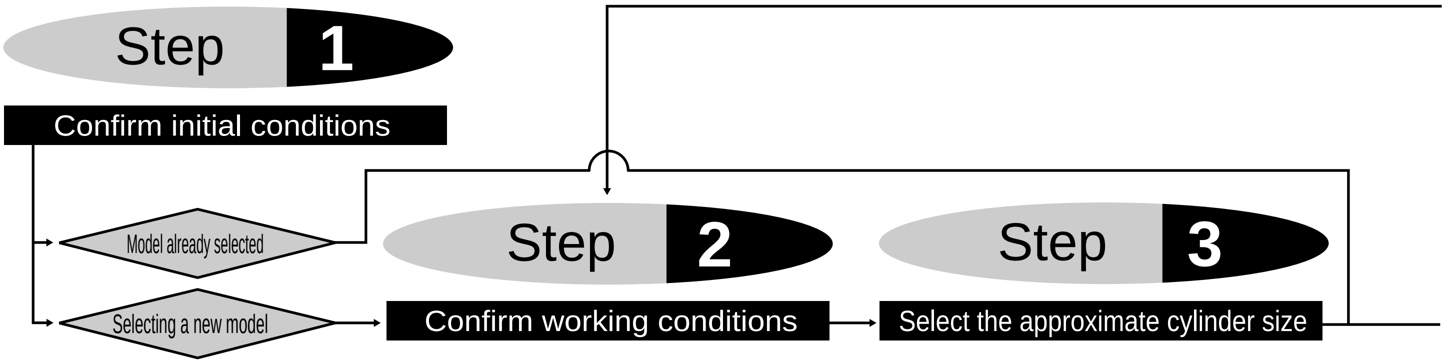
Selection conditions differ from the general air cylinder. Check the suitability with the selection guide.



Step 2 Confirm working conditions

1. Working pressure P (MPa)
2. Load weight W (N)
   <Load weight>
   Consider the weight of the cylinder's guide rod when determining load weight.
   W = (load weight) + (jig weight) + (guide rod's weight: a) value.
   Calculate the guide rod's weight with calculation formulas in Table 1.

Table 1 Guide rod weight calculation formula

Bore size	a : Guide section weight (N)	
	STS	STL
ϕ 8	(0.36)+0.004 X st	(0.43)+0.004 X st
ϕ12	(0.54)+0.008 X st	(0.69)+0.008 X st
ϕ16	(0.81)+0.012 X st	(1.10)+0.012 X st
ϕ20	(1.30)+0.030 X st	(2.00)+0.030 X st
ϕ25	(1.50)+0.033 X st	(2.20)+0.033 X st
ϕ32	(3.90)+0.065 X st	(5.80)+0.065 X st
ϕ40	(4.10)+0.065 X st	(6.10)+0.065 X st
ϕ50	(7.40)+0.101 X st	(11.2)+0.101 X st
ϕ63	(8.30)+0.101 X st	(12.1)+0.101 X st
ϕ80	(26.2)+0.234 X st	(40.6)+0.234 X st

st: Stroke length (mm)

3. Installation direction
   <Operation method>
   Horizontal, vertical - rise, vertical - lower
4. Stroke L (mm)
5. Operation time t (s)
6. Operation speed V (mm/s)
   Cylinder average operation speed Va calculation formula
   Va = L/t (mm/s)

Step 3 Select the approximate cylinder size

●Cylinder size (inner bore) calculation formula

$F = \pi/4 \times D^2 \times P$

$\therefore D = \sqrt{4F/\pi P}$

D: Cylinder bore size (mm)
P: working pressure (MPa)
F: Cylinder's theoretical thrust (N)

●Obtaining with the theoretical thrust
Approximate required thrust ≧ load weight x 2
(x 2 in the load weight x 2 is when the load is 50% as the safety coefficient)

<Example> Working pressure 0.5 (MPa)
Load 25 (N)
Required thrust is: 25 (N) x 2=50 (N)
Based on Table 2, the tube diameter is ϕ12 and over to satisfy a theoretical thrust of 50N and over at a working pressure of 0.5MPa.
D = ϕ12

Step 4

Calculating the weight (W) and each moment

To next page

Step 4 Calculating the weight (W) and each moment

●Calculate the static load (W_0) and moment (M) based on how the load is installed on the cylinder.

