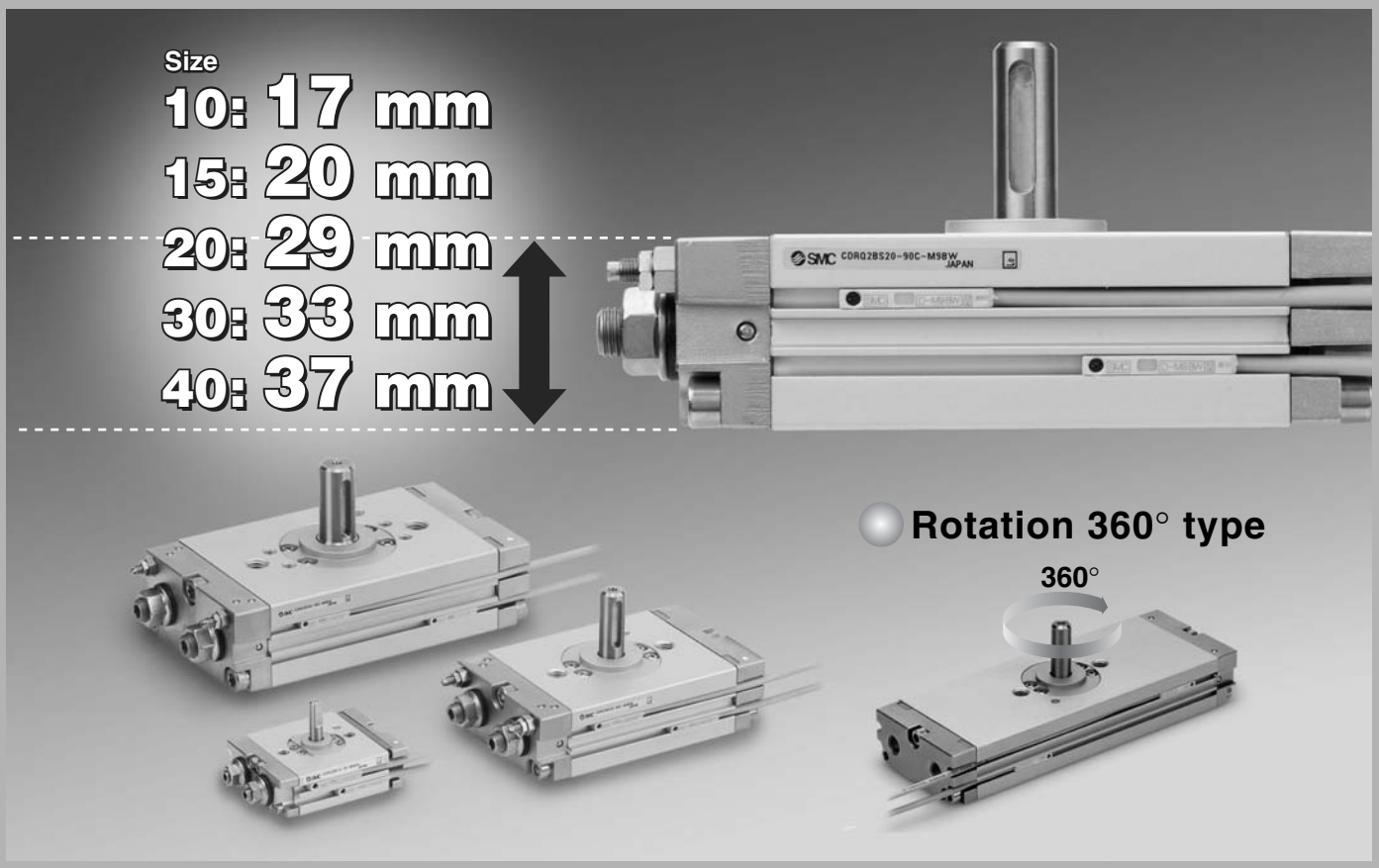
Compact Rotary Actuator

Series CRQ2

Rack & Pinion Style/Size: 10, 15, 20, 30, 40



Series Variations

				Size					Page
				10	15	20	30	40	
Standard	Rotating angle	80° to 100° 170° to 190° 350° to 370°		●	●	●	●	●	P. 246 to P. 253
	Shaft type	Single shaft	S	●	●	●	●	●	
		Double shaft	W	●	●	●	●	●	
	Cushion	None				●	●	●	
		Rubber cushion		●	●				
		Air cushion				●	●	●	
	Variations	With auto switch		●	●	●	●	●	
		Copper-free (Standard)	20-	●	●	●	●	●	
Made to Order	Shaft type	Single shaft with four chamfers	X			●	●	●	P. 254, P. 255
		Double shaft key	Y			●	●	●	
		Double shaft with four chamfers	Z			●	●	●	
		Single round shaft	T	●	●	●	●	●	
		Double shaft (Without long shaft key)	J	●	●	●	●	●	
		Double round shaft	K	●	●	●	●	●	
	Pattern	Shaft end form		●	●	●	●	●	P. 256 to P. 270
		Rotating range		●	●	●	●	●	
	Shaft and parallel key stainless steel spec.		-X6	●	●	●	●	●	

Compact Rotary Actuator

Rack & Pinion Style/Size: 10, 15, 20, 30, 40

Built-in cushion

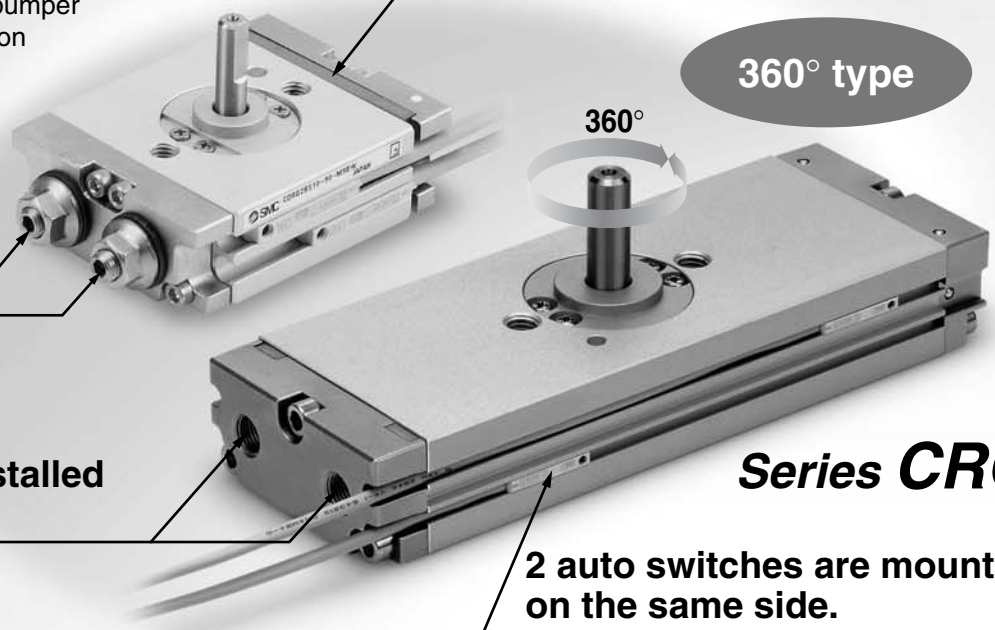
10, 15 : Rubber bumper
20, 30, 40 : Air cushion

Rotary actuator body serves as a flange.

360° type

360°

Equipped with an angle adjusting mechanism (±5°)



Piping can be installed from one end.

Series CRQ2

2 auto switches are mountable on the same side. (Mountable on the both sides.)

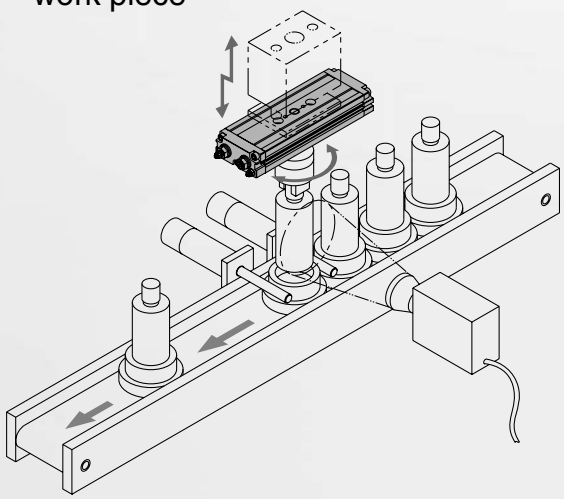
Mounting smaller auto switches prevents the auto switch from protruding from the body edge and realizes space-savings.

Double piston style Compact, with no backlash

Both single shaft and double shaft are available in all sizes.

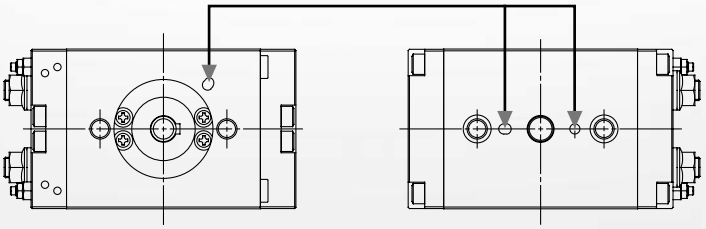
360° type application example

Complete external inspection of a work piece



Centering is easy when mounting the main body.

Pin hole for positioning the main body



Series	Size	Shaft type	Rotating angle	Cushion	
				Rubber	Air
CRQ2	10	• Single • Double	• 80° to 100° • 170° to 190° • 350° to 370°	●	—
	15			●	—
	20			—	●
	30			—	●
	40			—	●

Compact Rotary Actuator
Rack & Pinion Style
Series CRQ2

How to Order

Without auto switch CRQ2B **S** □ **20** □ — **90** □ — □

With auto switch CDRQ2B **S** □ **20** □ — **90** □ — **M9BW** □ — □

Built-in magnet

Shaft type

S	Single shaft
W	Double shaft

∗ Refer to pages 254 and 255 for the shaft type variations.

Pattern

Nil	Standard
P	Combination of simple specials and Made to Order

∗ Refer to pages 256 to 270 for details.

Size

10
15
20
30
40

Port type

Size	Port type	
10, 15	**Nil**	M5
20, 30, 40	**Nil**	Rc 1/8
	TF	G 1/8
	TN	NPT 1/8
	TT	NPTF 1/8

Rotating angle

90	80° to 100°
180	170° to 190°
360	350° to 370°

Suffix symbol

Symbol	Cushion	Size				
		10	**15**	**20**	**30**	**40**
Nil	Without cushion	—	—	●	●	●
	Rubber bumper	●	●	—	—	—
C	Air cushion	—	—	●	●	●

Auto switch

Nil	Without auto switch (Built-in magnet)

∗ For the applicable auto switch model, refer to the table below.

Number of auto switches

Nil	2 pcs.
S	1 pc.
n	n pcs.

Made to order
Refer to page 247 for details.

Applicable Auto Switches/Refer to pages 761 to 809 for further information on auto switches.

Type	Special function	Electrical entry	Indicator light	Wiring (Output)	Load voltage DC		Load voltage AC	Auto switch model Perpendicular	Auto switch model In-line	Lead wire length (m) 0.5 (Nil)	1 (M)	3 (L)	5 (Z)	Pre-wired connector	Applicable load	
Solid state switch	——	Grommet	Yes	3-wire (NPN)	24V	5V,12V	—	**M9NV**	**M9N**	●	●	●	○	○	IC circuit	Relay, PLC
				3-wire (PNP)				**M9PV**	**M9P**	●	●	●	○	○		
				2-wire		12V		**M9BV**	**M9B**	●	●	●	○	○	—	
	Diagnostic indication (2-color)			3-wire (NPN)		5V,12V		**M9NWV**	**M9NW**	●	●	●	○	○	IC circuit	
				3-wire (PNP)				**M9PWV**	**M9PW**	●	●	●	○	○		
				2-wire		12V		**M9BWV**	**M9BW**	●	●	●	○	○	—	
	Water resistant (2-color)			3-wire (NPN)		5V,12V		**M9NAV**∗∗	**M9NA**∗∗	○	○	●	○	○	IC circuit	
				3-wire (PNP)				**M9PAV**∗∗	**M9PA**∗∗	○	○	●	○	○		
				2-wire		12V		**M9BAV**∗∗	**M9BA**∗∗	○	○	●	○	○	—	
Reed switch	——	Grommet	Yes	3-wire (NPN equiv.)	—	5V	—	**A96V**	**A96**	●	—	●	—	—	IC circuit	—
				2-wire	24V	12V	100V	**A93V**	**A93**	●	—	●	—	—	—	Relay, PLC
			No				100 V or less	**A90V**	**A90**	●	—	●	—	—	IC circuit	

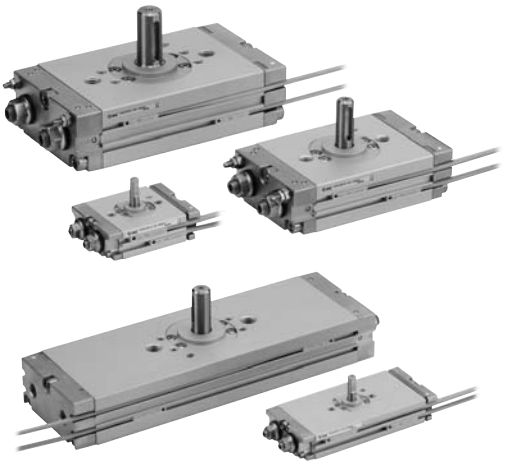
∗∗ Although it is possible to mount water resistant type auto switches, note that the rotary actuator itself is not of water resistant construction.

∗ Lead wire length symbols: 0.5 m ····· Nil (Example) M9NW
1 m ····· M (Example) M9NWM
3 m ····· L (Example) M9NWL
5 m ····· Z (Example) M9NWZ

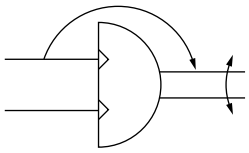
∗ Auto switches are shipped together, (but not assembled).

∗ Auto switches marked with "○" are made to order specification.

Made to Order Refer to pages 796 and 797 for the details of solid state auto switch with pre-wired connector.



JIS Symbol



Made to Order

Made to order
Refer to pages 256 to 270 for details.

Symbol	Specifications/Content	Applicable shaft type
—	Shaft type variation	X, Y, Z, T, J, K
XA1 to XA24	Shaft pattern sequencing I	S, W
XA31 to XA59	Shaft pattern sequencing II	X, Y, Z, T, J, K
XC7	Reversed shaft	S, W, X, T, J
XC8 to XC11	Change of rotating range	S, W, Y X*, Z*, T*, J*, K*
XC12 to XC15	Change of angle adjustable range (0° to 100°)	
XC16, XC17	Change of angle adjustable range (90° to 190°)	
XC18, XC19	Change of rotating range	
XC20, XC21	Change of angle adjustable range (90° to 190°)	
XC22	Without inner rubber bumper	S, W, X, Y, Z, T, J, K
XC30	Fluorine grease	
XC69	Fluororubber seal	
X6	Shaft and parallel key made of stainless steel	

∗ Among the symbols XC8 to XC21, only XC12 and XC16 are compatible with shaft types X, Z, T, J and K.

Specifications

Size	10	15	20	30	40
Fluid	Air (Non-lube)				
Max. operating pressure	0.7 MPa		1.0 MPa		
Min. operating pressure	0.15 MPa		0.1 MPa		
Ambient and fluid temperature	0° to 60°C (No freezing)				
Cushion	Rubber bumper		Not attached, Air cushion		
Angle adjustment range	Rotation end ±5°				
Rotation	90°, 180°, 360°				
Port size	M5 x 0.8		Rc 1/8, G 1/8, NPT 1/8, NPTF 1/8		
Output (N·m)∗	0.3	0.75	1.8	3.1	5.3

∗ Output under the operating pressure at 0.5 MPa. Refer to page 30 for further information.

Allowable Kinetic Energy and Rotation Time Adjustment Range

Size	Allowable kinetic energy			Cushion angle	Stable operational rotation time adjustment range
	Allowable kinetic energy (J)				
	Without cushion	Rubber bumper	With air cushion∗		Rotation time (s/90°)
10	—	0.00025	—	—	0.2 to 0.7
15	—	0.00039	—	—	0.2 to 0.7
20	0.025	—	0.12	40°	0.2 to 1
30	0.048	—	0.25	40°	0.2 to 1
40	0.081	—	0.4	40°	0.2 to 1

∗ Allowable kinetic energy for the bumper equipped type
Maximum absorbed energy under proper adjustment of the cushion needles.

If operated where the kinetic energy exceeds the allowable value, this may cause damage to the internal parts and result in product failure. Please pay special attention to the kinetic energy levels when designing, adjusting and during operation to avoid exceeding the allowable limit.

Mass

(g)

Size	Standard mass∗		
	90°	180°	360°
10	120	150	200
15	220	270	380
20	600	700	1000
30	900	1100	1510
40	1400	1600	2280

∗ Excluding the mass of auto switch.

⚠ Precautions

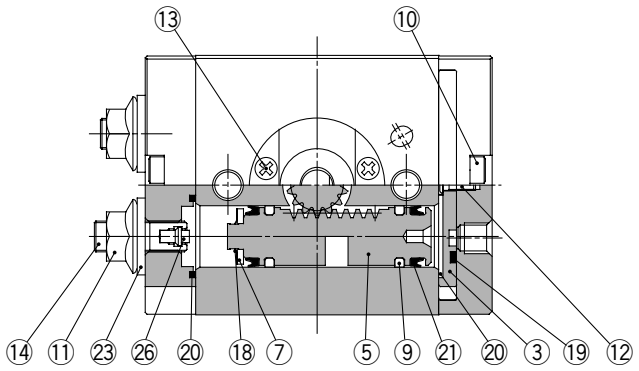
Be sure to read before handling.
Refer to front matters 38 and 39 for Safety Instructions and pages 4 to 13 for Rotary Actuator and Auto Switch Precautions.

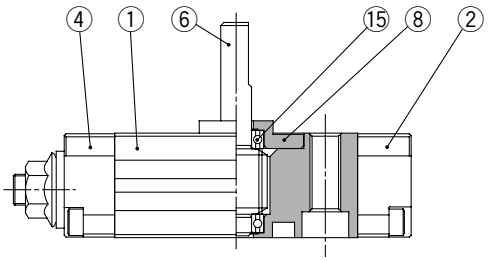
⚠ Caution

(1) The angle adjusting screw (angle adjustment bolt) is set at random within the adjustable rotating range. Therefore, it must be readjusted to obtain the angle that suits your application.

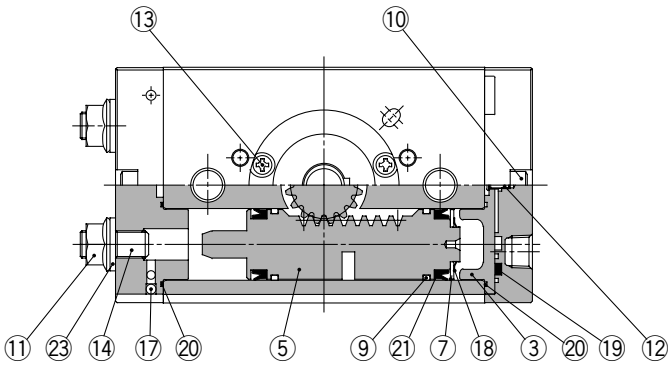
Construction

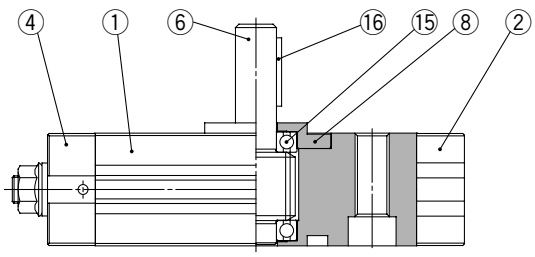
Basic style
Size 10/15





Basic style
Size 20/30/40





Component Parts

No.	Description	Material	Note
1	**Body**	Aluminum alloy	Anodized
2	**Cover**	Aluminum alloy	Electroless Nickel Plated
3	**Plate**	Aluminum alloy	Chromated
4	**End cover**	Aluminum alloy	Electroless Nickel Plated
5	**Piston**	Stainless steel	
6	**Shaft**	Stainless steel	Size: 10, 15
		Chrome molybdenum steel	Size: 20, 30, 40
7	**Seal retainer**	Aluminum alloy	Chromated
8	**Bearing retainer**	Aluminum alloy	Anodized
9	**Wearing**	Resin	
10	**Hexagon socket head cap screw**	Stainless steel	
11	**Hexagon nut with flange**	Steel wire	Electroless Nickel Plated
12	**Cross recessed No. 0 screw**	Steel wire	Zinc chromated
13	**Cross recessed No. 0 screw**	Steel wire	Size: 10, 15 Nickel plated
	Cross recessed screw		Size: 20, 30, 40 Nickel plated

Component Parts

No.	Description	Material	Note
14	**Hexagon socket head set screw**	Chrome molybdenum steel	Electroless Nickel Plated
15	**Bearing**	Bearing steel	
16	**Parallel key**	Carbon steel	Size: 20, 30, 40 only
17	**Steel ball**	Stainless steel	Size: 20, 30, 40 only
18	**Type CS retaining ring**	Stainless steel	
19	**Seal**	NBR	
20	**Gasket**	NBR	
21	**Piston seal**	NBR	
22	**Cushion seal**	Rubber material	Size: 20, 30, 40 only with cushion
23	**Seal washer**	NBR	
24	**Magnet**	—	With auto switch only
25	**Cushion valve assembly**		Size: 20, 30, 40 with cushion only
26	**Cushion pad**	Rubber material	Size: 10,15

Replacement Parts

Description	Part no.				
	10	**15**	**20**	**30**	**40**
Seal kit	P473010-1	P473020-1	P473030-1	P473040-1	P473050-1

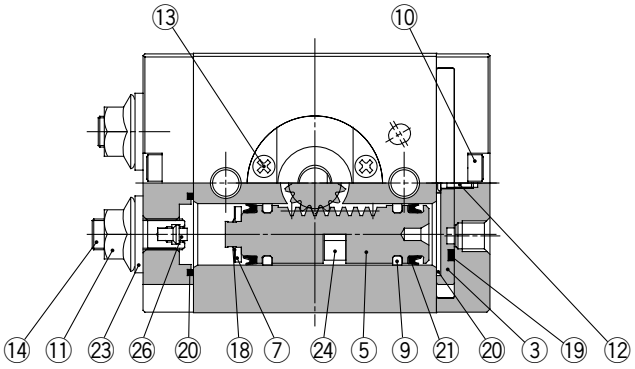
A grease pack (10 g) is included. When you need a grease pack only, order with the following part number.
Grease pack part no: GR-S-010 (10g)

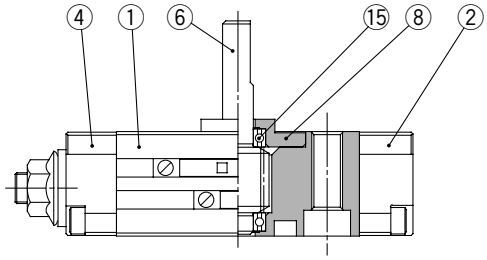
	No.	Description	Qty.	Note
Applicable parts	**19**	**Seal**	1	
	20	**Gasket for cover**	2	Size: 10, 15
		Gasket for endcover	1	
		Gasket	4	Size: 20, 30, 40
	21	**Piston seal**	4	
	23	**Seal washer**	2	

∗ A set includes all parts above.

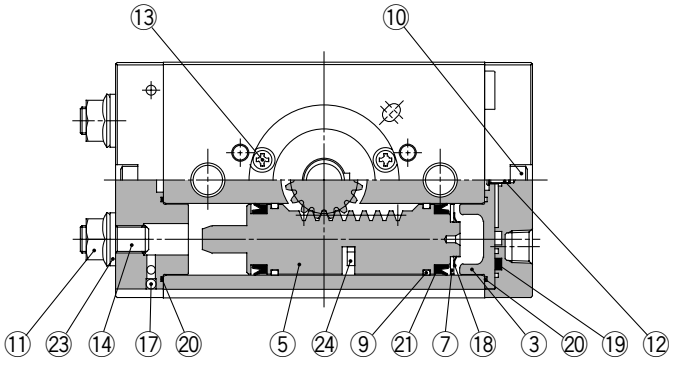
Construction

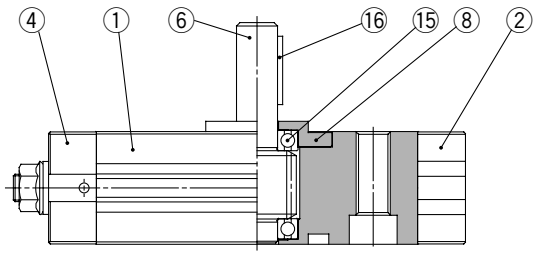
With auto switch
Size 10/15



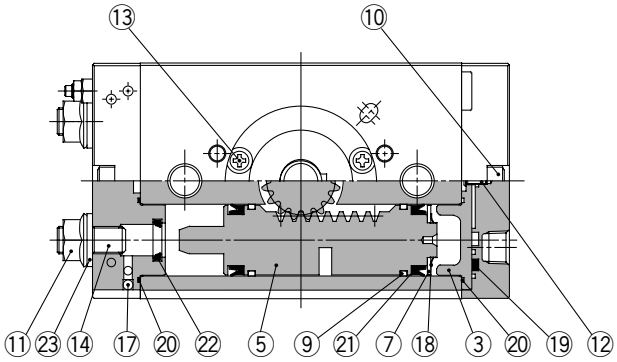


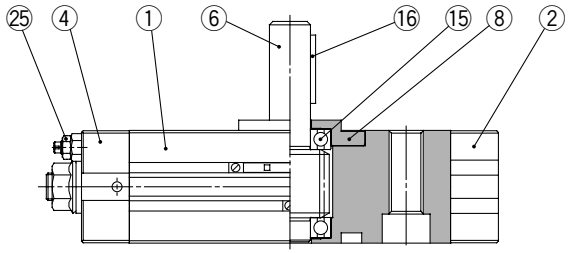
With auto switch
Size 20/30/40



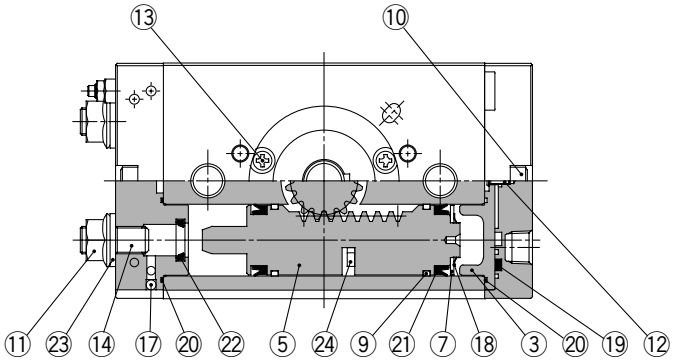


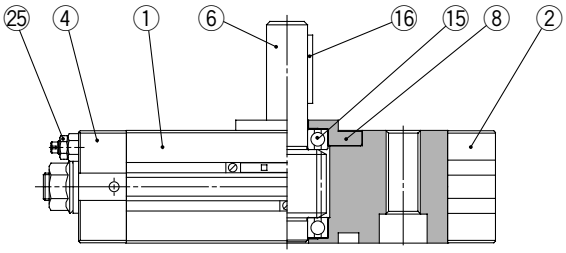
With cushion
Size 20/30/40





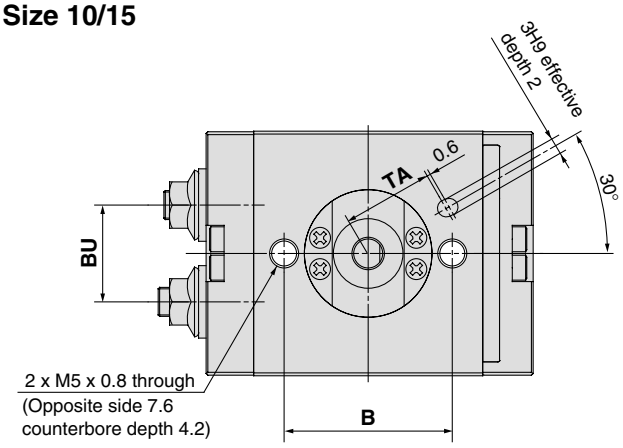
With auto switch and cushion
Size 20/30/40

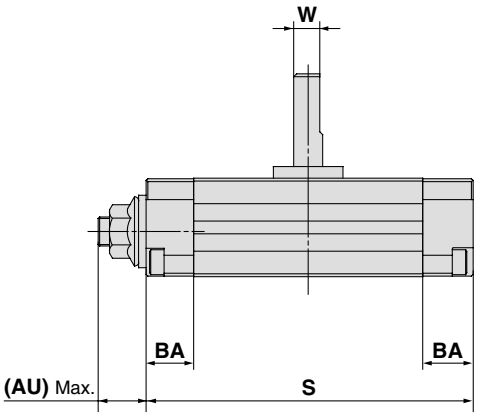


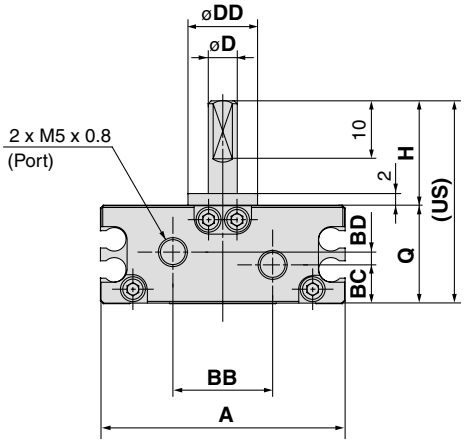


Dimensions

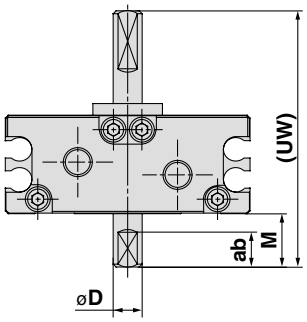
Size 10/15

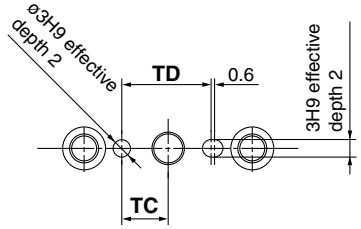






With double shaft





(mm)

Size	Rotating angle	A	AU*	B	BA	BB	BC	BD	BU	D (g6)	DD (h9)	H
10	90°, 180°, 360°	42	(8.5)	29	8.5	17	6.7	2.2	16.7	5	12	18
15	90°, 180°, 360°	53	(9.5)	31	9	26.4	10.6	—	23.1	6	14	20

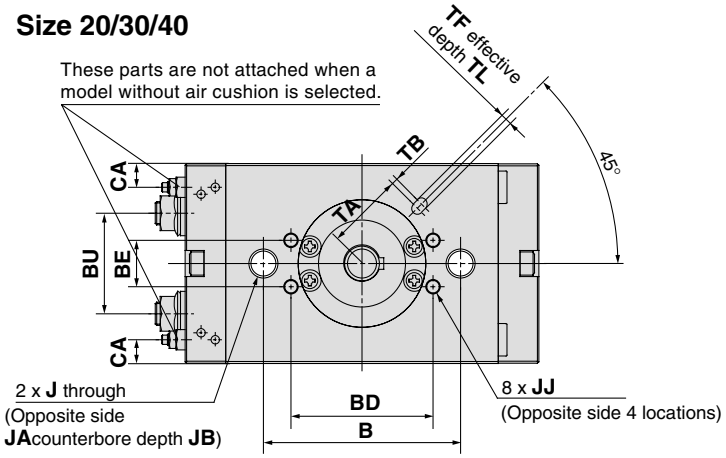
Size	Rotating angle	W	Q	S	US	UW	ab	M	TA	TC	TD
10	90°	4.5	17	56	35	44	6	9	15.5	8	15.4
	180°			69							
	360°			97							
15	90°	5.5	20	65	40	50	7	10	16	9	17.6
	180°			82							
	360°			116							

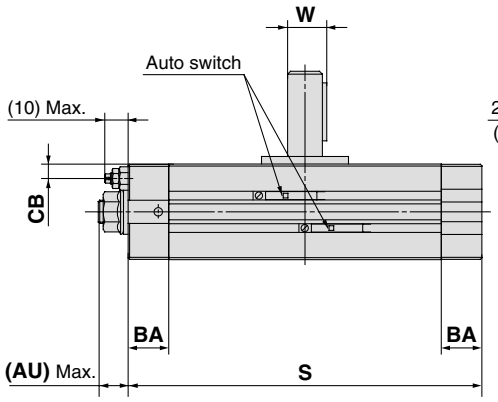
∗ AU dimension is not the dimension at the time of shipment, since its dimension is for adjustment parts.

