

Vane Type Rotary Actuator  
**Series CRB2/CRBU2/CRB1**



# Vane Type

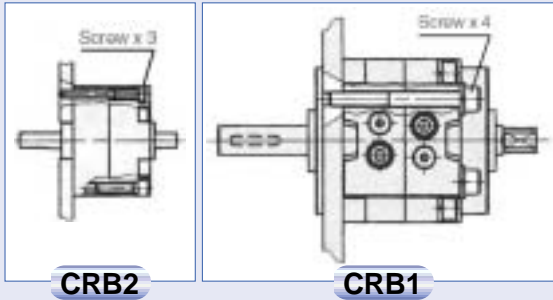
## Rotation: 90°, 180°, 270°

### All series can rotate up to 270°.

The use of specially designed seals and stoppers now enables our compact vane type rotary actuators to rotate up to 270° (single vane type).

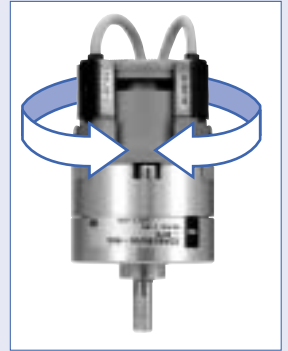
## Direct mounting

The body of rotary actuator can be mounted directly.  
\* Direct mounting is possible for size 10 to 30 rotary actuators with angle adjuster only.



## Unrestricted auto switch mounting position

Since the switches can be moved anywhere along the circumference of rotary actuator, they can be mounted at the optimum position according to the rotary actuator's specifications.



## Direct mounting from 3 different directions is possible (CRBU2).

Series CRBU2 can be mounted in 3 directions: axial, top-ported, and side-ported. In the axial direction, there are 3 mounting variations.

## Excellent reliability and durability

The use of bearings in all series (CRB2/CRBU2/CRB1) to support thrust and radial loads, along with the implementation of an internal rubber bumper (except for size 10), improves reliability and durability.

## Two different connecting port positions (side and axial) are available.

The port position can be selected according to the application. (Only side ports are available for actuators with angle adjuster.)

## Low pressure operation

Special seal construction allows for a broader operating pressure range and makes operation in low pressure applications possible.

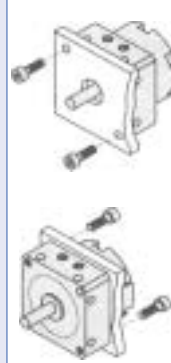
### Minimum operating pressure

Size 10: 0.2MPa

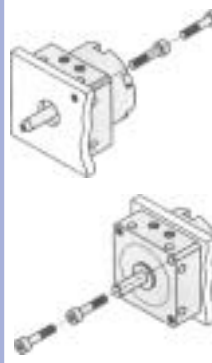
Sizes 15 to 100: 0.15MPa

### Axial mounting

#### Body taps

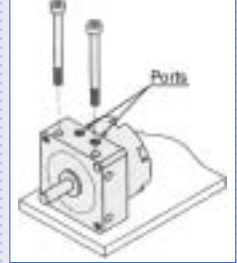


#### Body through holes



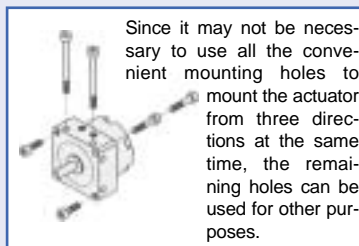
### Top-ported mounting

#### Body through holes

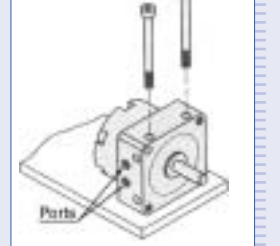


### Side-ported mounting

#### Body through holes



Since it may not be necessary to use all the convenient mounting holes to mount the actuator from three directions at the same time, the remaining holes can be used for other purposes.



## Block (Unit) type construction

Auto switch units and angle adjusters do not protrude beyond the outside diameter of the actuator body, and can be easily retrofitted to any actuator in the series.

### Basic type + Switch unit



# Rotary Actuator

**CRB2**  
 Sizes: 10, 15, 20, 30, 40



Free-mounting type

**CRBU2**  
 Sizes: 10, 15, 20, 30, 40



**CRB1**  
 Sizes: 50, 63, 80, 100

## Double vane construction is now a standard feature for 90° and 100° rotation type actuators.

Although the outside dimensions of the double vane construction actuators are equivalent to those of the single vane construction type (except for size 10), the double vane construction achieves twice the torque of the single vane type.

Model		Rotations					
		90°	100°	180°	190°	270°	280°
CRB2	Single vane	•		•		•	
	Double vane	•	•	•		•	
CRBU2	Single vane	•		•		•	
	Double vane	•	•	•		•	
CRB1	Single vane	•	•	•	•	•	•
	Double vane	•	•	•		•	

Basic type + Angle adjuster



Basic type + Angle adjuster + Switch unit



CRB2

Free-Mounting Type  
 CRBU2

CRB1

# Rotary Actuator: Vane Type

# Series *CRB1*

Sizes: 50, 63, 80, 100

		Fluid	Air																
		Size	50				63				80				100				
		Vane type	S		D		S		D		S		D		S		D		
		Port position	Side ports	Axial ports	Side ports	Axial ports	Side ports	Axial ports	Side ports	Axial ports	Side ports	Axial ports	Side ports	Axial ports	Side ports	Axial ports	Side ports	Axial ports	
Standard	Rotation	90°	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
		180°	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
		270°	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
		Optional	100°	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
			190°	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
			280°	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Shaft type	Double shaft	W	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
	Cushion	Rubber bumper	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
	Variations	Basic type	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
		With auto switch	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
Built-in One-touch fitting		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		
Clean room specifications		10-	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		
Copper-free		20-	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		
Option	Mounting type	With foot bracket	L	●	●	●	●	●	●	●	●	●	●	●	●	●	●		
Made to Order	Material	Stainless steel specifications for main parts	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
		Shaft type	Double shaft	Double shaft (Long shaft without keyway & four chamfers)	J	●	●	●	●	●	●	●	●	●	●	●	●	●	
	Double shaft with four chamfers	Z		●	●	●	●	●	●	●	●	●	●	●	●	●	●		
	Double shaft key	Y		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
	Double round shaft	K		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
	Single shaft	Single shaft key	S	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
		Single round shaft	T	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
		Single shaft with four chamfers	X	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
	Pattern	Shaft pattern	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
		Rotation pattern	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
	With solenoid valve	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		

CRB2

Free-Mounting Type  
CRBU2

CRB1

# Поворотный привод

## CRB1BW

Типоразмер: 50, 63, 80, 100

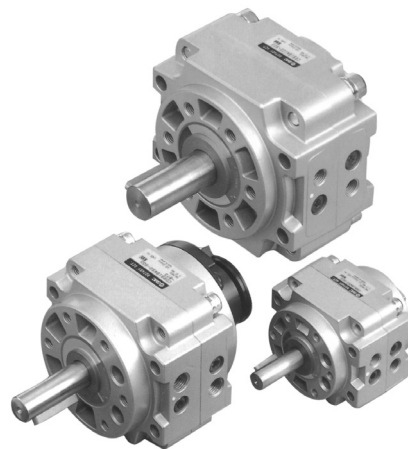
Поворотный привод двустороннего действия

- Компактная конструкция
- Возможность установки датчиков положения
- Модификации с удвоенным крутящим моментом

### Технические характеристики

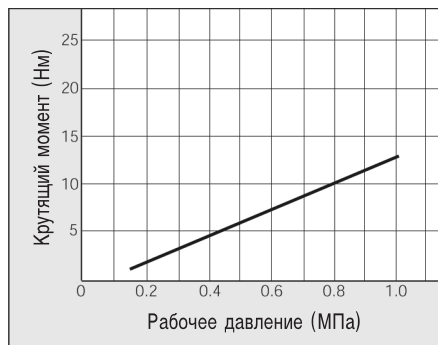
Типоразмер	CRB1BW50	CRB1BW63	CRB1BW80	CRB1BW100	
Присоединительная резьба	G1/8	G1/8	G1/4	G1/4	
Среда	Сжатый воздух, с содержанием или без содержания масла				
Диапазон рабочих давлений (МПа)	0.15 ~ 1.0				
Диапазон рабочих температур (°C)	5 ~ 60				
Допустимое время поворота (с/90°)*	0.1 ~ 1.0				
Монтажное положение	произвольное				
Макс. кинетическая энергия (Дж)	0.082	0.12	0.398	0.6	
Внутренний объем (см³)	66	118	188	376	
Вес (кг)	270°	0.77	1.29	1.95	3.76

\* Время поворота зависит от момента инерции

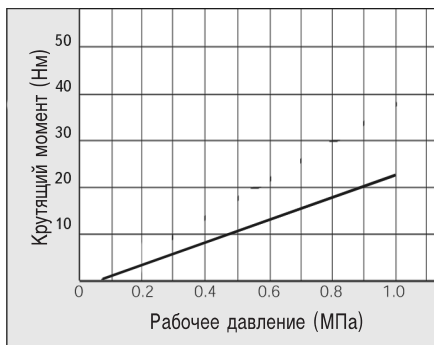


### Крутящий момент

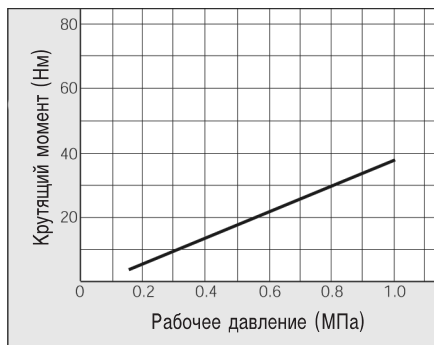
#### CRB1BW50



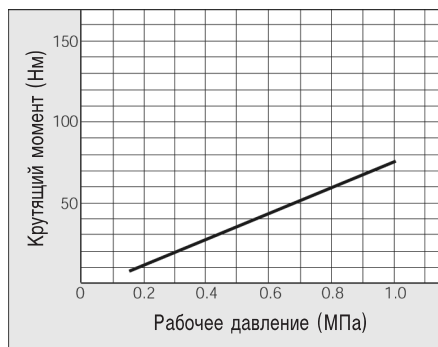
#### CRB1BW63



#### CRB1BW80



#### CRB1BW100



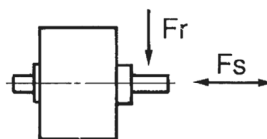
### Допуски по углу поворота

Давление на входе "А" вызывает поворот по часовой стрелке



## Нагрузка на вал в Н (статическая нагрузка)

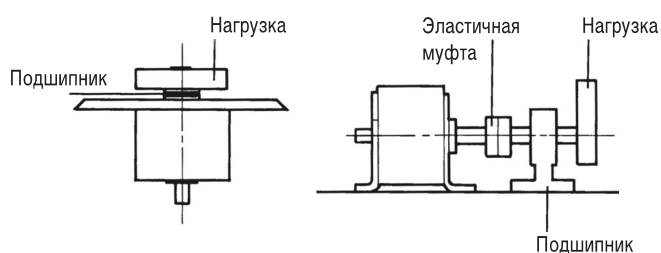
Типоразмер	Fr	Fs
50	245	196
63	390	340
80	490	490
100	588	539



Вышеприведенная таблица относится к статической нагрузке.

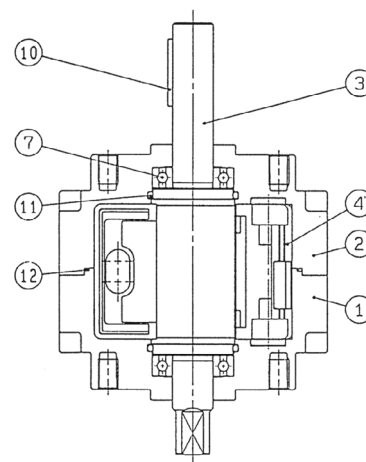
При динамической нагрузке грузы не должны устанавливаться непосредственно на поворотном валу. При этом могут использоваться следующие конструктивные варианты

## Конструктивные предложения при динамической нагрузке на вал



## Конструкция

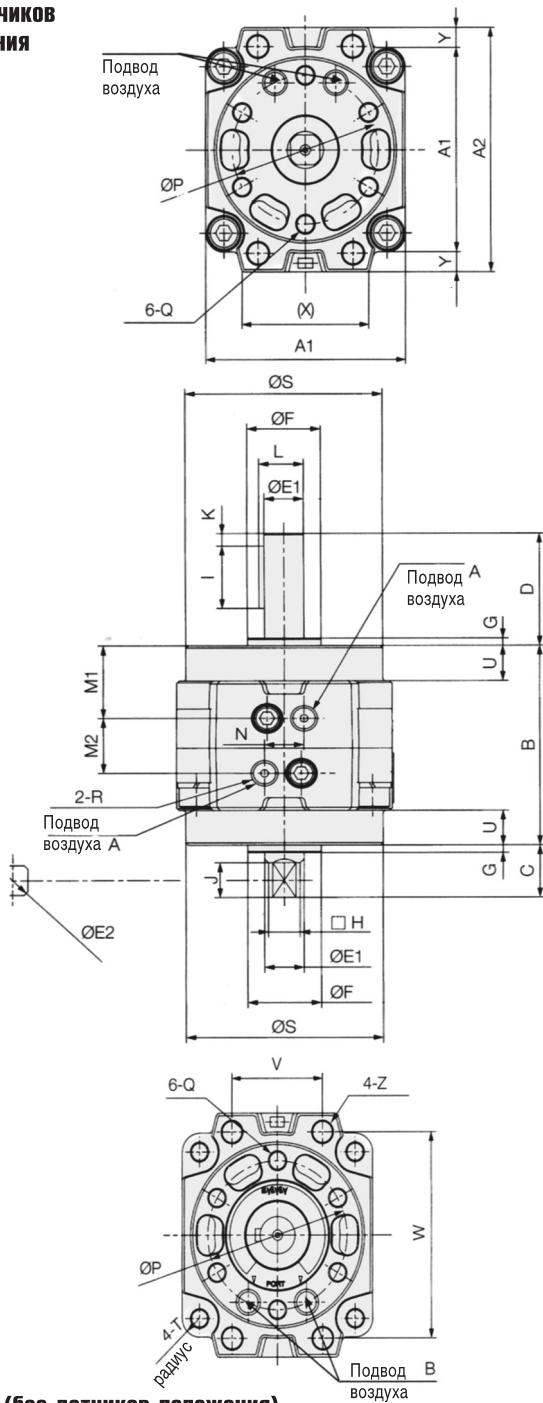
Поз.	Обозначение	Материал
1	Корпус А	Алюминиевое литье под давлением
2	Корпус В	Алюминиевое литье под давлением
3	Вал	Сталь
4	Упор	-
7	Шарикоподшипник	-
10	Шпонка	Сталь
11	Кольцевое уплотнение	NBR
12	Кольцевое уплотнение	NBR



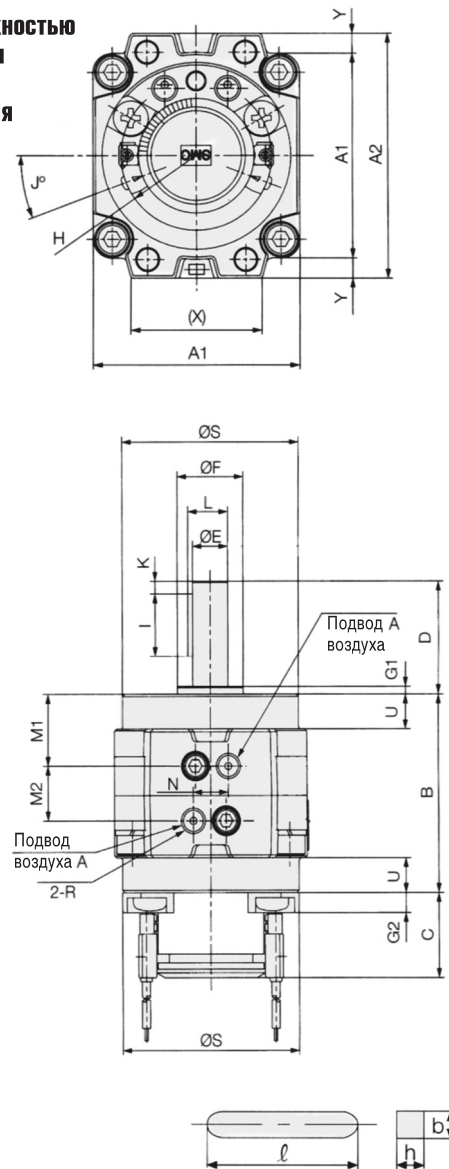
# Поворотный привод CRB1BW

## Размеры

Без датчиков  
положения



С возможностью  
установки  
датчиков  
положения



Шпонка	b (h9)	h (h9)	l
Ø50	4	4	20
Ø63	5	5	25
Ø80	5	5	36
Ø100	7	7	40

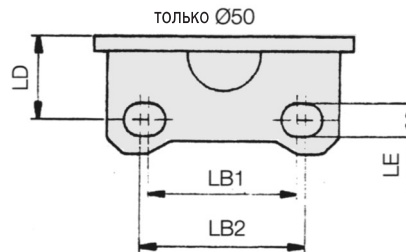
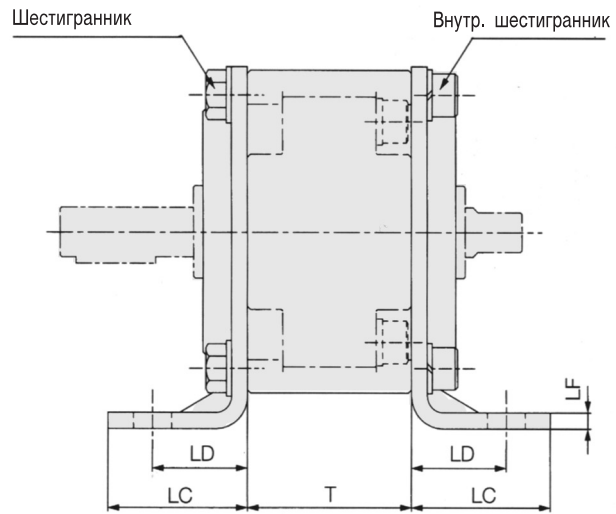
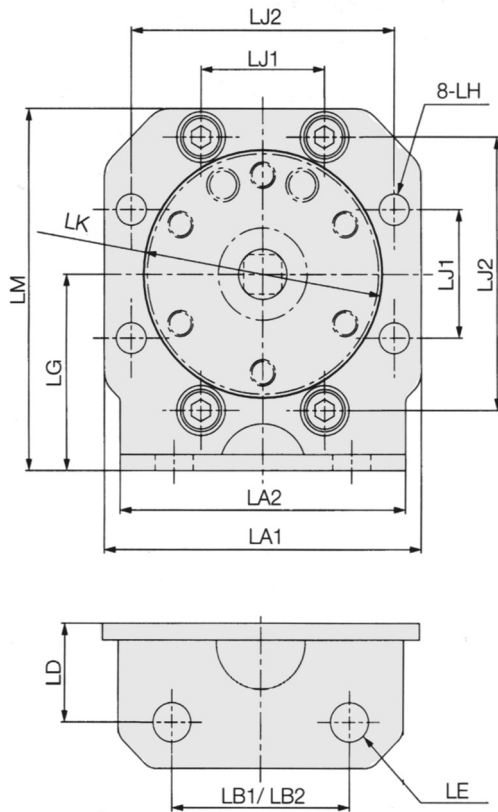
### CRB1BW (без датчиков положения)

Типоразмер	A1	A2	B	C	D	E1 (g9)	E2 (h9)	F (h9)	G	H	J	K	L	M1	M2	N	P	Q	R	S	T	U	V	W	X	Y	Z
50	67	78	70	19.5	39.5	12	11.9	25	3	10	13	5	13.5	26	18	14	50	M6	1/8	60	6	11	34	66	45	5.5	6.5
63	82	98	80	21	45	15	14.9	28	3	12	14	5	17	29	22	15	60	M8	1/8	75	7.5	14	39	83	52	8	9
80	95	110	90	23.5	53.5	17	16.9	30	3	13	16	5	19	30	30	20	70	M8	1/4	88	8	15	48	94	63	7.5	9
100	125	140	103	30	65	25	24.9	45	4	19	22	5	28	35.5	32	24	80	M10	1/4	108	11	11.5	60	120	78	7.5	11

### CRB1BW (с возможностью установки датчиков положения)

Типоразмер	A1	A2	B	C	D	E (g9)	F (h9)	G1	G2	H	J	K	L	M1	M2	N	P	Q	R	S	T	U	V	W	X	Y	Z
50	67	78	70	32	39.5	12	25	3	6.5	22.5	32.5	5	13.5	26	18	14	50	M6	1/8	60	6	11	34	66	45	5.5	6.5
63	82	98	80	34	45	15	28	3	8	30	21	5	17	29	22	15	60	M8	1/8	75	7.5	14	39	83	52	8	9
80	95	110	90	34	53.5	17	30	3	8	30	21	5	19	30	30	20	70	M8	1/4	88	8	15	48	94	63	7.5	9
100	125	140	103	39	65	25	45	4	13	30	21	5	28	35.5	32	24	80	M10	1/4	108	11	11.5	60	120	78	7.5	11

