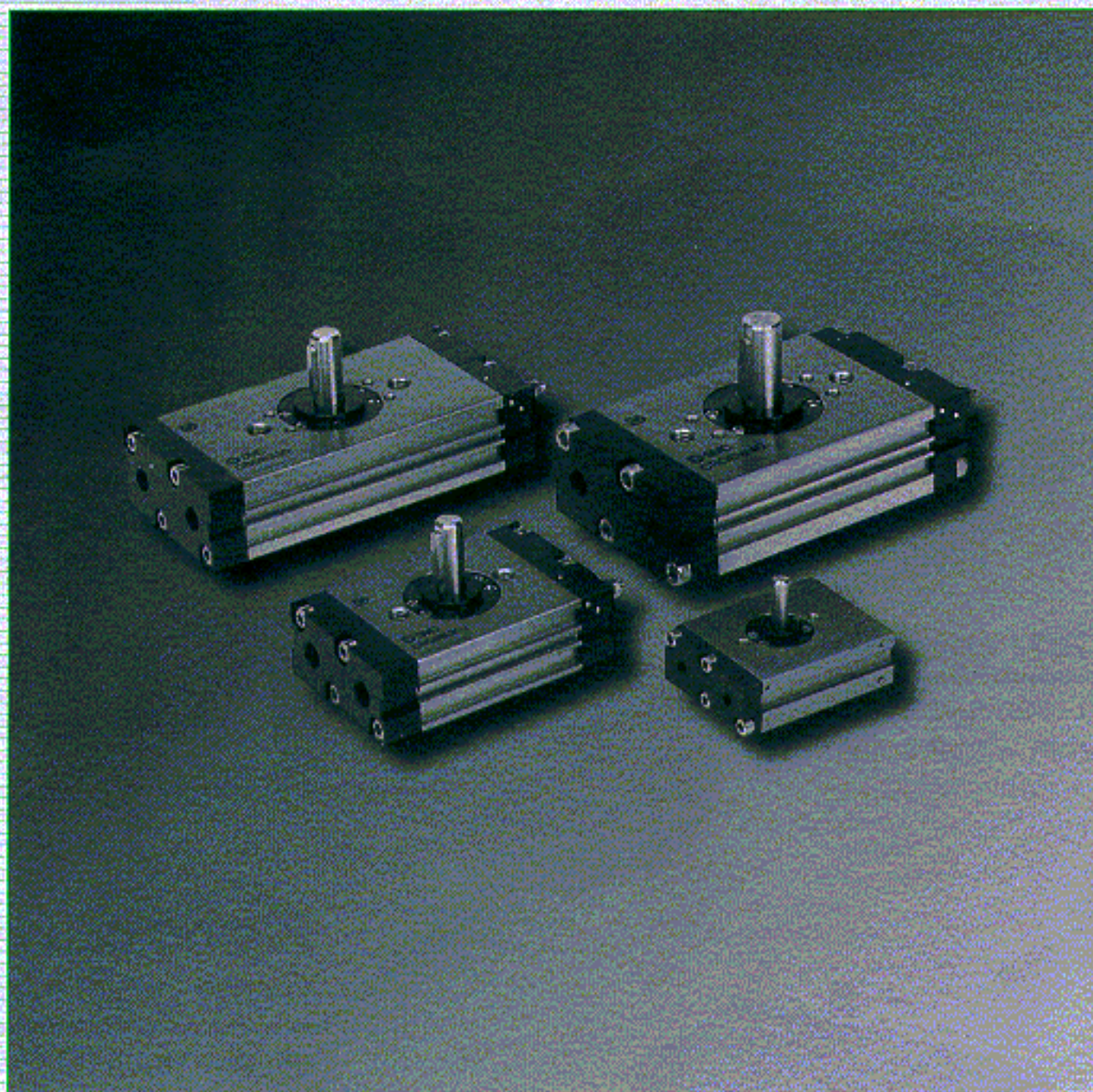




Rotary Actuator

NCRQ Series

Rack and Pinion Model



Compact Double Rack Design Eliminates Backlash
Body can be Mounted as Flange
Stainless Steel Shaft
Rotation Adjustment is Standard
Auto Switch Capable

Compact Rotary Actuator

Series NCRQ Rack and Pinion Model

Body can be mounted as flange

Requires 6-32 UNC bolt.
Hard alumite aluminum body for corrosion resistance and wear protection.

Double piston

Compact carbon steel (stainless with D option)
Single piece piston/rack design eliminates backlash and increases strength.
Wearband standard.

Stainless steel shaft

Increased wear characteristics and corrosion resistance.

Auto switch option

State-of-the-art reed and solid state switches available with 2 color indicator lamp.

Piping can be done from one side

Simplified piping equals space savings.

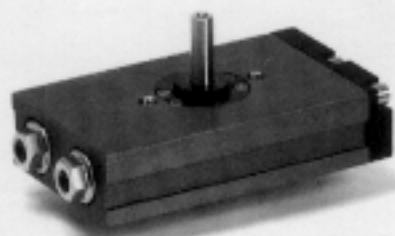
Built-in rubber bumper

Standard feature for noise reduction and longer life.

Rotations adjustment

Adjustable $\pm 5^\circ$ in either rotation on 90° and 180° rotations for increased flexibility.

How To Order



NCRQBW 10-90

Bore •

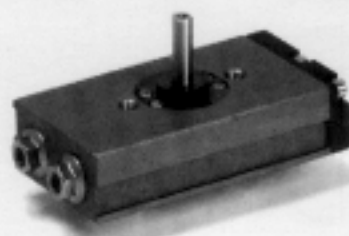
Bore size	Nom. Torque
10mm	3/8 inch (2.6 in-lbs)
15mm	5/8 inch (6.5 in-lbs)

*at 70 PSI supply pressure

• Rotation

90 - 90°

180 - 180°



Auto Switch Capable

NCDRQBW 10-90-A73 S

Auto Switch •

D -with auto switch capability(built in magnet)

Bore •

Bore size	Nom. Torque
10mm	3/8 inch (2.6 in-lbs)
15mm	5/8 inch (6.5 in-lbs)

*at 70 PSI supply pressure

• Rotation

90 - 90°

180 - 180°

• Applicable auto switch/Mounting rail type
- - Without auto switch

Reed Switch

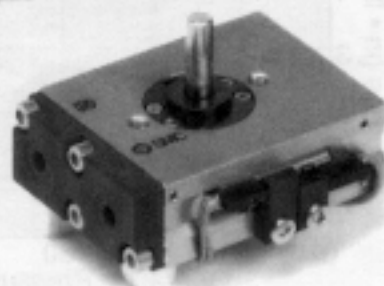
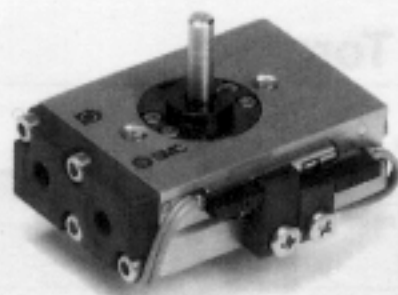
A72	D-A72
A73	D-A73
A73C	D-A73C
A73H	D-A73H
A76H	D-A76H
A80	D-A80
A80C	D-A80C
A80H	D-A80H

Solid State Switch

J79	D-J79
J79C	D-J79C
F79	D-F79C
F7BV	D-F7BV
F7NV	D-F7NV
F7P	D-F7P
F7PV	D-F7PV
2-color	
F79F	D-F79F
F7LF	D-F7LF

Note 1) Add "L" at the end of part number for 3m lead wire.
Example: A73-D-A73L

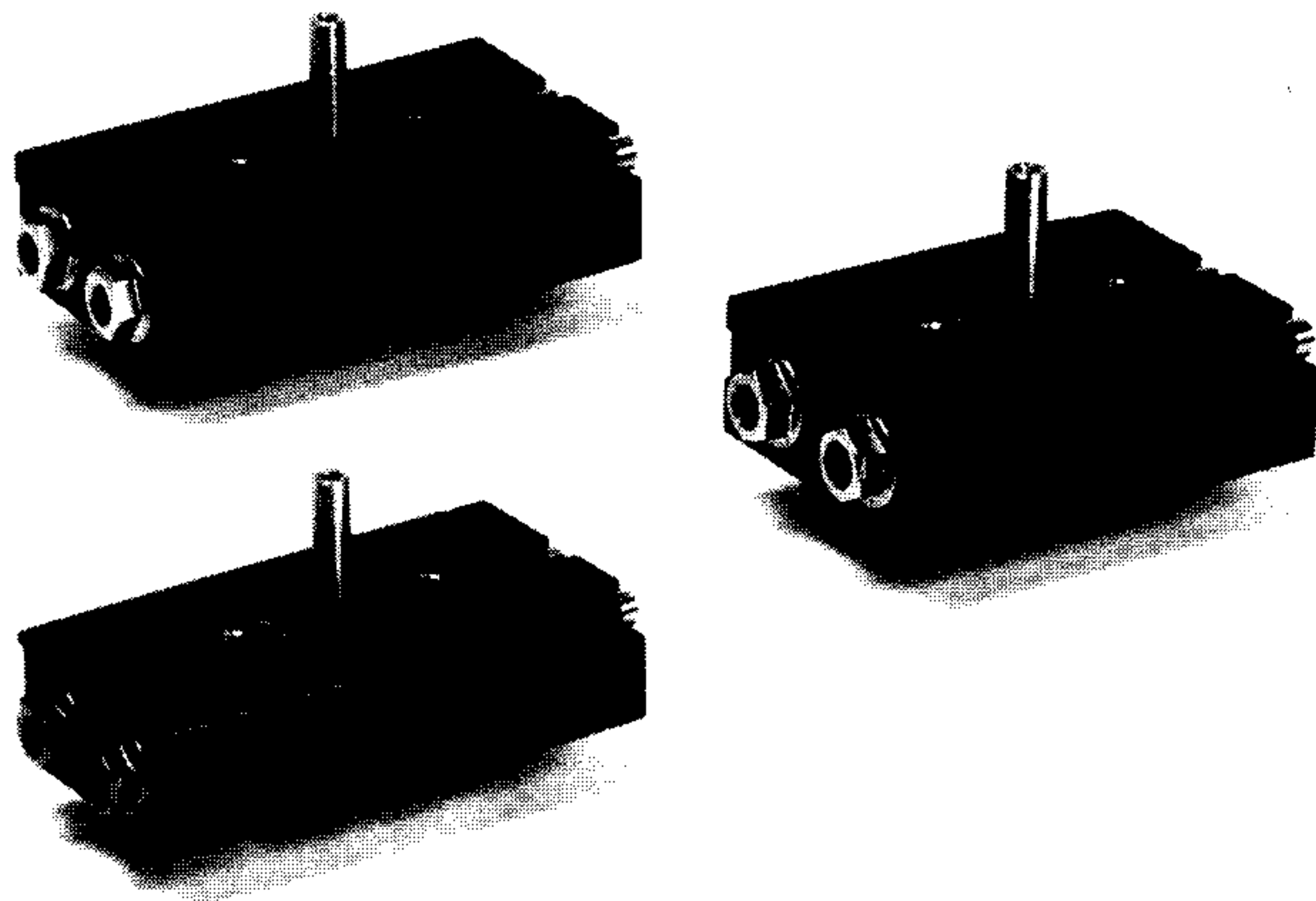
Note2) Please contact us for 2-color display not specified above.



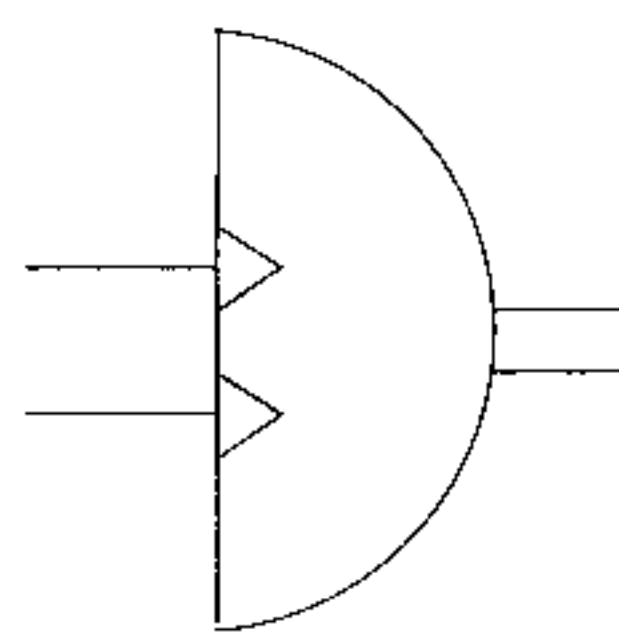
Auto Switch	Mounting Kit
All	NCD-M3

Series NCRQ: Index

How To Order	P. 3	Operational Instructions/Precautions	P. 8
Specifications	P. 4	With Auto Switch/Dimensions	P. 9
Dimensions	P. 5	Construction/Parts List	P. 10
With Auto Switch/Auto Switch Specifications	P. 6	How To Set Rotation Time	P. 11
Auto Switch Mounting Position/Auto Switch Internal			
Auto Switch Internal Circuits	P. 7		



Symbol



Specifications

Bore mm (nom. inch)	10 (3/8")	15 (5/8")
Fluid	(pre-lubricated at factory)	
Max. operating pressure	100 psig (7kgf/cm ²)	
Min. operating pressure	20 psig (1.5kgf/cm ²)	
Ambient and operating temperature	40°F~140°F (5~60°)	
Rotation	90°, 180°	
Adjustable rotation range	±5°	
Cushion	Rubber cushion	
Port size	10-32 UNF	
Mounting	Basic Type	
Force (at 70 psi supply pressure)	2.6 in-lbs	6.5 in-lbs
Shaft Axis diameter (inch)	3/16	1/4

Allowable Kinetic Energy

Model	Kinetic energy in•lbs
NCRQBW10	2.2×10^{-3}
NCRQBW15	3.5×10^{-3}

Fluid Volume

Model	Rotation	
	90°	180°
NCRQBW10	0.07	0.13
NCRQBW15	0.18	0.34

Stable Rotation Time Regulation Range

Model	Rotation time (sec)
NCRQBW10	0.2~0.7
NCRQBW15	0.2~0.7

If rotation time is slower than 0.7s/90° sticking may occur.

How To Set Rotation Time

Due to inertia, even a small torque generated by the rotary actuator can cause damage. Therefore, when adjusting rotation time, take the moment of inertia of the load and kinetic energy into consideration.

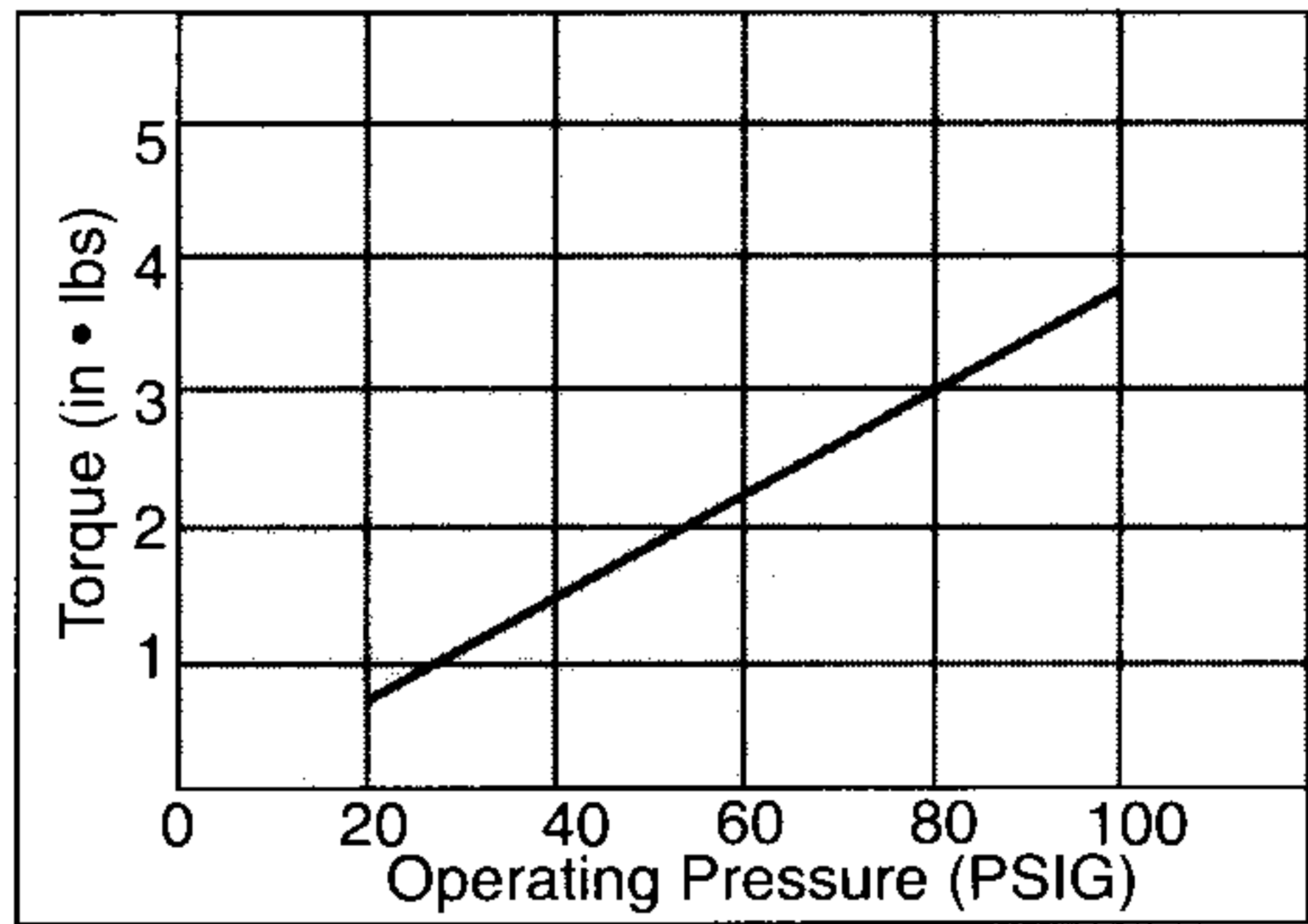
For further details, refer to the Appendices on page 10.