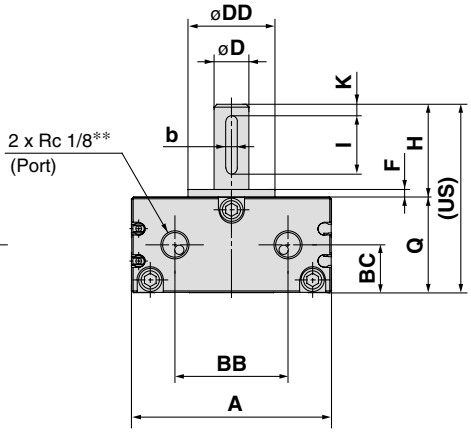
S: Upper 90°, Middle 180°, Lower 360°

Dimensions

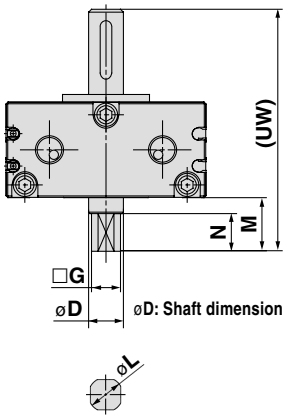
Size 20/30/40

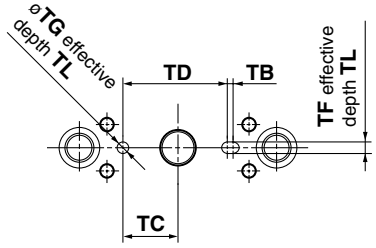






With double shaft





(mm)

Size	Rotating angle	A	AU*	B	BA	BB	BC	BD	BE	BU	CA	CB	D (g6)	DD (h9)	F	H	J	JA	JB
20	90°, 180°, 360°	63	(11)	50	14	34	14.5	—	—	30.4	7	4.7	10	25	2.5	30	M 8 x 1.25	11	6.5
30	90°, 180°, 360°	69	(11)	68	14	39	16.5	49	16	34.7	8.1	4.9	12	30	3	32	M10 x 1.5	14	8.5
40	90°, 180°, 360°	78	(13)	76	16	47	18.5	55	16	40.4	8.3	5.2	15	32	3	36	M10 x 1.5	14	8.6

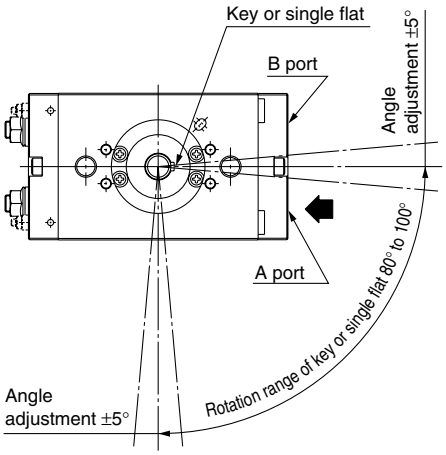
Size	Rotating angle	JJ	K	Q	S	W	Key dimensions b	Key dimensions l	US	TA	TB	TC	TD	TF (H9)	TG (H9)	TL	UW	G	M	N	L
20	90°	—	3	29	104	11.5	$4^{0}_{-0.03}$	20	59	24.5	1	13.5	27	4	4	2.5	74	$8^{0}_{-0.1}$	15	11	$9.6^{0}_{-0.1}$
	180°				130																
	360°				180																
30	90°	M5 x 0.8 depth 6	4	33	122	13.5	$4^{0}_{-0.03}$	20	65	27	2	19	36	4	4	2.5	83	$10^{0}_{-0.1}$	18	13	$11.4^{0}_{-0.1}$
	180°				153																
	360°				216																
40	90°	M6 x 1 depth 7	5	37	139	17	$5^{0}_{-0.03}$	25	73	32.5	2	20	39.5	5	5	3.5	93	$11^{0}_{-0.1}$	20	15	$14^{0}_{-0.1}$
	180°				177																
	360°				253																

∗ AU dimension is not the dimension at the time of shipment, since its dimension is for adjustment parts.
S: Upper 90°, Middle 180°, Lower 360°
∗∗ In addition to Rc 1/ 8, G 1/ 8, NPT 1/ 8, NPTF 1/ 8 are also available.

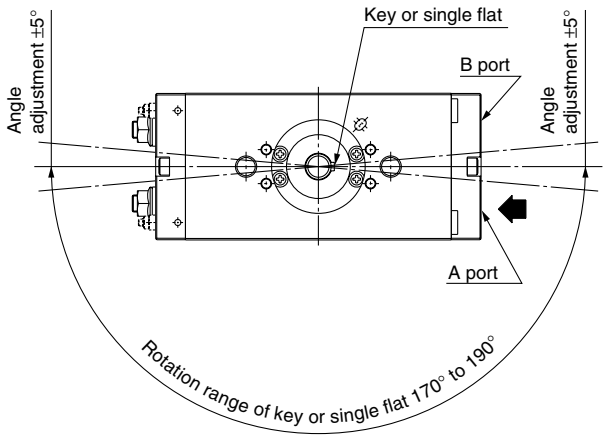
Rotation Range

When pressurized from the port indicated by the arrow, the shaft will rotate in a clockwise direction.

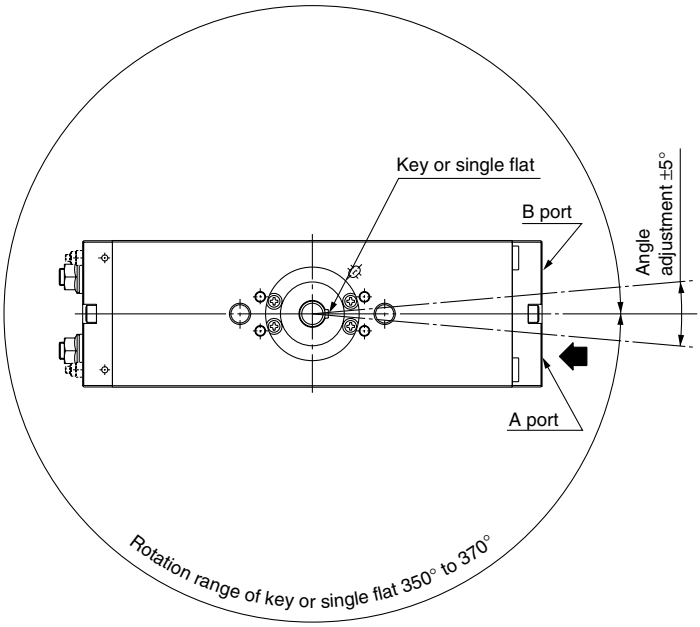
Rotating angle: 90°



Rotating angle: 180°

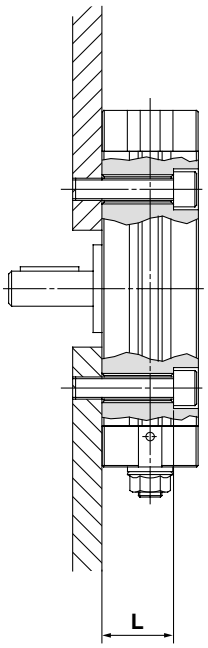


Rotating angle: 360°



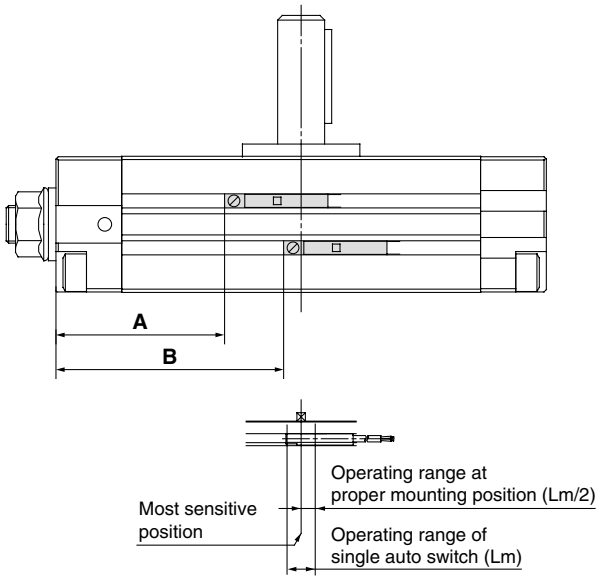
Unit Used as Flange Mount

The L dimensions of this unit are shown in the table below. When hexagon socket head cap bolt of the JIS standard is used, the head of the bolt will recess into the groove of actuator.



Size	L	Screw
10	13	M4
15	16	M4
20	22.5	M6
30	24.5	M8
40	28.5	M8

Auto Switch Proper Mounting Position at Rotation End



Size	Rotating angle	Solid state switch				Reed switch			
		A	**B**	Operating angle (θ m)	Hysteresis angle	**A**	**B**	Operating angle (θ m)	Hysteresis angle
10	90°	19	25.5	61°	5°	15	21.5	63°	12°
	180°	22	35			18	31		
	360°	29	56.5			25	52.5		
15	90°	22.5	31	47°	4°	18.5	27	52°	9°
	180°	26.5	43.5			22.5	39.5		
	360°	34.5	68.5			30.5	64.5		
20	90°	40	52.5	40°	4°	36	48.5	41°	9°
	180°	46	71.5			42	67.5		
	360°	59.5	110			55.5	106		
30	90°	47	63	29°	2°	43	59	32°	7°
	180°	55	86			51	82		
	360°	66	129.5			62	125.5		
40	90°	54	73	24°	2°	50	69	24°	5°
	180°	63.5	101.5			59.5	97.5		
	360°	76.5	156			72.5	152		

Operating angle θ m: The value of the individual switch's movement range Lm as represented by an angle.
Hysteresis angle: Value of the switch's hysteresis as represented by an angle.

Note) Since the above values are only provided as a guideline, they are not guaranteed. In the actual setting, adjust them after confirming the auto switch performance.

1 Shaft Type Variation, Four Chamfers (Size 20/30/40) — Shaft Type: X, Z

C RQ2B / CDRQ2B **Shaft type** | **Size** — **Rotating angle**

Refer to "How to Order" on page 246 for further information.

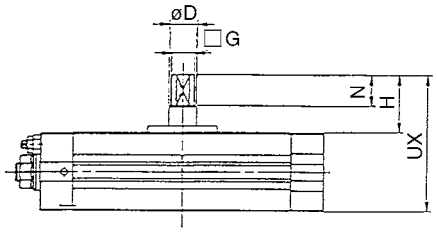
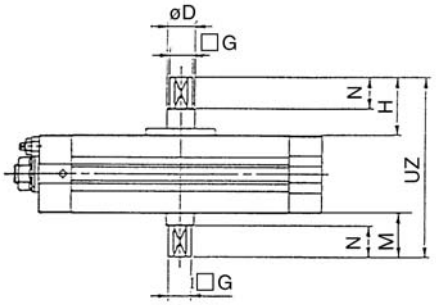
Shaft type

X	Single shaft with four chamfers
Z	Double shaft with four chamfers

Specifications

Fluid	Air (Non-lube)
Applicable shaft type	Single w/ four chamfers (**X**), Double w/ four chamfers (**Z**)
Applicable size	20, 30, 40
Max. operating pressure	1.0 MPa
Min. operating pressure	0.1 MPa
Cushion	Not attached, Air cushion
Rotation	80° to 100°, 170° to 190°, 350° to 370°
Port size	Rc 1/8, G 1/8, NPT 1/8, NPTF 1/8
Auto switch	Mountable

Dimensions

Shaft type	X	Z
Form		

(mm)

Size	**D** (g6)	**G**	**H**	**N**	**UX**	**UZ**	**M**
20	10	$8^{0}_{-0.1}$	21	11	50	65	15
30	12	$10^{0}_{-0.1}$	24	13	57	75	18
40	15	$11^{0}_{-0.1}$	27	15	64	84	20

2 Shaft Type Variation, Double Shaft With Key (Size 20/30/40) — Shaft Type: Y

C RQ2B / CDRQ2B **Y** | **Size** — **Rotating angle**

Refer to "How to Order" on page 246 for further information.

Shaft type

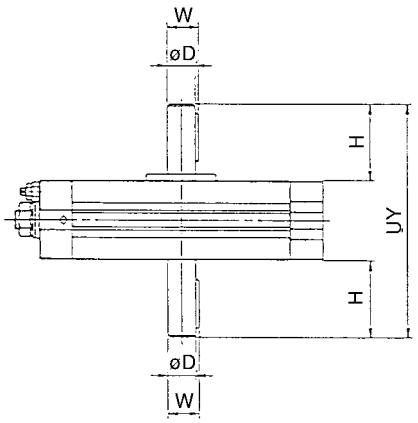
Y	Double shaft with key

Specifications

Fluid	Air (Non-lube)
Applicable shaft type	Double shaft with key (**Y**)
Applicable size	20, 30, 40
Max. operating pressure	1.0 MPa
Min. operating pressure	0.1 MPa
Cushion	Not attached, Air cushion
Rotating angle	80° to 100°, 170° to 190°, 350° to 370°
Port size	Rc 1/8, G 1/8, NPT 1/8, NPTF 1/8
Auto switch	Mountable

Dimensions

Y



(mm)

Size	**D** (g6)	**W**	**H**	**UY**
20	10	11.5	30	89
30	12	13.5	32	97
40	15	17	36	109

3 Shaft Type Variation/Without Keyway — Shaft Type: T, J, K

C RQ2B / CDRQ2B **Shaft type** **Size** — **Rotating angle**

Refer to "How to Order" on page 246 for further information.

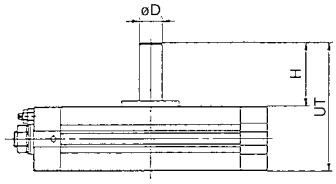
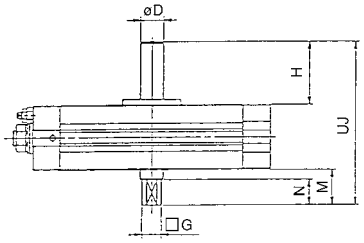
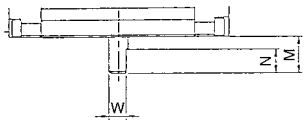
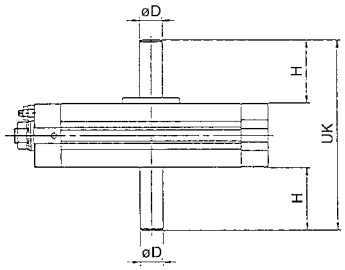
Shaft type

T	Single round shaft	
J	Double shaft	Without long shaft key, with four chamfers on short shaft, one chamfer on short shaft for 10 and 15.
K	Double round shaft	

Specifications

Fluid	Air (Non-lube)	
Applicable shaft type	Single round shaft (**T**), Double shaft (**J**), Double round shaft (**K**)	
Applicable size	10, 15	20, 30, 40
Max. operating pressure	0.7 MPa	1.0 MPa
Min. operating pressure	0.15 MPa	0.1 MPa
Cushion	Rubber bumper	Not attached, Air cushion
Rotating angle	80° to 100°, 170° to 190°, 350° to 370°	
Port size	M5 x 0.8	Rc 1/8, G 1/8, NPT 1/8, NPTF 1/8
Auto switch	Mountable	

Dimensions

Shaft type	T	J	K
Form		**Size 20, 30, 40**  **Size 10, 15** 	

Size	D (g6)	G	W	H	M	N	UT	UJ	UK
10	5	—	4.5	18	9	6	35	44	53
15	6	—	5.5	20	10	7	40	50	60
20	10	$8^{0}_{-0.1}$	—	30	15	11	59	74	89
30	12	$10^{0}_{-0.1}$	—	32	18	13	65	83	97
40	15	$11^{0}_{-0.1}$	—	36	20	15	73	93	109

Series CRQ2 (Size: 10, 15, 20, 30, 40)
Simple Specials:
-XA1 to -XA24: Shaft Pattern Sequencing I

Shaft pattern sequencing is dealt with a simple made-to-order system. (Refer to front matter 33.)
Please contact SMC for a specification sheet when placing an order.

Shaft Pattern Sequencing I — -XA1 to XA24

Applicable shaft type: S, W

How to Order

C D RQ2B S P 20 [ ] – 90 C – M9BW – X A2 A24 C30 -X6

Built-in magnet

Nil	None
D	Built-in magnet

Shaft type

S	Single shaft
W	Double shaft

Pattern

Size

10
15
20
30
40

Thread type

Size	Port type	
10, 15	Nil	M5
20, 30, 40	Nil	Rc 1/8
	TF	G 1/8
	TN	NPT 1/8
	TT	NPTF 1/8

How to order model with auto switches

Refer to page 246 for "How to Order"products with auto switch.

Air cushion

Size	Air cushion	
	None	Attached
10, 15	Nil	—
20, 30, 40		C

Rotating angle

90	80° to 100°
180	170° to 190°
360	350° to 370°

Auto switch

Refer to page 246 for the part no. of auto switches.

Symbol for simple special, made to order products
- When the number of combinations is 1 or 2, refer to chart 1 and 2.
- ∗ Combination of XA is possible for up to 2 types.
- ∗ Combination of -X6 (Shaft, parallel stainless spec) is available with all the types.

• Combination 3 Types — **• Combination of Applicable Chart**

A 1	A24	C30	Chart 1, 2
A 2	A24	-X 6	Chart 1
A13	C 8	C30	Chart 2, 5
A14	C30	-X 6	Chart 2

Combination is available only when all the conditions are fulfilled among the combination chart above.

• Combination 4 Types — **• Combination of Applicable Chart**

A 1	A 2	C 8	C30	Chart 1, 2, 5
A 2	A24	C10	-X 6	Chart 1, 2
A14	C11	C30	-X 6	Chart 2, 5
A14	C 8	C12	C30	Chart 2, 5

Combination is available only when all the conditions are fulfilled among the combination chart above.

∗ **Combination of simple specials and made-to-order, it is possible for up to 4 types.**

Combination Chart of Simple Specials for Tip End Shape

Chart 1. Combination between -XA□ and -XA□ (S, W shaft)

Symbol	Description	Top port Upper	Top port Lower	Shaft type S	Shaft type W	Applicable size	Combination
XA 1	Female thread at the end	●	–	●	●	10, 15	XA 1
XA 2	Female thread at the end	–	●	●	●	20, 30, 40	● XA 2
XA 3	Tip end of male thread	●	–	●	●	10, 15	– ● XA 3
XA 4	Tip end of male thread	–	●	–	●		W∗ – W∗ XA 4
XA 5	Stepped round shaft	●	–	●	●		– ● – ● XA 5
XA 6	Stepped round shaft	–	●	–	●		W∗ – W∗ – W∗ XA 6
XA 7	Round shaft with steps and male thread	●	–	●	●		– ● – ● – ● XA 7
XA 8	Round shaft with steps and male thread	–	●	–	●		W∗ – W∗ – W∗ – W∗ XA 8
XA 9	Change of the length of standard chamfered face	●	–	●	●		– ● – ● – ● – ● XA 9
XA10	Change of the length of standard chamfered face	–	●	–	●		W∗ – W∗ – W∗ – W∗ – W∗ XA10
XA11	Two-sided chamfer	●	–	●	●		– ● – ● – ● – ● – ● XA11
XA12	Two-sided chamfer	–	●	–	●		W∗ – W∗ – W∗ – W∗ – W∗ – W∗ XA12
XA13	Shaft through-hole	●	●	●	●	10, 15	– – – – – – – – ● ● – – XA13
XA14	Shaft through-hole and female thread	●	–	●	●	20, 30, 40	– – – – – – – – ● ● – – – XA14
XA15	Shaft through-hole and female thread	–	●	●	●		– – – – – – – – ● ● – – – – XA15
XA16	Shaft through-hole and female thread	●	●	●	●		– – – – – – – – – – – – – – – XA16
XA17	Shortened shaft	●	–	●	●	10,15	– ● – ● – ● – ● – ● – ● – ● ● – ● – XA17
XA18	Shortened shaft	–	●	–	●	10, 15, 20, 30, 40	W∗ – W∗ – W∗ – W∗ – W∗ – W∗ – W∗ – W∗ W∗ – – W∗ XA18
XA19	Shortened shaft	●	●	–	●	10,15	– – – – – – – – – – – – W∗ – – – – –
XA20	Reversed shaft	●	●	●	●	10, 15, 20, 30, 40	– – – – – – – – – – – – ● – – – – – XA20
XA21	Stepped round shaft with double-sided chamfer	●	–	●	●	10, 15	– ● – ● – ● – ● – ● – ● – ● – – – – – ● ● XA21
XA22	Stepped round shaft with double-sided chamfer	–	●	–	●		W∗ – W∗ – W∗ – W∗ – W∗ – W∗ – W∗ – – – – W∗ – – W∗ XA22
XA23	Right-angle chamfer	●	–	●	●		● ● – ● – ● – ● – ● – ● ● ● ● ● – ● ● – ●
XA24	Double key	●	–	●	●	20, 30, 40	● ● – – – – – – – – – – ● ● ● ● – ● ● – –

∗ Describes the combination available for corresponding shaft shapes.

Combination Chart of Made to Order

Chart 2. Combination between -XA□ and -XC□ (Made to Order/ Details of -XC□, refer to page 266.)

Symbol	Description	Applicable size	Combination XA1 to XA24
XC 7	Reversed shaft	10, 15, 20, 30, 40	–
XC 8	Change of rotating range		●
XC 9			●
XC10			●
XC11			●
XC12	Change in angle adjustable range 0° to 100°		●
XC13			●
XC14			●
XC15			●
XC16	Change in angle adjustable range 90° to 190°		●
XC17			●

Symbol	Description	Applicable size	Combination XA1 to XA24
XC18	Change of rotating range	20, 30, 40	●
XC19			●
XC20	Change in angle adjustable range 90° to 190°		●
XC21			●
XC22	Without inner rubber bumper	10, 15	●
XC30	Fluorine grease	10, 15, 20, 30, 40	●
XC69	Fluororubber seal	10, 15, 20, 30, 40	●

∗ Chart 5. Refer to page 266 for combination available between -XC□ and -XC□.

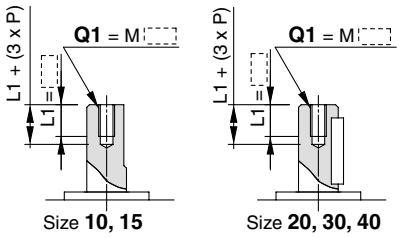
Shaft Pattern Sequencing I — -XA1 to XA8

Additional Reminders

1. Enter the dimensions within a range that allows for additional machining.
2. SMC will make appropriate arrangements if no dimensional, tolerance, or finish instructions are given in the diagram.
3. The length of the unthreaded portion is 2 to 3 pitches.
4. Unless specified otherwise, the thread pitch is based on coarse metric threads.
   M3 x 0.5, M4 x 0.7, M5 x 0.8
   M6 x 1
5. Enter the desired figures in the ☐ portion of the diagram.
6. XA1 to XA24 are the standard products that have been additionally machined.
7. Chamfer face of the parts machining additionally is C0.5.

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 = 6
• Applicable shaft types: S, W

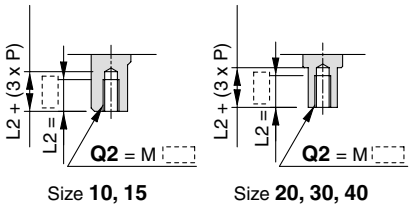


(mm)

Size	Q1
10	M3
15	M3, M4
20	M3, M4
30	M3, M4, M5
40	M4, M5, M6

Symbol: A2

Machine female threads into the short shaft.
The maximum dimension L2 is, as a rule, twice the thread size. (Example) For M4: L2 = 8
• Applicable shaft types: S, W

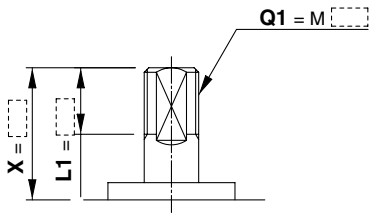


(mm)

Size	Q2
10	M3
15	M3, M4
20	M3, M4
30	M3, M4, M5
40	M4, M5, M6

Symbol: A3

The long shaft can be further shortened by machining male threads into it.
(If shortening the shaft is not required, indicate "∗" for dimension X.)
• Applicable shaft types: S, W

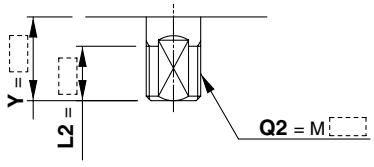


(mm)

Size	X	L1 max	Q1
10	9 to 18	X – 4	M5
15	10 to 20	X – 4	M6

Symbol: A4

The short shaft can be further shortened by machining male threads into it.
(If shortening the shaft is not required, indicate "∗" for dimension Y.)
• Applicable shaft type: W

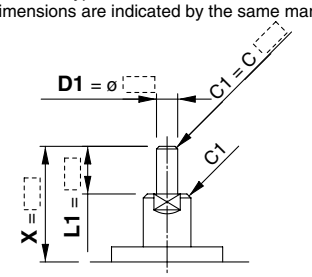


(mm)

Size	Y	L2 max	Q2
10	7 to 9	Y – 2	M5
15	8 to 10	Y – 3	M6

Symbol: A5

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.)
(If not specifying dimension C1, indicate "∗" instead.)
• Applicable shaft types: S, W
• Equal dimensions are indicated by the same marker.

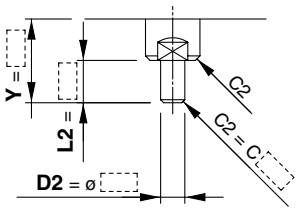


(mm)

Size	X	L1 max	D1
10	3 to 18	X – 2	ø3.5 to ø4.9
15	3 to 20	X – 2	ø3.5 to ø5.9

Symbol: A6

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.)
(If not specifying dimension C2, indicate "∗" instead.)
• Applicable shaft type: W
• Equal dimensions are indicated by the same marker.

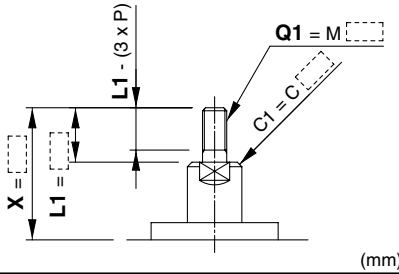


(mm)

Size	Y	L2 max	D2
10	1 to 9	Y	ø3.5 to ø4.9
15	1 to 10	Y	ø3.5 to ø5.9

Symbol: A7

The long shaft can be further shortened by machining it into a stepped round shaft with male threads.
(If shortening the shaft is not required, indicate "∗" for dimension X.)
(If not specifying dimension C1, indicate "∗" instead.)
• Applicable shaft types: S, W

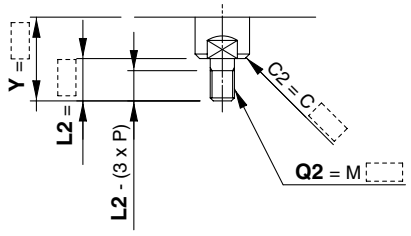


(mm)

Size	X	L1 max	Q1
10	8 to 18	X – 2	M3, M4
15	9.5 to 20	X – 2	M3, M4, M5

Symbol: A8

The short shaft can be further shortened by machining it into a stepped round shaft with male threads.
(If shortening the shaft is not required, indicate "∗" for dimension Y.)
(If not specifying dimension C2, indicate "∗" instead.)
• Applicable shaft type: W



(mm)

Size	Y	L2 max	Q2
10	6 to 9	Y	M3, M4
15	7.5 to 10	Y	M3, M4, M5

Series ***CRQ2*** **(Size: 10, 15, 20, 30, 40)**
Simple Specials:
-XA1 to -XA24: Shaft Pattern Sequencing I

Shaft pattern sequencing is dealt with a simple made-to-order system. (Refer to front matter 33.)
Please contact SMC for a specification sheet when placing an order.

