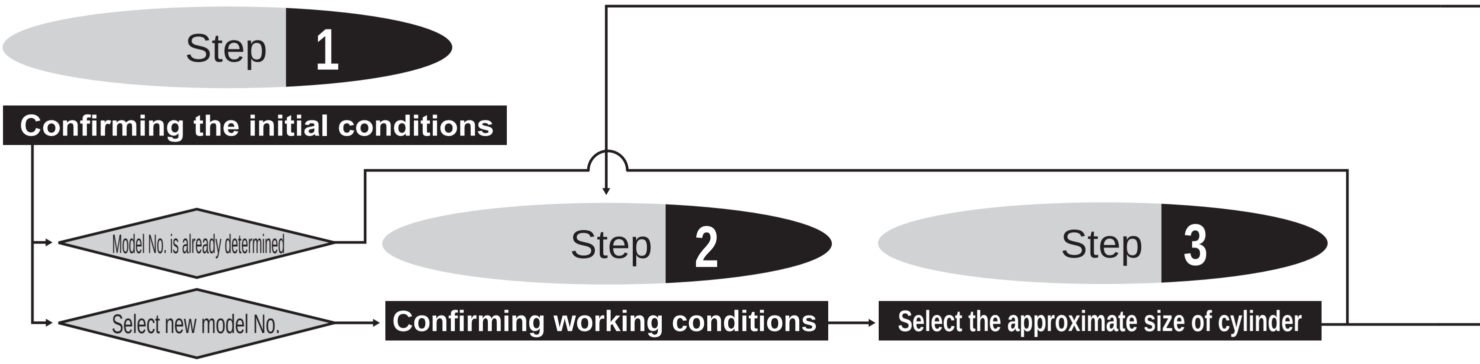
As the selection conditions are different from those of general air cylinders, confirm whether the model is adequate or not according to selection guide.



Step 2 Confirming working conditions

1. Working pressure P (MPa)
2. Total applied load W (N)
   [Total applied load]
   W = (Applied load) + (Jig load) + (Self weight of movable part: Fa). Table 1 shows the formula of the self weight of movable part.

Table 1. Formula of the self weight of movable part

Tube	Fa: Own gravity of movable part (N)
	STR2
ø6	0.16 + 0.002ST
ø10	0.38 + 0.004ST
ø16	1.08 + 0.013ST
ø20	1.66 + 0.013ST
ø25	2.82 + 0.025ST
ø32	4.33 + 0.025ST

3. Mounting orientation
   [Actuation]
   Horizontal, vertical-rise, vertical-decline
4. Stroke ST (mm)
5. Operation time t (s)
6. Operation speed V (mm/s)
   Formula of the cylinder's average operation speed Va
   Va = L /t (mm/s)

Step 3 Select the approximate size of cylinder

● Formula for calculating the size (bore size) of cylinder

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

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

D: Cylinder bore size (mm)
P: Working pressure (MPa)
F: Cylinder theoretical thrust (N)

● When calculating from the theoretical thrust value in Table 2

Approximate required thrust ≥ Applied load × 2
("× 2" in "Applied load × 2" is for when the load factor is approx. 50% as a safety coefficient)

[Example] Working pressure 0.5 (MPa)
Applied load 25 (N)
Required thrust is 25 (N) × 2 = 50 (N)
The bore size selected from Table 2 with theoretical thrust of 50 N and over at working pressure of 0.5 MPa will be ø10 or more.
D = ø10

[Cylinder theoretical thrust]

Table 2 Cylinder theoretical thrust table

Theoretical thrust table Unit: N

Bore size (mm)	Operating direction	Working pressure MPa 0.1	0.15	0.2
ø6	Push	-	-	11.3
	Pull	-	-	6.28
ø10	Push	-	-	31.4
	Pull	-	-	20.1
ø16	Push	40.2	60.3	80.4
	Pull	24.5	36.8	49.0
ø20	Push	62.8	94.2	1.26×10^2
	Pull	40.2	60.3	80.4
ø25	Push	98.2	1.47×10^2	1.96×10^2
	Pull	67.4	1.01×10^2	1.35×10^2
ø32	Push	1.61×10^2	2.41×10^2	3.22×10^2
	Pull	1.21×10^2	1.81×10^2	2.41×10^2

*Refer to page 240 for theoretical thrust table.

Step **4**

Calculate the total applied load (W) and each moment

To the next page

Step 4 Calculate the total applied load (W) and each moment

● Calculate the static load (W_0) and moment (M) based on the load mounted on the cylinder

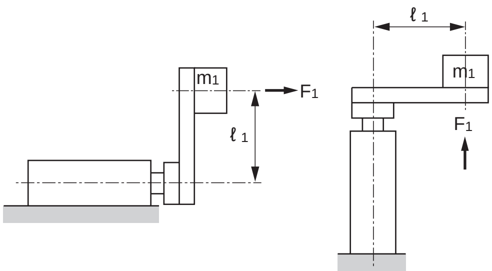
W_0 = (Applied load) + (Jig load)	(N)
$M_1 = F_1 \times \ell_1$	(N·m)
$M_2 = F_2 \times \ell_2$	(N·m)
$M_3 = F_3 \times \ell_3$	(N·m)

For values of F_1, F_2 and F_3, use those shown in Fig. 2.

