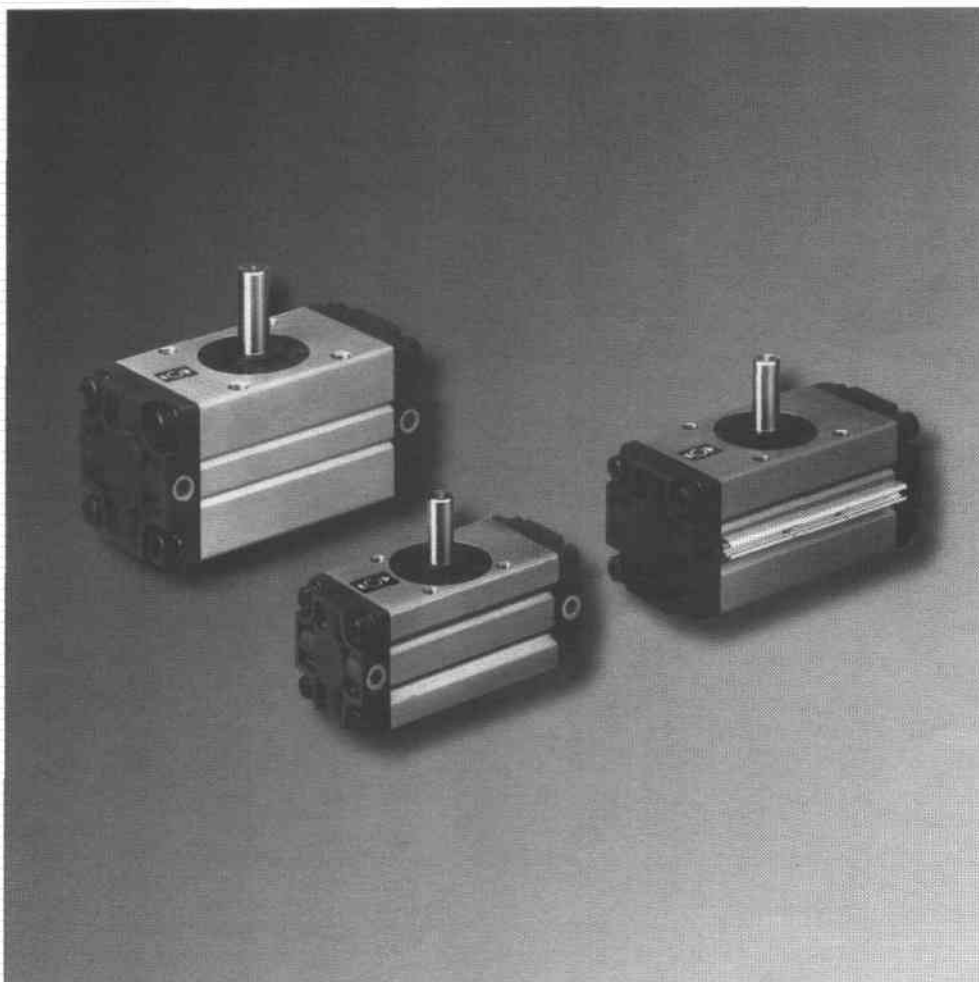




Rotary Actuator

NCRA1 Series

Single Rack and Pinion



Compact and Light Weight

Single and Double Shaft

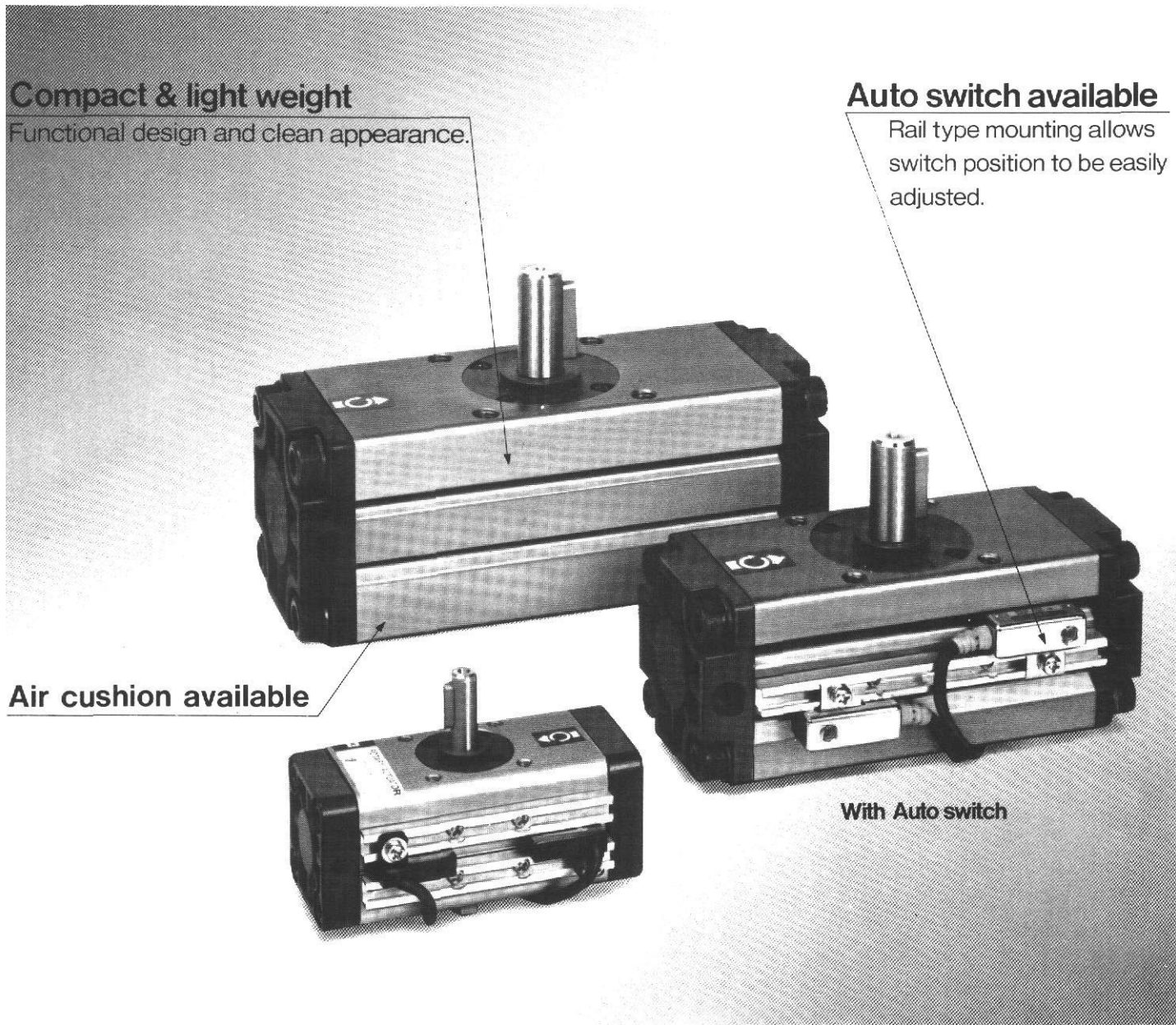
5 Bore Sizes

Air Cushions Available on Both Ends

Auto Switch Capable

Rotary Actuator

Series:NCRA1/Rack and Pinion Type



INDEX

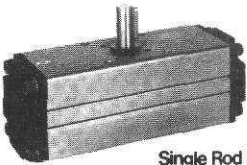
Series:NCRA1	
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Torque Diagram/Weight Chart/Rotation Range	P 4
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How To Order

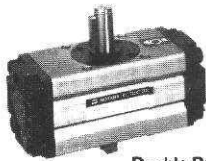
NCRA1B

Mounting
B — Basic

Shaft
S — Single rod end
*W — Double rod end
* 30mm bore double rod end only



Single Rod End



Double Rod End

W 50 90

Adjustable cushion
C — Both end cushion
Not available on NCRA1BW30

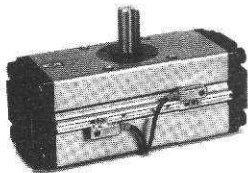
Rotation
<Standard> * <Optional>
90 — 90° 100 — 100°
180 — 180° 190 — 190°
* 30mm: 90° or 180° only
Special order only

Size — Nom (Torque)
(mm) (inch)
30 — 1 3/16 (16.5 in-lbs)
50 — 2 (80 in-lbs)
63 — 2 1/2 (150 in-lbs)
80 — 3 1/8 (270 in-lbs)
100 — 4 (640 in-lbs)

With Auto Switch Capability

NC D RA1B W 50 90 C A53

With Auto Switch Capability
D — With built-in magnet



Mounting
B — Basic

Shaft
See above

Bore
See above

Auto switch type

Bore 30/CDRA1 □ 30

Type	Suffix	Model No.
Reed Switch	A72	D-A72
	A73	D-A73
	A80	D-A80
	A72H	D-A72H
	A73H	D-A73H
	A76H	D-A76H
Solid State Switch	A80H	D-A80H
	F79	D-F79
	F7NV	D-F7NV
	F7P	D-F7P
	F7PV	D-F7PV
	F7BV	D-F7BV
	J79	D-J79
	J79C	D-J79C