Weight List

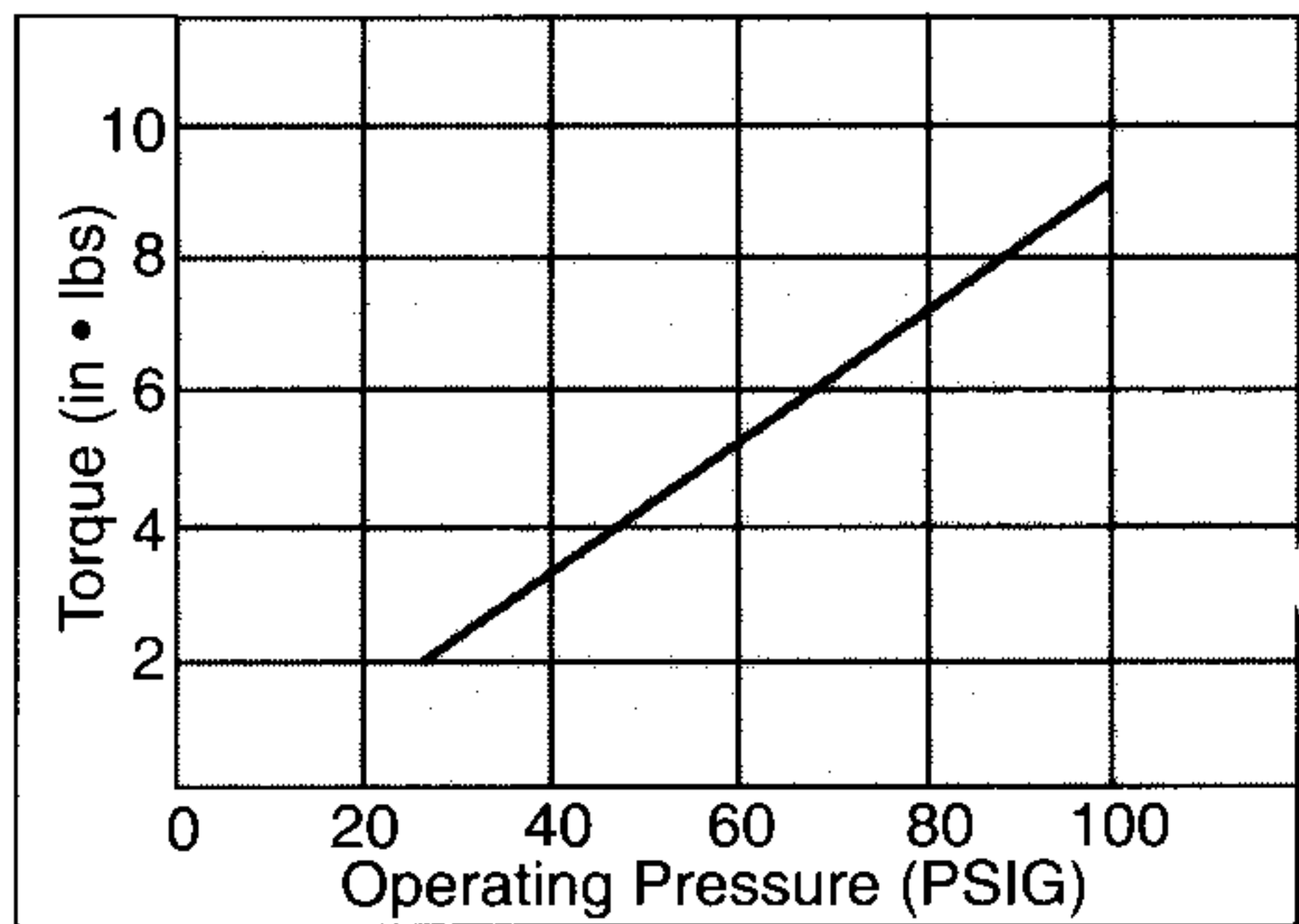
Model	Basic weight		Additional weight with auto switch
	90°	180°	
NCRQBW10	0.26	0.33	0.08
NCRQBW15	0.49	0.60	0.08

Actual Torque

NCRQBW10

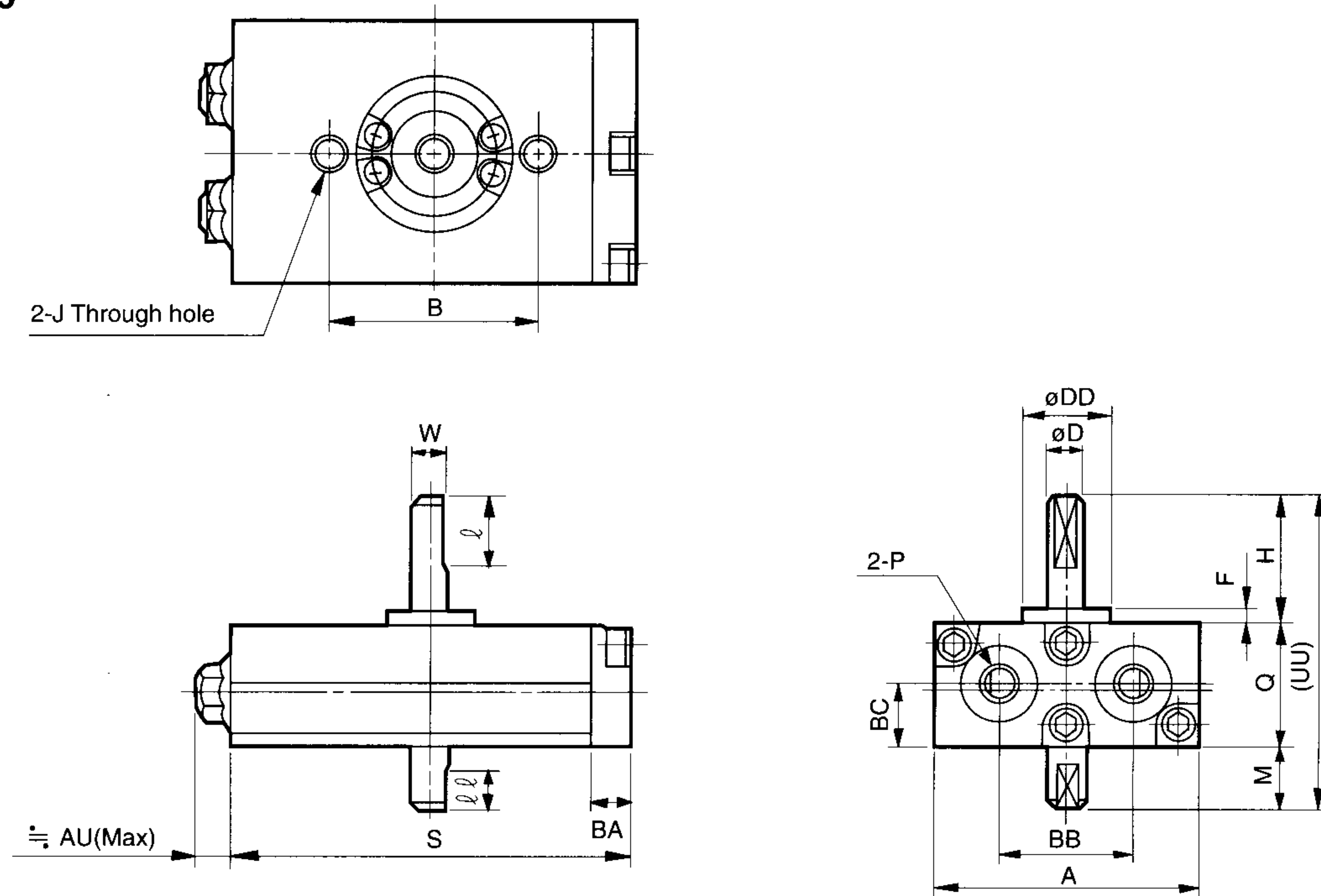


NCRQBW15



Dimensions

NCRQ1BW10•15

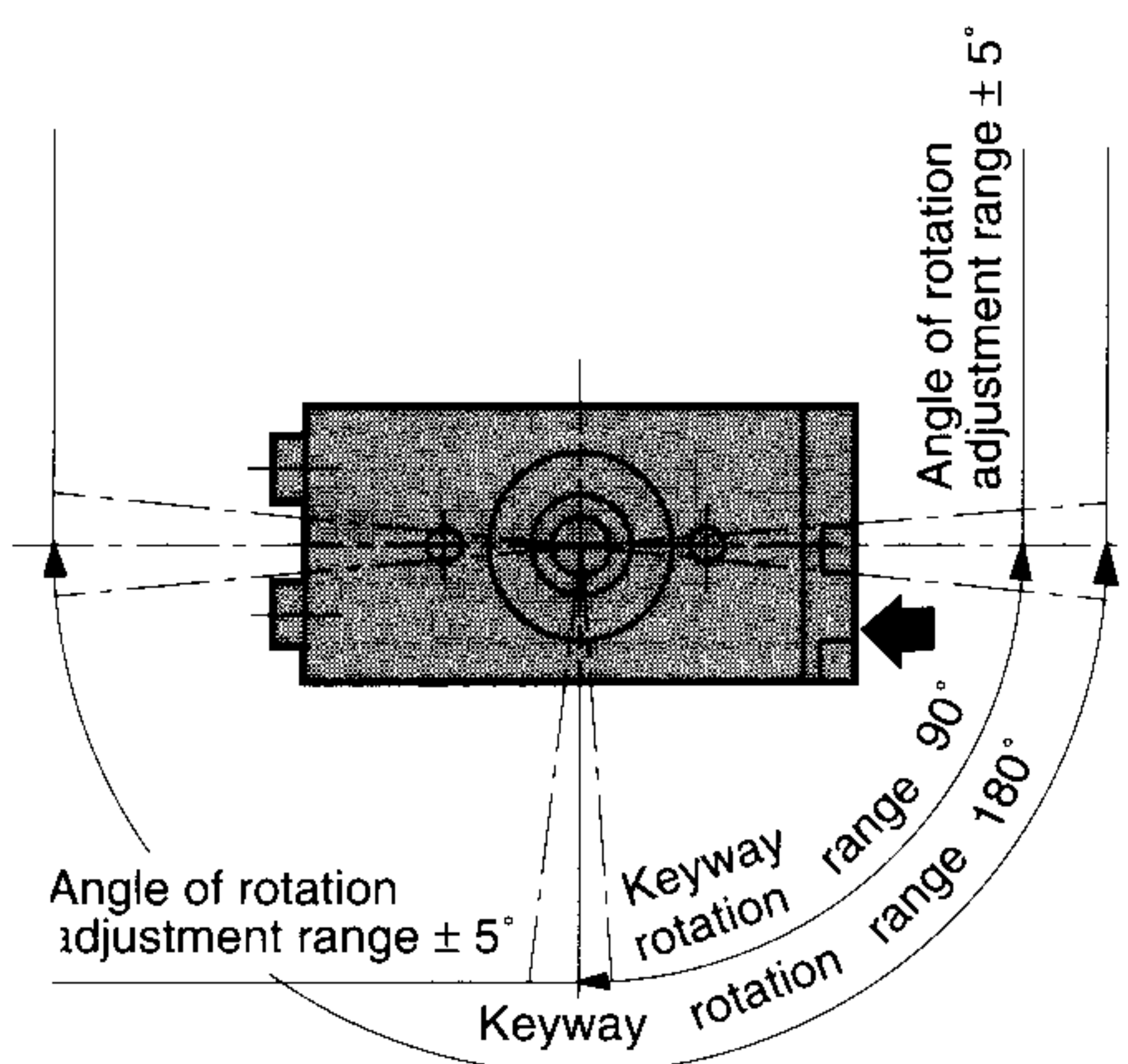


Model	A	B	BB	øDg6	øDD	F	H	J	l	ll	M	P	Q	S	(UU)	W	=AU
NCRQBW10-90	1.46	1 5/32	0.75	3/16	15/32	0.08	0.71	10-24UNC	0.39	0.24	0.35	10-32UNF	0.67	2.20	1.73	0.17	0.20
NCRQBW10-180	1.46	1 5/32	0.75	3/16	15/32	0.08	0.71	10-24UNC	0.39	0.24	0.35	10-32UNF	0.67	2.72	1.73	0.17	0.20
NCRQBW15-90	1.89	1 1/4	1.06	1/4	9/16	0.08	0.79	10-24UNC	0.39	0.28	0.39	10-32UNF	0.79	2.56	1.97	0.23	0.20
NCRQBW15-180	1.89	1 1/4	1.06	1/4	9/16	0.08	0.79	10-24UNC	0.39	0.28	0.39	10-32UNF	0.79	3.23	1.97	0.23	0.20

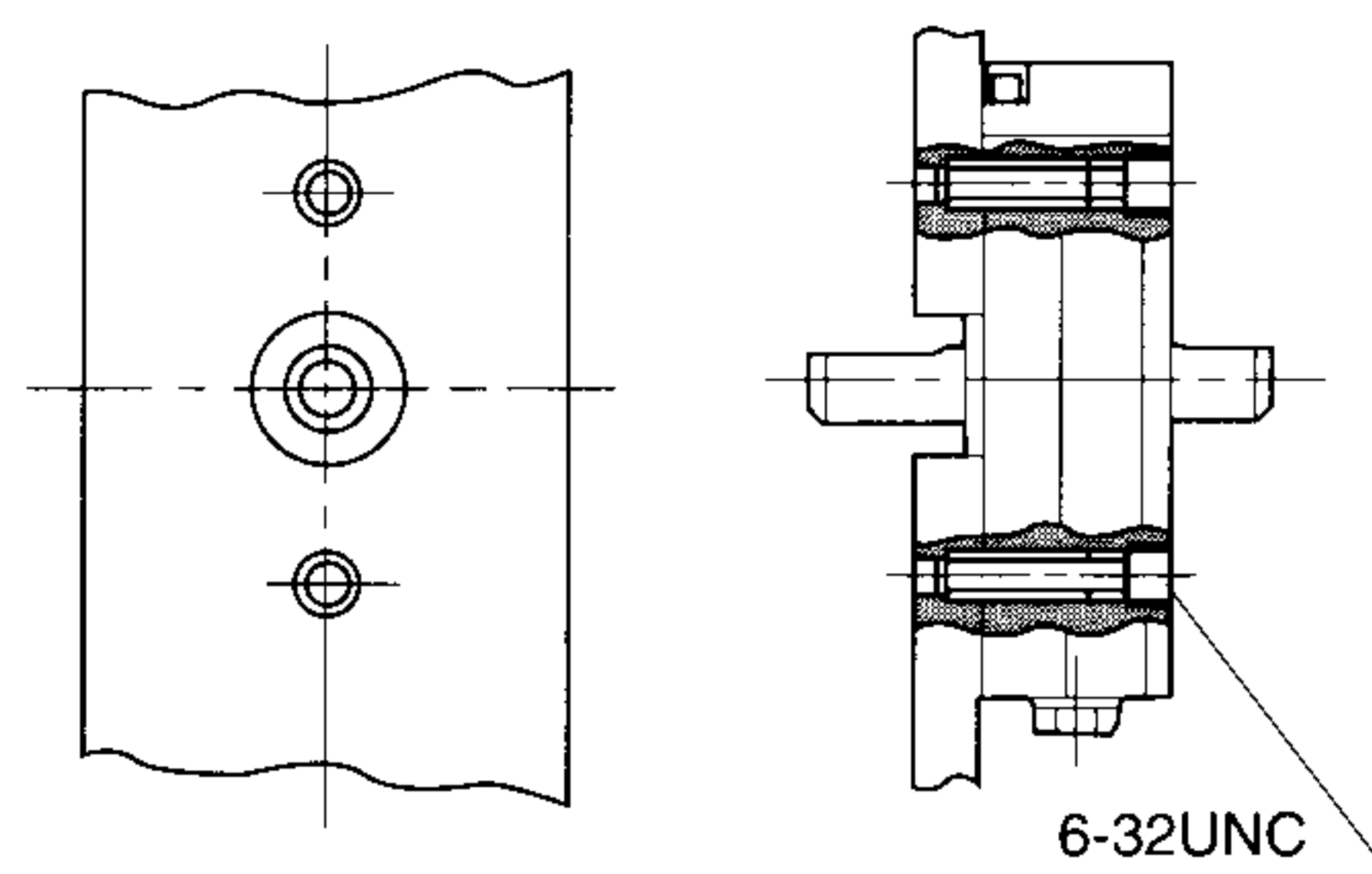
Model	BA	BC
NCRQBW10-90	0.24	0.33
NCRQBW10-180	0.24	0.33
NCRQBW15-90	0.28	0.39
NCRQBW15-180	0.28	0.39

Keyway Rotation Range

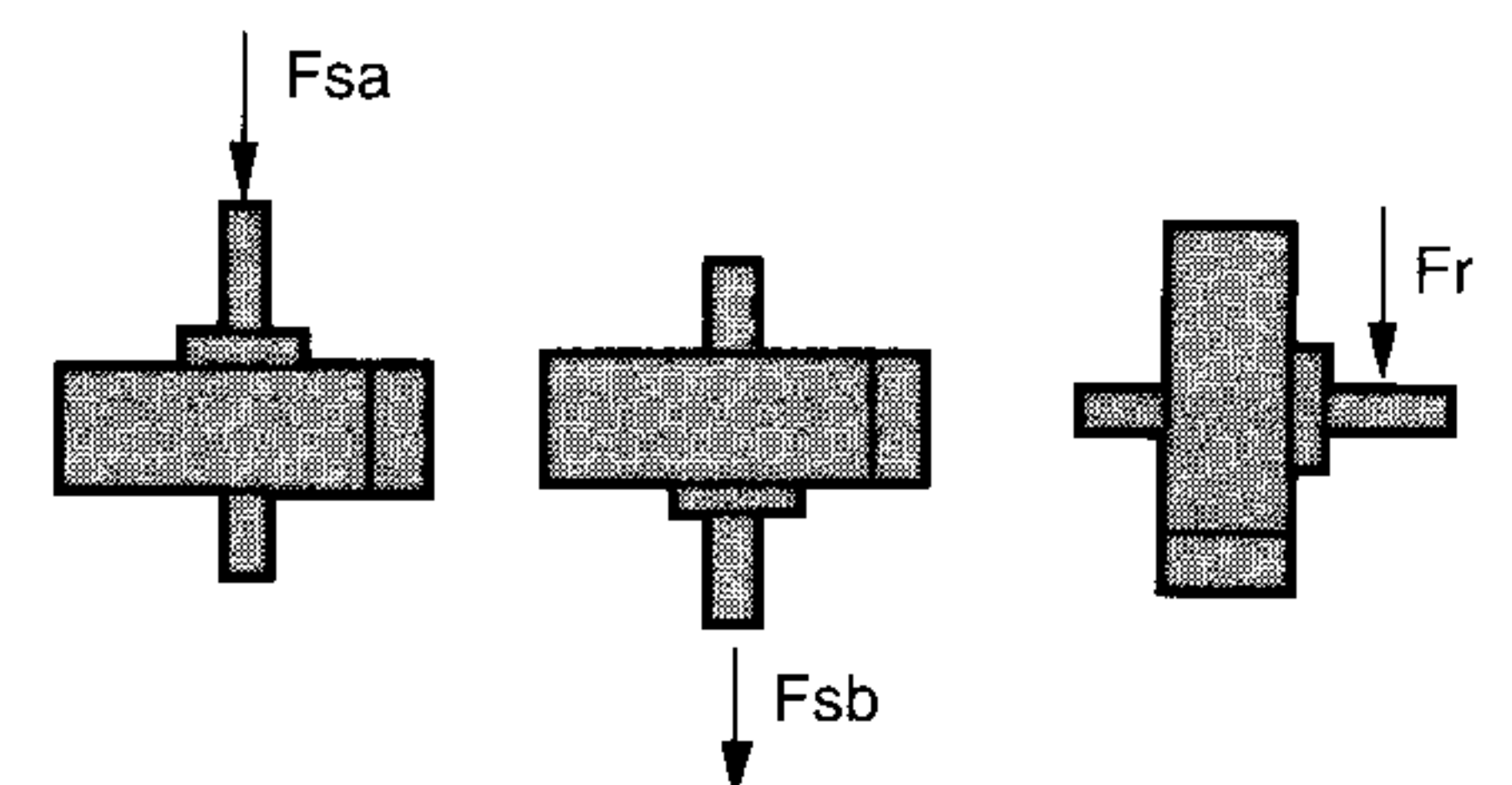
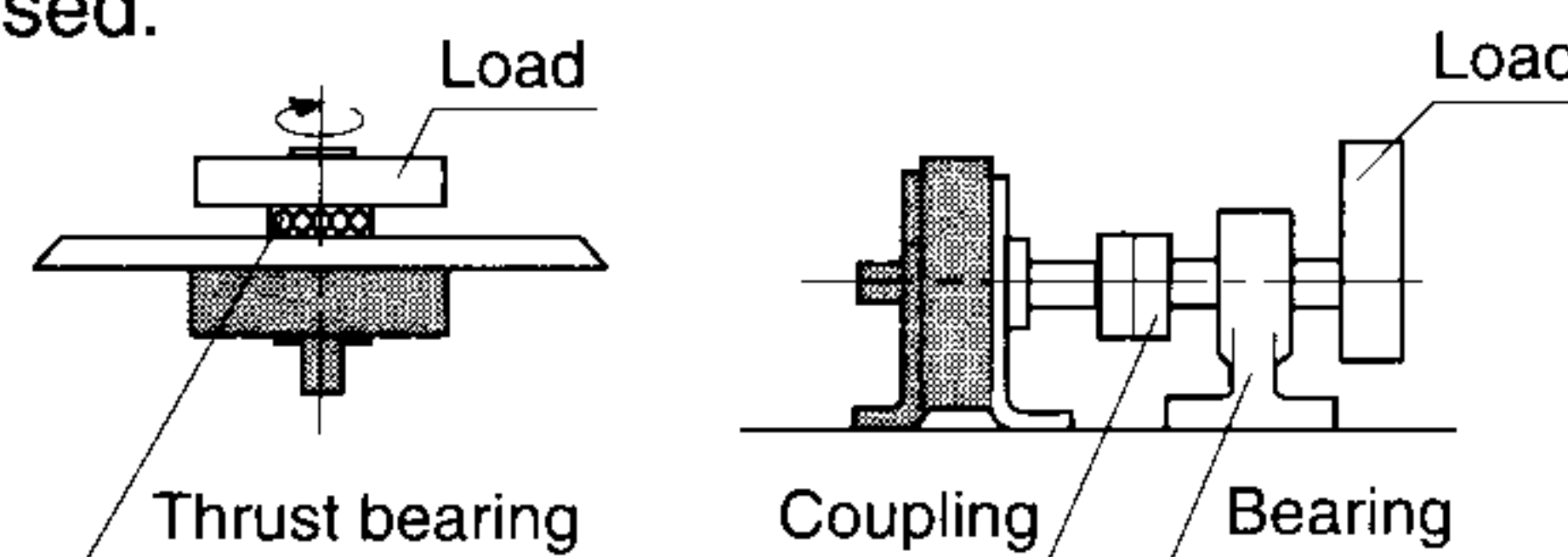
When the port with the arrow mark is pressurized, the shaft will rotate in a clockwise direction.