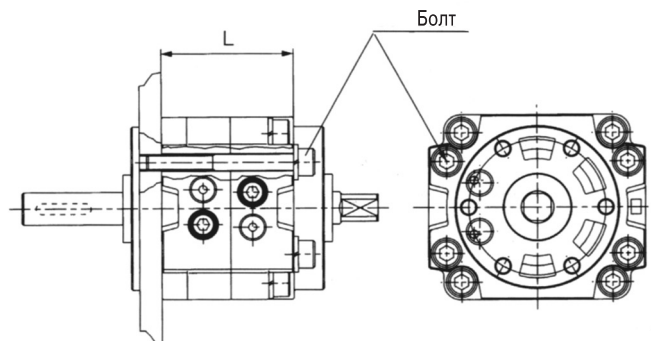
## Размеры - крепление на лапах



Типоразмер	LA1	LA2	LB1	LB2	LC	LD	LE	LF	LG	ØLH	LJ1	LJ2	ØLK	LM	T
50	78	70	45	50	36	25.5	10	4.5	45	7.5	34	66	60.5	84	48
63	100	90		56	44	30	Ø12	5	60	9.5	39	83	75.5	110	52
80	111	100		63	46	32	Ø12	6	65	9.5	48	94	88.5	120.5	60
100	141	126		80	55	39.5	Ø14	6	80	11.5	60	120	108.5	150.5	80

## Непосредственный монтаж

Типоразмер	L	Болт
50	48	M6
63	52	M8
80	60	M8
100	80	M10





# Поворотный привод CRB1BW

## Номер для заказа

### Без датчиков положения

Типоразмер	Угол поворота 90°	Угол поворота 180°	Угол поворота 270°
50	CRB1BW50-90S-XF	CRB1BW50-180S-XF	CRB1BW50-270S-XF
63	CRB1BW63-90S-XF	CRB1BW63-180S-XF	CRB1BW63-270S-XF
80	CRB1BW80-90S-XF	CRB1BW80-180S-XF	CRB1BW80-270S-XF
100	CRB1BW100-90S-XF	CRB1BW100-180S-XF	CRB1BW100-270S-XF

### С возможностью установки датчиков положения

Типоразмер	Угол поворота 90°	Угол поворота 180°	Угол поворота 270°
50	CDRB1BW50-90S-XF	CDRB1BW50-180S-XF	CDRB1BW50-270S-XF
63	CDRB1BW63-90S-XF	CDRB1BW63-180S-XF	CDRB1BW63-270S-XF
80	CDRB1BW80-90S-XF	CDRB1BW80-180S-XF	CDRB1BW80-270S-XF
100	CDRB1BW100-90S-XF	CDRB1BW100-180S-XF	CDRB1BW100-270S-XF

### Принадлежности (заказываются отдельно)

Типоразмер	CRB1BW50	CRB1BW63	CRB1BW80	CRB1BW100
Крепление типа лапа (2 шт.)	P411020-5	P411030-5	P411040-5	P411050-5
Ремкомплект (полный)	KT-CRB1BW50S	KT-CRB1BW63S	KT-CRB1BW80S	KT-CRB1BW100S
Ремкомплект (только уплотнения)	CRB1BW50S-PS	CRB1BW63S-PS	CRB1BW80S-PS	CRB1BW100S-PS
Датчики положения	D-R731L и D-R732L (с индикацией) либо D-R801L и D-R802L (без индикации)			
Крепежный элемент для датчиков положения *	P411020-1	P411030-1	P411040-1	P411050-1

\* для установки двух датчиков

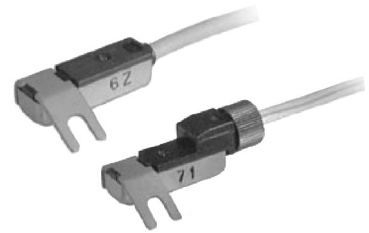
### Герконовые датчики положения

#### Техническая информация\*

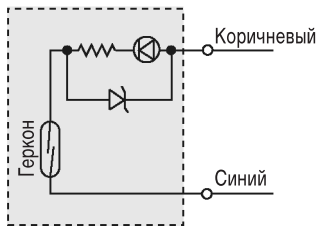
D-R731L, D-R732L, D-97L (с индикатором рабочего состояния); D-R801L, D-R802L, D-90L (без индикатора рабочего состояния) + длина кабеля 3м						
Номер для заказа	D-R731L, D-R732L D-97L		D-90L	D-R801L, D-R802L		
Область применения	Реле, ПЛК					
Рабочее напряжение	24V DC	110V AC	24V DC	5, 12, 24V AC/DC	48V AC/DC	110V AC/DC
Макс. ток (мА)	5 ~ 40	5 ~ 18	5 ~ 40	50	40	23
Схема защиты контактов	-					
Подключение	Кабель 3м					
Внутреннее падение напряжения (В)	<2,4					
Индикация рабочего состояния	Вкл.: красный светодиод		Без индикации			

\* при необходимости можно заказать электронные датчики положения

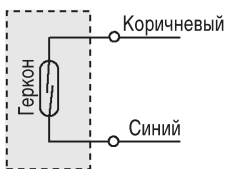
- Ток утечки - отсутствует
- Время срабатывания - макс. 1.2 мс
- Кабель - маслостойкий винил, наружн.  $\varnothing 2.7$  мм, 0.2 мм<sup>2</sup>, 2 жилы (синяя - коричневая)
- Устойчивость к ударным нагрузкам - 30G
- Сопротивление изоляции - не менее 50 МОм при измерении с напряжением 500V DC
- Испытательное напряжение - 1500V AC (в течение 1 мин.)
- Температура окружающей среды - -10 ~ 60 °C
- Степень защиты - IP67, водонепроницаемость по JISC0920, маслостойкость



#### D-R801L, D-R802L, D-90L

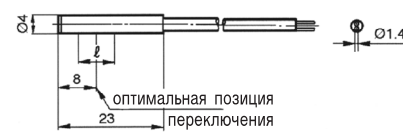


#### D-R731L, D-R732L, D-97L

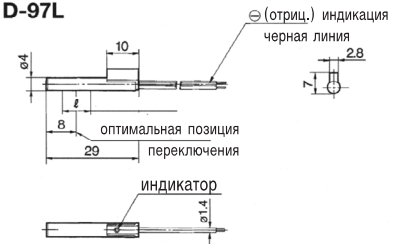


#### D-90L

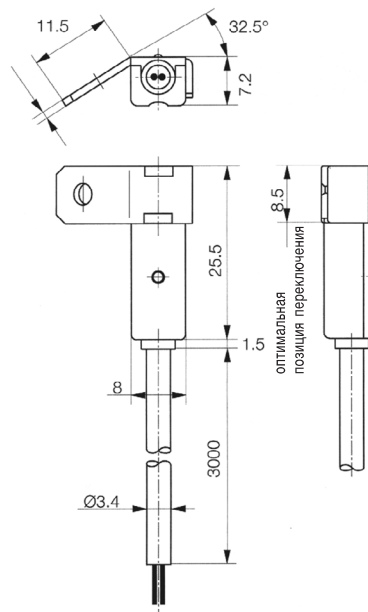
(только для типоразмеров 10, 20, 30)



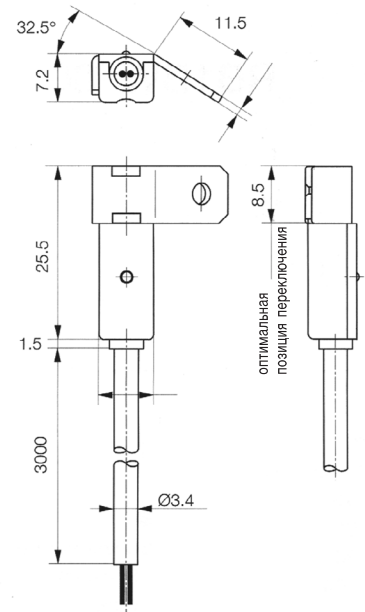
#### D-97L



#### D-R731L/D-R801L (монтаж слева)



#### D-R732L/D-R802L (монтаж справа)



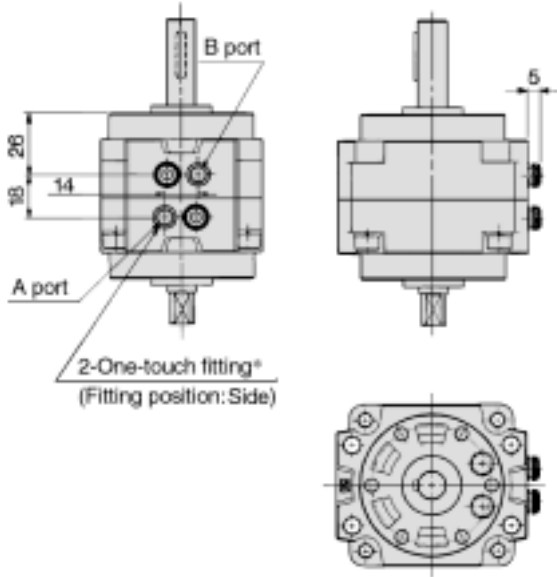
# Series CRB1

## Rotary Actuator with Built-in One-Touch Fitting: 50

### Basic type

CRB1□W50F-□□

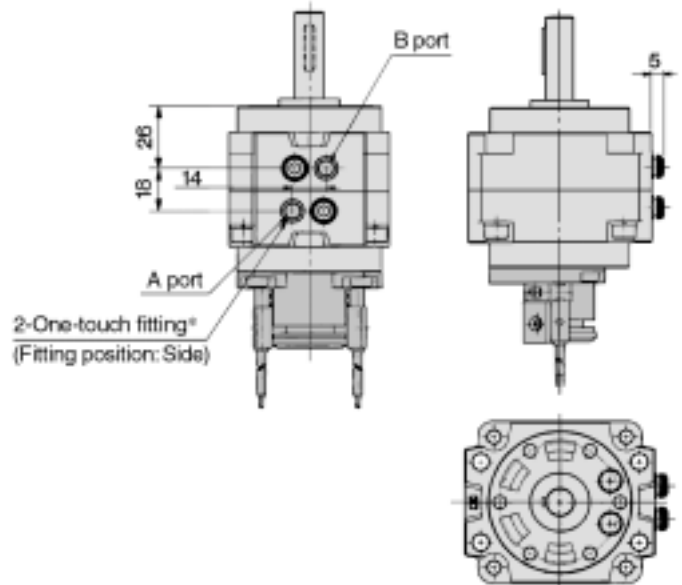
<Port position: Side ports>



### With auto switch

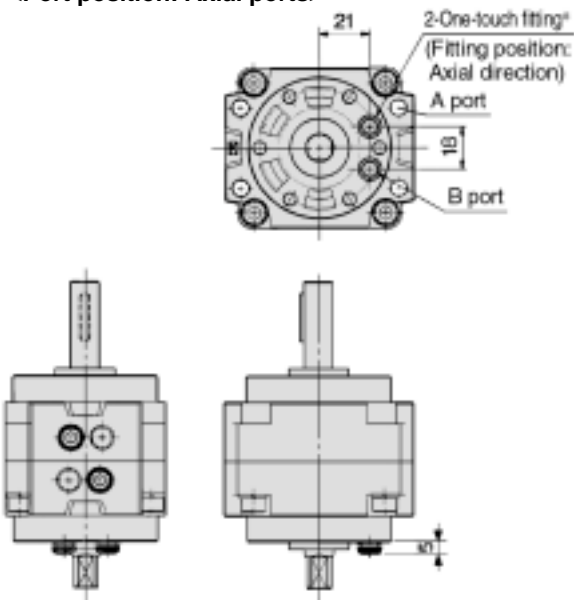
CDRB1□W50F-□□-□

<Port position: Side ports>



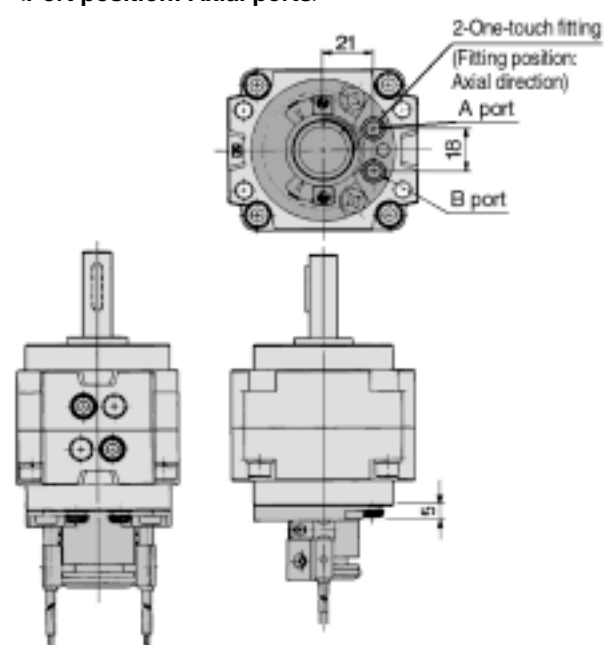
CRB1□W50F-□□E

<Port position: Axial ports>



CDRB1□W50F-□□E-□

<Port position: Axial ports>



### Applicable tube and size

Applicable tube O.D./I.D (mm)	ø6/ø4
Applicable tube materials	Nylon, Soft nylon, Polyurethane

\* Dimensions not indicated in the above illustrations are the same as size 50 actuator. Refer to pages 73 and 74.

\* Keys in the illustrations above show the intermediate rotation position for single vane type.

# Series CRB1 (Sizes: 50, 63, 80, 100) Simple Specials

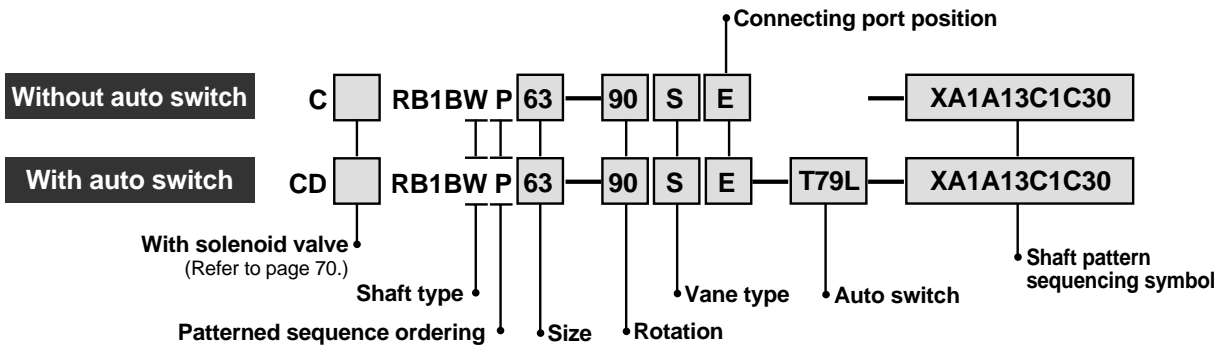
## -XA1 to -XA24: Shaft Pattern Sequencing 1

Simple Specials System (a system for Made to Order) will be used for Shaft Pattern Sequencing (for ordering). (Refer to Features 3.) Please contact SMC for a specification sheet when placing an order.

### Shaft Pattern Sequencing 1

-XA1 to XA24

Applicable shaft type: W (Standard)



### Shaft Pattern Sequencing Symbols

#### • Axial: Top (long-shaft side)

Symbol	Description	Applicable sizes
XA1	Shaft-end female threads	50, 63, 80, 100
XA14*	Shaft through hole + Shaft-end female threads	
XA24	Double key	

#### • Axial: Bottom (short-shaft side)

Symbol	Description	Applicable sizes
XA2*	Shaft-end female threads	50, 63, 80, 100
XA15*	Shaft through hole + Shaft-end female thread	

#### • Double shaft

Symbol	Description	Applicable sizes
XA13*	Shaft through hole	50, 63, 80, 100
XA16*	Shaft through hole + Double shaft-end female threads	



\* These specifications are not available for rotary actuators with auto switch unit.

### Combinations

#### XA□ combinations

Symbol	Combination	
	XA1	XA24
XA1	—	●
XA2	—	●
XA13	●	●
XA14	—	●
XA15	—	●
XA16	—	●
XA24	—	—

A combination of up to two XA□s are available.  
Example: -XA1A13

#### XA□, XC□ combinations

Combination other than -XA□, such as Made to Order (-XC□), is also available. Refer to pages 82 and 83 for detailed description of Made to Order.

Symbol	Description	Applicable sizes	XA1, XA2 XA13 to 16, 24
XC1	Add connecting port	50	●
XC4	Change rotation range and direction		●
XC5	Change rotation range and direction	63	●
XC6	Change rotation range and direction		●
XC7	Reversed shaft	80	—
XC26	Change rotation range and direction		●
XC27	Change rotation range and direction	100	●
XC30	Fluorine grease		●

\* A total of four XA□ and XC□ combinations is available.  
Examples: -XA1A13C1C30

#### Combination

●	Available
—	Not available

CRB2

Free-Mounting Type  
CRBU2

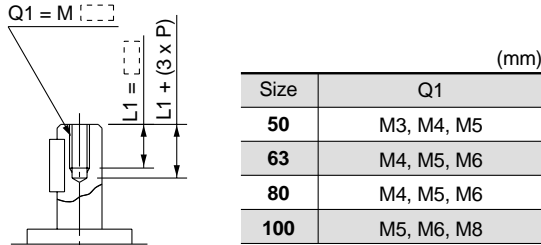
CRB1

# Series CRB1

## Axial: Top (Long-shaft side)

**Symbol: A1** Machine female threads into the long shaft.

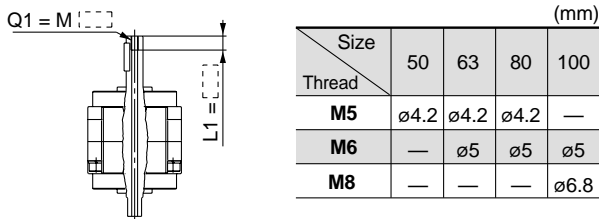
- The maximum dimension L1 is, as a rule, twice the thread size. (Example) For M3: L1 = 6mm
- Applicable shaft type: W



**Symbol: A14** Applicable to single vane type only

A special end is machined onto the long shaft, and a through hole is drilled into it. Female threads are machined into the through hole, whose diameter is equivalent to the pilot hole diameter.

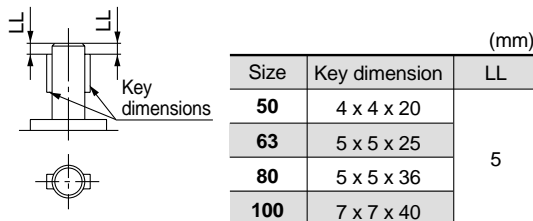
- The maximum L1 dimension is, as a rule, twice the thread size. (Example) For M5: L1 = 10mm
- Applicable shaft type: W



**Symbol: A24** Double key

Keys and keyways are machined at 180° of standard position.

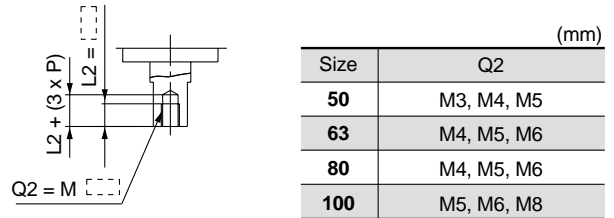
- Applicable shaft type: W
- Equal dimensions are indicated by the same marker.



## Axial: Bottom (Short-shaft side)

**Symbol: A2** Machine female threads into the long shaft.

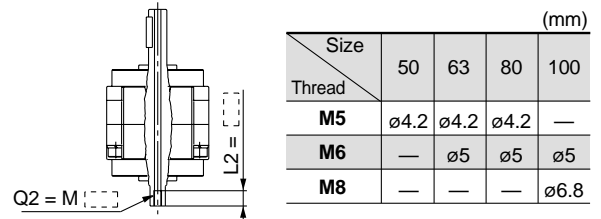
- The maximum dimension L2 is, as a rule, twice the thread size. (Example) For M4: L2 = 8mm
- Applicable shaft type: W



**Symbol: A15** Applicable to single vane type only

A special end is machined onto the long shaft, and a through hole is drilled into it. Female threads are machined into the through hole, whose diameter is equivalent to the pilot hole diameter.

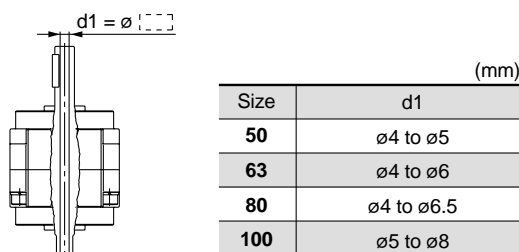
- The maximum L2 dimension is, as a rule, twice the thread size. (Example) For M5: L2 = 10mm
- Applicable shaft type: W



## Double shaft

**Symbol: A13** Applicable to single vane type only

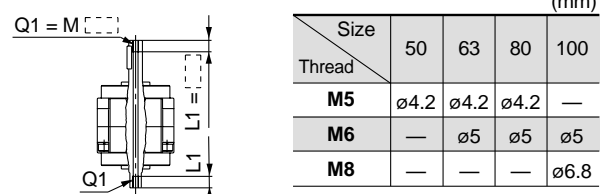
- Shaft with through hole
- Applicable shaft type: W



**Symbol: A16** Applicable to single vane type only

A special end is machined onto both the long and short shafts, and a through hole is drilled into both. Female threads are machined into the through holes, whose diameter is equivalent to the diameter of the pilot holes.

- The maximum L1 dimension is, as a rule, twice the thread size. (Example) For M5: L1 = 10mm
- Applicable shaft type: W
- Equal dimensions are indicated by the same marker.



