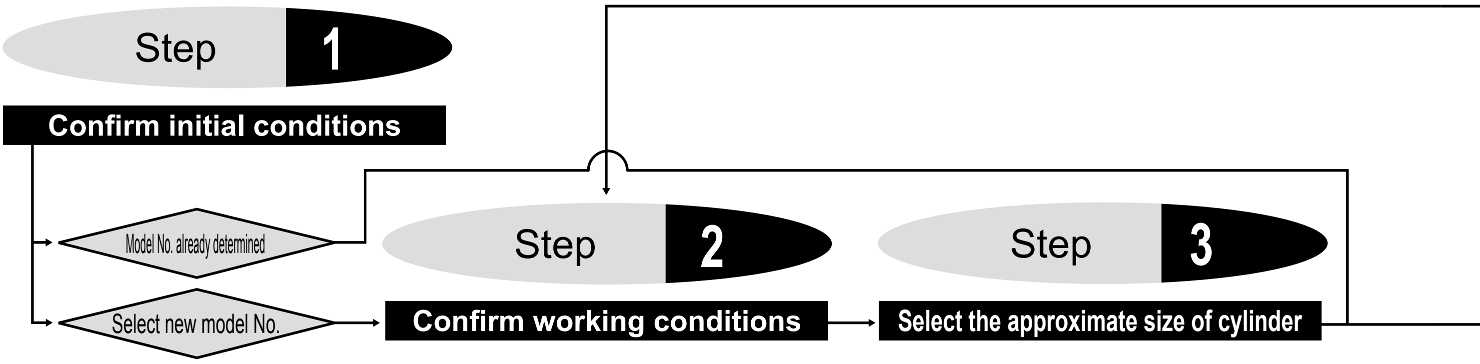
As the selection conditions are different from those of general air cylinders, confirm whether the model is adequate or not according to the selection guide.



Step 2 Confirm working conditions

1. Working pressure P (MPa)
2. Total applied load W (N)
   [Total applied load]
   When determining the total applied load, take into account the weight of the guide rod part of the cylinder body.
   W = (Applied load) + (Jig load) + (Self-weight of guide rod part: Fa).
   Table 1 shows the formula for the self-weight of the guide rod part.

Table 1 Formula of the self weight of movable parts

Bore size	Fa: Self-weight of movable part (N)	
	STS	STL
ø 8	(0.36)+0.004 × ST	(0.43)+0.004 × ST
ø12	(0.54)+0.008 × ST	(0.69)+0.008 × ST
ø16	(0.81)+0.012 × ST	(1.10)+0.012 × ST
ø20	(1.30)+0.030 × ST	(2.00)+0.030 × ST
ø25	(1.50)+0.033 × ST	(2.20)+0.033 × ST
ø32	(3.90)+0.065 × ST	(5.80)+0.065 × ST
ø40	(4.10)+0.065 × ST	(6.10)+0.065 × ST
ø50	(7.40)+0.101 × ST	(11.2)+0.101 × ST
ø63	(8.30)+0.101 × ST	(12.1)+0.101 × ST
ø80	(26.2)+0.234 × ST	(40.6)+0.234 × ST
ø100	(52.3)+0.248 × ST	(65.8)+0.248 × ST

ST: Stroke length (mm)

3. Mounting orientation
   [Actuation]
   Horizontal, vertical-rise, vertical-decline
4. Stroke length 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 value in Table 2

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 ø12 or more.
D=ø12

[Cylinder theoretical thrust]

Table 2 Cylinder theoretical thrust table

Theoretical thrust table ø8, ø12 Unit: N

Actuation direction	Pressure MPa	Bore size mm	
		ø8	ø12
Push	0.15	7.5	17
	0.2	10	22.6
	0.3	15.1	33.9
	0.4	20	45.2
	0.5	25.1	56.6
	0.6	30.1	67.8
	0.7	35.2	79.1
	0.8	40.2	90.4
	0.9	45.2	101.8

* Refer to page 449 for theoretical thrust table.

