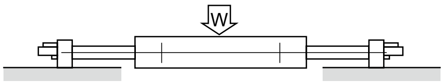
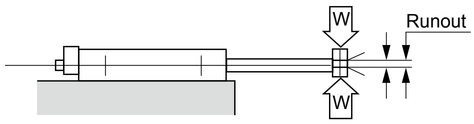
1 Sag of the piston rod due to concentrated load (reference value)

Put the center of gravity of load as close as possible to the center of the unit cylinder.



[Unit: mm]

Bore size (mm)	Stroke length (mm) / Load (N)	75	100	125	150	175	200
ø10	15	0.05	0.10	—	—	—	—
ø16	40	0.02	0.05	0.09	0.16	0.25	0.38
ø25	70	0.01	0.03	0.06	0.10	0.16	0.24
ø32	100	0.005	0.02	0.04	0.07	0.11	0.15



[Unit: mm]

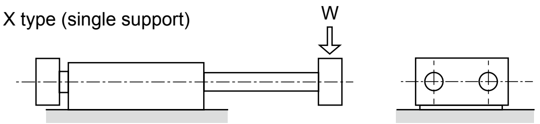
Bore size (mm)	Stroke length (mm) / Load (N)	25	50	75	100	125	150	175	200
ø10	7	0.04	0.10	0.18	0.27	-	-	-	-
ø16	20	0.03	0.07	0.12	0.20	0.28	0.37	0.48	0.60
ø25	35	0.02	0.04	0.08	0.13	0.17	0.24	0.32	0.41
ø32	50	0.01	0.03	0.06	0.10	0.14	0.21	0.29	0.38

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

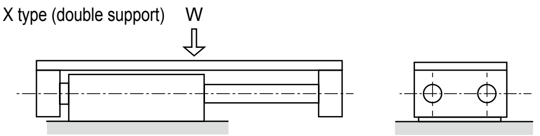
2 Determination of allowable load

1. Vertical load

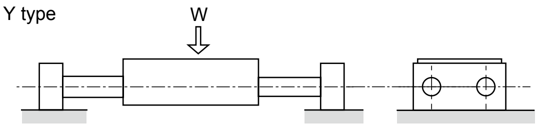
X type (single support)



X type (double support)



Y type



[Unit: N]

Bore size (mm) \ Fixing method \ Type	X type: Single support	X type: Double support	Y type
ø10	6.9	14.7	
ø16	19.6	39.2	
ø25	34.3	68.6	
ø32	49	98	

W = Load N

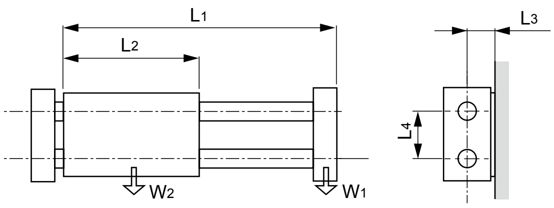
2. With overhang load applied

Calculate the load as described below to select the bore size.
However, the overhang load (W) should be equal to or less than the vertical load in 1 above and the overhang length (L) should be equal to or less than 100 mm.

2-1. Conditions and items required in calculation of the allowable load

W = Load (N)
L = Amount of overhang (mm)
V = Operating speed (mm/s)
S = Stroke length (mm)
F = Max. load applied to each bearing (N)

W_1 = End plate weight (kg)
W_2 = Cylinder body weight (kg)
L_1 = Length from the end plate to the body (mm)
L_2 = Cylinder body length (mm)
L_3 = Length from the rod center to the cylinder body (mm)
L_4 = Pitch between rods (mm)



