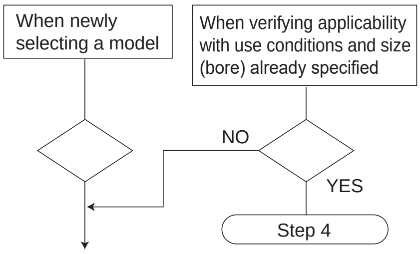
SRG3 Series selection guide

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.

1 Step 1



2 Step 2 Confirming working conditions

1. Working pressure (P) (MPa)
2. Load weight (M) (kg)
3. Applied load (F_L) (N)
4. Mounting orientation
5. Stroke (L) (mm)
6. Travel time (t) (s)
7. Operation speed (V) (m/s)

   Formula of the cylinder's average operation speed V

$$V = \frac{L}{t} \times \frac{1}{1000} \text{ (m/s)}$$

[Load weight]

Value of (weight of transported object + jig weight)

[Mounting orientation]

Operating direction: Horizontal + vertical

Mounting direction: With table upward, with table downward

3 Step 3 Selection of approximate size of cylinder

● Formula for calculating cylinder size (bore size)

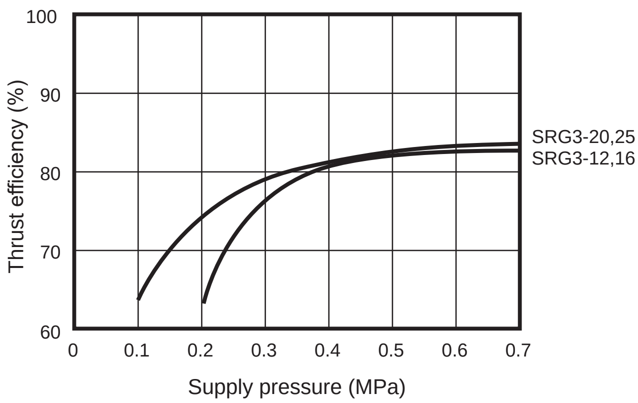
$$F = \frac{\pi}{4} \times D^2 \times P \times \frac{a}{100} \text{ (N)}$$

$$\therefore D = \sqrt{\frac{4F}{\pi \cdot P \cdot a}} \text{ (mm)}$$

D: Cylinder bore size (mm)
P: Working pressure (MPa)
a: Thrust efficiency (%) (Refer to Fig. 1)
F: Cylinder theoretical thrust (N)

D= ø

Figure 1 Trends of thrust efficiency of SRG3



● When calculating from the theoretical thrust value in Table 1

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 5 N

* Required thrust is 5 (N) x 2 = 10 N

The bore size selected from Table 1 with theoretical thrust of 10 N and over at working pressure of 0.5 MPa will be ø12.

D= ø12

[Cylinder theoretical thrust]

Table 1 Cylinder theoretical thrust value

Unit: N

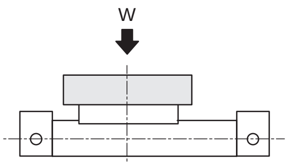
Bore size (mm)	Pressurized area (mm^2)	Working pressure MPa						
		0.1	0.2	0.3	0.4	0.5	0.6	0.7
ø12 or equiv.	138	-	28	41	55	69	83	97
ø16 or equiv.	216	-	43	65	86	108	130	151
ø20 or equiv.	315	-	63	94	126	157	189	220
ø25 or equiv.	542	54	108	163	217	271	325	380

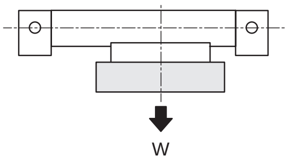
Note: Values in Table 1 do not include thrust efficiency.

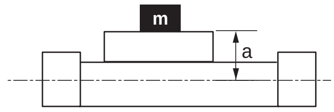
4 Step 4 Calculation of load (W) and moments

Vertical load and static moment work according to the cylinder mounting direction and the position of center of gravity of load.