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

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 cylinder mounting status.

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)

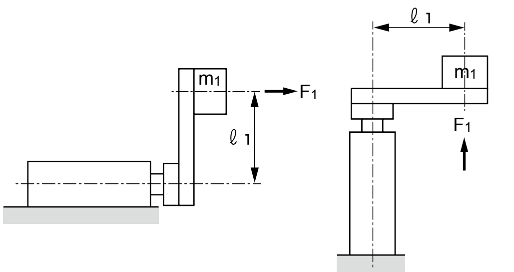
$M_3=F_3 \times \ell_3$ (N·m)

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 total applied load, inertia force coefficient and eccentric distance.

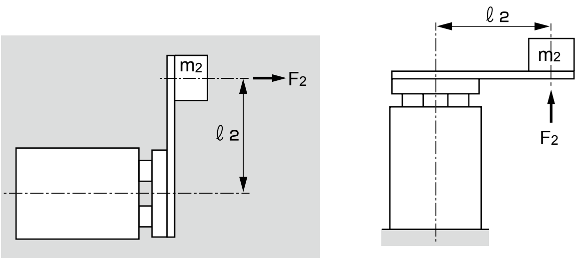
[Bending moment]

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



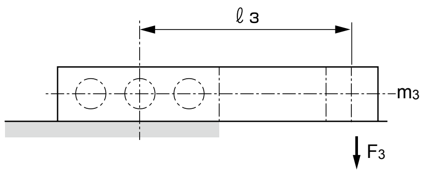
[Radial moment]

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



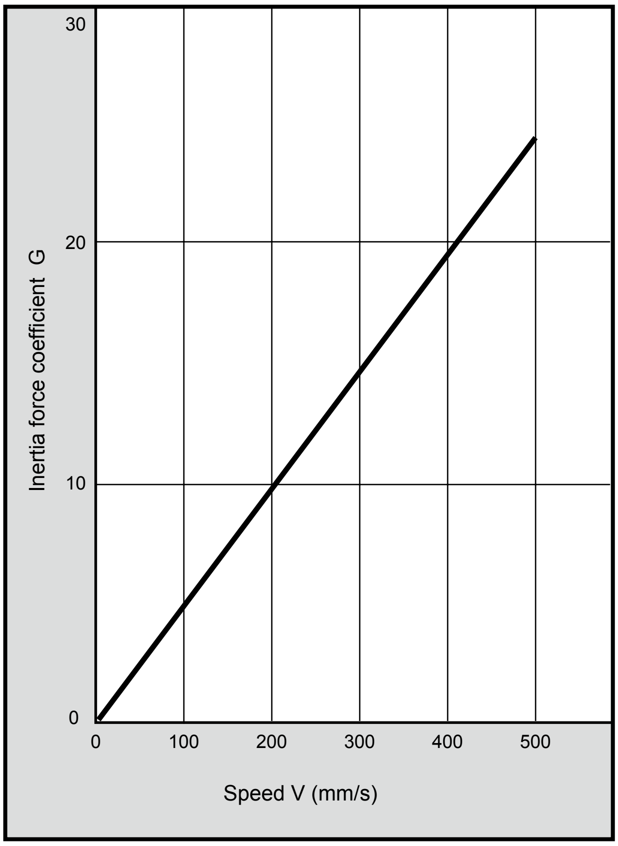
[Torsion moment]