Bore 50 ~ 100/CDRA1 □ 50 ~ 100

Type	Suffix	Model No.
Reed Switch	A53	D-A53
	A54	D-A54
	A56	D-A56
	A64	D-A64
	A67	D-A67
	A59W	D-A59W
Solid State Switch	F59	D-F59
	F5P	D-F5P
	F5NTL	D-F5NTL
	F59F	D-F59F
	J59	D-J59
	J51	D-J51
Two Color Light	F59W	D-F59W
	F5PW	D-F5PW
	J59W	D-J59W
	F5BAL	D-F5BAL

* The standard lead wire length is 18 inches. "L" is added for 10 foot long lead wire.
Ex: A73L D-A73L

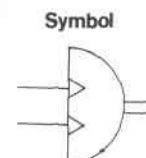
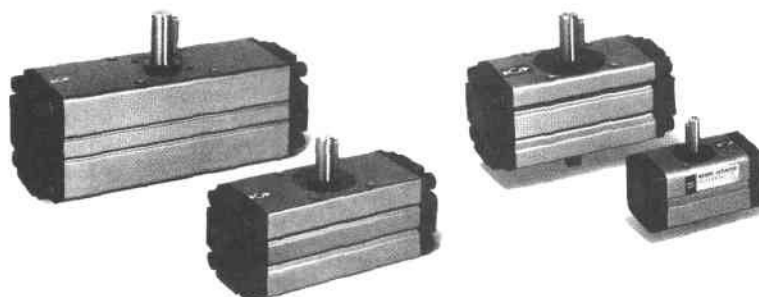
Cushion
See above

Rotation
See above

Parts

Model	Switch rail	Mounting Screw
NCRA1B*30-90	P2940157	M3 X 0.5 X 3
NCRA1B*30-180	P2940158	M3 X 0.5 X 3
NCRA1B*50-90	P2940260	M3 X 0.5 X 5
NCRA1B*50-180	P2940261	M3 X 0.5 X 5
NCRA1B*63-90	P2940360	M3 X 0.5 X 5
NCRA1B*63-180	P2940361	M3 X 0.5 X 5
NCRA1B*80-90	P2940460	M3 X 0.5 X 5
NCRA1B*80-180	P2940461	M3 X 0.5 X 5
NCRA1B*100-90	P2940560	M3 X 0.5 X 5
NCRA1B*100-180	P2940561	M3 X 0.5 X 5

Rotary Actuator Series:NCRA1/Rack and Pinion Type



Series

●: Standard ●: Optional —: Not available

Bore mm (nominal inch)		30(1 3/16)	50(2), 63(2 1/2), 80(3 1/8), 100(4)
Fluid		Air	Air
Rotation	90°	●	●
	180°	●	●
	100°	1) —	●
	190°	1) —	●
Mounting	Basic	●	●
Shaft	Single end	—	●
	Double end	●	●
Body option	With cushion	—	●
	With auto switch	●	●

1) 30 (1 3/16): Loosening rotation adjustment screw allows changing the angle of rotation to 110° from 90° model and to 200° from 180° model.

Specifications

Fluid	Lubrication not required; pre-lubed at factory
Max. operating pressure	150 PSI (9.9 kgf/cm ²)
Min. operating pressure	15 PSI (1 kgf/cm ²)
Operating temperature	40 ~ 140°F (5 ~ 60°C)
Cushion	Optional
Tube bore mm (inch)	30(1 3/16), 50(2), 63(2 1/2), 80(3 1/8), 100(4)
Mounting	Basic

Allowable Dynamic Load

Model	Kinetic energy (in-lbs)*		Effective cushion range
	Without cushion	With cushion	
NCRA1BW30	0.08	—	—
NCRA1○50	0.43	8.7	35°
NCRA1○63	1.0	13	35°
NCRA1○80	1.4	17	35°
NCRA1○100	4.8	26	35°

*Kinetic energy is the max. absorbed energy with optimum adjustment of the cushion needle.

Air Volume

(inch³)

Model	Rotation			
	90°	180°	100°	190°
NCRA1BW30	0.45	0.85	—	—
NCRA1○50	1.95	3.97	2.20	4.15
NCRA1○63	3.66	7.32	4.09	7.75
NCRA1○80	6.77	13.49	7.51	14.22
NCRA1○100	15.81	31.61	17.57	33.38

Stable Rotation Time Regulating Range

Model	Rotation time(sec/90°)
NCRA1BW30	0.2~1
NCRA1○50	0.2~2
NCRA1○63	0.2~3
NCRA1○80	0.2~4
NCRA1○100	0.2~5

Excessive Rotation time may cause sticking.

How To Control Rotation Time

Even a small torque generated by the rotary actuator, due to inertia, may cause damage. Therefore, please control rotation time taking the moment of inertia of the load and kinetic energy into consideration. For further details, refer to the Appendices on pages 18 and 19.

Weight Chart

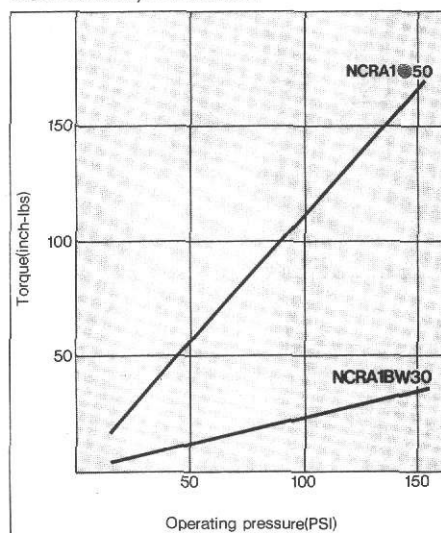
(lbs)

Model	Basic weight		Additional accessory weight
	90°	180°	With auto switch ¹⁾
NCRA1BW30	0.66	0.88	0.22
NCRA1BS50	3.31	3.75	0.44
NCRA1BS63	5.51	6.62	0.88
NCRA1BS80	9.48	11.03	1.32
NCRA1BS100	18.74	20.95	1.98

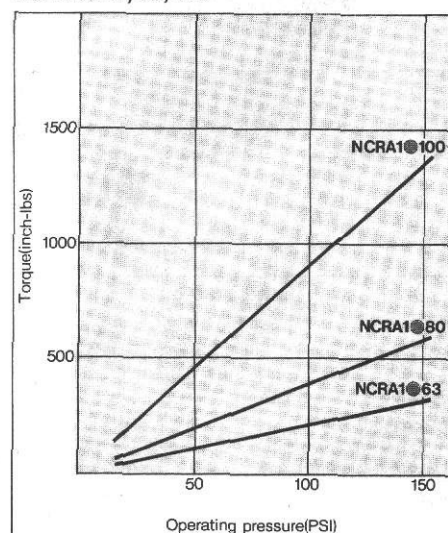
Note 1) Weight with 2 switches

Torque Diagram

NCRA1BW30, NCRA1○50



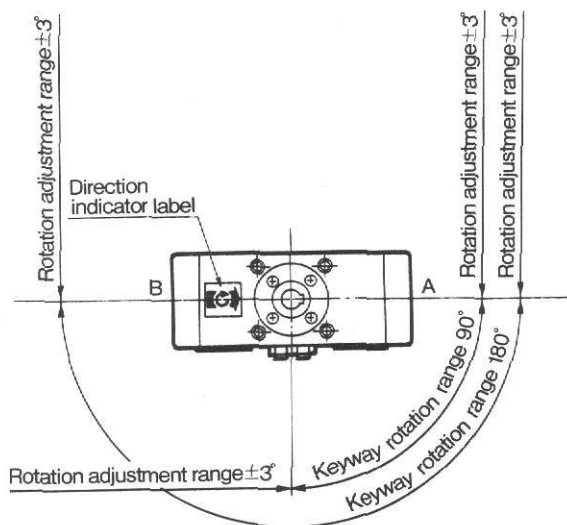
NCRA1○63, 80, 100



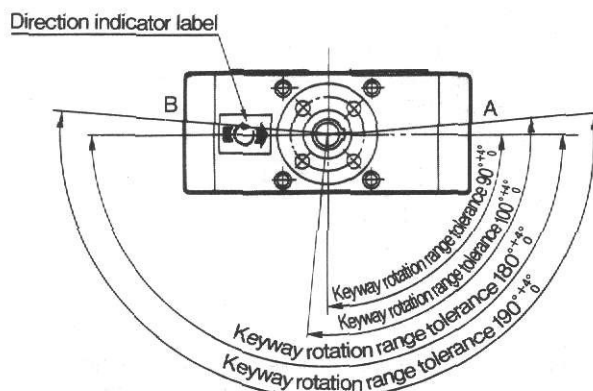
Keyway/Rotation Range

Pressure to the side indicated by label B rotates the shaft clockwise, pressure to the side labeled A rotates the shaft counterclockwise.