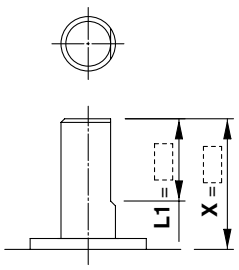
Shaft Pattern Sequencing I

Additional Reminders

1. Enter the dimensions within a range that allows for additional machining.
2. SMC will make appropriate arrangements if no dimensional, tolerance, or finish instructions are given in the diagram.
3. The length of the unthreaded portion is 2 to 3 pitches.
4. Unless specified otherwise, the thread pitch is based on coarse metric threads.
   M3 x 0.5, M4 x 0.7, M5 x 0.8
   M6 x 1
5. Enter the desired figures in the [ ] portion of the diagram.
6. XA9 to XA24 are the standard products that have been additionally machined.
7. Chamfer face of the parts machining additionally is C0.5.

Symbol: A9

The long shaft can be further shortened by changing the length of the standard chamfer on the long shaft side.
(If shortening the shaft is not required, indicate "∗" for dimension X.)
• Applicable shaft types: S, W

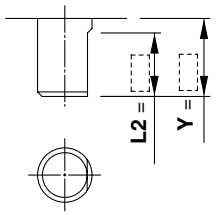


(mm)

Size	X	L1
10	8 to18	{10 – (18 – X) } to (X – 2)
15	10 to 20	{10 – (20 – X) } to (X – 2)

Symbol: A10

The short shaft can be further shortened by changing the length of the standard chamfer.
(If shortening the shaft is not required, indicate "∗" for dimension Y.)
• Applicable shaft type: W

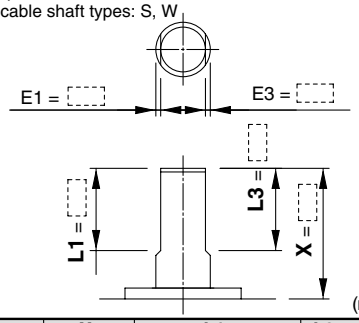


(mm)

Size	Y	L2
10	3 to 9	6 – (9 – Y) to Y
15	3 to 10	7 – (10 – Y) to Y

Symbol: A11

The long shaft can be further shortened by machining a double-sided chamfer on to it.
• Since L1 is a standard chamfer, dimension E1 is 0.5 or more.
(If altering the standard chamfer and shortening the shaft are not required, indicate "∗" for both the L1 and X dimensions.)
• Applicable shaft types: S, W

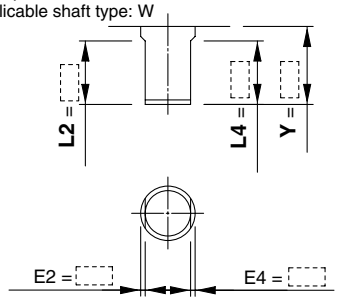


(mm)

Size	X	L1	L3 max
10	8 to 18	{10 – (18 – X)} to (X – 2)	X – 2
15	10 to 20	{10 – (20 – X)} to (X – 2)	X – 2

Symbol: A12

The short shaft can be further shortened by machining a double-sided chamfer on to it.
• Since L2 is a standard chamfer, dimension E2 is 0.5 or more.
(If altering the standard chamfer and shortening the shaft are not required, indicate "∗" for both the L2 and Y dimensions.)
• Applicable shaft type: W

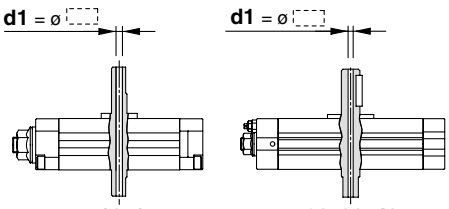


(mm)

Size	Y	L2	L4 max
10	3 to 9	6 – (9 – Y) to Y	Y
15	3 to10	7 – (10 – Y) to Y	Y

Symbol: A13

Shaft with through-hole
Minimum machining diameter for d1 is 0.1.
• Applicable shaft types: S, W



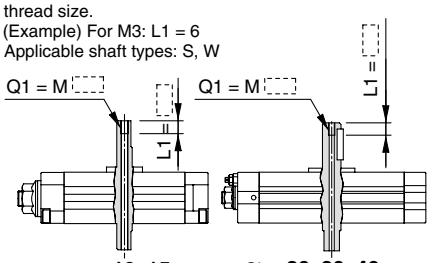
Size **10, 15** Size **20, 30, 40**

(mm)

Size	d1
10	ø2 to ø3
15	ø2 to ø4
20	ø2.5 to ø3.5
30	ø3 to ø5.5
40	ø4 to ø7

Symbol: A14

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 dimension L1 is, as a rule, twice the thread size.
(Example) For M3: L1 = 6
• Applicable shaft types: S, W



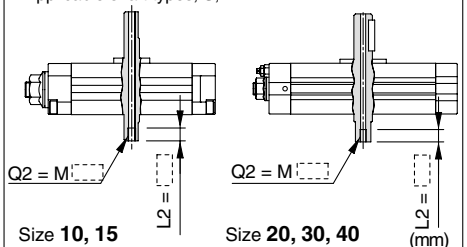
Size **10, 15** Size **20, 30, 40**

(mm)

Thread \ Size	10	15	20	30	40
M3 x 0.5	ø2.5	ø2.5	ø2.5	—	—
M4 x 0.7	—	ø3.3	ø3.3	ø3.3	—
M5 x 0.8	—	—	—	ø4.2	ø4.2
M6 x 1	—	—	—	—	ø5

Symbol: A15

A special end is machined onto the short 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 dimension L2 is, as a rule, twice the thread size. (Example) For M4: L2 = 8
• Applicable shaft types; S, W



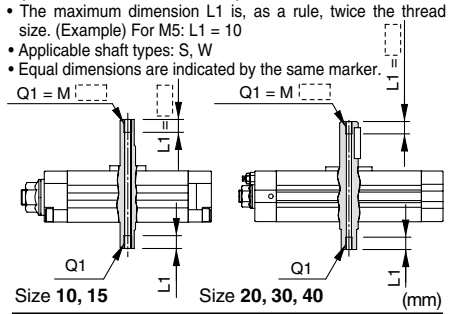
Size **10, 15** Size **20, 30, 40**

(mm)

Thread \ Size	10	15	20	30	40
M3 x 0.5	ø2.5	ø2.5	ø2.5	—	—
M4 x 0.7	—	ø3.3	ø3.3	ø3.3	—
M5 x 0.8	—	—	—	ø4.2	ø4.2
M6 x 1	—	—	—	—	ø5

Symbol: A16

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 dimension L1 is, as a rule, twice the thread size. (Example) For M5: L1 = 10
• Applicable shaft types: S, W
• Equal dimensions are indicated by the same marker.



Size **10, 15** Size **20, 30, 40**

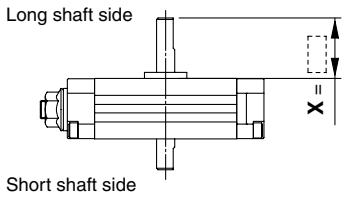
(mm)

Thread \ Size	10	15	20	30	40
M3 x 0.5	ø2.5	ø2.5	ø2.5	—	—
M4 x 0.7	—	ø3.3	ø3.3	ø3.3	—
M5 x 0.8	—	—	—	ø4.2	ø4.2
M6 x 1	—	—	—	—	ø5

-XA9 to XA24

Symbol: A17

Shorten the long shaft.
• Applicable shaft types: S, W

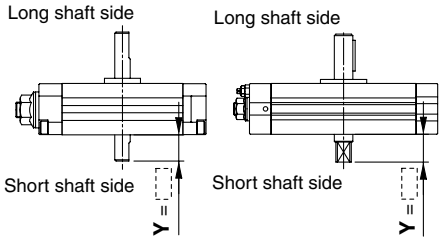


(mm)

Size	X
10	2 to 18
15	2 to 20
20	17 to 30
30	18 to 32
40	18.5 to 36

Symbol: A18

Shorten the short shaft.
• Applicable shaft type: W



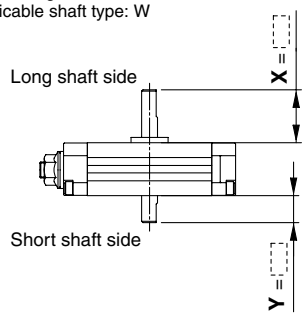
Size **10, 15** Size **20, 30, 40**

(mm)

Size	Y
10	1 to 9
15	1 to 10
20	1 to 15
30	1 to 18
40	1 to 20

Symbol: A19

Both the long shaft and short shaft are shortened.
• Applicable shaft type: W

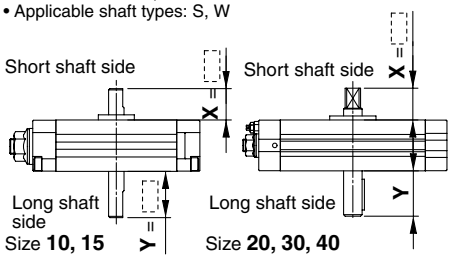


(mm)

Size	X	Y
10	2 to 18	1 to 9
15	2 to 20	1 to 10
20	17 to 30	1 to 15
30	18 to 32	1 to 18
40	18.5 to 36	1 to 20

Symbol: A20

Reverse the assembly of the shaft. (Thus shortening the long end and the short end of the shaft.)
(If shortening the shaft is not required, indicate "∗" for dimension X and Y.)
• Applicable shaft types: S, W



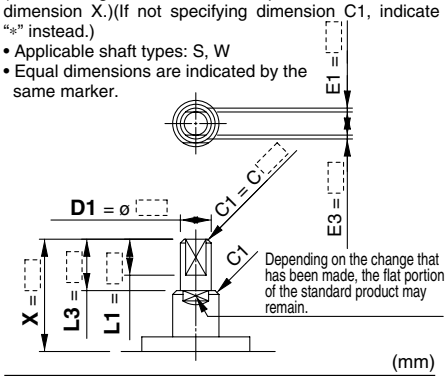
Size **10, 15** Size **20, 30, 40**

(mm)

Size	X	Y
10	2 to 10	1 to 17
15	2 to 11	1 to 19
20	2.5 to 16.5	16 to 28.5
30	3 to 20	16 to 30
40	3 to 22	16.5 to 34

Symbol: A21

The long shaft can be further shortened by machining it into a stepped round shaft with a double-sided chamfer.
(If shortening the shaft is not required, indicate "∗" for dimension X.)(If not specifying dimension C1, indicate "∗" instead.)
• Applicable shaft types: S, W
• Equal dimensions are indicated by the same marker.

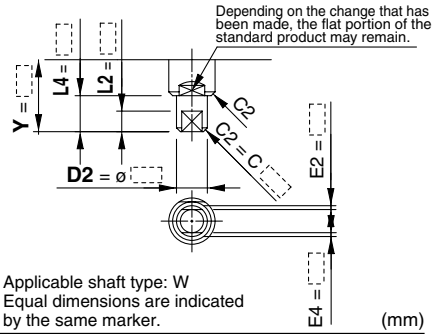


(mm)

Size	X	L1 max	L3	D1
10	5 to 18	X – 3.5	L1 + 1.5	ø3.5 to ø4.9
15	5.5 to 20	X – 4	L1 + 2	ø3.5 to ø5.9

Symbol: A22

The short shaft can be further shortened by machining it into a stepped round shaft with a double-sided chamfer.
(If shortening the shaft is not required, indicate "∗" for dimension Y.)
(If not specifying dimension C2, indicate "∗" instead.)



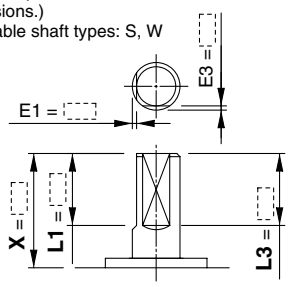
• Applicable shaft type: W
• Equal dimensions are indicated by the same marker.

(mm)

Size	Y	L2 max	L4	D2
10	3 to 9	Y – 1.5	L1 + 1.5	ø3.5 to ø4.9
15	3.5 to 10	Y – 2	L1 + 2	ø3.5 to ø5.9

Symbol: A23

The long shaft can be further shortened by machining right-angle double-sided chamfer onto it.
• Since L1 is a standard chamfer, dimension E1 is 0.5 or more.
(If altering the standard chamfer and shortening th shaft are not required, indicate "∗" for both the L1 and X dimensions.)
• Applicable shaft types: S, W

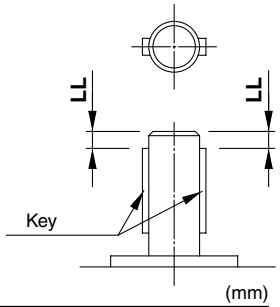


(mm)

Size	X	L1	L3 max
10	8 to 18	{10 – (18 – X)} to (X – 2)	X-2
15	10 to 20	{10 – (20 – X)} to (X – 2)	X-2

Symbol: A24

Double key
Keys and keyways are machined at 180° from the standard position.
• Applicable shaft types: S, W
• Equal dimensions are indicated by the same marker.



(mm)

Size	Key dimensions	LL
20	4 x 4 x 20	3
30	4 x 4 x 20	4
40	5 x 5 x 25	5

Series ***CRQ2*** (Size: 10, 15, 20, 30, 40)
Simple Specials:
-XA31 to -XA59: Shaft Pattern Sequencing II

Shaft pattern sequencing is dealt with a simple made-to-order system. (Refer to front matter 33.)
Please contact SMC for a specification sheet when placing an order.

Shaft Pattern Sequencing II

Applicable shaft type: X, Y, Z, T, J and K

How to Order

C D RQ2B T P 20 [ ] – 90 C – M9BW – X A34 A37 C30 -X6

Built-in magnet

Nil	None
D	Built-in magnet

Shaft type

X	Single shaft with four chamfers
Y	Double shaft key
Z	Double shaft with four chamfers
T	Single round shaft
J	Double shaft
K	Double round shaft

∗ Refer to pages 254 and 255 for the shaft type variations.

Size

10
15
20
30
40

Auto switch

Refer to page 246 for "How to Order" products with auto switches.

Air cushion

Size	Air cushion	
	None	Attached
10, 15	Nil	—
20, 30, 40		**C**

Rotating angle

90	80° to 100°
180	170° to 190°
360	350° to 370°

Pattern

How to order model with auto switches

Refer to page 246 for "How to Order" products with auto switches.

Thread type

Size	Port type	
10, 15	**Nil**	M5
20, 30, 40	**Nil**	Rc 1/8
	TF	G 1/8
	TN	NPT 1/8
	TT	NPTF 1/8

Symbol for simple specials, made to order products

- When number of combinations is 1 or 2, refer to chart 3 and 4.
- ∗ Combination of XA is possible for up to 2 types.
- ∗ Combination of -X6 (shaft, parallel key stainless spec) is available for all the types.

• Combination 3 Types

			• Combination of Applicable Chart
A33	**A34**	**C30**	Chart 3, 4
A34	**A37**	**-X6**	Chart 3
A35	**C30**	**C12**	Chart 4, 5
A40	**C8**	**-X6**	Chart 4, 5

Combination is available only when all the conditions are fulfilled among the nation chart above.

• Combination 4 Types

				• Combination of Applicable Chart
A33	**A34**	**C30**	**C12**	Chart 3, 4, 5
A34	**A37**	**C12**	**-X6**	Chart 3, 4
A43	**C12**	**C30**	**-X6**	Chart 4, 5

Combination is available only when all the conditions are fulfilled among the nation chart above.

∗ Combination of simple specials and made-to-order, it is possible for up to 4 types.

Combination Chart of Simple Specials for Tip End Shape

Chart 3. Combination between -XA□ and -XA□ (X, Y, Z, T, J, K shafts)

Symbol	Description	Top port		Shaft type						Applicable size	Combination												
		Upper	Lower	J	K	T	X	Y	Z														
XA31	Female thread at the end	●	–	–	–	–	–	●	–	20, 30, 40	**XA31**												
XA32	Female thread at the end	–	●	–	–	–	–	●	–		Y *	**XA32**											
XA33	Female thread at the end	●	–	●	●	●	–	–	–	10, 15,	–	–	**XA33**										
XA34	Female thread at the end	–	●	–	●	●	●	–	–	20, 30, 40	–	–	K, T *	**XA34**									
XA35	Female thread at the end	●	–	–	–	–	●	–	●	20, 30, 40	–	–	–	–	**XA35**								
XA36	Female thread at the end	–	●	●	–	–	–	–	●		–	–	J *	–	X, Z *	**XA36**							
XA37	Stepped round shaft	●	–	●	●	●	–	–	–	10, 15,	–	–	–	KT *	–	J *	**XA37**						
XA38	Stepped round shaft	–	●	–	●	–	–	–	–	20, 30, 40	–	–	K *	–	–	–	K *						
XA39	Shaft through hole	●	●	–	–	–	–	●	–	20, 30, 40	–	–	–	–	–	–	–						
XA40	Shaft through hole	●	●	–	●	●	–	–	–	10, 15,	–	–	–	–	–	–	–						
XA41	Shaft through hole	●	●	●	–	–	●	–	●	20, 30, 40	–	–	–	–	–	–	–						
XA42	Shaft through hole and female thread	●	●	–	–	–	–	●	–	20, 30, 40	–	–	–	–	–	–	–						
XA43	Shaft through hole and female thread	●	●	–	●	●	–	–	–		–	–	–	–	–	–	–						
XA44	Shaft through hole and female thread	●	●	●	–	–	●	–	●	10, 15,	–	–	–	–	–	–	–	**XA38**					
XA45	Middle-cut chamfer	●	–	●	●	●	–	–	–	20, 30, 40	–	–	–	K *	–	J *	–	K *	**XA39**	**XA40**	**XA41**	**XA45**	
XA46	Middle-cut chamfer	–	●	–	●	–	–	–	–		–	–	K *	–	–	–	K *	–	–	–	–	K *	**XA46**
XA48	Change of long shaft length	●	–	–	–	–	–	●	–		–	Y *	Y *	–	–	–	–	–	Y *	–	–	–	–
XA49	Change of short shaft length	–	●	–	–	–	–	●	–	20, 30, 40	Y *	–	–	–	–	–	–	–	Y *	–	–	–	–
XA50	Change of double shaft length	●	●	–	–	–	–	●	–		–	–	–	–	–	–	–	–	Y *	–	–	–	–
XA51	Change of long shaft length	●	–	●	●	●	–	–	–		–	–	–	K, T *	–	J *	–	K *	–	K, T *	–	–	K *
XA52	Change of short shaft length	–	●	–	●	–	–	–	–	10, 15,	–	–	K *	–	–	–	K *	–	–	K *	–	K, T *	–
XA53	Change of double shaft length	●	●	–	●	–	–	–	–	20, 30, 40	–	–	–	–	–	–	–	–	–	K *	–	–	–
XA54	Change of long shaft length	●	–	–	–	–	●	–	●		–	–	–	X *	–	Z *	–	–	–	–	X, Z *	–	–
XA55	Change of short shaft length	–	●	●	–	–	–	–	●	20, 30, 40	–	–	J *	–	Z *	–	J *	–	–	–	J, Z *	–	J *
XA56	Change of double shaft length	●	●	–	–	–	–	–	●		–	–	–	–	–	–	–	–	–	–	Z *	–	–
XA57	Change of double shaft length	●	●	●	–	–	–	–	–	10, 15,	–	–	–	–	–	–	–	–	–	–	J *	–	–
XA58	Reversed shaft, Change of double shaft length	●	●	●	–	●	–	–	–	20, 30, 40	–	–	–	–	–	–	–	–	–	T *	J *	–	–
XA59	Reversed shaft, Change of double shaft length	●	●	–	–	–	●	–	–	20, 30, 40	–	–	–	–	–	–	–	–	–	–	X *	–	–

∗ Corresponding shafts type available for combination

Combination Chart of Made to Order

Chart 4. Combination between -XA□ and -XC□ (Made to Order/Details of -XC□, refer to page 266.)

Symbol	Description	Applicable size	Combination
			XA31 to XA59
XC 7	Reversed shaft	10, 15, 20, 30, 40	–
XC 8	Change of rotating range		●
XC 9			●
XC10			●
XC11			●
XC12	Change in angle adjustable range 0° to 100°		●
XC13			●
XC14			●
XC15			●
XC16	Change in angle adjustable range 90° to 190°		●
XC17			●
XC18	Change of rotating range	20, 30, 40	●
XC19			●
XC20	Change in angle adjustable range 90° to 190°		●
XC21			●
XC22	Without inner rubber bumper	10, 15	●
XC30	Fluorine grease	10, 15, 20, 30, 40	●
XC69	Fluororubber seal	10, 15, 20, 30, 40	●

∗ Chart 5. Refer to page 266 for combination available between -XC□ and -XC□.

Series ***CRQ2*** **(Size: 10, 15, 20, 30, 40)**
Simple Specials:
-XA31 to -XA59: Shaft Pattern Sequencing II

Shaft pattern sequencing is dealt with a simple made-to-order system. (Refer to front matter 33.)
Please contact SMC for a specification sheet when placing an order.

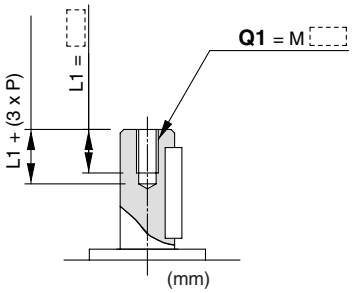
Shaft Pattern Sequencing II

Additional Reminders

1. Enter the dimensions within a range that allows for additional machining.
2. SMC will make appropriate arrangements if no dimensional, tolerance, or finish instructions are given in the diagram.
3. The length of the unthreaded portion is 2 to 3 pitches.
4. Unless specified otherwise, the thread pitch is based on coarse metric threads.
   M3 x 0.5, M4 x 0.7, M5 x 0.8
   M6 x 1
5. Enter the desired figures in the ⬚ portion of the diagram.
6. XA31 to XA59 are the standard products that have been additionally machined.
7. Chamfer face of the parts machining additionally is C0.5.

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 = 6
- Applicable shaft type: Y

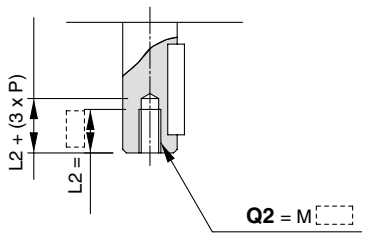


(mm)

Size	Q1
20	M3, M4
30	M3, M4, M5
40	M4, M5, M6

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 = 8
- Applicable shaft type: Y

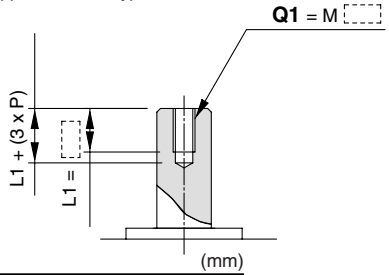


(mm)

Size	Q2
20	M3, M4
30	M3, M4,M5
40	M4, M5,M6

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 = 6
- Applicable shaft types: J, K, T

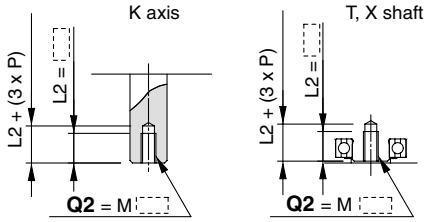


(mm)

Size	Q1
10	M3
15	M3, M4
20	M3, M4, M5, M6
30	M4, M5, M6, M8
40	M4, M5, M6, M8, M10

Symbol: A34

Machine female threads into the short shaft.
- The maximum dimension L2 is, as a rule, twice the thread size.
  (Example) For M5: L2 = 10
- Applicable shaft types: K, T, X

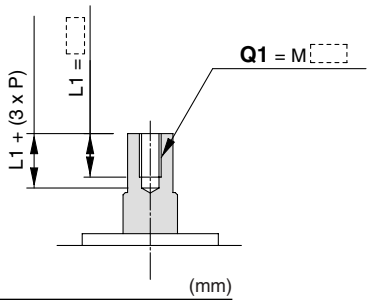


(mm)

Size	Q2
10	M3
15	M3, M4
20	M3, M4, M5, M6
30	M4, M5, M6, M8
40	M4, 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 = 6
- Applicable shaft types: X, Z

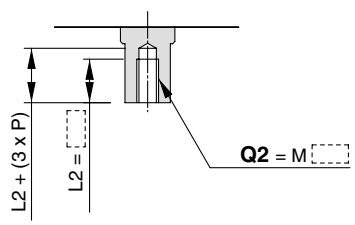


(mm)

Size	Q1
20	M3, M4
30	M3, M4, M5, M6
40	M4, M5, M6, M8

Symbol: A36

Machine female threads into the short shaft.
- The maximum dimension L2 is, as a rule, twice the thread size.
  (Example) For M4: L2 = 8
- Applicable shaft types: J, Z

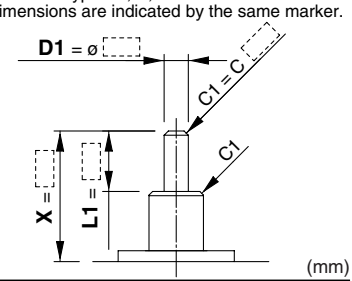


(mm)

Size	Q2
20	M3, M4
30	M3, M4, M5, M6
40	M4, 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.) (If not specifying dimension C1, indicate "∗" instead.)
- Applicable shaft types: J, K, T
- Equal dimensions are indicated by the same marker.

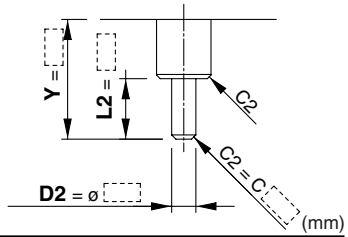


(mm)

Size	X	L1 max	D1
10	3 to 18	X – 2	ø3.5 to ø4.9
15	3 to 20	X – 2	ø3.5 to ø5.9
20	3.5 to 30	X – 2.5	ø5 to ø9.9
30	4 to 32	X–3	ø5 to ø11.9
40	4 to 36	X – 3	ø5 to ø14.9

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



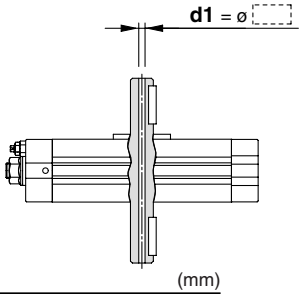
(mm)

Size	Y	L2 max	D2
10	1 to 18	Y	ø3.5 to ø4.9
15	1 to 20	Y	ø3.5 to ø5.9
20	1 to 30	Y	ø5 to ø9.9
30	1 to 32	Y	ø5 to ø11.9
40	1 to 36	Y	ø5 to ø14.9

-XA31 to XA48

Symbol: A39

Shaft with through-hole
Minimum machining diameter for d1 is 0.1.
• Applicable shaft type: Y

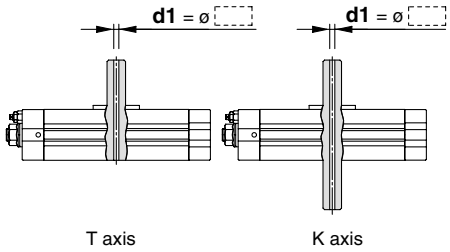


(mm)

Size	d1
20	ø2.5 to ø3.5
30	ø3 to ø5.5
40	ø4 to ø7

Symbol: A40

Shaft with through-hole
Minimum machining diameter for d1 is 0.1.
• Applicable shaft types: K, T

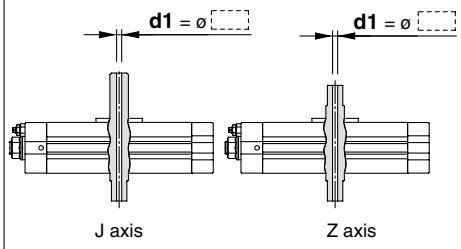


(mm)

Size	d1
10	ø2 to ø3
15	ø2 to ø4
20	ø2.5 to ø6
30	ø3 to ø8
40	ø4 to ø10

Symbol: A41

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

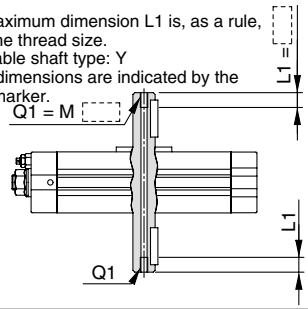


(mm)

Size	d1
10	ø2 to ø3
15	ø2 to ø4
20	ø2.5 to ø5
30	ø3 to ø7
40	ø4 to ø8

Symbol: A42

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 dimension L1 is, as a rule, twice the thread size.
• Applicable shaft type: Y
• Equal dimensions are indicated by the same marker.

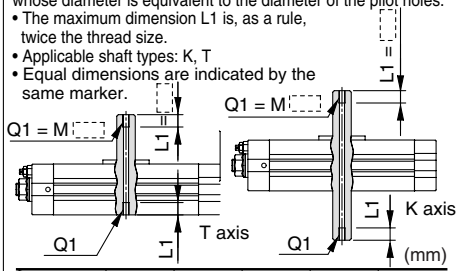


(mm)

Thread \ Size	20	30	40
M3 x 0.5	ø2.5	—	—
M4 x 0.7	ø3.3	ø3.3	—
M5 x 0.8	—	ø4.2	ø4.2
M6 x 1	—	—	ø5

Symbol: A43

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 dimension L1 is, as a rule, twice the thread size.
• Applicable shaft types: K, T
• Equal dimensions are indicated by the same marker.