Bore size (mm)	Type \ Code	L_1	L_2	L_3	L_4	W_1	W_2
ø10	Metal	69 + 2·S	54+S	9	26	$0.099 + 7 \times 10^{-4} \cdot S$	$0.174 + 2 \times 10^{-3} \cdot S$
	Bearing	91 + 2·S	76+S	9	26	$0.109 + 7 \times 10^{-4} \cdot S$	$0.214 + 2 \times 10^{-3} \cdot S$
ø16	Metal	71 + 2·S	50+S	12	34	$0.199 + 21 \times 10^{-4} \cdot S$	$0.334 + 3.2 \times 10^{-3} \cdot S$
	Bearing	117 + 2·S	96+S	12	34	$0.239 + 21 \times 10^{-4} \cdot S$	$0.338 + 3.2 \times 10^{-3} \cdot S$
ø25	Metal	87 + 2·S	62+S	16	42	$0.456 + 36 \times 10^{-4} \cdot S$	$0.6 + 4.7 \times 10^{-3} \cdot S$
	Bearing	121 + 2·S	96+S	16	42	$0.509 + 36 \times 10^{-4} \cdot S$	$0.615 + 4.7 \times 10^{-3} \cdot S$
ø32	Metal	100 + 2·S	75+S	19	58	$0.636 + 47 \times 10^{-4} \cdot S$	$0.92 + 7 \times 10^{-3} \cdot S$
	Bearing	139 + 2·S	114+S	19	58	$0.714 + 47 \times 10^{-4} \cdot S$	$1.313 + 7 \times 10^{-3} \cdot S$