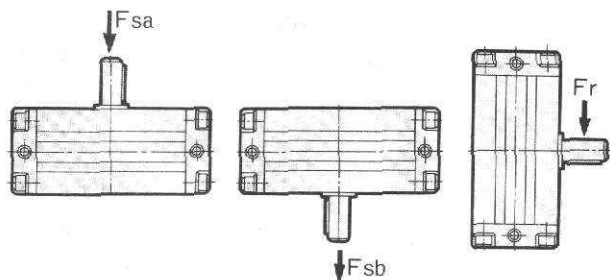
NCRA1BW30



NCRA1○50~100



Shaft Load

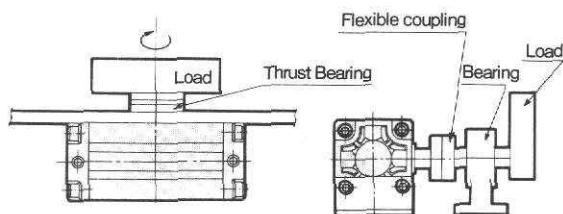


(lbs)

Model	Load direction		
	Fsa	Fsb	Fr
NCRA1BW30	6	6	6
NCRA1●50	110	44	44
NCRA1●63	132	44	66
NCRA1●80	198	44	88
NCRA1●100	220	44	132

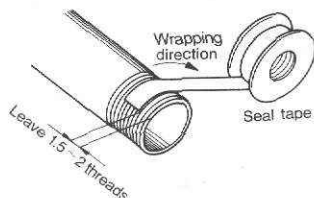
In the stop position, the load can meet the value given in the list, please do not mount the load directly to the shaft.

For trouble free operation, the following illustrated mounting methods are recommended.



Operational Instructions

- ① Piping should be thoroughly flushed or cleaned to prevent contamination by chips, cutting oil, dust, etc.
- ② When piping and fittings are installed, care should be taken to prevent contamination. (Chips from piping thread, and seal materials.)
In addition, when wrapping seal tape, please leave 1.5-2 threads uncovered on the pipe end.

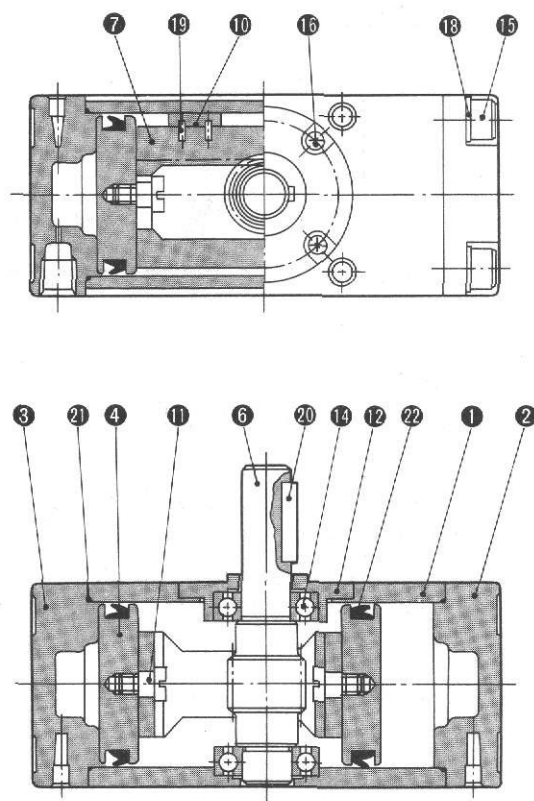
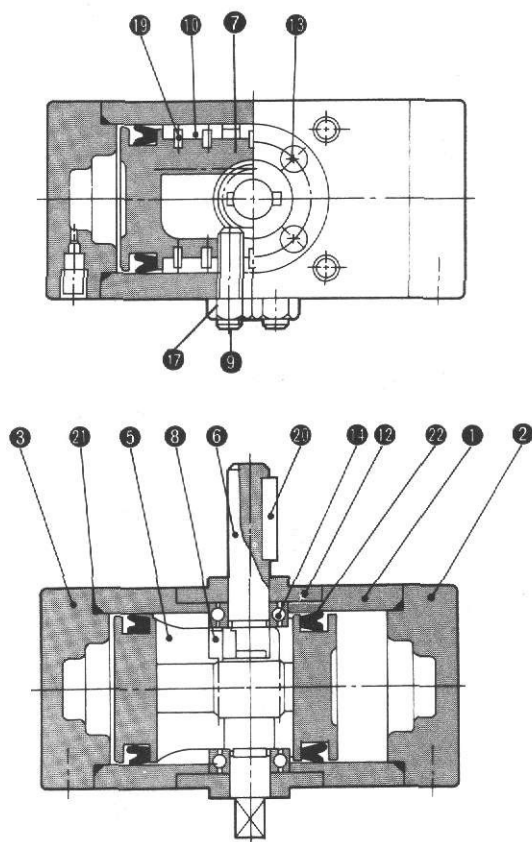


- ③ For high speed and large load applications, the actuator absorbs a large amount of energy. It is recommended to contact a SMC representative before selecting type and model to be used for such loads.
- ④ Never enlarge the fixed orifice of the port. An enlarged orifice can easily lead to actuator damage and failure.

Construction/Parts List

CRA1BW30

NCRA1○50~100



Parts List

No.	Description	Material	Note
1	Body	Aluminium alloy	Hard alumite
2	Cover	Aluminium alloy	Black alumite
3	Cover	Aluminium alloy	Black alumite
4	Piston	Aluminium alloy	Chromate
5	Piston	Carbon steel	Nitrided
6	Shaft	Chromium-molybdenum steel	
7	Rack-assembly	Carbon steel	Nitrided
8	Stopper	Cr. Mb. steel	
9	Stopper screw	Cr. Mb. steel	Black dye
10	Slider	Delrin	

Parts List

No.	Description	Material	Note
11	Connecting screw	Carbon steel	Zinc-chromate
12	Bearing retainer	Aluminium alloy	Black alumite
13	Phillips head screw	Steel wire	Black dye
14	Bearing	—	
15	Hexagon socket head cap screw	Cr. Mb. steel	Black dye
16	Phillip Pan-head screw	Steel wire	Black dye
17	Hexagon nut	Steel wire	Black dye
18	Spring washer	Steel wire	Black dye
19	Spring pin	Steel wire	

Parts List

No.	Description	Material	Part Number				
			30	50	63	80	100
20	Parallel key	Carbon steel	P2941050	P2941051	P2941052	P2941053	P2941054

Packing List

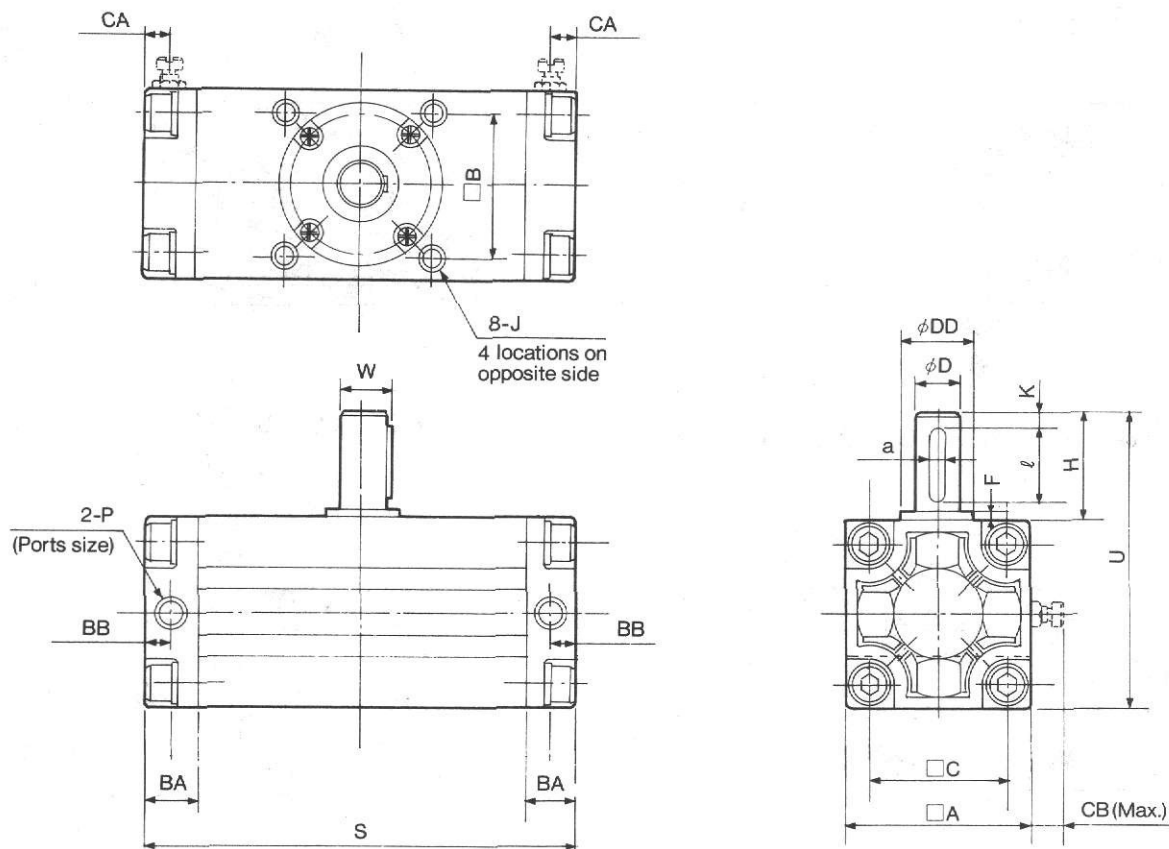
No.	Description	Material	Part Number					Qty
			30	50	63	80	100	
—	Seal Kit	—	CRA1-30-PS	CRA1-50-PS	CRA1-63-PS	CRA1-80-PS	CRA1-100-PS	—
21	Tube Gasket	NBR	21.9 x 29.5 x 1.2	CA50-1602	CA63-1603	CA80-1604	CA100-1605	2
22	Piston Packing	NBR	PGY-30	PGY-50	PGY-63	PGY-80	PGY-100	2