Fig. 2. Formula for calculating each moment
Calculate each moment from the applied load, inertia force coefficient G and eccentric distance.

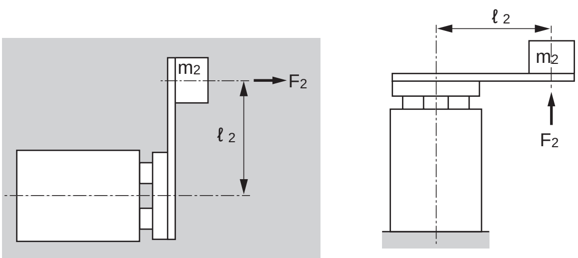
[Bending moment]

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



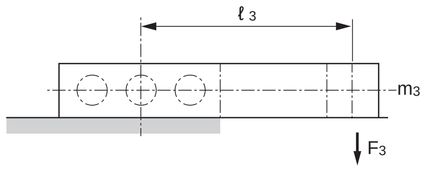
[Radial moment]

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



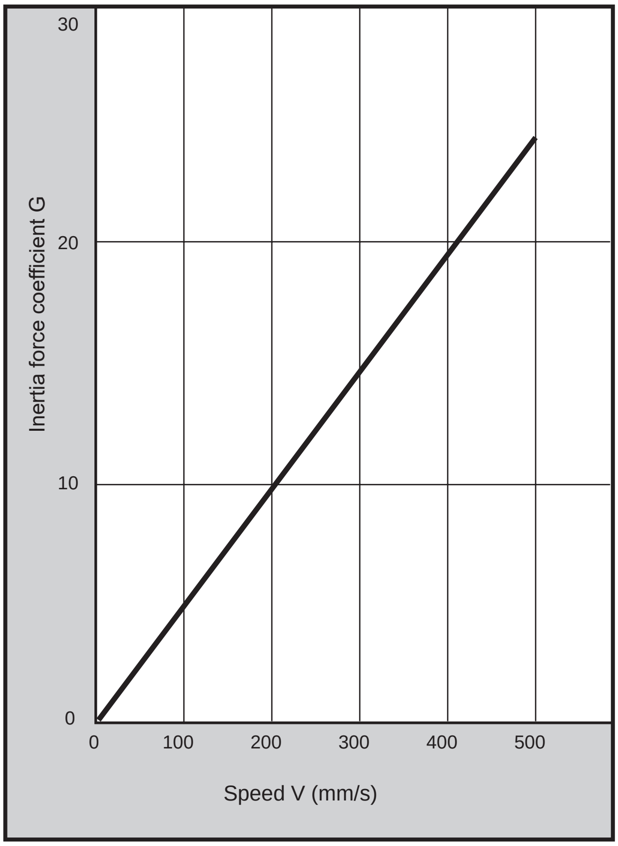
[Torsion moment]

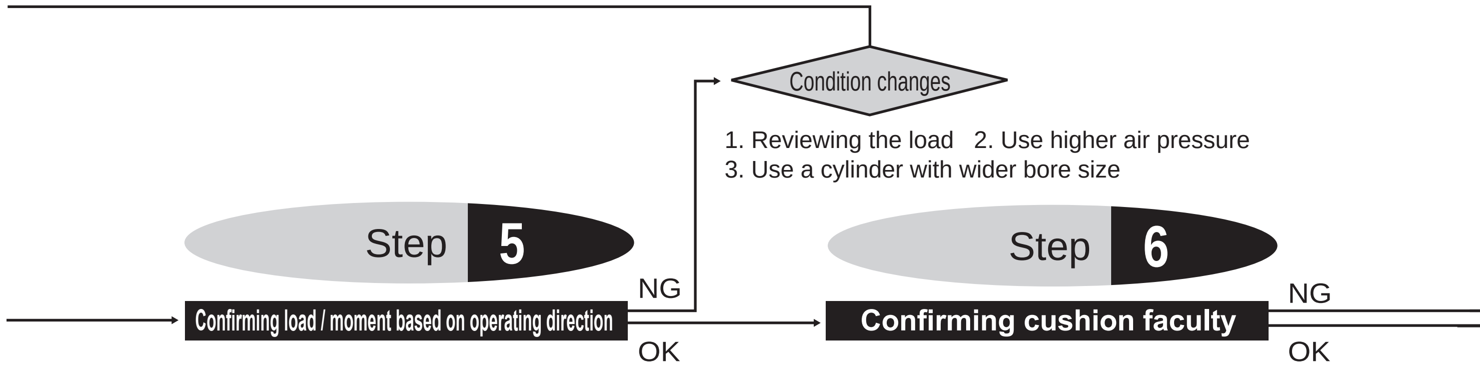
$$M_3 = F_3 \times \ell_3 = 10 \times m_3 \times \ell_3$$



m_1:
m_2: Load weight (kg)
m_3:
ℓ_1:
ℓ_2: Eccentric distance (m)
ℓ_3:
G: Inertia force coefficient (Fig. 3)

Fig. 3. Trend of inertia force coefficient





Step 5 Confirming the load and moment depending on the operating direction

5-1 Confirm applied load

❶ For horizontal operation

The value of applied static load must be the allowable load value or less.

