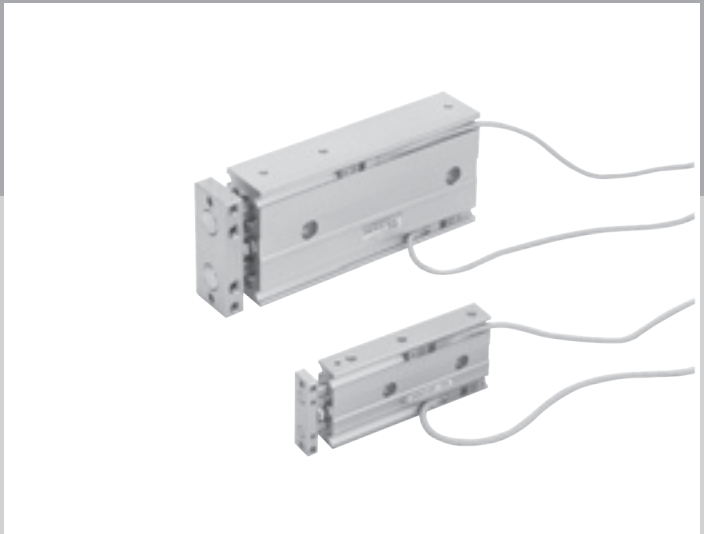
STR2

Twin rod cylinder

ø6/ø10/ø16/ø20/ø25/ø32

Combined functions



Overview

Guided twin rod cylinder for pick & place device. The twin rod mechanism can improve the non-rotating accuracy and also double the thrust.

Features

High level of non-rotating accuracy

The two single rod cylinders fixed to the end plate do not require the rotation-stop mechanism to provide a high level of non-rotating accuracy.

Space saving

The detection switch fits neatly into cylinder body. The simple design makes elegant use of space.

Ultracompact is available.

The ultracompact of ø6 bore size has been added to the series.
providing you with more choices.

Piping ports can be installed on either side.

Piping ports can be installed on the right or left side.
Connect pipes according to the configuration.

Easy to install

A reamed hole for parallel pin has been provided to facilitate the work when the cylinder is removed for maintenance.

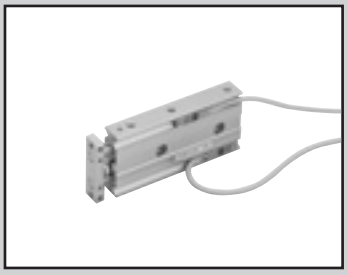
CONTENTS

Variation and option selection table

◎ : Option variation (check category 2)
○ : C5 compatible (check category 3)
△ : Available depending on conditions (estimation)
: Not available

			Clean room specifications			
			Exhaust treatment	Vacuum treatment	Exhaust treatment	Vacuum treatment
		Code	P72	P73	P52	P53
Variation	Double acting basic (ball bearing)	B	◎	◎	○	○
	Fine speed	F	○	○		
	Double rod	D	○	○	○	○
	Position locking	Q	△	△	△	△
	Low speed	O	○	○		
Port thread	NPT1/8 (ø32)	N	○	○	○	○
	G 1/8 (ø32)	G	○	○	○	○
Option	End plate material: steel	F	○	○	○	○
	Piping port position on the 180° opposite side	O	◎	◎	○	○
	Rear piping	R				

MEMO



Twin rod cylinder Double acting/standard

STR2-B Series

● Bore size: ø6/ø10/ø16/ø20/ø25/ø32

JIS symbol

RoHS CAD

Structure and material restriction

	Structure	Material restriction			Model No.
P7 Series	Exhaust treatment				P72
	Vacuum treatment				P73
P5 Series	Exhaust treatment	Copper-based materials prohibited	Silicon-based materials prohibited	Halogen-based materials prohibited (fluorine, chlorine, bromine)	P52
	Vacuum treatment	Copper-based materials prohibited	Silicon-based materials prohibited	Halogen-based materials prohibited (fluorine, chlorine, bromine)	P53

Specifications

Descriptions		STR2-B-P7*/P5*					
Bore size mm		ø6	ø10	ø16	ø20	ø25	ø32
Actuation		Double acting					
Working fluid		Compressed air					
Max. working pressure MPa		0.7 (≈100 psi, 7 bar)					
Min. working pressure MPa		0.2*	0.15**	0.1 (≈15 psi, 1 bar)			
Proof pressure MPa		1.05 (≈150 psi, 10.5 bar)					
Ambient temperature °C		-10 (14°F) to 60 (140°F) (no freezing)					
Port size		M5					Rc1/8
Port size (relief port)		M5					Rc1/8
Stroke tolerance mm		+2.0 0					
Adjustable stroke range mm		0 to -5					
Working piston speed mm/s		50 to 500					
Non-rotating accuracy		±0.2°	±0.1°			±0.3°	
Piston rod bearing		Ball bearing					
Cushion		Rubber cushion					
Lubrication		Not available					
Allowable energy absorption J	PUSH	0.008	0.061	0.181	0.303	0.68	1.3
	PULL	0.059	0.083	0.083	0.127	0.237	0.311

*0.2 (≈29 psi, 2 bar), **0.15 (≈22 psi, 1.5 bar)

Stroke length

Bore size	Stroke (mm)	Max. stroke (mm)	Available stroke (mm)	Min. stroke (mm)	Min. stroke with switch (mm)
ø6	10, 20, 30, 40, 50	50	Up to 100	5	10
ø10					
ø16	10, 20, 30, 40, 50 60, 70, 80, 90, 100	100 *1	Up to 200		
ø20					
ø25					
ø32					

*1: The custom stroke length is available by 1 mm increments.
However, the total length is the same as that of the next longer standard stroke length.

Theoretical thrust table

(Unit: N)

Bore size (mm)	Operating direction	Working pressure MPa							
		0.1	0.15	0.2	0.3	0.4	0.5	0.6	0.7
ø6	Push	-	-	11.3	17.0	22.6	28.3	33.9	39.6
	Pull	-	-	6.28	9.42	12.6	15.7	18.8	22.0
ø10	Push	-	23.6	31.4	47.1	62.8	78.5	94.2	1.10×10^2
	Pull	-	15.1	20.1	30.2	40.2	50.3	60.3	70.4
ø16	Push	40.2	60.3	80.4	1.21×10^2	1.61×10^2	2.01×10^2	2.41×10^2	2.81×10^2
	Pull	24.5	36.8	49.0	73.5	98.0	1.23×10^2	1.47×10^2	1.72×10^2
ø20	Push	62.8	94.2	1.26×10^2	1.88×10^2	2.51×10^2	3.14×10^2	3.77×10^2	4.40×10^2
	Pull	40.2	60.3	80.4	1.21×10^2	1.61×10^2	2.01×10^2	2.41×10^2	2.81×10^2
ø25	Push	98.2	1.47×10^2	1.96×10^2	2.95×10^2	3.93×10^2	4.91×10^2	5.89×10^2	6.87×10^2
	Pull	67.4	1.01×10^2	1.35×10^2	2.02×10^2	2.70×10^2	3.37×10^2	4.04×10^2	4.72×10^2
ø32	Push	1.61×10^2	2.41×10^2	3.22×10^2	4.83×10^2	6.43×10^2	8.04×10^2	9.65×10^2	1.13×10^3
	Pull	1.21×10^2	1.81×10^2	2.41×10^2	3.62×10^2	4.83×10^2	6.03×10^2	7.24×10^2	8.44×10^2