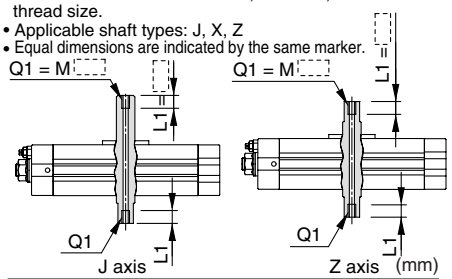


(mm)

Thread \ Size	10	15	20	30	40
M 3 x 0.5	ø2.5	ø2.5	ø2.5	—	—
M 4 x 0.7	—	ø3.3	ø3.3	ø3.3	—
M 5 x 0.8	—	—	ø4.2	ø4.2	ø4.2
M 6 x 1	—	—	ø5	ø5	ø5
M 8 x 1.25	—	—	—	ø6.8	ø6.8
M10 x 1.5	—	—	—	—	ø8.5
Rc 1/8	—	—	—	—	ø8.2

Symbol: A44

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 dimension L1 is, as a rule, twice the thread size.
• Applicable shaft types: J, X, Z
• Equal dimensions are indicated by the same marker.

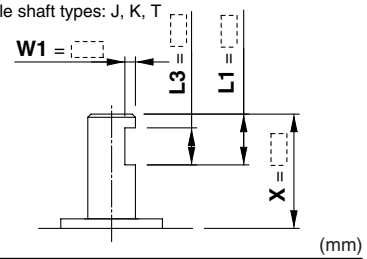


(mm)

Thread \ Size	10	15	20	30	40
M3 x 0.5	ø2.5	ø2.5	ø2.5	—	—
M4 x 0.7	—	ø3.3	ø3.3	ø3.3	—
M5 x 0.8	—	—	ø4.2	ø4.2	ø4.2
M6 x 1	—	—	—	ø5	ø5
M8 x 1.25	—	—	—	—	ø6.8

Symbol: A45

The long shaft can be further shortened by machining a middle-cut chamfer into it.
(If shortening the shaft is not required, indicate "∗" for dimension X.)
(The position is that of the standard flat at the keyway portion.)
• Applicable shaft types: J, K, T

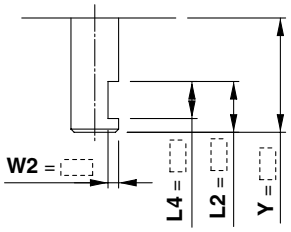


(mm)

Size	X	W1	L1 max	L3 max
10	6 to 18	0.5 to 1.5	X – 2	L1 – 1
15	6.5 to 20	0.5 to 1.5	X – 2	L1 – 1
20	9.5 to 30	1 to 2	X – 2.5	L1 – 2
30	11.5 to 32	1 to 2	X – 3	L1 – 2
40	12.5 to 36	1 to 2	X – 3	L1 – 2

Symbol: A46

The short shaft can be further shortened by machining a middle-cut chamfer into it.
(If shortening the shaft is not required, indicate "∗" for dimension Y.)
(The position is that of the standard flat at the keyway portion.)
• Applicable shaft type: K

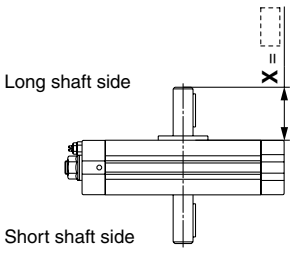


(mm)

Size	Y	W2	L2 max	L4 max
10	4 to 18	0.5 to 1.5	Y	L2 – 1
15	4.5 to 20	0.5 to 1.5	Y	L2 – 1
20	6.5 to 30	1 to 2	Y	L2 – 2
30	8.5 to 32	1 to 2	Y	L2 – 2
40	9.5 to 36	1 to 2	Y	L2 – 2

Symbol: A48

Shorten the long shaft.
• Applicable shaft type: Y



Size **20, 30, 40**

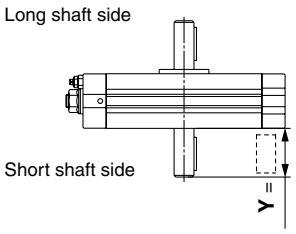
(mm)

Size	X
20	17 to 30
30	18 to 32
40	18.5 to 36

Shaft Pattern Sequencing II

Symbol: A49

Shorten the short shaft.
• Applicable shaft type: Y



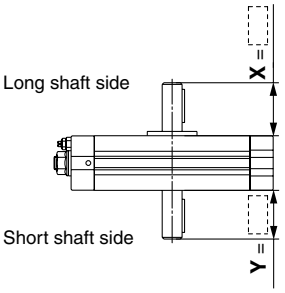
Size **20, 30, 40**

(mm)

Size	Y
20	17 to 30
30	18 to 32
40	18.5 to 36

Symbol: A50

Both the long shaft and short shaft are shortened.
• Applicable shaft type: Y



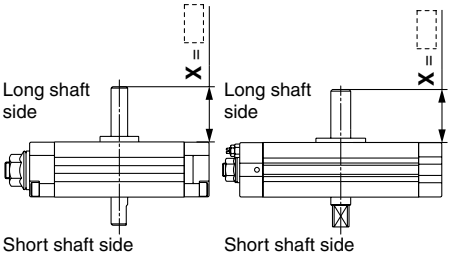
Size **20, 30, 40**

(mm)

Size	X	Y
20	17 to 30	17 to 30
30	18 to 32	18 to 32
40	18.5 to 36	18.5 to 36

Symbol: A51

Shorten the long shaft.
• Applicable shaft types: J, K, T



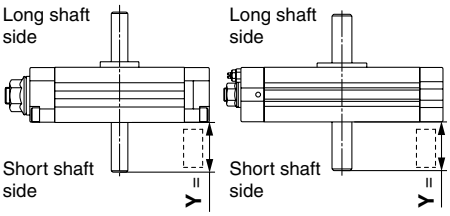
Size **10, 15** Size **20, 30, 40**

(mm)

Size	X
10	3 to 18
15	3 to 20
20	3.5 to 30
30	4 to 32
40	4 to 36

Symbol: A52

Shorten the short shaft.
• Applicable shaft type: K



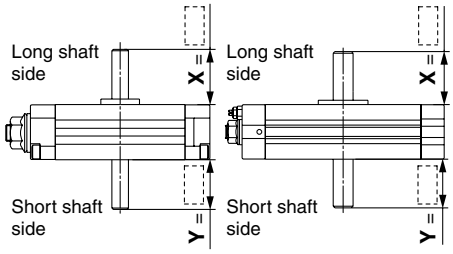
Size **10, 15** Size **20, 30, 40**

(mm)

Size	Y
10	1 to 18
15	1 to 20
20	1 to 30
30	1 to 32
40	1 to 36

Symbol: A53

Both the long shaft and short shaft are shortened.
• Applicable shaft type: K



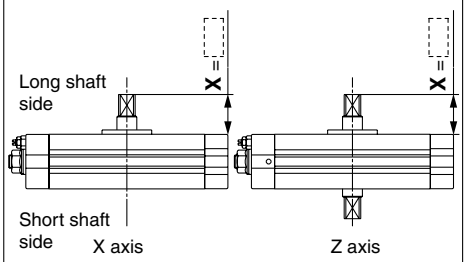
Size **10, 15** Size **20, 30, 40**

(mm)

Size	X	Y
10	3 to 18	1 to 18
15	3 to 20	1 to 20
20	3.5 to 30	1 to 30
30	4 to 32	1 to 32
40	4 to 36	1 to 36

Symbol: A54

Shorten the long shaft.
• Applicable shaft types: X, Z

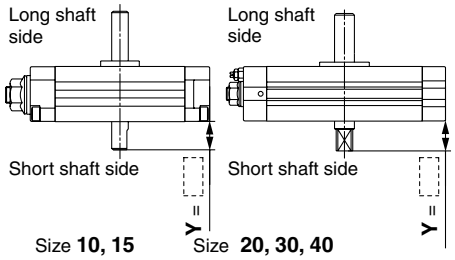


(mm)

Size	X
20	3.5 to 21
30	4 to 24
40	4 to 27

Symbol: A55

Shorten the short shaft.
• Applicable shaft type: J, Z



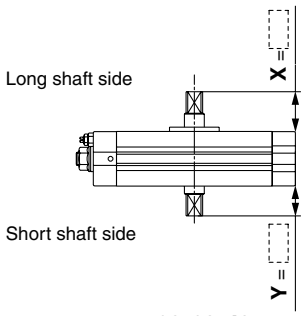
Size **10, 15** Size **20, 30, 40**

(mm)

Size	Y
10	1 to 9
15	1 to 10
20	1 to 15
30	1 to 18
40	1 to 20

Symbol: A56

Both the long shaft and short shaft are shortened.
• Applicable shaft type: Z



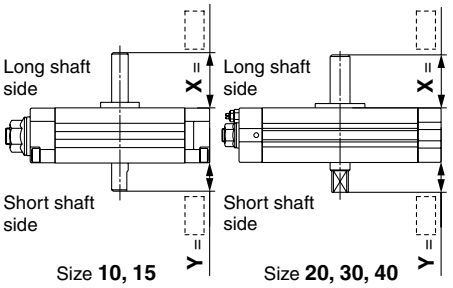
Size **20, 30, 40**

(mm)

Size	X	Y
20	3.5 to 21	1 to 15
30	4 to 24	1 to 18
40	4 to 27	1 to 20

Symbol: A57

Both the long shaft and short shaft are shortened.
• Applicable shaft type: J



Size **10, 15** Size **20, 30, 40**

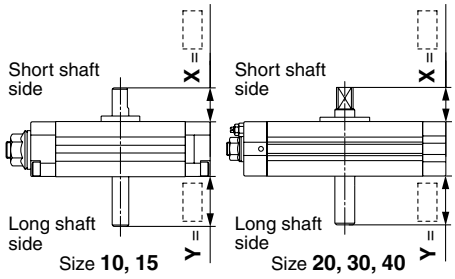
(mm)

Size	X	Y
10	3 to 18	1 to 9
15	3 to 20	1 to 10
20	3.5 to 30	1 to 15
30	4 to 32	1 to 18
40	4 to 36	1 to 20

-XA49 to XA59

Symbol: A58

The rotation axis is reversed, and then shorten the long and short shafts.
• Applicable shaft type: J, T

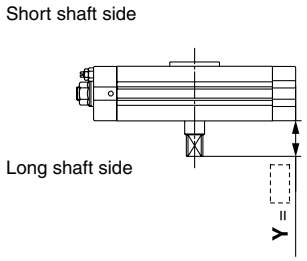


(mm)

Size	X	Y
10	3 to 10	1 to 17
15	3 to 11	1 to 19
20	3.5 to 16.5	1 to 28.5
30	4 to 20	1 to 30
40	4 to 22	1 to 34

Symbol: A59

The rotation axis is reversed, and then shorten the long shaft.
• Applicable shaft type: X



(mm)

Size	Y
20	1 to 19.5
30	1 to 22
40	1 to 25

Series CRQ2 (Size: 10, 15, 20, 30, 40)
Made to Order Specifications: -XC7 to -XC22/XC30/XC69

How to Order

C | D | RQ2B | S | P | 20 | | – | 90 | | – | M9BW | – X | C7 | C12 | C30 | -X6

Built-in magnet

Nil	None
D	Built-in magnet

Shaft type

Standard	S	Single shaft
	W	Double shaft
Shaft type variation	X	Single shaft with four chamfers
	Y	Double shaft key
	Z	Double shaft with four chamfers
	T	Single round shaft
	J	Double shaft
	K	Double round shaft

Pattern

Size

10
15
20
30
40

Thread type

Size	Port type	
10, 15	Nil	M5
20, 30, 40	Nil	Rc 1/8
	TF	G 1/8
	TN	NPT 1/8
	TT	NPTF 1/8

Rotating angle

90	80° to 100°
180	170° to 190°
360	350° to 370°

Air cushion

Size	Air cushion	
	None	Attached
10, 15	Nil	—
20, 30, 40		C

Auto switch

Refer to page 246 for the part no. of auto switches.

How to order model with auto switches

Refer to page 246 for "How to Order" products with auto switches.

Symbol for simple specials, Made-to-order products

- When number of combinations is 1 or 2, refer to chart 2, 4 and 5.
- ∗ Combination of XA is possible for up to 2 types.
- ∗ Combination of -X6 (shaft, parallel key stainless spec.) is available for all the types.

• Combination 3 Types

C7	C30	C22
C22	C22	-X6

• Combination of Applicable Chart

Chart 5
Chart 5

Combination is available only when all the conditions are fulfilled among the combination chart above.

• Combination 4 Types

C7	C12	C30	-X6

• Combination of Applicable Chart

Chart 5

Combination is available only when all the conditions are fulfilled among the combination chart above.

∗ Combination of made-to-order is available up to 4 types.

Combination Chart of Made to Order

Chart 5. Combination between -XC□ and -XC□

Symbol	Description	Applicable size	Combination			
XC7	Reversed shaft	10, 15, 20, 30, 40				
XC8 to XC11	Change of rotating range					
XC12 to XC15	Change in angle adjustable range 0° to 100°					
XC16	Change in angle adjustable range 90° to 190°					
XC17						
XC18	Change of rotating range	20, 30, 40	XC7 to XC17	XC18 to XC21	XC22	XC30
XC19						
XC20	Change in angle adjustable range 90° to 190°					
XC21						
XC22	Without inner rubber bumper	10, 15	●	●	●	●
XC30	Fluorine grease	10, 15, 20, 30, 40	●	●	●	●
XC69	Fluororubber seal	10, 15, 20, 30, 40	●	●	●	●

Series CRQ2 (Size: 10, 15, 20, 30, 40)
Made to Order Specifications: -XC7

Please consult with SMC for further information on specifications, dimensions and delivery.

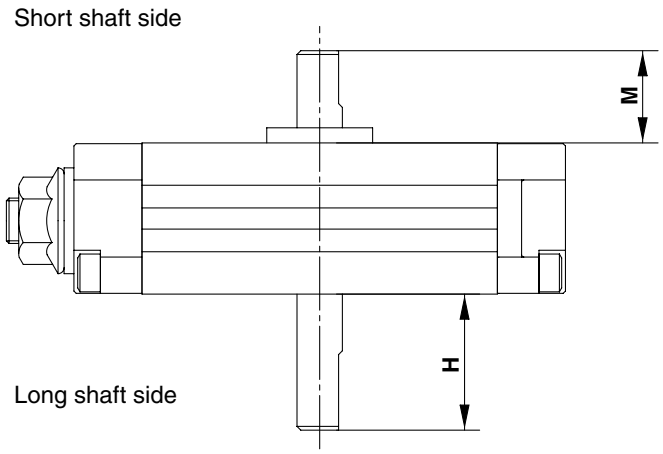
1 Reversed Shaft -XC7

CRQ2B
CDRQ2B → **Refer to "How to Order" on page 256.** — **XC7**

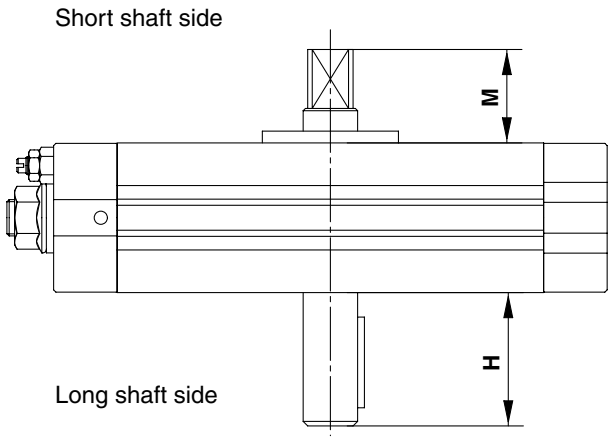
Reversed shaft

Specifications

Applicable size	10, 15, 20, 30, 40
Applicable shaft type	S, W, X, T, J shaft



Size 10, 15



Size 20, 30, 40

(mm)

Size	M	H
10	10	17 (—)*
15	11	19 (—)*
20	16.5	28.5 (19.5)*
30	20	30 (22)*
40	22	34 (25)*

∗ For X shaft

Series ***CRQ2*** (Size: 10, 15, 20, 30, 40)
Made to Order Specifications:
-XC8 to -XC11, XC18/XC19: Change of Rotating Range

Please consult with SMC for further information on specifications, dimensions and delivery.

2 Change of Rotating Range -XC8 to XC11, XC18/XC19

CRQ2B
CDRQ2B → Refer to "How to Order" on page 256. **−X C8**

Specifications

Applicable shaft type	S, W, Y

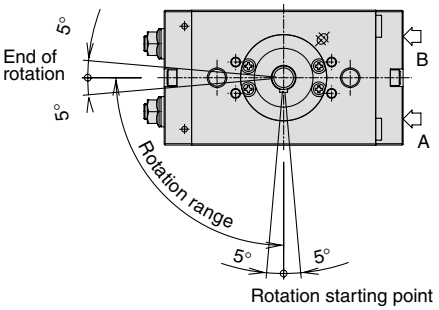
Symbol
-XC8 to XC11, XC18/XC19

Additional Reminders

The rotation starting point shows the positions of one flat chamfering and the key groove when pressurized to the connecting port (B).

Symbol: C8

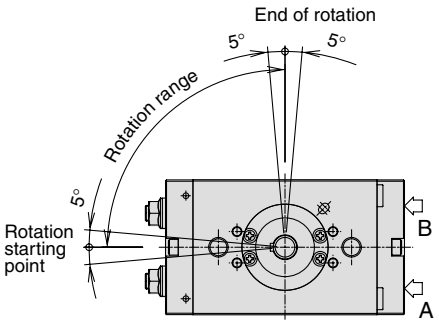
Angle adjustment at the rotation starting point and the end point are at ±5°.
Rotating range is changed. Rotation angle is at 90° ±10°.
The rotation starting point is on the perpendicular line (down).



The figure shows the view from the long shaft end.

Symbol: C9

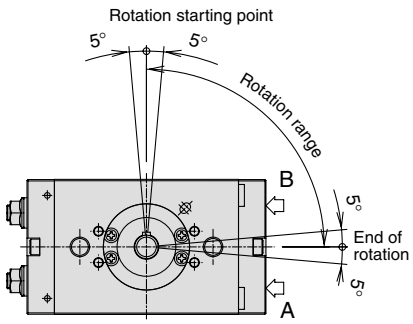
Angle adjustment at the rotation starting point and the end point are at ±5°.
Rotating range is changed. Rotation angle is at 90° ±10°.
The rotation starting point is on the horizontal line (left).



The figure shows the view from the long shaft end.

Symbol: C10

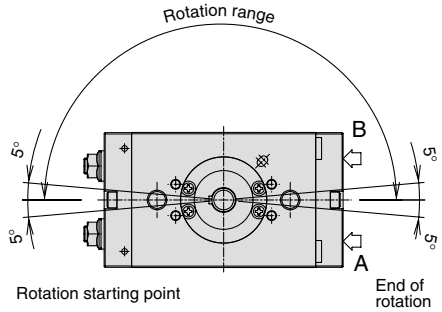
Angle adjustment at the rotation starting point and the end point are at ±5°.
Rotating range is changed. Rotation angle is at 90° ±10°.
The rotation starting point is on the perpendicular line (up).



The figure shows the view from the long shaft end.

Symbol: C11

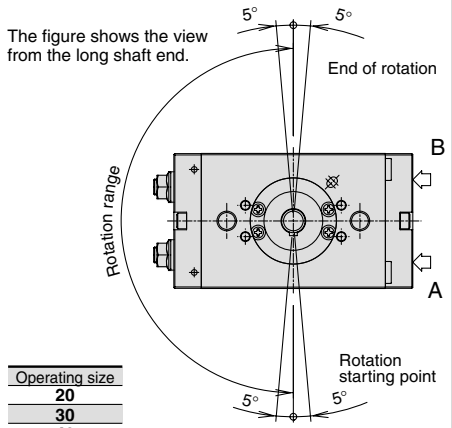
Angle adjustment at the rotation starting point and the end point are at ±5°.
Rotating range is changed. Rotation angle is at 180° ±10°.
The rotation starting point is on the horizontal line (left).



The figure shows the view from the long shaft end.

Symbol: C18

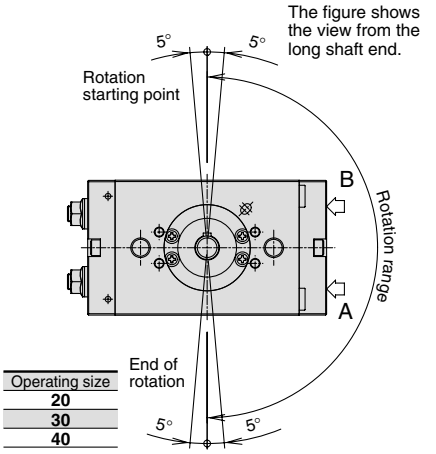
Angle adjustment at the rotation starting point and the end point are at ±5°.
Rotating range is changed. Rotation angle is at 180° ±10°.
The rotation starting point is on the perpendicular line (down).



Operating size
20
30
40

Symbol: C19

Angle adjustment at the rotation starting point and the end point are at ±5°.
Rotating range is changed. Rotation angle is at 180° ±10°.
The rotation starting point is on the perpendicular line (up).



Operating size
20
30
40

Series ***CRQ2*** (Size: 10, 15, 20, 30, 40)
Made to Order Specifications:
-XC12 to XC17, XC20/XC21: Change of Angle Adjusting Range (0° to 100°, 90° to 190°)

Please consult with SMC for further information on specifications, dimensions and delivery.

3 Change of Angle Adjustable Range (0° to 100°, 90° to 190°) -XC12 to XC17, XC20/XC21

CRQ2B
CDRQ2B
→ Refer to "How to Order" on page 256.
— X **C12**

Symbol
-XC12 to XC17, XC20/XC21

Specifications

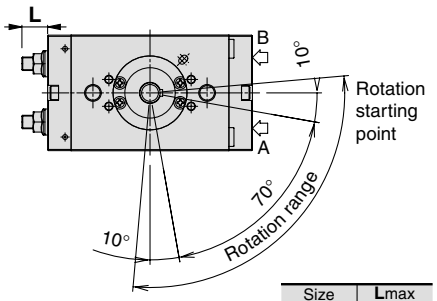
Applicable shaft type	S, W, Y, X*, Z*, T*, J*, K*

Additional Reminders

The rotation starting point is the position of the flat and the key groove when the actuator is pressurized through connection port B.
There are no air cushion effects in the rotating ranges of 70° or 160° shown in the diagram.
* Only XC12 and XC16 are compatible with shaft types X, Z, T, J and K.

Symbol: C12

The rotation angle can be adjusted between 0° and 100°.

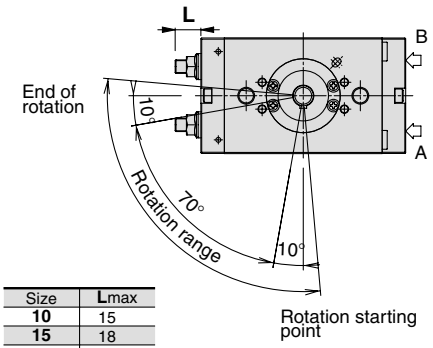


Size	Lmax
10	15
15	18
20	24
30	27
40	31.5

The figure shows the view from the long shaft end.

Symbol: C13

The rotation angle can be adjusted between 0° and 100°.

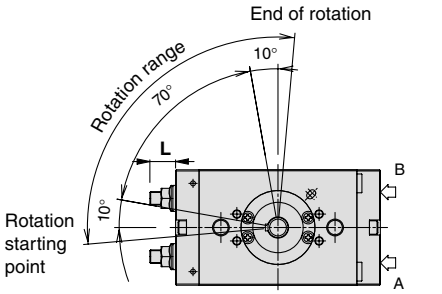


Size	Lmax
10	15
15	18
20	24
30	27
40	31.5

The figure shows the view from the long shaft end.

Symbol: C14

The rotation angle can be adjusted between 0° and 100°.

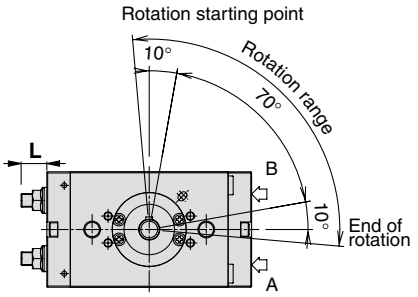


Size	Lmax
10	15
15	18
20	24
30	27
40	31.5

The figure shows the view from the long shaft end.

Symbol: C15

The rotation angle can be adjusted between 0° and 100°.

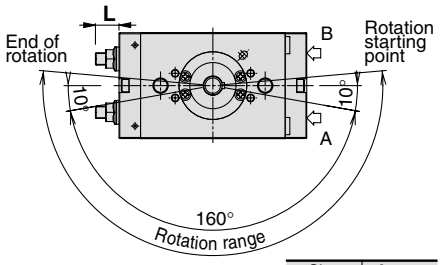


Size	Lmax
10	15
15	18
20	24
30	27
40	31.5

The figure shows the view from the long shaft end.

Symbol: C16

The rotation angle can be adjusted between 90° and 190°.

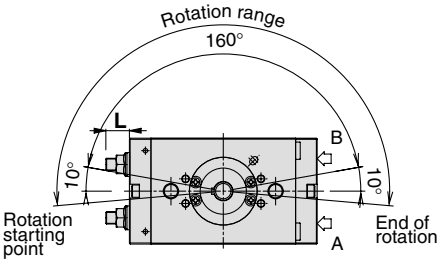


Size	Lmax
10	15
15	18
20	24
30	27
40	31.5

The figure shows the view from the long shaft end.

Symbol: C17

The rotation angle can be adjusted between 90° and 190°.

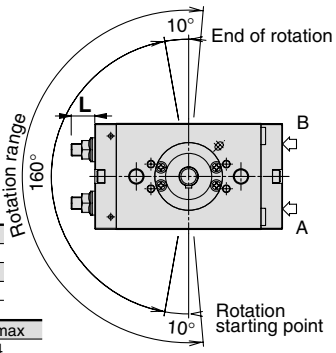


Size	Lmax
10	15
15	18
20	24
30	27
40	31.5

The figure shows the view from the long shaft end.

Symbol: C20

The rotation angle can be adjusted between 90° and 190°.



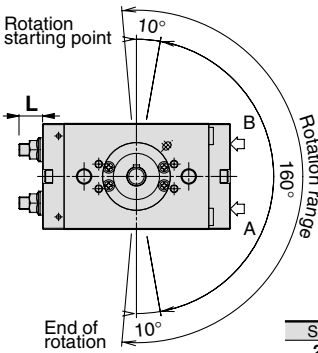
Operating size
20
30
40

Size	Lmax
20	24
30	27
40	31.5

The figure shows the view from the long shaft end.

Symbol: C21

The rotation angle can be adjusted between 90° and 190°.



Operating size
20
30
40

Size	Lmax
20	24
30	27
40	31.5

The figure shows the view from the long shaft end.

Series CRQ2 (Size: 10, 15, 20, 30, 40)
Made to Order Specifications:

-XC22: Without Inner Rubber Bumper, -XC30: Fluorine Grease
-XC69: Fluororubber Seal, -X6: Shaft, Parallel Key Made of Stainless Steel Spec.
Please consult with SMC for further information on specifications, dimensions and delivery.

4 Without Inner Rubber Bumper -XC22

C RQ2B
CDRQ2B → Refer to "How to Order" on page 256. − XC22

Without inner rubber bumper

Specifications

Fluid	Air (Non-lube)
Applicable size	10, 15
Max. operating pressure	0.7 MPa
Min. operating pressure	0.15 MPa
Port size	M5 x 0.8
Rotation	80° to 100°, 170° to 190°, 350° to 370°
Applicable shaft type	S, W, X, Y, Z, T, J, K
Auto switch	Mountable

∗Refer to page 247 for other specifications.

Refer to page 250 for other specifications.

5 Fluorine Grease -XC30

C RQ2B
CDRQ2B → Refer to "How to Order" on page 256. − XC30

Fluorine grease

Fluorine grease is used as lubricant oil in seal part of packing and inner wall of cylinder. (Not for low-speed specification.)

6 Fluororubber Seal -XC69

C RQ2B
CDRQ2B → Refer to "How to Order" on page 256. − XC69

Fluororubber seal

Seal material is changed to fluororubber.

7 Shaft, Parallel Key Made of Stainless Steel Spec. -X6

C RQ2B
CDRQ2B [Shaft type] [Size] − [Rotation] S-X6

- Shaft type: Refer to "How to Order" on page 246 for further information.
- Size
- Rotation
- S-X6: Shaft, parallel key made of stainless steel

Stainless steel is used as a substitute material for standard parts when used under conditions with a possibility of oxidization or decay.

Fluid	Air (Non-lube)
Applicable shaft type	S, W, X, Y, Z, T, J, K
Applicable size	20, 30, 40
Max. operating pressure	1.0 MPa
Min. operating pressure	0.1 MPa
Cushion	Not attached, Air cushion
Rotation range	80° to 100°, 170° to 190°, 350° to 370°
Stainless steel part	Shaft, Parallel key
Port size	Rc 1/8, G 1/8, NPT 1/8, NPTF 1/8
Auto switch	Mountable

Rotary Actuators Precautions 1

Be sure to read this before handling.

Design / Selection

⚠Warning

1. Confirm the specifications.

Products represented in this catalog are designed only for use in compressed air systems (including vacuum).
Do not operate at pressures or temperatures, etc., beyond the range of specifications, as this can cause damage or malfunction. (Refer to the specifications.)
Please contact SMC when using a fluid other than compressed air (including vacuum).
We do not guarantee against any damage if the product is used outside of the specification range.

2. If the operation involves load fluctuations, ascending/descending movements, or changes in frictional resistance, make sure to provide safety measures.

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

3. If there is a chance that the product will pose a hazard to humans, install a protective cover.

If the moving portion of the product will pose a hazard to humans or will damage machinery or equipment, provide a construction that prevents direct contact with those areas.

4. Be certain that the secured portions will not loosen.

Be certain to adopt a reliable connecting method if the rotary actuator is used very frequently or if it is used in a location that is exposed to a large amount of vibration.

5. There may be cases in which a speed reduction circuit or a shock absorber is required.

If the driven object moves at high speeds or is heavy, it will be unfeasible for only the rotary actuator's cushion to absorb the shock. Therefore, provide a speed-reduction circuit to reduce the rotary actuator's speed before the thrust is applied to the cushion, or an external shock absorber to dampen the shock. If these countermeasures are taken, make sure to take the rigidity of the mechanical equipment into consideration.