UCA2/UCA2-B Series

Technical data ❷ Determination of allowable load

2-2. Calculation of allowable load

Calculate F from "Mounting orientation examples" and check that
Fk obtained with the following formula is within the allowable value in Table 3.

$F_K = F \times K$
F_K : Operating speed load (N)
K : Speed coefficient

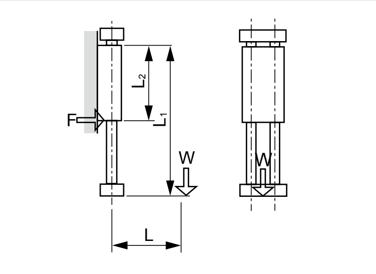
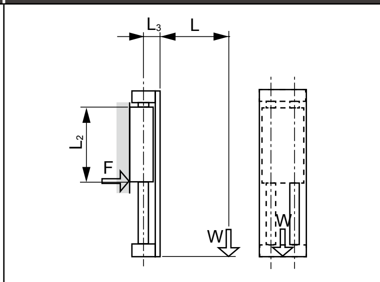
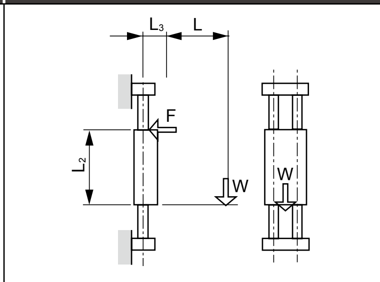
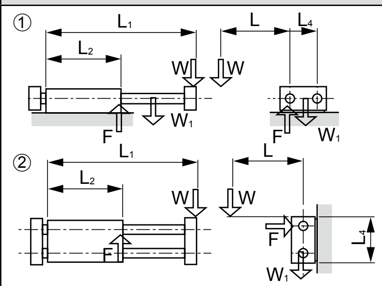
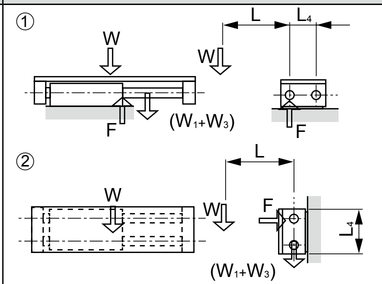
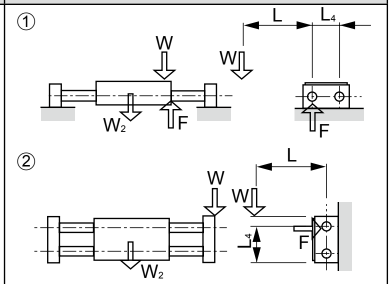
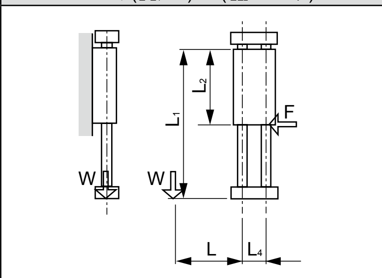
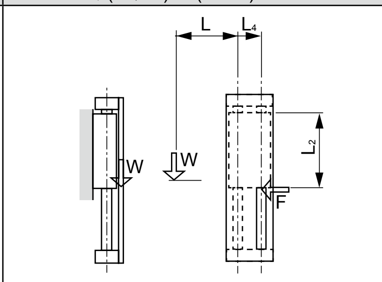
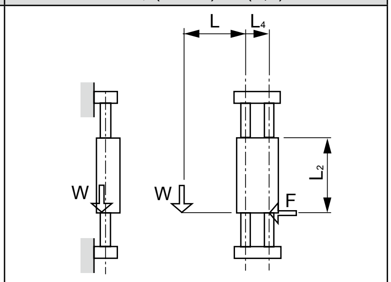
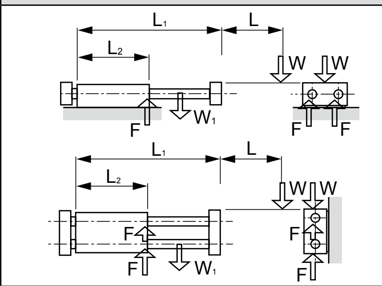
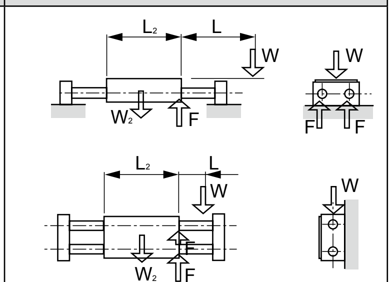
Table 3 Allowable operating speed load (F_K)