Switch specifications

● 1-color/2-color display

Descriptions	Proximity 2-wire		Proximity 3-wire			Reed 2-wire			
	K2H/K2V	K2YH/K2YV	K3H/K3V	K3PH/K3PV (custom order)	K3YH/K3YV	K0H/K0V		K5H/K5V	
Applications	Programmable controller		Programmable controller, relay			Programmable controller, relay		Programmable controller, relay IC circuit (without indicator lamp), serial connection	
Output method	-		NPN output	PNP output	NPN output	-			
Power supply voltage	-		10 to 28 VDC			-			
Load voltage	10 to 30 VDC		30 VDC or less			12/24 VDC	110 VAC	5/12/24 VDC	110 VAC
Load current	5 to 20 mA (*2)		50 mA or less			5 to 50 mA	7 to 20 mA	50 mA or less	20 mA or less
Indicator lamp	LED (Lit when ON)	Red/green LED (Lit when ON)	LED (Lit when ON)	Yellow LED (Lit when ON)	Red/green LED (Lit when ON)	LED (Lit when ON)		-	
Leakage current	1 mA or less		10 μA or less			0 mA			
Weight g	1 m: 18 3 m: 49 5 m: 80	1 m: 31 3 m: 85 5 m: 139	1 m: 18 3 m: 49 5 m: 80		1 m: 31 3 m: 85 5 m: 139	1 m: 18 3 m: 49 5 m: 80			

*1: Refer to page 309 for detailed switch specifications and Dimensions.
*2: Max. load current: 20mA at 25°C.The current is lower than 25 mA if the operating ambient temperature around the switch is higher than 20˚C. (60 to 5 mA at 10°C)

Cylinder weight

Unit: g

Bore size	Weight for 0 mm stroke length STR2-B	Additional weight per S = 10 mm
ø6	74	10
ø10	169	14
ø16	320	20
ø20	445	40
ø25	662	52
ø32	1233	83

(Example) Product weight

STR2-B-6-10-K2H-D-P7*

- Product weight for 0 mm stroke length..... 74 g
- Additional weight for stroke length 10 mm.....10 g × 1 = 10 g
- Weight of 2 cylinder switches. .....18 g × 2 = 36 g
- Product weight.....74g + 10g + 36 g = 120 g

How to order

Without switch (Magnet for switch incorporated)

STR2-B-16-30——O P72

With switch (Magnet for switch incorporated)

STR2-B-16-30-K0H-R-O P72

Model No.

Ⓐ Bearing

Ⓑ Bore size

Ⓒ Stroke length
■ The custom stroke length is available by 1 mm increments.

Ⓓ Switch model No.
*1

Ⓔ Switch quantity

Ⓕ Option
*2
*3

Ⓖ Clean room specifications

Code	Content
Ⓐ Bearing	
B	Ball bearing

Ⓑ Bore size (mm)	
6	ø6
10	ø10
16	ø16
20	ø20
25	ø25
32	ø32

Ⓒ Stroke (mm)

Bore size	Stroke	Available stroke	Custom stroke
ø6	**5 to 50**	**Up to 100**	**By 1 mm increments**
ø10	**5 to 50**	**Up to 100**	
ø16	**5 to 100**	**Up to 200**	
ø20	**5 to 100**	**Up to 200**	
ø25	**5 to 100**	**Up to 200**	
ø32	**5 to 100**	**Up to 200**	

Ⓓ Switch model No.

Lead wire straight	Lead wire L-shaped	Contact	Voltage AC	Voltage DC	Indicator	Lead wire
K0H*	**K0V***	Reed	●	●	1-color display	2 wires
K5H*	**K5V***		●	●	Without indicator lamp	
K2H*	**K2V***	Proximity		●	1-color display	2 wires
K3H*	**K3V***			●		3 wires
K3PH*	**K3PV***			●	1-color display (custom order)	3 wires
K2YH*	**K2YV***			●	2-color display	2 wires
K3YH*	**K3YV***			●		3 wires

*** Lead wire length**	
Blank	1 m (standard)
3	3 m (option)
5	5 m (option)

Ⓔ Switch quantity	
R	1 (on rod end)
H	1 (on head end)
D	2

Ⓕ Option	
Blank	None
O	Piping port position on the 180° opposite side

Ⓖ Clean room specifications

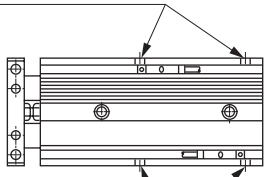
	Structure	Material restriction
P72	Exhaust treatment	-
P73	Vacuum treatment	-
P52	Exhaust treatment	Copper-based/silicon-based/halogen-based materials (fluorine, chlorine, bromine) are prohibited
P53	Vacuum treatment	Copper-based/silicon-based/halogen-based materials (fluorine, chlorine, bromine) are prohibited

⚠ Precautions for model No. selection

*1: STR2-B-6 and 10 are not compatible with a reed switch.
Ⓓ Switches other than switch model No. are also available.
(custom order)
Refer to page 309 for the details.

*2: The piping port positions for "O" are as shown in the figure below.

Piping port positions for standard (blank)



Piping port position on the 180° opposite side (code: O) piping port

*3: Refer to page 238 for combination of variations/ options.

[Example of model No.]