6. Consider the possibility of a reduction in the circuit air pressure caused by a power failure.

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

7. Consider the possibility of power source related malfunctions that could occur.

For the equipment that rely on power sources such as compressed air, electricity, or hydraulic pressure, adopt a countermeasure to prevent the equipment from causing a hazard to humans or damage to the equipment in the event of malfunction.

8. If a speed controller is provided in the exhaust restrictor, implement a safety design taking the residual pressure into consideration.

If air pressure is applied to the air supply side without residual pressure in the exhaust side, the rotary actuator will operate at abnormally high speed, which could pose a hazard to humans and can damage the machinery and equipment.

9. Consider the behavior of the rotary actuator in the event of an emergency stop.

Devise a safe system so that if a person engages the emergency stop, or if a safety device is tripped during a system malfunction such as a power failure, the movement of the rotary actuator will not cause a hazard to humans or damage the equipment.

10. Consider the action of the rotary actuator when restarting after an emergency stop.

Devise a safe design so that the restarting of the rotary actuator will not pose a hazard to humans or damage the equipment. Install manually controlled equipment for safety when the actuator has to be reset to the starting position.

11. Do not use the product as a shock absorber.

If an abnormal pressure or air leakage occurs, the rotary actuator's speed reduction capability could become severely effected, which could pose a hazard to humans and damage the machinery and equipment.

12. Select a speed within the product's allowable energy value.

If the product's kinetic energy of the load exceeds the allowable value, it could damage the product, and cause a hazard to humans and damage the machinery and equipment.

13. Provide a shock absorber if the kinetic energy that is applied to the product exceeds the allowable value.

If the product's kinetic energy exceeds the allowable value, it could damage the product, and cause a hazard to humans and damage the machinery or equipment.

14. Do not stop or hold the product at midpoint by keeping air pressure in the product.

For a product lacking an external stopping mechanism, if the directional control valve is closed to keep the air pressure in the product, in an attempt to stop the product at midpoint, it might not be possible to maintain that stopped position due to an air leakage. As a result, it could pose a hazard to humans and cause damage to machinery and/or equipment.

15. Give consideration to the decline in strength caused by changes of the shaft type.

Some shaft types, such as simple specials, may have shapes and dimensions that result in decreased strength when compared with standard models. Consider this carefully when using.

16. Do not use two or more rotary actuators with the aim of synchronized movement.

One of the actuators may bear the load of operation, making synchronized movement impossible, and possibly leading to deformation of the equipment.

17. Do not use in a location where adverse effect could be occurred by the oozing of the lubricant to the exterior.

The lubricant coating the interior of the product may leak to the outside of the product from the portion of the connection of the rotary shaft, body cover, etc.

18. Do not disassemble the product or make any modifications, including additional machining.

It may cause human injury and/or an accident.

19. Refer to the Auto Switches Precautions for using with an auto switch.

Rotary Actuators Precautions 2

Be sure to read this before handling.

Design / Selection

⚠Caution

1. Do not use below the speed adjustment range specified for the product.

If the product is used below the specified speed adjustment range, it could cause the product to stick, slip, or the movement to stop.

2. Do not apply an external torque to the product that exceeds the rated output.

If an external force that exceeds the product's rated output is applied to the product, it could damage the product.

3. The holding torque of the rotating end of the double piston type.

If the internal piston of a double piston product comes in contact with the angle adjustment screen or the cover and stops, the holding torque at the rotating end is one half of the actual output.

4. If it is necessary to provide repeatability of the rotation angle, directly stop the load externally.

Even with a product that is equipped with an angle adjuster, there are times in which the initial rotation angle could change.

5. Do not use under hydraulic pressure.

The product will be damaged if it is used by applying hydraulic pressure.

6. There is a possibility of backlash being generated when stopping the double piston style in the middle with a valve of the closed center type.

7. For the vane type product, if it is necessary to ensure a rotation angle, make sure to use a minimum pressure of 0.3 MPa.

8. Do not use the made-to-order -XC30 at low speeds.

Although fluorine grease is used, it is not designed for low-speed applications.
For information on fluorine grease, refer to the Material Safety Data Sheet (MSDS).

9. Do not use in places where there are many temperature fluctuations. When using in lower temperature applications, use caution so that frost does not occur inside the cylinder or the piston rod.

Operation may be unstable.

10. Adjust the speed control in the environment in which it will be used in.

Speed adjustment may be changed if the environment is different.

Mounting

⚠Warning

1. Operation manual

Install the product and operate it only after reading the operation manual carefully and understanding its contents. Also, keep the manual in a location where it can be referred to as necessary.

Mounting

⚠Warning

2. Ensure sufficient space for maintenance activities.

When installing the products, allow access for maintenance.

3. Tighten threads with the proper tightening torque.

When installing the products, follow the listed torque specifications.

4. Before adjusting the angle by supplying air pressure, take appropriate measures to prevent the equipment from rotating unnecessarily.

When an adjustment is performed under air pressure, the equipment could rotate and fall during the adjustment, depending on the mounted placement of the equipment. As a result, it could pose a hazard to humans and damage the machinery and equipment.

5. Do not loosen the angle adjustment screw beyond the allowable adjustment range.

The angle adjustment screw could fall out if it is loosened beyond its allowable adjustment range and cause a hazard to humans and damage to machinery and equipment.

6. Do not place a magnetic object near the product.

The auto switch is a magnetic sensing type. If a magnetic object is placed close to it, the rotary actuator could operate suddenly, which could pose a hazard to humans and damage the machinery and equipment.

7. Do not perform additional machining to the product.

Additional machining to the product can result in insufficient strength and cause damage to the product. This can lead to possible human injury and damage to the surrounding equipment.

8. Do not enlarge the fixed throttle by modifying the pipe connectors.

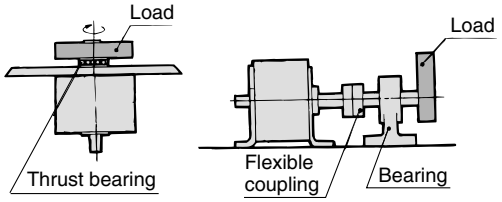
If the hole diameter is enlarged, the product's rotation speed will increase, causing the shock force to increase and damage to the product. As a result, it could pose a hazard to humans and damage the machinery and equipment.

9. If shaft couplings are used, use those with angular freedom.

If shaft couplings that lack angular freedom are used, they could scrape due to eccentricity, leading to equipment malfunction and product damage. As a result, it could pose a hazard to humans and damage the machinery and equipment.

10. Do not apply to the shaft a load that exceeds the values given in a catalog.

If a load that exceeds the allowable value is applied to the product, it could lead to equipment malfunction, a hazard to humans, and damage to the machinery and equipment. Provided that a dynamic load is not generated, a load that is within the allowable radial/thrust load can be applied. However, applications in which the load is applied directly to the shaft should be avoided wherever possible. The methods such as those described below are recommended to prevent the load from being applied directly to the shaft in order to ensure a proper operating condition.



Rotary Actuators Precautions 3

Be sure to read this before handling.

Mounting

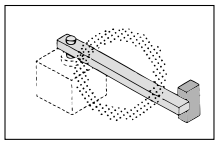
⚠Warning

11. Place an external stopper in a position that is away from the rotating shaft.

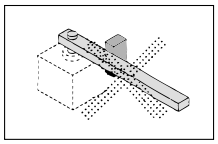
If the stopper is placed near the rotating shaft, the torque that is generated by the product itself will cause the reaction force which is directed to the stopper to be redirected and applied to the rotating shaft. This will lead to the breakage of the rotating shaft and bearing. As a result, it could pose a hazard to humans and damage the machinery and equipement.

Precautions when Using External Stoppers

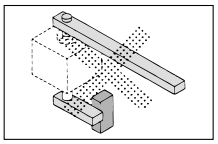
- Be sure to install external stoppers in the proper places. Installation in the wrong place can result in equipment breakage, which could damage other equipment or cause human injury.



Install the stopper at a sufficient distance from the rotating shaft.

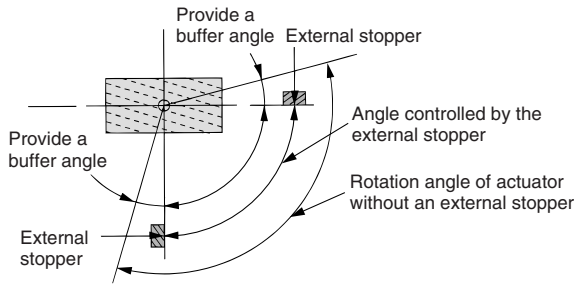


The external stopper becomes a fulcrum, resulting in the load's inertia force being applied to the shaft as a bending moment.



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

- Install external stoppers within the range of the rotating shaft angle.
  Installing an external stopper at the maximum rotation angle may result in inability to fully absorb the kinetic energy generated, and damage to equipment may occur.
  When using external stoppers at rotation angles of 90°, 180°, or 270°, use products with rotation angles of 100°, 190°, or 280° respectively.

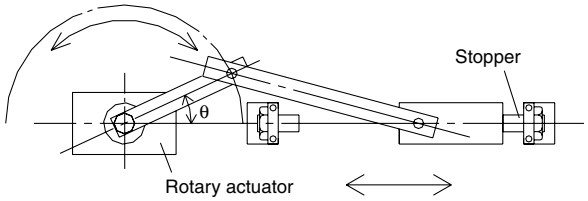


Backlash of the Single Rack Pinion Type CRA1 Series

There is a backlash of within 1° at the rotation end of the CRA1 series. It is necessary to decide the position of the external stopper when precise rotation is required.

Precautions when Converting Rotational Motion to Linear Motion

When using a link mechanism, etc., to convert rotational motion to linear motion, and determining the operation end using the stopper on the linear motion end (see below), a small value for θ at the operation end may result in the torque of the rotary actuator causing excessive radial load to act on the output axle, and equipment breakage may occur.
Install a stopper on the rotational motion side, or increase the value of θ at the operation end, to make sure the load generated does not exceed the allowable value for the product.



12. Do not use springs, etc., to add force in the rotational movement direction.

When rotational force from an external spring, etc., acts and generates negative pressure on the product's interior, breakage of the internal seal or acceleration of abrasion may occur.

⚠Caution

1. Observe the specified torque to secure the block of the angle adjustment unit.

If it is secured with a torque that is lower than the specified torque, the block could become loosened during use, causing the angle to exceed the set angle.

2. Do not use organic solvent to wipe the area of the name plate that shows the model.

It will erase what is indicated on the name plate.

3. Do not hit the rotating shaft by securing the body or hit the body by securing the rotating shaft.

These actions could cause the shaft to bend or damage the bearing. When a load must be coupled to the rotating shaft, secure the rotating shaft.

4. Do not place your foot directly on the shaft or on the equipment that is coupled to the shaft.

Placing one's weight directly onto the rotating shaft could cause the rotating shaft or the bearing to become damaged.

5. If a product is equipped with an angle adjustment function, use it within the specified adjustment range.

If the product is used outside the specified adjustment range, it could lead to equipment malfunction or product damage. Refer to the product specifications for details on the adjustment range of the products.

Piping

⚠Caution

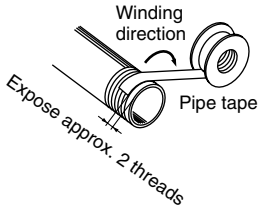
1. Refer to the Fittings and Tubing Precautions (Best Pneumatics No. 6) for handling one-touch fittings.

2. Preparation before piping

Before piping is connected, it should be thoroughly blown out with air (flushing) or washed to remove chips, cutting oil and other debris from inside the pipe.

3. Wrapping of pipe tape

When screwing piping or fittings into ports, ensure that chips from the pipe threads or sealing material do not enter the piping. Also, if pipe tape is used, leave 1.5 to 2 thread ridges exposed at the end of the threads.



SMC

Rotary Actuators Precautions 4

Be sure to read this before handling.

Speed and Cushion Adjustment

⚠Warning

1. To make a speed adjustment, gradually adjust starting from the low speed end.

If the speed adjustment is performed from the high speed end, it could damage the product. As a result, it could pose a hazard to humans and damage the machinery and equipment.

2. The cushion needle is not adjusted at the time of shipment. Therefore, an adjustment must be made in accordance with the operating speed and the moment of inertia of the load.

The absorption of kinetic energy by the bumper is regulated by the adjustment of the needle. An improper adjustment could lead to damage of the equipment and the product. As a result, it could pose a hazard to humans and damage the machinery and equipment.

3. Do not operate with the cushion needle in a fully closed condition.

This could tear the seal, which could pose a hazard to humans and damage the machinery and equipment.

4. Do not apply an excessive force to loosen the cushion needle.

The needle itself is provided with a pull stop. However, the pullstop could be damaged if the needle is loosened through the application of excessive force. As a result, it could pose a hazard to humans and damage the machinery and equipment.

5. For products with shock absorbers, when the shock absorber stops motion before reaching the stroke end using a stopper mechanism with the objective of shortening takt time, be sure the shock absorber is stopped in a position where it has adequately absorbed the kinetic energy.

Failure to do so can result in damage to equipment.

Lubrication

⚠Warning

1. This product should be used without lubrication. Although it will operate even if it is lubricated, it could lead to sticking or slipping.

Air Supply

⚠Warning

1. Type of fluids

Please consult with SMC when using the product in applications other than compressed air.

2. When there is a large amount of drainage.

Compressed air containing a large amount of drainage can cause malfunction of pneumatic equipment. An air dryer or water separator should be installed upstream from filters.

3. Drain flushing

If condensation in the drain bowl is not emptied on a regular basis, the bowl will overflow and allow the condensation to enter the compressed air lines. It causes malfunction of pneumatic equipment.

Air Supply

⚠Warning

If the drain bowl is difficult to check and remove, installation of a drain bowl with an auto drain option is recommended.

For compressed air quality, refer to Best Pneumatics No. 5.

4. Use clean air.

Do not use compressed air that contains chemicals, synthetic oils including organic solvents, salt or corrosive gases, etc., as it can cause damage or malfunction.

⚠Caution

1. When extremely dry air is used as the fluid, degradation of the lubrication properties inside the equipment may occur, resulting in reduced reliability (or reduced service life) of the equipment. Please consult with SMC.

2. Install an air filter.

Install an air filter upstream near the valve. Select an air filter with a filtration size of 5 μm or smaller.

3. Take measures to ensure air quality, such as by installing an aftercooler, air dryer, or water separator.

Compressed air that contains a large amount of drainage can cause malfunction of pneumatic equipment such as rotary actuators. Therefore, take appropriate measures to ensure air quality, such as by providing an aftercooler, air dryer, or water separator.

4. Ensure that the fluid and ambient temperature are within the specified range.

If the fluid temperature is 5°C or less, the moisture in the circuit could freeze, causing damage to the seals and equipment malfunction. Therefore, take appropriate measures to prevent freezing.

For compressed air quality, refer to Best Pneumatics No. 5.

Operating Environment

⚠Warning

1. Do not use in an atmosphere having corrosive gases, chemicals, sea water, water, water steam, or where there is direct contact with any of these.

Refer to the construction for information on the rotary actuators material.

2. Do not expose the product to direct sunlight for an extended period of time.

3. Do not use in a place subject to heavy vibration and/or shock.

4. Do not mount the product in locations where it is exposed to radiant heat.

5. Do not use in dusty locations or where water or oil, etc., splash on the equipment.

Rotary Actuators Precautions 5

Be sure to read this before handling.

Maintenance

⚠Warning

1. Perform maintenance inspection according to the procedures indicated in the operation manual.

If handled improperly, malfunction and damage of machinery or equipment may occur.

2. Maintenance work

If handled improperly, compressed air can be dangerous. Assembly, handling, repair and element replacement of pneumatic systems should be performed by a knowledgeable and experienced person.

3. Drain flushing

Remove drainage from air filters regularly.

4. Removal of equipment, and supply/exhaust of compressed air

When components are removed, first confirm that measures are in place to prevent workpieces from dropping, run-away equipment, etc. Then, cut off the supply pressure and electric power, and exhaust all compressed air from the system using the residual pressure release function.

When machinery is restarted, proceed with caution after confirming that appropriate measures are in place to prevent cylinders from sudden movement.

⚠Caution

1. For lubrication, use the designated grease for each specific product.

The use of a non-designated lubricant could damage the seals.

Rotary Actuators Precautions 6

Be sure to read this before handling.

For Air-hydro Type

Please read this page along with the Rotary Actuators Precautions.

Design

⚠Warning

1. Do not use the product near flames, or in equipment or machinery that exceeds an ambient temperatures of 60°C.

There is a danger of causing a fire because the air-hydro type uses a flammable hydraulic fluid.
Refer to the Material Safety Data Sheet (MSDS) of the hydraulic fluid when supplying the fluid.

2. Do not use the product in a clean room.

⚠Caution

1. Do not use in an environment, equipment, or machine that is not compatible with oil mist.

The air-hydro type generates an oil mist during operation which may affect the environment.

2. Be certain to install an exhaust cleaner on the directional control valve for the air-hydro type.

A very small amount of hydraulic fluid is discharged from the exhaust port of a directional control valve, which may contaminate the surrounding area.

3. Install the air-hydro type in locations where it can be serviced easily.

Since the air-hydro type requires maintenance, such as refilling of hydraulic fluid and bleeding of air, ensure sufficient space for these activities.

Selection

⚠Caution

1. Select an air-hydro type in combination with an air-hydro unit.

Since good operation of an air-hydro type depends on its combination with an air-hydro unit, carefully select an appropriate air-hydro unit.

Piping

⚠Warning

1. For air-hydro type piping, use self-aligning fittings.

Do not use one-touch fittings in the piping for an air-hydro type, because oil leakage may occur.

2. For air-hydro type piping, use hard nylon tubing or copper piping.

As in the case of hydraulic circuits, surge pressures greater than the operating pressure may occur in an air-hydro type piping, making it necessary to use safer piping materials.

Lubrication

⚠Warning

1. Completely discharge the compressed air in the system before filling the air-hydro unit with hydraulic oil.

When supplying hydraulic fluid to the air-hydro unit, first confirm that safety measures are implemented to prevent dropping of objects and the release of clamped objects, etc. Then, shut off the air supply and the equipment's electric power and exhaust the compressed air in the system.
If the air-hydro unit's supply port is opened with compressed air still remaining in the system, there is a danger of hydraulic fluid being blown out.
Refer to the Material Safety Data Sheet (MSDS) of the hydraulic fluid when supplying the fluid.

2. Use petroleum hydraulic fluid which can be used as turbine oil.

If non-flammable hydraulic fluid is used, it may cause problems.
Suitable viscosity is in the range of approximately 40 to 100 mm^2/s in operating temperature.
The suitable operating temperature for ISO VG32 is the range of 15 to 35°C. If the operating temperature range is beyond ISO VG32, select ISO VG46 (suitable for 25 to 45°C range).

ISO VG32 Turbine Oil
(Example)

[With no additive]

Idemitsu Kosan Co., Ltd.	: Turbine Oil P-32
Nippon Oil Corporation	: Turbine Oil 32
	: Mitsubishi Turbine Oil 32
Cosmo Oil Co., Ltd.	: Cosmo Turbine 32

[With additive]

Idemitsu Kosan Co., Ltd.	: Daphne Turbine Oil 32
Nippon Oil Corporation	: FBK Turbine 32
	: Diamond Turbine Oil 32
Cosmo Oil Co., Ltd.	: Turbine Super 32

Maintenance

⚠Caution

1. Bleed air from the air-hydro type on a regular basis.

Since air may accumulate inside the air-hydro type, bleed air from it, for example before starting work. Bleed air from a bleeder valve provided on the air-hydro type or the piping.

2. Verify the oil level of the air-hydro system on a regular basis.

Since a very small amount of hydraulic fluid is discharged from the air-hydro type and the air-hydro unit circuit, the fluid will gradually decrease. Therefore, check the fluid regularly and refill as necessary.
The oil level can be checked with a level gauge in the air-hydro converter.

Auto Switches Precautions 1

Be sure to read this before handling.

Design / Selection

⚠Warning

1. Confirm the specifications.

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

We do not guarantee against any damage if the product is used outside of the specification range.

2. 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 avoid trouble by providing a mechanical protection function, or by also using another switch (sensor) together with the auto switch.

Also, perform periodic maintenance and confirm proper operation.

3. Do not make any modifications (including exchanging the printed circuit boards) to the product.

It may cause human injuries and accidents.

⚠Caution

1. Pay attention to the length of time that a switch is ON at an intermediate stroke position.

When an auto switch is placed at an intermediate position of the stroke and a load is driven at the time the piston passes, the auto switch will operate, but if the speed is too great the operating time will be shortened and the load may not operate properly. The maximum detectable piston speed is:

$$V\ (mm/s) = \frac{\text{Auto switch operating range (mm)}}{\text{Time load applied (ms)}} \times 1000$$

In cases of high piston speed, the use of an auto switch (D-F5NTL, F7NTL, G5NTL, M5NTL, M5PTL) with a built-in OFF delay timer (≈ 200 ms) makes it possible to extend the load operating time.

The wide-range detection type D-G5NBL (operating range 35 to 50 mm) may also be useful, depending on the application. Please consult with SMC for other models.

⚠Caution

2. Keep wiring as short as possible.

<Reed>

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) Use a contact protection box when the wire length is 5 m or longer.
2) Even if an auto switch has a built-in contact protection circuit, when the wiring is more than 30 m long, it is not able to adequately absorb the rush current and its life may be reduced. It is again necessary to connect a contact protection box in order to extend its life. Please consult with SMC in this case.

<Solid state>

3) Although wire length should not affect switch function, use a wire 100 m or shorter.
   If the wiring is longer it will likely increase noise although the length is less than 100 m.
   When the wire length is long, we recommend the ferrite core is attached to the both ends of the cable to prevent excess noise.

A contact protection box is not necessary for solid state switches due to the nature of this product construction.

3. Do not use a load that generates surge voltage. If a surge voltage is generated, the discharge occurs at the contact, possibly resulting in the shortening of product life.

If driving a load such as a relay that generates a surge voltage,

<Reed>

Use an auto switch with built-in contact protection circuit or use a contact protection box.

<Solid state>

Use a built-in surge absorbing element type device.

4. Take precautions when multiple cylinders/actuators are used close together.

When multiple auto switch cylinders/actuators are used in close proximity, magnetic field interference may cause the auto switches to malfunction. Maintain a minimum cylinder separation of 40 mm. (When the allowable interval is specified for each cylinder series, use the indicated value.)

The auto switches may malfunction due to the interference from the magnetic fields.

Use of a magnetic screen plate (MU-S025) or commercially available magnetic screen tape can reduce the interference of magnetic force.

Auto Switches Precautions 2

Be sure to read this before handling.

Design / Selection

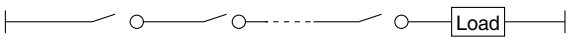
⚠Caution

5. Pay attention to the internal voltage drop of the auto switch.

<Reed>

1) Auto switch with an indicator light (Except D-A56, A76H, A96, A96V, C76, E76A, Z76)

- 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 the 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.



- In the same way, when operating under a specified voltage, although an auto switch may operate normally, the load may not operate. Therefore, the formula below should be satisfied after confirming the minimum operating voltage of the load.

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

2) If the internal resistance of a light emitting diode causes a problem, select an auto switch without an indicator light (D-A6□, A80, A80H, A90, A90V, C80, R80, 90, E80A, Z80).

<Solid state/2-wire type>

3) Generally, the internal voltage drop will be greater with a 2-wire solid state auto switch than with a reed auto switch. Take the same precautions as in 1).
Also, take note that a 12 VDC relay is not applicable.

6. Pay attention to leakage current.

<Solid state/2-wire type>

Current (leakage current) flows to the load to operate the internal circuit even when in the OFF state.

Operating current of load (OFF condition) > Leakage current

If the criteria given in the above formula are not met, it will not reset correctly (stays ON). Use a 3-wire switch if this specification will not be satisfied.
Moreover, leakage current flow to the load will be "n" times larger when "n" auto switches are connected in parallel.

7. Ensure sufficient clearance for maintenance activities.

When designing an application, be certain to allow sufficient clearance for maintenance.

8. When multiple auto switches are required.

"n" indicates the number of auto switches which can be physically mounted on the cylinders/actuators. Detection intervals depends on the auto switch mounting structure and set position, therefore some required interval and set positions may not be available.

9. Limitations of detectable positioning

When using certain mounting brackets, the surface and position where an auto switch can be mounted maybe restricted due to physical interference. For example, when using some bracket types the auto switch cannot be surface mounted at the bottom side of foot bracket, etc.
Select the set position of the auto switch so that it does not interfere with the mounting bracket of the cylinders/actuators (such as trunnion or reinforcement ring).

10. Use the cylinder and auto switch in proper combination.

The auto switch is pre-adjusted to activate properly for an auto-switch-capable SMC cylinder/actuator.
If the auto switch is mounted improperly, used for another brand of cylinders/actuators or used after the alternation of the machine installation, the auto switch may not activate properly.

Mounting / Adjustment

⚠Caution

1. Do not drop or bump.

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

2. Observe the proper tightening torque for mounting an auto switch.

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

3. Do not carry a cylinder by the auto switch lead wires.

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

4. Fix the auto switch with appropriate screw installed on the switch body. If using other screws, auto switch may be damaged.

Auto Switches Precautions 3

Be sure to read this before handling.

Wiring

⚠Caution

1. Confirm proper insulation of wiring.

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

2. Do not wire 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.

3. Avoid repeatedly bending or stretching lead wires.

Broken lead wires will result from repeatedly applying bending stress or stretching force to the lead wires.
Stress and tensile force applied to the connection between the cable and auto switch increases the possibility of disconnection.
Fix the cable in the middle so that it is not movable in the area where it connects with the auto switch.

4. Be certain 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 auto switch will be instantly damaged because of excess current (short circuit).
It is the same as when the 2-wire brown lead wire (+, output) is directly connected to the (+) power supply terminal.

5. Do not allow short-circuit of loads.

<Reed>

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

<Solid state>

All models of D-J51, G5NB and PNP output type auto switches do not have built-in short circuit protection circuits.
If a load is short circuited, the auto switch will be instantly damaged as in the case of reed auto switches.
Take special care to avoid reverse wiring with the brown power supply line and the black output line on 3-wire type auto switches.

6. Avoid incorrect wiring.

<Reed>

A 24 VDC auto 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 (–).

[For D-97, (+) is on the no-displayed side, (–) is on the black line side.]

1) If connections are reversed, an auto switch will operate, however, the light emitting diode will not light up.
Also, take note that a current greater than that specified will damage a light emitting diode and it will no longer operate.
Applicable model:
D-A73, A73H, A73C, C73, C73C, E73A, Z73
D-R73, R73C, 97, 93A, A93, A93V
D-A33, A34, A33A, A34A, A44, A44A
D-A53, A54, B53, B54

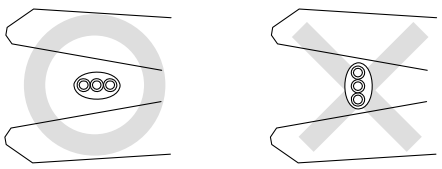
2) When using a 2-color indicator type auto switch (D-A79W, A59W and B59W), the auto switch will constantly remain ON if the connections are reversed.

<Solid state>

1) If connections are reversed on a 2-wire type auto switch, the auto switch will not be damaged if protected by a protection circuit, but the auto switch will always stay in an ON state. However, it is still necessary to avoid reversed connections, since the auto switch could be damaged by a load short circuit in this condition.

2) If connections are reversed (power supply line + and power supply line –) on a 3-wire type auto switch, the auto 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 auto switch will be damaged.

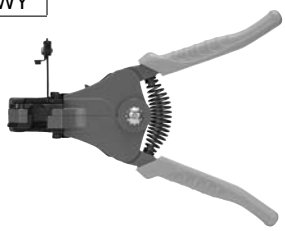
7. When the cable sheath is stripped, confirm the stripping direction. The insulator may be split or damaged depending on the direction. (D-M9□ only)



Recommended Tool

Description	Model
Wire stripper	D-M9N-SWY

∗ Stripper for a round cable (ø2.0) can be used for a 2-wire type cable.



Auto Switches Precautions 4

Be sure to read this before handling.

Operating Environment

⚠Warning

1. Never use in an atmosphere of explosive gases.

The structure 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.
Please contact SMC concerning ATEX compliant products.

⚠Caution

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

Auto switches will malfunction or magnets inside cylinders/actuators will become demagnetized. (Please consult with SMC if a magnetic field resistant auto switch can be used.)

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

Although auto switches satisfy IEC standard IP67 construction (JIS C 0920: waterproof construction) except some models (D-A3□, A44□, G39□, K39□, RNK, RPK) do not use auto switches in applications where continually exposed to water splash or spray. Poor insulation or swelling of the potting resin inside auto switches may cause malfunction.

3. Do not use in an environment with oil or chemicals.

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

4. Do not use in an environment with temperature cycles.

Please consult with SMC if auto switches are used where there are temperature cycles other than normal temperature changes, as there may be adverse effects inside the auto switches.

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

<Reed>

When excessive impact (300 m/s^2 or more) is applied to a reed auto switch during operation, the contact point will malfunction and generate or cut off a signal momentarily (1 ms or less). Please consult with SMC if a solid state auto switch can be used according to the environment.

6. Do not use in an area where surges are generated.

<Solid state>

When there are units (solenoid type lifter, high frequency induction furnace, motor, radio equipment etc.) which generate a large amount of surge in the area around cylinders/actuators with solid state auto switches, this may cause deterioration or damage to the auto switch's internal circuit elements. Avoid sources of surge generation and disorganized lines.

⚠Caution

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

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

8. Please contact SMC concerning water resistance, elasticity of lead wires, usage at welding sites, etc.

9. Do not use in direct sunlight.

10. Do not mount the product in locations where it is exposed to radiant heat.

Maintenance

⚠Warning

1. Removal of equipment, and supply/exhaust of compressed air

Before any machinery or equipment is removed, first ensure that the appropriate measures are in place to prevent the fall or erratic movement of driven objects and equipment, then cut off the electric power and reduce the pressure in the system to zero. Only then should you proceed with the removal of any machinery and equipment.
When machinery is restarted, proceed with caution after confirming that appropriate measures are in place to prevent actuators from moving suddenly.

⚠Caution

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

1) Secure and tighten auto 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 auto switches or repair lead wires, etc., if damage is discovered.