Bore size (mm)	Allowable Fk (N)
ø10	21.6
ø16	75.5
ø25	103.0
ø32	157.0

Speed coefficient

Operating speed (mm/s)	K
30 ≤ V < 100	1.0
100 ≤ V < 200	1.1
200 ≤ V < 300	1.2

2-3. Mounting orientation examples

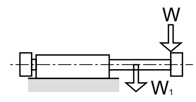
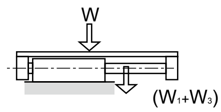
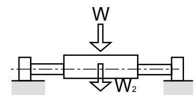
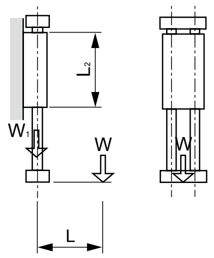
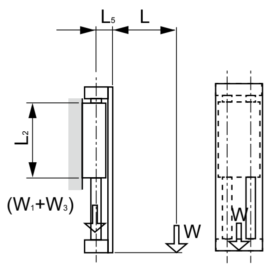
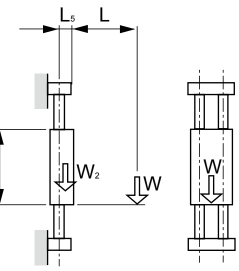
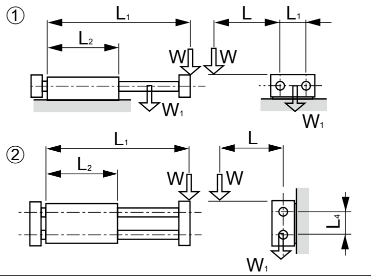
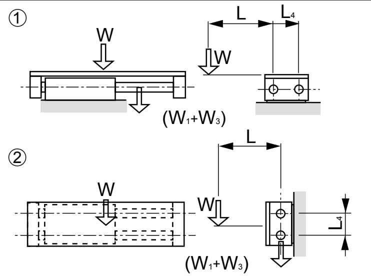
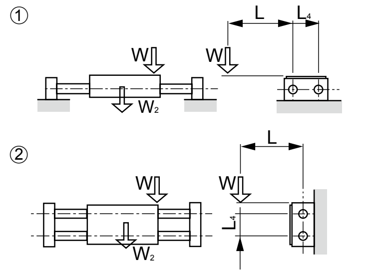
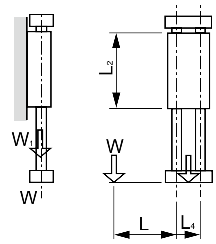
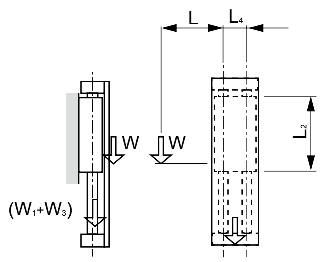
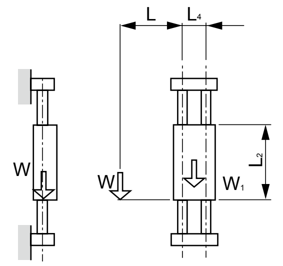
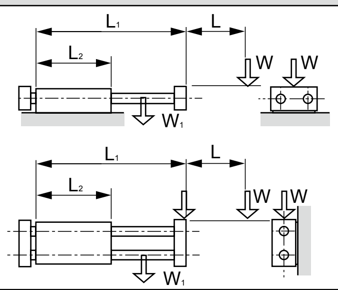
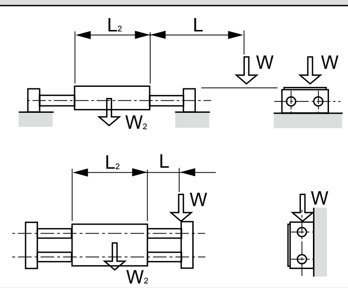
	X type (single support)	X type (double support)	Y type
(Overhang load is applied vertically.) Vertical direction			
Max. load applied to each bearing (N)	$F = \frac{L}{2L_2} \cdot W$	$F = \frac{L+L_3}{2 \cdot L_2} \cdot W$	$F = \frac{L+L_3}{2 \cdot L_2} \cdot W$
(Overhang load is applied perpendicularly to the stroke length.) ① Horizontal direction ② Horizontal side mount			
Max. load applied to each bearing (N)	① $F = (\frac{L+L_4}{2 \cdot L_4} + \frac{L_1}{2L_2})W + \frac{W_1}{4}$ ② $F = \sqrt{(\frac{L}{2 \cdot L_4} \cdot W)^2 + (\frac{L_1}{2L_2} \cdot W + \frac{W_1}{4})^2}$	① $F = \frac{L+L_4}{2 \cdot L_4} \cdot W + \frac{W_1+W_3}{4}$ ② $F = \sqrt{(\frac{L}{2 \cdot L_4} \cdot W)^2 + (\frac{W_1+W_3}{4})^2}$ W_3: Sub-plate Weight (kg)	① $F = \frac{L+L_4}{2 \cdot L_4} \cdot W + \frac{W_1+W_2}{4}$ ② $F = \sqrt{(\frac{L}{2 \cdot L_4} \cdot W)^2 + (\frac{W_2}{4})^2}$
(Overhang load is applied laterally.) Vertical direction			
Max. load applied to each bearing (N)	$F = \frac{L+L_4}{L_2} \cdot W$	$F = \frac{L+L_4}{L_2} \cdot W$	$F = \frac{L+L_4}{L_2} \cdot W$
(Overhang load is applied along the stroke length.) Horizontal direction Horizontal side mount			
Max. load applied to each bearing (N)	$F = \frac{L+L_1}{2 \cdot L_2} \cdot W + \frac{W_1}{4}$		$F = \frac{L+L_2}{2 \cdot L_2} \cdot W + \frac{W_2}{4}$

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

3 Calculation of load factor

1. Refer to Table 4 and calculate the necessary thrust according to the weight, direction and mounting orientation of the load.