STR2-B-16-30-K0H-R-OP72

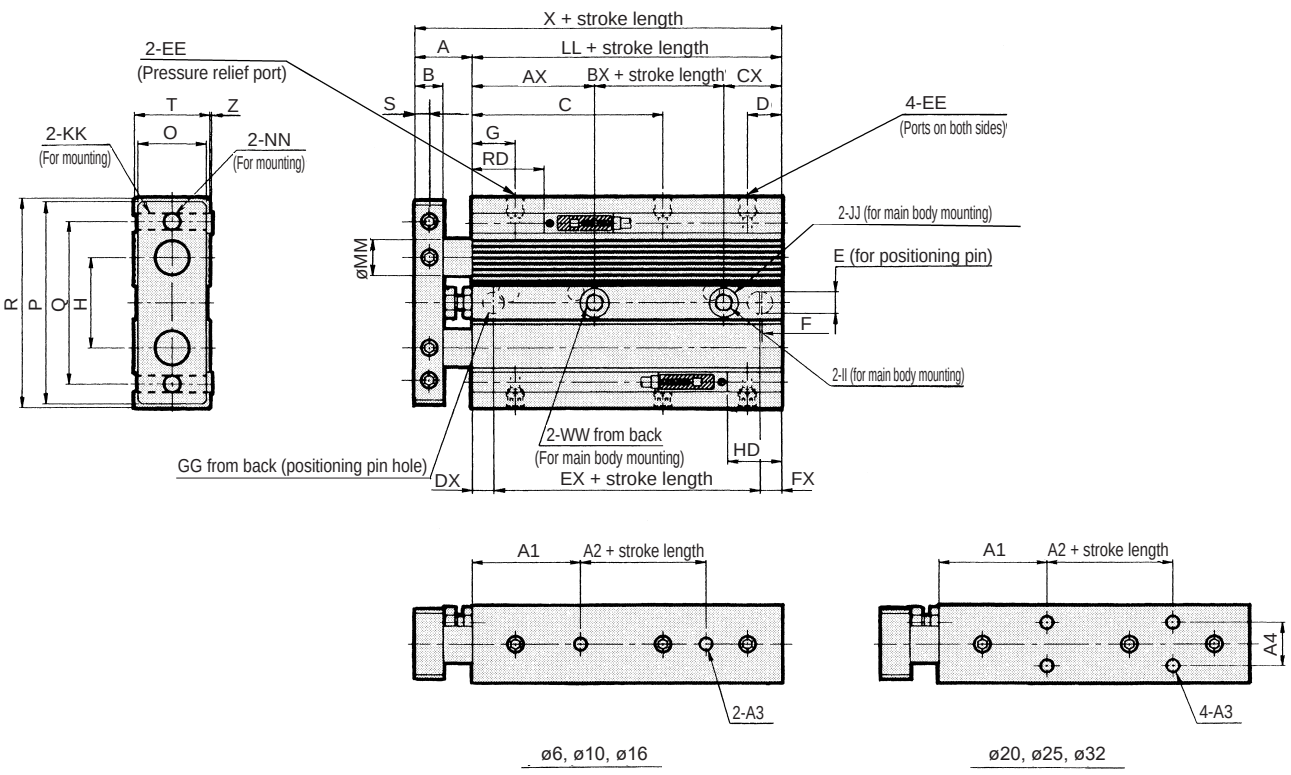
Model: Twin rod cylinder, standard

Ⓐ Bearing : Metal bush bearing
Ⓑ Bore size : ø16 mm
Ⓒ Stroke length : 30 mm
Ⓓ Switch model No. : Reed K0H switch/Lead wire 1 m
Ⓔ Switch quantity : 1 (on rod end)
Ⓕ Option : Piping port position on the 180° opposite side
Ⓖ Clean room specifications : Exhaust treatment

MEMO

Dimensions

● STR2-B-P7*/P5*



ø6, ø10, ø16

ø20, ø25, ø32

*1: When using a custom stroke length, the total length is the same as that of the next longer standard stroke length.
*2: Refer to page 245 for HD, RD and protruding dimensions of the 2-color display switch.

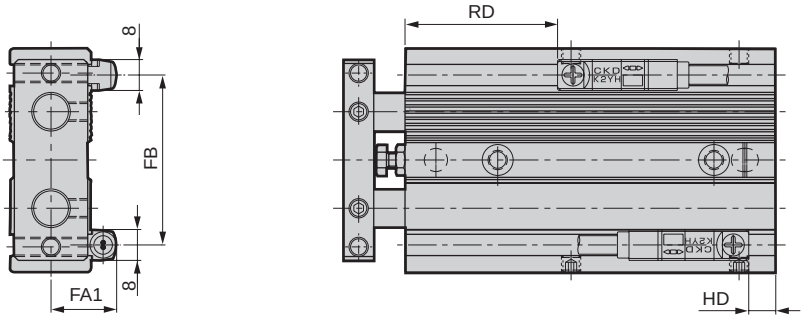
Code / Bore size (mm)	A	B	C	D	E	EE	F	G	GG	H	II	JJ	KK	LL	MM	NN	O
ø6	12	6	34.5	7.5	$4^{+0.07}_{+0.02}$ depth 3	M5	1	11	$4^{+0.07}_{+0.02}$ depth 3	14	ø3.4	6.5 spot face depth 3.3	M3 penetrating	54	4	M3 penetrating	11
ø10	14	6	45	7	$4^{+0.07}_{+0.02}$ depth 4	M5	1	15	$4^{+0.07}_{+0.02}$ depth 4	20	ø4.3	8 spot face depth 4.4	M4 penetrating	65	6	M4 penetrating	13
ø16	16	8	53	9.5	$6^{+0.07}_{+0.02}$ depth 6	M5	1	12	$6^{+0.07}_{+0.02}$ depth 6	25	ø4.3	8 spot face depth 4.4	M5 penetrating	76	10	M5 penetrating	19
ø20	20	10	56	9.5	$6^{+0.07}_{+0.02}$ depth 6	M5	1	12.5	$6^{+0.07}_{+0.02}$ depth 6	28	ø5.2	9.5 spot face depth 5.4	M5 penetrating	85	12	M5 penetrating	24
ø25	22	12	54	10.5	$6^{+0.07}_{+0.02}$ depth 6	M5	1	13.5	$6^{+0.07}_{+0.02}$ depth 6	34	ø6.3	11 spot face depth 6.5	M6 penetrating	85	14	M6 penetrating	30
ø32	22	12	66	11	$6^{+0.07}_{+0.02}$ depth 6	Rc1/8	1	14	$6^{+0.07}_{+0.02}$ depth 6	44	ø6.3	11 spot face depth 6.5	M6 penetrating	101	16	M6 penetrating	36

Code / Bore size (mm)	P	Q	R	S	T	WW	X	AX	BX	CX	DX	EX	FX	Z	A1	A2	A3	A4	K0/K5/K2/K3 HD	K0/K5/K2/K3 RD
ø6	34	29	36	3	13	M4 depth 5	66	30	10	14	7	40	7	0.5	25	10	M3 depth 4	-	3.5	31
ø10	42	36	44	3	15	M5 depth 6	79	34	14	17	8	48	9	0.5	25	20	M3 depth 3.5	-	2.5	43
ø16	56	45	58	4	21	M5 depth 6	92	34	26	16	8	60	8	0	30	25	M4 depth 4	-	7	49.5
ø20	60	50	62	5	27	M6 depth 8	105	34	33	18	9	67	9	0	30	30	M4 depth 4	13	10.5	55
ø25	70	60	72	6	33	M8 depth 8	107	34	33	18	9	67	9	0	30	30	M5 depth 6	18	11.5	53.5
ø32	94	75	96	6	38	M8 depth 8	123	34	47	20	9	83	9	0	30	40	M5 depth 8	24	15.5	65.5

*3: STR2-B6 and 10 are not compatible with K0 and K5 reed switches.
*4: The cylinder may tilt due to uneven surface if it is installed with the spot face side (JJ) contacted. In this case, change the port position or use the option of piping port position on the 180° opposite side (O) to keep the spot face side from being the contacting surface.
*5: HD and RD dimensions for 10 mm stroke length differ from these dimensions according to the setting.

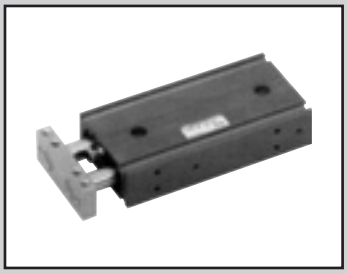
Dimensions with switches (2-color display switch)

2-color display swtich ($K2Y^{H}/_{V}$, $K3Y^{H}/_{V}$)



● 2-color display K□YH/V

Code / Bore size (mm)	FA1	FB	RD	HD
ø6	13.5	24	30	2.5
ø10	14.5	34	42	1
ø16	17	44	48.5	5.5
ø20	20	49	54	9.5
ø25	23	58	52.5	10.5
ø32	25.5	71	64.5	14.5



Twin rod cylinder Double acting/fine speed

STR2-BF Series (Made to order)

● Bore size: ø10/ø16/ø20/ø25/ø32

JIS symbol

RoHS CAD

Structure and material restriction

	Structure	Model No.
P7 Series	Exhaust treatment	P72
	Vacuum treatment	P73

Specifications

Descriptions	STR2-BF-P7*				
Bore size mm	ø10	ø16	ø20	ø25	ø32
Actuation	Double acting				
Working fluid	Compressed air				
Max. working pressure MPa	0.7				
Min. working pressure MPa	0.15**	0.1			
Ambient temperature °C	5 to 60				
Port size	M5				Rc1/8
Port size (relief port)	M5				Rc1/8
Stroke tolerance mm	0 to -5				
Working piston speed mm/s	1 to 200				
Non-rotating accuracy	±0.1°			±0.3°	
Piston rod bearing	Ball bearing				
Cushion	Rubber cushion				
Lubrication	Lubrication not possible				
Allowable energy absorption J	0.061	0.181	0.303	0.68	1.3

* The low speed (STR2-0) is recommended for ø6.