When The Unit Is Used As Flange Mount



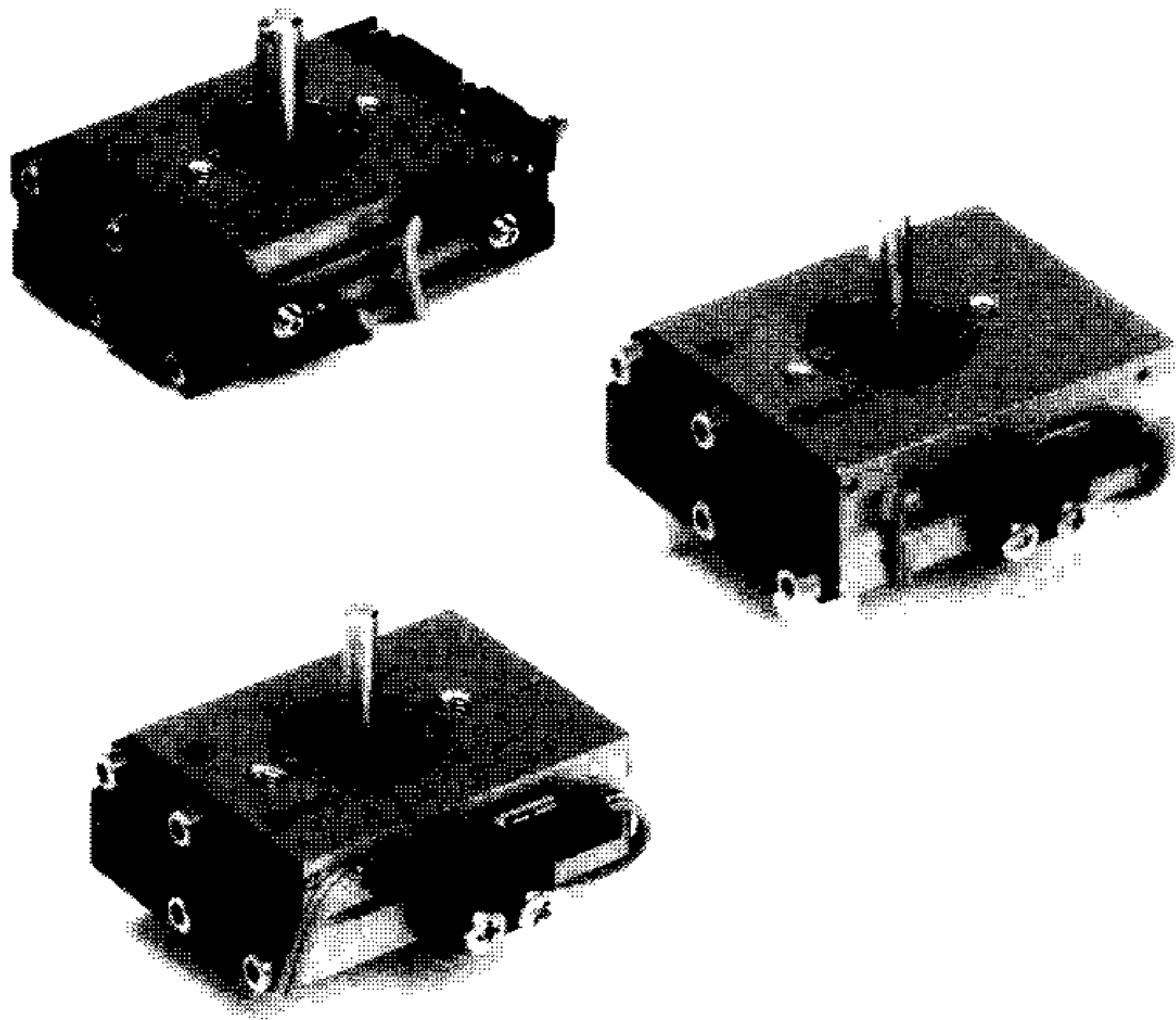
For trouble free operation, the following illustrated mounting methods should be used.



Shaft Loading

Model	Load		
	Fsa	Fsb	Fr
NCRQBW10	3.5	1.8	3.3
NCRQBW15	4.4	2.2	4.4

Auto Switch Specifications



Applicable Auto Switch Model

Type of Auto Switch	Size	Auto Switch Model	Switch Mounting Type	Electrical Entry
Reed Switch	10, 15	D-9	Direct	Grommet
		D-A7	Rail	Grommet (vertical)
		D-A8		
Solid State Switch	10, 15	D-F7/J7	Rail	Grommet (horizontal)
		D-F7 □ V		Grommet (vertical)
		D-J79C		Connector

Reed Switch

Part No.	Voltage	Max. Current or Current Range	Interval Voltage Drop	Indicator Light	Application
D-90	AC DC 5V	50mA	0	N/A	IC Circuit, Relay, Sequence Controller
	AC DC 12V				
	AC DC 24V				
D-97	DC24V	5~40mA	2.4V Max.	Available	Relay, Sequence Controller
D-A72 D-A72H	AC200V	5~10mA			
D-A73 D-A73H	DC24V	5~40mA			
	DC100V	5~20mA			
D-A76H	DC4~8V	20mA		IC Circuit	
D-A80 D-A80H	AC DC 24V	50mA	0	N/A	IC Circuit, Relay, Sequence Controller
	AC DC 48V	40mA			
	AC DC 100V	5~20mA			
D-A73C	DC24V	5~40mA	2.4V Max.		Relay, Sequence Controller
D-A80C	AC DC 24V	50mA	0		IC Circuit, Relay, Sequence Controller

Solid State Switch

Auto Switch Model No.	Wiring Output	Voltage	Current (mA)	Voltage	Internal Voltage Drop @ 10mA	Indicator Light	Application
D-F79/F7NV	3 wire NPN	DC5~24V	12	DC28 Max.	0.8V Max.	Available, light up red, color emitted diode when energized	IC Circuit, Relay, Sequence Controller
D-F7P/F7PV	3 wire PNP		15	—			
D-J79/F7BV	2 wire	—	—	DC24V (DC10~28V	3V Max.		DC24V Relay, Sequence Controller
D-J79C							
D-F79F	4 wire NPN	DC5~24V	10	DC28V Max.	0.8V Max.	Operating position (red color emitted diode is lighted) most suitable operating position (green color emitted diode is lighted)	IC Circuit, Relay, Sequence Controller
D-F7LF		DC24V	20			Relay, Sequence Controller	

Auto Switch Applicable Mounting Position

NCRQ1BW10•15



D-A7, D-A8, D-F7-J7

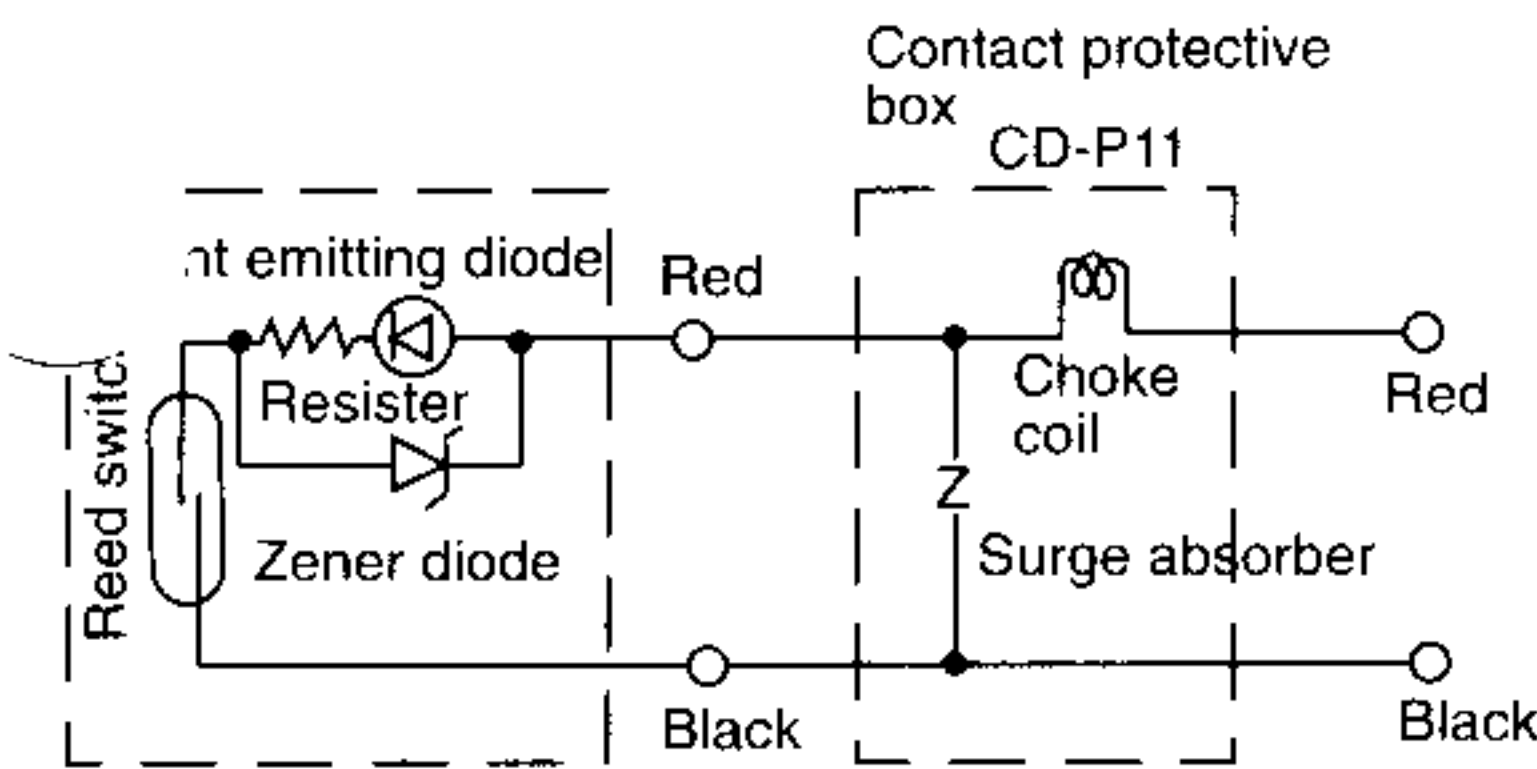
D-90-97

Model	Rotation	D-A73 Model • A80 Model			D-F7 • J7 Model			D-90 • 97 Model			
		A	Rotation Range	Differential Response	A	Rotation Range	Differential Response	A	B	Rotation Range	Differential Response
CDRQBW10	90	14.5	100°	20°	14.5	100°	20°	2	12	115°	25°
	180	18			18			6	22		
CDRQBW15	90	18.5			18.5			6	17	100°	20°
	180	22.5			22.5			10	30		

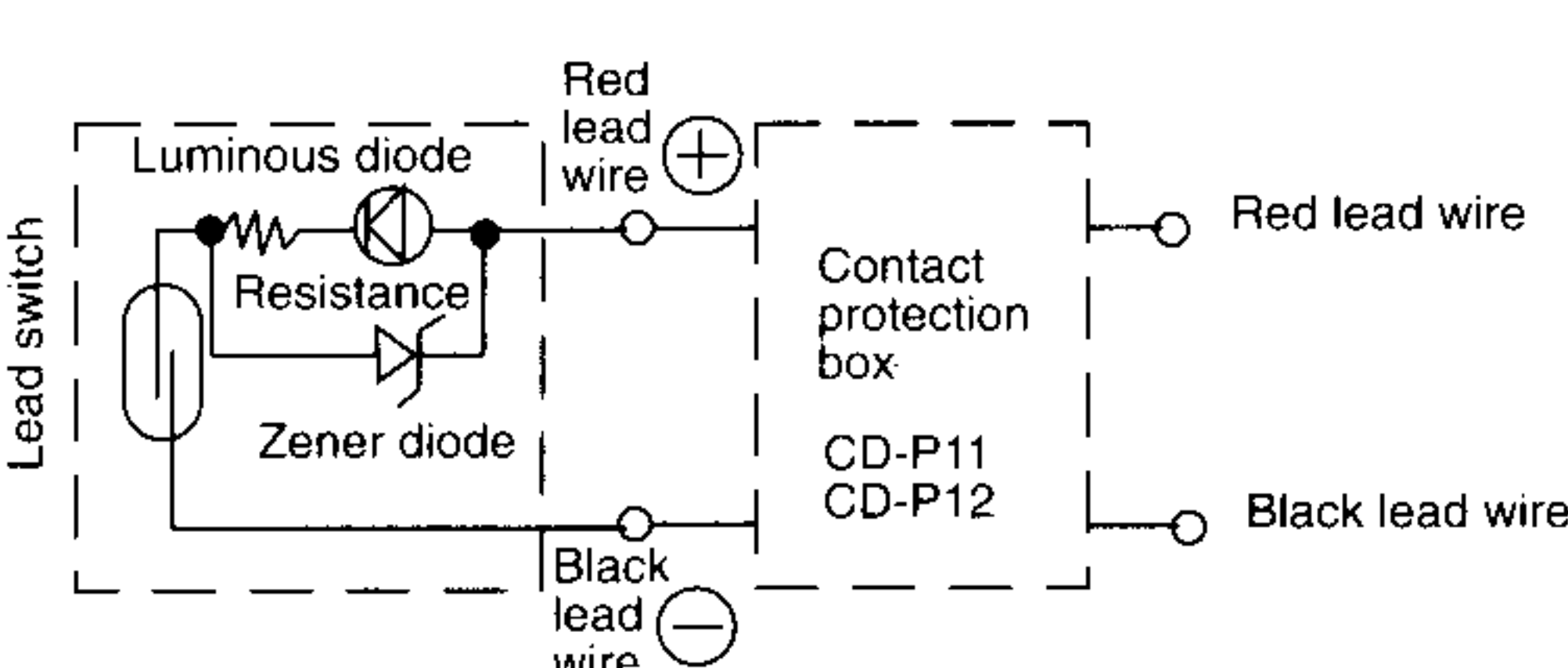
- Dimensions are not for mounting position used during shipping, but for the most sensitive auto switch position.
- Rotation Range: available angle range for a switch
- Switch Actuation Range (Differential Response): available actuation angle range for a switch .
- *Please contact SMC for an auto switch not specified above.