Single Rod End Type:NCRA1OSO

Single Rod End/Dimensions

(inch)

NCRA1BS50~100



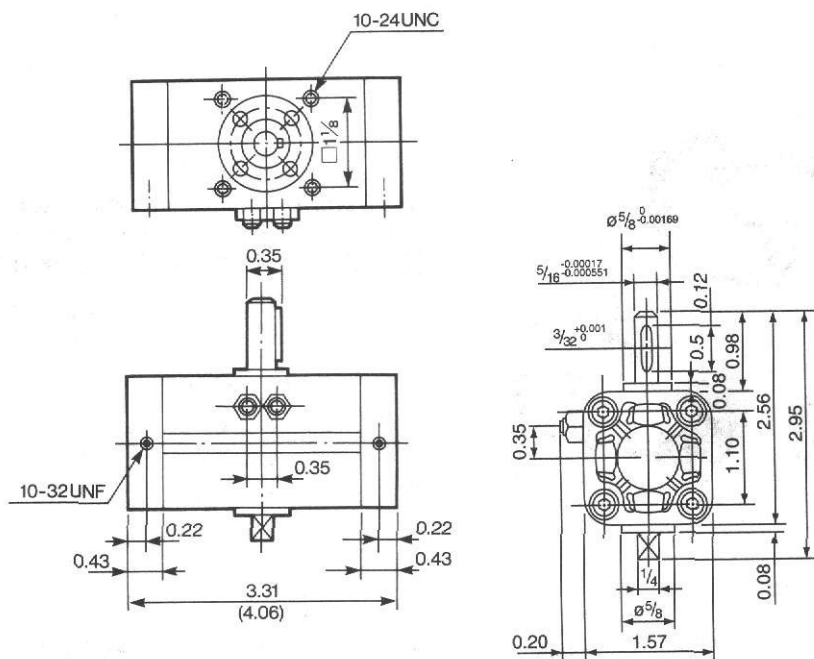
Model	P (NPTF)	□A	□B	□C	φD	φDD	F	H	J	K	S*	U	W	BA	BB	CA	CB	KEY		
																		a	Tolerance	ℓ
NCRA1BS50-○○	1/8	2.44	17/8	1.81	9/16 ^{-0.000236} _{-0.000669}	1 ⁰ _{-0.00205}	0.1	1.42	5/16-18UNC Depth 0.31	0.2	5.67 (6.97)	3.86	0.62	0.67	0.33	0.33	0.51	1/8	+0.001 0	1
NCRA1BS63-●●	1/8	2.99	2 3/8	2.24	5/8 ^{-0.000236} _{-0.000669}	1 1/8 ⁰ _{-0.00244}	0.1	1.61	9/8-16UNC Depth 0.47	0.2	6.42 (7.93)	4.61	0.70	0.79	0.39	0.39	0.55	3/16		1.25
NCRA1BS80-○○	1/4	3.62	2 7/8	2.76	3/4 ^{-0.000276} _{-0.000787}	1 3/8 ⁰ _{-0.00244}	0.12	1.97	1 1/2-13 UNC Depth 0.51	0.2	7.32 (9.06)	5.59	0.83	0.93	0.47	0.47	0.71	3/16		1.5
NCRA1BS100-●●	3/8	4.41	3 3/8	3.35	1 ^{-0.000276} _{-0.000787}	1 5/8 ⁰ _{-0.00244}	0.16	2.36	1 1/2-13UNC Depth 0.55	0.2	9.65 (12.24)	6.77	1.11	0.98	0.49	0.49	0.71	1/4		1.75

* (in parentheses) are the dimensions for rotations of 180°, 190°.

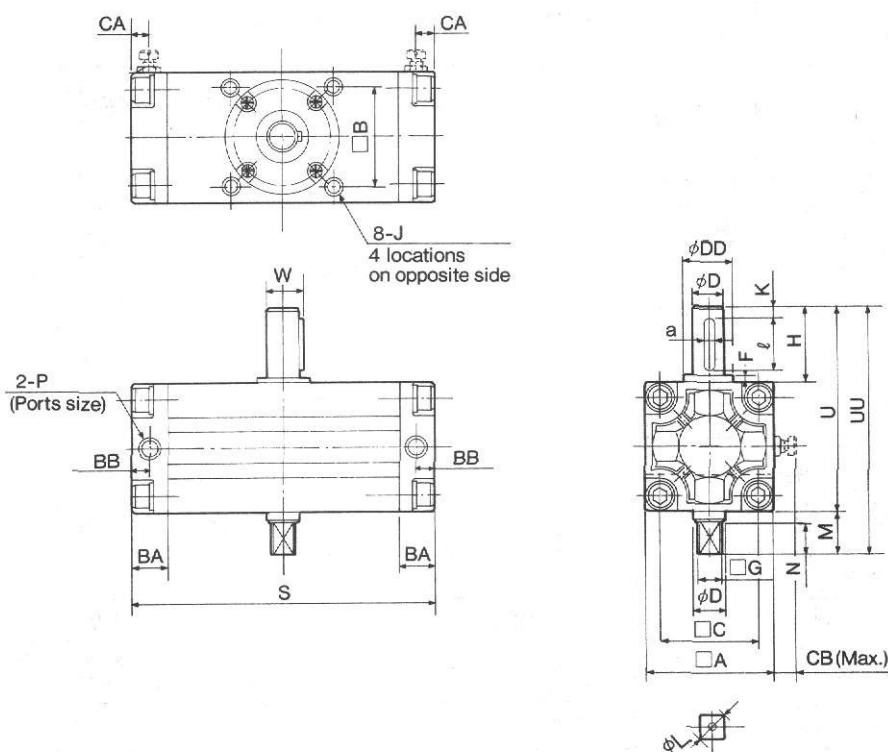
Double Rod End/Dimensions

(inch)

NCRA1BW30



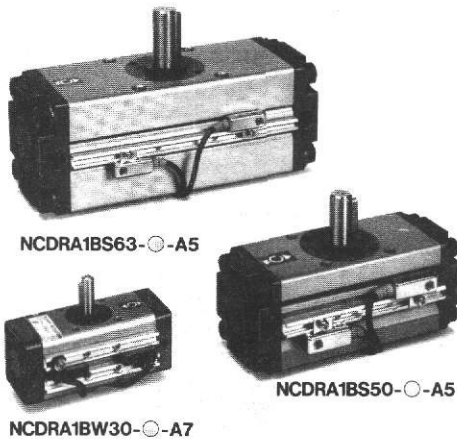
NCRA1BW50~100



Model	P (NPTF)	A	B	C	D	E	F	G	H	J	K	L	M	N	S*	U	UU	W	BA	BB	CA	CB	KEY		
																							a	Tolerance	2
NCRA1BW50-〇〇	1/8	2.44	17/8	1.81	0.000236 3/4-0.000669	0 -0.000205	0.1	7/16	1.42	5/16-18UNC Depth 0.31	0.2	3/16	0.79	0.59	5.67 (6.97)	3.86	4.65	0.62	0.67	0.33	0.33	0.51	1/8	+0.001 0	1
NCRA1BW63-●●	1/8	2.99	2 5/8	2.24	0.000236 5/8-0.000669	0 -0.000244	0.1	1/2	1.61	3/8-16UNC Depth 0.47	0.2	5/8	0.87	0.67	6.42 (7.93)	4.61	5.47	0.70	0.79	0.39	0.39	0.55	3/16		1.25
NCRA1BW80-〇〇	1/4	3.62	2 7/8	2.76	0.000236 3/4-0.000787	0 -0.000244	0.12	5/8	1.97	1/2-13 UNC Depth 0.51	0.2	3/4	0.98	0.79	7.32 (9.06)	5.59	6.57	0.83	0.93	0.47	0.47	0.71	3/16		1.5
NCRA1BW100-●●	3/8	4.41	3 3/8	3.35	0.000236 1-0.000787	0 -0.000244	0.16	3/4	2.36	1/2-13UNC Depth 0.55	0.2	1	1.18	0.98	9.65 (12.24)	6.77	7.95	1.11	0.98	0.49	0.49	0.71	1/4		1.75

* (in parentheses) are the dimensions for rotations of 180°, 190°.