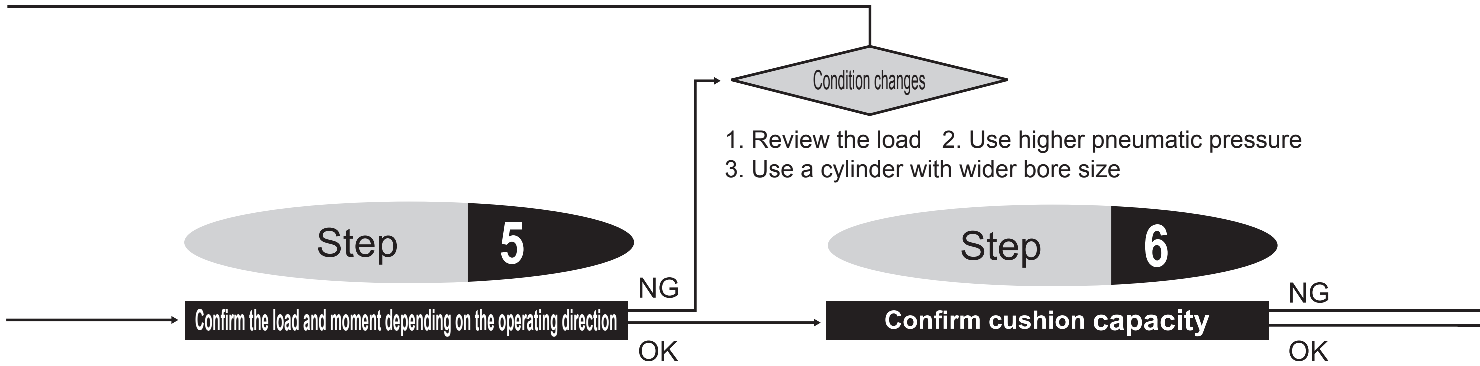
$$M_3 = F_3\times \ell_3 =10\times m_3\times \ell_3$$



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

Fig. 3 Trend of inertia force coefficient for guided cylinder





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

5-1 Confirming total applied load

1 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 or the graph depending on stroke

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

$W_o \le W_{max}$

Table 3 Allowable lateral load

Unit: N

Bore size (mm)	Type	Bearing	STS 10	STS 20	STS 25
ø 8	ST$^{S}_{L}$-M-8	Metal bush bearing	14	11	-
	ST$^{S}_{L}$-B-8	Ball bearing	16	11	-
ø12	ST$^{S}_{L}$-M-12	Metal bush bearing	23	19	-
	ST$^{S}_{L}$-B-12	Ball bearing	30	21	-
ø16	ST$^{S}_{L}$-M-16	Metal bush bearing	40	34	-
	ST$^{S}_{L}$-B-16	Ball bearing	44	32	-
ø20	ST$^{S}_{L}$-M-20	Metal bush bearing	-	-	48
	ST$^{S}_{L}$-B-20	Ball bearing	-	-	45
ø25	ST$^{S}_{L}$-M-25	Metal bush bearing	-	-	48
	ST$^{S}_{L}$-B-25	Ball bearing	-	-	45
ø32	ST$^{S}_{L}$-M-32	Metal bush bearing	-	-	141
	ST$^{S}_{L}$-B-32	Ball bearing	-	-	49

* Refer to page 564 for allowable lateral load.
Also refer to the graphs on pages 566 to 569 for eccentric load.

2 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 449 depending on the pressure

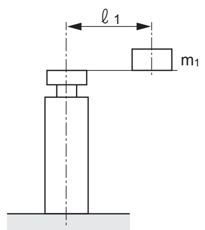
$\alpha = W/F \times 100$ (%)

● 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	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
ø8	0.015+st	ø32	0.022+st
ø12	0.015+st	ø40	0.022+st
ø16	0.016+st	ø50	0.025+st
ø20	0.016+st	ø63	0.025+st
ø25	0.016+st	ø80	0.046+st
		ø100	0.055+st

5-2 Confirming static moment

1 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: Calculated value in Step 4

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

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 (mm)	Allowable bending moment M_1 max, M_2 max (N·m)
ø8	4.1
ø12	6.1
ø16	19.3
ø20	32.6
ø25	48.5
ø32	107.4
ø40	107.4
ø50	201.7
ø63	201.7
ø80	726.0
ø100	726.0

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

$M_3 \leq M_3max$

Table 6 Allowable torque (N·m)