# Series CRB1 (Sizes: 50, 63, 80, 100)

## Simple Specials

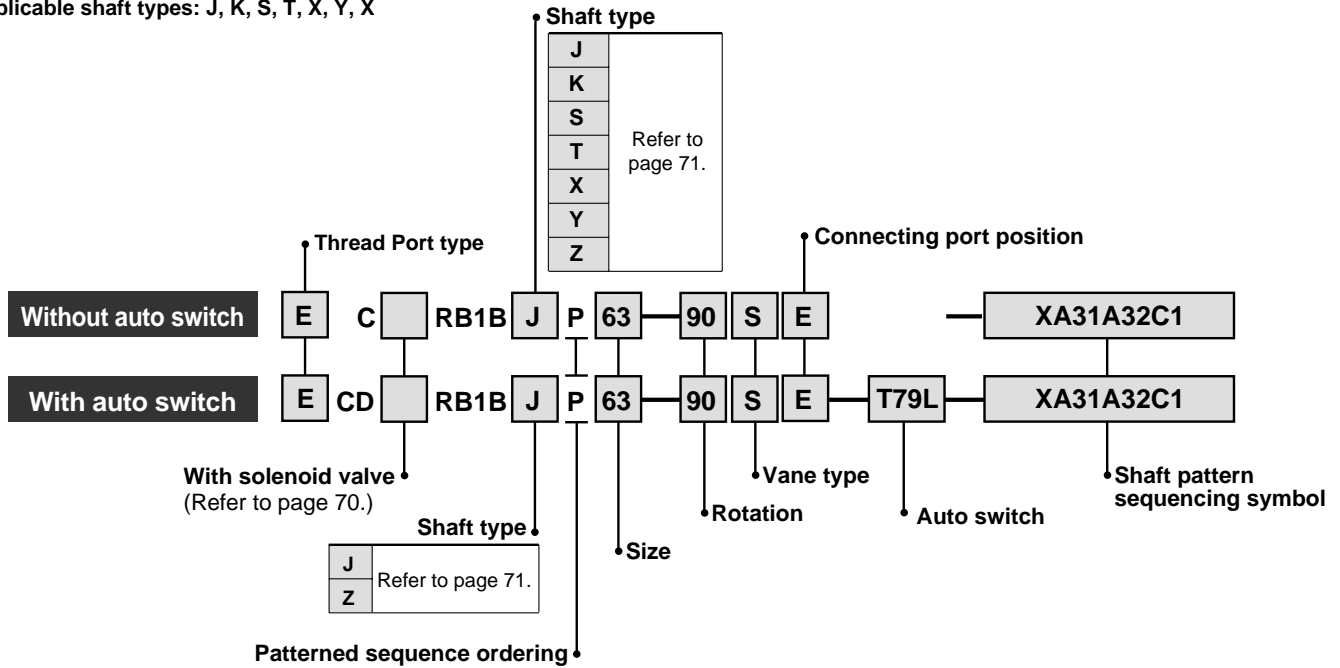
# -XA31 to -XA46: Shaft Pattern Sequencing 2

Simple Specials System (a system for Made to Order) will be used for Shaft Pattern Sequencing (for ordering). (Refer to Features 3.) Please contact SMC for a specification sheet when placing an order.

### Shaft Pattern Sequencing 2

**-XA31 to XA46**

Applicable shaft types: J, K, S, T, X, Y, X



## Shaft Pattern Sequencing

### • Axial: Top (long-shaft side)

Symbol	Description	Shaft types	Applicable sizes
XA31	Shaft-end female threads	S, Y	50
XA33	Shaft-end female threads	J, K, T	63
XA35	Shaft-end female threads	X, Z	80
XA37	Stepped round shaft	J, K, T	100
XA45	Middle-cut chamfer	J, K, T	100

### • Axial: Bottom (short-shaft side)

Symbol	Description	Shaft types	Applicable sizes
XA32*	Shaft-end female threads	S, Y	50
XA34*	Shaft-end female threads	K, T	63
XA36*	Shaft-end female threads	J, X, Z	80
XA38*	Stepped round shaft	K	100
XA46*	Middle-cut chamfer	K	100

### • Double shaft

Symbol	Description	Shaft types	Applicable sizes
XA39*	Shaft through hole	S, Y	50
XA40*	Shaft through hole	K, T	63
XA41*	Shaft through hole	J, X, Z	80
XA42*	Shaft through hole + Shaft-end female threads	S, Y	100
XA43*	Shaft through hole + Shaft-end female threads	K, T	100
XA44*	Shaft through hole + Shaft-end female threads	J, X, Z	100

\* These specifications are not available for rotary actuators with auto switch unit and/or angle adjuster.

## Combinations

### XA□ combinations

Symbol	Combination						
XA31	XA31						
XA32	●						
XA33	—	XA33					
XA34	—	●	XA34				
XA35	—	—	—	XA35			
XA36	—	J*	—	X, Z*	XA36		
XA37	—	—	K, T*	—	J*	XA37	
XA38	—	●	—	—	—	●	
XA45	—	—	K, T*	—	J*	—	XA45
XA46	—	●	—	—	—	●	●

Combinations of XA39 to XA44 with others are not available. A combination of up to two XA□s are available. Example: -XA1A24

### XA□, XC□ combinations

Combination other than -XA□, such as Made to Order (-XC□), is also available. Refer to pages 82 and 83 for detailed description of Made to Order.

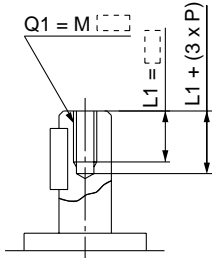
Symbol	Description	Shaft types	XA31 to XA46
		J, K, S, T, X, Y, Z	
XC1	Add connecting port	●	●
XC4	Change of rotation range and direction	●	●
XC5	Change of rotation range and direction	●	●
XC6	Change of rotation range and direction	●	●
XC7	Reversed shaft	J, S, T, X	—
XC26	Change of rotation range and direction	●	●
XC27	Change of rotation range and direction	●	●
XC30	Fluorine grease	●	●

\* These specifications are not available for rotary actuators with auto switch unit. A total of four XA□ and XC□ combinations is available. Example: -XA1A24C1C30 -XA2C1C4C30

## Axial: Top (Long-shaft side)

**Symbol: A31** Machine female threads into the long shaft.

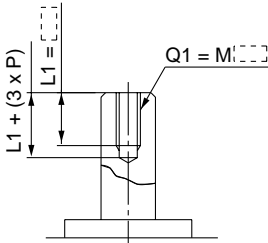
- The maximum dimension L1 is, as a rule, twice the thread size.  
(Example) For M3: L1 = 6mm
- Applicable shaft types: S, Y



Size	Q1 (mm)	
	S	Y
50	M3, M4, M5	
63	M4, M5, M6	
80	M4, M5, M6	
100	M5, M6, M8	

**Symbol: A33** Machine female threads into the long shaft.

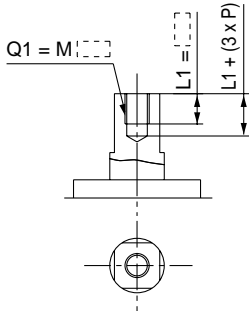
- The maximum dimension L1 is, as a rule, twice the thread size.  
(Example) For M3: L1 = 6mm
- Applicable shaft types: J, K, T



Size	Q1 (mm)		
	J	K	T
50	M3, M4, M5, M6		
63	M4, M5, M6		
80	M4, M5, M6, M8		
100	M5, M6, M8, M10		

**Symbol: A35** Machine female threads into the long shaft.

- The maximum dimension L1 is, as a rule, twice the thread size.  
(Example) For M3: L1 = 6mm
- Applicable shaft types: X, Z



Size	Q1 (mm)	
	X	Z
50	M3, M4, M5	
63	M4, M5, M6	
80	M4, M5, M6	
100	M5, M6, M8	

**Symbol: A37** The long shaft can be further shortened by machining it into a stepped round shaft. (If shortening the shaft is not required, indicate "\*" for dimension X.)

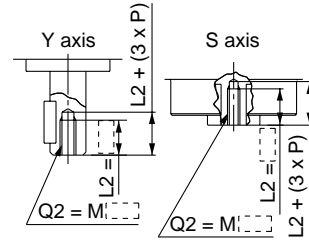
- Applicable shaft types: J, K, T
- Equal dimensions are indicated by the same marker.  
(If not specifying dimension C1, indicate "\*" instead.)

Size	Q1 (mm)								
	X			L1 max.			D1		
	J	K	T	J	K	T	J	K	T
50	4 to 39.5			X-3			3 to 11.9		
63	4 to 45			X-3			3 to 14.9		
80	4 to 53.5			X-3			3 to 16.9		
100	5 to 65			X-4			3 to 24.9		

## Axial: Bottom (Short-shaft side)

**Symbol: A32** Machine female threads into the short shaft.

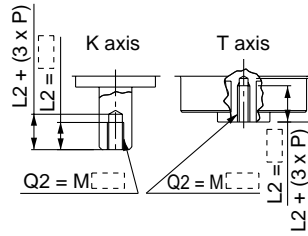
- The maximum dimension L2 is, as a rule, twice the thread size.  
(Example) For M4: L2 = 8mm
- Applicable shaft types: S, Y



Size	Q2 (mm)	
	S	Y
50	M3, M4, M5, M6	M3, M4, M5
63	M4, M5, M6	M4, M5, M6
80	M4, M5, M6, M8	M4, M5, M6
100	M5, M6, M8, M10	M5, M6, M8

**Symbol: A34** Machine female threads into the short shaft.

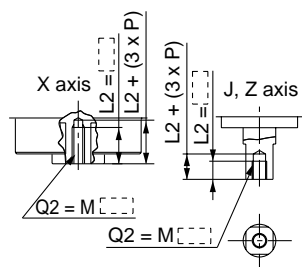
- The maximum dimension L2 is, as a rule, twice the thread size.  
(Example) For M3: L2 = 6mm
- Applicable shaft types: K, T



Size	Q2 (mm)	
	K	T
50	M3, M4, M5, M6	
63	M4, M5, M6	
80	M4, M5, M6, M8	
100	M5, M6, M8, M10	

**Symbol: A36** Machine female threads into the short shaft.

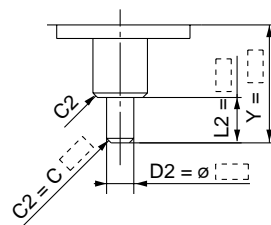
- The maximum dimension L2 is, as a rule, twice the thread size.  
(Example) For M3: L2 = 6mm
- Applicable shaft types: J, X, Z



Size	Q2 (mm)		
	X	J	Z
50	M3, M4, M5, M6	M3, M4, M5	
63	M4, M5, M6	M4, M5, M6	
80	M4, M5, M6, M8	M4, M5, M6	
100	M5, M6, M8, M10	M5, M6, M8	

**Symbol: A38** The short shaft can be further shortened by machining it into a stepped round shaft. (If shortening the shaft is not required, indicate "\*" for dimension Y.)

- Applicable shaft type: K
- Equal dimensions are indicated by the same marker.  
(If not specifying dimension C2, indicate "\*" instead.)



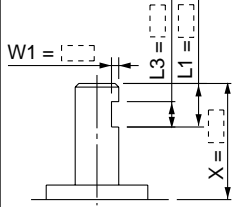
Size	Q2 (mm)		
	Y	L2 max.	D2
50	4 to 39.5	Y-3	3 to 11.9
63	4 to 45	Y-3	3 to 14.9
80	4 to 53.5	Y-3	3 to 16.9
100	5 to 65	Y-4	3 to 24.9

## Axial: Top (Long-shaft side)

### Symbol: **A45**

The long shaft can be further shortened by machining a middle-cut chamfer into it. (The position of the chamfer is at the standard keyway.)  
(If shortening the shaft is not required, indicate "\*" for dimension X.)

- Minimum machining dimension is 0.1mm.
- Applicable shaft types: J, K, T



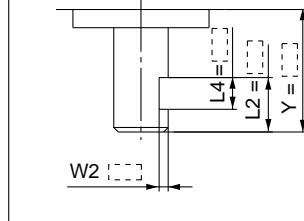
Size	X			W1			L1 max.			L3 max.		
	J	K	T	J	K	T	J	K	T	J	K	T
50	11.5 to 39.5	1 to 6	X-3	L1-2								
63	12.5 to 45	1 to 7.5	X-3	L1-2								
80	13.5 to 53.5	1 to 8.5	X-3	L1-2								
100	18.5 to 65	1 to 12.5	X-4	L1-2								

## Axial: Bottom (Short-shaft side)

### Symbol: **A46**

The short shaft can be further shortened by machining a middle-cut chamfer into it. (The position of the chamfer is same as the standard one.)  
(If shortening the shaft is not required, indicate "\*" for dimension Y.)

- Minimum machining dimension is 0.1mm.
- Applicable shaft type: K



Size	Y			W2			L2 max.			L4 max.		
	J	K	T	J	K	T	J	K	T	J	K	T
50	11.5 to 39.5	1 to 6	Y-3	L2-2								
63	12.5 to 45	1 to 7.5	Y-3	L2-2								
80	13.5 to 53.5	1 to 8.5	Y-3	L2-2								
100	18.5 to 65	1 to 12.5	Y-4	L2-2								

## ⚠ Caution

For the shaft patterns A45 and A46, a middle-cut chamfer may interfere with the center hole if the W1/W2 dimensions and (L1-L3), (L2-L4) dimensions are less than what are shown in the tables at right.

Size	W1	W2	L1-L3	L2-L4
50	4.5 to 6		2 to 5.5	
63	6 to 7.5		2 to 3	

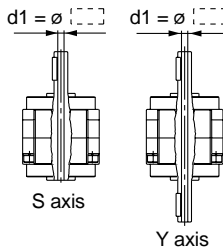
Size	W1	W2	L1-L3	L2-L4
80	6.5 to 8.5		2 to 6.5	
100	10.5 to 12.5		2 to 6.5	

## Double shaft

### Symbol: **A39**

Applicable to single vane type only  
Shaft with through hole (Additional machining of S, Y shaft)

- Minimum machining diameter for d1 is 0.1mm.
- Applicable shaft types: S, Y

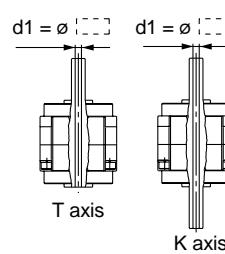


Size	d1	
	S	Y
50	ø4 to ø5	
63	ø4 to ø6	
80	ø4 to ø6.5	
100	ø5 to ø8	

### Symbol: **A40**

Applicable to single vane type only  
Shaft with through hole (Additional machining of K, T shaft)

- Minimum machining diameter for d1 is 0.1mm.
- d1 = d3 for sizes 20 to 40.
- Applicable shaft types: K, T

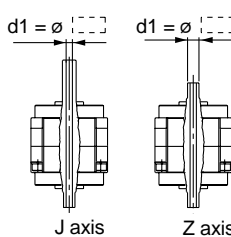


Size	d1	
	K	T
50	ø4 to ø5.5	
63	ø4 to ø6	
80	ø4 to ø7.5	
100	ø5 to ø10	

### Symbol: **A41**

Applicable to single vane type only

- Shaft with through hole
- Minimum machining diameter for d1 is 0.1mm.
  - Applicable shaft types: J, X, Z

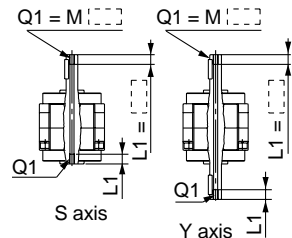


Size	d1		
	J	X	Z
50	ø4 to ø5		
63	ø4 to ø6		
80	ø4 to ø6.5		
100	ø5 to ø8		

### Symbol: **A42**

Applicable to single vane type only

- A special end is machined onto both the long and short shafts, and a through hole is drilled into both shafts. Female threads are machined into the through holes, whose diameter is equivalent to the diameter of the pilot holes.
- The maximum L1 dimension is, as a rule, twice the thread size.
  - Applicable shaft types: S, Y
  - Equal dimensions are indicated by the same marker.

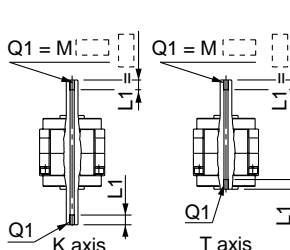


Size	50		63		80		100	
	S	Y	S	Y	S	Y	S	Y
M5	ø4.2	ø4.2	ø4.2	ø4.2	ø4.2	ø4.2	ø4.2	ø4.2
M6	—	ø5	ø5	ø5	ø5	ø5	ø5	ø5
M8	—	—	—	—	ø6.8	ø6.8	ø6.8	ø6.8

### Symbol: **A43**

Applicable to single vane type only

- A special end is machined onto both the long and short shafts, and a through hole is drilled into both. Female threads are machined into the through holes, whose diameter is equivalent to the diameter of the pilot holes.
- The maximum L1 dimension is, as a rule, twice the thread size.
  - Applicable shaft types: K, T
  - Equal dimensions are indicated by the same marker.

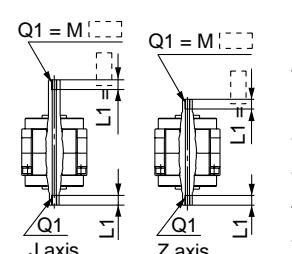


Size	50		63		80		100	
	K	T	K	T	K	T	K	T
M5	ø4.2	ø4.2	ø4.2	ø4.2	ø4.2	ø4.2	ø4.2	ø4.2
M6	ø5	ø5	ø5	ø5	ø5	ø5	ø5	ø5
M8	—	—	—	—	ø6.8	ø6.8	ø6.8	ø6.8
M10	—	—	—	—	—	—	ø8.6	ø8.6

### Symbol: **A44**

Applicable to single vane type only

- A special end is machined onto both the long and short shafts, and a through hole is drilled into both shafts. Female threads are machined into the through holes, whose diameter is equivalent to the diameter of the pilot holes.
- The maximum L1 dimension is, as a rule, twice the thread size.
  - Applicable shaft types: J, X, Z
  - Equal dimensions are indicated by the same marker.



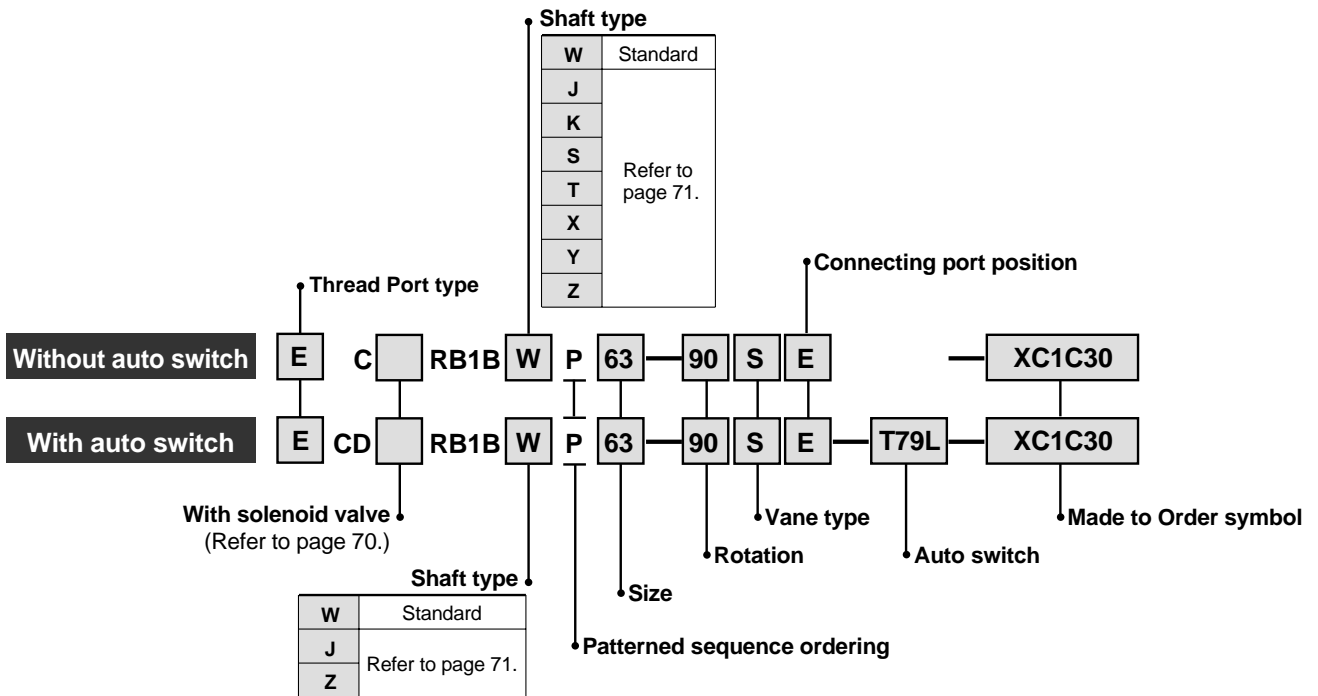
Size	50		63		80		100	
	J	X	Z	J	X	Z	J	X
M5	ø4.2	ø4.2	ø4.2	ø4.2	ø4.2	ø4.2	ø4.2	ø4.2
M6	—	ø5	ø5	ø5	ø5	ø5	ø5	ø5
M8	—	—	—	—	—	—	ø6.8	ø6.8



Series **CRB1** (Sizes: 50, 63, 80, 100)

**Made to Order**

**XC1, 4, 5, 6, 7, 26, 27, 30**



### Made to Order Symbols

Symbol	Description	Applicable shaft types	Applicable sizes
		W, J, K, S, T, X, Y, Z	
XC1	Add connecting port	●	50
XC4	Change of rotation range and direction	●	
XC5	Change of rotation range and direction	●	
XC6	Change of rotation range and direction	●	63
XC7*	Reversed shaft	●	
XC26	Change of rotation range and direction	●	80
XC27	Change of rotation range and direction	●	
XC30	Fluorine grease	●	100

\* This specification is not available for rotary actuators with auto switch unit and/or angle adjuster.