With Auto Switch:Series NCDRA1



Applicable Actuator and Switch Model

Applicable actuator Bore size mm (inch)	Switch mounting	Switch model	*Indicator light	Electrical entry
30 (1 3/16)	Rail Type	D-A7	●	Grommet
		D-A8	x	
50 (2), ø63 (2 1/2) 80 (3 1/8), ø100 (4)	Rail Type	D-A5	●	
		D-A6	x	

* ● : Available, X: Not available

Reed Switch Specifications

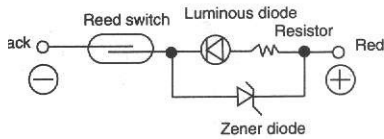
Model	D-A72 D-A72H	D-A73 D-A73H		D-A76H	D-A80 D-A80H			D-A53	D-A54			D-A56	D-A59W	D-A64			D-A67
Application	Relay, Sequencer			IC Circuit	Relay, Sequencer, IC Circuit			Relay, Sequencer	Relay, Sequencer			IC Circuit	Relay, Sequencer	Relay, Sequencer, IC Circuit			Relay, Sequencer IC Circuit
Load voltage	200VAC	24VDC	100VAC	4-8VDC	Max. 24VAC, DC	48VAC, DC	100VAC, DC	24VDC	24VDC	100VAC	200VAC	4-8VDC	24VDC	24VAC/ DC	100VAC	200VAC	24VDC
Max. load current/ load current range	5~10mA	5-40mA	5~20mA	20mA	50mA	40mA	20mA	5-20mA	5-20mA	5-25mA	5~12.5mA	20mA	5~40mA	50mA	25mA	12.5mA	30mA
Internal voltage drop	Max. 2.4V			Max. 0.8V	0			Max. 2.4V	Max. 2.4V			Max. 0.7V	Max. 4V	0			
Indicator lamp	ON: Red light emitting diode				—			ON: Red light emitting diode					ON: Red light emitting diode Best Position: Gren light	—			
Protection circuit for contact breaker pt.	—																

Solid State Switch Specifications

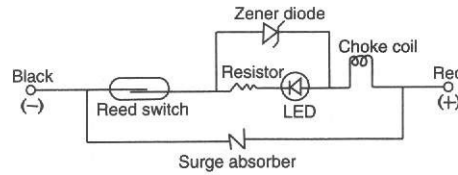
Model	D-F79 D-F7NV	D-F7P D-F7PV	D-J79 D-F7BV	D-J79C	D-F59	D-F5P	D-J59	D-J51	D-F59W	D-F5PW	D-J59W	D-F5BAL	D-F59F	D-F5NTL	
Wiring	3-wire		2-wire		3-wire		2-wire		3-wire		2-wire		4-wire	3-wire	
Output	NPN	PNP	—		NPN	PNP	—		NPN	PNP	—	NPN	NPN		
Application	Relay, IC, Sequence controller		Relay, Sequence controller		Relay, IC, Sequence controller		Relay, Sequence controller		Relay, Sequence controller	Relay, IC	Relay, Sequence controller		Relay, IC, Sequence controller		
Power voltage	5-24VDC		—		5 ~12-24VDC		—	—	12-24VDC	5~12-24VDC	—	—	5-12-24VDC (4.5-28VDC)		
Current consumption	Max. 12mA	Max. 15mA	—		12mA	15mA	—	—	10mA	12mA	—	—	10mA		
Load voltage	Max. 28VDC	—	10~28VDC		28VDC or less	—	24VDC (10-28VDC)	80-260VAC	28VDC	—	24VDC (10-28VDC)		28VDC		
Load current	Max. 150mA	Max. 100mA	5~100mA		150mA	100mA	5-150mA	5~80mA	80mA		5-40mA		40mA	80mA	
Internal voltage drop (When load voltage is 10mA)	Max. 0.8V		Max. 3V		0.8V		3V	14V	0.8V		4V		1.5V	2V	
Leak current	Max. 10μA		Max. 1mA		24VDC: 10mA or less		24VDC: 1mA or less	100VAC: 1mA or less 200VAC: 1.5mA or less	24VDC 10mA or less		24VDC 1mA or less		24VDC 10mA or less		
Indicator lamp	ON: Red light emitting diode								ON: Red light emitting diode Best Position: Green light				ON: Red light		