W_0 = (load) + (jig weight) (N)

$M_1 = F_1 \times \ell_1$ (N·m)

$M_2 = F_2 \times \ell_2$ (N·m)

$M_3 = F_3 \times \ell_3$ (N·m)

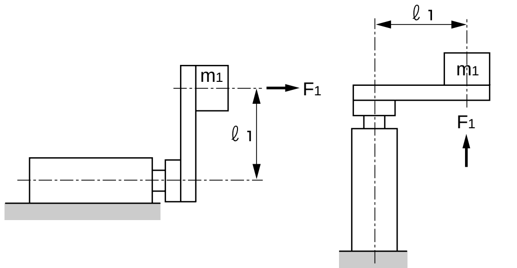
Use Fig. 2 for the F_1, F_2 and F_3 values

Fig. 2 Moment calculation formula

Calculate each moment from the load, inertia force coefficient and eccentricity length.

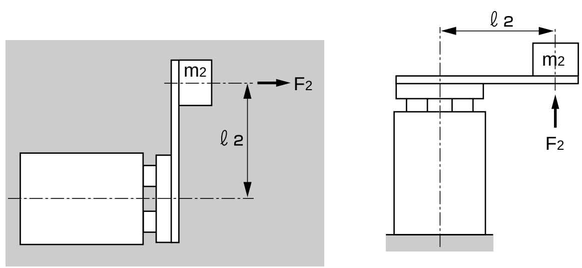
<Bending moment>

$$M_1 = F_1 \times \ell_1 = 10 \times m_1 \times G \times \ell_1$$



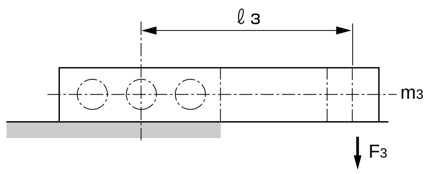
<Radial moment>

$$M_2 = F_2 \times \ell_2 = 10 \times m_2 \times G \times \ell_2$$



<Twisting moment>

$$M_3 = F_3 \times \ell_3 = 10 \times m_3 \times \ell_3$$

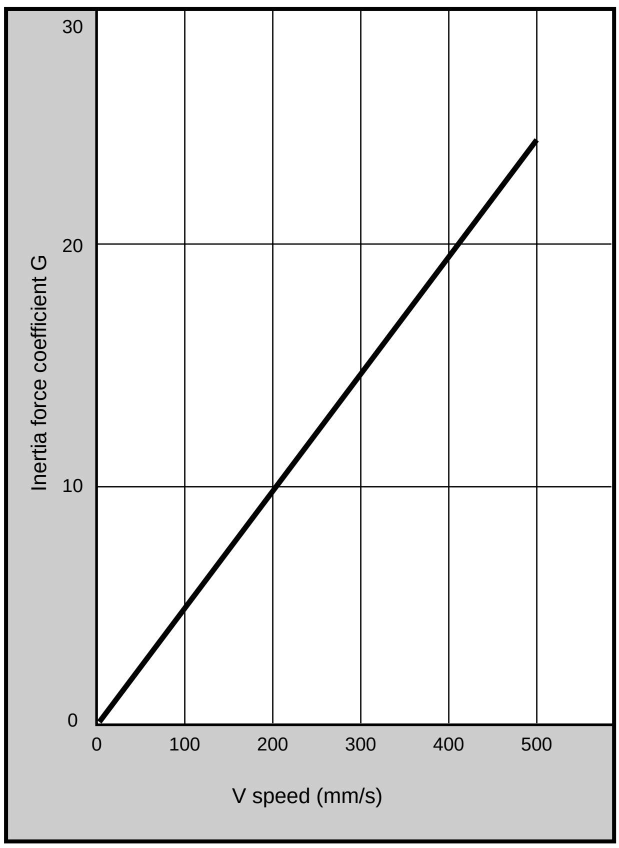


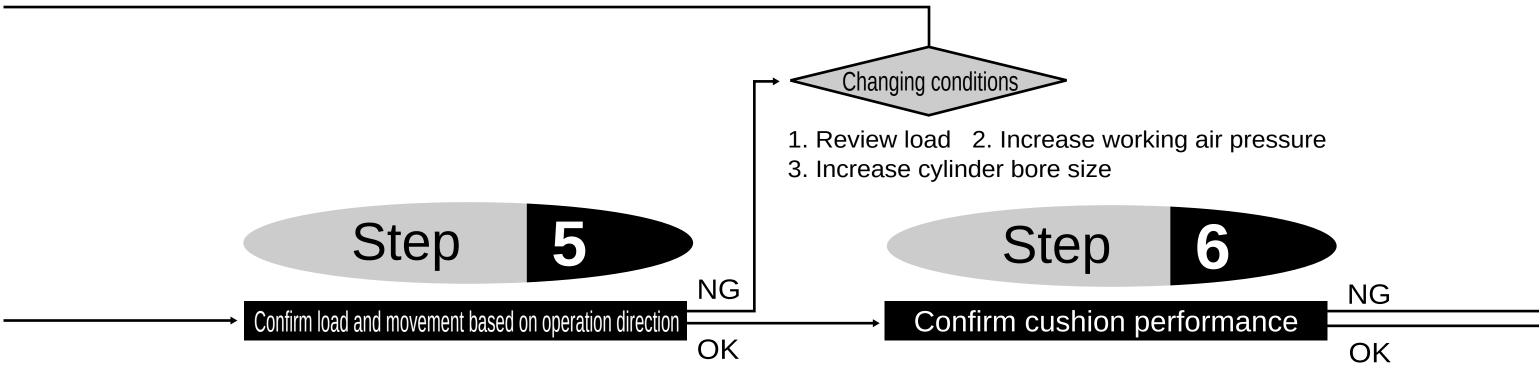
m_1:, m_2:, m_3: Load (N)

ℓ_1:, ℓ_2:, ℓ_3: Eccentricity distance (m)

G: Inertia force coefficient

Fig. 3 Trends of moment of inertia coefficient for guided cylinder





Step 5 Confirm load and movement based on operation direction

5-1 Confirm load

❶ During horizontal operation

The static load must be less than the allowable load

Static load W_0 Value calculated in Step 4

Allowable lateral load Wmax Select from Table 2 based on the stroke

(For the custom stroke length, select the longer standard stroke)

$W_0 \leqq W_{max}$

Table 2 Allowable lateral load Unit: N

Bore size Inner diameter (mm)	Type	Bearing type	STS 10	STS 20	STS 25
