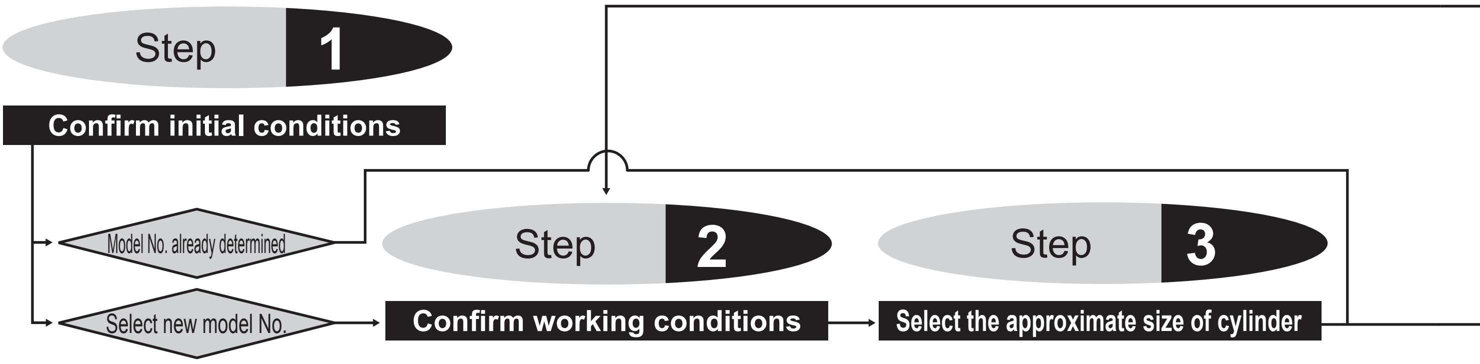
LCM
LCR
LCG
LCW
LCX
STM
STG
STS/STL
**STR2**
UCA2
ULK*
JSK/M2
JSG
JSC3/JSC4
USSD
UFCD
USC
UB
JSB3
LMB
LML
HCM
HCA
LBC
CAC4
UCAC2
CAC-N
UCAC-N
RCS2
RCC2
PCC
SHC
MCP
GLC
MFC
BBS
RRC
GRC
RV3*
NHS
HRL
LN
Hand
Chuk
MecHnd/Chuk
ShkAbs
FJ
FK
SpdContr
Ending

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




## Step 2 Confirm 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 parts.

Table 1 Formula of the self weight of movable parts

| Tube | Fa: Self-weight 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 cylinder average operation speed Va
   **Va=ST /t (mm/s)**

## Step 3 Select the approximate size of cylinder

● Formula for calculating cylinder size (bore size)

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

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

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

● When calculating from the theoretical thrust table

Approximate required thrust ≥ Applied load x 2
("x 2" in "Applied load x 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: 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 | $1.26\times10^2$ |
| | Pull | 40.2 | 60.3 | 80.4 |
| ø25 | Push | 98.2 | $1.47\times10^2$ | $1.96\times10^2$ |
| | Pull | 67.4 | $1.01\times10^2$ | $1.35\times10^2$ |
| ø32 | Push | $1.61\times10^2$ | $2.41\times10^2$ | $3.22\times10^2$ |
| | Pull | $1.21\times10^2$ | $1.81\times10^2$ | $2.41\times10^2$ |

*Refer to page 580 for the 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 the 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)

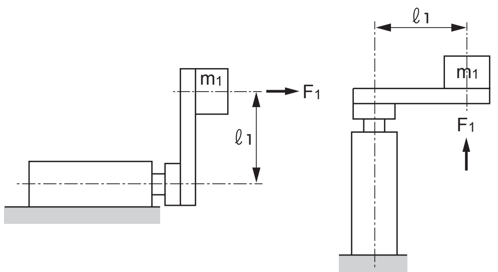
$M_3=F_3\times \ell_3$ (N·m)

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 and eccentric distance.