3) Confirm the lighting of the green light on the 2-color indicator type auto switch.
Confirm that the green LED is on when stopped at the established position. If the red LED is on, the mounting position is not appropriate. Readjust the mounting position until the green LED lights up.

Safety Instructions

These safety instructions are intended to prevent hazardous situations and/or equipment damage. These instructions indicate the level of potential hazard with the labels of **"Caution," "Warning"** or **"Danger."** They are all important notes for safety and must be followed in addition to International Standards (ISO/IEC), Japan Industrial Standards (JIS)*1) and other safety regulations*2).

* 1) ISO 4414: Pneumatic fluid power – General rules relating to systems.
ISO 4413: Hydraulic fluid power – General rules relating to systems.
IEC 60204-1: Safety of machinery – Electrical equipment of machines. (Part 1: General requirements)
ISO 10218-1992: Manipulating industrial robots -Safety.
JIS B 8370: General rules for pneumatic equipment.
JIS B 8361: General rules for hydraulic equipment.
JIS B 9960-1: Safety of machinery – Electrical equipment of machines. (Part 1: General requirements)
JIS B 8433-1993: Manipulating industrial robots - Safety.
etc.
* 2) Labor Safety and Sanitation Law, etc.

⚠ 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 possibility of serious injury or loss of life.

⚠ Warning

1. The compatibility of the product is the responsibility of the person who designs the equipment or decides its specifications.

Since the product specified here is used under various operating conditions, its compatibility with specific equipment must be decided by the person who designs the equipment or decides its specifications based on necessary analysis and test results. The expected performance and safety assurance of the equipment will be the responsibility of the person who has determined its compatibility with the product. This person should also continuously review all specifications of the product referring to its latest catalog information, with a view to giving due consideration to any possibility of equipment failure when configuring the equipment.

2. Only personnel with appropriate training should operate machinery and equipment.

The product specified here may become unsafe if handled incorrectly. The assembly, operation and maintenance of machines or equipment including our products must be performed by an operator who is appropriately trained and experienced.

3. Do not service or attempt to remove product and machinery/equipment until safety is confirmed.

1. The inspection and maintenance of machinery/equipment should only be performed after measures to prevent falling or runaway of the driven objects have been confirmed.
2. When the product is to be removed, confirm that the safety measures as mentioned above are implemented and the power from any appropriate source is cut, and read and understand the specific product precautions of all relevant products carefully.
3. Before machinery/equipment is restarted, take measures to prevent unexpected operation and malfunction.

4. Contact SMC beforehand and take special consideration of safety measures if the product is to be used in any of the following conditions.

1. Conditions and environments outside of the given specifications, or use outdoors or in a place exposed to direct sunlight.
2. Installation on equipment in conjunction with atomic energy, railways, air navigation, space, shipping, vehicles, military, medical treatment, combustion and recreation, or equipment in contact with food and beverages, emergency stop circuits, clutch and brake circuits in press applications, safety equipment or other applications unsuitable for the standard specifications described in the product catalog.
3. An application which could have negative effects on people, property, or animals requiring special safety analysis.
4. Use in an interlock circuit, which requires the provision of double interlock for possible failure by using a mechanical protective function, and periodical checks to confirm proper operation.

Safety Instructions

⚠Caution

The product is provided for use in manufacturing industries.
The product herein described is basically provided for peaceful use in manufacturing industries.
If considering using the product in other industries, consult SMC beforehand and exchange specifications or a contract if necessary. If anything is unclear, contact your nearest sales branch.

Limited Warranty and Disclaimer/Compliance Requirements

The product used is subject to the following “Limited Warranty and Disclaimer” and “Compliance Requirements”. Read and accept them before using the product.

Limited Warranty and Disclaimer

1. **The warranty period of the product is 1 year in service or 1.5 years after the product is delivered.**∗3)
   Also, the product may have specified durability, running distance or replacement parts. Please consult your nearest sales branch.
2. **For any failure or damage reported within the warranty period which is clearly our responsibility, a replacement product or necessary parts will be provided.**
   This limited warranty applies only to our product independently, and not to any other damage incurred due to the failure of the product.
3. **Prior to using SMC products, please read and understand the warranty terms and disclaimers noted in the specified catalog for the particular products.**

∗ **3) Vacuum pads are excluded from this 1 year warranty.**
A vacuum pad is a consumable part, so it is warranted for a year after it is delivered.
Also, even within the warranty period, the wear of a product due to the use of the vacuum pad or failure due to the deterioration of rubber material are not covered by the limited warranty.

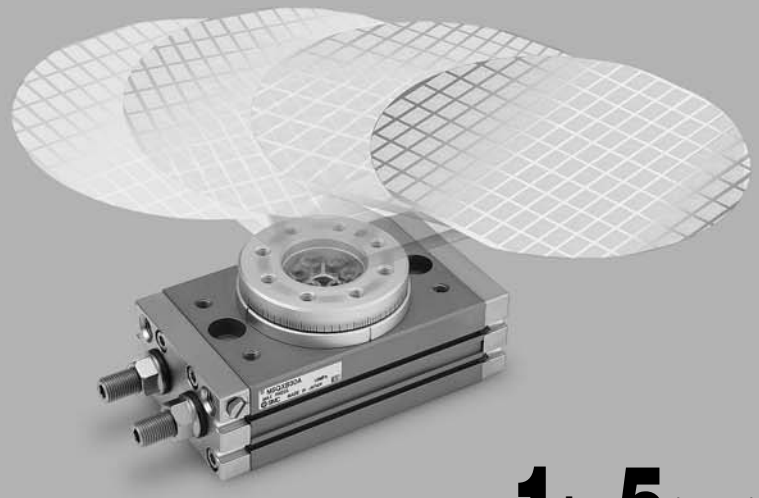
Compliance Requirements

When the product is exported, strictly follow the laws required by the Ministry of Economy, Trade and Industry (Foreign Exchange and Foreign Trade Control Law).

Low-Speed Rotary Actuator

Series CRQ2X/MSQX

Possible to transfer a workpiece at low-speed.

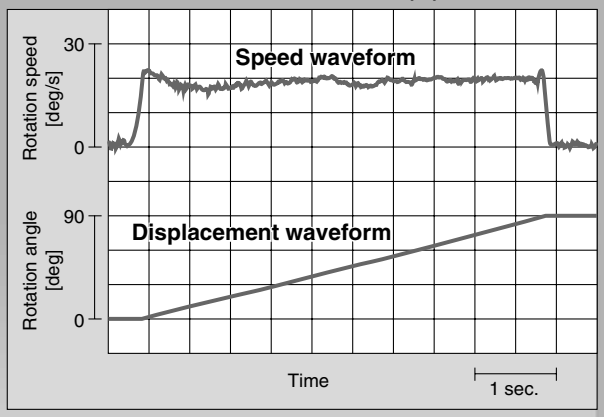


● Rotation time adjustment range: 1 to 5 (s/90°)

Model		Size	Rotation time adjustment range (s/90°) 1 2 3 4 5
Low-speed	**CRQ2X**	10, 15, 20, 30, 40	**1 to 5** (0.7 to 5 for CRQ2X□10,15)
	MSQX	10, 20, 30, 50	
Standard	CRQ2	10, 15, 20, 30, 40	0.2 to 1 (0.2 to 0.7 for CRQ2□10,15)
	MSQ	10, 20, 30, 50	

● Realized a stable motion at 5s/90°.

Smooth motion without stick-slip phenomemon

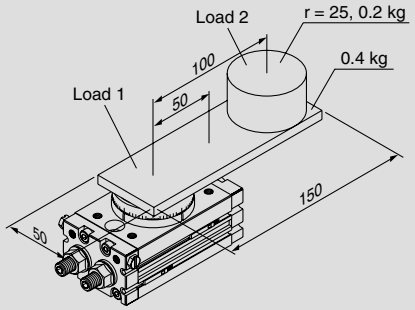


Measurement conditions / Fluid: Air
Mounting orientation: Vertical without load
Operating pressure: 0.5 MPa
Pneumatic circuit: Meter-out circuit
Ambient temperature: Room temperature

● Dimensions compatible with the CRQ2, MSQ series

Series CRQ2X/MSQX
Model Selection

* The selection procedure of the rotary for low-speed is the same as for an ordinary rotary. If the rotation time exceeds 2s per 90°, however, the necessary torque and the kinetic energy are calculated with rotation time of 2s per 90°.

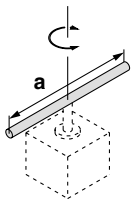
Selection Procedure	Remarks	Selection Example
0 Operating conditions		
Operating conditions are as follows: • Provisionally selected model • Operating pressure: MPa • Mounting position • Load type Static load: N·m Resistance load: N·m Inertial load: N·m • Load dimension: m • Load mass: kg • Rotation time: s • Rotation angle: rad	• See P. 314 for load type. • The unit of the rotation angle is Radians. 180° = πrad 90° = π/2rad	 Provisionally selected model: MSQXB10A Operating pressure: 0.3 MPa Mounting position: Vertical, Type of load: Inertial load Rotation time: 6s Rotation angle: πrad (180°)
1 Calculation of moment of inertia		
Calculate the moment of inertia of the load. ⇒ P. 313	• If the moment of inertia of the load is made up of multiple components, calculate the moment of inertia of each component and add them together.	Load 1 moment of inertia: I_1 $I_1 = 0.4 \times \frac{0.15^2 + 0.05^2}{12} + 0.4 \times 0.05^2 = 0.001833$ Load 2 moment of inertia: I_2 $I_2 = 0.2 \times \frac{0.025^2}{2} + 0.2 \times 0.1^2 = 0.002063$ Total moment of inertia: I $I = I_1 + I_2 = 0.003896\ [kg \cdot m^2]$
2 Calculation of necessary torque		
Calculate necessary torque corresponding to the load type, and ensure it is within effective torque range. • Static load (Ts) Necessary torque T = Ts • Resistance load (Tf) Necessary torque T = Tf x (3 to 5) • Inertial load (Ta) Necessary torque T = Ta x 10 ⇒ P. 314	• When calculating the inertial load, if the rotation time exceeds 2s per 90°, inertial load is calculated with rotation time of 2s per 90°. • Even for resistance load, when the load is rotated, necessary torque calculated from inertial load shall be added. Necessary torque T = Tf x (3 to 5) + Ta x 10	Inertial load: Ta $Ta = I \cdot \dot{\omega}$ $\dot{\omega} = \frac{2\theta}{t^2}\ [rad/s^2]$ Necessary torque: T T = Ta x 10 $= 0.003896 \times \frac{2 \times \pi}{4^2} \times 10 = 0.015\ [N \cdot m]$ (t is calculated with 2s per 90°.) 0.109 N·m < Effective torque OK
3 Checking rotation time		
Confirm that it is within the adjustable range of rotation time. ⇒ P. 315	• Converted to the time per 90° for comparison. (For comparison, 6s/180° is converted to 3s/90°.)	$1.0 \leq t \leq 5$ t = 3s/90° OK
4 Calculation of kinetic energy		
Confirm that the load's kinetic energy is within the allowable value. Can be confirmed by the graph of the moment of inertia and the rotation time. ⇒ P. 315	• If the rotation time exceeds 2s per 90°, kinetic energy is calculated with rotation time of 2s per 90°. • If the allowable value is exceeded, an external cushioning mechanism such as an absorber needs to be installed.	$E = \frac{1}{2} \cdot I \cdot \omega^2$ $\omega = \frac{2 \cdot \theta}{t}$ Kinetic energy $\frac{1}{2} \times 0.003896 \times \left(\frac{2 \times \pi}{4}\right)^2 = 0.0048\ [J]$ (t is calculated with 2s per 90°.) 0.0048 [J] < Allowable energy OK
5 Checking allowable load		
Check if the load applied to the product is within the allowable range. ⇒ P. 316	• If the allowable value is exceeded, an external bearing needs to be installed.	M = 0.4 x 9.8 x 0.05 + 0.2 x 9.8 x 0.1 = 0.392 [N·m] 0.392 [N·m] < Allowable moment load OK
6 Calculation of air consumption and necessary air quantity		
Calculate air consumption and necessary air quantity as required. ⇒ P. 317		

Equation Table of Moment of Inertia (Calculation of moment of inertia I)

I: Moment of inertia (kg·m²) **m**: Load mass (kg)

1. Thin shaft

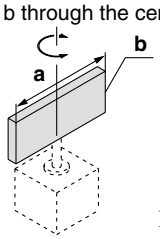
Position of rotational axis:
Perpendicular to the shaft through the center of gravity



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

2. Thin rectangular plate

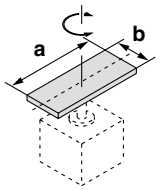
Position of rotational axis:
Parallel to side b through the center of gravity



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

3. Thin rectangular plate (Including rectangular parallelepiped)

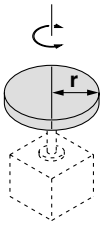
Position of rotational axis:
Perpendicular to the plate through the center of gravity



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

4. Round plate (Including column)

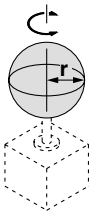
Position of rotational axis:
Passing through the center axis



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

5. Solid sphere

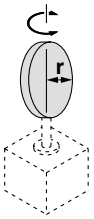
Position of rotational axis:
Passing through the diameter



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

6. Thin round plate

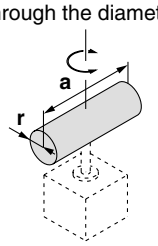
Position of rotational axis:
Passing through the diameter



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

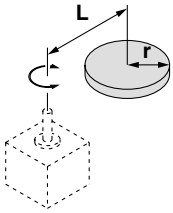
7. Cylindrical

Position of rotational axis:
Passing through the diameter and the center of gravity



$$I = m \cdot \frac{3r^2 + a^2}{12}$$

8. When rotational axis and the center of the load are not concentric.

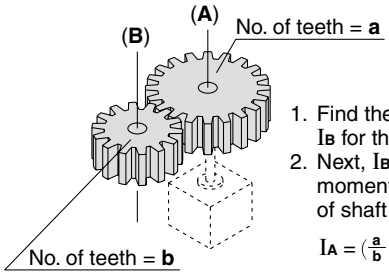


$I = K + m \cdot L^2$

K: The moment of inertia around the center of gravity of the load

In case of 4. Round plate $K = m \cdot \frac{r^2}{2}$

9. Gear transmission



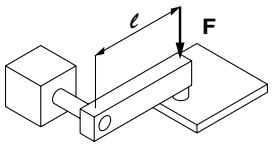
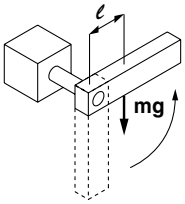
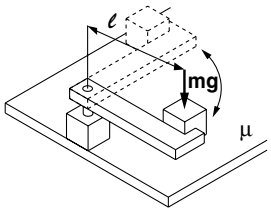
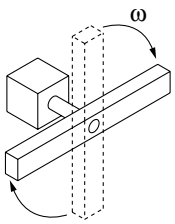
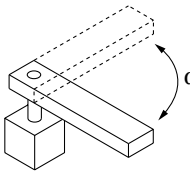
1. Find the moment of inertia I_B for the rotation of shaft (**B**).
2. Next, I_B is entered to find I_A the moment of inertia for the rotation of shaft (**A**) as

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

Model Selection

Load Type

Calculation method of necessary torque depends on the load type. Refer to the table below.

Load type		
Static load: Ts	**Resistance load: Tf**	**Inertial load: Ta**
Only pressing force is necessary. (e.g. for clamping)	Weight or friction force is applied to rotating direction.	Rotate the load with inertia.
	Gravity is applied.   Friction force is applied.	Center of rotation and center of gravity of the load are concentric.   Rotation shaft is vertical (up and down).
Ts = **F**·ℓ **Ts**: Static load (N·m) **F** : Clamping force (N) ℓ : Distance from the rotation center to the clamping position (m)	Gravity is applied in rotating direction. **Tf** = **m**·**g**·ℓ Friction force is applied in rotating direction. **Tf** = μ·**m**·**g**·ℓ **Tf** : Resistance load (N·m) **m** : Load mass (kg) **g** : Gravitational acceleration 9.8 (m/s²) ℓ : Distance from the rotation center to the point of application of the weight or friction force (m) μ : Friction coefficient	$\mathbf{Ta} = I \cdot \omega = I \cdot \frac{2\theta}{\mathbf{t}^2}$ **Ta**: Inertial load (N·m) I : Moment of inertia (kg·m²) ω : Angular acceleration (rad/s²) θ : Rotation angle (rad) **t** : Rotation time (s) For low speed rotary, if the rotation time exceeds 2s per 90°, inertial load is calculated with rotation time of 2s per 90°.
Necessary torque: **T** = **Ts**	Necessary torque: **T** = **Tf** x (3 to 5) Note)	Necessary torque: **T** = **Ta** x 10 Note)

• Resistance load: Gravity or friction force is applied to rotating direction.
  Ex. 1) Rotation shaft is horizontal (lateral), and the rotation center and the center of gravity of the load are not concentric.
  Ex. 2) Load moves by sliding on the floor

  ∗ The total of resistance load and inertial load is the necessary torque. **T** = **Tf** x (3 to 5) + **Ta** x 10

• Not resistance load: Neither weight or friction force is applied in rotating direction.
  Ex. 1) Rotation shaft is vertical (up and down).
  Ex. 2) Rotation shaft is horizontal (lateral), and rotation center and the center of gravity of the load are not concentric.

  ∗ Necessary torque is inertial load only. **T** = **Ta** x 10

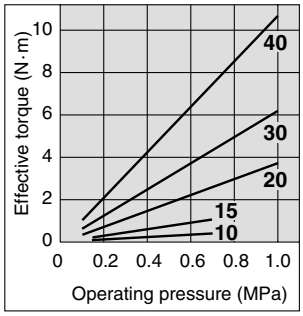
Note) To adjust the speed, margin is necessary for Tf and Ta.

Effective Torque

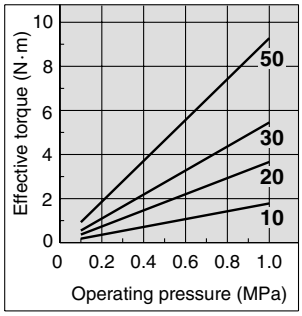
Unit: N·m

Model	Size	Operating pressure (MPa)										
		0.1	0.15	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
CRQ2X	10	—	0.09	0.12	0.18	0.24	0.30	0.36	0.42	—	—	—
	15	—	0.22	0.30	0.45	0.60	0.75	0.90	1.04	—	—	—
	20	0.37	0.55	0.73	1.10	1.47	1.84	2.20	2.57	2.93	3.29	3.66
	30	0.62	0.94	1.25	1.87	2.49	3.11	3.74	4.37	4.99	5.60	6.24
	40	1.06	1.59	2.11	3.18	4.24	5.30	6.36	7.43	8.48	9.54	10.6
MSQX	10	0.18	—	0.36	0.53	0.71	0.89	1.07	1.25	1.42	1.60	1.78
	20	0.37	—	0.73	1.10	1.47	1.84	2.20	2.57	2.93	3.29	3.66
	30	0.55	—	1.09	1.64	2.18	2.73	3.19	3.82	4.37	4.91	5.45
	50	0.93	—	1.85	2.78	3.71	4.64	5.57	6.50	7.43	8.35	9.28

CRQ2X



MSQX



Note 1) Values of operating torque in the above table are representative values, and not guaranteed. Make use of the values as a reference when ordering.
Note 2) Except for cases when an external stopper is used, the holding torque at the operation end is half of the table value.

Kinetic Energy/Rotating Time

In a rotational movement, the kinetic energy of a load may damage the internal parts, even if the required torque for a load is small. Consider the moment of inertia and rotation time before selecting a model.
(For model selection, refer to the moment of inertia and rotation time graph as shown on the below table.)

Allowable kinetic energy and rotation time adjustment range

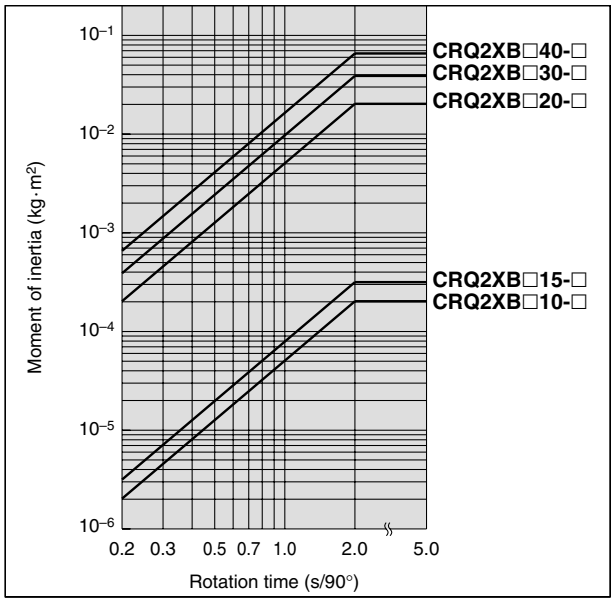
Set the rotation time, within stable operational guidelines, using the adjustment range specification table as detailed below. When operating at low-speeds which exceed the rotation time adjustment range, use caution as it may result in sticking or malfunction.

Model	Size	Allowable kinetic energy (J)	Stable operational rotation time adjustment range (s/90°)
CRQ2X	10	0.00025	0.7 to 5
	15	0.00039	
	20	0.025	1 to 5
	30	0.048	
	40	0.081	
MSQX	10	0.007	
	20	0.025	
	30	0.048	
	50	0.081	

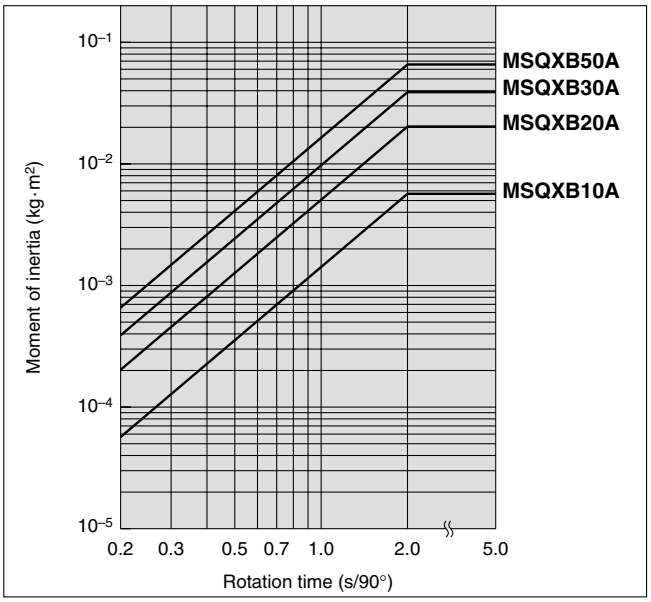
Model Selection

Select a model based on the moment of inertia and rotation time as shown graph below.

CRQ2X



MSQX



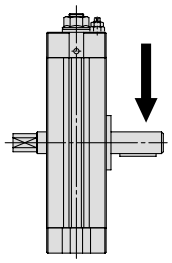
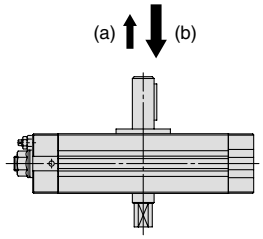
∗ If the rotation time exceeds 2 s per 90°, kinetic energy is calculated with rotation time of 2 s per 90°.

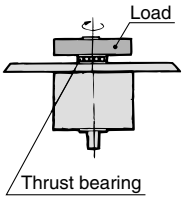
Model Selection

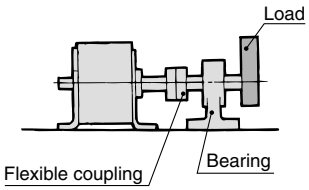
Allowable Load

CRQ2X

A load up to the allowable radial/thrust load can be applied provided that a dynamic load is not generated. However, applications which apply a load directly to the shaft should be avoided whenever possible. In order to further improve the operating conditions, a method such as that shown in the drawing on the right side is recommended so that a direct load is not applied to the shaft.

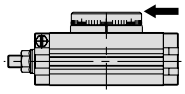
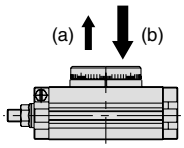
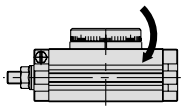
Size		
	Allowable radial load (N)	Allowable thrust load (N)
		(a) / (b)
10	14.7	7.8 / 15.7
15	19.6	9.8 / 19.6
20	49	29.4 / 49
30	78	49 / 98
40	98	59 / 108





MSQX

Do not allow the load and moment applied to the table to exceed the allowable values shown in the table below.
(Operation beyond the allowable values can cause adverse effects on service life, such as play in the table and loss of accuracy.)

Size			
	Allowable radial load (N)	Allowable thrust load (N)	Allowable moment (N·m)
		(a) / (b)	
10	78	74 / 78	2.4
20	147	137 / 137	4.0
30	196	197 / 363	5.3
50	314	296 / 451	9.7

Rotary Actuator Technical Data
Air Consumption

Air consumption is the volume of air which is expended by the rotary actuator's reciprocal operation inside the actuator and in the piping between the actuator and the switching valve, etc. This is necessary for selection of a compressor and for calculation of its running cost.

* The air consumption (Q_{CR}) required for one reciprocation of the rotary actuator alone is shown in the table below, and can be used to simplify the calculation.

Formulas

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

$$Q_{CP} = 2 \times a \times L \times \left(\frac{P}{0.1}\right) \times 10^{-6}$$

$$Q_C = Q_{CR} + Q_{CP}$$

Q_{CR} = Air consumption of rotary actuator [ℓ (ANR)]
Q_{CP} = Air consumption of tubing or piping [ℓ (ANR)]
V = Internal volume of rotary actuator [cm^3]
P = Operating pressure [MPa]
L = Length of piping [mm]
a = Internal cross section of piping [mm^2]
Q_C = Air consumption required for one reciprocation of rotary actuator [ℓ (ANR)]

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

Formulas

$$Qc_2 = Qc \times n \times \text{Number of actuators} \times \text{Reserve factor}$$

Qc_2 = Compressor discharge flow rate [ℓ/min (ANR)]
n = Actuator reciprocations per minute
Reserve factor: 1.5 or greater

Internal Cross Section of Tubing and Steel Piping

Nominal size	O.D. (mm)	I.D. (mm)	Internal cross section **a** (mm^2)
T□0425	4	2.5	4.9
T□0604	6	4	12.6
TU0805	8	5	19.6
T□0806	8	6	28.3
1/8B	—	6.5	33.2
T□1075	10	7.5	44.2
TU1208	12	8	50.3
T□1209	12	9	63.6
1/4B	—	9.2	66.5
TS1612	16	12	113
3/8B	—	12.7	127
T□1613	16	13	133
1/2B	—	16.1	204
3/4B	—	21.6	366
1B	—	27.6	598

Air Consumption

Air consumption: **Q_{CR}** ℓ (ANR)

Model	Size	Rotation angle (°)	Internal volume **V** (cm^3)	Operating pressure (MPa)										
				0.1	0.15	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
CRQ2X	**10**	90	1.2	—	0.006	0.007	0.009	0.012	0.014	0.016	0.018	—	—	—
		180	2.2	—	0.011	0.013	0.018	0.022	0.026	0.031	0.035	—	—	—
	15	90	2.9	—	0.015	0.017	0.023	0.029	0.035	0.041	0.046	—	—	—
		180	5.5	—	0.028	0.033	0.044	0.055	0.066	0.077	0.088	—	—	—
	20	90	7.1	0.028	0.036	0.043	0.057	0.071	0.085	0.099	0.114	0.128	0.142	0.156
		180	13.5	0.054	0.068	0.081	0.108	0.135	0.162	0.189	0.216	0.243	0.270	0.297
	30	90	12.1	0.048	0.060	0.073	0.097	0.121	0.145	0.169	0.193	0.218	0.242	0.266
		180	23.0	0.092	0.115	0.138	0.184	0.230	0.276	0.322	0.368	0.413	0.459	0.505
	40	90	20.6	0.082	0.103	0.123	0.164	0.206	0.247	0.288	0.329	0.370	0.411	0.452
		180	39.1	0.156	0.195	0.234	0.313	0.391	0.469	0.547	0.625	0.703	0.781	0.859
MSQX	**10**	190	6.6	0.026	0.033	0.040	0.053	0.066	0.079	0.092	0.106	0.119	0.132	0.145
	20		13.5	0.054	0.068	0.081	0.108	0.135	0.162	0.189	0.216	0.243	0.270	0.297
	30		20.1	0.080	0.101	0.121	0.161	0.201	0.241	0.281	0.322	0.362	0.402	0.442
	50		34.1	0.136	0.171	0.205	0.273	0.341	0.409	0.477	0.546	0.614	0.682	0.750

Low-Speed Compact Rotary Actuator
Rack & Pinion Style
Series CRQ2X
Size: 10, 15, 20, 30, 40

How to Order

Standard CRQ2 X B S 20 ☐ – 90

With auto switch CDRQ2 X B S 20 ☐ – 90 – M9BW ☐

Built-in magnet

Low-speed specification

Shaft type

S	Single shaft
W	Double shaft

Size

10
15
20
30
40

Thread type

Port type		Size
Nil	M5	10, 15
	Rc 1/8	20, 30, 40
TF	G 1/8	
TN	NPT 1/8	
TT	NPTF 1/8	

Rotation angle

90	80° to 100°
180	170° to 190°

Number of auto switches

Nil	2 pcs.
S	1 pc.
n	n pcs.

Auto switch

Nil	Without auto switch (Built-in magnet)

∗ For applicable auto switch models, refer to the table below.

Applicable Auto Switch/Refer to pages 761 to 809 for detailed auto switch specification.