[Vertical load]





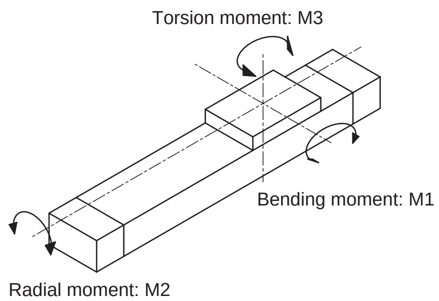


Value of a

Bore size	a(m)
ø25 or equiv.	0.033
ø32 or equiv.	0.035
ø40 or equiv.	0.040
ø63 or equiv.	0.050

[Static moment]

● Types of moment caused by load

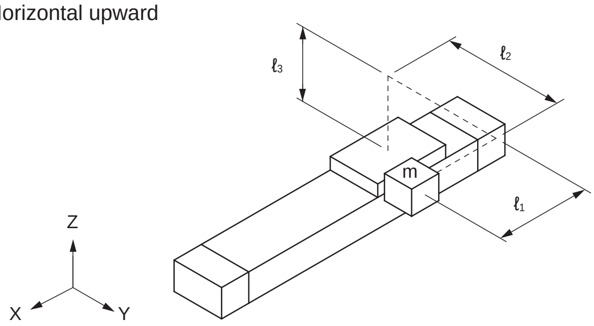


Unit: N·m

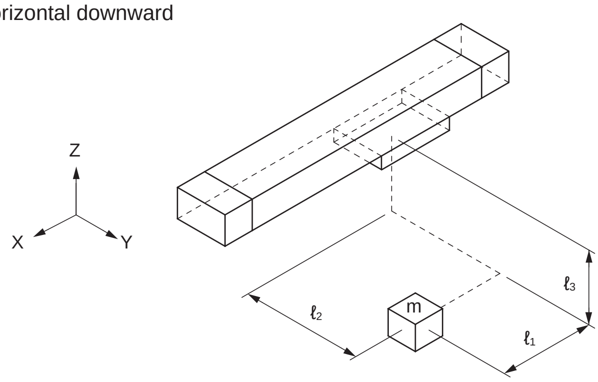
Mounting orientation		Horizontal upward	Horizontal downward	Horizontal lateral	Vertical
Vertical load W		mx9.8			-
Static moment	M1	Wxℓ_1	Wxℓ_1	-	Wx(ℓ_3+a)
	M2	Wxℓ_2	Wxℓ_2	Wx(ℓ_3+a)	-
	M3	-	-	Wxℓ_1	Wxℓ_2

m : Load weight [kg]
ℓ_1 : Length along the stroke direction from the center of table to the center of gravity of load [m]
ℓ_2 : Length in the width direction from the center of table to the center of gravity of load [m]
ℓ_3 : Length in the vertical direction from the center of table to the center of gravity of load [m]

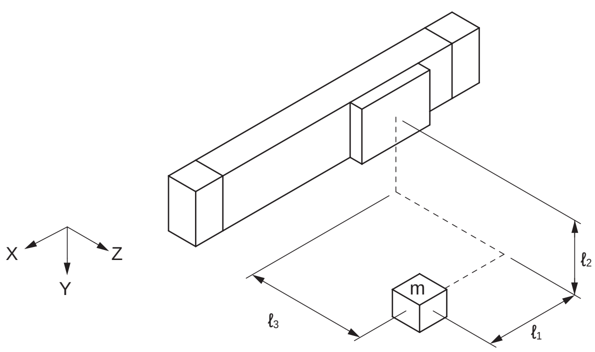
Horizontal upward



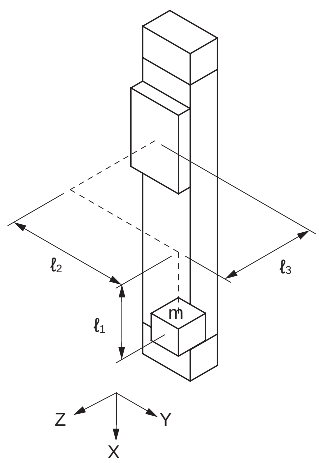
Horizontal downward



Horizontal lateral



Vertical



5 Step 5 Calculation of load and resultant moment

● Divide each load by the value shown in Table 2 to find load/moment ratio, and confirm that the total value is 1.0 or less.