Auto Switch Internal Circuit

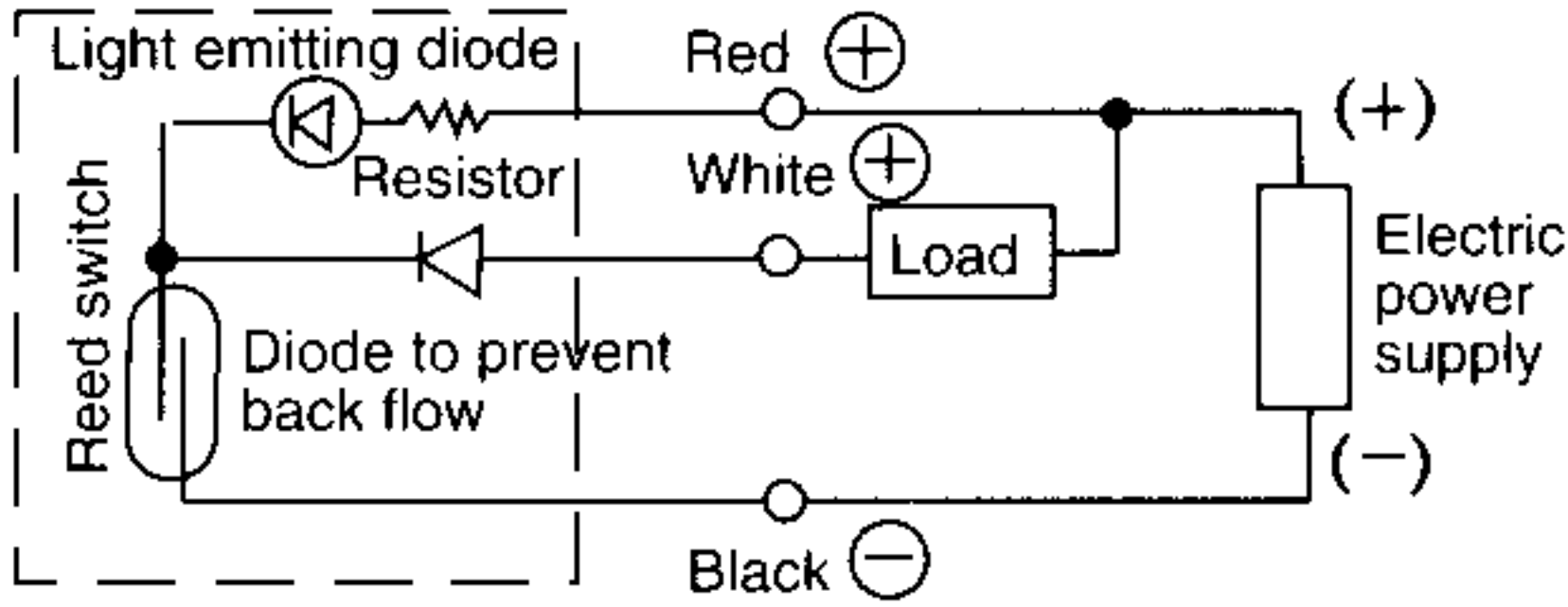
D-A72



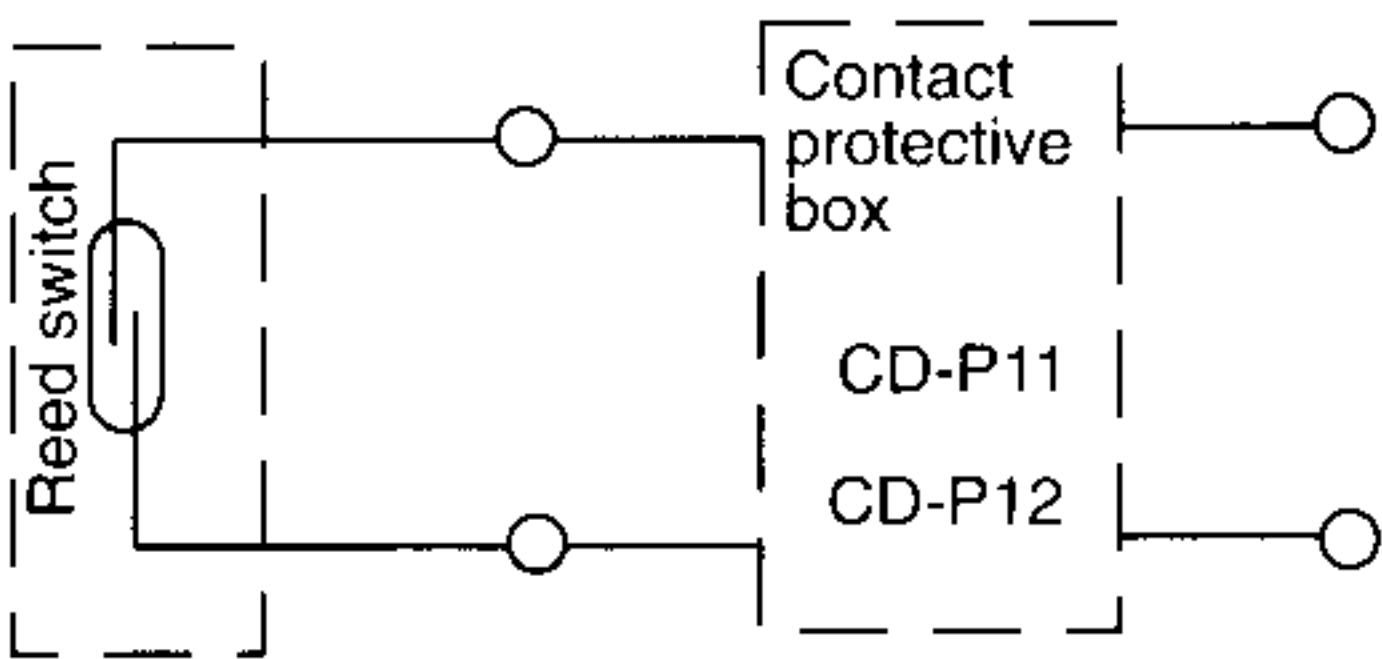
D-A73, D-A73H



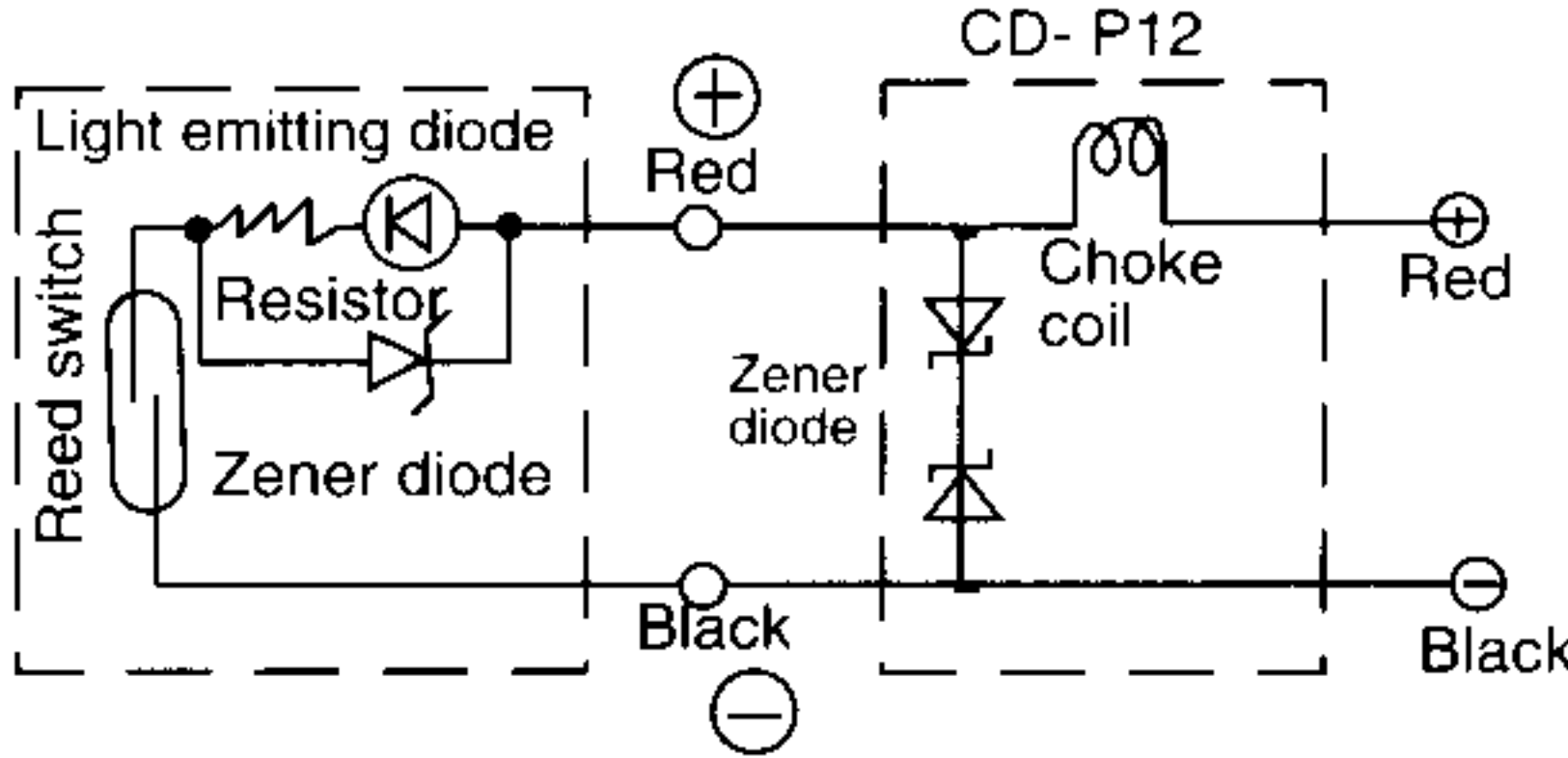
D-A76H



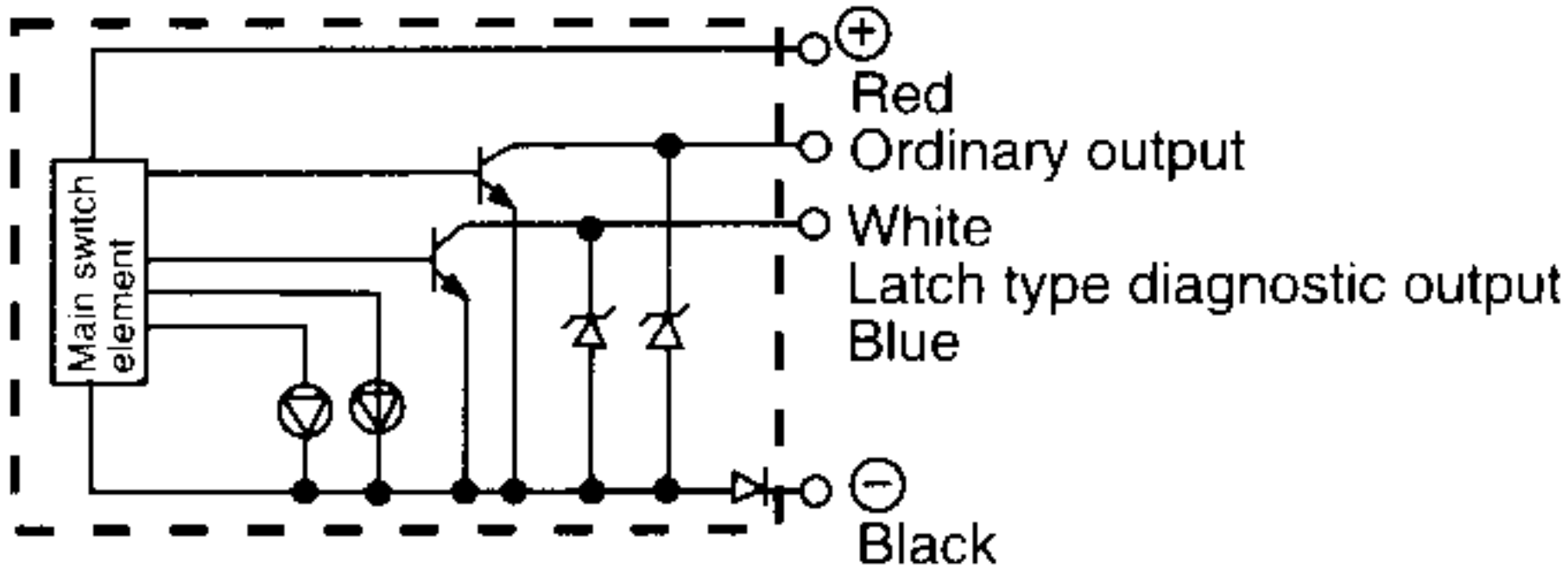
D-A80, D-A80C, D-A80H, D-90



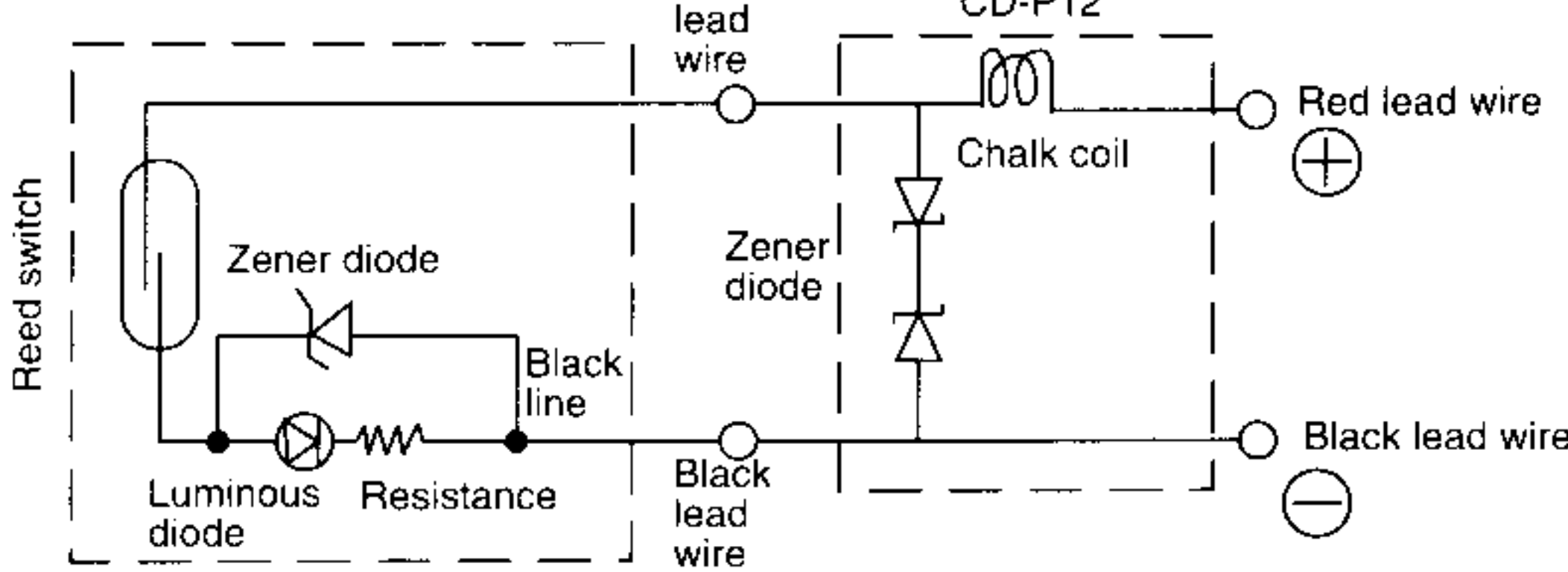
D-A73C



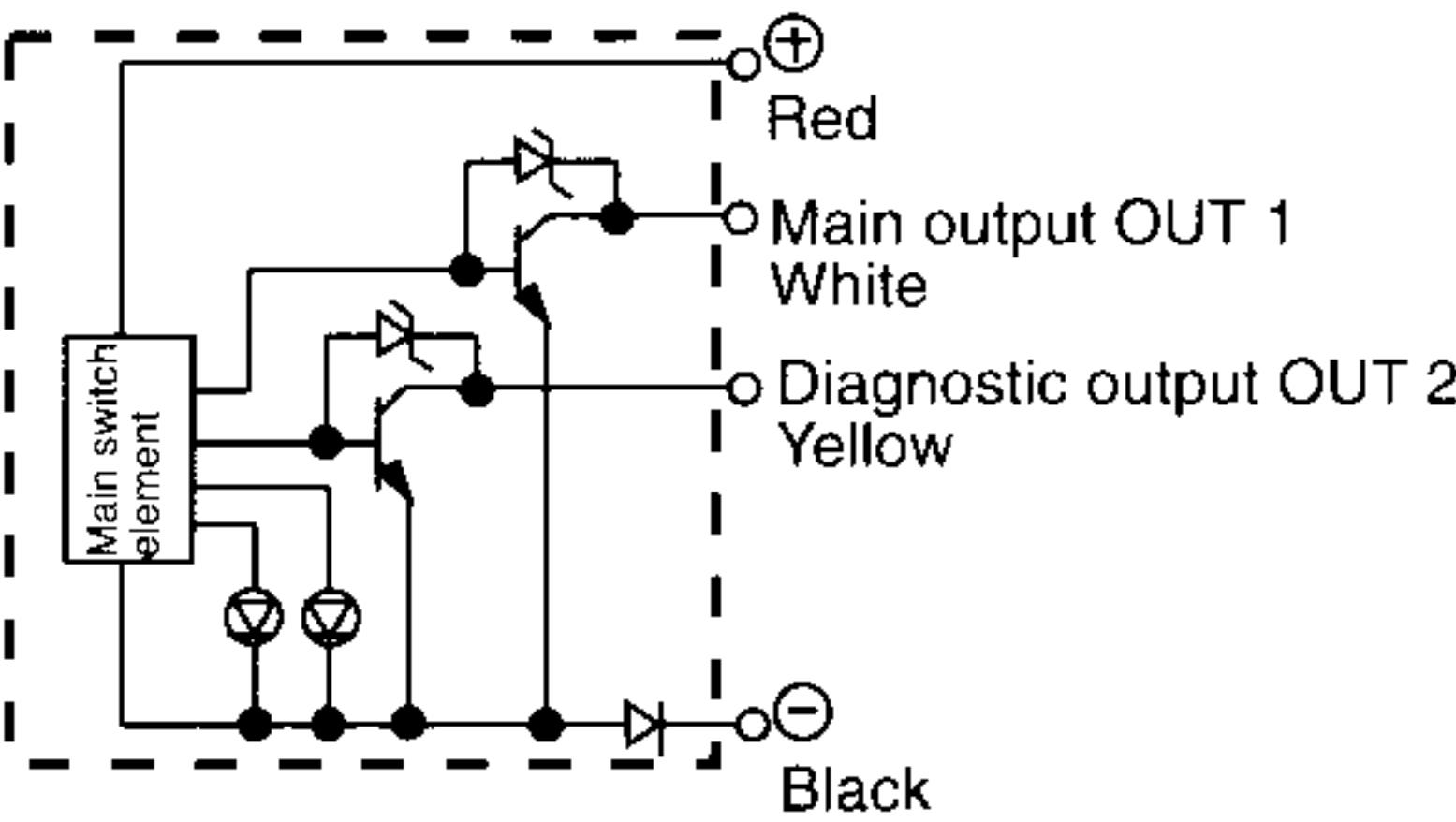
D-F7LF



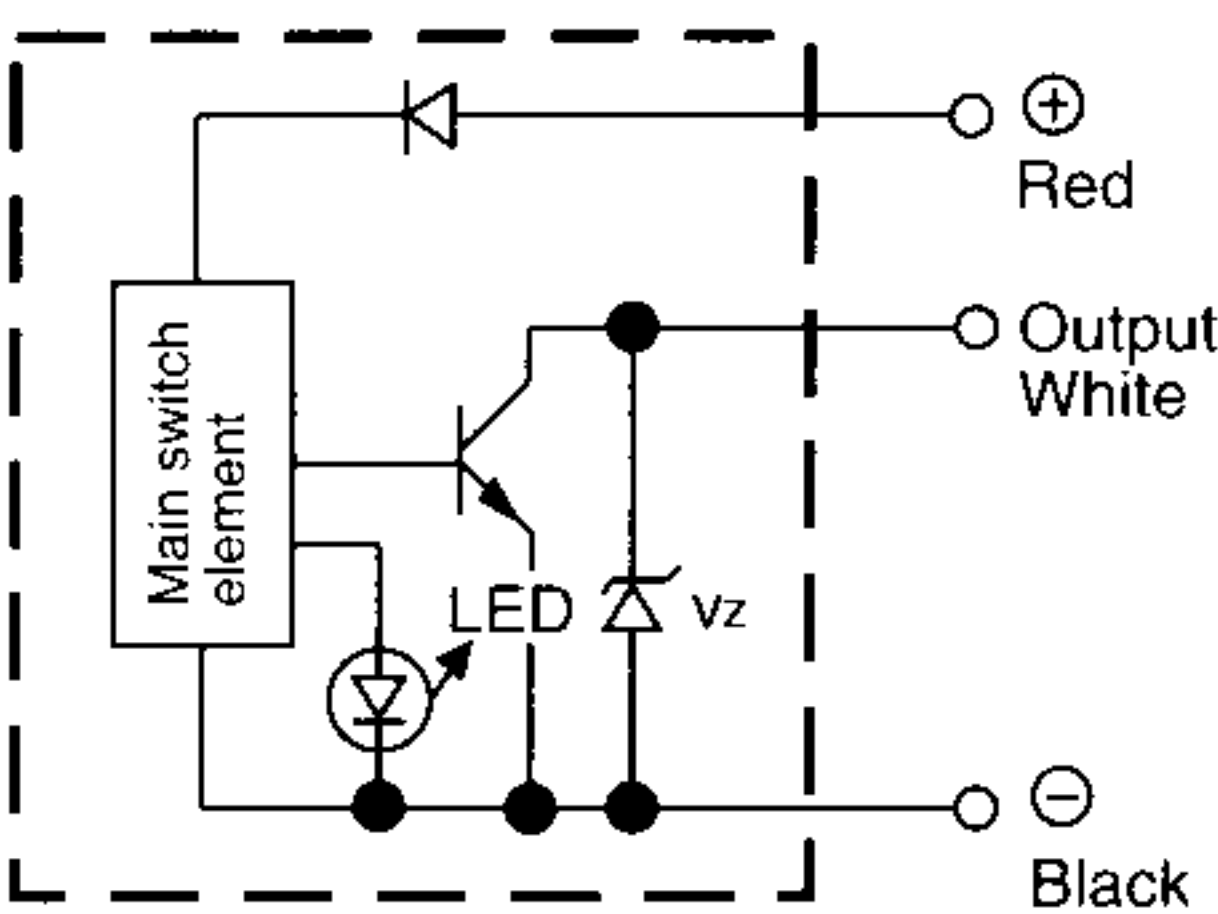
D-97



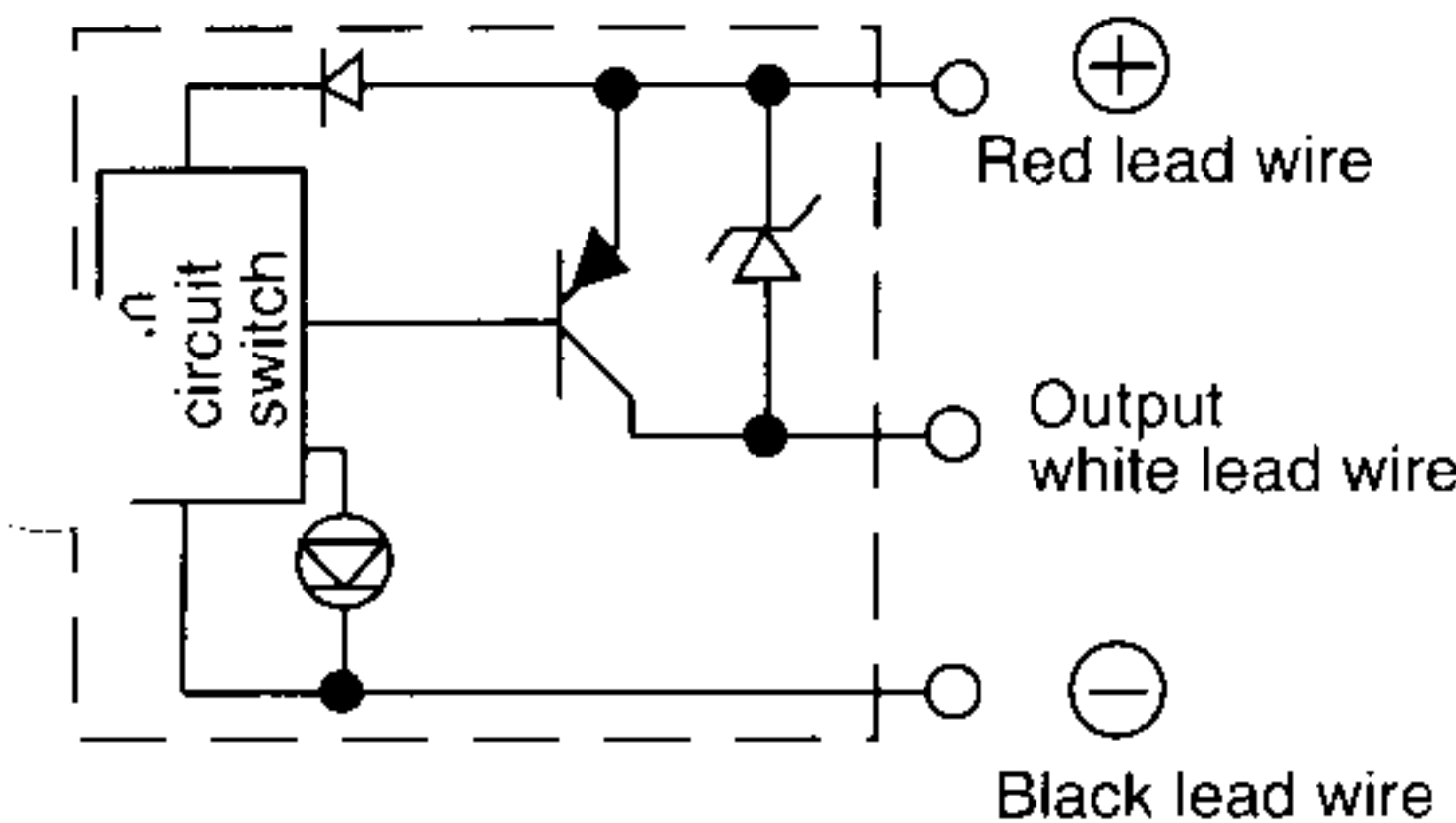
D-F79F