Stroke length

Model No.	Bore size (mm)	Standard stroke (mm)	Max. stroke (mm)	Available stroke (mm)	Min. stroke (mm)	Min. stroke with switch (mm)
STR2-BF	ø10	10, 20, 30, 40, 50	50	Up to 100	5	10
	ø16, ø20, ø25, ø32	10, 20, 30, 40, 50, 60, 70, 80, 90, 100	100	Up to 200		

*1: The custom stroke length is available by 1 mm increments. However, the total dimensions are the same as the longer standard stroke length.

Switch specifications

● 1-color/2-color display

Descriptions	Proximity 2-wire		Proximity 3-wire			Reed 2-wire			
	K2H/K2V	K2YH/K2YV	K3H/K3V	K3PH/K3PV (custom order)	K3YH/K3YV	K0H/K0V		K5H/K5V	
Applications	Programmable controller		Programmable controller, relay			Programmable controller, relay		Programmable controller, relay IC circuit (without indicator lamp), serial connection	
Output method	-		NPN output	PNP output	NPN output	-			
Power supply voltage	-		10 to 28 VDC			-			
Load voltage	10 to 30 VDC		30 VDC or less			12/24 VDC	110 VAC	5/12/24 VDC	110 VAC
Load current	5 to 20 mA (*2)		50 mA or less			5 to 50 mA	7 to 20 mA	50 mA or less	20 mA or less
Indicator lamp	LED (Lit when ON)	Red/green LED (Lit when ON)	LED (Lit when ON)	Yellow LED (Lit when ON)	Red/Green LED (Lit when ON)	LED (Lit when ON)		-	
Leakage current	1 mA or less		10 μA or less			0 mA			
Weight g	1 m: 18 3 m: 49 5 m: 80	1 m: 31 3 m: 85 5 m: 139	1 m: 18 3 m: 49 5 m: 80		1 m: 31 3 m: 85 5 m: 139	1 m: 18 3 m: 49 5 m: 80			

*1: Refer to page 309 for detailed switch specifications and Dimensions.
*2: Max. load current: 20mA at 25°C.The current is lower than 25 mA if the operating ambient temperature around the switch is higher than 20°C. (60 to 5 mA at 10°C)

Theoretical thrust table

(Unit: N)

Bore size (mm)	Operating direction	Working pressure MPa							
		0.1	0.15	0.2	0.3	0.4	0.5	0.6	0.7
ø10	Push	-	23.6	31.4	47.1	62.8	78.5	94.2	1.10×10^2
	Pull	-	15.1	20.1	30.2	40.2	50.3	60.3	70.4
ø16	Push	40.2	60.3	80.4	1.21×10^2	1.61×10^2	2.01×10^2	2.41×10^2	2.81×10^2
	Pull	24.5	36.8	49.0	73.5	98.0	1.23×10^2	1.47×10^2	1.72×10^2
ø20	Push	62.8	94.2	1.26×10^2	1.88×10^2	2.51×10^2	3.14×10^2	3.77×10^2	4.40×10^2
	Pull	40.2	60.3	80.4	1.21×10^2	1.61×10^2	2.01×10^2	2.41×10^2	2.81×10^2
ø25	Push	98.2	1.47×10^2	1.96×10^2	2.95×10^2	3.93×10^2	4.91×10^2	5.89×10^2	6.87×10^2
	Pull	67.4	1.01×10^2	1.35×10^2	2.02×10^2	2.70×10^2	3.37×10^2	4.04×10^2	4.72×10^2
ø32	Push	1.61×10^2	2.41×10^2	3.22×10^2	4.83×10^2	6.43×10^2	8.04×10^2	9.65×10^2	1.13×10^3
	Pull	1.21×10^2	1.81×10^2	2.41×10^2	3.62×10^2	4.83×10^2	6.03×10^2	7.24×10^2	8.44×10^2

Dimensions

It is identical with the double acting clean room specifications. Refer to page 244.

How to order

● Without switch (Magnet for switch incorporated)

STR2 - B F - 16 - 30 ——— O P72

● With switch (Magnet for switch incorporated)

STR2 - B F - 16 - 30 - K0H - R - O P72

Model No. Ⓐ Bearing — Ⓑ Bore size — Ⓒ Stroke length — Ⓓ Switch model No. *1 — Ⓔ Switch quantity — Ⓕ Option *2 — Ⓖ Clean room specifications

■ The custom stroke length is available by 1 mm increments. However, the total length is the same as that of the next longer standard stroke length.

Code	Content
Ⓐ Bearing	
B	Ball bearing
Ⓑ Bore size (mm)	
10	ø10
16	ø16
20	ø20
25	ø25
32	ø32

Ⓒ Stroke (mm)

Bore size	Stroke	Available stroke	Custom stroke
ø10	**5 to 50**	**Up to 100**	**By 1mm increments**
ø16	**5 to 100**	**Up to 100**	
ø20	**5 to 100**	**Up to 200**	
ø25	**5 to 100**	**Up to 200**	
ø32	**5 to 100**	**Up to 200**	

Ⓓ Switch model No.

Lead wire straight	Lead wire L-shaped	Contact	Voltage AC	Voltage DC	Display	Lead wire
K0H*	**K0V***	Reed	●	●	1-color display	2 wires
K5H*	**K5V***	Reed	●	●	No indicator lamp	2 wires
K2H*	**K2V***	Proximity		●	1-color display	2 wires
K3H*	**K3V***	Proximity		●	1-color display	3 wires
K3PH*	**K3PV***	Proximity		●	1-color display (custom order)	3 wires
K2YH*	**K2YV***	Proximity		●	2-color display	2 wires
K3YH*	**K3YV***	Proximity		●	2-color display	3 wires

*** Lead wire length**

Blank	1 m (standard)
3	3 m (option)
5	5 m (option)

Ⓔ Switch quantity

R	1 (on rod end)
H	1 (on head end)
D	2

Ⓕ Option

Blank	None
O	Piping port position on the 180° opposite side

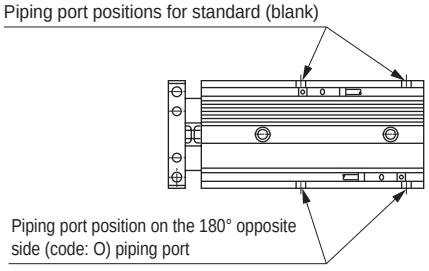
Ⓖ Clean room specifications

	Structure
P72	Exhaust treatment
P73	Vacuum treatment

⚠ Precautions for model No. selection

*1: STR2-BF-10 is not compatible with a reed switch.
*2: The piping port positions for "O" are as shown in the figure below.
*3: Refer to page 238 for combination of variations/options.