● Formula

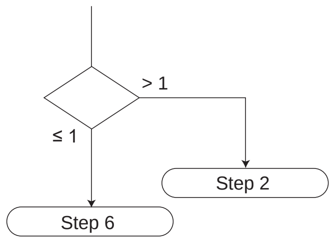
$$\frac{W}{Wmax} + \frac{M1}{M1max} + \frac{M2}{M2max} + \frac{M3}{M3max} \le 1.0$$

Table 2 Applied loads/allowable moments

Item / Bore size (mm)	Vertical load W(N)	Bending moment M1 (N·m)	Radial moment M2 (N·m)	Torsion moment M3 (N·m)
ø12 or equiv.	20	1	0.5	3
ø16 or equiv.	40	2.5	1	5.5
ø20 or equiv.	40	2.5	1	5.5
ø25 or equiv.	90	6.5	2.5	17

● If the total value is more than 1.0,

1. Review the load
2. Use a cylinder with wider bore size, etc., for revision.



6 Step 6 Calculation of required thrust

● Calculate the required cylinder thrust (F_N) that satisfies the conditions of the moments.

1. For horizontal operation

$F_N = F_W + F_{M1} + F_{M2} + F_{M3} + F_L$ (N)

F_W = Wx0.2 (N)

F_{M1} = M1xC1 (N)

F_{M2} = M2xC2 (N)

F_{M3} = M3xC3 (N)

F_L: Applied load (N)

C1: Coefficient of friction of moment M1 (Table 3)

C2: Coefficient of friction of moment M2 (Table 3)

C3: Coefficient of friction of moment M3 (Table 3)

2. For vertical operation

$F_N = W + F_{M1} + F_{M3} + F_L$ (N)

F_N = ☐ (N)

[Moment friction coefficients]

● The friction differs depending on the moment. Calculate the friction of each moment from Table 3.

Table 3 Coefficients of friction of moments

1/m

Bore size (mm)	C1	C2	C3
ø12 or equiv.	8	27	8
ø16 or equiv.	7	24	7
ø20 or equiv.	6	21	6
ø25 or equiv.	5	16	5

7 Step 7 Calculation of load factor

● Determine the load factor by taking into account the status of utilization such as stability, margin and service life of the cylinder.

● Formula of load factor (α)

$$\alpha = \frac{\text{Required thrust } (F_N)}{\text{Thrust of cylinder (F)}} \times 100\%$$

$$F = \frac{\pi}{4} x D^2 x P x \frac{\mu}{100} \text{ (N)}$$

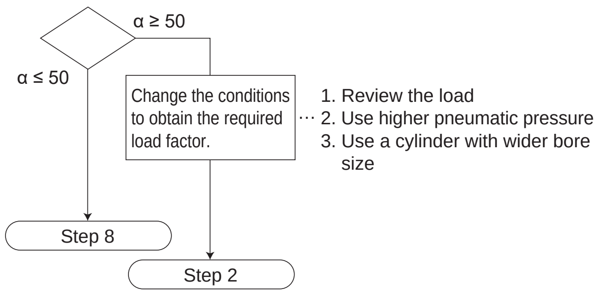
D: Cylinder bore size (mm)

$\frac{\pi}{4} x D^2$ = Pressurized area (mm^2)

● The cylinder theoretical thrust value in Table 1 can be used as the $\frac{\pi}{4} x D^2 x P$ value.

P : Working pressure MPa

μ : Thrust efficiency (Use the values in Figure 1.)



[Appropriate range of load factor]

● The piston speed differs depending on the load factor. In normal use, the values in Table 4 are recommended.