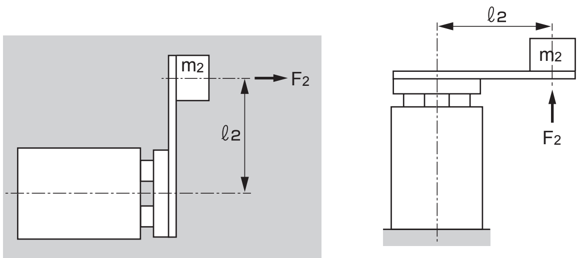
[Bending moment]

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



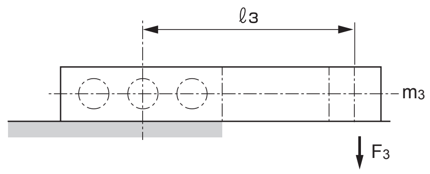

[L-shaped moment]

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




[Torsion moment]

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

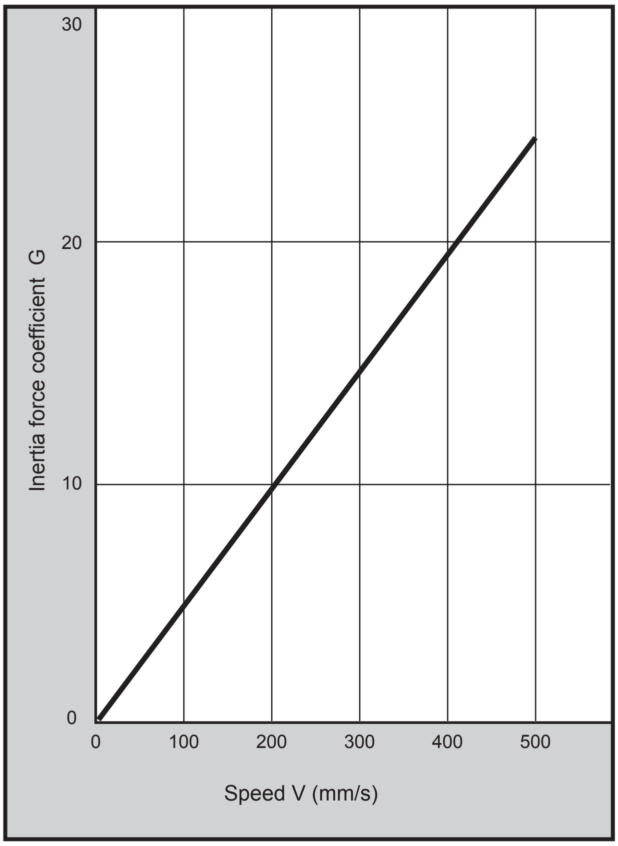


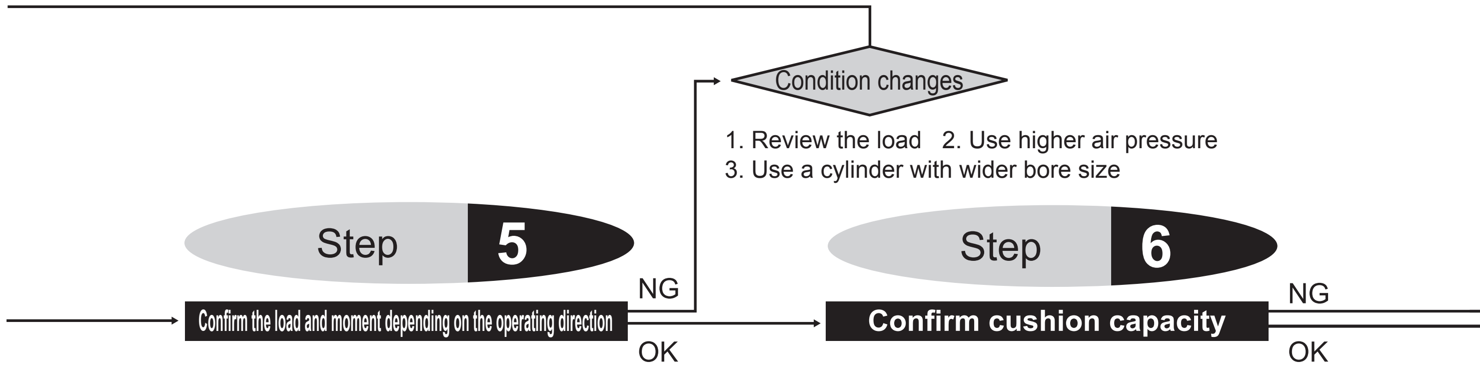

$m_1$:
$m_2$: Load weight (kg)
$m_3$:

$\ell_1$:
$\ell_2$: Eccentric distance (m)
$\ell_3$:

G : Inertia force coefficient

Fig. 3 Trend of inertia force coefficient for guided cylinder






## Step 5 Confirm the load and moment depending on the operating direction

### 5-1 Confirm applied load

❶ For horizontal operation

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

| | | |
|---|---|---|
| Static applied load | Wo | Value obtained in Step 4 |
| Allowable lateral load | Wmax | Select from Table 3 depending on the stroke |

(When using a custom stroke, select the longer standard stroke)

Wo≤Wmax

Table 3 Allowable lateral load

● Metal bush bearing — Unit: N

| Type | Stroke (mm) | | | |
|---|---|---|---|---|
| | 10 | 20 | 30 | 40 |
| STR2-M-6 | 2.4 | 1.9 | 1.5 | 1.3 |
| STR2-M-10 | 5.8 | 4.8 | 4.1 | 3.5 |
| STR2-M-16 | 15.9 | 13.3 | 11.5 | 10.1 |
| STR2-M-20 | 20.3 | 17.3 | 15.1 | 13.4 |
| STR2-M-25 | 22.1 | 18.9 | 16.5 | 14.7 |
| STR2-M-32 | 34.9 | 30.2 | 26.7 | 23.9 |

● Ball bearing — Unit: N

| Type | Stroke (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 624 for allowable lateral load.
Also refer to the graphs on pages 625 and 626 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 580 depending on the pressure |

α = W/F x 100 (%)

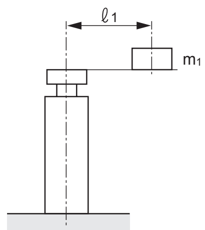
● Determine the load factor by taking into account the status of utilization such as stability margin and service life of the cylinder. For general use, the value within the range in Table 4 is desirable.

Table 4 Appropriate range of load factor (reference value)

| Working pressure (MPa) | Load factor (%) |
|---|---|
| 0.1 to 0.3 | α ≤ 40 |
| 0.3 to 0.6 | α ≤ 50 |
| 0.6 to 1.0 | α ≤ 60 |

● A lateral load works when an eccentric load is applied.

The lateral load should be within the allowable lateral load in Table 3.




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

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 static moment

❶ Divide the value of bending moment and L-shaped 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 $M_1$ } Calculated value
L-shaped moment $M_2$ } in Step 4

$M_1/M_1max+M_2/M_2max≤1.0$

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 $M_1$ max/$M_2$ max |
|---|---|
| ø6 | 3.6 |
| ø10 | 3.6 |
| ø16 | 9.2 |
| ø20 | 9.2 |
| ø25 | 74 |
| ø32 | 74 |

❷ The torsion moment is the allowable torque value or less.thing

Torsion moment M3 Value obtained in Step 4

Allowable torque

$M_3$ max Select from Table 6 depending on the stroke

(When using a custom stroke, select the longer standard stroke)

**$M_3 \leq M_3$ max**

Table 6 Allowable torque

● Metal bush bearing (N·m)

| Type | Stroke (mm) | | | |
|---|---|---|---|---|
| | 10 | 20 | 30 | 40 |
| STR2-M-6 | 0.008 | 0.006 | 0.005 | 0.004 |
| STR2-M-10 | 0.029 | 0.024 | 0.020 | 0.017 |
| STR2-M-16 | 0.099 | 0.083 | 0.071 | 0.063 |
| STR2-M-20 | 0.142 | 0.121 | 0.105 | 0.093 |
| STR2-M-25 | 0.187 | 0.160 | 0.140 | 0.125 |
| STR2-M-32 | 0.383 | 0.332 | 0.293 | 0.262 |

● Ball bearing (N·m)

| Type | Stroke (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 627 for allowable torque.

## Step 6 Confirm cushion capacity

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

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

● Kinetic energy of piston($E_2$)formula

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

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: Operating 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 absorbed energy (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)