Auto Switch/Circuit Diagrams

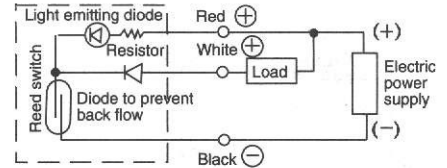
I-A53



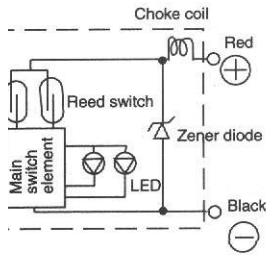
D-A54



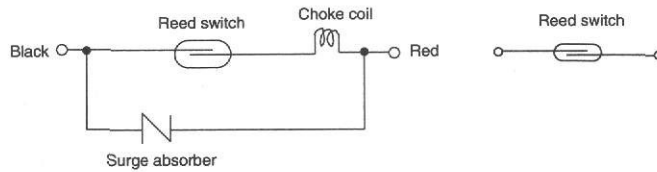
D-A56, D-A76H



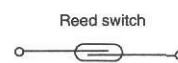
I-A59W



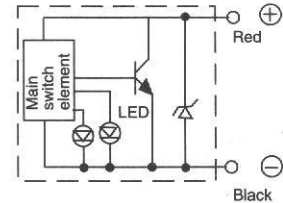
D-A64



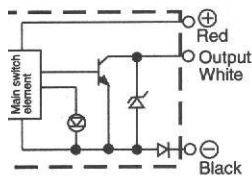
D-A67



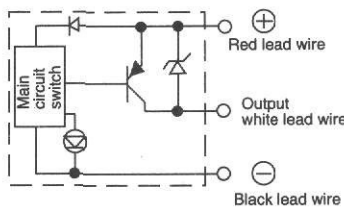
D-F5BAL/D-J59W



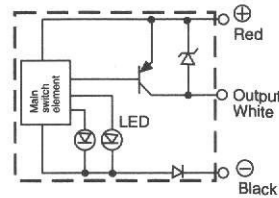
I-F5NTL



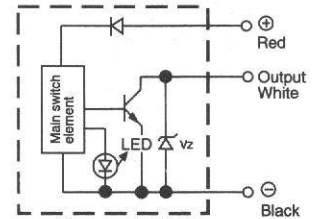
D-F5P, D-F7P, D-F7PV



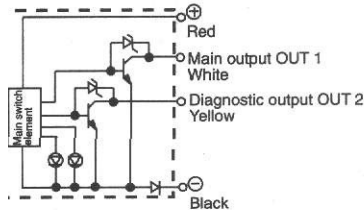
D-F5PW



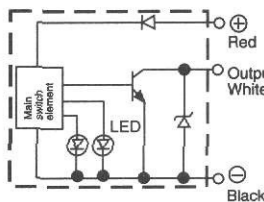
D-F59, D-F79, D-F7NV



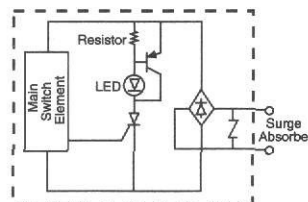
I-F59F



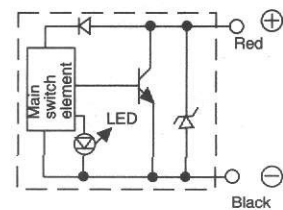
D-F59W



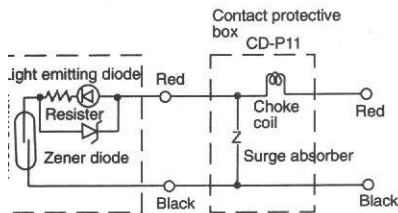
D-J51



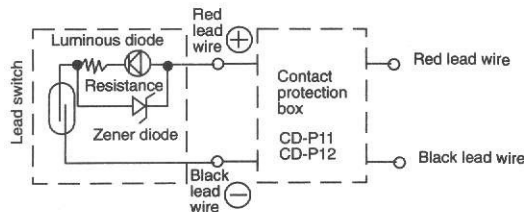
D-J59, D-J79, D-J79C, D-F7BV



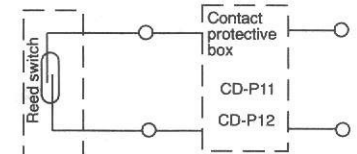
I-A72, D-A72H



D-A73, D-A73H



D-A80, D-A80H

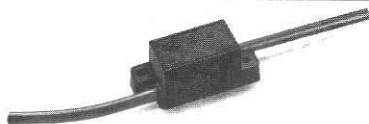


With Auto Switch:Series NCDRA1

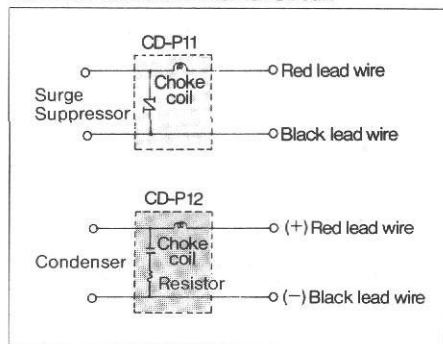
Contact Protection Box

D-A7 type and D-A8 type have no built-in contact protection circuit. Use this box for induction loads, 16ft(5m) or more of lead wire, or AC-100V applications.

Designation	Operating voltage	Length of lead wire
CD-P11	110VAC	Switch connecting side 1.5ft (0.5m)
CD-P12	24VDC	Load connecting side 1.5ft (0.5m)



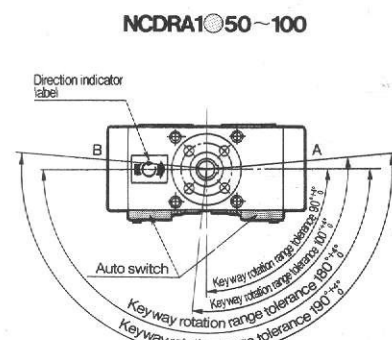
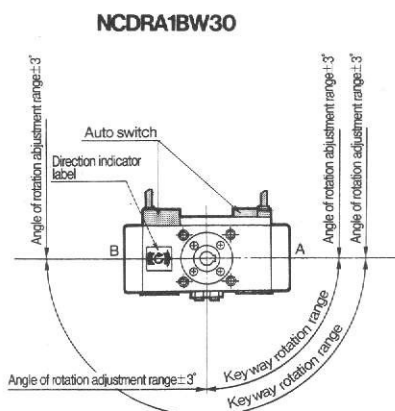
Contact Protection/Internal Circuit



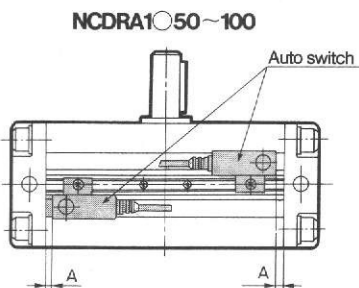
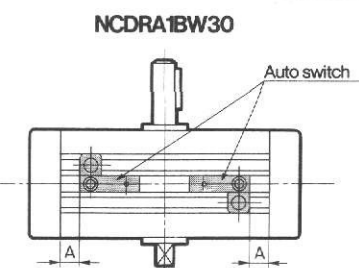
Operational Instructions

- 1 D-A73 & D-A53 (for 24VDC) have a light emitting diode as an indicator light, and therefore, have polarity. If using 24VDC, the black lead wire is (—) side, and the red lead is (+) side. If connection is reversed, the light will not go on although the switch will operate.
- 2 Electric current should be kept within the operating current range. If used at lower than operating current, the indicator light will not turn on, and if used at higher than operating current, the indicator light will be damaged.
- 3 D-A73, D-A54, D-A53 have no problem with parallel connections, but in the case of series connection, care should be taken since the internal resistance of the light emitting diode causes a large voltage drop. (about 2V/switch)

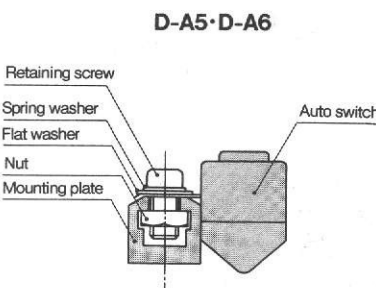
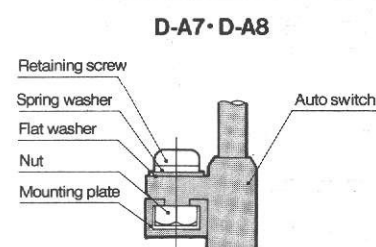
Keyway Rotation Range and Auto Switch Mounting Position



Switch Mounting Position



Auto Switch/How To Change Position



Model	A* (inch)	Rotation sensing range	Hysteresis
NCDRA1BW30	0.35(0.73)	95°	20°
NCDRA1 50	0.35(1.0)	65°	20°
NCDRA1 63	0.40(1.18)	60°	10°
NCDRA1 80	0.59(1.46)	45°	7°
NCDRA1 100	1.06(2.36)	35°	5°

* (in parentheses) are for rotation of 180°.

Position setting

Loosen the retaining screw, shift the switch, set it at any position to suit your need, re-tighten the retaining screw.

Mounting

- 1 The Switch should always be connected to the load before connecting to the power source.
- 2 When operating, please take care to avoid damage, or excessive shock to the switch.
- 3 Never use in a magnetically contaminated environment.
- 4 When operating 2 or more actuators with auto switches in parallel, be sure that the distance between them is 1.6 inch or more.

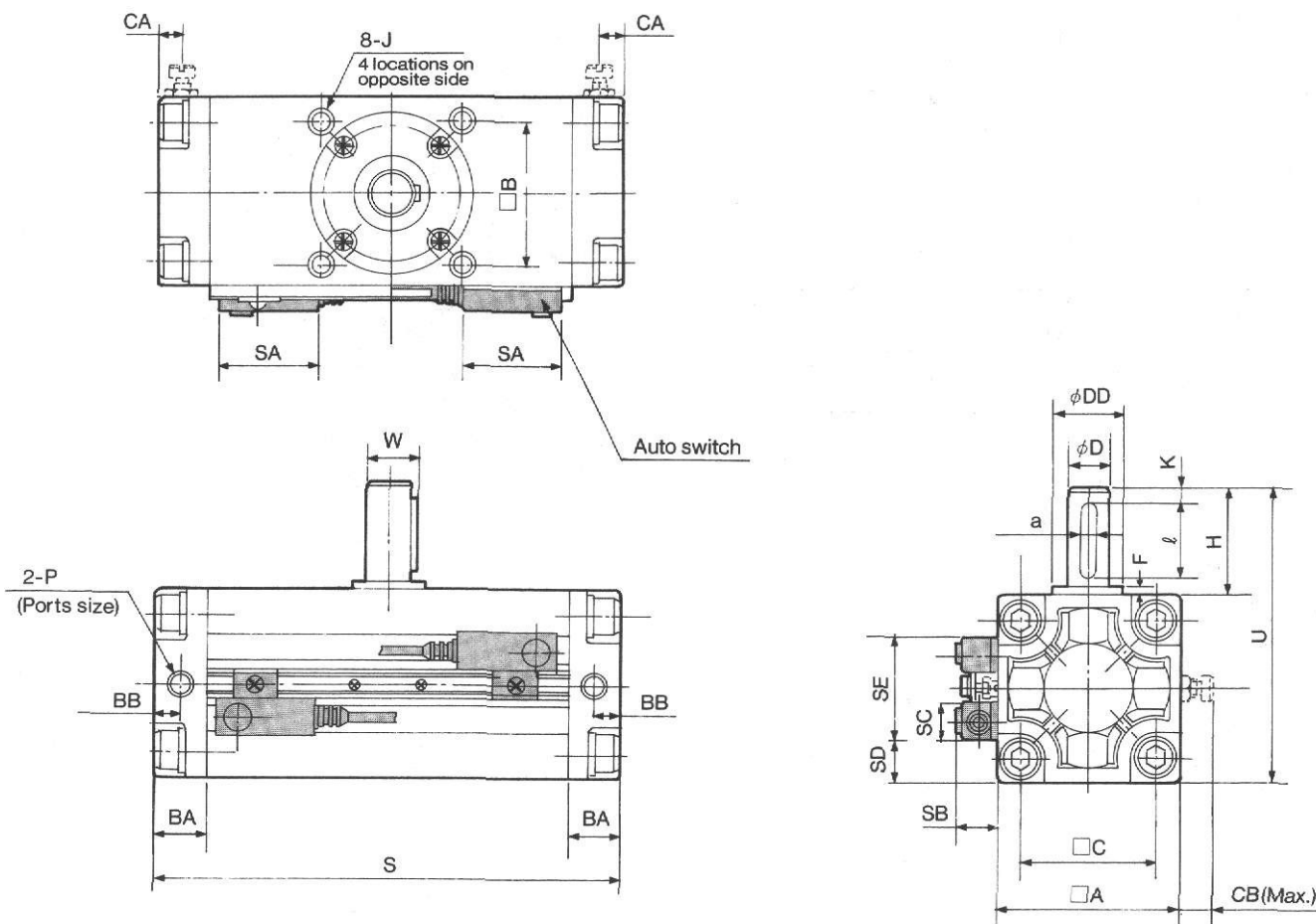
With Auto Switch/Dimensions

(inch)

Dimensions of single rod end with square and flange type are on page 7. Dimensions of double rod end with key and square are on page 8.