φ 8	ST S/L-B-8	Ball bearing	16	11	-
φ12	ST S/L-B-12	Ball bearing	30	21	-
φ16	ST S/L-B-16	Ball bearing	44	32	-
φ20	ST S/L-B-20	Ball bearing	-	-	45
φ25	ST S/L-B-25	Ball bearing	-	-	45
φ32	ST S/L-B-32	Ball bearing	-	-	49

*Refer to Page 126 for allowable lateral load.

❷ During vertical operation

The load weight must be a value that applies the load in theoretical thrust

● Calculating the load

Load W Value calculated in Step 2

Cylinder's theoretical thrust F

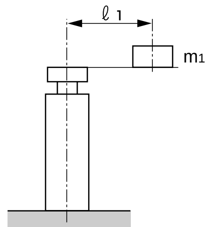
α = W/F X 100 (%)

● The load is determined based on use such as stability of the cylinder's operation speed, allowance, and life. General use should be within the range in Table 3.

Table 3 Appropriate range of load (references)

Working pressure (MPa)	Load factor (%)
0.1 to 0.3	$\alpha \leqq 40$
0.3 to 0.6	$\alpha \leqq 50$
0.6 to 1.0	$\alpha \leqq 60$

● Lateral load functions during an eccentric load. The functioning lateral load must be less than the allowable lateral load in Table 2.



$$\frac{m_1 \times \ell_1 \times 10}{L} \leqq W_{max}$$

st: Stroke length (m)

Bore size	L	Bore size	L
φ 8	0.015 + st	φ32	0.022 + st
φ12	0.015 + st	φ40	0.022 + st
φ16	0.016 + st	φ50	0.025 + st
φ20	0.016 + st	φ63	0.025 + st
φ25	0.016 + st	φ80	0.046 + st

5-2. Confirm moment

❶ Divide the bending moment and radial moment with the value in Table 4, and obtain the moment. The total moment must be 1.0 or less.