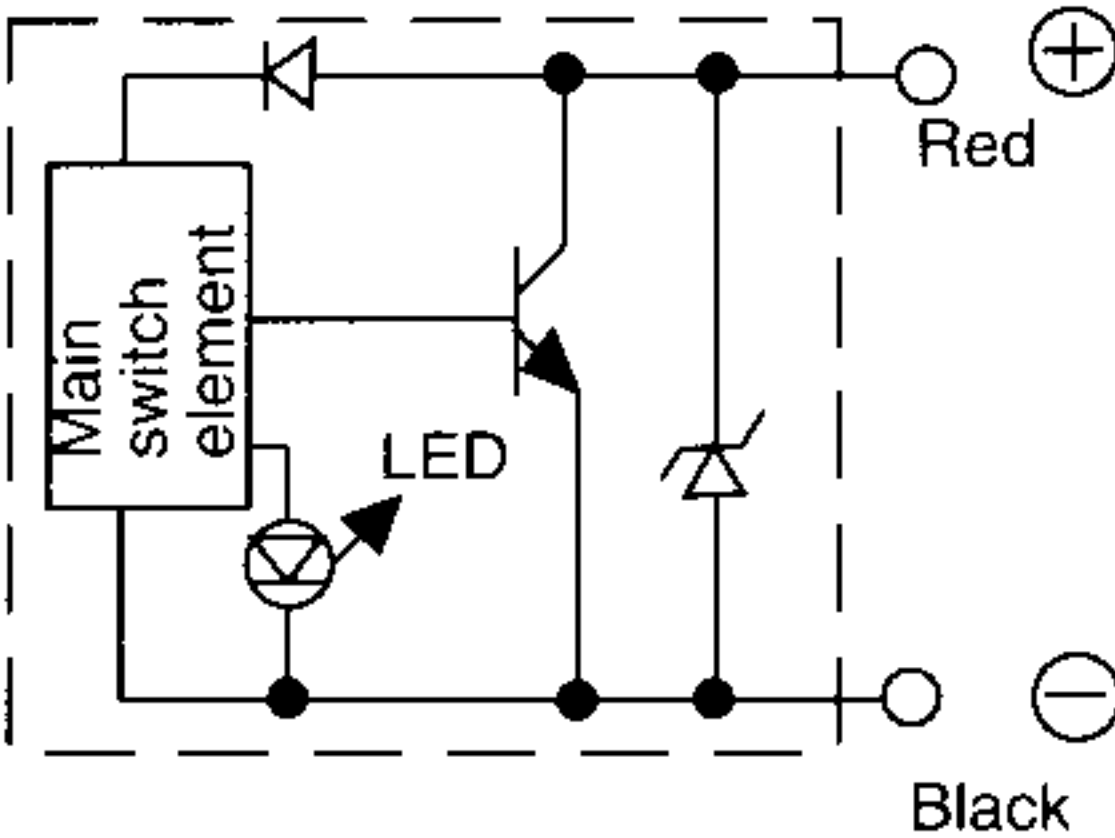
D-F79, D-F7NV



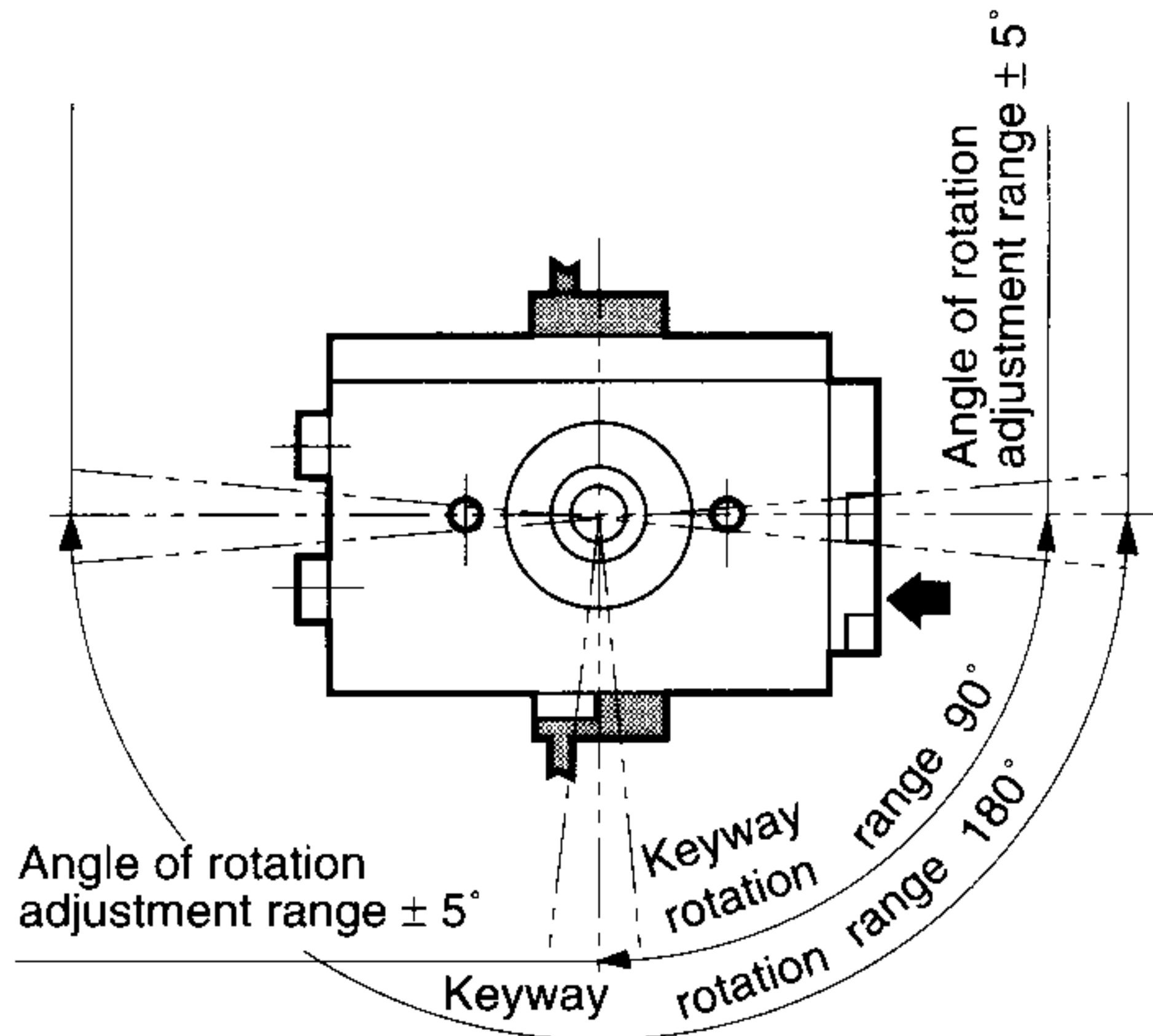
D-F7P, D-F7PV



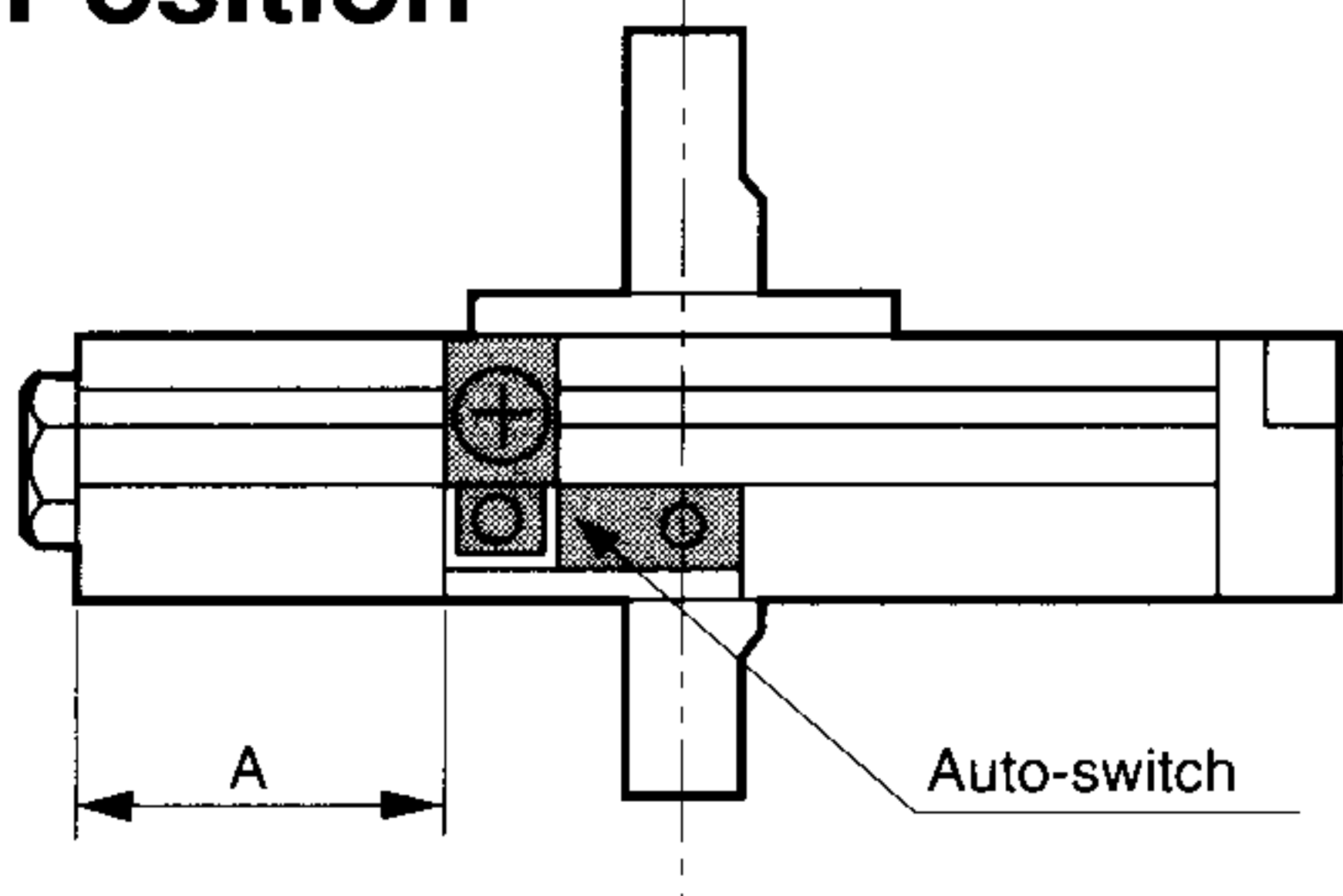
D-J79, D-J79C, D-F7BV



Key Rotation Range And Auto Switch Mounting Position



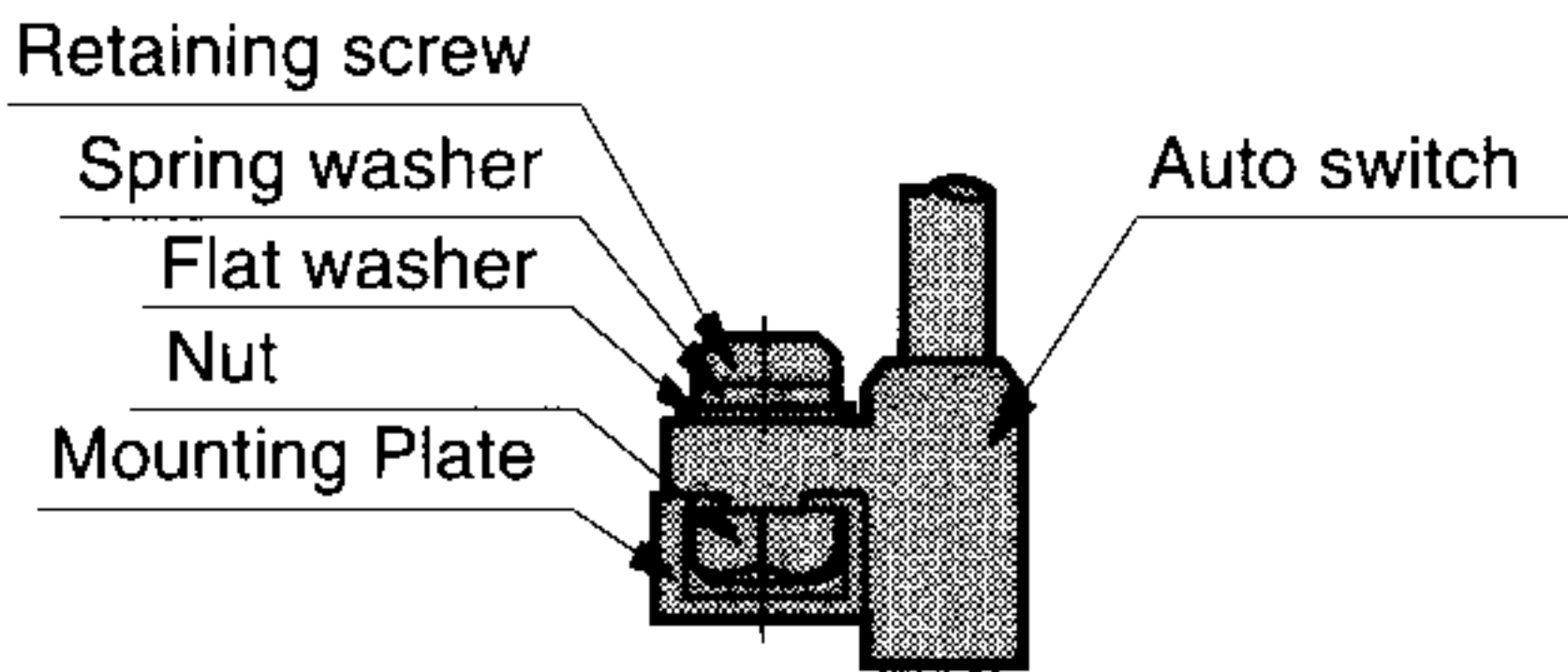
Auto Switch Mounting Position



Bore (mm)	A (inch)	Rotation range	Switch actuation range
10	0.65 (0.91)	100°	20°
15	0.79 (1.12)	100°	10°

*Dimensions in parentheses are for 180° rotation.