### Combinations

Symbol	Combination	
	XC1	XC2
XC1	—	●
XC4	●	●
XC5	●	●
XC6	●	●
XC7	●	●
XC26	●	●
XC27	●	●
XC30	●	—

**Symbol: C1** Add connecting ports on Body (A). (An additionally machined port will have an aluminum surface since it will be left unfinished.)

Size	Q	M	N
50	Rc 1/8	21	18
63	Rc 1/8	27	25
80	Rc 1/4	29	30
100	Rc 1/4	38	38

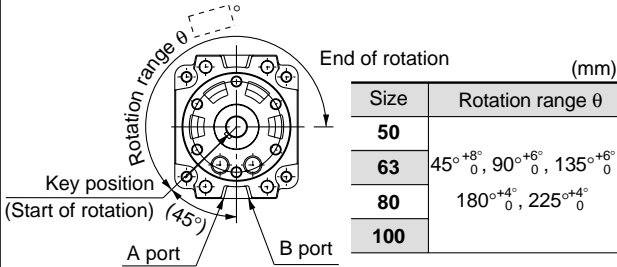
**Symbol: C4** Change of rotation. (Applicable to single vane type only)  
Rotation starts from the horizontal line (90° down from the top to the right side).

Size	Rotation range θ (mm)
50	45° <sup>+8°</sup> <sub>0</sub> , 90° <sup>+8°</sup> <sub>0</sub> , 135° <sup>+6°</sup> <sub>0</sub>
63	
80	
100	

Start of rotation is the position of the key when A port is pressurized. (Top view from long-shaft side)

**Symbol: C5**

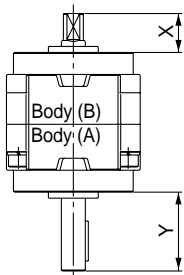
Change of rotation. (Applicable to single vane type only)  
Rotation starts from the horizontal line (45° down from the top to the left side).



Start of rotation is the position of the key when B port is pressurized.  
(Top view from long-shaft side)

**Symbol: C7**

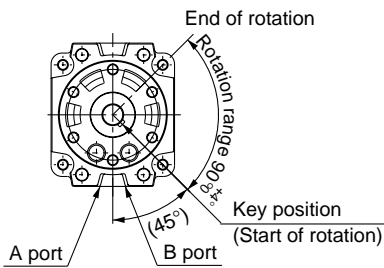
The shafts are reversed.



Size	Y	X
50	39.5	19.5
63	45	21
80	53.5	23.5
100	56	30

**Symbol: C27**

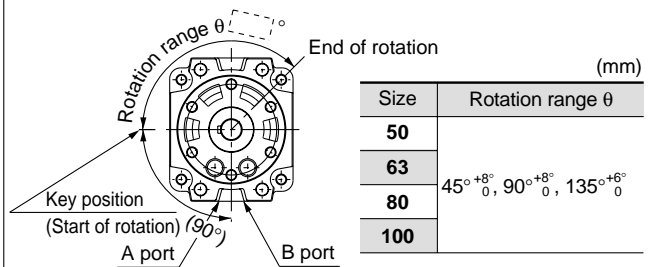
Change of rotation. (Applicable to double vane type only)  
Rotation: 90° Rotation starts from the horizontal line (45° down from the top to the right side).



Start of rotation is the position of the key when A port is pressurized.  
(Top view from long-shaft side)

**Symbol: C6**

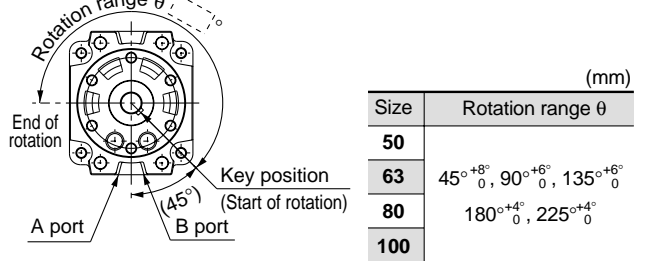
Change of rotation. (Applicable to single vane type only)  
Rotation starts from the horizontal line (90° down from the top to the left side).



Start of rotation is the position of the key when B port is pressurized.  
(Top view from long-shaft side)

**Symbol: C26**

Change of rotation. (Applicable to single vane type only)  
Rotation starts from the horizontal line (45° down from the top to the right side).



Start of rotation is the position of the key when A port is pressurized.  
(Top view from long-shaft side)

**Symbol: C30**

Change standard grease to fluorine grease.  
(Not for low-speed specification.)

CRB2

Free-Mounting Type  
CRBU2

CRB1

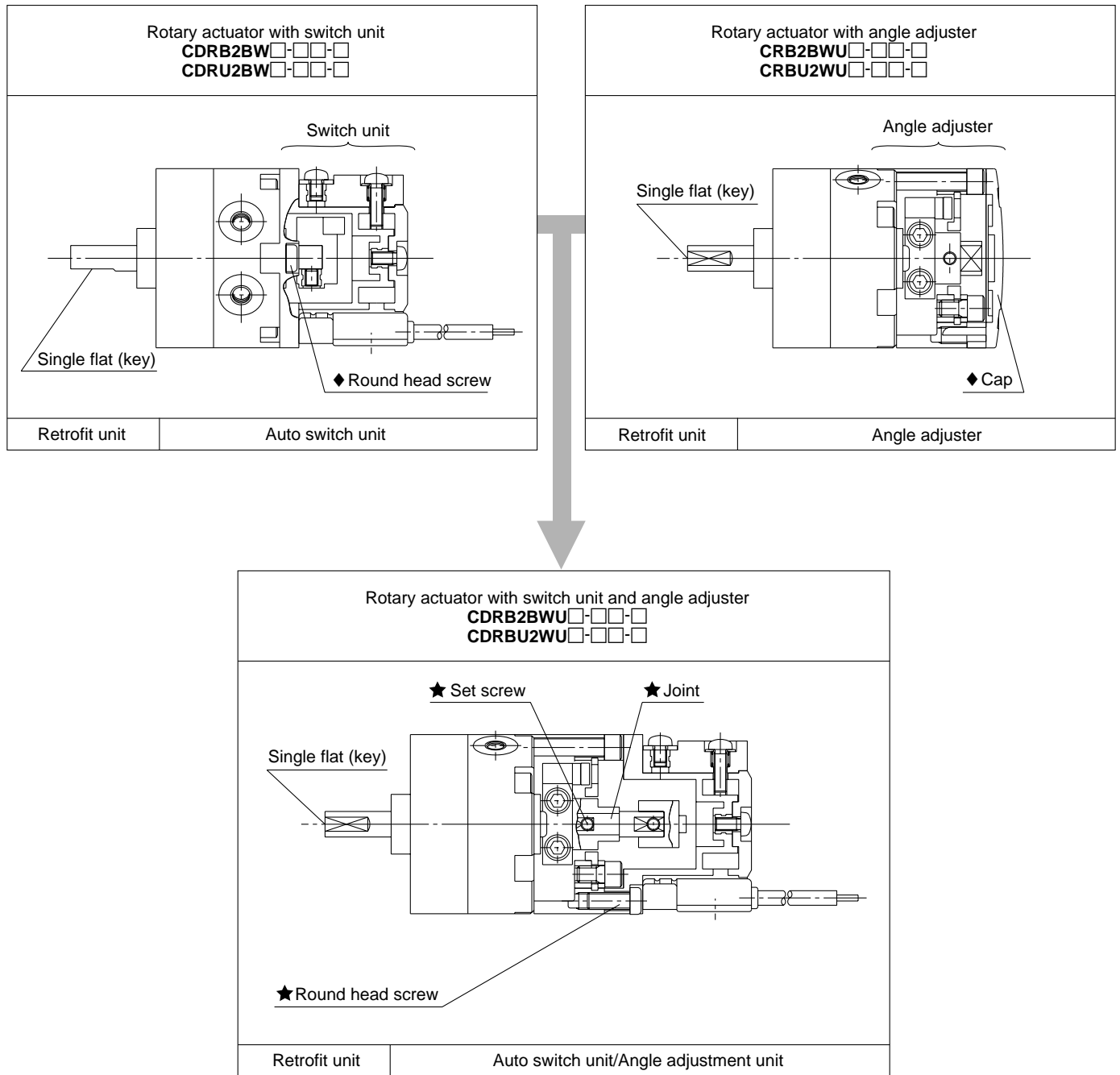
# Series CRB2/CRBU2/CRB1

## Rotary Actuator

# Component Unit

### Auto Switch Unit and Angle Adjuster

**Series CRB2/CRBU2** Auto switch unit and angle adjuster can be mounted on the rotary actuator vane type.



\* For rotary actuator with switch unit and angle adjuster is basically a combination of a switch unit and an angle adjuster. The items marked with ★ are additionally required parts for connection (joint unit parts), and the items marked with ◆ will not be in use.

\* Use a unit part number when ordering joint unit separately.

Note) Illustrations above show Series CRB2BW.

### 1 Auto switch unit part no.

Each unit can be retrofitted to the rotary actuator.

Series	Model	Vane type	Unit part no.
Series CRB2	CDRB2BW10	Single/Double type	P611070-1
	CDRB2BW15		P611090-1
	CDRB2BW20		P611060-1
	CDRB2BW30		P611080-1
	CDRB2BW40	Single type	P612010-1
		Double type	P611010-1
Free-mounting type Series CRBU2	CDRBU2W10	Single/Double type	P611070-1
	CDRBU2W15		P611090-1
	CDRBU2W20		P611060-1
	CDRBU2W30		P611080-1
	CDRBU2W40		P612010-1
Series CRB1	CDRB1BW50	Single/Double type	P411020-1
	CDRB1BW63		P411030-1
	CDRB1BW80		P411040-1
	CDRB1BW100		P411050-1

\* Auto switch unit can be ordered separately if the rotary actuator with auto switch unit is required after the product being delivered. Auto switch itself will not be included. Please order separately.

### 2 Switch block unit part no.

Auto switch unit comes with one right-hand and one left-hand switch blocks that are used for addition or when the switch block is damaged.

Series	Model	Unit part no.	
Series CRB2	CDRB2BW10, 15	Right-hand	P611070-8
		Left-hand	P611070-9
	CDRB2BW20, 30	Right-hand	P611060-8
		Left-hand	
	CDRB2BW40	Right-hand	P611010-8
		Left-hand	P611010-9
Free-mounting type Series CRBU2	CDRBU2W10, 15	Right-hand	P611070-8
		Left-hand	P611070-9
	CDRBU2W20, 30	Right-hand	P611060-8
		Left-hand	
	CDRBU2W40	Right-hand	P611010-8
		Left-hand	P611010-9
Series CRB1	CDRB1BW50	Right-hand	P411020-8
		Left-hand	P411020-9
	CDRB1BW63, 80, 100	Right-hand	P411040-8
		Left-hand	P411040-9

\* Solid state switch for size 10 and 15 requires no switch block, therefore the unit part no. will be P611070-13.

### 3 Angle adjuster part no.

Each unit can be retrofitted to the rotary actuator.

Series	Model	Vane type	Unit part no.
Series CRB2	CRB2BWU10	Single/Double type	P611070-3
	CRB2BWU15		P611090-3
	CRB2BWU20		P611060-3
	CRB2BWU30		P611080-3
	CRB2BWU40	Single type	P612010-3
		Double type	P611010-3
Free-mounting type Series CRBU2	CRBU2WU10	Single/Double type	P611070-3
	CRBU2WU15		P611090-3
	CRBU2WU20		P611060-3
	CRBU2WU30		P611080-3
	CRBU2WU40		P612010-3

### 4 Auto switch angle adjuster part no.

Each unit can be retrofitted to the rotary actuator.

Series	Model	Vane type	Unit part no.
Series CRB2	CDRB2BWU10	Single/Double type	P611070-4
	CDRB2BWU15		P611090-4
	CDRB2BWU20		P611060-4
	CDRB2BWU30		P611080-4
	CDRB2BWU40	Single type	P612010-4
		Double type	P611010-4
Free-mounting type Series CRBU2	CDRBU2WU10	Single/Double type	P611070-4
	CDRBU2WU15		P611090-4
	CDRBU2WU20		P611060-4
	CDRBU2WU30		P611080-4
	CDRBU2WU40		P612010-4

### 5 Joint unit part no.

Joint unit is a unit required to retrofit the angle adjuster to a rotary actuator with a switch unit or to retrofit the switch unit to a rotary actuator with angle adjuster.

Series	Model	Vane type	Unit part no.
Series CRB2	CDRB2BWU10	Single/Double type	P211070-10
	CDRB2BWU15		P211090-10
	CDRB2BWU20		P211060-10
	CDRB2BWU30		P211080-10
	CDRB2BWU40		P211010-10
Free-mounting type Series CRBU2	CDRBU2WU10	Single/Double type	P211070-10
	CDRBU2WU15		P211090-10
	CDRBU2WU20		P211060-10
	CDRBU2WU30		P211080-10
	CDRBU2WU40		P211010-10

# Rotary Actuator with Auto Switch

## Applicable Auto Switch

Applicable series	Switch type		Electrical entry
CDRB2BW10, 15 CDRBU2W10, 15	Reed	D-90, D-90A	Grommet, 2-wire
		D-97, D-93A	
	Solid state	D-S99, D-S99V*	Grommet, 3-wire (NPN)
		D-S9P, D-S9PV*	Grommet, 3-wire (PNP)
		D-T99, D-T99V	Grommet, 2-wire
CDRB2BW20, 30, 40 CDRBU2W20, 30, 40 CRB1BW50, 63, 80, 100	Reed	D-R73	Grommet, 2-wire
		D-R80	Connector, 2-wire
	Solid state	D-S79*	Grommet, 3-wire (NPN)
		D-S7P*	Grommet, 3-wire (PNP)
		D-T79	Grommet, 2-wire; Connector, 2-wire

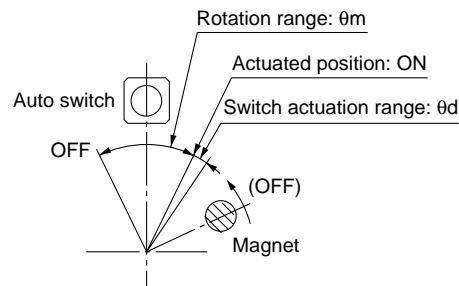
## Rotation Range and Actuation Range

\* Operating range:  $\theta_m$

The range between the position where the auto switch turns ON as the magnet inside the auto switch unit moves and the position where the switch turns OFF as the magnet travels the same direction.

\* Hysteresis range:  $\theta_d$

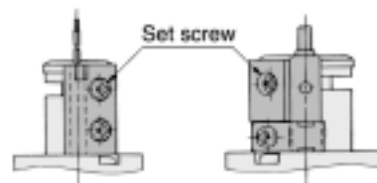
The range between the position where the auto switch turns ON as the magnet inside the auto switch unit moves and the position where the switch turns OFF as the magnet travels the opposite direction.



Model	Operating range: $\theta_m$	Switch actuation range: $\theta_d$
CDRB2BW10, 15	110°	10°
CDRBU2W10, 15		
CDRB2BW20, 30	90°	8°
CDRBU2W20, 30		
CDRB2BW40	52°	7°
CDRBU2W40		
CDRB1BW50	38°	7°
CDRB1BW63 to 100		

## Moving Auto Switch Detection Position

\* To set the detection position, move the switch to a desired position after loosening the set screw slightly and retighten the set screw. Do not tighten the screw past the tightening torque of approximately 0.49N·m as this could damage the switch, and the switch may not stay in place securely.



(CDRB2BW10, 15  
CDRBU2W10, 15)

(CDRB2BW20 to 40  
CDRBU2W20 to 30  
CDRB1BW50 to 100)

## Adjustment of Auto Switch

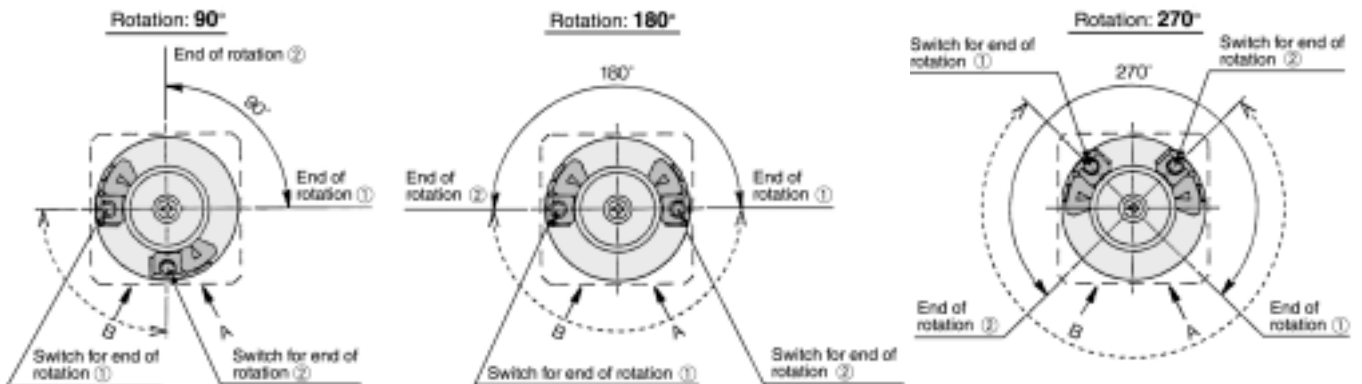
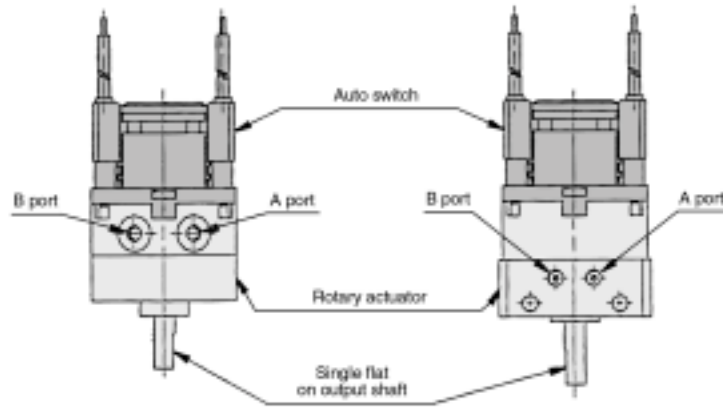
Rotation range of the output shaft with single flat (key for size 40 only) and auto switch mounting position  
 Sizes: 10, 15, 20, 30, 40

### <Single vane>

- \* Solid-lined curves indicate the rotation range of the output shaft with single flat (key). When the single flat (key) is pointing to end of rotation ①, the switch for end of rotation ① will operate, and when the single flat (key) is pointing to end of rotation ②, the switch for end of rotation ② will operate.
- \* Broken-lined curves indicate the rotation range of the built-in magnet. Rotation range of the switch can be decreased by either moving the switch for end of rotation ① clockwise or moving the switch for end of rotation ② counter-clockwise. Auto switch in the illustrations above is at the most sensitive position.
- \* Each auto switch unit comes with one right-hand switch and one left-hand switch.