Type	Special function	Electrical entry	Indicator light	Wiring (Output)	Load voltage DC		Load voltage AC	Auto switch model Perpendicular	Auto switch model In-line	Lead wire length (m) 0.5 (Nil)	1 (M)	3 (L)	5 (Z)	Pre-wired connector	Applicable load	
Solid state switch	—	Grommet	Yes	3-wire (NPN)	24 V	5 V, 12 V	—	M9NV	M9N	●	●	●	○	○	IC circuit	Relay, PLC
				3-wire (PNP)				M9PV	M9P	●	●	●	○	○		
				2-wire		12 V		M9BV	M9B	●	●	●	○	○	—	
	Diagnostic indication (2-color display)			3-wire (NPN)		5 V, 12 V		M9NWV	M9NW	●	●	●	○	○	IC circuit	
				3-wire (PNP)				M9PWV	M9PW	●	●	●	○	○		
				2-wire		12 V		M9BWV	M9BW	●	●	●	○	○	—	
	Water resistant (2-color indication)			3-wire (NPN)		5 V, 12 V		M9NAV**	M9NA**	○	○	●	○	○	IC circuit	
				3-wire (PNP)				M9PAV**	M9PA**	○	○	●	○	○		
				2-wire		12 V		M9BAV**	M9BA**	○	○	●	○	○	—	
Reed switch	—	Grommet	Yes	3-wire (NPN equiv.)	—	5 V	—	A96V	A96	●	—	●	—	—	IC circuit	—
			No	2-wire	24 V	12 V	100 V	A93V	A93	●	—	●	—	—	—	Relay, PLC
							100 V or less	A90V	A90	●	—	●	—	—	IC circuit	

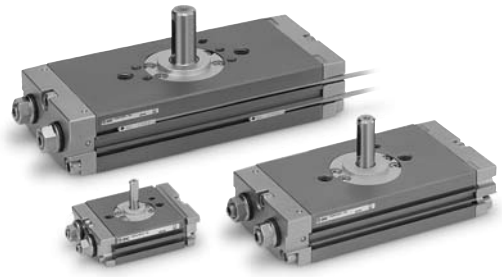
** Although it is possible to mount water resistant type auto switches, note that the rotary actuator itself is not of water resistant construction.

∗ Lead wire length symbols: 0.5 m ····· Nil (Example) M9NW
1 m ····· M (Example) M9NWM
3 m ····· L (Example) M9NWL
5 m ····· Z (Example) M9NWZ

∗ Auto switches marked with a "○" are produced upon receipt of orders.

∗ Auto switches are shipped together, (but not assembled).

Made to Order Refer to pages 796 and 797 for the details of solid state auto switch with pre-wired connector.



Specifications

Size	10	15	20	30	40
Fluid	Air (Non-lube)				
Max. operating pressure	0.7 MPa		1 MPa		
Min. operating pressure	0.15 MPa		0.1 MPa		
Ambient and fluid temperature	0° to 60°C (No freezing)				
Cushion	Not attached				
Angle adjustment range	Rotation end ±5°				
Rotation angle	80° to 100°, 170° to 190°				
Port size	M5 x 0.8		Rc 1/8, G 1/8, NPT 1/8, NPTF 1/8		
Output (N·m)∗	0.30	0.75	1.8	3.1	5.3

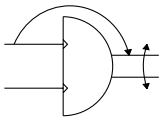
∗ Output under the operating pressure at 0.5 MPa. Refer to page 315 for further information.

Allowable Kinetic Energy and Rotation Time Adjustment Range

Size	Allowable kinetic energy (J)	Stable operational rotation time adjustment range (s/90°)
10	0.00025	0.7 to 5
15	0.00039	
20	0.025	1 to 5
30	0.048	
40	0.081	

Note) If operated where the kinetic energy exceeds the allowable value, this may cause damage to the internal parts and result in product failure. Please pay special attention to the kinetic energy levels when designing, adjusting and during operation to avoid exceeding the allowable limit.

JIS Symbol



Mass

(g)

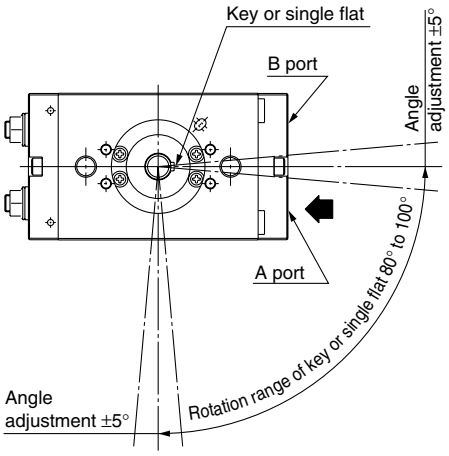
Size	Standard mass∗	
	90°	180°
10	120	150
15	220	270
20	600	700
30	900	1100
40	1400	1600

∗ Not including the mass of auto switch.

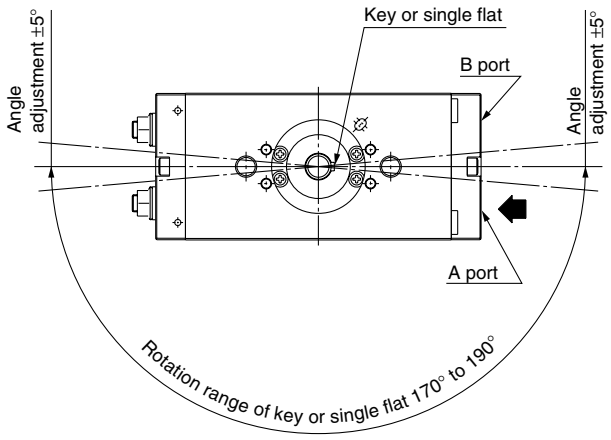
Rotation Range

When pressurized from the port indicated by the arrow, the shaft will rotate in a clockwise direction.

Rotation angle: 90°

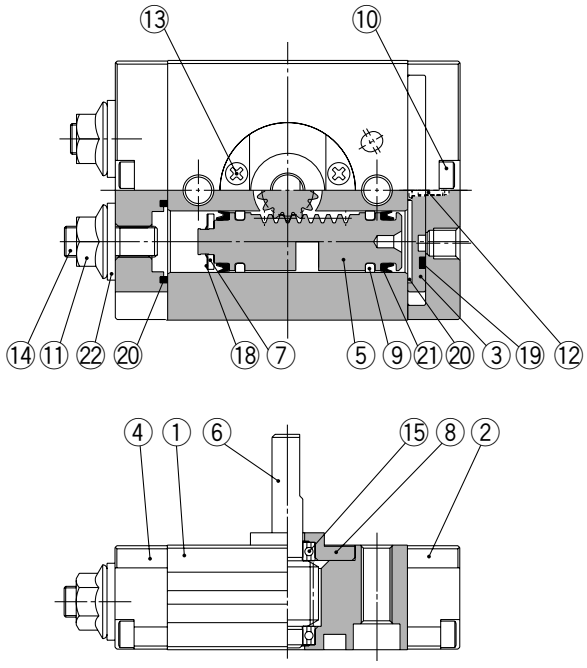


Rotation angle: 180°

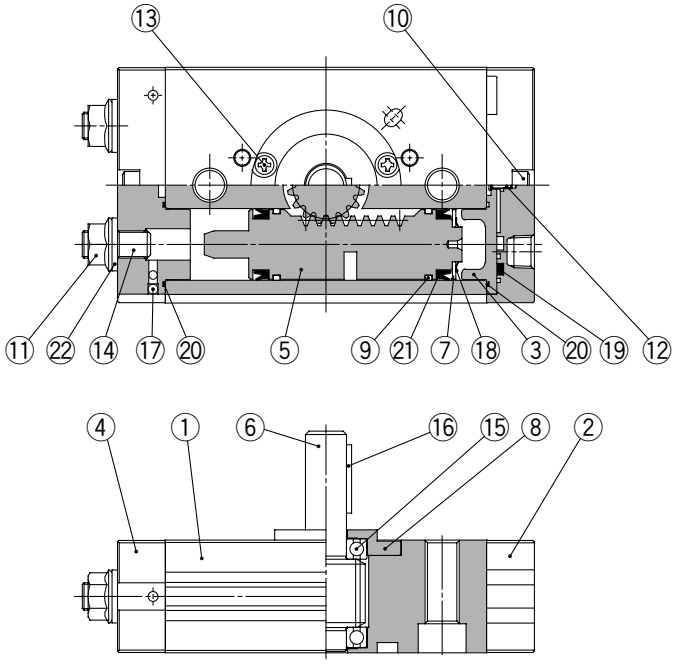


Construction

Standard
Size 10/15



Standard
Size 20/30/40



Component Parts

No.	Description		Material
1	**Body**		Aluminum alloy
2	**Cover**		Aluminum alloy
3	**Plate**		Aluminum alloy
4	**End cover**		Aluminum alloy
5	**Piston**		Stainless steel
6	**Size: 10, 15**	**Shaft**	Stainless steel
	Size: 20, 30, 40		Chrome molybdenum steel
7	**Seal retainer**		Aluminum alloy
8	**Bearing retainer**		Aluminum alloy
9	**Wear ring**		Resin
10	**Hexagon socket head cap screw**		Stainless steel
11	**Hexagon nut with flange**		Steel wire
12	**Cross recessed screw No. 0**		Steel wire

Component Parts

No.	Description		Material
13	**Size: 10, 15**	**Cross recessed screw No. 0**	Steel wire
	Size: 20, 30, 40	**Cross recessed screw**	
14	**Hexagon socket head set screw**		Chrome molybdenum steel
15	**Bearing**		Bearing steel
16	**Size: 20, 30, 40 only**	**Parallel key**	Carbon steel
17	**Size: 20, 30, 40 only**	**Steel ball**	Stainless steel
18	**Type CS retaining ring**		Stainless steel
19	**Seal**		NBR
20	**Gasket**		NBR
21	**Piston seal**		NBR
22	**Seal washer**		NBR
23	**With auto switch only**	**Magnet**	—

Replacement Parts

Description	Part no.					Note
	10	**15**	**20**	**30**	**40**	
Seal kit	P473010-23	P473020-23	P473030-23	P473040-23	P473050-23	A set of above numbers ⑨, ⑲, ⑳, ㉑ and ㉒

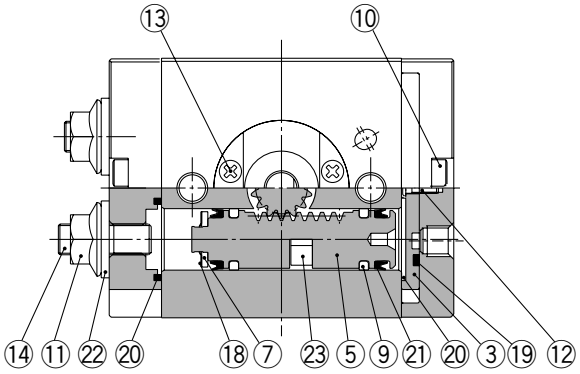
Parts included in Seal Kit

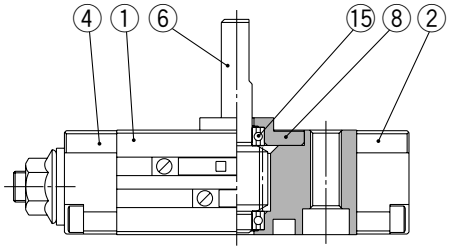
No.	Description	Qty.	Note
9	**Wear ring**	4	
19	**Seal**	1	
20	**Gasket for cover**	2	Size: 10, 15
	Gasket for end cover	1	
	Gasket	4	Size: 20, 30, 40
21	**Piston seal**	4	
22	**Seal washer**	2	

∗ A set includes all parts above.
A grease pack (10 g) is included. When only a grease pack is needed, order with the following part number.
Replacement parts/Grease pack part no: P523010-21 (10 g)

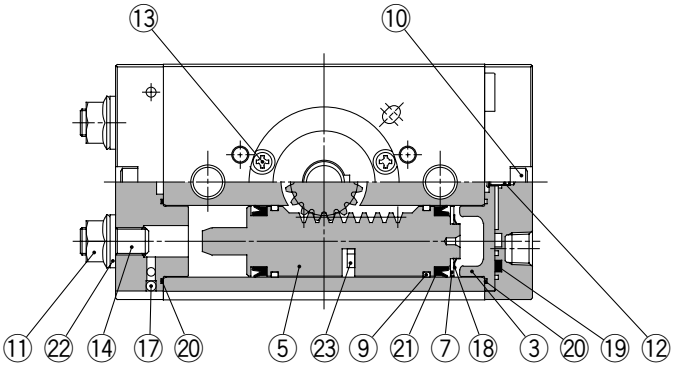
Construction

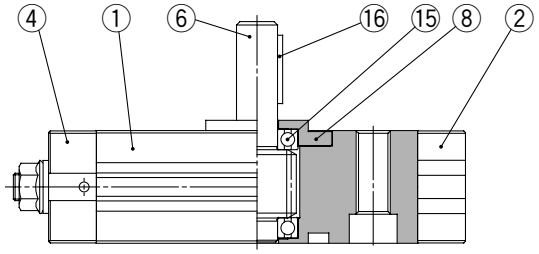
With auto switch
Size 10/15





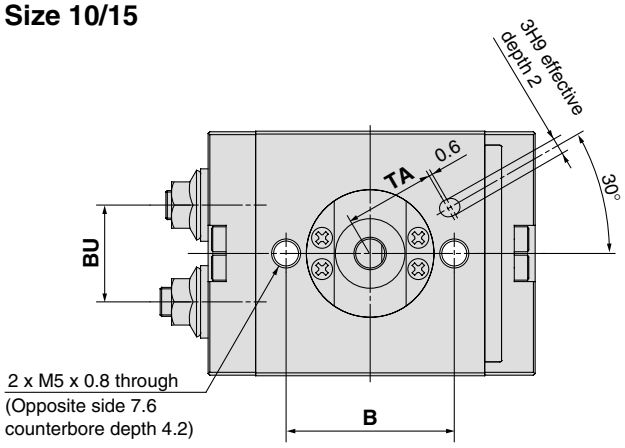
With auto switch
Size 20/30/40

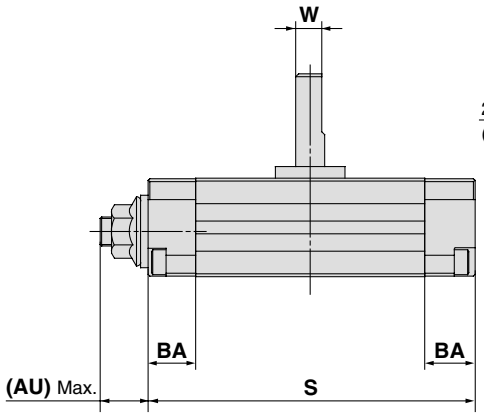


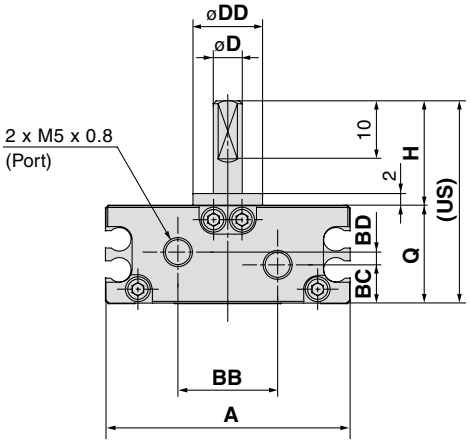


Dimensions

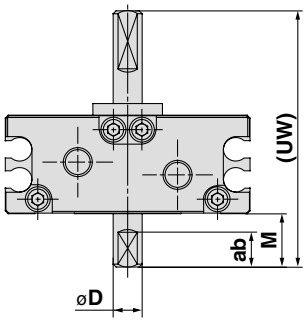
Size 10/15

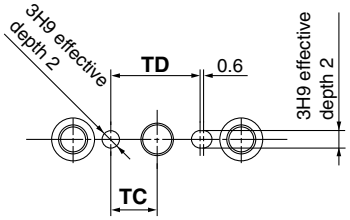






With double shaft





(mm)

Size	Rotation angle	A	AU*	B	BA	BB	BC	BD	BU	D (g6)	DD (h9)	H
10	90°, 180°	42	(8.5)	29	8.5	17	6.7	2.2	16.7	5	12	18
15	90°, 180°	53	(9.5)	31	9	26.4	10.6	—	23.1	6	14	20

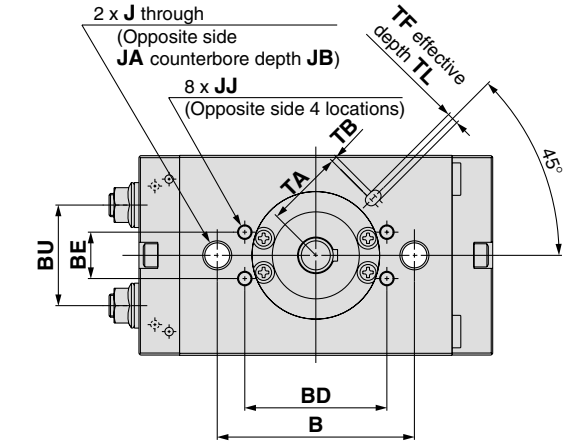
Size	Rotation angle	W	Q	S	US	UW	ab	M	TA	TC	TD
10	90°	4.5	17	56	35	44	6	9	15.5	8	15.4
	180°			69							
15	90°	5.5	20	65	40	50	7	10	16	9	17.6
	180°			82							

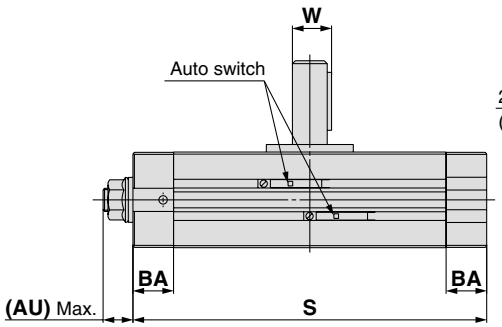
∗ The AU dimension is not the dimension at the time of shipment, since its dimension is for adjustment parts.

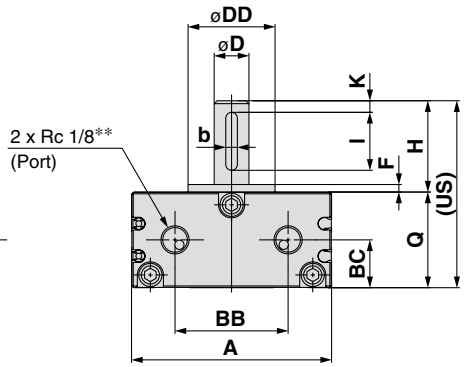
S: Upper 90°, Lower 180°

Dimensions

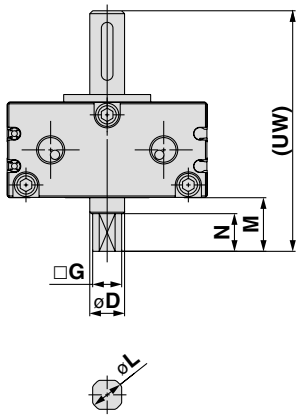
Size 20/30/40

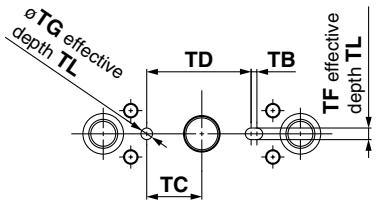






With double shaft





(mm)

Size	Rotation angle	A	AU*	B	BA	BB	BC	BD	BE	BU	D (g6)	DD (h9)	F	H	J	JA	JB	JJ	K
20	90°, 180°	63	(11)	50	14	34	14.5	—	—	30.4	10	25	2.5	30	M8 x 1.25	11	6.5	—	3
30	90°, 180°	69	(11)	68	14	39	16.5	49	16	34.7	12	30	3	32	M10 x 1.5	14	8.5	M5 x 0.8 depth 6	4
40	90°, 180°	78	(13)	76	16	47	18.5	55	16	40.4	15	32	3	36	M10 x 1.5	14	8.6	M6 x 1 depth 7	5

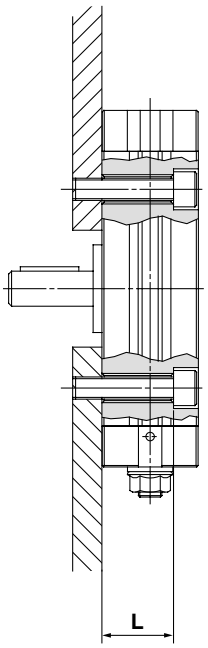
Size	Rotation angle	Q	S	W	Key dimensions b	Key dimensions l	US	TA	TB	TC	TD	TF (H9)	TG (H9)	TL	UW	G	M	N	L
20	90°	29	104	11.5	$4^{0}_{-0.03}$	20	59	24.5	1	13.5	27	4	4	2.5	74	$8^{0}_{-0.1}$	15	11	$9.6^{0}_{-0.1}$
	180°		130																
30	90°	33	122	13.5	$4^{0}_{-0.03}$	20	65	27	2	19	36	4	4	2.5	83	$10^{0}_{-0.1}$	18	13	$11.4^{0}_{-0.1}$
	180°		153																
40	90°	37	139	17	$5^{0}_{-0.03}$	25	73	32.5	2	20	39.5	5	5	3.5	93	$11^{0}_{-0.1}$	20	15	$14^{0}_{-0.1}$
	180°		177																

∗ The AU dimension is not the dimension at the time of shipment, since its dimension is for adjustment parts.
S: Upper 90°, Lower 180°

∗∗ In addition to Rc 1/ 8, G 1/ 8, NPT 1/ 8 and NPTF 1/ 8 are also available.

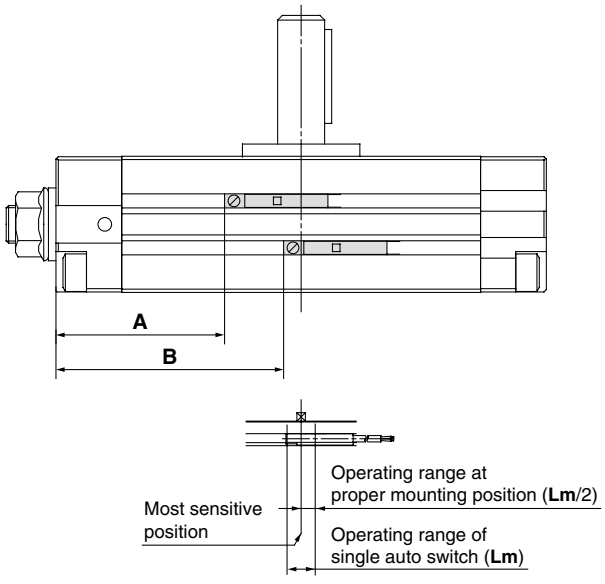
Unit Used as Flange Mount

The L dimensions of this unit are shown in the below table. When hexagon socket head cap bolt of the JIS standard is used, the head of the bolt will recess into the groove of actuator.



Size	L	Screw
10	13	M4
15	16	M4
20	22.5	M6
30	24.5	M8
40	28.5	M8

Auto Switch Proper Mounting Position (at Rotation End Detection)



Size	Rotation angle	Reed switch				Solid state switch			
		A	B	Operating angle (θ m)	Hysteresis angle	A	B	Operating angle (θ m)	Hysteresis angle
10	90°	15	21.5	63°	12°	19	25.5	61°	5°
	180°	18	31			22	35		
15	90°	18.5	27	52°	9°	22.5	31	47°	4°
	180°	22.5	39.5			26.5	43.5		
20	90°	36	48.5	41°	9°	40	52.5	40°	4°
	180°	42	67.5			46	71.5		
30	90°	43	59	32°	7°	47	63	29°	2°
	180°	51	82			55	86		
40	90°	50	69	24°	5°	54	73	24°	2°
	180°	59.5	97.5			63.5	101.5		

Operating angle θ**m**: Value of the operating range of single auto switch (Lm) as represented by rotation angle for shaft
Hysteresis angle: Value of the auto switch hysteresis as represented by angle

Note) Since the above values are only provided as a guideline, they are not guaranteed.
In the actual setting, adjust them after confirming the auto switch operating condition.

Low-Speed Rotary Table
Rack & Pinion Style
Series MSQX
Size: 10, 20, 30, 50

How to Order

Basic **MSQ X B 10 ☐ A – M9BW ☐ – ☐**

Low-speed specification

Size

10
20
30
50

Thread type

Port type		Size
Nil	M5	10, 20
	Rc 1/8	30, 50
TF	G 1/8	
TN	NPT 1/8	
TT	NPTF 1/8	

With adjustment bolt

Auto switch

Nil	Without auto switch (Built-in magnet)

∗ For applicable auto switch models, refer to the table below.

Number of auto switches

Nil	2 pcs.
S	1 pc.
n	n pcs.

Made to order
Refer to page 327 for details.

Applicable Auto Switch/Refer to pages 761 to 809 for detailed auto switch specification.

Type	Special function	Electrical entry	Indicator light	Wiring (Output)	Load voltage DC		Load voltage AC	Auto switch model Perpendicular	Auto switch model In-line	Lead wire length (m) 0.5 (Nil)	1 (M)	3 (L)	5 (Z)	Pre-wired connector	Applicable load	
Solid state switch	—	Grommet	Yes	3-wire (NPN)	24 V	5 V, 12 V	—	M9NV	M9N	●	●	●	○	○	IC circuit	Relay, PLC
				3-wire (PNP)				M9PV	M9P	●	●	●	○	○		
				2-wire		12 V		M9BV	M9B	●	●	●	○	○	—	
	Diagnostic indication (2-color display)			3-wire (NPN)		5 V, 12 V		M9NWV	M9NW	●	●	●	○	○	IC circuit	
				3-wire (PNP)				M9PWV	M9PW	●	●	●	○	○		
				2-wire		12 V		M9BWV	M9BW	●	●	●	○	○	—	
	Water resistant (2-color indication)			3-wire (NPN)		5 V, 12 V		M9NAV**	M9NA**	○	○	●	○	○	IC circuit	
				3-wire (PNP)				M9PAV**	M9PA**	○	○	●	○	○		
				2-wire		12 V		M9BAV**	M9BA**	○	○	●	○	○	—	
Reed switch	—	Grommet	Yes	3-wire (NPN equiv.)	—	5 V	—	A96V	A96	●	—	●	—	—	IC circuit	—
			No	2-wire	24 V	12 V	100 V	A93V	A93	●	—	●	—	—	—	Relay, PLC
							100 V or less	A90V	A90	●	—	●	—	—	IC circuit	

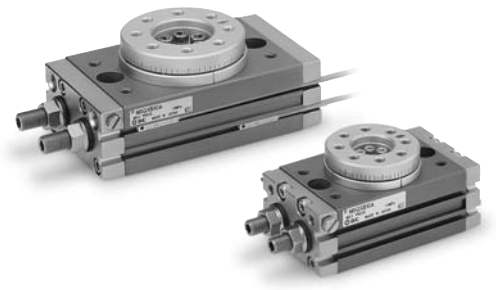
∗∗ Although it is possible to mount water resistant type auto switches, note that the rotary actuator itself is not of water resistant construction.

∗ Lead wire length symbols: 0.5 m ····· Nil (Example) M9NW
1 m ····· M (Example) M9NWM
3 m ····· L (Example) M9NWL
5 m ····· Z (Example) M9NWZ

∗ Auto switches are shipped together, (but not assembled).

∗ Auto switches marked with a "○" are produced upon receipt of orders.

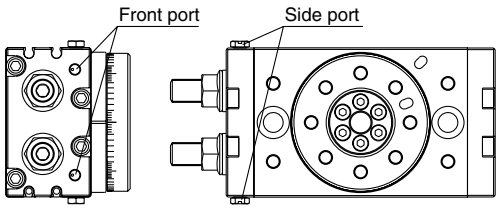
Made to Order Refer to pages 796 and 797 for the details of solid state auto switch with pre-wired connector.



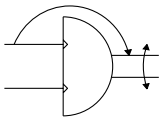
Specifications

Size		10	20	30	50
Fluid		Air (Non-lube)			
Max. operating pressure		1 MPa			
Min. operating pressure		0.1 MPa			
Ambient and fluid temperature		0° to 60°C (No freezing)			
Cushion		Not attached			
Angle adjustment range		0 to 190°			
Maximum rotation angle		190°			
Port size	**End port**	M5 x 0.8		Rc 1/8, G 1/8, NPT 1/8, NPTF 1/8	
	Side port	M5 x 0.8			
Output (N·m)∗		0.89	1.8	2.7	4.6

∗ Output under the operating pressure at 0.5 MPa. Refer to page 315 for further information.



JIS Symbol



Made to Order

Made to order
Refer to page 333 for details.

Symbol	Specifications/Content
-X15□	With external stopper

Allowable Kinetic Energy and Rotation Time Adjustment Range

Size	Allowable kinetic energy (J)	Stable operational rotation time adjustment range (s/90°)
10	0.007	1 to 5
20	0.025	
30	0.048	
50	0.081	

Note) If operated where the kinetic energy exceeds the allowable value, this may cause damage to the internal parts and result in product failure. Please pay special attention to the kinetic energy levels when designing, adjusting and during operation to avoid exceeding the allowable limit.

Mass

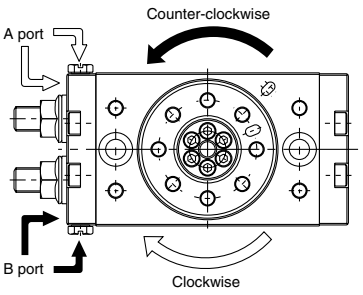
(g)

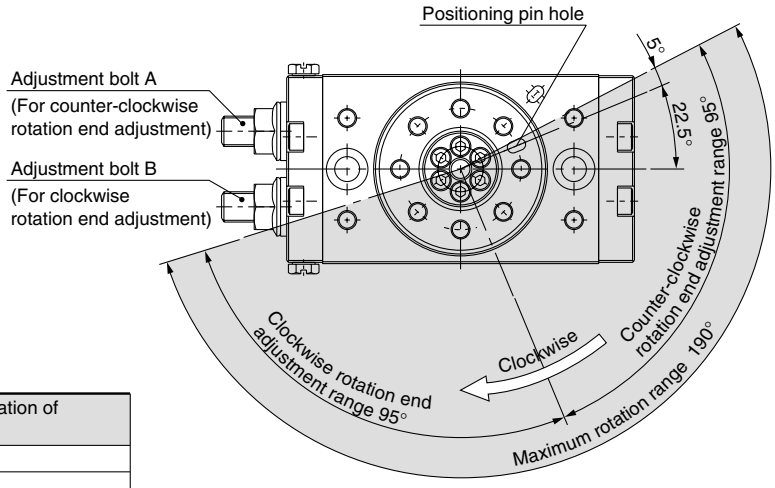
Size	10	20	30	50
Basic	530	990	1290	2080

∗ Not including the mass of auto switch.