Piping port positions for standard (blank)



Piping port position on the 180° opposite side (code: O) piping port

[Example of model No.]

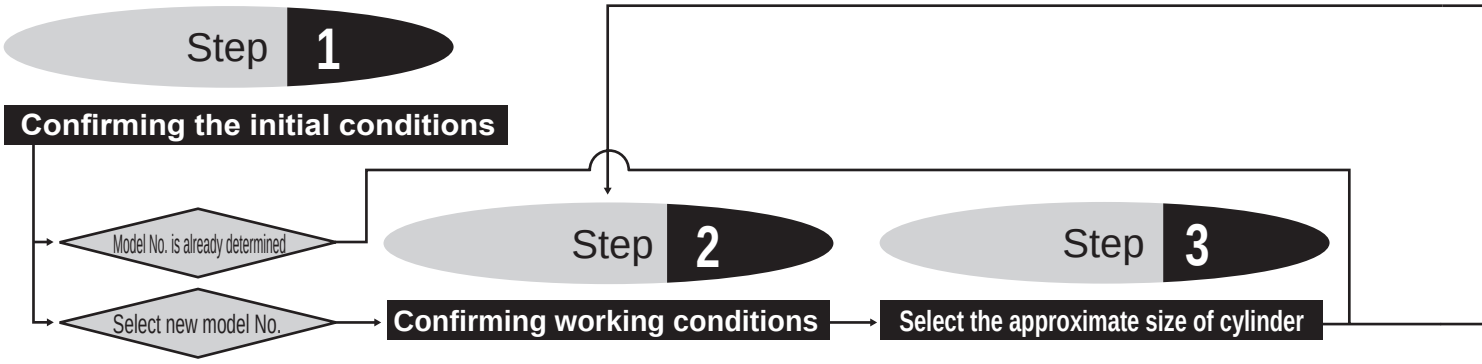
STR2-BF-16-30-K0H-R-OP72

Model: Twin rod cylinder, fine speed

Ⓐ Bearing : Ball bearing
Ⓑ Bore size : ø16 mm
Ⓒ Stroke length : 30 mm
Ⓓ Switch model No. : Reed K0H switch, lead wire 1 m
Ⓔ Switch quantity : 1 (on rod end)
Ⓕ Option : Piping port position on the 180° opposite side
Ⓖ Clean room specifications : Exhaust treatment

MEMO

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)

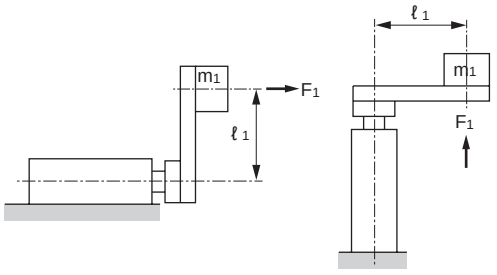
$M_3 = F_3 \times \ell_3$ (N·m)

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.

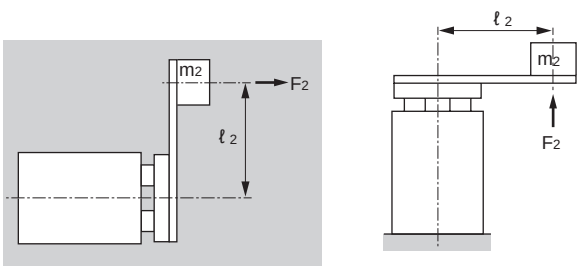
[Bending moment]

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



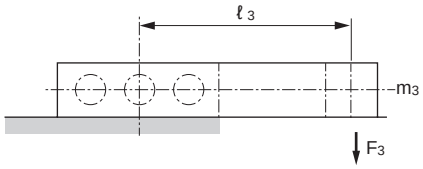
[Radial moment]

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



[Torsion moment]

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

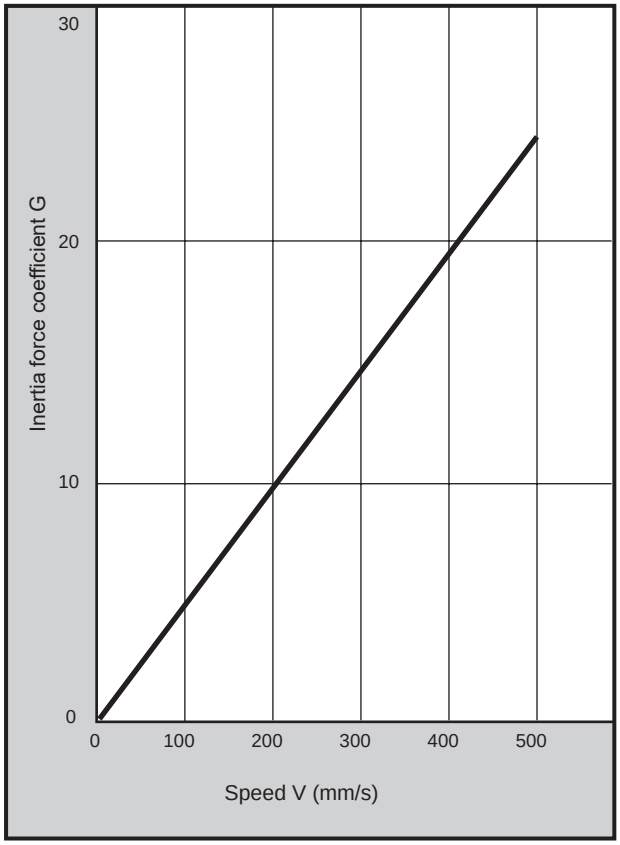


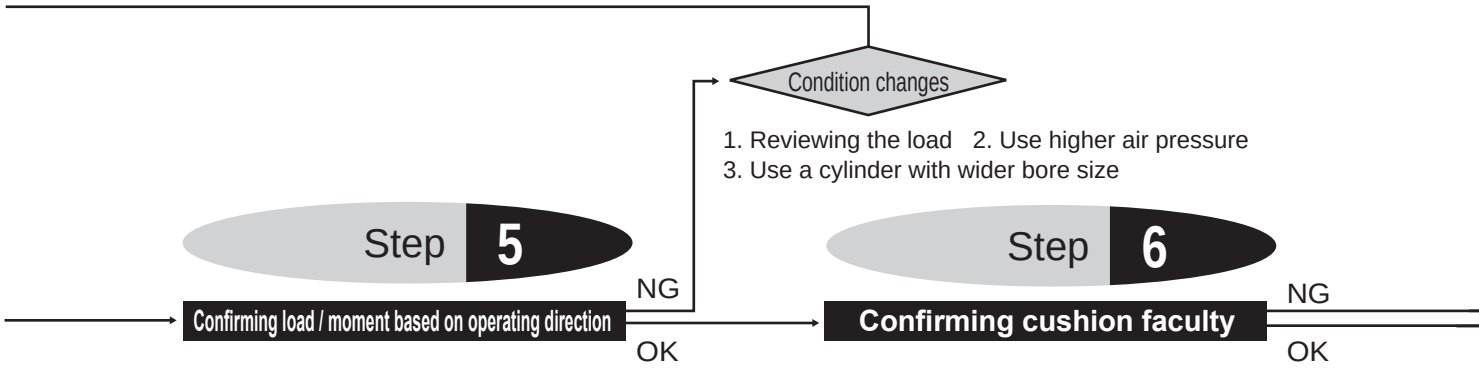
m_1: m_2: m_3: Load weight (kg)

ℓ_1: ℓ_2: ℓ_3: Eccentric distance (m)

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

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

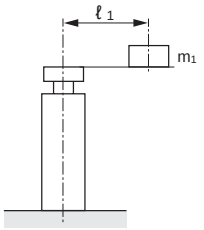
● Determine the load factor by taking into account the status of utilization such as stability margin and service life of the cylinder. For general use, the value within the range in Table 4 is desirable.