● Calculating the moment

Bending moment M_1 } Value calculated in Step 4

Radial moment M_2

$M_1/M_1\max + M_2/M_2\max \leqq 1.0$

Changing conditions

1. Install an external damper (shock killer)
2. Lower operation speed
3. Increase cylinder bore size

End of selection

Table 4 Allowable moment (N·m)

Bore size (mm)	Allowable bending moment M1, M2 (N·m)
ϕ 8	4.1
ϕ12	6.1
ϕ16	19.3
ϕ20	32.6
ϕ25	48.5
ϕ32	107.4
ϕ40	107.4
ϕ50	201.7
ϕ63	201.7
ϕ80	726.0

❷ The twisting moment must be less than the tolerable rotation torque
Twisting moment M3 Value calculated in Step 4 Allowable rotation torque
M3max Select from Table 5 based on stroke length.
(For a custom stroke length, select the longer standard stroke)
$M_3 \leqq M_{3max}$

Table 5 Allowable rotation torque (N·m)

Bore size (mm)	Type	Bearing type	STS 10	STS 20	STS 25
ϕ 8	ST$^{S}_{L}$-B-8	Ball bearing	0.16	0.11	-
ϕ12	ST$^{S}_{L}$-B-12	Ball bearing	0.31	0.22	-
ϕ16	ST$^{S}_{L}$-B-16	Ball bearing	0.51	0.37	-
ϕ20	ST$^{S}_{L}$-B-20	Ball bearing	-	-	1.19
ϕ25	ST$^{S}_{L}$-B-25	Ball bearing	-	-	1.28
ϕ32	ST$^{S}_{L}$-B-32	Ball bearing	-	-	0.99
ϕ40	ST$^{S}_{L}$-B-40	Ball bearing	-	-	1.10
ϕ50	ST$^{S}_{L}$-B-50	Ball bearing	-	-	2.01
ϕ63	ST$^{S}_{L}$-B-63	Ball bearing	-	-	2.26
ϕ80	ST$^{S}_{L}$-B-80	Ball bearing	-	-	8.48

* Refer to page 126 for the allowable rotation torque.

Step 6 Confirm cushion performance

Confirm that the kinetic energy of the load actually being used is absorbed by the cylinder's own cushion performance.

● Allowable energy absorption of cylinder (E_1) is unique to the cylinder. The values in Table 7 are used for STS and STL.

● Piston's kinetic energy (E_2) calculation formula

$$E_2 = 1/2 \times W \times V^2 \times \frac{1}{10} \text{ (J)}$$

W: load (N) Value calculated in Step 2
V: Piston cushion rush speed (m/s)
$V = L/t \times (1 + 1.5 \times \alpha/100)$
L: Stroke length (m)
T: Operation time (s)
α: Load (%)

Cylinder's allowable energy absorption

● The value of the kinetic energy absorption performance provided by the cylinder's cushion mechanism differs based on the cylinder's bore size. This energy is comparable to the values in Table 6 for the guided cylinder.

Table 6 STS and STL allowable energy absorption (E1)

Bore size (mm)	Allowable energy absorption (J) Rubber cushion	Rubber air cushion	Air cushion
ϕ 8	0.029	-	-
ϕ12	0.056	-	-
ϕ16	0.088	-	-
ϕ20	0.157	-	-
ϕ25	0.157	-	1.18
ϕ32	0.401	0.401	2.27
ϕ40	0.627	0.627	3.05
ϕ50	0.980	0.980	3.81
ϕ63	1.560	1.560	15.64
ϕ80	2.510	2.510	20.18

$E_1 > E_2$
(Allowable energy absorption) > (Piston's kinetic energy)

End of selection

$E_1 < E_2$
(Allowable energy absorption) < (Piston's kinetic energy)