Table 4

	Body fixing (single support)	Body fixing (double support)	Plate fixing
Load is applied to the cylinder center. Horizontal direction			
Required thrust	$f=\mu(W+W_1)$	$f=\mu(W+W_1+W_3)$	$f=\mu(W+W_2)$
Overhang load is applied vertically. Vertical direction			
Required thrust	$f=\frac{2\mu\cdot L}{L_2}\cdot W+W+W_1$	$f=\frac{2\mu\cdot(L+L_5)}{L_2}\cdot W+W+W_1+W_3$	$f=\frac{2\mu\cdot(L+L_5)}{L_2}\cdot W+W+W_2$
Overhang load is applied perpendicularly to the stroke length. ① Horizontal direction ② Horizontal side mount			
Required thrust	① $f=\mu\{(\frac{2\cdot L+L_4}{L_4}+\frac{2\cdot L+L_2}{L_2})\cdot W+W+W_1\}$ ② $f=\mu\cdot\sqrt{(\frac{2\cdot L}{L_4}\cdot W)^2+(\frac{2\cdot L_1-L_2}{L_2}\cdot W+W+W_1)^2}$	① $f=\mu\cdot(\frac{2\cdot L+L_4}{L_4}\cdot W+W+W_1+W_3)$ ② $f=\mu\cdot\sqrt{(\frac{2\cdot L}{L_4}\cdot W)^2+(W+W_1+W_3)^2}$	① $f=\mu(\frac{2\cdot L+L_4}{L_4}\cdot W+W+W_2)$ ② $f=\mu\cdot\sqrt{(\frac{2\cdot L}{L_4}\cdot W)^2+(W+W_2)^2}$
Overhang load is applied laterally. Vertical direction			
Required thrust	$f=\frac{\mu(2\cdot L+L_4)}{L_2}\cdot W+W+W_1$	$f=\frac{\mu(2\cdot L+L_4)}{L_2}\cdot W+W+W_1+W_4$	$f=\frac{\mu(2\cdot L+L_4)}{L_2}\cdot W+W+W_2$
Overhang load is applied along the stroke length. Horizontal direction Horizontal side mount		Note) W_3: Sub-plate weight (kg)	
Required thrust	$f=\mu\{\frac{2(L+L_1)-L_2}{L_2}\cdot W+W+W_1\}$		$f=\mu(\frac{2\cdot L+L_2}{L_2}\cdot W+W+W_2)$

f : Required thrust N

μ : Coefficient of friction Metal bush bearing 0.3
Ball bearing 0.1

For the other items and dimensions, refer to “Determination of allowable load”.

2.Calculate the load factor from the necessary thrust obtained in 1, the theoretical thrust table and the thrust efficiency graph. (The load factor must be 50% or less.)