Applied static load	W_0	Value obtained in Step 4
Allowable lateral load	Wmax	Select from Table 3 depending on the stroke length

(when using custom stroke length, select the longer standard stroke length)

$W_0 \leq Wmax$

Table 3 Allowable lateral load

● Ball bearing — Unit: N

Type	Stroke length (mm) 10	20	30	40
STR2-B-6	2.6	1.9	1.5	1.2
STR2-B-10	6.0	4.4	3.6	3.0
STR2-B-16	11.4	8.5	7.0	5.9
STR2-B-20	12.7	9.6	7.9	6.8
STR2-B-25	14.7	11.1	9.2	7.9
STR2-B-32	24.3	18.5	15.4	13.3

* Refer to page 254 for allowable lateral load.
Also, refer to the graph on page 255 for eccentric load.

❷ For vertical operation

The total applied load value must be the value obtained by applying the load factor to the theoretical thrust

● Calculation of load factor

Total applied load	W	Value obtained in Step 2
Theoretical thrust of cylinder	F	Select from the theoretical thrust table on page 240 depending on the pressure

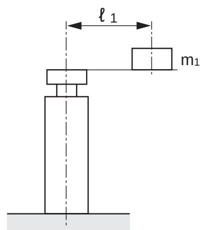
$\alpha = W/F \times 100$ (%)

● Determine the load factor by taking into account the status of utilization such as stability margin and service life of the cylinder. For general use, the value within the range in Table 4 is desirable.

Table 4 Appropriate range of load factor (reference value)

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	$\alpha \leqq 60$

● A lateral load works when an eccentric load is applied.
The lateral load should be within the allowable lateral load in Table 3.



$$\frac{m_1 \times \ell_1 \times 10}{L} \leq Wmax$$

ST: Stroke (m)

Bore size	L	Bore size	L
ø6	0.022+ST	ø20	0.032+ST
ø10	0.027+ST	ø25	0.034+ST
ø16	0.026+ST	ø32	0.036+ST

5-2 Confirming the static moment

❶ Divide the value of bending moment and radial moment by the value in Table 5 to obtain the moment ratio and check that the total value of the moment ratio is 1.0 or less.

● Calculation of moment ratio

Bending moment M_1, Radial moment M_2 } Value obtained in Step 4

$M_1/M_{1}max + M_2/M_{2}max \leq 1.0$

Condition changes

1. Install an external shock absorber.
2. Decrease the operation speed
3. Use a cylinder with larger bore size

Selection complete

Table 5. Allowable value of moment (N·m)

Bore size	Allowable bending moment M1max, M2max
ø6	3.6
ø10	3.6
ø16	9.2
ø20	9.2
ø25	74
ø32	74

❷ The value of torsion moment must be the allowable torque value or less

Torsion moment M3 Value obtained in Step 4

Allowable torque

M3max Select from Table 6 depending on the stroke length

(when using custom stroke length, select the longer standard stroke length)

$M_3 \leq M_3max$

Table 6. Allowable torque

● Ball bearing (N·m)

Type	Stroke length (mm)			
	10	20	30	40
STR2-B-6	0.009	0.006	0.005	0.004
STR2-B-10	0.030	0.022	0.018	0.015
STR2-B-16	0.071	0.053	0.043	0.036
STR2-B-20	0.088	0.067	0.055	0.047
STR2-B-25	0.125	0.094	0.078	0.067
STR2-B-32	0.267	0.203	0.169	0.146

* Refer to page 254 for allowable torque.

Step 6 CONFIRMING CUSHION FACULTY

Check if the kinetic energy generated by an actual load can be absorbed by the cylinder cushion.

● For the allowable absorbed energy of cylinder (E1), use the value in Table 7.

● Formula for calculating the kinetic energy of piston (E2)

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

W: Total applied load (N) Value obtained in Step 2

V: Speed of the piston entering the cushion (m/s)

V = ST/t × (1 + 1.5 × α/100)

ST: Stroke (m)

t: Operation time (s)

α: Load factor (%)

Allowable absorbed energy of cylinder

● The kinetic energy absorption performance of the cylinder's cushion depends on the cylinder bore size. For the guided cylinder, use the values in Table 7 for comparison.

Table 7. Allowable absorbed energy value (E_1) of STR2

Bore size	Allowable energy absorption (J)	
	Rubber cushion	
	push	pull
ø6	0.008	0.059
ø10	0.061	0.083
ø16	0.181	0.083
ø20	0.303	0.127
ø25	0.68	0.237
ø32	1.3	0.311

$E_1 > E_2$

(Allowable absorbed energy) > (Kinetic energy of piston)

Selection complete

$E_1 < E_2$

(Allowable absorbed energy) < (Kinetic energy of piston)

Consider changing the following conditions:

1. Install an external shock absorber
2. Decrease the operation speed
3. Use a cylinder with larger bore size