Bore size (mm)	Type	Bearing	STS 10	STS 20	STS 25
ø 8	ST^S_L-M-8	Metal bush bearing	0.14	0.11	-
	ST^S_L-B-8	Ball bearing	0.16	0.11	-
ø 12	ST^S_L-M-12	Metal bush bearing	0.24	0.19	-
	ST^S_L-B-12	Ball bearing	0.31	0.22	-
ø 16	ST^S_L-M-16	Metal bush bearing	0.46	0.39	-
	ST^S_L-B-16	Ball bearing	0.51	0.37	-
ø 20	ST^S_L-M-20	Metal bush bearing	-	-	0.71
	ST^S_L-B-20	Ball bearing	-	-	1.19
ø 25	ST^S_L-M-25	Metal bush bearing	-	-	0.76
	ST^S_L-B-25	Ball bearing	-	-	1.28
ø 32	ST^S_L-M-32	Metal bush bearing	-	-	2.86
	ST^S_L-B-32	Ball bearing	-	-	0.99
ø 40	ST^S_L-M-40	Metal bush bearing	-	-	3.17
	ST^S_L-B-40	Ball bearing	-	-	1.10
ø 50	ST^S_L-M-50	Metal bush bearing	-	-	5.86
	ST^S_L-B-50	Ball bearing	-	-	2.01
ø 63	ST^S_L-M-63	Metal bush bearing	-	-	6.60
	ST^S_L-B-63	Ball bearing	-	-	2.26
ø 80	ST^S_L-M-80	Metal bush bearing	-	-	13.95
	ST^S_L-B-80	Ball bearing	-	-	8.48
ø100	ST^S_L-M-100	Metal bush bearing	-	-	18.23
	ST^S_L-B-100	Ball bearing	-	-	11.07

* Refer to page 564 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.

- The allowable absorbed energy of cylinder (E_1) depends on the cylinder model. Use the values in Table 7 for STS and STL.
- Formula for calculating the piston kinetic energy (E_2)

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

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

V: Speed of the piston entering the cushion (m/s)
V = ST/t x (1 + 1.5 x 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 (E1) of STS/STL

Bore size (mm)	Allowable absorbed energy (J) Rubber cushion	Rubber-air cushion	Air cushion	Without cushion
ø8	0.029	—	—	—
ø12	0.056	—	—	0.004
ø16	0.088	—	—	0.010
ø20	0.157	—	—	0.016
ø25	0.157	—	1.18	0.021
ø32	0.401	0.401	2.27	0.025
ø40	0.627	0.627	3.05	0.092
ø50	0.980	0.980	3.81	0.100
ø63	1.560	1.560	15.64	0.120
ø80	2.510	2.510	20.18	0.270
ø100	3.920	—	—	0.560

$E_1 > E_2$
(Allowable absorbed energy) > (Kinetic energy of piston)

Selection complete

$E_1 < E_2$
(Allowable absorbed energy) < (Kinetic energy of piston)