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	}	Value obtained in Step 4
Radial moment M_2	}	

$M_1/M_1max + M_2/M_2max \leq 1.0$

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

M_3max 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 (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)

$V = ST/t \times (1 + 1.5 \times \alpha/100)$

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

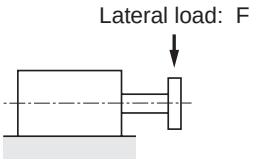
$E_1 < E_2$

(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

Allowable lateral load

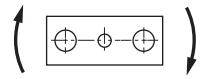


● Ball bearing

(N)

Type	Stroke length (mm)									
	10	20	30	40	50	60	70	80	90	100
STR2-B-6	2.6	1.9	1.5	1.2	1.0	-	-	-	-	-
STR2-B-10	6.0	4.4	3.6	3.0	2.6	-	-	-	-	-
STR2-B-16	11.4	8.5	7.0	5.9	5.1	4.5	4.0	3.7	3.3	3.0
STR2-B-20	12.7	9.6	7.9	6.8	5.9	5.3	4.7	4.3	3.9	3.6
STR2-B-25	14.7	11.1	9.2	7.9	6.9	6.1	5.5	5.0	4.6	4.2
STR2-B-32	24.3	18.5	15.4	13.3	11.7	10.5	9.5	8.7	8.0	7.4

Allowable torque

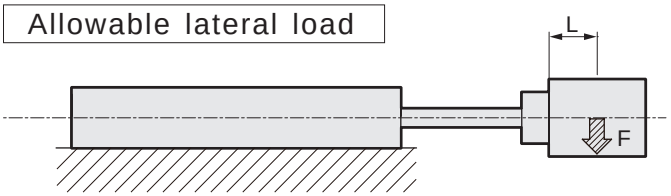


● Ball bearing

(N·m)

Type	Stroke length (mm)									
	10	20	30	40	50	60	70	80	90	100
STR2-B-6	0.009	0.006	0.005	0.004	0.003	-	-	-	-	-
STR2-B-10	0.030	0.022	0.018	0.015	0.013	-	-	-	-	-
STR2-B-16	0.071	0.053	0.043	0.036	0.031	0.028	0.025	0.023	0.020	0.018
STR2-B-20	0.088	0.067	0.055	0.047	0.041	0.037	0.032	0.030	0.027	0.025
STR2-B-25	0.125	0.094	0.078	0.067	0.058	0.051	0.046	0.042	0.039	0.035
STR2-B-32	0.267	0.203	0.169	0.146	0.128	0.115	0.104	0.095	0.088	0.081

Allowable lateral load

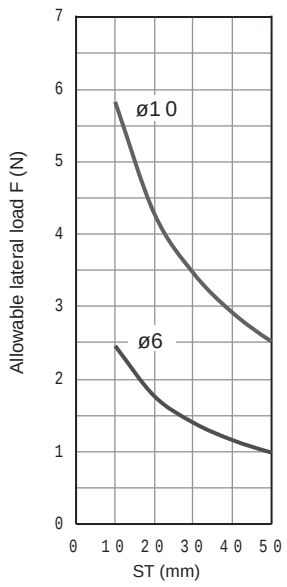


F: Lateral load (N)
L: Position of center of gravity of load (mm)

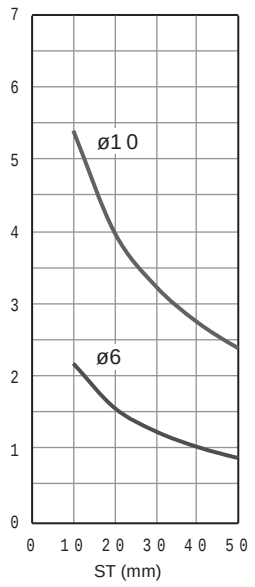
Basic Ball bearing

STR2-B-6/10-P7*

●In the case of L=5

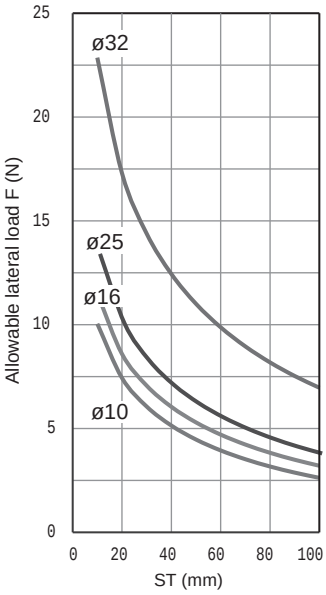


●In the case of L=15

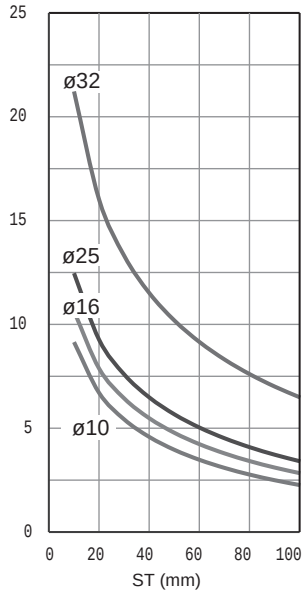


STR2-B-16/20/25/32-P7*

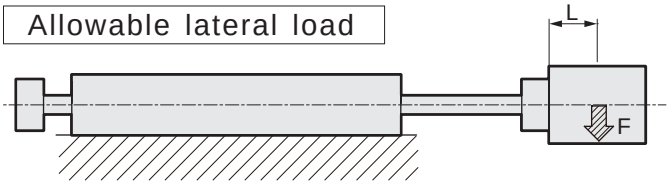
●In the case of L=15



●In the case of L=30



Allowable lateral load

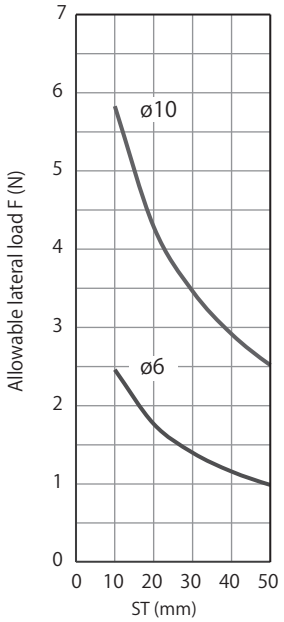


F: Lateral load (N)
L: Position of center of gravity of load (mm)