Auto Switch/How To Change Position



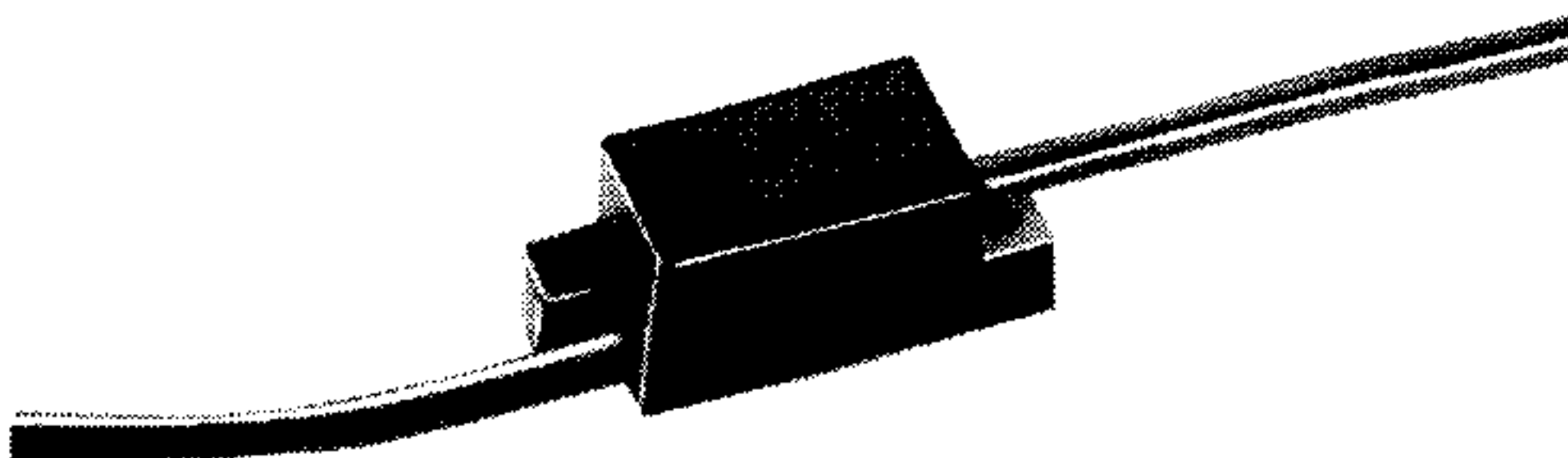
Position setting
Loosen the retaining screw, adjust the switch, set it to any position that suits your needs, re-tighten the retaining screw.

Note: excessive tightening may cause damage to the screw. Be sure to use about 5 in lbs, torque when tightening.

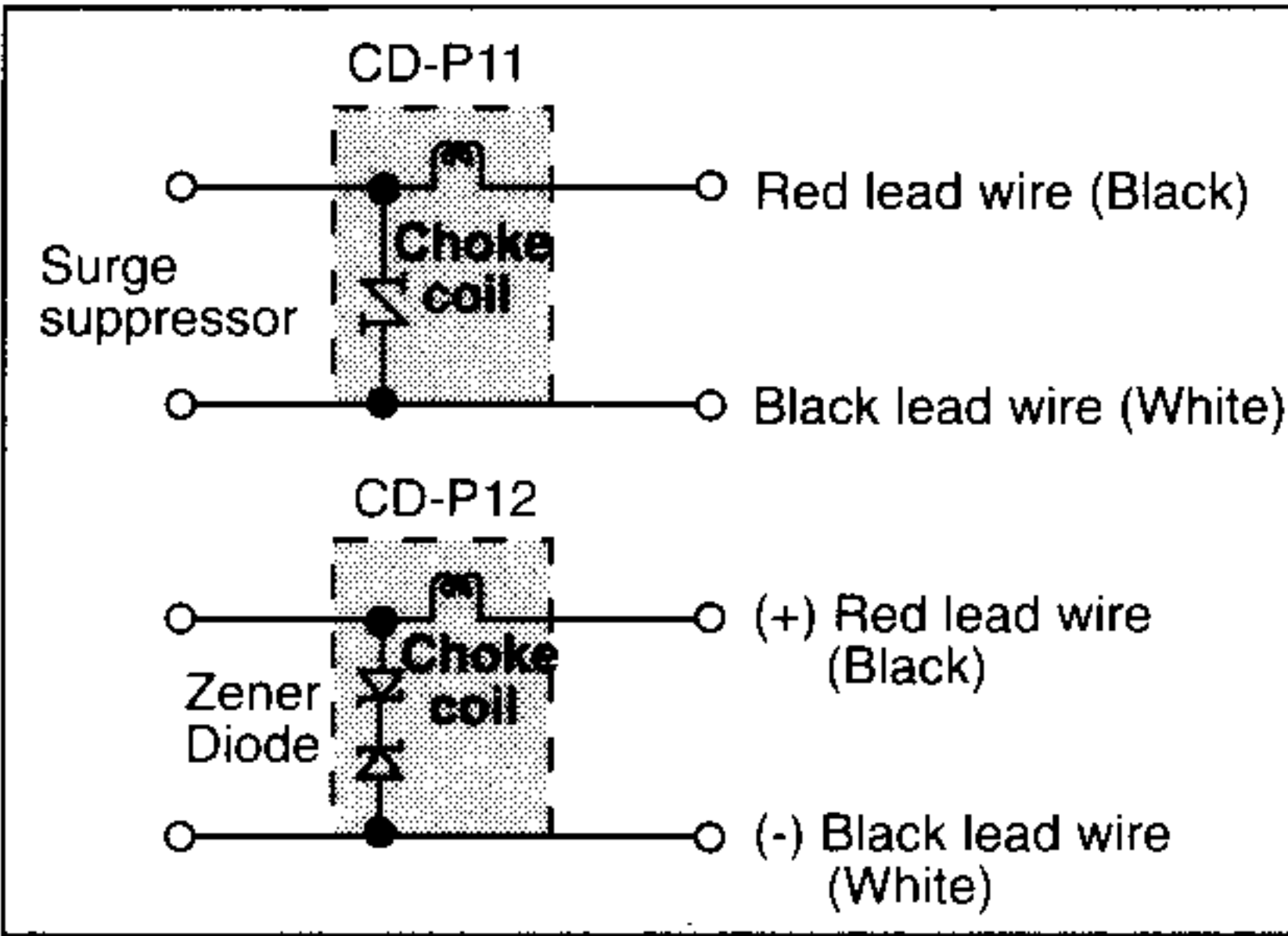
Contact Protection Box

D-A7 type and D-A8 type have no built-in contact protection circuit. Use this box for induction loads with 1.5 ft (0.5m) or more of lead wire, or 100 VAC applications.

Model No.	Operating voltage	Length of lead wire
CD-P11	100 VAC	Switch connecting side 1.5 ft.
CD-P12	24 VDC	Load connecting side 1.5 ft.

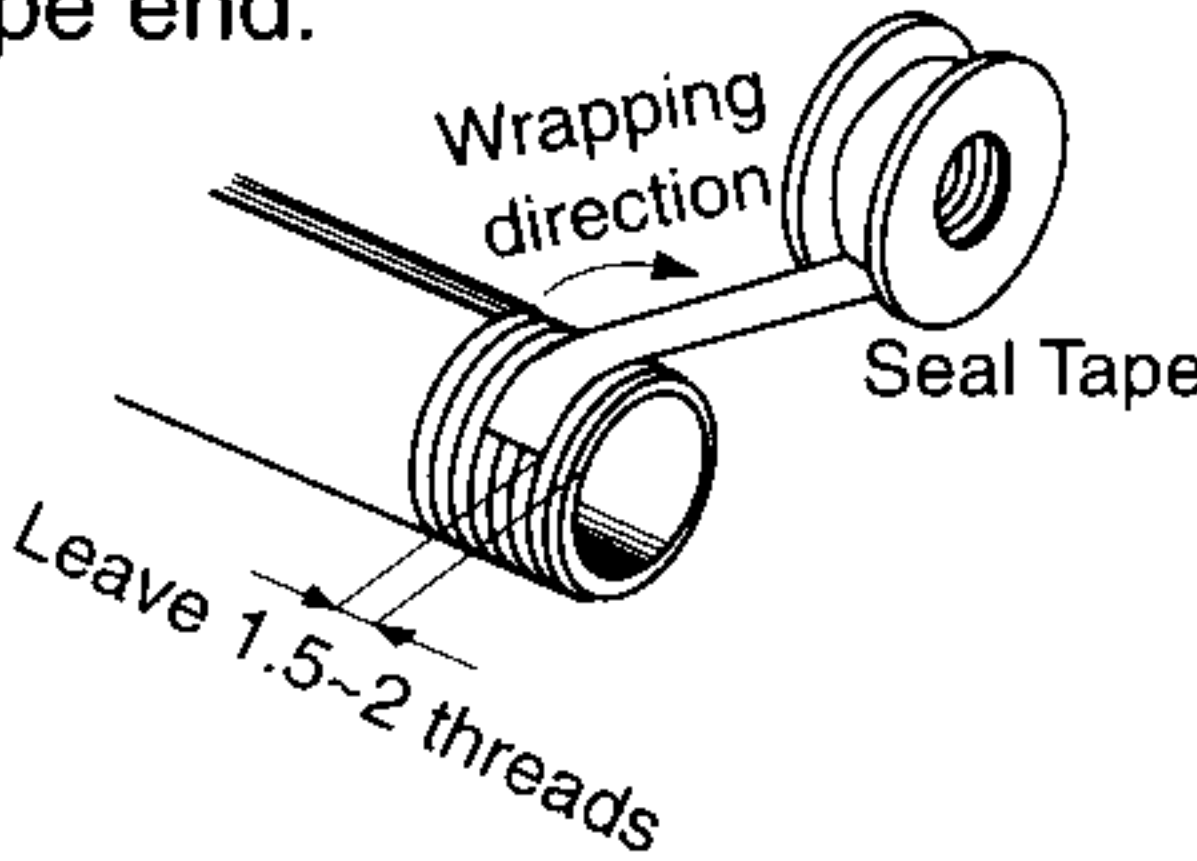


Contact protection box/Internal circuit



Operational Instructions

Piping should be thoroughly flushed or cleaned to prevent contamination by chips, oil, cutting oil, dust, etc. When piping and fittings are installed, care should be taken to prevent contamination. When wrapping with seal tape, please leave 1.5~2 threads uncovered on the pipe end.



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

Precautions When Mounting Switches

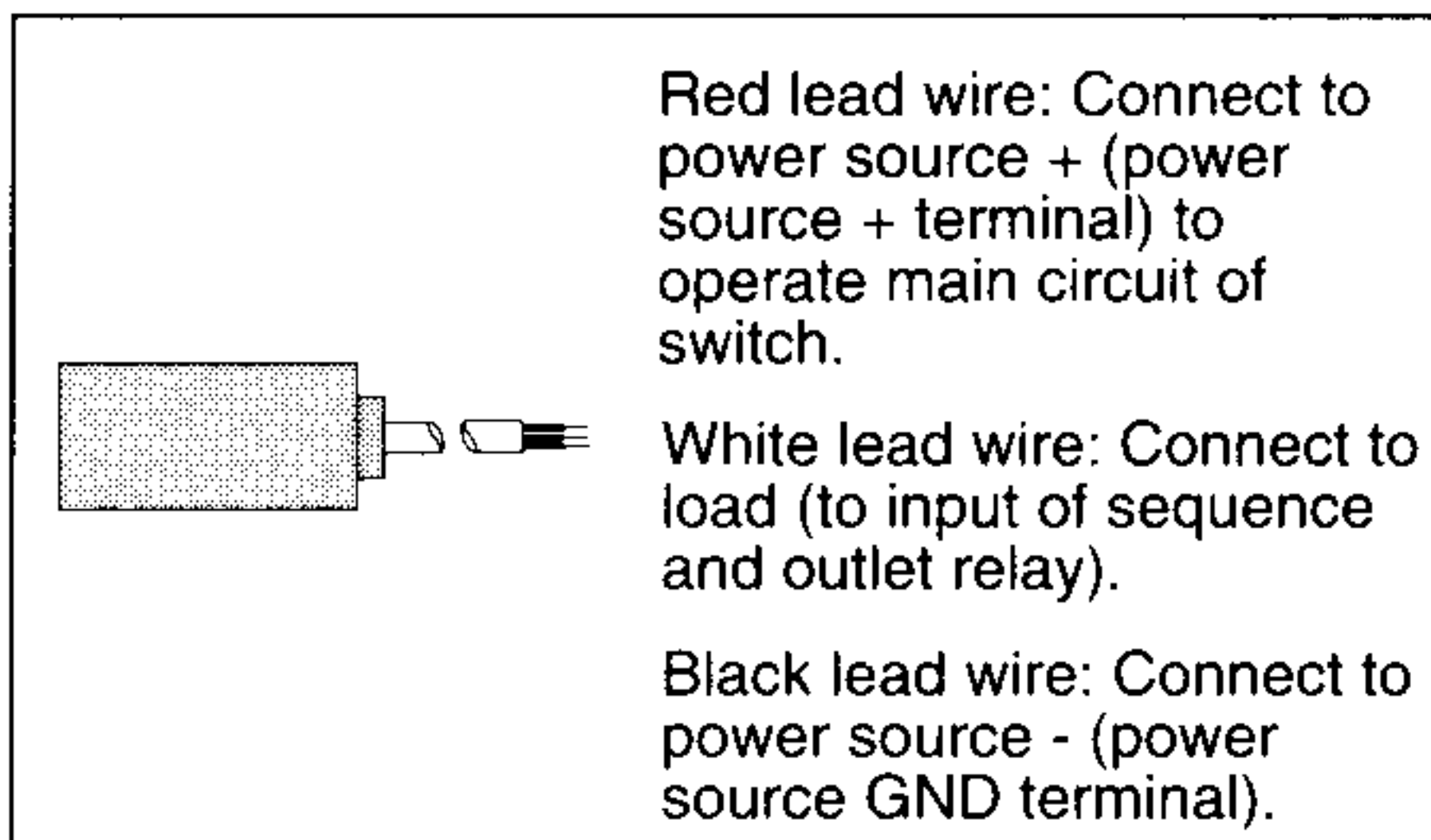
Reed switch/Type D-A7, A8

D-A77 and D-A79 have indicator lights which are polarized (light emitting diodes). Red lead wire is (+), and black lead wire is (-). When connection is reversed, switch will operate, but indicator light will not turn on. Electrical current should be kept within the operating current range. When used at current levels less than the operating current range, the indicator light will not turn on, and if operated in excess of the operating current range, the indicator light will be damaged. D-A71, D-A77 and D-A79 can be connected in parallel, series connections can cause large voltage drops due to the internal resistance in the LED. (Approx. 2V/switch).

Solid state switch/Type D-F7

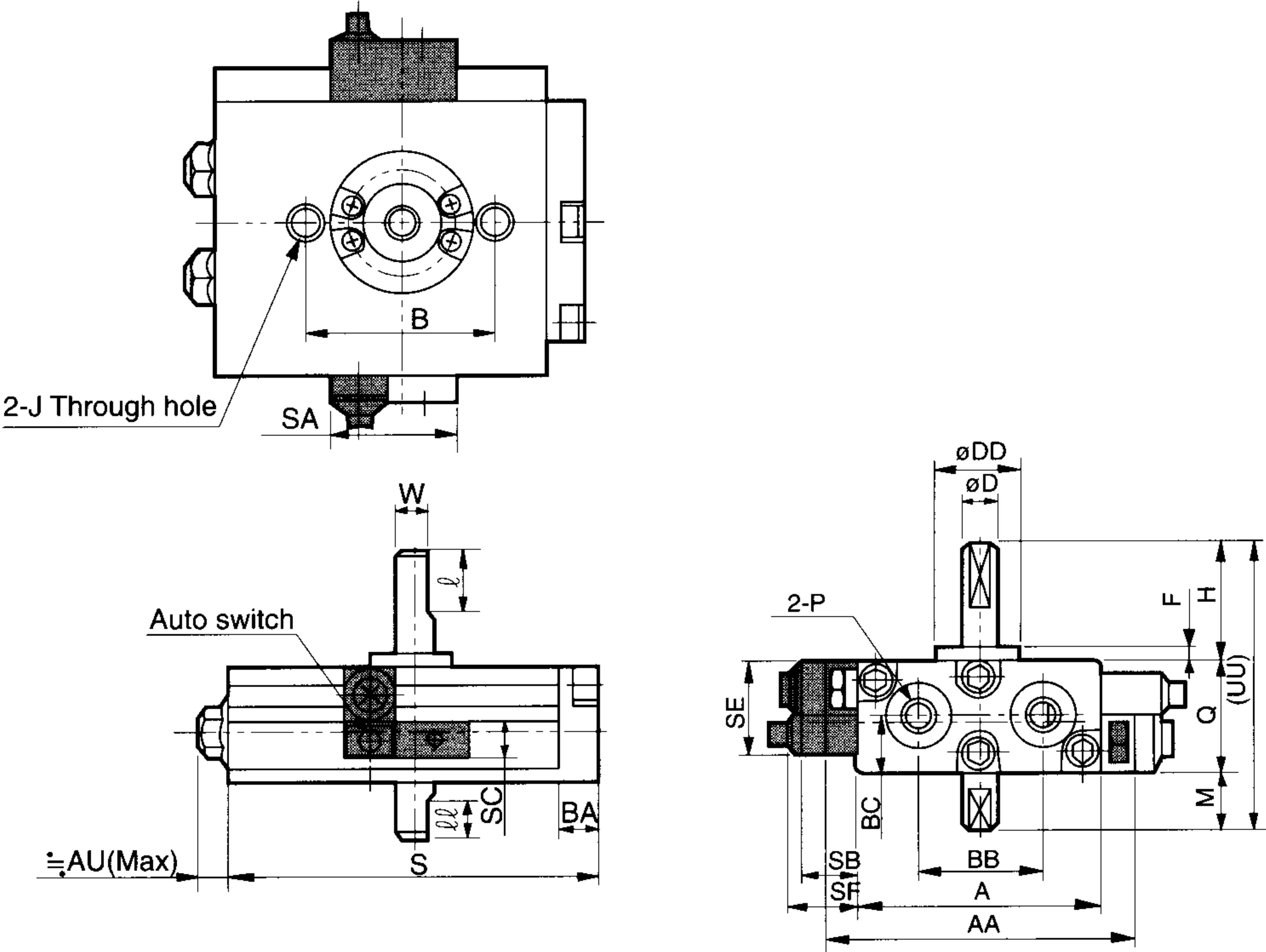
The switch should always be connected to the load before connecting to the power source. When operating, please take care to avoid damage, or excessive shock to the switch. Never use in a magnetically contaminated environment. When operating 2 or more actuators with auto switches in parallel, be sure that the distance between them is at least 1.6 inches (40mm).