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

● Short stroke

Unit: g

Model series	Bore size (mm)	Bearing	Weight for 0 mm stroke				Additional weight per St = 25 mm (ø8 to ø16: Additional weight per St = 10 mm)
			Cylinder body	End plate		Weight per switch (Grommet)	
				Standard	Steel		
● Standard single rod STS-$^{M}_{B}$ ● Low speed STS-$^{M}_{B}$O ● Copper and PTFE free STS-$^{M}_{B}$-P6 ● Corrosion proof STS-$^{M}_{B}$-M/M1 ● Heat resistance STS-$^{M}_{B}$T ● Packing fluoro rubber STS-$^{M}_{B}$T2 ● Rubber-air cushioned STS-$^{M}_{B}$-*C ● Fine speed STS-$^{M}_{B}$F	ø 8	M	102	22	62	Refer to the weight in the switch specifications.	29
		B	89				
	ø12	M	151	27	76		37
		B	154				
	ø16	M	225	37	104		47
		B	229				
	ø20	M	483	72	200		150
		B	363				
	ø25	M	534	78	219		169
		B	415				
	ø32	M	924	162	451		231
		B	804				
	ø40	M	1333	195	543		283
		B	1214				
	ø50	M	2026	415	1158		428
		B	1915				
	ø63	M	2803	530	1478		557
		B	2569				
	ø80	M	6435	1335	3720		1265
		B	5876				1150
	ø100	M	10850	2685	7491		1933
		B	9934				1817
● Stroke adjustable STS-$^{M}_{B}$P	ø 8	M	260	22	62	Refer to the weight in the switch specifications.	33
		B	243				
	ø12	M	340	27	76		45
		B	333				
	ø16	M	462	37	104		59
		B	454				
	ø20	M	742	72	200		210
		B	602				
	ø25	M	836	78	219		229
		B	697				
	ø32	M	1499	162	451		335
		B	1331				
	ø40	M	2006	195	543		407
		B	1841				
	ø50	M	3323	415	1158		620
		B	3106				
	ø63	M	4458	530	1478		749
		B	4118				
	ø80	M	9505	1335	3720		1755
		B	8776				1526
● Position locking STS-$^{M}_{B}$Q-H (with head side position locking)	ø20	M	680	72	200	Refer to the weight in the switch specifications.	150
		B	560				
	ø25	M	767	78	219		169
		B	648				
	ø32	M	1235	162	451		231
		B	1115				
	ø40	M	2183	195	543		283
		B	2064				
	ø50	M	3305	415	1158		428
		B	3194				
	ø63	M	4554	530	1478		557
		B	4320				
	ø80	M	11583	1335	3720		1265
		B	10679				1150
● Position locking STS-$^{M}_{B}$Q-R (with rod side position locking)	ø20	M	666	72	200	Refer to the weight in the switch specifications.	150
		B	546				
	ø25	M	749	78	219		169
		B	630				
	ø32	M	1221	162	451		231
		B	1101				
	ø40	M	2126	195	543		283
		B	2007				
	ø50	M	3214	415	1158		428
		B	3103				
	ø63	M	4434	530	1478		557
		B	4200				
	ø80	M	11340	1335	3720		1265
		B	10436				1150

● Short stroke

Unit: g

Model series	Bore size (mm)	Bearing	Weight for 0 mm stroke: Cylinder body	End plate: Standard	End plate: Steel	Weight per switch (Grommet)	Additional weight per St = 25 mm
● Coil scraper STS-$^{M}_{B}$G1 ● Rubber scraper STS-$^{M}_{B}$G ● Coolant proof STS-$^{M}_{B}$G2, G3 ● Anti-spatter adherence STS-$^{M}_{B}$G4	ø20	M	572	72	200	Refer to the weight in the switch specifications.	150
		B	452				
	ø25	M	630	78	219		169
		B	511				
	ø32	M	1083	162	451		231
		B	963				
	ø40	M	1667	195	543		283
		B	1548				
	ø50	M	2299	415	1158		428
		B	2188				
	ø63	M	3125	530	1478		557
		B	2891				
	ø80	M	6861	1335	3720		1265
		B	6302				1150
● Valve equipped STS-$^{M}_{B}$V$^{1}_{2}$(with valve on front)	ø20	M	668	72	200	Refer to the weight in the switch specifications.	150
		B	548				
	ø25	M	719	78	219		169
		B	600				
	ø32	M	1136	162	451		231
		B	1016				
	ø40	M	1648	195	543		283
		B	1529				
	ø50	M	2428	415	1158		428
		B	2317				
	ø63	M	3205	530	1478		557
		B	2971				
● Valve equipped STS-$^{M}_{B}$V$^{1}_{2}$S (with valve on side)	ø20	M	663	72	200	Refer to the weight in the switch specifications.	150
		B	543				
	ø25	M	714	78	219		169
		B	595				
	ø32	M	1104	162	451		231
		B	684				
	ø40	M	1651	195	543		283
		B	1532				
	ø50	M	2344	45	1158		428
		B	2233				
	ø63	M	3121	530	1478		557
		B	2887				

Note: Refer to Ending Page 16 for the switch weight of 3 m and 5 m switch lead wire lengths.

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