Table 4 (Appropriate range of load factor - reference value)

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

[Example] Size of the cylinder used: ø12 or equiv.

Required thrust 1.78(N)

Working pressure 0.5 (MPa)

$$\alpha = \frac{1.78}{138 x 0.5 x \frac{82}{100}} x 100$$

= 3.1%

Appropriate since the result is α ≤ 50%.

8 Step 8 Confirming cushion capacity

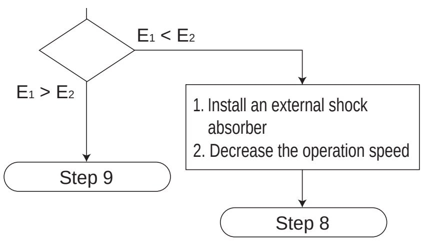
Check if the kinetic energy generated by an actual load can be absorbed by the cylinder cushion.

[Allowable absorbed energy of cylinder: E_1]

- The kinetic energy absorption performance of the cylinder's cushion depends on the cylinder bore size. The values of SRG3 are shown in Table 5.

Table 5 SRG3 allowable absorbed energy (E_1)

Bore size (mm)	Allowable absorbed energy (J)
ø12 or equiv.	0.03
ø16 or equiv.	0.22
ø20 or equiv.	0.59
ø25 or equiv.	1.40



[Piston kinetic energy: E_2]

- Formula for calculating the piston kinetic energy

$$E_2 = \frac{1}{2} \times M \times Va^2 (J)$$

M: Applied load weight (kg)

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

$$Va = \frac{L}{t} \times \left(1 + 1.5 \times \frac{\alpha}{100}\right)$$

L : Stroke (m)

t : Operating time (s)

α : Load factor (%)

9 Step 9 Confirmation of inertia load

● Check whether the inertia force of the load caused by the piston operation is within the allowable range of the cylinder.

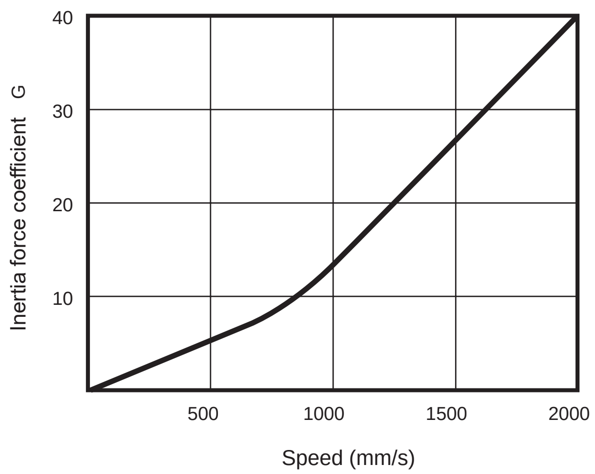
(1) Obtain the G coefficient from the speed of entering the cushion (Va) and Figure 2 (Trends of inertia force coefficient for SRG3). Use the speed of entering the cushion (Va) calculated in Step 8.

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

$$Va=\frac{L}{t}x(1 + 1.5x\frac{\alpha}{100})$$

L	: Stroke	(mm)
t	: Operating time	(S)
α	: Load factor	(%)

Figure 2 Trends of inertia force coefficient for SRG3



(2) Obtain the bending moment (M1i) and torsion moment (M3i) of the inertia force.

Unit: N·m

Mounting orientation		Horizontal upward	Horizontal downward	Vertical	Horizontal lateral
Dynamic moment	M1i	$Wx(\ell_3 + a)xG$			
	M2i	M2i dynamic moment is not generated.			
	M3i	$Wx\ell_2xG$			

Moment of inertia force can be calculated with the formulas above regardless of the mounting direction.

(3) Add moments of static load (M1 and M3) and moments of inertia force (M1i and M3i) and check that the resulting values are within the values in Table 2.

$$M1 + M1i \leq M1max$$
$$M3 + M3i \leq M3max$$

M1max and M3max are the values in Table 2.