(CDRB2BW10 to 40)

(CDRBU2W10 to 40)

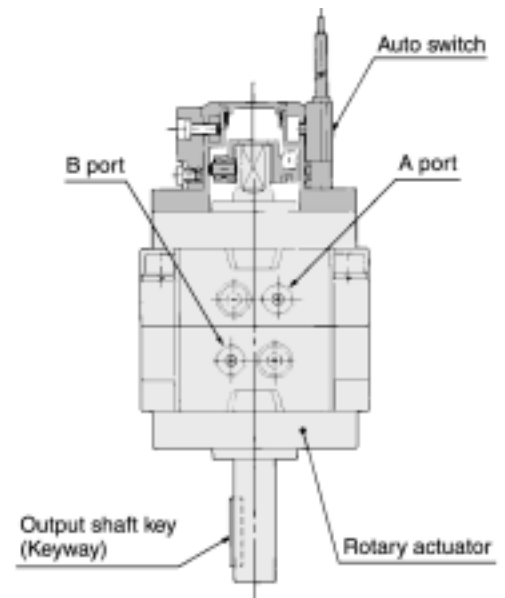
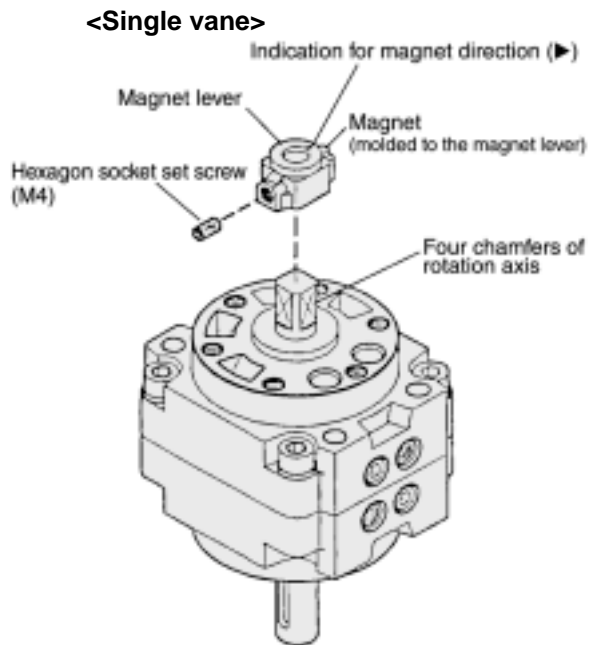


# Series CDRB2/CDRBU2/CRB1

## Adjustment of Auto Switch

Rotation range of the output key (keyway) and auto switch mounting position

Sizes: 50, 63, 80, 100



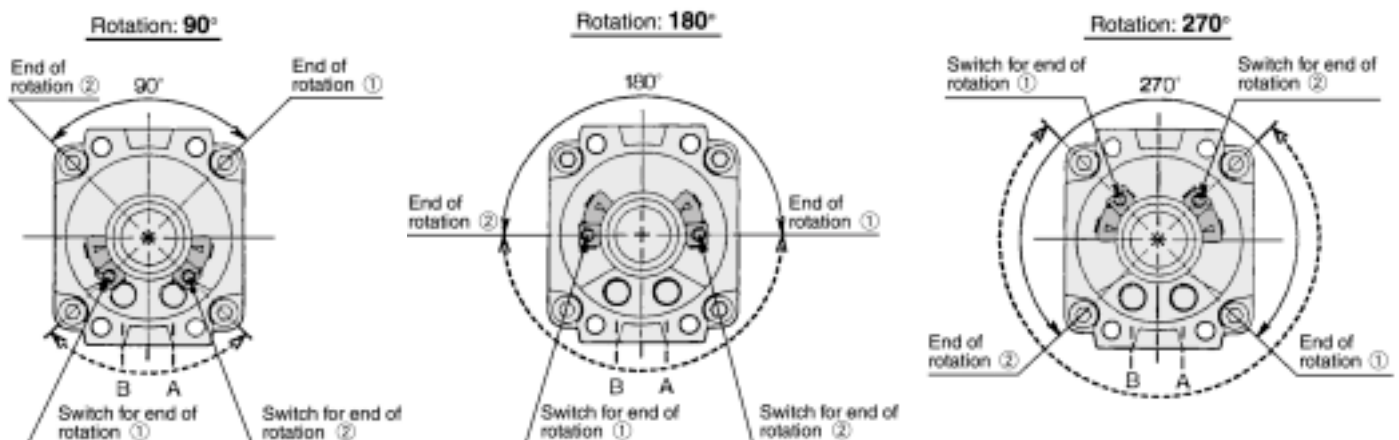
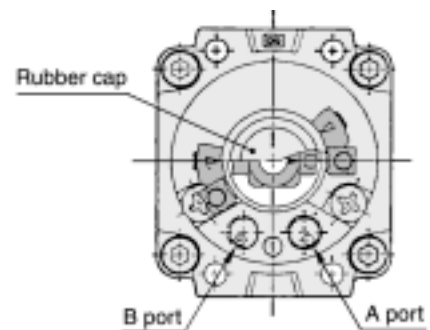
\* Solid-lined curves indicate the rotation range of the output key (keyway). When the key is pointing to end of rotation ①, the switch for end of rotation ① will operate, and when the key is pointing to end of rotation ②, the switch for end of rotation ② will operate.

\* Broken-lined curves indicate the rotation range of the built-in magnet. Rotation range of the switch can be decreased by either moving the switch for end of rotation ① clockwise or moving the switch for end of rotation ② counter-clockwise. Auto switch in the illustrations above is at the most sensitive position.

\* Each auto switch unit comes with one right-hand and one left-hand switches.

\* The magnet position can be checked with a convenient ▶ indication by removing a rubber cap when adjusting the auto switch position.

\* Since four chamfers are machined into the axis of rotation, a magnet position can be readjusted at 90° intervals.



# Series CRB Auto Switch Specifications

## Auto Switch Common Specifications

Type	Reed switch	Solid state switch
Leakage current	None	3 wire: 100 $\mu$ A or less; 2 wire: 0.8mA or less
Operating time	1.2ms	1ms or less
Impact resistance	300m/s <sup>2</sup>	1000m/s <sup>2</sup>
Insulation resistance	50M $\Omega$ or more at 500VDC (between lead wire and case)	
Withstand voltage	1500VAC for 1 min.*1) (between lead wire and case)	1000VAC for 1 min. (between lead wire and case)
Ambient temperature	-10° to 60°C	
Enclosure	IEC529 standard IP67, JIS C0920 watertight construction	

\*1) Electrical entry: Connector type (R73C, R80C) and D-9, D-9□A, D-A9, and D-A9□V are 1000VAC for 1 minute. (between lead wire and case)

## Lead Wire Lengths

### Lead wire length indication

(Example) **D-90A** **L**

#### Lead wire length

Nil	0.5m
L	3m
Z	5m
N*	None

\* Applicable only to connector type switches D-□□C.

Note) Lead wire length: Z (5m) applicable auto switches  
Reed: D-90, D-97, D-90A, D-93A, D-R73C, D-R80C  
Solid state: All types are produced upon receipt of order.

### Part numbers for lead wire with connector

(applicable only to connector type)

Model	Lead wire length
D-LC05	0.5m
D-LC30	3m
D-LC50	5m

## Contact Protection Boxes: CD-P11, CD-P12

### <Applicable switch types>

D-R73(C), D-R80(C), D-9, and D-9□A do not have built-in contact protection circuits.

A contact protection box should be used in any of the following conditions, otherwise, the life of the contacts may be reduced (They may stay on continuously):

1. The operating load is an induction load.
2. The length of wiring to the load is 5m or more.
3. The load voltage is 100 or 200VAC.

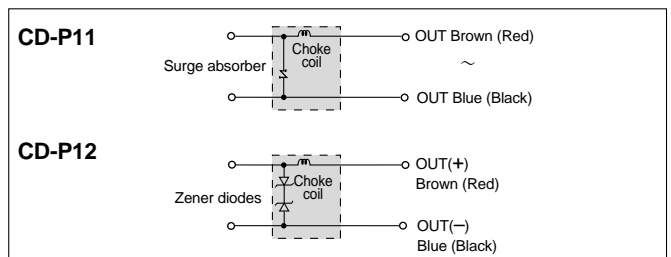
### Specifications

Part no.	CD-P11		CD-P12
Load voltage	100VAC	200VAC	24VDC
Maximum load current	25mA	12.5mA	50mA

\* Lead wire length — Switch connection side: 0.5m  
Load connection side: 0.5m

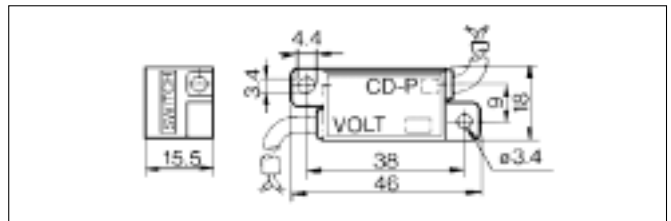


### Internal circuits



Lead wire colors inside ( ) are those prior to conformity with IEC standards.

### Dimensions



## Contact Protection Box: Connection

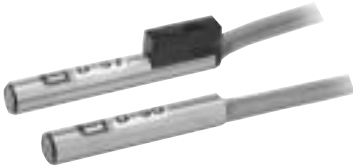
To connect a switch unit to a contact protection box, connect the lead wire from the side of the contact protection box marked SWITCH to the lead wire coming out of the switch unit.

The switch unit should be kept as close as possible to the contact protection box with a lead wire that is no more than 1 meter in length.



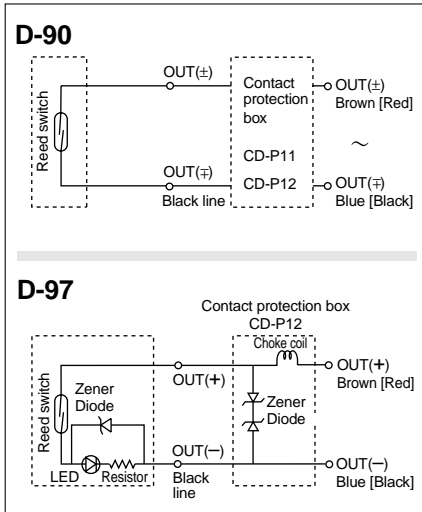
# Reed Switches: Direct Mount Type D-90, D97

**Grommet**  
Lead wire: Parallel cord



## Internal circuits

Lead wire colors inside ( ) are those prior to conformity with IEC standards.



Note) Use a contact protection box in either of the following conditions, as the life of the contacts may otherwise be reduced (Refer to page 91 for details regarding contact protection boxes.):

1. The load is an induction load.
2. The lead wire length to the load is 5m or more.

## Specifications

### D-90 (without indicator light)

Auto switch part no.	D-90		
Application	Relay, IC circuit, PLC		
Load voltage	5V <sup>AC</sup> DC	12V <sup>AC</sup> DC	24V <sup>AC</sup> DC
Maximum load current	50mA		
Internal resistance	1Ω or less (including lead wire length of 3m)		

### D-97 (with indicator light)

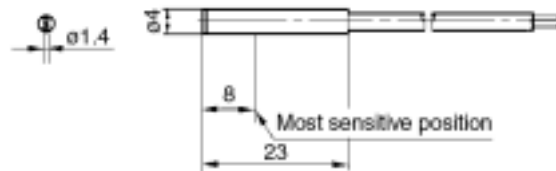
Auto switch part no.	D-97	
Application	Relay, PLC	
Load voltage	24VDC	
Load current range	5 to 40mA	
Internal voltage drop	2.4V or less	

• Lead wires — Parallel vinyl cord: 0.5m, 0.2mm<sup>2</sup> x 2 cores [Brown, Blue (Red, Black)]

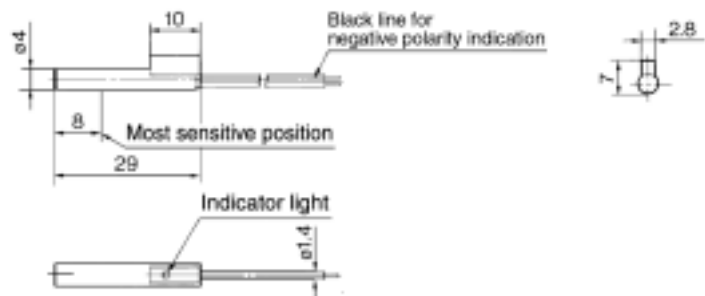
Note) Refer to page 91 for auto switch common specifications and lead wire length.

## Dimensions

### D-90



### D-97



# Reed Switches: Direct Mount Type

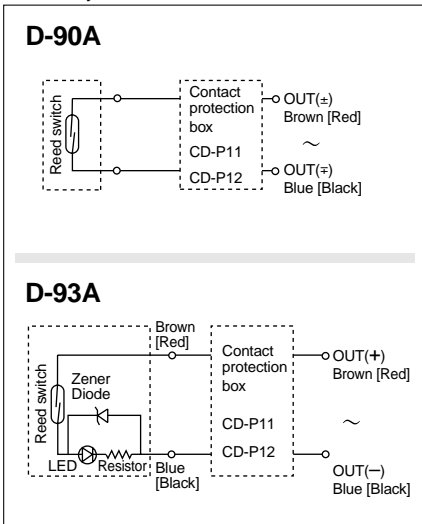
## D-90A, D-93A

**Grommet**  
Lead wire: Heavy-duty cord



### Internal circuits

Lead wire colors inside ( ) are those prior to conformity with IEC standards.



Note) Use a contact protection box in any of the following conditions, as the life of the contacts may otherwise be reduced. (Refer to page 91 for details regarding contact protection boxes.):

1. The load is an induction load.
2. The lead wire length to the load is 5m or more.
3. The load voltage is 100VAC.

### Specifications

#### D-90A (without indicator light)

Auto switch part no.	D-90A			
Applicable load	Relay, IC circuit, PLC			
Load voltage	5V <sup>AC</sup> <sub>DC</sub>	12V <sup>AC</sup> <sub>DC</sub>	24V <sup>AC</sup> <sub>DC</sub>	100V <sup>AC</sup> <sub>DC</sub>
Maximum load current	50mA			20mA
Internal resistance	1Ω or less (including lead wire length of 3m)			

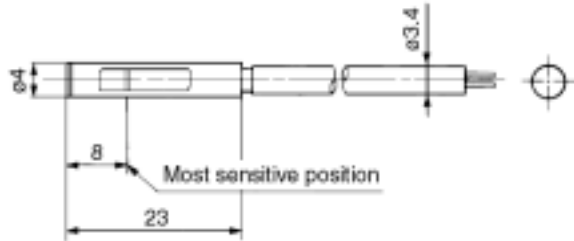
#### D-93A (with indicator light)

Auto switch part no.	D-93A	
Application	Relay, PLC	
Load voltage	24VDC	100VAC
Load current range	5 to 40mA	5 to 20mA
Internal voltage drop	2.4V or less	
Indicator light	Red LED lights up when ON	

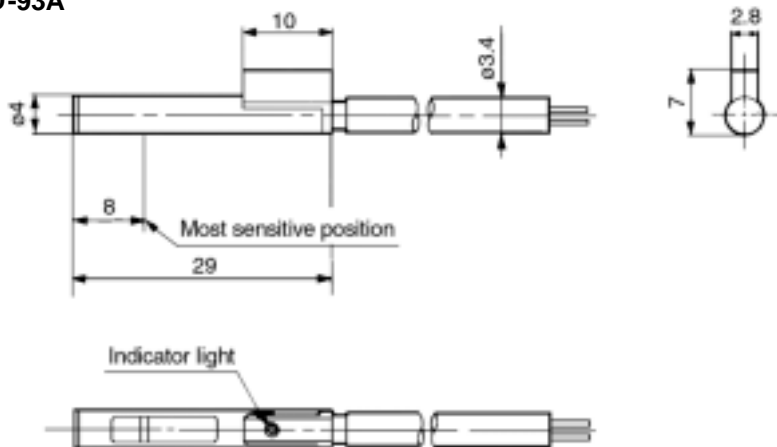
• Lead wires — Oilproof heavy-duty vinyl cord: 0.5m, 0.2mm<sup>2</sup> x 2 cores [Brown, Blue (Red, Black)]  
Note) Refer to page 91 for auto switch common specifications and lead wire length.

### Dimensions

#### D-90A



#### D-93A



CRB2

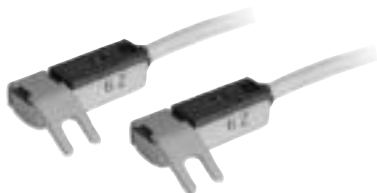
Free-Mounting Type  
CRBU2

CRB1

# Reed Switches: Direct Mount Type

## D-R73, D-R80

**Grommet**  
Electrical entry direction: In-line



### Specifications

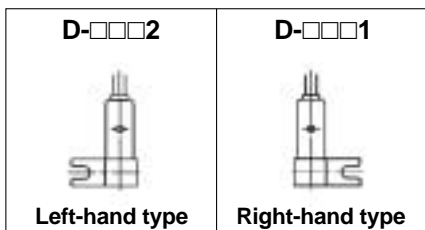
#### D-R73□ (with indicator light)

Auto switch part no.	D-R731, D-R732	
Applicable load	Relay, PLC	
Load voltage	100VAC	24VDC
Maximum load current and load current range	5 to 20mA	5 to 40mA
Contact protection circuit	Not available	
Internal voltage drop	2.4V or less	
Indicator light	Red LED lights up when ON	

#### D-R80□ (without indicator light)

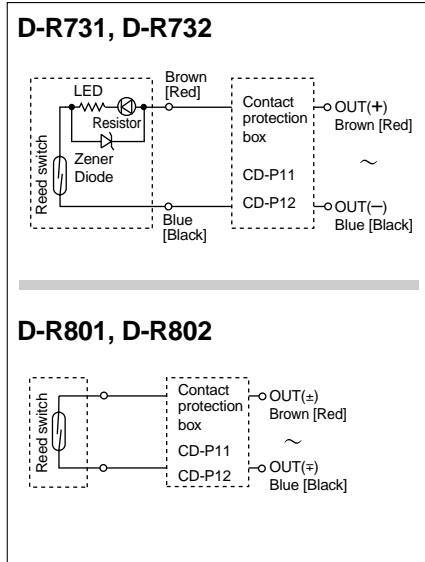
Auto switch part no.	D-R801, D-R802		
Applicable loads	Relay, IC circuit, PLC		
Load voltage	24V <sup>AC</sup> <sub>DC</sub> or less	48V <sup>AC</sup> <sub>DC</sub>	100V <sup>AC</sup> <sub>DC</sub>
Maximum load current and load current range	50mA	40mA	20mA
Contact protection circuit	Not available		
Internal voltage drops	0		
Indicator light	None		

• Lead wires — Oilproof heavy-duty vinyl cord: 0.5m, 0.2mm<sup>2</sup> x 2 cores [Brown, Blue (Red, Black)]  
Note) Refer to page 91 for auto switch common specifications and lead wire length.



### Internal circuits

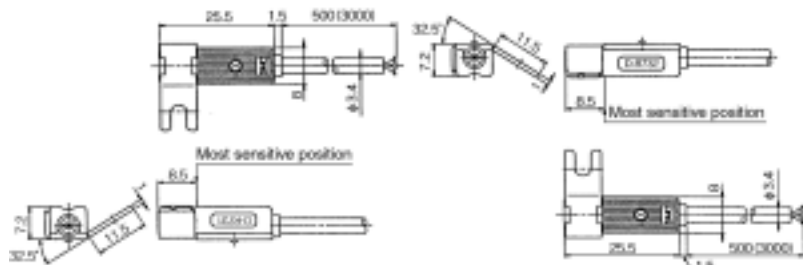
Lead wire colors inside ( ) are those prior to conformity with IEC standards.



### Dimensions

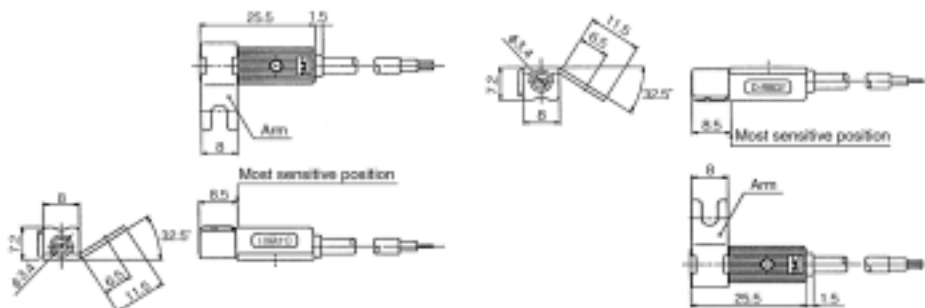
#### D-R731: Right-hand type

#### D-R732: Left-hand type



#### D-R801: Right-hand type

#### D-R802: Left-hand type



# Reed Switches: Direct Mount Type

## D-R73□C, D-R80□C

**Connector**  
Electrical entry direction: In-line



### Specifications

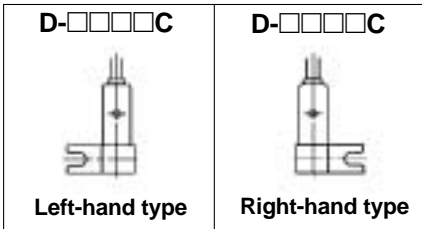
#### D-R73□C (with indicator light)

Auto switch part no.	D-R731C, D-R732C
Applicable load	Relay, PLC
Load voltage	24VDC
Load current range	5 to 40mA
Contact protection circuit	Not available
Internal voltage drop	2.4V or less
Indicator light	Red LED lights up when ON

#### D-R80□C (without indicator light)

Auto switch part no.	D-R801C, D-R802C
Applicable load	Relay, PLC
Load voltage	24V <sup>AC</sup> or less
Load current range	50mA
Contact protection circuits	Not available
Internal voltage drops	0
Indicator light	None

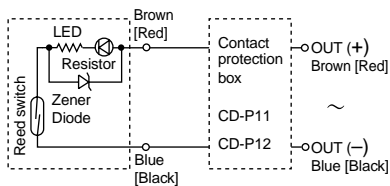
• Lead wires — Oilproof heavy-duty vinyl cord: 0.5m,  $\phi 3.4$ , 0.2mm<sup>2</sup> x 2 cores [Brown, Blue (Red, Black)]  
Note) Refer to page 91 for auto switch common specifications and lead wire length.



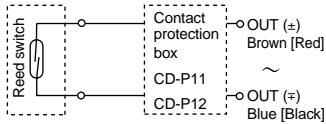
### Internal circuits

Lead wire colors inside ( ) are those prior to conformity with IEC standards.

#### D-R731C, D-R732C

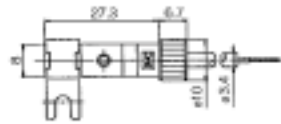


#### D-R801C, D-R802C

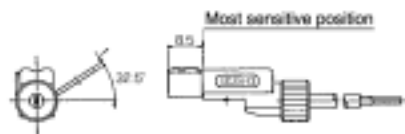


### Dimensions

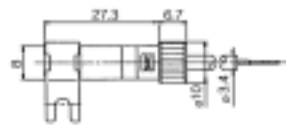
#### D-R731C: Right-hand type



#### D-R732C: Left-hand type



#### D-R801C: Right-hand type

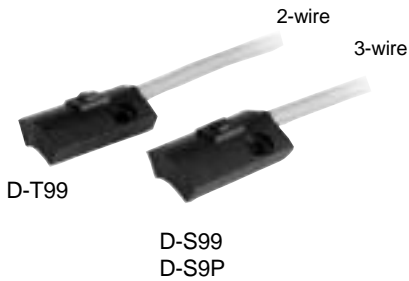


#### D-R802C: Left-hand type



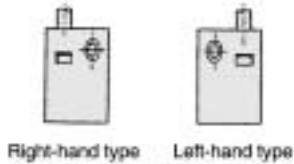
# Solid State Switches: Direct Mount Type D-S99(V), D-S9P(V), D-T99(V)

## Grommet



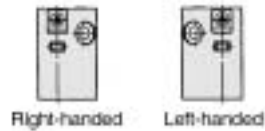
D-□991

D-□992



D-□99V1

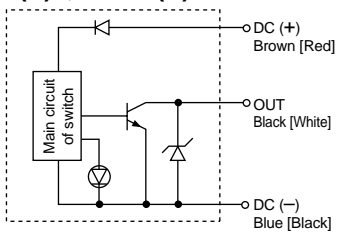
D-□99V2



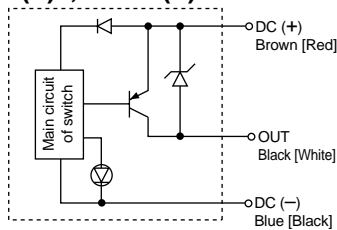
## Auto switch internal circuits

Lead wire colors inside ( ) are those prior to conformity with IEC standards.