Auto Switch connection/Solid State Type



With Auto Switch/Dimensions

NCDRQ1BW10•15

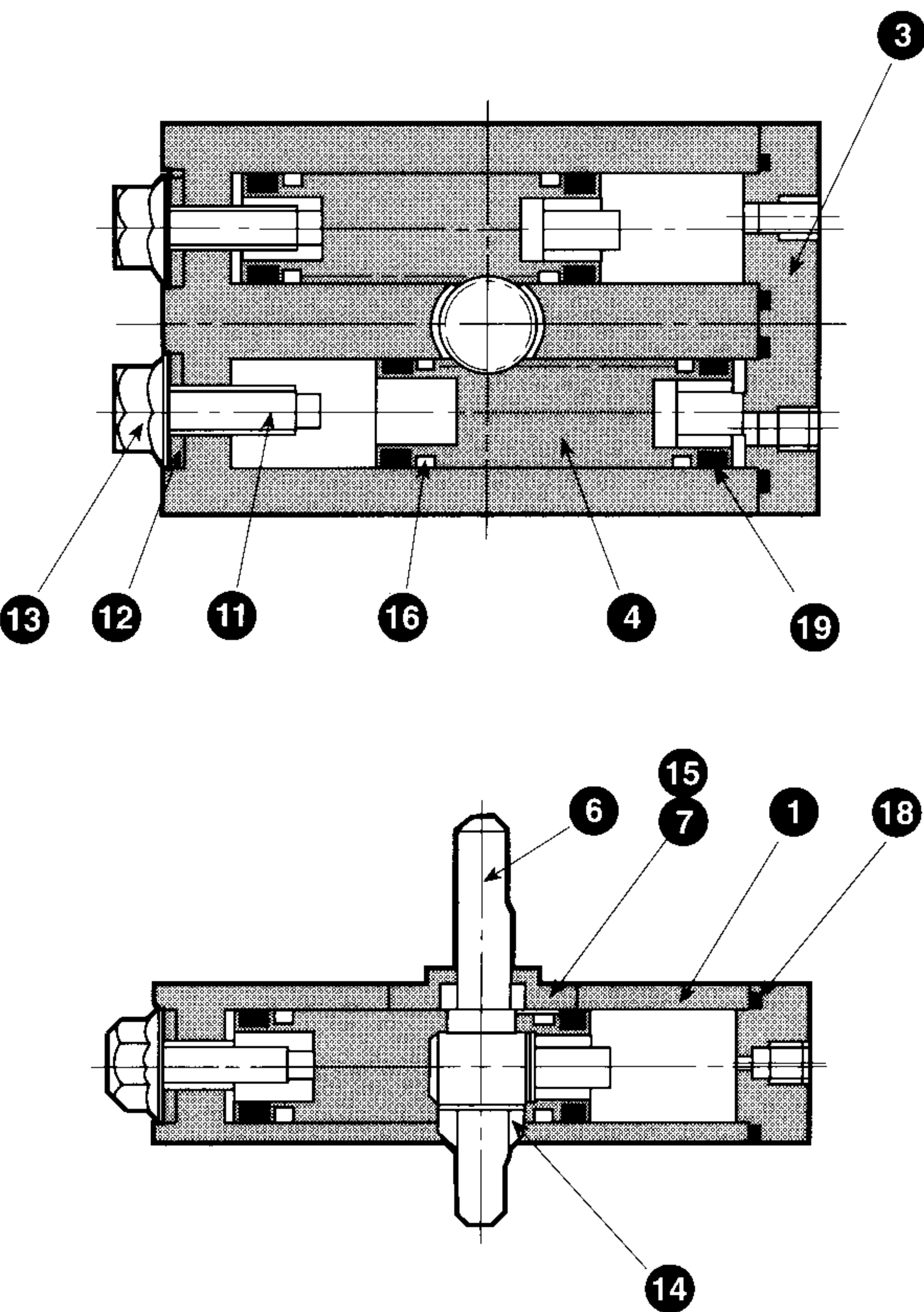


Model	A	AA	B	BB	ØD	ØDD	F	H	J	l	ll	M	P
NCDRQBW10-90- ○○○	1.46	1.85	1 5/32	0.75	3/16	15/32	0.08	0.71	10-24UNC	0.39	0.24	0.35	10-32UNF
NCDRQBW10-180- ●●●	1.46	1.85	1 5/32	0.75	3/16	15/32	0.08	0.71	10-24UNC	0.39	0.24	0.35	10-32UNF
NCDRQBW15-90- ○○○	1.89	2.20	1 1/4	1.06	1/4	9/16	0.08	0.79	10-24UNC	0.39	0.28	0.39	10-32UNF
NCDRQBW15-180- ●●●	1.89	2.20	1 1/4	1.06	1/4	9/16	0.08	0.79	10-24UNC	0.39	0.28	0.39	10-32UNF

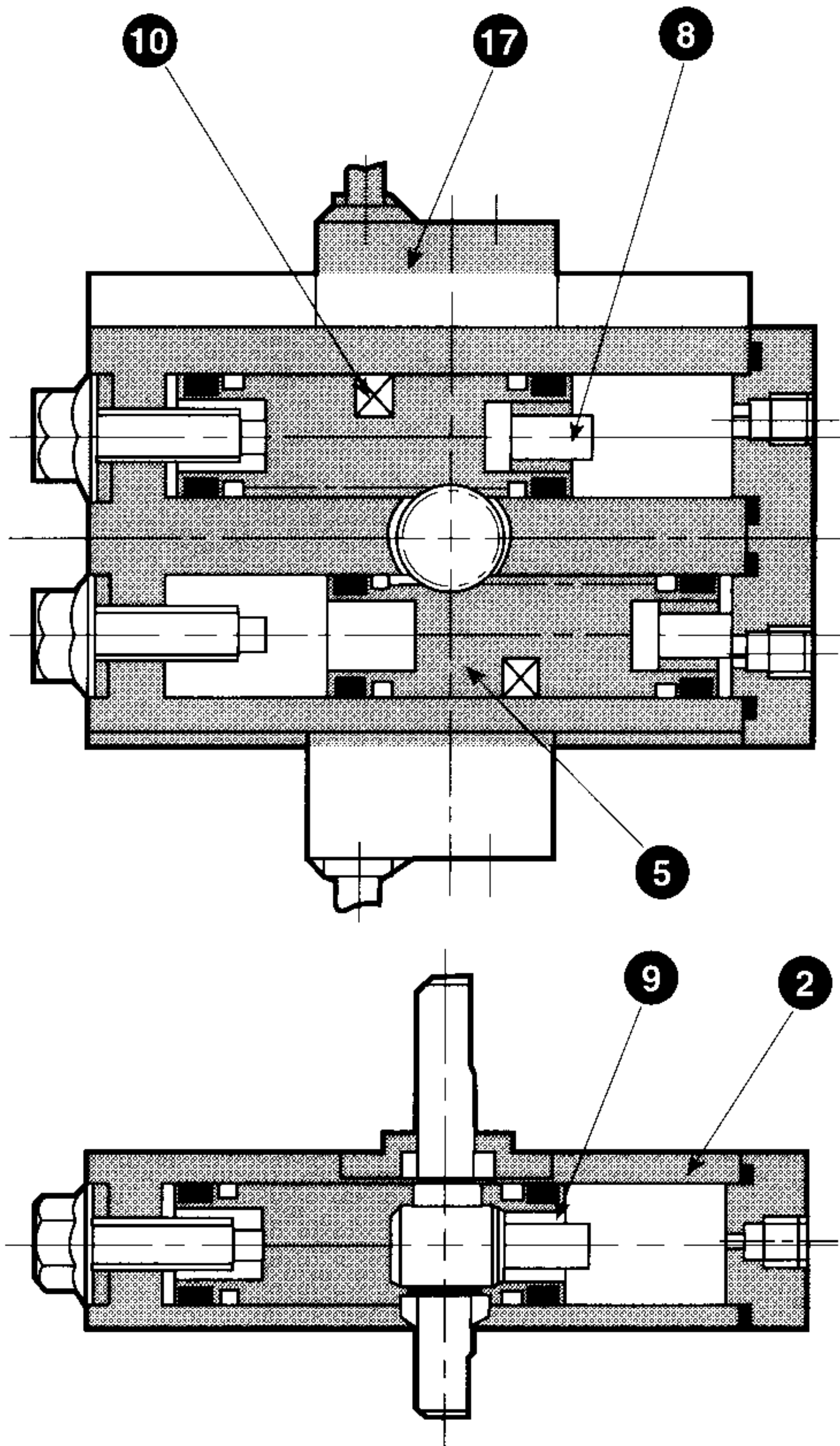
Model	Q	S	(UU)	W	AU	BA	BC	SA	SB	Reed Switch			Solid State Switch		
										SC	SE	SF	SC	SE	SF
NCDRQBW10-90- ○○○	0.67	2.20	1.73	0.17	0.20	0.24	0.33	0.87	0.31	0.24	0.55	0.43	0.28	0.59	0.35
NCDRQBW10-180- ●●●	0.67	2.72	1.73	0.17	0.20	0.24	0.33	0.87	0.31	0.24	0.55	0.43	0.28	0.59	0.35
NCDRQBW15-90- ○○○	0.79	2.56	1.97	0.23	0.20	0.28	0.39	0.87	0.28	0.24	0.55	0.39	0.28	0.59	0.31
NCDRQBW15-180- ●●●	0.79	3.23	1.97	0.23	0.20	0.28	0.39	0.87	0.28	0.24	0.55	0.39	0.28	0.59	0.31

With Auto Switch/Dimensions

NCDRQ1BW10•15



With Auto Switch/NCDRQ1BW10•15



Parts List

No.	Part Name	Material	Surface treatment
1	Body	Aluminum alloy	Hard alumite
2	Body	Aluminum alloy	Hard alumite
3	Cover	Aluminum alloy	Black alumite
4	Piston	Carbon steel	
5	Piston	Stainless steel	
6	Shaft	Satinless steel	
7	Bearing retainer	Aluminum alloy	Black dye
8	Cushion pat	Polyurethane	
9	Collar		
10	Magnet		
11	Adjustment bolt	Cr.Mb steel	Black dye
12	Thread seal	NBR/steel	

Parts List

No.	Part Name	Material	Surface treatment
13	Hexagon nut with flange	Steel	
14	Bearing	—	
15	Screw	Steel	
16	Wear ring	Plastic	
17	Auto switch	—	

Packing List

No.	Description	Material	Part No.		Qty. for Seal Kit
			10	15	
	Seal Kit	NBR	CRQ-10-PS	CRQ-15-PS	
18	O-Ring	NBR	P3040158	P3040258	2
19	Piston packing	NBR	DYP-10	DYP-14	4

Appendix1: How To Wet Rotation Time

How To Set Rotation Time

Due to inertia, even a small torque generated by the rotary actuator can cause damage. Therefore when adjusting rotation time, take the moment of inertia of the load and kinetic energy into consideration. (The values of kinetic energy, and ** diagram will be very helpful in setting the rotation time).

Allowable Dynamic Load

Model	Kinetic energy (in-lbs)
NCRQBW10	2.2 x 10 ⁻³
NCRQBW15	3.5 x 10 ⁻³

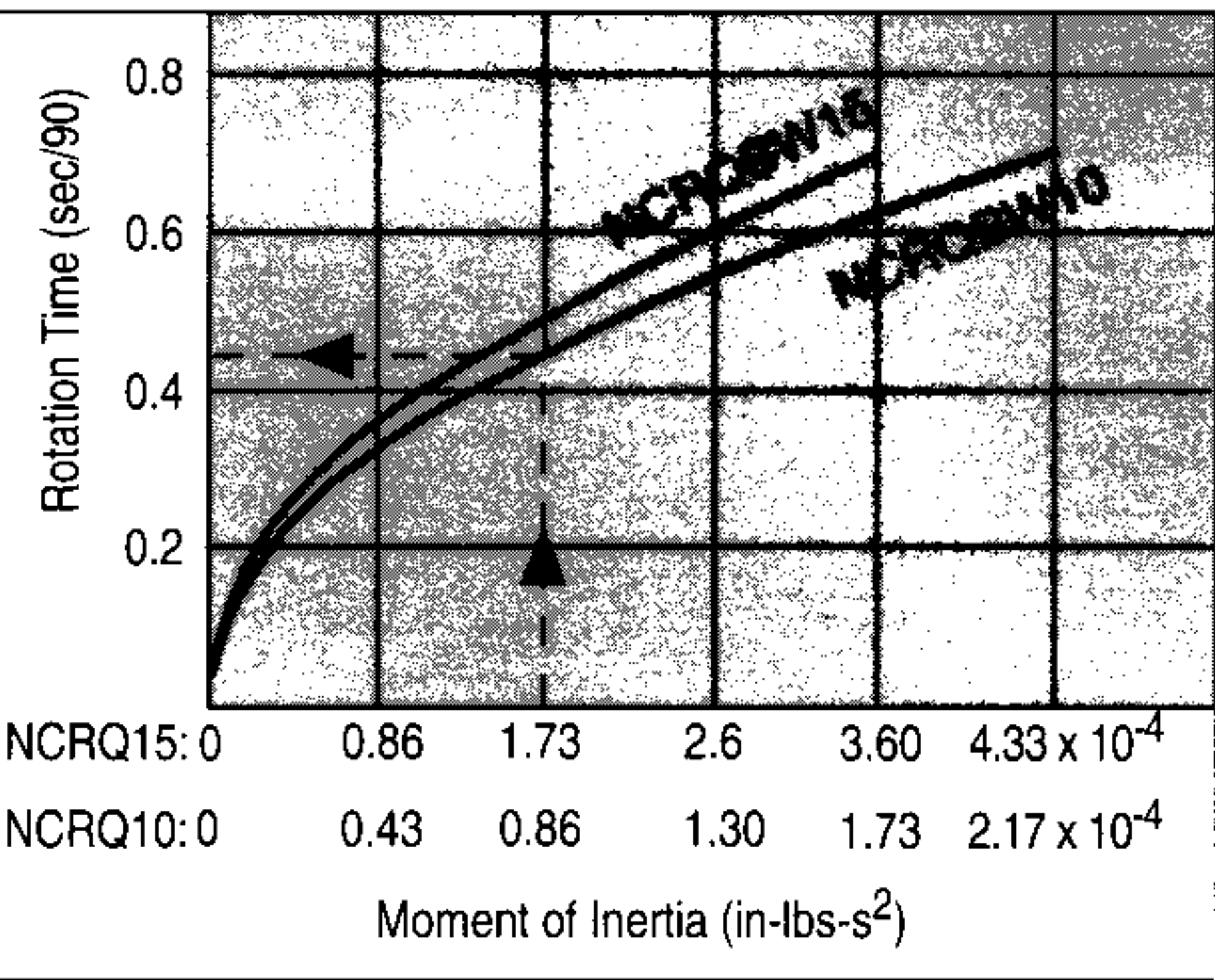
Stable Rotation Time Regulation Range

Model	Rotation time (Sec/90°)
NCRQBW10	0.2 ~ 0.7
NCRQBW15	

How to Calculate Energy of the Load

E=1/2•J•ω² E: Kinetic energy (in•lbs)
J: Moment of inertia (in-lbs -s²)
ω=2θ / t ω: Rotation speed (rad/s)
θ: Rotation (rad)
180°=3.14 rad
t: Rotation time (s)