Single Rod End:

NCDRA1●S○



Model	P (NPTF)	A	B	C	D	DD	F	H	J	K	S*	U	W	BA	BB	CA	CB	SA	SB	SC	SD	SE	KEY		
																							a	Tolerance	L
NCDRA1BS050-00-A00	1/8	2.44	17/8	1.81	5/16 -0.000236 -0.000669	1 0 -0.00205	0.1	1.42	5/16-18UNC Depth 0.31	0.2	6.14 (7.44)	3.86	0.62	0.67	0.33	0.33	0.51	1.3	0.53	0.47	0.55	1.34	1/8	+0.001 0	1.25
NCDRA1BS063-00-A00	1/8	2.99	2 1/8	2.24	5/16 -0.000236 -0.000669	1 1/8 0 -0.00244	0.1	1.61	3/8-16UNC Depth 0.47	0.2	6.89 (8.41)	4.61	0.70	0.79	0.39	0.39	0.55	1.3	0.57	0.47	0.83	1.34	3/16		1.5
NCDRA1BS080-00-A00	1/4	3.62	2 7/8	2.76	3/4 -0.000216 -0.000787	1 3/8 0 -0.00244	0.12	1.97	1/2-13 UNC Depth 0.51	0.2	7.83 (9.57)	5.59	0.83	0.93	0.47	0.47	0.71	1.3	0.61	0.47	1.14	1.34	3/16		1.75
NCDRA1BS100-00-A00	3/8	4.41	3 3/8	3.35	1 -0.000216 -0.000787	1 5/8 0 -0.00244	0.16	2.36	1/2-13UNC Depth 0.55	0.2	10.2 (12.8)	6.77	1.11	0.98	0.49	0.49	0.71	1.3	0.63	0.47	1.54	1.34	1/4		1.75

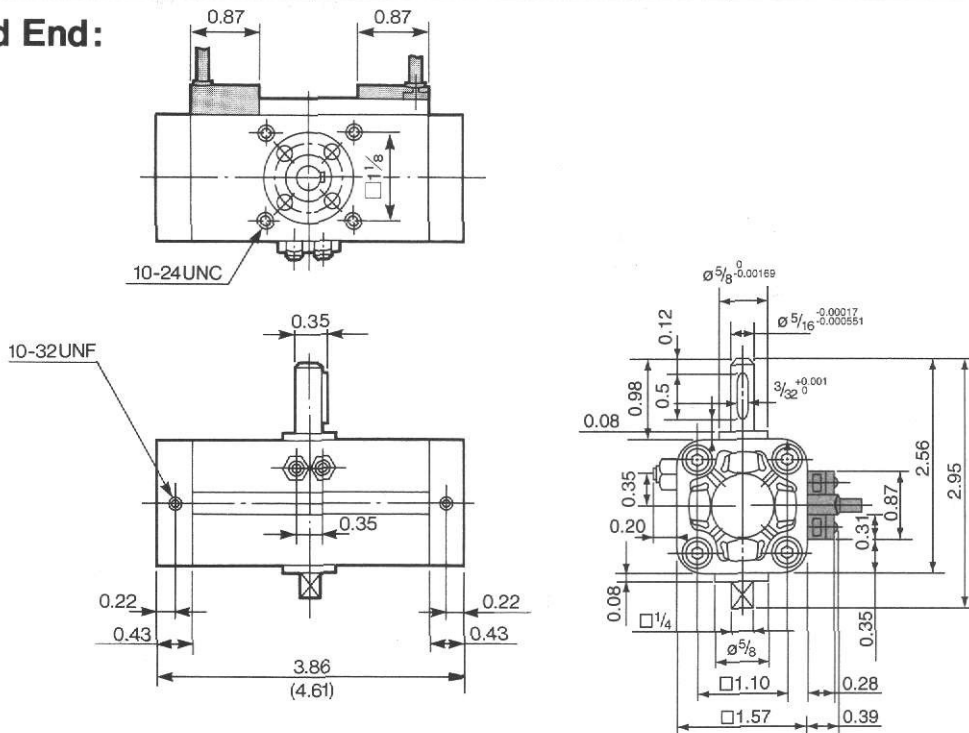
* (in parentheses) are the dimensions for rotations of 180°, 190°.

With Auto Switch:Series NCDRA1

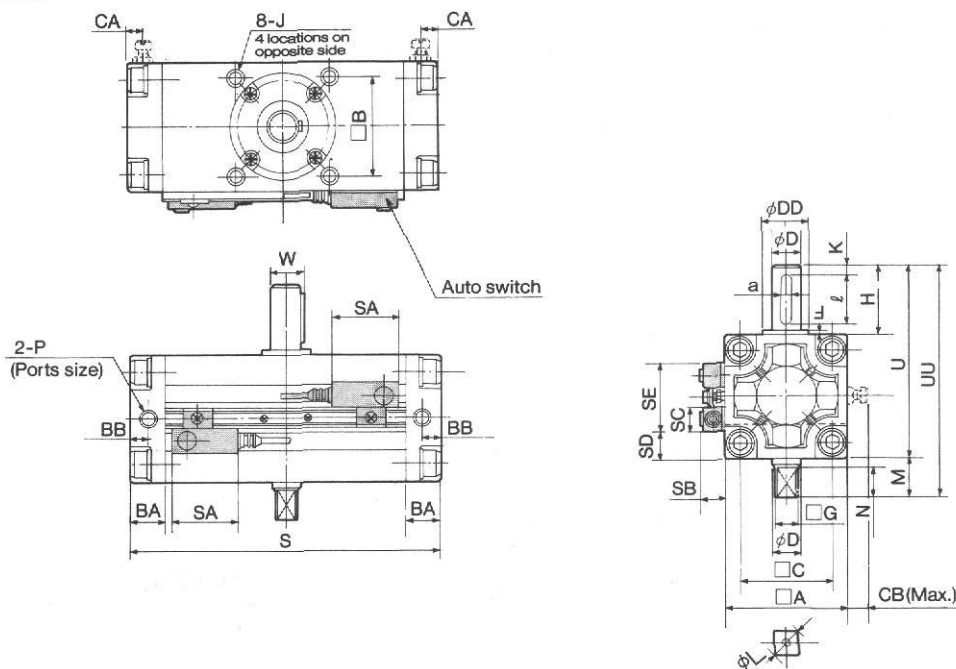
With Auto Switch/Dimensions

(inch)

Double Rod End: NCDR1BW30



NCDRA1BW50~100



Model	P (NPTF)	A	B	C	D	DD	F	G	H	J	K	L	M	N	S*	U	UU	W	BA	BB	CA	CB	SA	SB	SC	SD	SE	KEY		
																												a	Tolerance	ℓ
NCDRA1BW50-00-A00	1/8	2.44	1 7/8	1.81	5/16 -0.000236 0 -0.000669	1 0 -0.00205	0.1	7/16	1.42	5/16-18UNC Depth 0.31	0.2	5/16	0.79	0.59	6.14 (7.44)	3.86	4.65	0.62	0.67	0.33	0.33	0.51	1.3	0.53	0.47	0.55	1.34	1/8	+0.001 0	1
NCDRA1BS63-00-A00	1/8	2.99	2 3/8	2.24	3/8 -0.000236 0 -0.000669	1 1/8 0 -0.00244	0.1	1/2	1.61	3/8-16UNC Depth 0.47	0.2	3/8	0.87	0.67	6.89 (8.41)	4.61	5.47	0.70	0.79	0.39	0.39	0.55	1.3	0.57	0.47	0.83	1.34	3/16		1.25
NCDRA1BS80-00-A00	1/4	3.62	2 7/8	2.76	3/4 -0.000276 0 -0.000787	1 3/8 0 -0.00244	0.12	5/8	1.97	1/2-13 UNC Depth 0.51	0.2	3/4	0.98	0.79	7.83 (9.57)	5.59	6.57	0.83	0.93	0.47	0.47	0.71	1.3	0.61	0.47	1.14	1.34	3/8		1.5
NCDRA1BS100-00-A00	3/8	4.41	3 3/8	3.35	1 -0.000276 0 -0.000787	1 5/8 0 -0.00244	0.16	3/4	2.36	1/2-13UNC Depth 0.55	0.2	1	1.18	0.98	10.2 (12.8)	6.77	7.95	1.11	0.98	0.49	0.49	0.71	1.3	0.63	0.47	1.54	1.34	1/2		1.75

* (in parentheses) are the dimensions for rotations of 180°, 190°.