$$\omega = \frac{f}{B} \times 100 \leq 50$$

$$B = \frac{a}{100} \cdot A$$

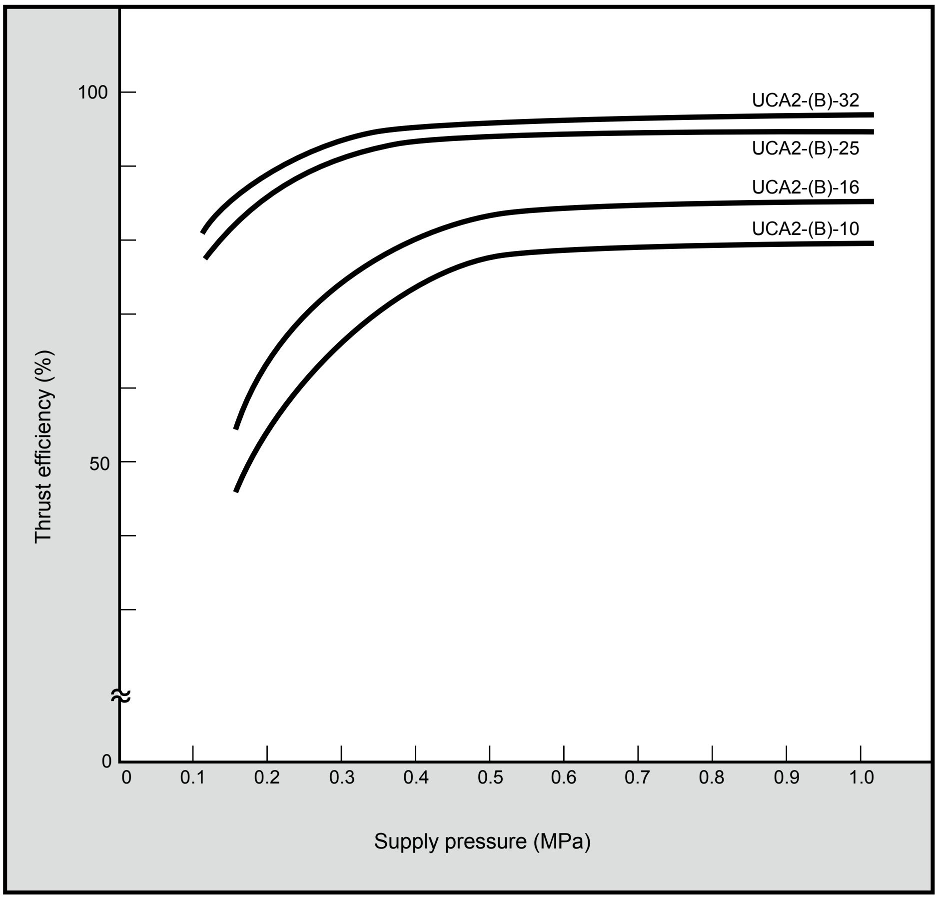
ω : Load factor (%)
f : Required thrust (N)
A : Theoretical thrust (N)
a : Thrust efficiency (%)
B : Effective thrust (N)

Theoretical thrust

[Unit: N]

Model No.	Working pressure MPa								
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
UCA2-10	10	20	29	39	49	59	69	78	88
UCA2-16	25	48	73	96	121	145	169	193	217
UCA2-25	66	132	198	265	330	396	463	528	594
UCA2-32	119	236	355	474	591	710	828	846	1065
UCA2-B-10	10	20	29	39	49	59	69	78	88
UCA2-B-16	25	48	73	96	121	145	169	193	217
UCA2-B-25	66	132	198	265	330	396	463	528	594
UCA2-B-32	119	236	355	474	591	710	828	946	1065

Thrust efficiency



4 Formula for kinetic energy calculation

Calculate the kinetic energy from the load weight (W) and speed (V), and check that it is within the allowable value in Table 7. If it is more than the allowable value, use a larger cylinder or add an external shock absorber to keep it within the allowable value.

The speed mentioned here is the speed of the piston entering the cushion, not the average speed. Therefore, calculate the speed of the piston entering the cushion with the formula (1).

$$E = \frac{1}{2} mV^2 + f S_1$$

$$Va = \frac{S_2}{t}$$

$$V = Va \times \left(1 + 1.5\frac{\omega}{100}\right) \text{———} (1)$$

E : Kinetic energy (J)
m : Weight (kg)
V : Cushion entry speed (m/s)
f : Thrust (N)
S_1 : Shock absorber stroke length (m)
Va : Average speed (m/s)
S_2 : Cylinder stroke length (m)
t : Travel time (s)
ω : Load factor (%)

■ Table 7 Allowable absorbed energy value

Bore size (mm)	Allowable absorbed energy (J)
ø10	0.25
ø16	0.65
ø25	2.4
ø32	4.5

■ Shock absorber stroke length

Bore size (mm)	Stroke length (mm)
ø10	4.5
ø16	5.0
ø25	6.5
ø32	7.0