Moment of Inertia and Rotation time Diagram



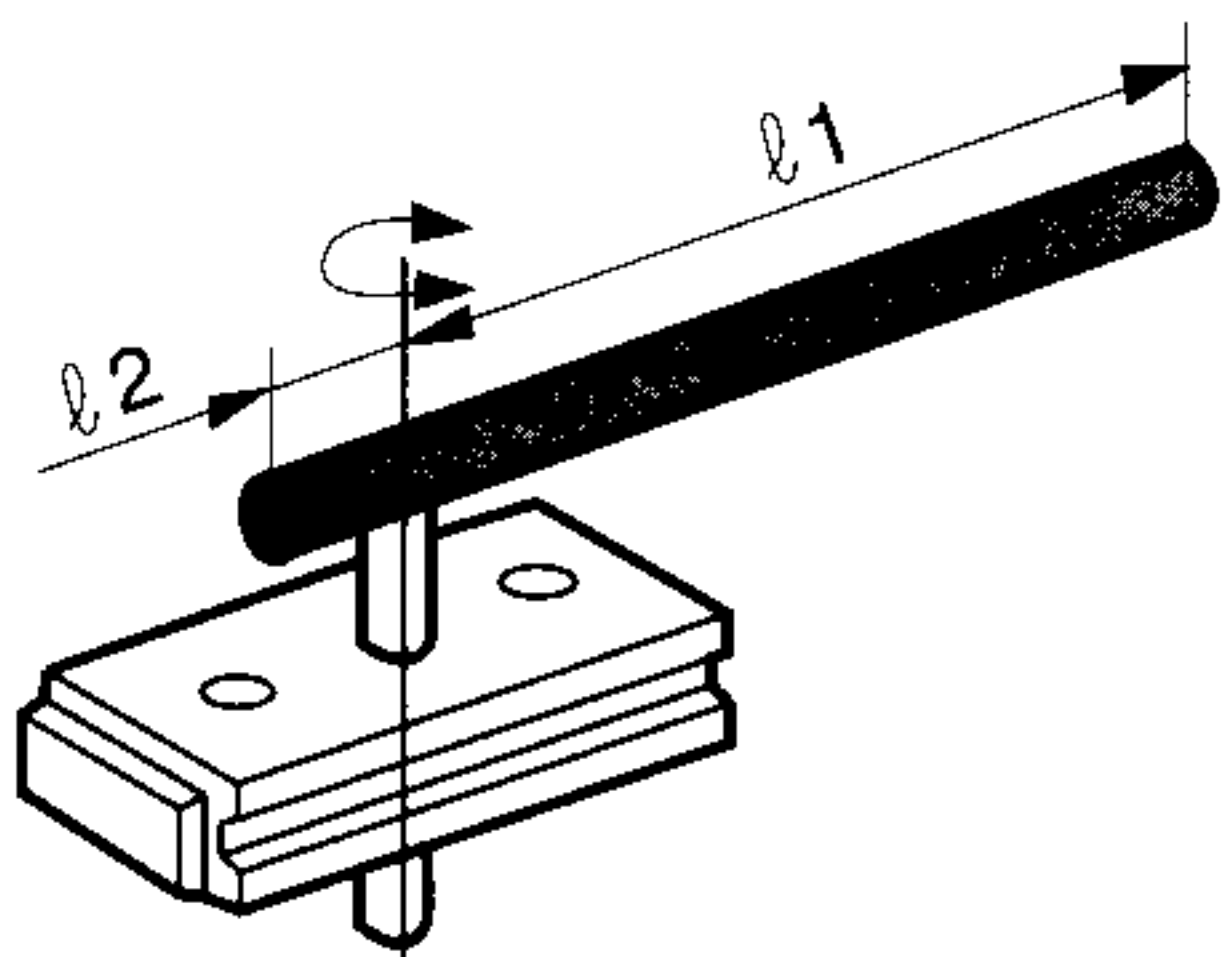
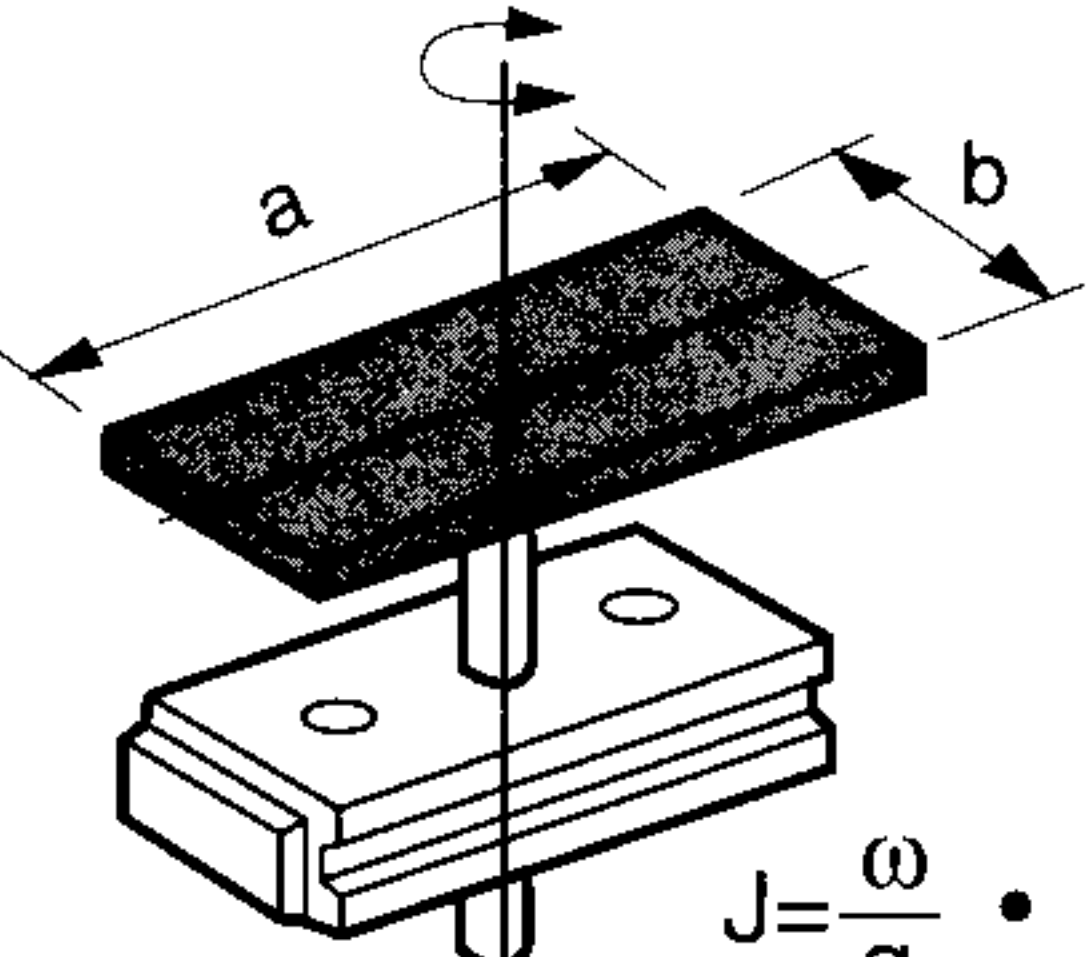
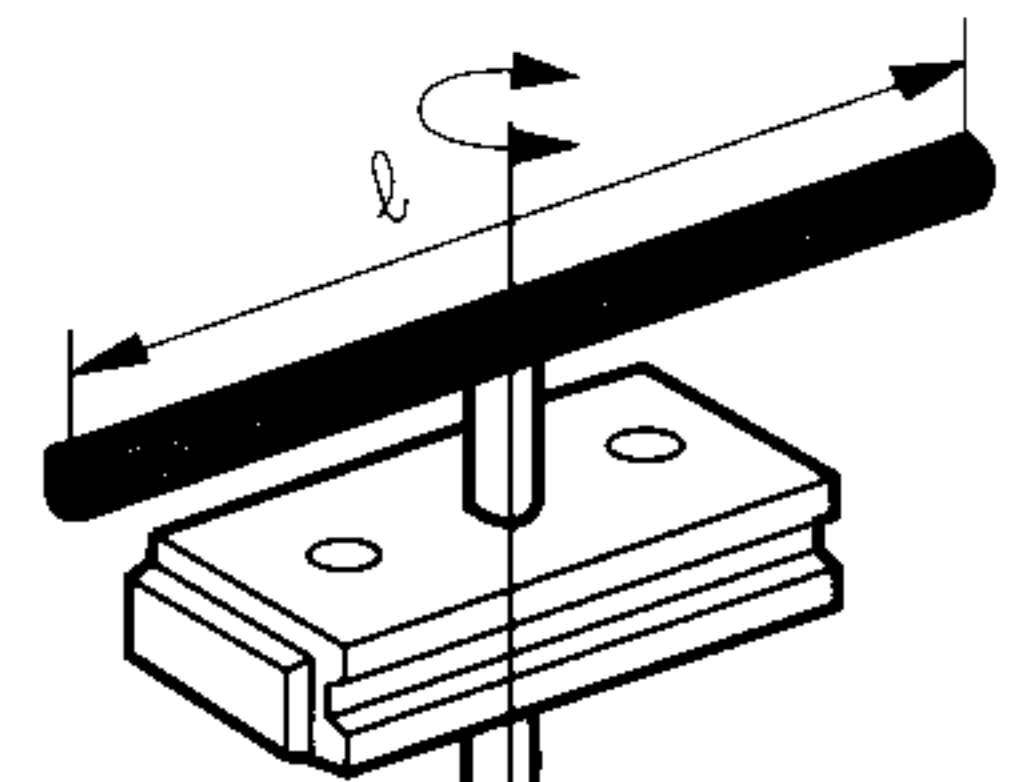
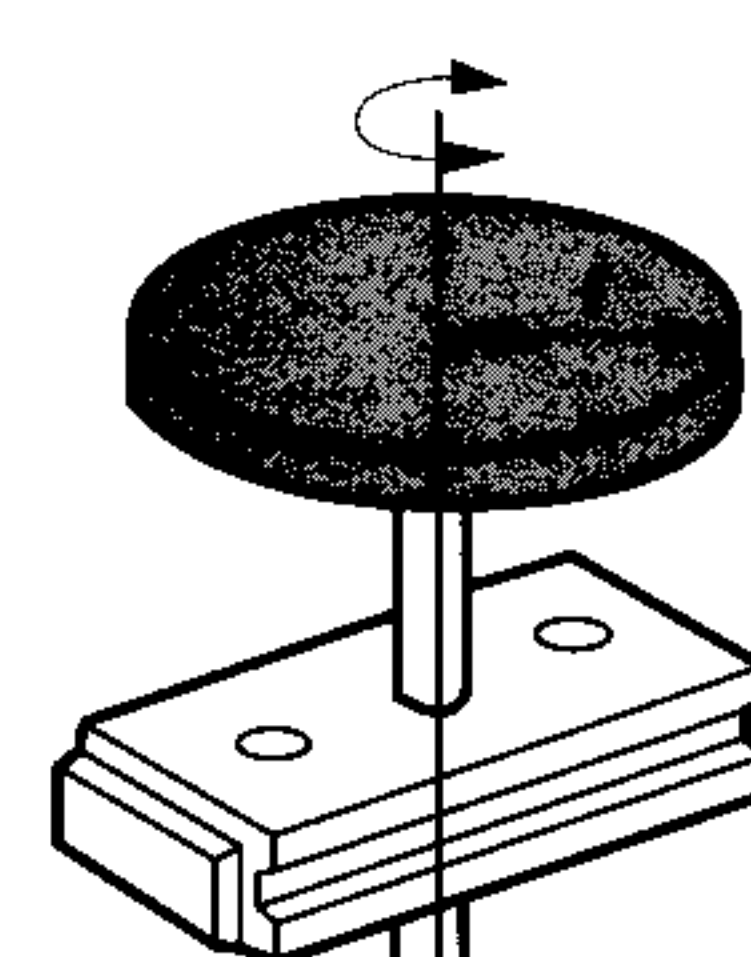
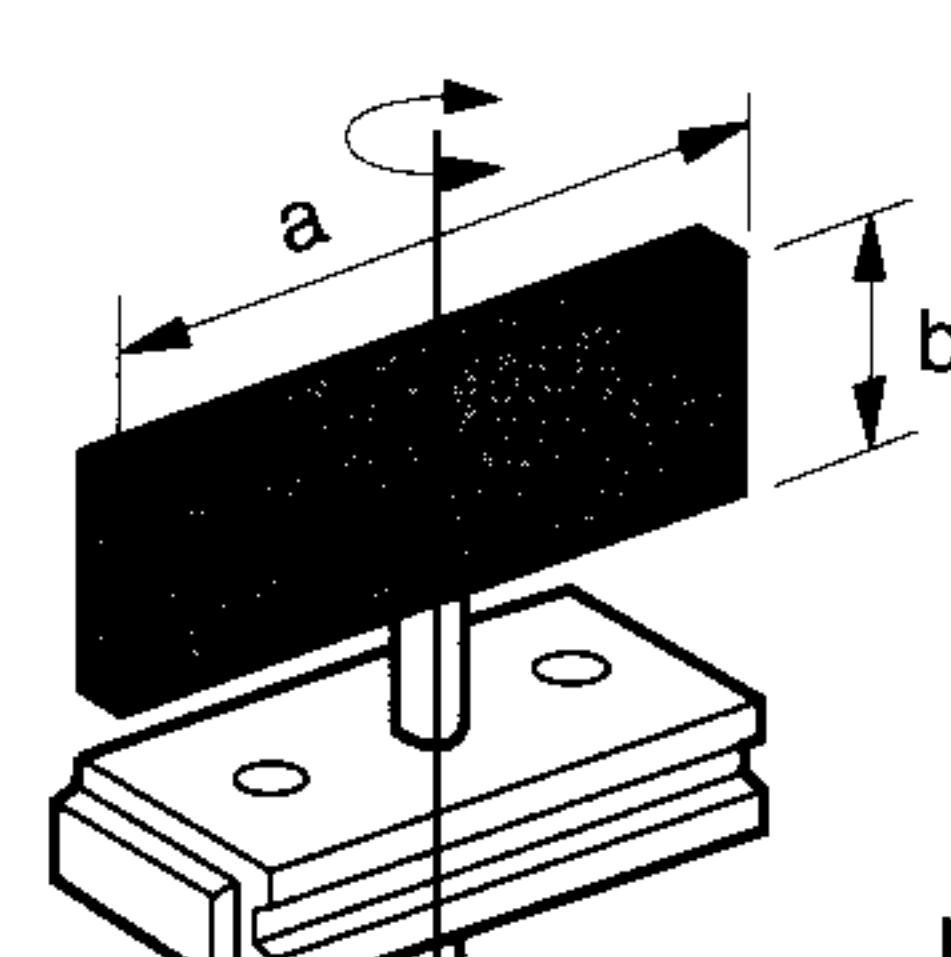
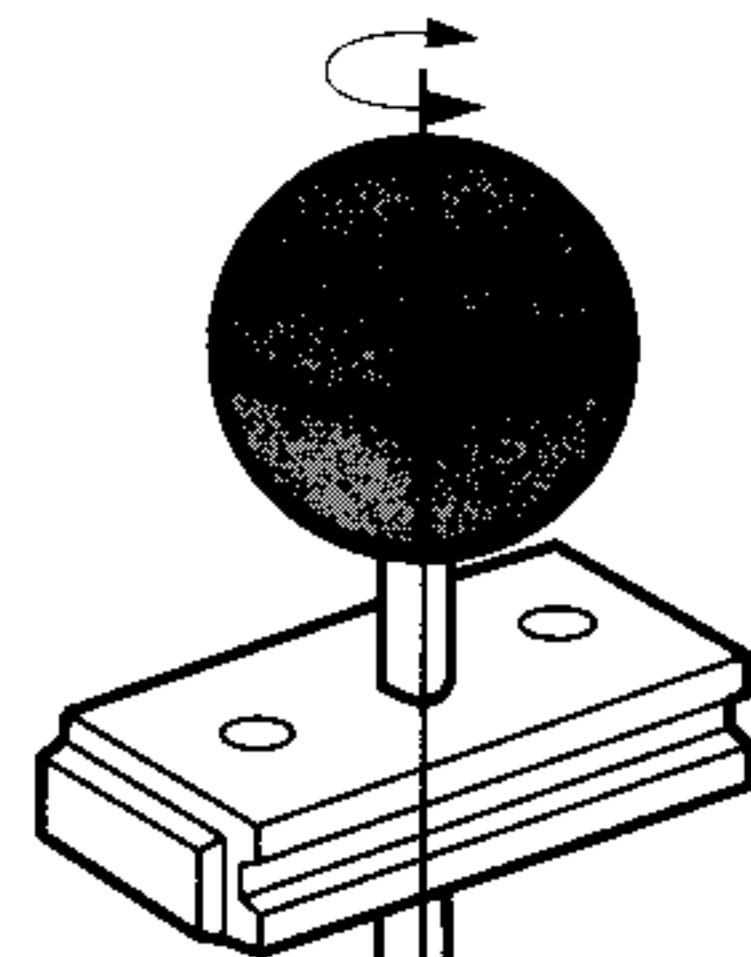
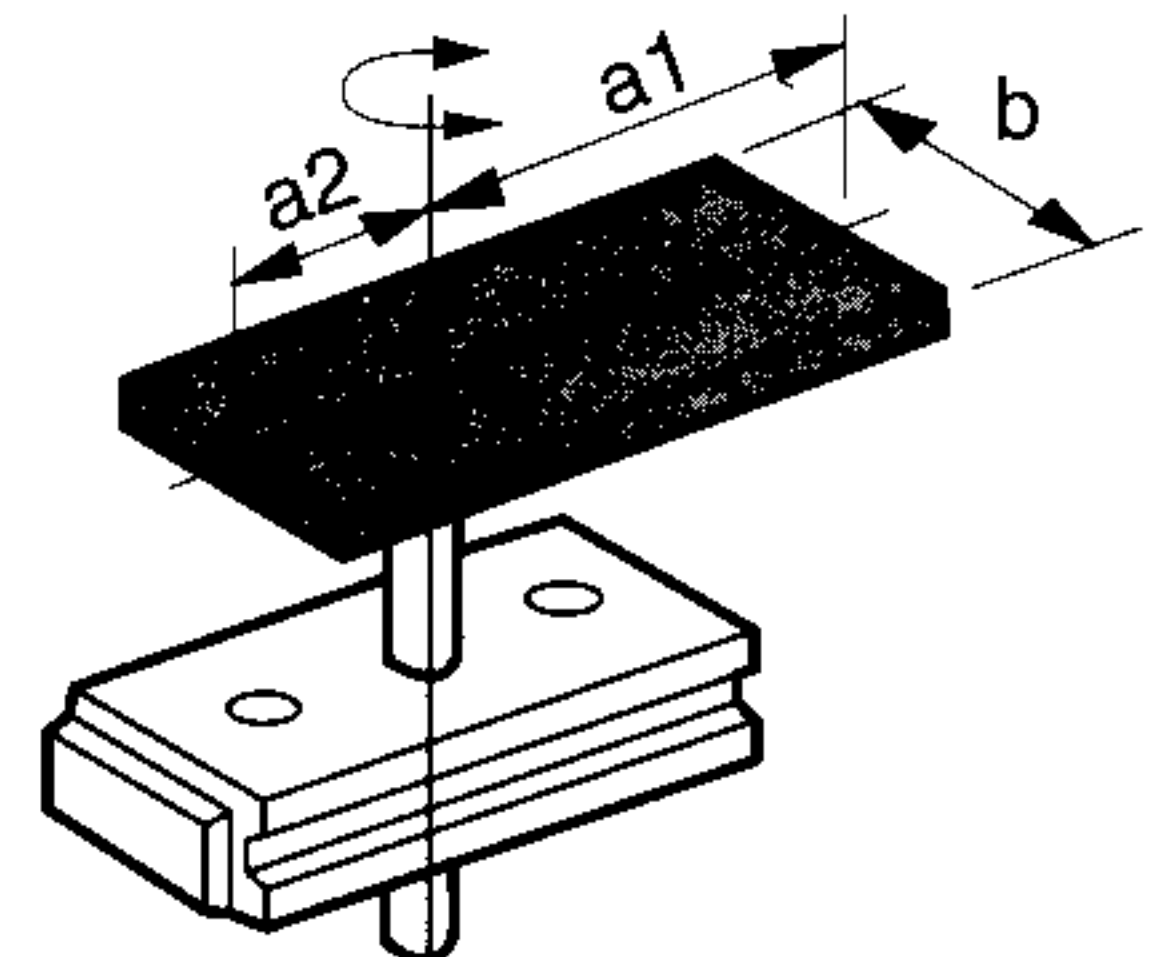
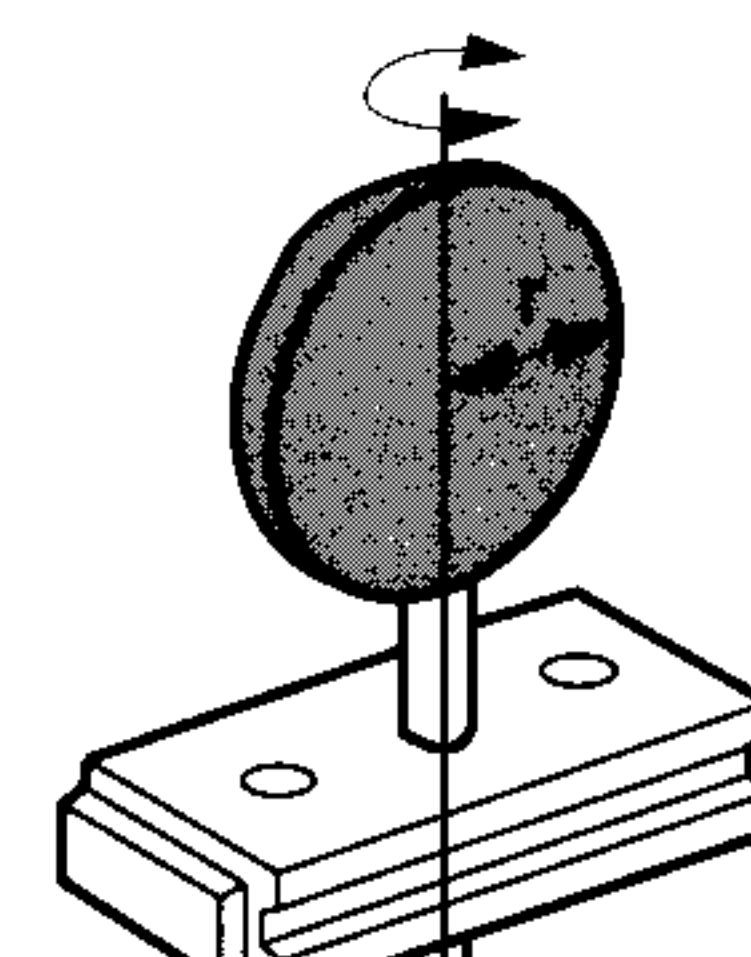
Setting the rotation time for a 0.86 x 10⁻³ in-lbs-s² moment of inertia load. (NCRQBW10)

Vertically draw a line from the value, 0.86 x 10⁻³ in-lbs-s² on the horizontal axis, to the intersection point with the graph of NCRQBW10. From this point horizontally draw a line, which indicates a rotation time of 0.45 sec/90°. Set the operating speed between 0.45 ~ 0.7 sec/90°.

Appendix2: How To Calculate 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 (386in/s²)

Thin rod Position of pivot: Passes through one end perpendicular to the rod.  $J = \frac{\omega_1}{g} \cdot \frac{l_1^2}{3} + \frac{\omega_2}{g} \cdot \frac{l_2^2}{3}$	Rectangular plate Position of pivot: Passes through the center of gravity perpendicular to the plate.  $J = \frac{\omega}{g} \cdot \frac{a^2 + b^2}{12}$
Thin rod Position of pivot: Passes through the center of gravity perpendicular to the rod.  $J = \frac{\omega}{g} \cdot \frac{l^2}{12}$	Column (inclusive of thin disc) Position of pivot: Axis  $J = \frac{\omega}{g} \cdot \frac{r^2}{2}$
Rectangular plate Position of pivot: Passes through the center of gravity, parallel to side b.  $J = \frac{\omega}{g} \cdot \frac{a^2}{12}$	Solid globe Position of pivot L Diameter  $J = \frac{\omega}{g} \cdot \frac{2r^2}{5}$
Rectangular plate Position of pivot: Passes through one end perpendicular to the plate.  $J = \frac{\omega_1}{g} \cdot \frac{4a_1^2 + b^2}{12} + \frac{\omega_2}{g} \cdot \frac{4a_2^2 + b^2}{12}$	Thin disc Position of pivot: Diameter  $J = \frac{\omega}{g} \cdot \frac{r^2}{4}$