Appendix 1: How To Set Rotation Time

How To Set Rotation Time

Even a small torque generated by the rotary actuator, due to inertia of the load, can cause damage to the shaft and internal parts.

Therefore, please set rotation time taking the inertia of the load and kinetic energy into consideration. (The values of kinetic energy in lists ①, ②, and diagram ① will be very helpful in setting the rotation time.)

List ①: Allowable Dynamic Load

Model	Kinetic energy in-lbs.		Effective cushion range
	w/o cushion	*w/cushion	
NCRA1BW30	0.08	—	—
NCRA1○50	0.43	8.7	35°
NCRA1○63	1.0	13	35°
NCRA1○80	1.4	17	35°
NCRA1○100	4.8	26	35°

*Kinetic energy w/cushion is max. absorbable energy for optimum adjustment of the cushion needle valve.

List ②: Stable Rotation Time Regulation Range

Model	Rotation time (sec/90°)*
NCRA1BW30	0.2~1
NCRA1○50	0.2~2
NCRA1○63	0.2~3
NCRA1○80	0.2~4
NCRA1○100	0.2~5

*Excessive rotation time may cause sticking.

How to Calculate Energy of the Load

$$E = \frac{1}{2} \cdot J \cdot \omega^2$$

E: Kinetic energy (in-lbs)
J: Moment of inertia (in·lbs·s²)

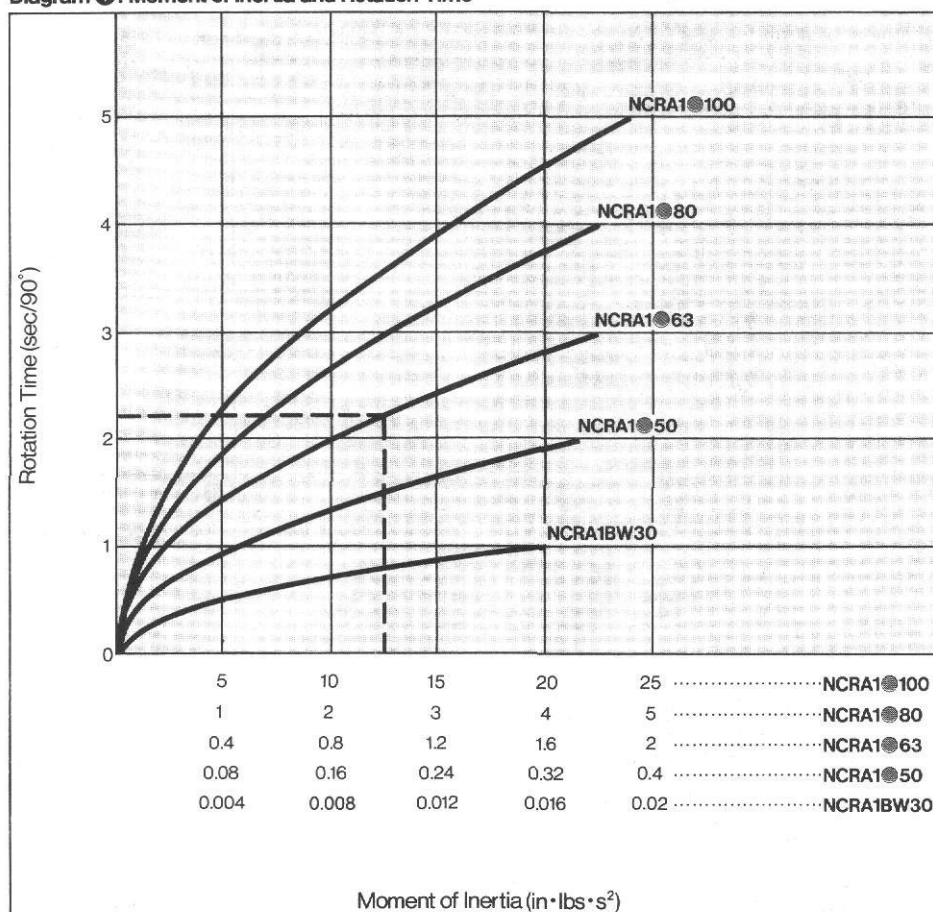
$$\omega = \frac{2\theta}{t}$$

* ω : Rotation speed (rad/s)
 θ : Rotation (rad)

$$180^\circ = 3.14 \text{ rad}$$

$$t: \text{Rotation time (s)}$$

Diagram ①: Moment of Inertia and Rotation Time



<How to read graph>

Setting the rotation time for a 1 in·lbs·s² moment of inertia load: Vertically draw a line from the value, 1 in·lbs·s² on the horizontal axis, to the intersection point with the graph of NCRA1○63. From this point horizontally draw a line, which indicates a rotation time of 2.2 sec/90°. Set the operating speed slower than 2.2 sec/90°.

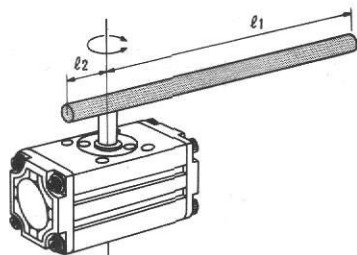
Appendix 2:How To Calculate a Moment of Inertia

Calculating a Moment of Inertia

J: Moment of inertia in-lbs-s² W: Weight of load lbs. g: Acceleration due to gravity 386 in/s².

1 Thin rod

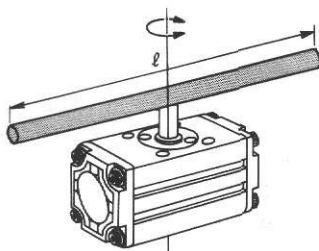
Position of pivot: Passes through one end perpendicular to the rod.



$$J = \frac{W_1}{g} \cdot \frac{l_1^2}{3} + \frac{W_2}{g} \cdot \frac{l_2^2}{3}$$

2 Thin rod

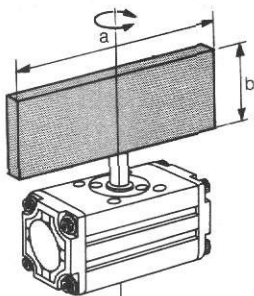
Position of pivot: Passes through the center of gravity perpendicular to the rod.



$$J = \frac{W}{g} \cdot \frac{l^2}{12}$$

3 Rectangular plate

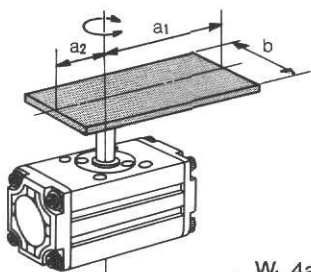
Position of pivot: Passes through the center of gravity, parallel to side b.



$$J = \frac{W}{g} \cdot \frac{a^2}{12}$$

4 Rectangular plate

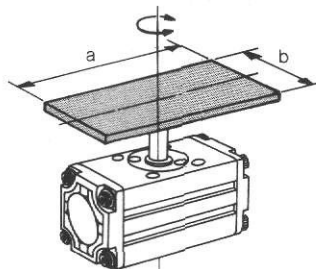
Position of pivot: Passes through one end perpendicular to the plate.



$$J = \frac{W_1}{g} \cdot \frac{4a_1^2 + b^2}{12} + \frac{W_2}{g} \cdot \frac{4a_2^2 + b^2}{12}$$

5 Rectangular plate

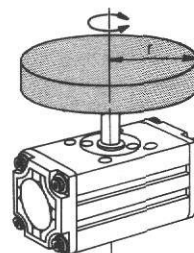
Position of pivot: Passes through the center of gravity perpendicular to the plate. (inclusive of rectangular parallelepiped)



$$J = \frac{W}{g} \cdot \frac{a^2 + b^2}{12}$$

6 Column (inclusive of thin disc)

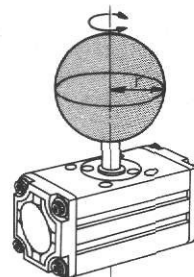
Position of pivot: Axis



$$J = \frac{W}{g} \cdot \frac{r^2}{2}$$

7 Solid globe

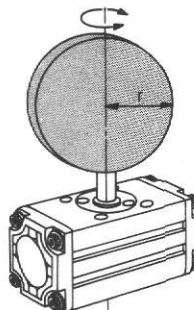
Position of pivot: Diameter



$$J = \frac{W}{g} \cdot \frac{2r^2}{5}$$

8 Thin disk

Position of pivot: Diameter



$$J = \frac{W}{g} \cdot \frac{r^2}{4}$$

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