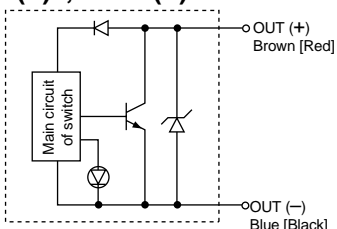
### D-S99(V)1, D-S99(V)2



### D-S9P(V)1, D-S9P(V)2



### D-T99(V)1, D-T99(V)2



## Specifications

### D-S99(V), D-S9P(V), D-T99(V) (with indicator light)

Auto switch part no.	D-S991 D-S992	D-S99V1 D-S99V2	D-S9P1 D-S9P2	D-S9PV1 D-S9PV2	D-T991 D-T992	D-T99V1 D-T99V2
Electrical entry direction	In-line	Perpendicular	In-line	Perpendicular	In-line	Perpendicular
Wiring type	3-wire				2-wire	
Output type	NPN		PNP		—	
Applicable load	IC circuit, Relay, PLC				24VDC Relay, PLC	
Power supply voltage	5, 12, 24VDC (4.5 to 28VDC)				—	
Current consumption	10mA or less				—	
Load voltage	28VDC or less		—		24VDC (10 to 28VDC)	
Load current	40mA or less		80mA or less		5 to 40mA	
Internal voltage drop	1.5V or less (0.8V or less at 10mA load current)		0.8V or less		4V or less	
Leakage current	100μA or less at 24VDC				0.8mA or less at 24VDC	
Indicator light	Red LED lights up when ON					

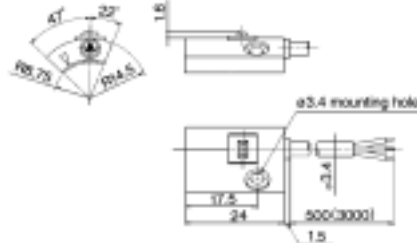
• Lead wires — Oilproof heavy-duty vinyl cord, 0.5m, ø3.4, 0.2mm<sup>2</sup> x 3 cores [Brown, Black, Blue (Red, White, Black)]  
0.2mm<sup>2</sup> x 2 cores [Brown, Blue (Red, Black)]

(Note) Refer to page 91 for auto switch common specifications and lead wire length.

## Dimensions

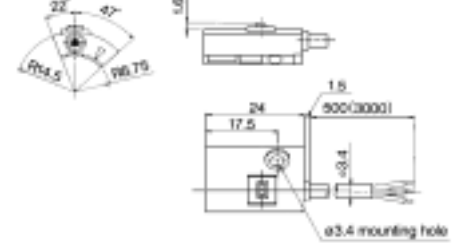
### D-S991: Right-hand type

### D-S9P1:

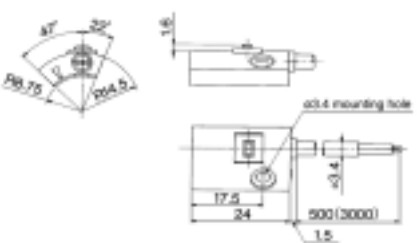


### D-S992: Left-hand type

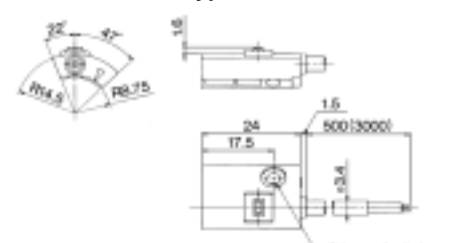
### D-S9P2:



### D-T991: Right-hand type

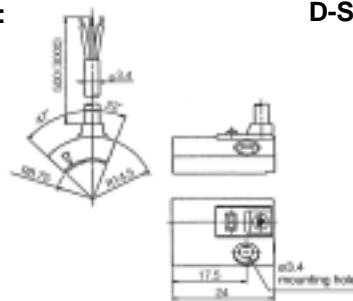


### D-T992: Left-hand type



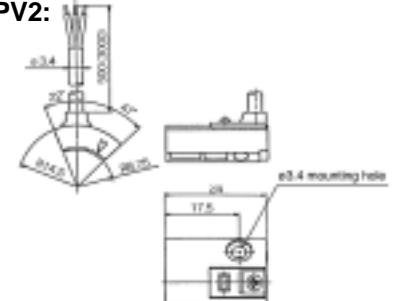
### D-S99V1: Right-hand type

### D-S9PV1:

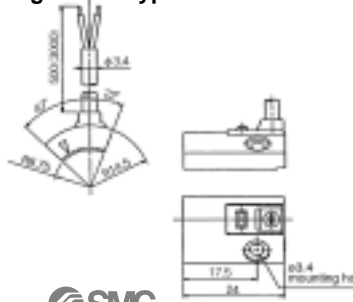


### D-S99V2: Left-hand type

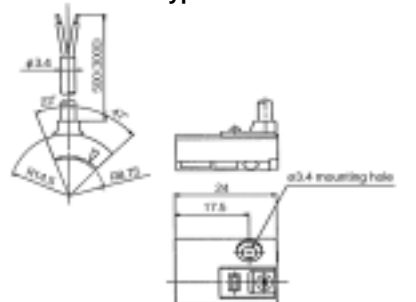
### D-S9PV2:



### D-T99V1: Right-hand type



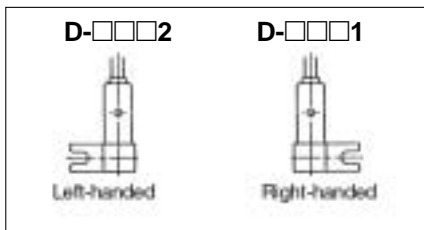
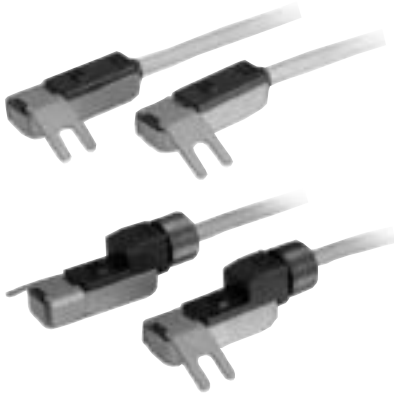
### D-T99V2: Left-hand type



# Solid State Switches: Direct Mount Type

## D-S79, D-S7P, D-T79(C)

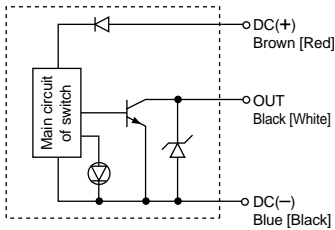
**Grommet, Connector**  
Electrical entry direction: In-line



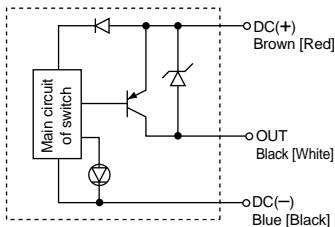
### Auto switch internal circuits

Lead wire colors inside ( ) are those prior to conformity with IEC standards.

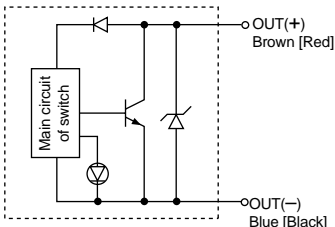
#### D-S791, D-S792



#### D-S7P1, D-S7P2



#### D-T791(C), D-T792(C)



## Specifications

### D-S79, D-S7P, D-T79 (with indicator light)

Auto switch model no.	D-S791, D-S792	D-S7P1, D-S7P2	D-T791, D-T792, D-T791C, D-T792C
Wiring type	3-wire		2-wire
Output type	NPN	PNP	—
Applicable load	IC circuit, Relay, PLC		24VDC relay, PLC
Power supply voltage	5, 12, 24VDC (4.5 to 28VDC)		—
Current consumption	10mA or less		—
Load voltage	28VDC or less	—	24VDC (10 to 28VDC)
Load current	40mA or less	80mA or less	5 to 40mA
Internal voltage drop	1.5V or less (0.8V or less at 10mA load current)	0.8V or less	4V or less
Leakage current	100μA or less at 24VDC		0.8mA or less at 24VDC
Indicator light	Red LED lights up when ON		

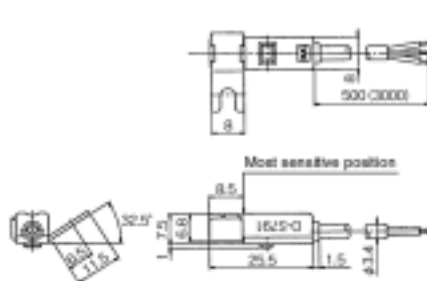
• Lead wires — Oilproof heavy-duty vinyl cord, 0.5m,  $\phi 3.4$ , 0.2mm<sup>2</sup> x 3 cores [Brown, Black, Blue (Red, White, Black)]  
0.2mm<sup>2</sup> x 2 cores [Brown, Blue (Red, Black)]

Note) Refer to page 91 for auto switch common specifications and for lead wire length.

## Dimensions

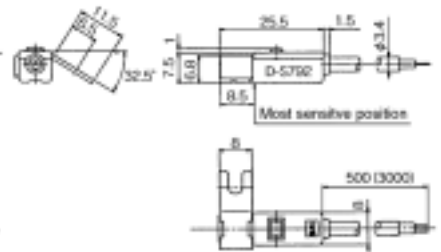
### D-S791: Right-hand type

### D-S7P1:

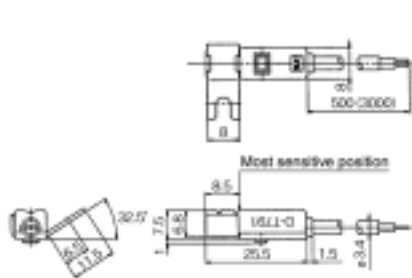


### D-S792: Left-hand type

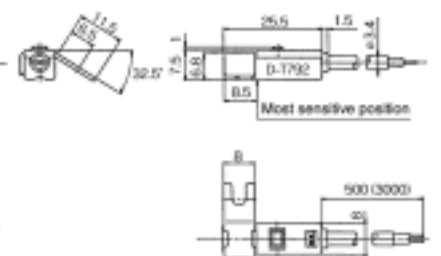
### D-S7P2:



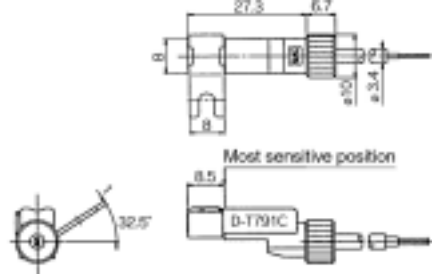
### D-T791: Right-hand type



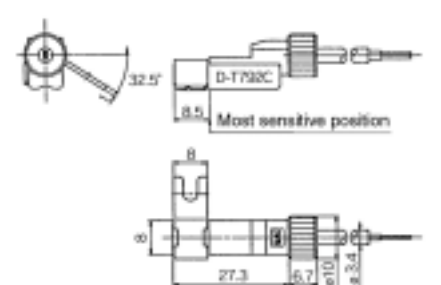
### D-T792: Left-hand type



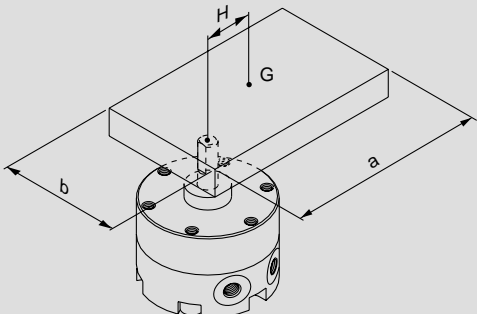
### D-T791C: Right-hand type



### D-T792C: Left-hand type



# Series CRB2/CRBU2/CRB1 Model Selection

Selection Procedure	Formulas	Selection Example										
<p><b>1</b> <b>Operating conditions</b></p> <p>List the operating conditions.</p>	<ul style="list-style-type: none"> <li>• Model used</li> <li>• Operating pressure</li> <li>• Load types               <ul style="list-style-type: none"> <li>Ts (N·m)</li> <li>Tf (N·m)</li> <li>Ta (N·m)</li> </ul> </li> <li>• Load configuration</li> <li>• Rotation time t (s)</li> <li>• Rotation</li> <li>• Load weight m (kg)</li> <li>• Distance between central axis and center of gravity H (mm)</li> </ul>	 <p>Rotary actuator: CRB2BW30-90S; Pressure: 0.5MPa            Mounting orientation: Vertical; Type of load: Inertial load Ta            Load configuration: 60mm x 40mm (rectangular plate)            Rotation time (t): 0.3s; Rotation (θ): 90°            Load weight (m): 0.15kg            Distance between central axis and center of gravity (H): 30mm</p>										
<p><b>2</b> <b>Required torque</b></p> <p>Confirm the type of load as shown below, and select an actuator that satisfies the required torque.</p> <ul style="list-style-type: none"> <li>• Static load: Ts</li> <li>• Resistance load: Tf <b>Load types</b></li> <li>• Inertial load: Ta</li> </ul>	<p>Effective torque ≥ Ts            Effective torque ≥ (3 to 5)·Tf            Effective torque ≥ 10·Ta</p> <p><b>Effective torque</b></p>	<p>Inertial load</p> $10 \times Ta = 10 \times I \times \dot{\omega} = 10 \times 0.0002 \times \pi / 0.3^2 = 0.07 \text{ N}\cdot\text{m} < \text{Effective torque OK}$ <p>Note) "I" substitutes for ⑤, the value for moment of inertia.  <math display="block">\dot{\omega} = \frac{2\theta}{t^2} \text{ (}\dot{\omega}\text{: Angular acceleration)}</math></p>										
<p><b>3</b> <b>Rotation time</b></p> <p>Confirm that it is within the adjustable range of rotation time.</p>	<table border="1"> <thead> <tr> <th>Model</th> <th>Rotation time adjustment range for stable operation S/90°</th> </tr> </thead> <tbody> <tr> <td>CRB2BW/CRBU2W10, 20</td> <td>0.03 to 0.3</td> </tr> <tr> <td>CRB2BW/CRBU2W30</td> <td>0.04 to 0.3</td> </tr> <tr> <td>CRB2BW/CRBU2W40</td> <td>0.07 to 0.5</td> </tr> <tr> <td>CRB1BW50 to 100</td> <td>0.1 to 1</td> </tr> </tbody> </table>	Model	Rotation time adjustment range for stable operation S/90°	CRB2BW/CRBU2W10, 20	0.03 to 0.3	CRB2BW/CRBU2W30	0.04 to 0.3	CRB2BW/CRBU2W40	0.07 to 0.5	CRB1BW50 to 100	0.1 to 1	<p>0.3s/90° OK</p>
Model	Rotation time adjustment range for stable operation S/90°											
CRB2BW/CRBU2W10, 20	0.03 to 0.3											
CRB2BW/CRBU2W30	0.04 to 0.3											
CRB2BW/CRBU2W40	0.07 to 0.5											
CRB1BW50 to 100	0.1 to 1											
<p><b>4</b> <b>Allowable load</b></p> <p>Confirm that the radial load, thrust load, and moment are within the allowable ranges.</p>	<p>Thrust load: <math>m \times 9.8 \leq \text{Allowable load}</math></p> <p><b>Allowable load</b></p>	<p><math>0.15 \times 9.8 = 1.47 \text{ N} &lt; \text{Allowable load OK}</math></p>										
<p><b>5</b> <b>Inertial moment</b></p> <p>Find the load's inertial moment "I" for the energy calculation.</p>	$I = m \times (a^2 + b^2) / 12 + m \times H^2$ <p><b>Inertial moment</b></p>	$I = 0.15 \times (0.06^2 + 0.04^2) / 12 + 0.15 \times 0.03^2 = 0.0002 \text{ kg}\cdot\text{m}^2$										
<p><b>6</b> <b>Kinetic energy</b></p> <p>Confirm that the load's kinetic energy is within the allowable value.</p>	$1/2 \times I \times \dot{\omega}^2 < \text{Allowable energy}$ <p><math>\dot{\omega} = 2\theta / t</math> (ω: Terminal angular velocity)            θ: Rotation angle (rad)            t: Rotation time (s)</p> <p><b>Allowable kinetic energy/Rotation time</b></p>	$1/2 \times (0.0002) \times (2 \times (\pi/2) / 0.3)^2 = 0.01096 \text{ J} < \text{Allowable energy OK}$										

## Effective Torque

Unit: N·m

Size	Vane type	Operating pressure (MPa)									
		0.15	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
10	Single vane	—	0.03	0.06	0.09	0.12	0.15	0.18	—	—	—
	Double vane	—	0.07	0.13	0.19	0.25	0.31	0.37	—	—	—
15	Single vane	0.06	0.10	0.17	0.24	0.32	0.39	0.46	—	—	—
	Double vane	0.13	0.20	0.34	0.48	0.65	0.79	0.93	—	—	—
20	Single vane	0.16	0.23	0.39	0.54	0.70	0.84	0.99	—	—	—
	Double vane	0.33	0.47	0.81	1.13	1.45	1.76	2.06	—	—	—
30	Single vane	0.44	0.62	1.04	1.39	1.83	2.19	2.58	3.03	3.40	3.73
	Double vane	0.90	1.26	2.10	2.80	3.70	4.40	5.20	6.09	6.83	7.49
40	Single vane	0.81	1.21	2.07	2.90	3.73	4.55	5.38	6.20	7.03	7.86
	Double vane	1.78	2.58	4.3	5.94	7.59	9.24	10.89	12.5	14.1	15.8
50	Single vane	1.20	1.86	3.14	4.46	5.69	6.92	8.14	9.5	10.7	11.9
	Double vane	2.70	4.02	6.60	9.21	11.8	14.3	16.7	19.4	21.8	24.2
63	Single vane	2.59	3.77	6.11	8.45	10.8	13.1	15.5	17.8	20.2	22.5
	Double vane	5.85	8.28	13.1	17.9	22.7	27.5	32.3	37.10	41.9	46.7
80	Single vane	4.26	6.18	10.4	14.2	18.0	21.9	25.7	30.0	33.8	37.6
	Double vane	8.70	12.6	21.1	28.8	36.5	44.2	51.8	60.4	68.0	75.6
100	Single vane	8.6	12.2	20.6	28.3	35.9	43.6	51.2	59.7	67.3	75
	Double vane	17.9	25.2	42.0	57.3	72.6	87.9	103	120	135	150

## Load Types

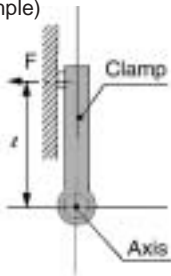
### • Static load: Ts

#### Definition for our purposes:

A load that requires pressing force only, as represented by the clamp.

(If the mass of the clamp itself in the drawing below is considered in the calculations, it should be regarded as an inertial load.)

(Example)



F: Pressing force (N)  
Static torque calculation  
 $T_s = F \times L$  (N·m)

### • Static load: Ts

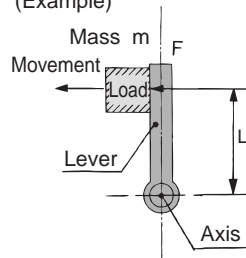
#### Definition for our purposes:

A load that is affected by external forces such as friction or gravity. Since the purpose is to move the load, and speed adjustment is necessary, allow an extra margin of 3 to 5 times in the effective torque.

\* Actuator effective torque  $\geq (3 \text{ to } 5) \times T_f$

(If the mass of the lever itself in the drawing below is considered in the calculations, it should be regarded as an inertial load.)

(Example)



Friction coefficient:  $\mu$

$$F = \mu mg$$

Static torque calculation

$$T_f = F \times L \text{ (N·m)}$$

$$g = 9.8 \text{ m/s}^2$$

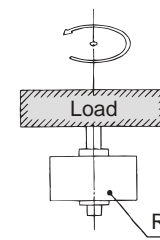
### • Inertial load: Ta

#### Definition for our purposes:

A load that is actually rotated by the actuator. Since the purpose is to rotate the load, and speed adjustment is necessary, allow an extra margin of 10 times or more in the effective torque.

\* Actuator effective torque  $\geq S \times T_a$   
(S is 10 times or more).

#### Accelerating torque calculation



$$T_a = I \cdot \dot{\omega} \text{ (N·m)}$$

I: Inertial moment  
Refer to page 100.

$\dot{\omega}$ : Angular acceleration

$$\dot{\omega} = \frac{2\theta}{t^2} \text{ (rad/s}^2\text{)}$$

$\theta$ : Rotation angle (rad)

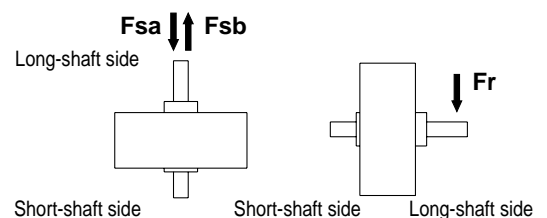
t: Rotation time (S)

## Allowable Load

Application of the load on the axial direction is tolerated if no dynamic load is generated and the values are within what is shown in the table below. However, avoid such operation that the load is applied directly to the shaft.