Rotation Direction and Rotation Angle

• The rotary table turns in the clockwise direction when the A port is pressurized, and in the counter-clockwise direction when the B port is pressurized.
• By adjusting the adjustment bolt, the rotation end can be set within the range shown in the drawing for the desired rotation angle.





With Adjustment Bolt

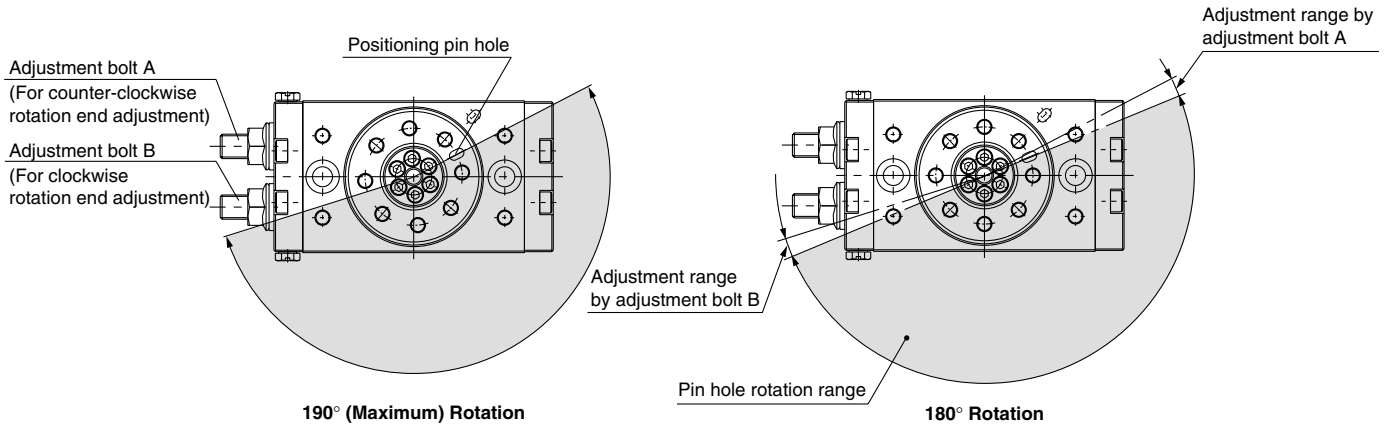
Size	Adjustment angle per rotation of angle adjustment screw
10	10.2°
20	7.2°
30	6.5°
50	8.2°

Note) • The drawing shows the rotation range of the positioning pin hole.
• The pin hole position in the drawing shows the counter-clockwise rotation end when the adjustment bolts A and B are tightened equally and the rotation is adjusted 180°.

Rotation Angle Range Example

• Various rotation ranges are possible as shown in the drawings below using adjustment bolts A and B.
(The drawings also show the rotation ranges of the positioning pin hole.)

• The rotation angle can also be set on a type with inertial absorber.



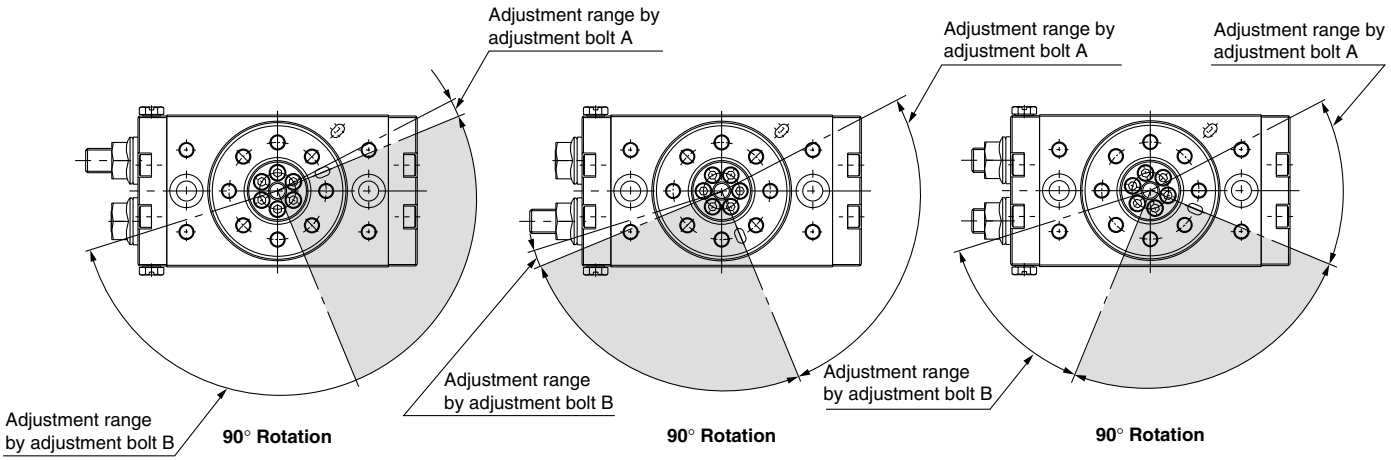
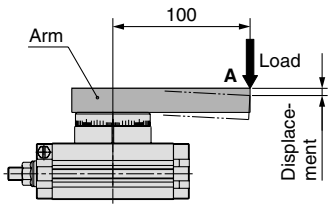
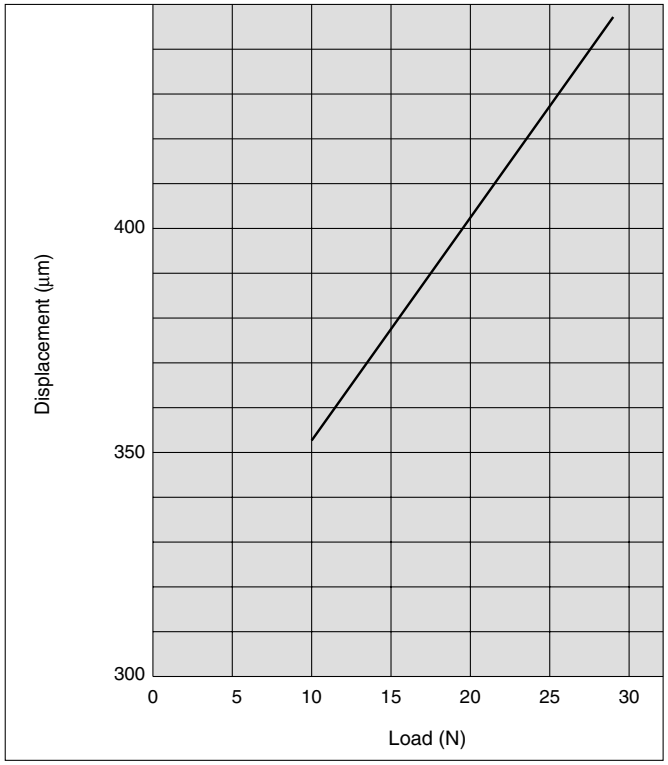


Table Displacement (Reference values)

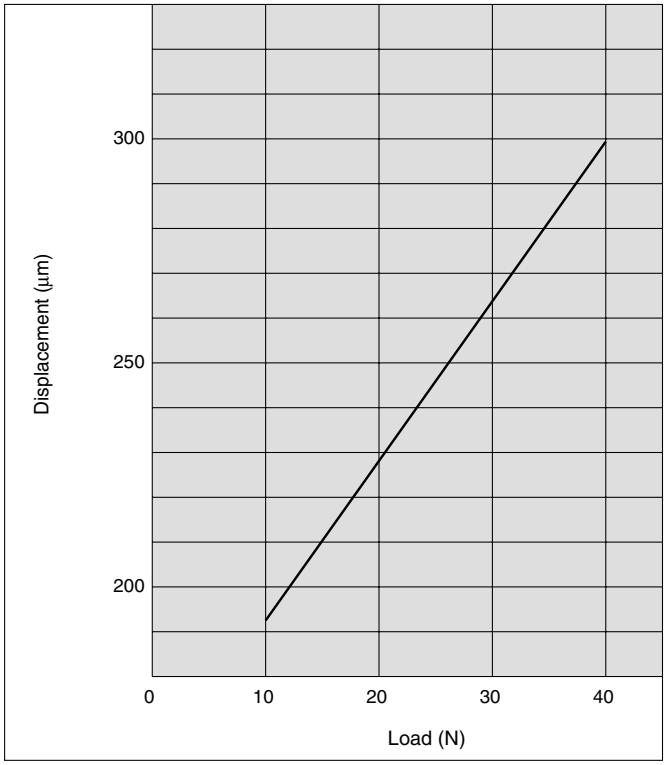
• The following graphs show the displacement at point A, which is 100 mm apart from the center of rotation, where the load is applied.



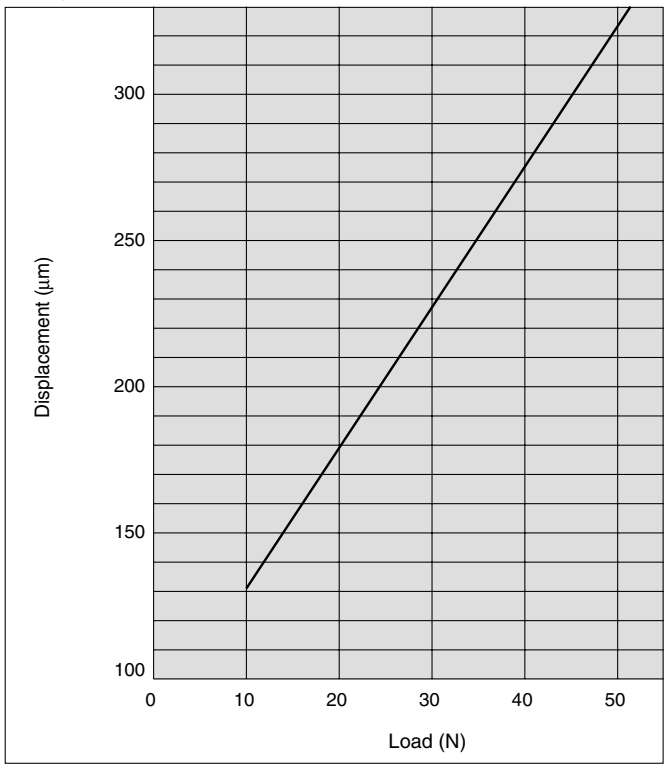
MSQXB10A



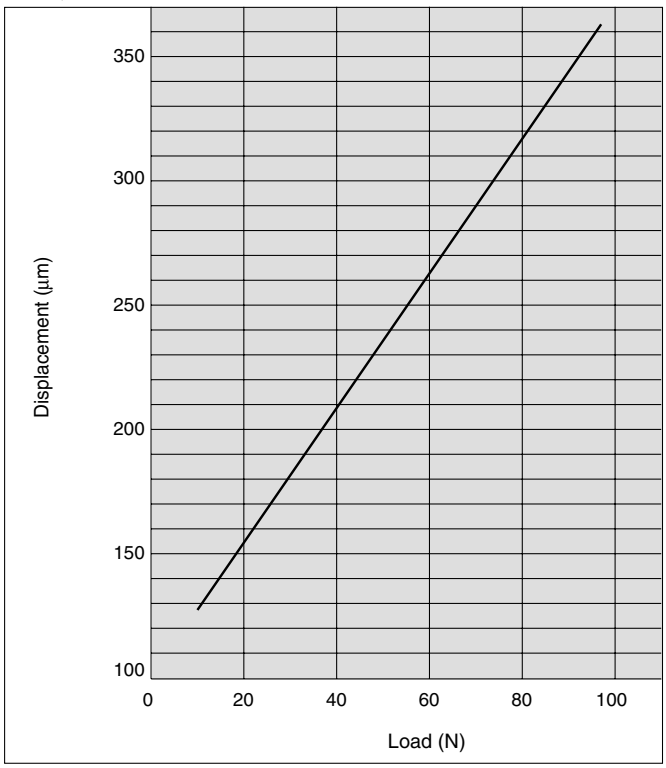
MSQXB20A



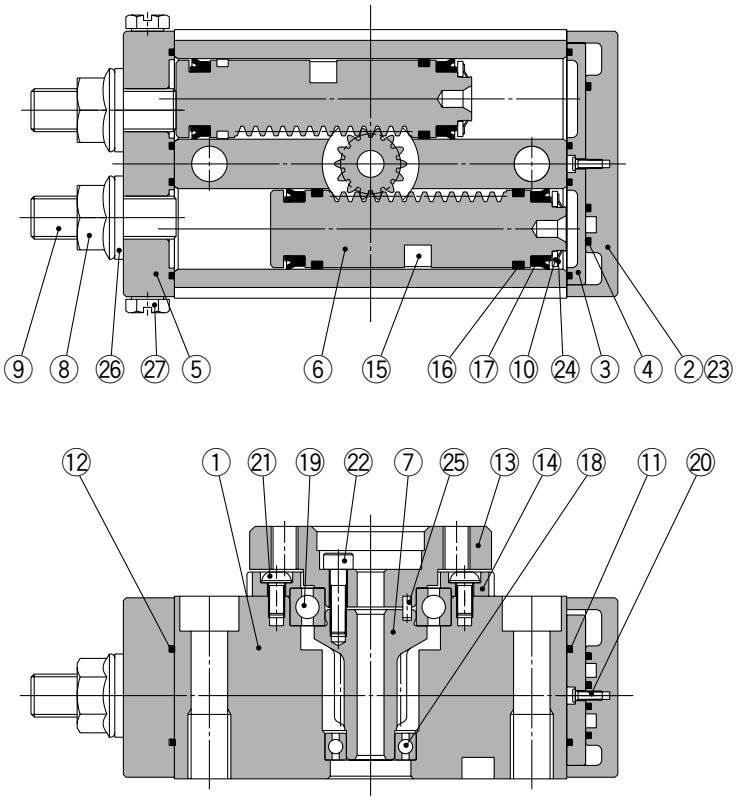
MSQXB30A



MSQXB50A



Construction



Component Parts

No.	Description	Material
1	**Body**	Aluminium alloy
2	**Cover**	Aluminium alloy
3	**Plate**	Resin
4	**Seal**	NBR
5	**End cover**	Aluminium alloy
6	**Piston**	Stainless steel
7	**Pinion**	Chrome molybdenum steel
8	**Hexagon nut with flange**	Steel wire
9	**Adjustment bolt**	Chrome molybdenum steel
10	**Seal retainer**	Aluminium alloy
11	**Gasket**	NBR
12	**Gasket**	NBR
13	**Table**	Aluminium alloy
14	**Bearing retainer**	Aluminium alloy

Component Parts

No.	Description		Material
15	**Magnet**		—
16	**Wear ring**		Resin
17	**Piston seal**		NBR
18	**Deep groove ball bearing**		Bearing steel
19	**Deep groove ball bearing**		Bearing steel
20	**Cross recessed screw No. 0**		Steel wire
21	**Cross recessed screw**		Stainless steel
	Low head cap screw	**Size: 10**	Chrome molybdenum steel
22	**Hexagon socket head cap screw**	**Size: 20 to 50**	Stainless steel
23	**Hexagon socket head cap screw**		Stainless steel
24	**Type CS retaining ring**		Spring steel
25	**Parallel pin**		Carbon steel
26	**Seal washer**		NBR
27	**Plug**		Brass

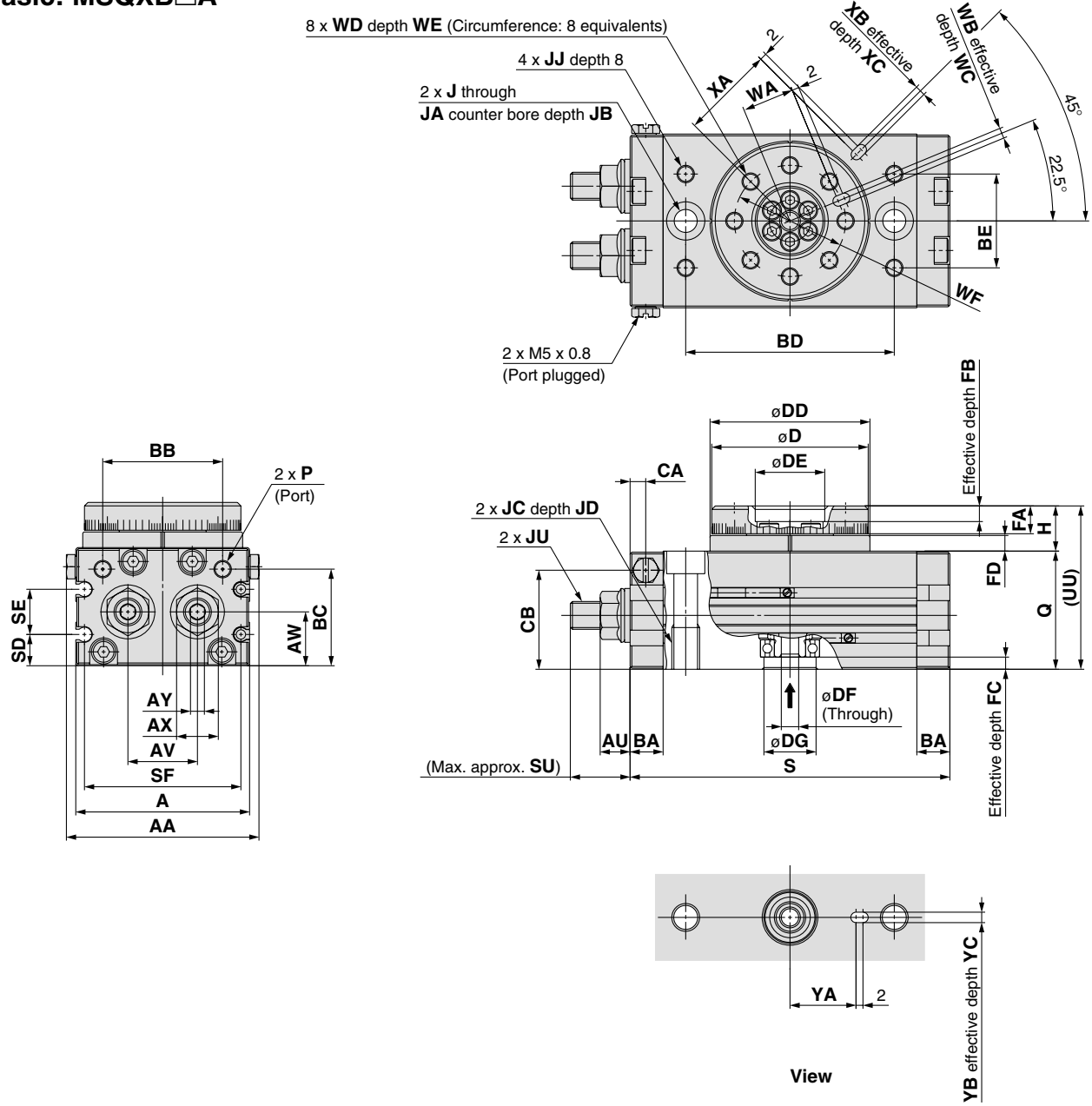
Replacement Parts

Description	Part no.											
	10			**20**			**30**			**50**		
Seal kit	P523010-20			P523020-20			P523030-20			P523040-20		
Parts included in seal kit	No.	Description	Qty.	No.	Description	Qty.	No.	Description	Qty.	No.	Description	Qty.
	4	**Seal**	1	**4**	**Seal**	1	**4**	**Seal**	1	**4**	**Seal**	1
	11	**Gasket**	1	**11**	**Gasket**	1	**11**	**Gasket**	1	**11**	**Gasket**	1
	12	**Gasket**	1	**12**	**Gasket**	1	**12**	**Gasket**	1	**12**	**Gasket**	1
	16	**Wear ring**	4	**16**	**Wear ring**	4	**16**	**Wear ring**	4	**16**	**Wear ring**	4
	17	**Piston seal**	4	**17**	**Piston seal**	4	**17**	**Piston seal**	4	**17**	**Piston seal**	4
	26	**Seal washer**	2	**26**	**Seal washer**	2	**26**	**Seal washer**	2	**26**	**Seal washer**	2

∗ A set includes all parts above.
A grease pack (10 g) is included. When only a grease pack is needed, order with the following part number.
Replacement parts/Grease pack part no: P523010-21 (10 g)

Dimensions

Basic: MSQXB□A



(mm)

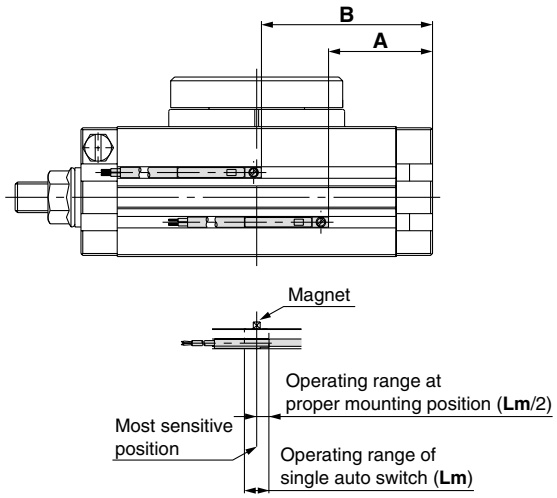
Size	AA	A	AU	AV	AW	AX	AY	BA	BB	BC	BD	BE	CA	CB	D	DD	DE	DF	DG	FA	FB	FC	FD	H	J	JA	JB
10	55.4	50	8.6	20	15.5	12	4	9.5	34.5	27.8	60	27	4.5	28.5	45h9	46h9	20H9	5	15H9	8	4	3	4.5	13	6.8	11	6.5
20	70.8	65	10.6	27.5	16	14	5	12	46	30	76	34	6	30.5	60h9	61h9	28H9	9	17H9	10	6	2.5	6.5	17	8.6	14	8.5
30	75.4	70	10.6	29	18.5	14	5	12	50	32	84	37	6.5	33.5	65h9	67h9	32H9	9	22H9	10	4.5	3	6.5	17	8.6	14	8.5
50	85.4	80	14	38	22	19	6	15.5	63	37.5	100	50	10	37.5	75h9	77h9	35H9	10	26H9	12	5	3	7.5	20	10.5	18	10.5

(mm)

Size	JC	JD	JJ	JU	P	Q	S	SD	SE	SF	SU	UU	WA	WB	WC	WD	WE	WF	XA	XB	XC	YA	YB	YC
10	M 8 x 1.25	12	M5 x 0.8	M 8 x 1	M5 x 0.8	34	92	9	13	45	17.7	47	15	3H9	3.5	M5 x 0.8	8	32	27	3H9	3.5	19	3H9	3.5
20	M10 x 1.5	15	M6 x 1	M10 x 1	M5 x 0.8	37	117	10	12	60	25	54	20.5	4H9	4.5	M6 x 1	10	43	36	4H9	4.5	24	4H9	4.5
30	M10 x 1.5	15	M6 x 1	M10 x 1	Rc 1/8**	40	127	11.5	14	65	25	57	23	4H9	4.5	M6 x 1	10	48	39	4H9	4.5	28	4H9	4.5
50	M12 x 1.75	18	M8 x 1.25	M14 x 1.5	Rc 1/8**	46	152	14.5	15	75	31.4	66	26.5	5H9	5.5	M8 x 1.25	12	55	45	5H9	5.5	33	5H9	5.5

** In addition to Rc 1/ 8, G 1/ 8, NPT 1/ 8 and NPTF 1/ 8 are also available.

Auto Switch Proper Mounting Position (at Rotation End Detection)



Size	Rotation angle	Reed switch				Solid state switch			
		A	B	Operating angle (θ m)	Hysteresis angle	A	B	Operating angle (θ m)	Hysteresis angle
10	190°	27	45	90°	10°	31	49	55°	10°
20	190°	35	62	80°	10°	39	66	45°	10°
30	190°	39	68	65°	10°	43	72	35°	10°
50	190°	49	83	50°	10°	53	87	30°	10°

Operating angle θ**m**: Value of the operating range of single auto switch (Lm) as represented by rotation angle for shaft
Hysteresis angle: Value of the auto switch hysteresis as represented by angle

Note) Since the above values are only provided as a guideline, they are not guaranteed.
In the actual setting, adjust them after confirming the auto switch operating condition.

Made to Order Specifications:

Made to Order

Please contact SMC for detailed specifications, lead times and prices.

Symbol

With External Stopper — X150/X151/X152/X153

Prevent holding torque from being halved at the rotation end.

How to Order

MSQXB 10 □ AX – M9NW – X150

Size

10
20
30
50

Port type

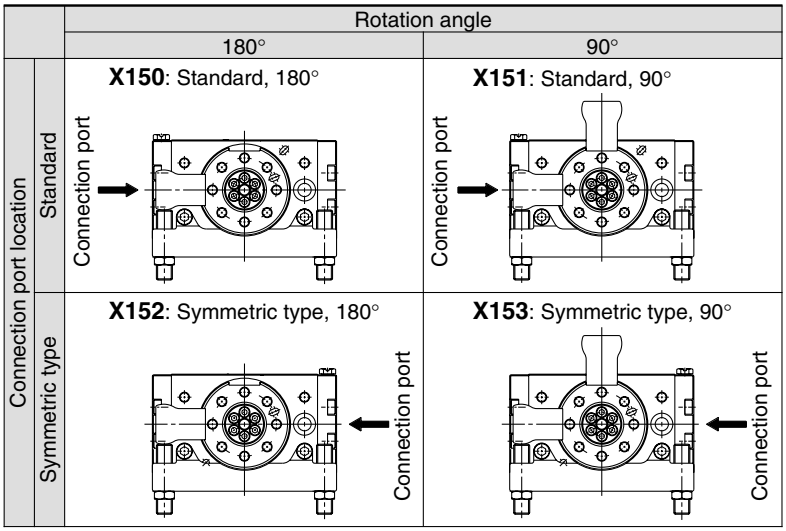
Port type		Size
Nil	M5	10, 20
	Rc 1/8	30, 50
TF	G 1/8	
TN	NPT 1/8	
TT	NPTF 1/8	

Auto switch

Nil	Without auto switch (Built-in magnet)

Connection port location and rotation angle

X150	Standard, 180°
X151	Standard, 90°
X152	Symmetric type, 180°
X153	Symmetric type, 90°



Specifications

Size	10	20	30	50
Rotation angle	90°, 180°			
Angle adjustment range	Each rotation end $^{+3°}_{-5°}$			

∗ Specifications other than the above are the same as standard.

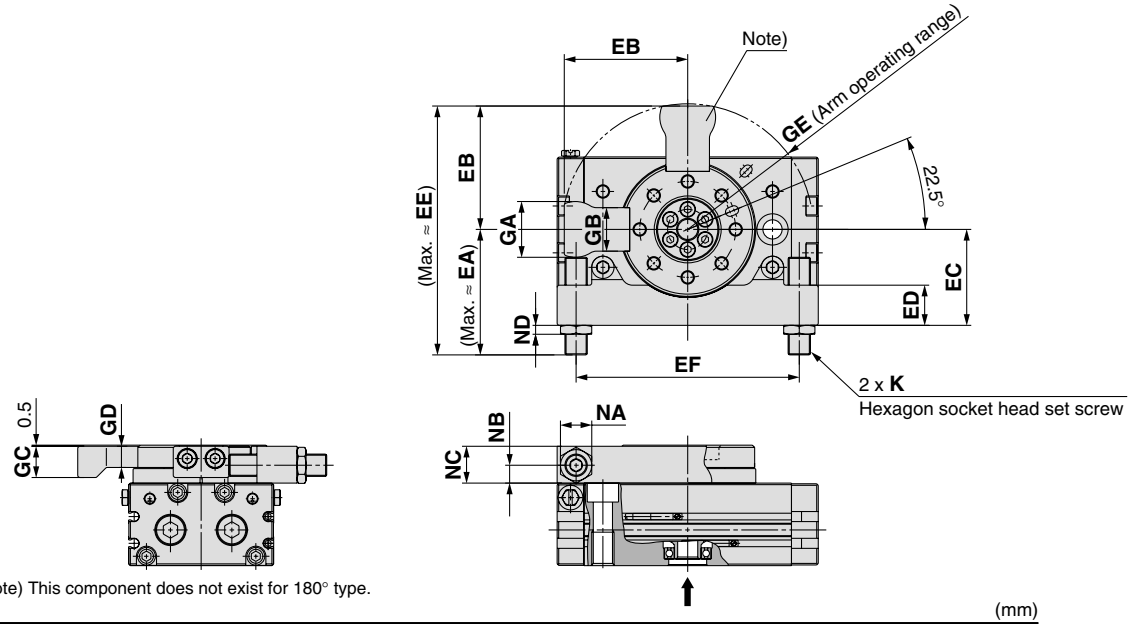
Mass

(g)

Size	10	20	30	50
90° spec.	630	1200	1520	2480
180° spec.	600	1140	1450	2370

∗ Values not including the auto switch mass.

Dimensions



Note) This component does not exist for 180° type.

(mm)

Size	EA	EB	EC	ED	EE	EF	GA	GB	GC	GD	GE	K	NA	NB	NC	ND
10	47.1	44.3	33.5	14	91.4	80	20	15.6	11	7.5	45.2	M8 x 1	10	5.5	12.5	4
20	57.1	55.3	43	18	112.4	100	25	19.5	14	9.5	56.4	M10 x 1	14	8	16.5	4
30	58.4	60.3	46	19.5	118.7	110	27	21.5	14	9.5	61.5	M10 x 1	14	8	16.5	4
50	74.4	71.4	56	22	145.8	130	32	28	18	11.5	72.9	M14 x 1.5	19	8.5	19.5	6

∗ Dimensions other than the above are the same as standard.

Series CRQ2X/MSQX
Specific Product Precautions

Be sure to read before handling.
Refer to front matters 38 and 39 for Safety Instructions and pages 4 to 13 for Rotary Actuator and Auto Switch Precautions.

Selection

⚠ Caution

1. Changes in speed occur in applications in which there are changes to the load during operation, such as the load being lifted (lowered) against gravity.

2. The purpose of this product is stable rotation at low-speed.

It does not provide any function to cushion the impact at the operation start or end.

3. Speed may vary at the rotation end depending on operating conditions. (This phenomenon can be avoided by using the external stopper.)