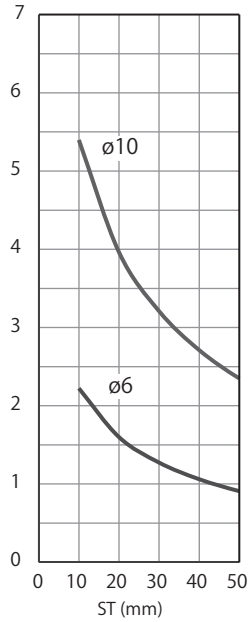
Double rod Ball bearing

STR2-B-6/10-P7*

●In the case of L=5

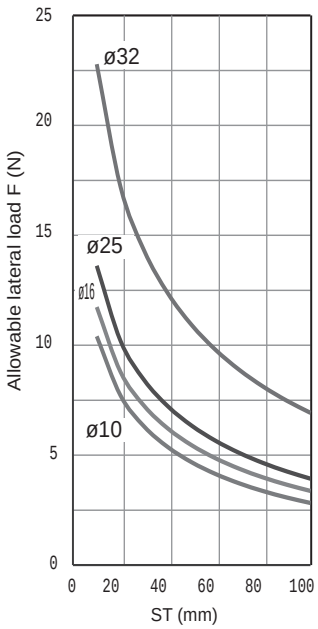


●In the case of L=15

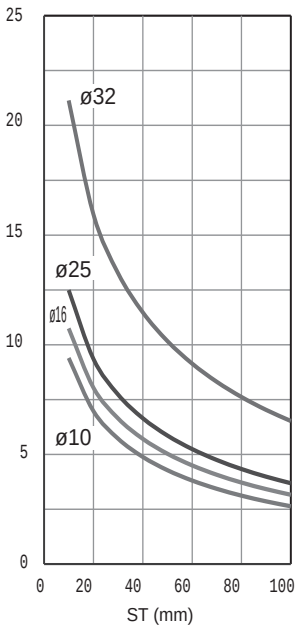


STR2-B-16/20/25/32-P7*

●In the case of L=15



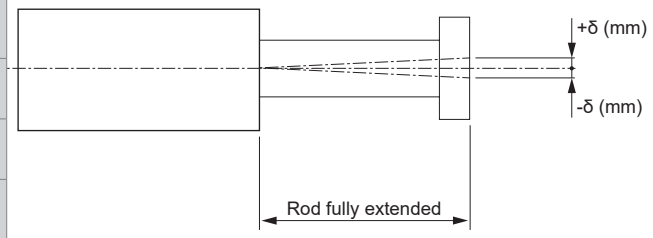
●In the case of L=30



Deflection

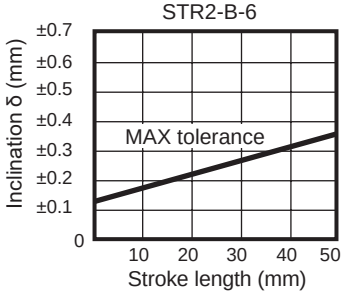
(Reference value)

For the inclination that is produced at the end of the end plate when no load is applied, the value in the graph below is used as a guide. (excluding the deflection of the piston rod)

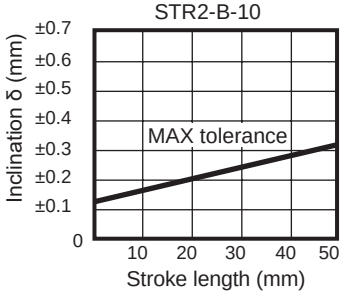


■ STR2-B

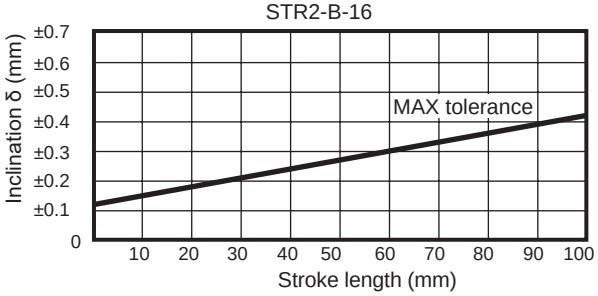
STR2-B-6



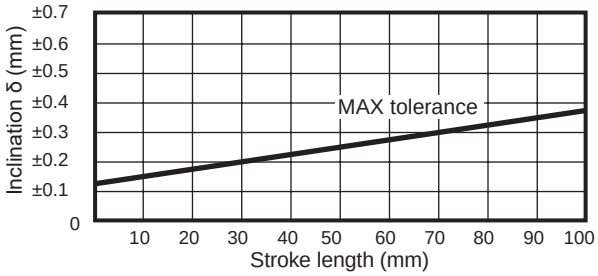
STR2-B-10



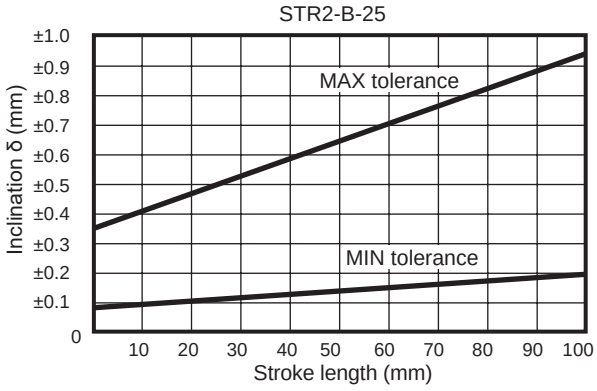
STR2-B-16



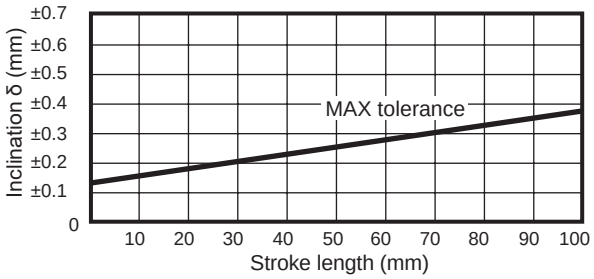
STR2-B-20



STR2-B-25



STR2-B-32



Pneumatic components

Safety Precautions

Always read this section before use.
Refer to page 2 for general information of the cylinder, and to page 320 for general information of the cylinder switch.

Twin rod cylinder STR2 Series

Design & selection

1. Fine speed STR2-F

⚠CAUTION

■ Use the product with no lubrication.
Application of lubrication may cause changes in characteristics.

■ Assemble the speed controller near the cylinder.
When installed far from the cylinder, the speed becomes unstable.
Use SC-M3/M5, SC3W, SCD-M3/M5 and SC3WU Series for the speed controller.

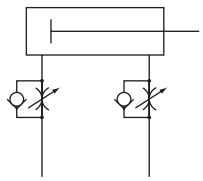
■ In general, the speed is stabler at higher air pressure and lower load factor.
Use at a 50% or less load factor.

■ Do not apply a lateral load to the cylinder .
Also install the sliding guide so that it is not twisted.
With a large difference between static friction and kinematic friction of the guide, operation becomes unstable.

■ Avoid using this product where vibration is present.
The product will be adversely affected by vibration and operation will be unstable.

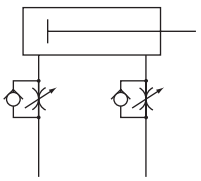
■ Stable speed control is achieved with a meter-out circuit.
When fine speed activation is performed with operating direction PUSH for the single rod cylinder, the popping out phenomenon occurs when operation starts if the load resistance is low. For the countermeasures, choose the circuit of ⓑ, ⓒ, or ⓓ.
Note that the circuit ⓓ is the most stable.