Unit: N

Model	Load direction		
	Fsa	Fsb	Fr
CRB2BW, CRBU2W10	9.8	9.8	14.7
CRB2BW, CRBU2W15	9.8	9.8	14.7
CRB2BW, CRBU2W20	19.6	19.6	24.5
CRB2BW, CRBU2W30	24.5	24.5	29.4
CRB2BW, CRBU2W40	40	40	60
CRB1BW50	196	196	245
CRB1BW63	340	340	390
CRB1BW80	490	490	490
CRB1BW100	539	539	588



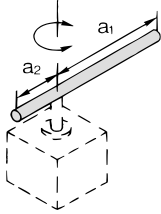


## Inertial Moment

I: Inertial moment kg·m<sup>2</sup>; m: Load weight kg

### 1. Thin shaft

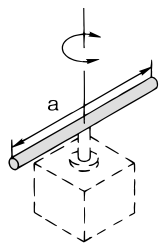
Position of rotational axis: Perpendicular to the shaft anywhere along its length



$$I = m_1 \cdot \frac{a_1^2}{3} + m_2 \cdot \frac{a_2^2}{3}$$

### 2. Thin shaft

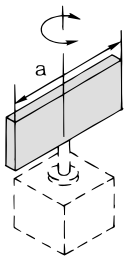
Position of rotational axis: Through the shaft's center of gravity



$$I = m \cdot \frac{a^2}{12}$$

### 3. Thin rectangular plate (rectangular parallelepiped)

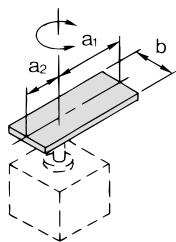
Position of rotational axis: Through the plate's center of gravity



$$I = m \cdot \frac{a^2}{12}$$

### 4. Thin rectangular plate (rectangular parallelepiped)

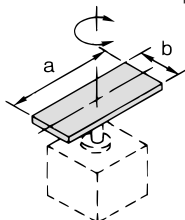
Position of rotational axis: Perpendicular to the plate through one end (also the same in case of a thicker plate)



$$I = m_1 \cdot \frac{4a_1^2 + b^2}{12} + m_2 \cdot \frac{4a_2^2 + b^2}{12}$$

### 5. Thin rectangular plate (rectangular parallelepiped)

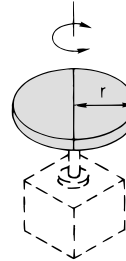
Position of rotational axis: Through the center of gravity and perpendicular to the plate (also the same in case of a thicker plate)



$$I = m \cdot \frac{a^2 + b^2}{12}$$

### 6. Cylinder (including thin round plate)

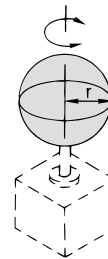
Position of rotational axis: Through the plate's central axis



$$I = m \cdot \frac{r^2}{2}$$

### 7. Solid sphere

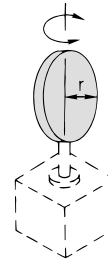
Position of rotational axis: Through the sphere's diameter



$$I = m \cdot \frac{2r^2}{5}$$

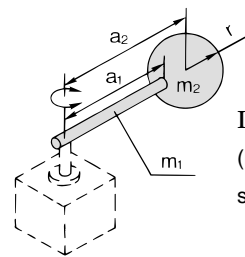
### 8. Thin round plate

Position of rotational axis: Through the plate's diameter



$$I = m \cdot \frac{r^2}{4}$$

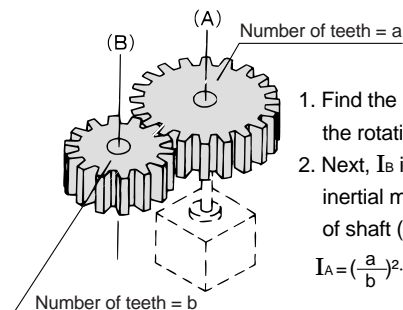
### 9. Load at the end of lever



$$I = m_1 \cdot \frac{a_1^2}{3} + m_2 \cdot a_2^2 + K$$

(Example) When the shape of  $m_2$  is a sphere, refer to 7 above:  $w K = m_2 \cdot \frac{2r^2}{5}$

### 10. Gear transmission



1. Find the inertial moment  $I_B$  for the rotation of shaft (B).
2. Next,  $I_B$  is entered to find the inertial moment  $I_A$  for the rotation of shaft (A) as

$$I_A = \left(\frac{a}{b}\right)^2 \cdot I_B$$

## Kinetic Energy/Rotation Time

Even in cases where the torque required for rotation of the load is small, damage to internal parts may result from the inertial force of the load.

Take into account the load's inertial moment, kinetic energy, and rotation time during operation when making your model selection. (The inertial moment and rotation time charts can be used for your convenience in making model selections.)

### 1. Allowable kinetic energy and rotation time adjustment range

From the table below, set the rotation time within the proper adjustment range for stable operation. Note that slow speed operation exceeding the rotation time adjustment time range may lead to sticking or stopping of operation.

#### CRB2BW, CRBU2W: Sizes 10 to 40

Model	Allowable kinetic energy (J)		Rotation time adjustment range for stable operation (s/90°)
	Single vane	Double vane	
CRB2BW10, CRBU2W10	0.00015	0.003	0.03 to 0.3
CRB2BW15, CRBU2W15	0.001	0.0012	
CRB2BW20, CRBU2W20	0.003	0.0033	
CRB2BW30, CRBU2W30	0.02		0.04 to 0.3
CRB2BW40, CRBU2W40	0.04		0.07 to 0.5

#### CRB1BW: Sizes 50 to 100

Model	Allowable kinetic energy (J)		Rotation time adjustment range for stable operation (s/90°)
	Single vane	Double vane	
CRB1BW50	0.082	0.112	0.1 to 1
CRB1BW63	0.12	0.16	
CRB1BW80	0.398	0.54	
CRB1BW100	0.6	0.811	

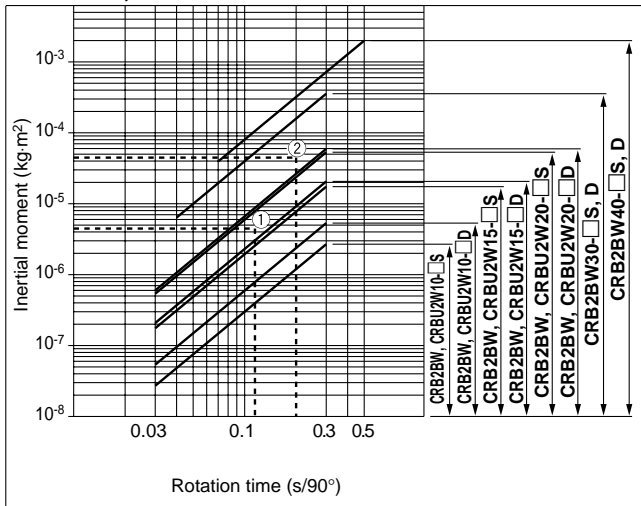
### 2. Inertial moment calculation

Since the formula for inertial moment differs depending on the configuration of the load, refer to the inertial moment calculation formulas on the preceding page.

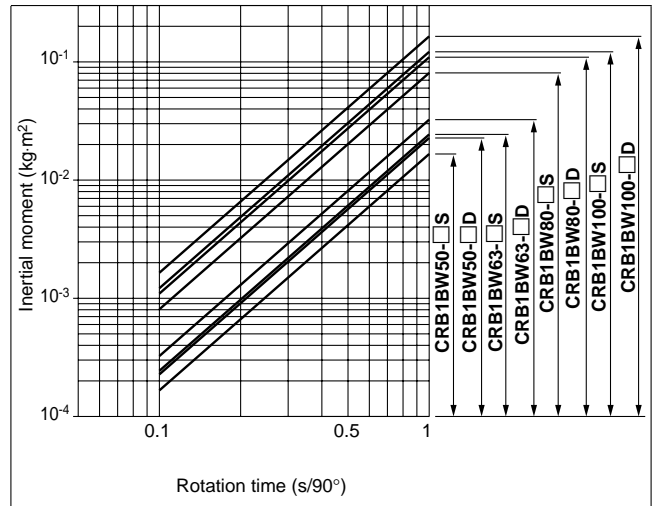
### 3. Model selection

Select models by applying the inertial moment and rotation time that you have calculated to the chart below.

#### CRB2BW, CRBU2W: Sizes 10 to 40



#### CRB1BW: Sizes 50 to 100



#### 1. <How to read the chart>

- Inertial moment .....  $3.5 \times 10^{-6} \text{ kg}\cdot\text{m}^2$
  - Rotation time .....  $0.12\text{s}/90^\circ$
- CRB2BW, CRBU2W20 are selected in this case.

#### 2. <Calculation example>

Load configuration: A cylinder of radius 0.03m and mass 0.1kg  
 Rotation time:  $0.2\text{s}/90^\circ$

$$I = 0.1 \times \frac{0.03^2}{2} = 4.5 \times 10^{-5} \text{ kg}\cdot\text{m}^2$$

In the inertial moment and rotation time chart, find the intersection of the lines extended from the points corresponding to  $4.5 \times 10^{-5} \text{ kg}\cdot\text{m}^2$  on the vertical axis (inertial moment) and  $0.2\text{s}/90^\circ$  on the horizontal axis (rotation time).

Since the resulting intersection point falls within the CRB2BW30 and CRBU2W30 selection range, CRB2BW30, CRBU2W30, CRB2BW40, or CRBU2W40 may be selected.

#### How to calculate the kinetic energy of the load

$$E = \frac{1}{2} \cdot I \cdot \omega^2, \quad \omega = \frac{2\theta}{t}$$

- E: Kinetic energy (J)
- I: Inertial moment of the load ( $\text{kg}\cdot\text{m}^2$ )

- \*  $\omega$ : Angular speed ..... (rad/s)
- $\theta$ : Rotation ..... (rad)
- $180^\circ = 3.14\text{rad}$
- t: Rotation time ..... (s)

\*  $\omega$  calculated using this formula is the angular speed at the end for equiangular accelerated motion.

# Series CRB2/CRBU2/CRB1

# Air Consumption/Required Air Capacity

## Air Consumption

Air consumption is the volume of air that is expended by the rotary actuator's reciprocal operation inside the actuator and in the piping between the actuator and the switching valve. It is required for selection of a compressor and for calculation of its running cost.

\* The air consumption (Q<sub>CR</sub>) required for one reciprocation of a single rotary actuator alone is shown in the table below, and can be used to simplify the calculation.

### Formulas

Q<sub>CR</sub>: When the internal volume of a rotary actuator varies depending on the A and B ports, use formula (1).

$$Q_{CR} = V \times \left( \frac{P + 0.1}{0.1} \right) \times 10^{-3} \dots \dots \dots \text{Formula (1)}$$

$$Q_{CR} = 2V \times \left( \frac{P + 0.1}{0.1} \right) \times 10^{-3} \dots \dots \dots \text{Formula (2)}$$

$$Q_{CP} = 2 \times a \times L \times \frac{P}{0.1} \times 10^{-6} \dots \dots \dots \text{Formula (3)}$$

$$Q_C = Q_{CR} + Q_{CP} \dots \dots \dots \text{Formula (4)}$$

- Q<sub>CR</sub> = Air consumption of rotary actuator [L (ANR)]
- Q<sub>CP</sub> = Air consumption of tubing or piping [L (ANR)]
- V = Internal volume of rotary actuator [cm<sup>3</sup>]
- P = Operating pressure [MPa]
- L = Piping length [mm]
- a = Internal cross section of piping [mm<sup>2</sup>]
- Q<sub>C</sub> = Air consumption required for one reciprocation of rotary actuator [L (ANR)]

When selecting a compressor, it is necessary to choose one that has sufficient reserve for the total downstream air consumption of all pneumatic actuators. This is affected by factors such as leakage in piping, consumption by drain valves and pilot valves, and reduction of air volume due to temperature drops.

### Formula

$$Q_{C2} = Q_C \times n \times \text{Number of actuators} \times \text{Reserve factor} \dots \dots \dots \text{Formula (5)}$$

Q<sub>C2</sub> = Compressor discharge flow rate [L/min (ANR)]

n = Actuator reciprocations per minute

Reserve factor = 1.5 or more

### Internal cross section of tubing and steel piping

Nominal size	O.D. (mm)	I.D. (mm)	Internal cross section a (mm <sup>2</sup> )
<b>T□ 0425</b>	4	2.5	4.9
<b>T□ 0604</b>	6	4	12.6
<b>TU 0805</b>	8	5	19.6
<b>T□ 0806</b>	8	6	28.3
<b>1/8B</b>	—	6.5	33.2
<b>T□ 1075</b>	10	7.5	44.2
<b>TU 1208</b>	12	8	50.3
<b>T□ 1209</b>	12	9	63.6
<b>1/4B</b>	—	9.2	66.5
<b>TS 1612</b>	16	12	113
<b>3/8B</b>	—	12.7	127
<b>T□ 1613</b>	16	13	133
<b>1/2B</b>	—	16.1	204

## Required Air Capacity

Required air capacity is the volume of air that is required to operate the rotary actuator at a certain speed. It is required for selection of an air preparation equipment and piping size.

### Formula

$$Q_R = 30 \times \frac{Q_C}{t} \dots \dots \dots \text{Formula (6)}$$

Q<sub>R</sub> = Required air capacity [L/min (ANR)]

Q<sub>C</sub> = Air consumption required for one reciprocation of rotary actuator [L (ANR)]

..... Formula (4)

t = Rotation time (one-way) of rotary actuator [s]

## Air Consumption

<Table 1> CRB2, CRBU2, CRB1


Unit: L (ANR)


Vane type	Size	Rotation	Volume: V(cm <sup>3</sup> )		Operating pressure (MPa)									
			Pressurized port: A	Pressurized port: B	0.15	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
Single vane	10	90	0.6	1.0	—	0.005	0.006	0.008	0.009	0.011	0.013	—	—	—
		180	1.2		—	0.007	0.010	0.012	0.014	0.017	0.019	—	—	—
		270	1.5		—	0.009	0.012	0.015	0.018	0.021	0.024	—	—	—
	15	90	1.0	1.5	0.006	0.007	0.010	0.012	0.015	0.017	0.020	—	—	—
		180	2.9		0.014	0.017	0.023	0.029	0.034	0.040	0.046	—	—	—
		270	3.7		0.018	0.022	0.029	0.037	0.044	0.051	0.059	—	—	—
	20	90	3.6	4.8	0.021	0.025	0.033	0.042	0.050	0.058	0.066	—	—	—
		180	6.1		0.030	0.036	0.048	0.060	0.072	0.084	0.097	—	—	—
		270	7.9		0.039	0.047	0.063	0.078	0.094	0.109	0.125	—	—	—
	30	90	8.5	11.3	0.049	0.059	0.078	0.098	0.118	0.137	0.157	0.176	0.196	0.215
		180	15		0.074	0.089	0.119	0.148	0.178	0.208	0.237	0.267	0.297	0.326
		270	20.2		0.100	0.120	0.160	0.200	0.240	0.280	0.320	0.359	0.399	0.439
	40	90	21	25	0.114	0.137	0.182	0.228	0.273	0.318	0.364	0.409	0.455	0.500
		180	31.5		0.156	0.187	0.250	0.312	0.374	0.436	0.498	0.561	0.623	0.685
		270	41		0.203	0.244	0.325	0.406	0.487	0.568	0.649	0.730	0.811	0.891
	50	90	30		0.149	0.178	0.238	0.297	0.356	0.415	0.475	0.534	0.593	0.652
		100	32		0.159	0.190	0.254	0.317	0.380	0.443	0.506	0.569	0.633	0.696
		180	49		0.243	0.291	0.388	0.485	0.582	0.678	0.775	0.872	0.969	1.065
		190	51		0.253	0.303	0.404	0.505	0.605	0.706	0.807	0.908	1.008	1.109
		270	66		0.327	0.393	0.523	0.653	0.784	0.914	1.044	1.174	1.305	1.435
		280	68		0.337	0.405	0.539	0.673	0.807	0.942	1.076	1.210	1.344	1.479
	63	90	70		0.347	0.416	0.555	0.693	0.831	0.969	1.107	1.246	1.384	1.522
		100	73		0.362	0.434	0.578	0.723	0.867	1.011	1.155	1.299	1.443	1.587
		180	94		0.466	0.559	0.745	0.930	1.116	1.302	1.487	1.673	1.858	2.044
		190	97		0.481	0.577	0.769	0.960	1.152	1.343	1.535	1.726	1.918	2.109
		270	118		0.585	0.702	0.935	1.168	1.401	1.634	1.867	2.100	2.333	2.566
		280	121		0.600	0.720	0.959	1.198	1.436	1.675	1.914	2.153	2.392	2.631
	80	90	88		0.437	0.523	0.697	0.871	1.045	1.218	1.392	1.566	1.740	1.913
		100	93		0.461	0.553	0.737	0.920	1.104	1.288	1.471	1.655	1.839	2.022
		180	138		0.685	0.821	1.093	1.366	1.638	1.911	2.183	2.456	2.728	3.001
190		143		0.709	0.851	1.133	1.415	1.698	1.980	2.262	2.545	2.827	3.109	
270		188		0.933	1.118	1.490	1.861	2.232	2.603	2.974	3.345	3.717	4.088	
280		193		0.958	1.148	1.529	1.910	2.291	2.672	3.053	3.434	3.815	4.196	
100	90	186		0.923	1.106	1.474	1.841	2.208	2.575	2.943	3.310	3.677	4.044	
	100	197		0.977	1.172	1.561	1.950	2.339	2.728	3.117	3.506	3.894	4.283	
	180	281		1.394	1.672	2.226	2.781	3.336	3.891	4.446	5.000	5.555	6.110	
	190	292		1.449	1.737	2.314	2.890	3.467	4.043	4.620	5.196	5.773	6.349	
	270	376		1.866	2.237	2.979	3.721	4.464	5.206	5.948	6.691	7.433	8.175	
	280	387		1.920	2.302	3.066	3.830	4.594	5.358	6.122	6.887	7.651	8.415	
Double vane	10	90	1.0		—	0.006	0.008	0.010	0.012	0.014	0.016	—	—	—
		100	1.1		—	0.007	0.009	0.011	0.013	0.015	0.017	—	—	—
	15	90	2.6		0.013	0.015	0.021	0.026	0.031	0.036	0.041	—	—	—
		100	2.7		0.013	0.016	0.021	0.027	0.032	0.037	0.043	—	—	—
	20	90	5.6		0.028	0.033	0.044	0.055	0.066	0.078	0.089	—	—	—
		100	5.7		0.028	0.034	0.045	0.056	0.068	0.079	0.090	—	—	—
	30	90	14.4		0.071	0.086	0.114	0.143	0.171	0.199	0.228	0.256	0.285	0.313
		100	14.5		0.072	0.086	0.115	0.144	0.172	0.201	0.229	0.258	0.287	0.315
	40	90	33		0.164	0.196	0.261	0.327	0.392	0.457	0.522	0.587	0.652	0.718
		100	34		0.169	0.202	0.269	0.337	0.404	0.471	0.538	0.605	0.672	0.739
	50	90	48		0.238	0.286	0.380	0.475	0.570	0.665	0.759	0.854	0.949	1.044
		100	52		0.258	0.309	0.412	0.515	0.617	0.720	0.823	0.925	1.028	1.131
	63	90	98		0.486	0.583	0.776	0.970	1.163	1.357	1.550	1.744	1.937	2.131
		100	104		0.516	0.619	0.824	1.029	1.235	1.440	1.645	1.851	2.056	2.261
	80	90	136		0.675	0.809	1.078	1.346	1.615	1.883	2.152	2.420	2.689	2.957
		100	146		0.724	0.869	1.157	1.445	1.733	2.022	2.310	2.598	2.886	3.175
	100	90	272		1.350	1.618	2.155	2.692	3.229	3.766	4.303	4.840	5.377	5.914
		100	294		1.459	1.749	2.329	2.910	3.490	4.071	4.651	5.232	5.812	6.393




# Series *CRB2/CRBU2/CRB1* Safety Instructions

These safety instructions are intended to prevent a hazardous situation and/or equipment damage. These instructions indicate the level of potential hazard by a label of "**Caution**", "**Warning**", or "**Danger**". To ensure safety, be sure to observe ISO 4414 Note 1), JIS B 8370 Note 2) and other safety practices.

 **Caution** : Operator error could result in injury or equipment damage.

 **Warning** : Operator error could result in serious injury or loss of life.

 **Danger** : In extreme conditions, there is a possible result of serious injury or loss of life.

Note 1) ISO 4414: Pneumatic fluid power – Recommendations for the application of equipment to transmission and control systems

Note 2) JIS B 8370: General Rules for Pneumatic Equipment

## **Warning**

### **1. The compatibility of pneumatic equipment is the responsibility of the person who designs the pneumatic system or decides its specifications.**

Since the products specified here are used in various operating conditions, their compatibility with the specific pneumatic system must be based on specifications or after analysis and/or tests to meet your specific requirements.

### **2. Only trained personnel should operate pneumatically operated machinery and equipment.**

Compressed air can be dangerous if handled incorrectly. Assembly, handling or repair of pneumatic systems should be performed by trained and experienced operators.

### **3. Do not service machinery/equipment or attempt to remove components until safety is confirmed.**

1. Inspection and maintenance of machinery/equipment should only be performed after confirmation of safe locked-out control positions.
2. When equipment is to be removed, confirm the safety process as mentioned above. Cut the supply pressure for this equipment and exhaust all residual compressed air in the system.
3. Before machinery/equipment is restarted, take measures to prevent shooting-out of cylinder piston rod, etc. (Bleed air into the system gradually to create back pressure.)

### **4. Contact SMC if the product is to be used in any of the following conditions:**

1. Conditions and environments beyond the given specifications, or if product is used outdoors.
2. Installation on equipment in conjunction with atomic energy, railway, air navigation, vehicles, medical equipment, food and beverages, recreation equipment, emergency stop circuits, press applications, or safety equipment.
3. An application which has the possibility of having negative effects on people, property, or animals, requiring special safety analysis.



## Series CRB2/CRBU2/CRB1

# Rotary Actuator Precautions 1

Be sure to read before handling.

### Design

#### ⚠ Warning

1. **The machinery should be designed to ensure a safety for load variations, lifting/lowering operations, or changes in frictional resistance.**

Operating speed will increase, and bodily injury may occur, or damage to the machinery itself may occur.

2. **A protective cover is recommended to minimize the risk of personal injury.**

If a driven object and moving parts of an actuator pose a danger of personal injury, design the structure to avoid contact with the human body.

3. **Securely tighten all stationary parts and connected parts so that they will not become loose.**

Particularly when a rotary actuator operates with high frequency or is installed where there is a lot of vibration, ensure that all parts remain secure.

4. **A shock absorber may be required.**

When a driven object is operated at high speed or the load is heavy, there is a danger of exceeding the allowable kinetic energy of the rotary actuator. Therefore, install an external shock absorber to relieve the impact before reaching the end of rotation. In this case, the rigidity of the machinery should also be examined.

5. **Take into account a possible drop in operating pressure due to a power outage.**

When an actuator is used as clamping mechanism, there is a danger of work piece dropping if there is a decrease in clamping force due to a drop in circuit pressure caused by a power outage. Therefore, safety equipment should be installed to prevent damage to machinery and bodily injury.

6. **Take into account a possible loss of power source.**

Measures should be taken to protect against bodily injury and equipment damage in the event that there is a loss of power to equipment controlled by pneumatics, electricity, or hydraulics.

7. **Design circuitry that takes residual pressure into a consideration when a speed controller is installed at exhaust side.**

If the supply side is pressurized when there is no residual pressure on the exhaust side, the actuator may operate abnormally fast and this can cause bodily injury, and/or damage to equipment.

8. **Take into account emergency stops.**

Design the system so that bodily injury and/or damage to machinery and equipment will not occur when machinery is stopped by a manual emergency stop or a safety device triggered by abnormal conditions such as a power outage.

9. **Take into account the action of the system when operation is restarted after an emergency stop or abnormal stop.**

Design machinery so that bodily injury or equipment damage will not occur upon restart of operation.

When the actuator has to be reset at the starting position, install safe manual control equipment.

### Design

#### ⚠ Warning

10. **Do not use this product as a shock absorbing mechanism.**

If abnormal pressure or leakage occurs, there may be a drastic loss of deceleration effectiveness, leading to danger of bodily injury as well as damage to equipment and machinery.

### Selection

#### ⚠ Warning

1. **Keep the speed setting within the product's allowable energy value.**

Operating with the kinetic energy of the load exceeding the allowable value can damage to the product, leading to bodily injury as well as damage to equipment and machinery.

2. **Provide a shock absorbing mechanism when kinetic energy applied to the product exceeds the allowable value.**

Operation of the actuator exceeding its allowable kinetic energy can damage the product, leading to bodily injury and damage to equipment and machinery.

3. **Do not perform intermediate stop or holding operations by trapping air pressure inside the actuator.**

If the operation of the actuator without an external stop mechanism is stopped at an intermediate position by trapping air pressure with a directional control valve, the stopping position may not be hold due to leakage. This can cause bodily injury and damage to equipment and machinery.

#### ⚠ Caution

1. **Do not operate the product at low speeds that are below the prescribed speed adjustment range.**

Operating at low speeds below the speed adjustment range may cause sticking and slipping or stopping of operation.

2. **Do not apply external torque that exceeds the product's rated output.**

Applying external force exceeding the product's rated output can damage the actuator.

3. **When repeatability of the rotation angle is required, the load should be directly stopped externally.**

The initial rotation angle may vary even for the actuator equipped with angle adjustment.

4. **Avoid operation with hydraulic system.**

Operation on hydraulic systems can damage the product.

5. **Allow a torque margin for the actuator when the load variations are anticipated.**

When the actuator is mounted horizontally (i.e., the actuator is in a lateral direction), load variations can cause adverse effects to the actuator.



# Series CRB2/CRBU2/CRB1 Rotary Actuator Precautions 2

Be sure to read before handling.

## Mounting

### ⚠ Warning

1. Be sure to keep equipment from rotating any more than necessary when the angle is adjusted by supplying pressure.

When the angle is adjusted by supplying air, the actuator may rotate and fall during the adjustment depending on its mounting orientation. This can cause bodily injury and damage to equipment and machinery.

2. Do not loosen the angle adjustment screw beyond the adjustment range.

Loosening the angle adjustment screw past the adjustment range can cause the screw to come out causing bodily injury and damage to equipment and machinery.

3. Do not allow external magnetism near the actuator.

Since the auto switches are sensitive to magnetism, external magnetism in close proximity to the actuator can cause malfunction leading to bodily injury and damage to equipment and machinery.

4. Do not perform additional machining on the product.

Additional machining of the product can adversely affect product strength and damage the actuator, leading to bodily injury and damage to equipment and machinery.

5. Do not enlarge the fixed restrictor on the piping port by remachining.

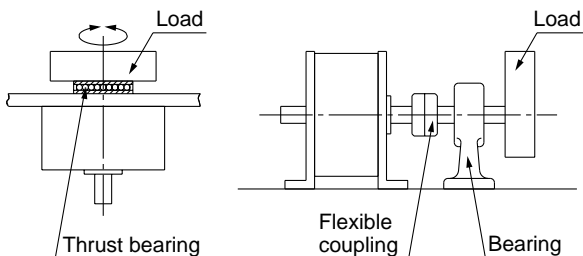
Enlarging the bore size will increase the rotation speed and impact force. This can damage the actuator leading to bodily injury and damage to equipment and machinery.

6. Avoid direct connection with output shaft, but rather align using a shaft coupling with a sufficient degree of freedom to absorb the decenter and deflection angle when using on the load side.

Directly connecting a bearing and output shaft will cause twisting due to the decenter and deflection angle, and this can cause a malfunction leading to bodily injury and damage to equipment and machinery.

7. Do not apply loads to the shaft exceeding the values shown on page 99.

Applying loads exceeding the allowable values to the actuator can cause the actuator to malfunction and leading to bodily injury and damage to equipment and machinery.



A load up to the allowable radial/thrust load can be applied provided that a dynamic load is not generated. However, applications that a load is directly applied to the shaft should be avoided whenever possible. In order to further improve operating conditions, methods such as shown in the drawings above are recommended so that the direct load is not applied to the shaft.

### ⚠ Warning

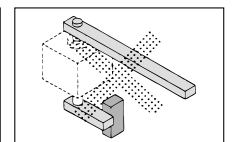
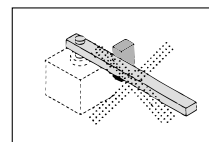
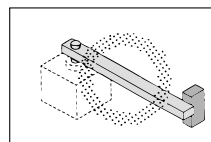
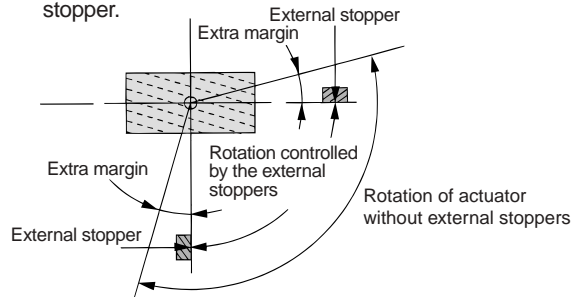
8. Install external stoppers away from the axis of rotation.

If the stopper is installed close to the axis of rotation, the reactive force operating on the stopper due to torque generated by the actuator itself will be applied to the shaft. This can damage the shaft and bearing, leading to bodily injury and damage to equipment and machinery.

#### Precautions when using external stoppers

When the kinetic energy generated by the load exceeds the limit value of the actuator, an external absorbing mechanism must be provided to absorb the energy.

The figure below illustrates the correct mounting of the external stopper.



External stopper becomes a fulcrum, and the load's inertial force is applied to the shaft as a bending moment.

If an external stopper is installed on the shaft side opposite the load, the inertial force generated by the load is applied directly to the shaft.

### ⚠ Caution

1. Secure the block of the angle adjustment unit using the specified torque range.

Using a tightening torque below the specified value can cause the block to slip out of position and exceed its set angle during operation.

2. Do not wipe the model number on the label with solutions such as organic solvents.

Using such solutions to wipe the label can erase the model numbers.

3. Do not strike the shaft while the body is secured, or strike the body while the shaft is secured.

This can bend the shaft and damage the bearing. Secure the shaft when installing a load on the shaft.

4. Do not step directly on the shaft or the equipment installed on the shaft.

Stepping directly on the shaft can damage the shaft and bearing.

5. Operate the actuator with the angle adjustment mechanism within the specified adjustment range.

Operating beyond the adjustment range can cause malfunctioning and damage to the actuator. Refer to product specifications for the adjustment range of each product.



## Series CRB2/CRBU2/CRB1

# Rotary Actuator Precautions 3

Be sure to read before handling.

### Air Supply

#### ⚠ Warning

##### 1. Use clean air.

Do not use compressed air which contains chemicals, synthetic oils containing organic solvents, salt, or corrosive gases, as this can cause damage or malfunction.

#### ⚠ Caution

##### 1. Install air filters.

Install air filters at the inlet side of valves. The filtration degree should be 5 $\mu$ m or finer.

##### 2. Install an after-cooler, air dryer, or water separator (Drain Catch).

Compressed air that includes excessive drainage or condensate may cause malfunction of rotary actuators and other pneumatic equipment. To prevent this, install an after-cooler, air dryer, or water separator (Drain Catch).

##### 3. Use the product within the specified range of fluid and ambient temperature.

Take measures to prevent freezing since moisture in circuits can freeze at, or below 5°C, and this can cause damage to seals and lead to malfunctions.

Refer to SMC's "Air Cleaning Equipment" catalog for further details on compressed air quality.

### Operating Environment

#### ⚠ Warning

##### 1. Do not use in environments where there is a danger of corrosion.

Refer to the construction drawings regarding materials of rotary actuators.

##### 2. Do not use in dusty environments or where exposure to water and oil spray or splash are expected.

### Speed Adjustment

#### ⚠ Warning

##### 1. Adjust the speed gradually increasing from a low speed to the desired setting.

Adjusting the speed from a high speed can damage machinery and bodily injury.

### Lubrication

#### ⚠ Caution

##### 1. Operate without lubrication from a pneumatic system lubricator. The actuator can be operated with lubrication; however, stick-slip will occur.

### Maintenance

#### ⚠ Warning

##### 1. Perform maintenance inspection according to the procedure indicated in the instructional manual. Improper handling and maintenance may cause malfunctioning and damage of machinery or equipment to occur.

##### 2. Do not disassemble the actuator while the power and supply air are turned on during maintenance inspection.

##### 3. Conduct suitable function tests after the product has been disassembled for maintenance inspection.

Failure to test functions can result in inability to satisfy the product specifications.

#### ⚠ Caution

##### 1. For lubrication, use the grease specified for each product.

The use of a lubricant other than specified can cause damage to seals.





# Series CRB2/CRBU2/CRB1

## Auto Switch Precautions 1

Be sure to read before handling.

### Design and Selection

#### Warning

##### 1. Confirm the specifications.

Read the specifications carefully and use the product appropriately. The product may be damaged or malfunction if it is used outside the range of specifications of load current, voltage, temperature, or impact.

##### 2. Take precautions when multiple actuators are used close together.

When two or more auto switch actuators are lined up in close proximity to each other, magnetic field interference may cause the switches to malfunction. Maintain a minimum actuator separation of 10mm. (When the allowable interval is specified for each actuator series, use the indicated value.)

##### 3. Keep wiring as short as possible.

<Reed switches>

As the length of the wiring to a load gets longer, the rush current at switching on becomes greater, and this may shorten the product's life. (The switch will stay on all the time.)

- 1) For an auto switch without a contact protection circuit, use a contact protection box when the wire length is 5m or longer.
- 2) Even when an auto switch has a built-in contact protection circuit, if the lead wire length is 30m or more, the rush current cannot be adequately absorbed and the life of the switch may be shortened. Contact SMC in this case, as it will be necessary to connect a contact protection box to extend the life of the switch.

<Solid state switches>

- 3) Although wire length should not affect switch function, use a wire that is 100m or shorter.

##### 4. Monitor the internal voltage drop of the switch.

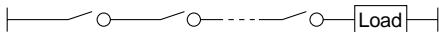
<Reed switches>

- 1) Switches with an indicator light

- If auto switches are connected in series as shown below, take note that there will be a large voltage drop because of internal resistance in the light emitting diodes. (Refer to internal voltage drop in the auto switch specifications.)

[The voltage drop will be "n" times larger when "n" auto switches are connected.]

Even though an auto switch operates normally, the load may not operate.



- Similarly, when operating below a specified voltage, it is possible that the load may be ineffective even though the auto switch function is normal. Therefore, the formula below should be satisfied after confirming the minimum operating voltage of the load.

$$\text{Supply voltage} - \text{Internal voltage drop of switch} > \text{Minimum operating voltage of load}$$

- 2) If the internal resistance of a light emitting diode causes a problem, select a switch without an indicator light.

<Solid state switches>

- 3) Generally, the internal voltage drop will be greater with a 2-wire solid state auto switch than with a reed switch. Take the same precautions as in 1) above.

Also, note that a 12VDC relay is not applicable.

##### 5. Monitor leakage current.

<Solid state switches>

With a 2-wire solid state auto switch, current (leakage current) flows to the load to operate the internal circuit even when in the off state.

$$\text{Current to operate load (off condition)} > \text{Leakage current}$$

If the condition given in the above formula is not met, it will not reset correctly (stays on). Use a 3-wire switch if this specification cannot be satisfied.

Moreover, leakage current flow to the load will be "n" times larger when "n" auto switches are connected in parallel.

##### 6. Do not use a load that generates surge voltage.

<Reed switches>

If driving a load that generates surge voltage, such as a relay, use a switch with a built-in contact protection circuit or a contact protection box.

<Solid state switches>

Although a zener diode for surge protection is connected at the output side of a solid state auto switch, damage may still occur if a surge is applied repeatedly. When directly driving a load which generates surge, such as a relay or solenoid valve, use a type of switch with a built-in surge absorbing element.

##### 7. Cautions for use in an interlock circuit

When an auto switch is used for an interlock signal requiring high reliability, devise a double interlock system to safeguard against malfunctions by providing a mechanical protection function, or by also using another switch (sensor) together with the auto switch.

Also, perform periodic inspection and confirm proper operation.

##### 8. Ensure sufficient clearance for maintenance activities.

When designing an application, be sure to allow sufficient clearance for maintenance and inspections.



# Series CRB2/CRBU2/CRB1

## Auto Switch Precautions 2

Be sure to read before handling.

### Mounting and Adjustment

#### ⚠ Warning

##### 1. Do not drop or bump.

Do not drop, bump, or apply excessive impacts (300m/s<sup>2</sup> or more for reed switches and 1000m/s<sup>2</sup> or more for solid state switches) while handling. Although the body of the switch may not be damaged, the inside of the switch could be damaged and cause a malfunction.

##### 2. Do not carry a rotary actuator by the auto switch lead wires.

Never carry a actuator by its lead wires. This may not only cause broken lead wires, but it may cause internal elements of the switch to be damaged by the stress.

##### 3. Mount switches using the proper tightening torque.

When a switch is tightened beyond the torque range, the mounting screws, mounting bracket or switch may be damaged. On the other hand, tightening below torque range may allow the switch to slip out of position.

##### 4. Mount a switch at the center of the operating range.

Adjust the mounting position of an auto switch so that the piston stops at the center of the operating range (the range in which a switch is on). (The mounting positions shown in the catalog indicate the optimum position at the stroke end.) If mounted at the end of the operating range (around the borderline of on and off), the operation will be unstable.

### Wiring

#### ⚠ Warning

##### 1. Avoid repeatedly bending or stretching lead wires.

Broken lead wires will result from repeatedly applying bending stress or stretching force to the lead wires.

##### 2. Be sure to connect the load before power is applied.

<2-wire type>

If the power is turned on when an auto switch is not connected to a load, the switch will be instantly damaged because of excess current.

##### 3. Confirm proper insulation of wiring.

Be certain that there is no faulty wiring insulation (such as contact with other circuits, ground fault, improper insulation between terminals). Damage may occur due to excess current flow into a switch.

##### 4. Do not wire in conjunction with power lines or high voltage lines.

Wire separately from power lines or high voltage lines, avoiding parallel wiring or wiring in the same conduit with these lines. Control circuits containing auto switches may malfunction due to noise from these other lines.

### Wiring

#### ⚠ Warning

##### 5. Do not allow short circuit of loads.

<Reed switches>

If the power is turned on with a load in a short circuited condition, the switch will be instantly damaged because of excess current flow into the switch.

<Solid state switches>

D-F9□(V), D-F9□W(V) and all models of PNP output type switches do not have built-in short circuit protection circuits. If loads are short circuited, the switches will be instantly damaged, as in the case of reed switches.

Take special care to avoid reverse wiring with the brown power supply line and the black output line on 3-wire type switches.

##### 6. Avoid incorrect wiring.

<Reed switches>

A 24VDC switch with indicator light has polarity. The brown lead wire or terminal No. 1 is (+), and the blue lead wire or terminal No. 2 is (-).

1) If connections are reversed, the switch will still operate, but the light emitting diode will not light up.

Also note that a current greater than the maximum specified one will damage a light emitting diode and make it inoperable.

<Solid state switches>

1) Even if connections are reversed on a 2-wire type switch, the switch will not be damaged because it is protected by a protection circuit, but it will remain in a normally on state. But reverse wiring in a load short circuit condition should be avoided to protect the switch from being damaged.

2) Even if (+) and (-) power supply line connections are reversed on a 3-wire type switch, the switch will be protected by a protection circuit. However, if the (+) power supply line is connected to the blue wire and the (-) power supply line is connected to the black wire, the switch will be damaged.

#### \* Lead wire colour changes

Lead wire colors of SMC switches have been changed in order to meet NECA Standard 0402 for production beginning September, 1996 and thereafter. Please refer to the tables provided. Special care should be taken regarding wire polarity during the time that the old colours still coexist with the new colours.

2-wire			3-wire		
	Old	New		Old	New
Output (+)	Red	Brown	Power supply (+)	Red	Brown
Output (-)	Black	Blue	GND	Black	Blue
			Output	White	Black



# Series **CRB2/CRBU2/CRB1**

## Auto Switch Precautions 3

Be sure to read before handling.

### Operating Environment

#### Warning

##### 1. Never use in an atmosphere of explosive gases.

The construction of auto switches is not intended to prevent explosion. Never use in an atmosphere with an explosive gas since this may cause a serious explosion.

##### 2. Do not use in an area where a magnetic field is generated.

Auto switches will malfunction or magnets inside actuators will become demagnetized. (Consult with SMC regarding the availability of magnetic field resistant auto switches.)

##### 3. Do not use in an environment where the auto switch will be continually exposed to water.

Switches satisfy IEC standard IP67 construction (JIS C 0920: watertight construction). Nevertheless, they should not be used in applications where they are continually exposed to water splash or spray. This may cause deterioration of the insulation or swelling of the potting resin inside switches and may cause a malfunction.

##### 4. Do not use in an environment with oil or chemicals.

Consult with SMC if auto switches will be used in an environment laden with coolants, cleaning solvents, various oils or chemicals. If auto switches are used under these conditions for even a short time, they may be adversely affected by a deterioration of the insulation, a malfunction due to swelling of the potting resin, or hardening of the lead wires.

##### 5. Do not use in an environment with temperature cycles.

Consult with SMC if switches are to be used where there are temperature cycles other than normal temperature changes, as they may be adversely affected internally.

##### 6. Do not use in an environment where there is excessive impact shock.

<Reed switches>

When excessive impact (300m/s<sup>2</sup> or more) is applied to a reed switch during operation, the contact point may malfunction and generate or cut off a signal momentarily (1ms or less). Consult with SMC regarding the need to use a solid state switch depending on the environment.

##### 7. Do not use in an area where surges are generated.

<Solid state switch>

When there are units (such as solenoid type lifters, high frequency induction furnaces, motors) that generate a large amount of surge in the area around actuators with solid state auto switches, their proximity or pressure may cause deterioration or damage to the internal circuit elements of the switches. Avoid sources of surge generation and crossed lines.

##### 8. Avoid accumulation of iron waste or close contact with magnetic substances.

When a large accumulated amount of ferrous waste such as machining chips or welding spatter, or a magnetic substance (something attracted by a magnet) is brought into close proximity to an actuator with auto switches, this may cause the auto switches to malfunction due to a loss of the magnetic force inside the actuator.

### Maintenance

#### Warning

##### 1. Perform the following maintenance inspection and services periodically in order to prevent possible danger due to unexpected auto switch malfunction.

- 1) Securely tighten switch mounting screws.

If screws become loose or the mounting position is dislocated, retighten them after readjusting the mounting position.

- 2) Confirm that there is no damage to lead wires.

To prevent faulty insulation, replace switches or repair lead wires if damage is discovered.

### Other

#### Warning

##### 1. Consult with SMC concerning water resistance, elasticity of lead wires, and usage at welding sites.





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