ⓐ



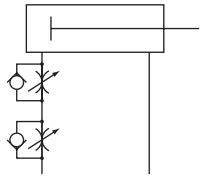
PUSH: Meter-out
PULL : Meter-out

ⓑ



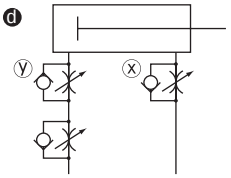
PUSH: Meter-in
PULL : Meter-in

ⓒ



PUSH: Meter-in
PULL : Meter-out

ⓓ

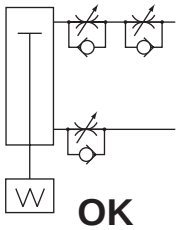


PUSH: Meter in-out
PULL : Meter-out

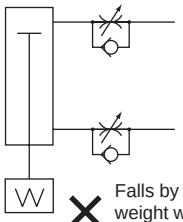
Speed adjustment method for PUSH operation of circuit ⓓ:
1. Set the speed with the speed controller x.
2. Restrict the speed with the speed controller y until there is no popping out.
3. Check the speed again.

(Note 1) When comparing ⓑ ⓒ ⓓ, the circuit ⓓ is most stable.

(Note 2) When installed vertically, the unit falls by its own weight in the meter-in circuit. Combine the cylinder with the meter-out circuit.

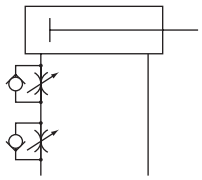


OK

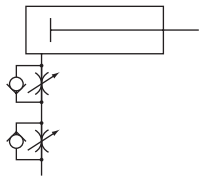


✕ Falls by its own weight when going down

(Note 3) Use the circuit as shown in the figure below for the serial connection of the speed control valves.



OK



✕ Speed control is unstable

(Guidelines for pop-out generation)
When the following condition is met, popping out could occur.
• Thrust > Resistance

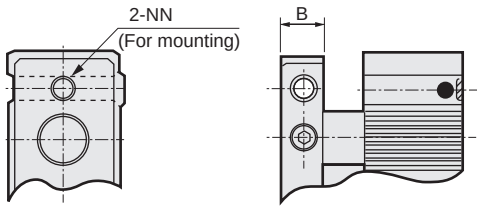
* Resistance: a force produced by a residual pressure on the outlet side (for fine speed, Inlet pressure = Residual pressure) + { For vertical use: friction caused by the load / For horizontal use: self-weight of the load }

Installation & adjustment

1. Common

⚠ CAUTION

- The twin rod cylinder has two piping ports each on both sides in the operating direction. Change the plugged ports according to your application. After the change, confirm that there is no air leakage from the plugged ports.
- Do not damage surface flatness by denting or scratching the body (tube) mounting surface or the end plate surface. Make sure that the flatness of the mating surface where the end plate will be attached is 0.05 mm or below.
- When using a screw hole NN of the end plate, make sure that the bolt length is equivalent to the B dimension. Not doing so could cause malfunction or damage of the end plate.



Bore size (mm)	B dimension
ø6	6
ø10	6
ø16	8
ø20	10
ø25	12
ø32	12

- Rubber cushion is integrated as a cushion mechanism. The table below shows kinetic energy can be absorbed by the rubber cushion. If the energy exceeds these values, consider using a separate shock absorber.

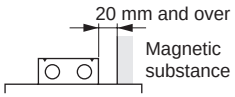
Bore size (mm)	Allowable energy absorption J	
	PUSH	PULL
ø6	0.008	0.059
ø10	0.061	0.083
ø16	0.181	0.083
ø20	0.303	0.127
ø25	0.68	0.237
ø32	1.3	0.311

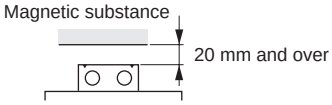
- The cylinder may tilt due to uneven surface if it is installed with the spot face side (JJ) contacted. In this case, change the port position or use the option of piping port position on the 180° opposite side (o) to keep the spot face side from being the contacting surface.
- The cylinder body may be damaged or may malfunction if a unit with excessive inertia, etc., is actuated. Use within the allowable absorbed energy range.
- The twin rod cylinder has a bolt for 0 to -5 mm stroke length adjustment on the piston rod retraction side. Loosen the hexagon nut, adjust to the desired stroke length and tighten the hexagon nut to fix the length.
- Do not use the product with the stroke length adjusting bolt removed.

1. Common; with switch

⚠ CAUTION

- STR2-B-6 and 10 are not compatible with a reed switch. When using a proximity switch for STR2-B-6, avoid mounting the cylinder on a magnetic substance such as a metal plate. Failure to do so could lead to switch detection malfunction.
- The cylinder switch could malfunction if there is a magnetic substance such as a metal plate installed adjacently. Check that the distance of 20 mm is provided from the surface of the cylinders. (Same clearance for all bore sizes)



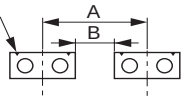
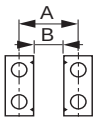
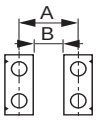
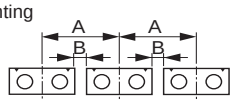
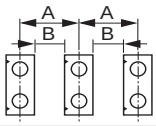


2. Fine speed STR2-F

⚠ CAUTION

- Perform adjustment such as centering so that a lateral load is not applied to the cylinder. Adjust and install the sliding guide so that it is not twisted.
  - When the load or the resistance fluctuates, operation becomes unstable.
  - If the differen ce be tw een static friction and kinetic friction of the guide is large, operation becomes unstable.

■ The cylinder switch could malfunction if cylinders are installed adjacently. Check that the following distances are provided between cylinders.

Adjacent conditions			Switch	ø6	ø10	ø16	ø20	ø25	ø32
Two cylinders in parallel	Horizontal mounting Switch 	A	K2,K3	43	45	56	66	75	111
			K0,K5	-	-	62	81	85	111
		B	K2,K3	7	1	2	4	3	15
			K0,K5	-	-	8	19	12	15
	Vertical mounting Switches are attached on the side of the adjacent cylinders 	A	K2,K3	28	27	36	47	47	58
			K0,K5	-	-	36	53	53	58
		B	K2,K3	15	12	15	20	14	20
			K0,K5	-	-	15	26	20	20
	Vertical mounting Switches are attached on the opposite side to the adjacent cylinders 	A	K2,K3	19	16	22	28	34	39
			K0,K5	-	-	22	33	34	39
		B	K2,K3	6	1	1	1	1	1
			K0,K5	-	-	1	6	1	1
More than two cylinders in parallel	Horizontal mounting 	A	K2,K3	44	45	57	67	77	111
			K0,K5	-	-	64	83	86	111
		B	K2,K3	8	1	3	5	5	15
			K0,K5	-	-	10	21	14	15
	Vertical mounting 	A	K2,K3	33	30	40	51	49	58
			K0,K5	-	-	42	60	97	58
		B	K2,K3	20	15	19	24	16	20
			K0,K5	-	-	21	33	25	20

*1: STR2-B-6 and 10 are not compatible with a reed switch.