

NO. OM-104E

INSTRUCTION MANUAL

PNEUMATIC 2-STAGE ACTUATOR

(MODEL TDT/TST)

HISAKA WORKS, LTD.

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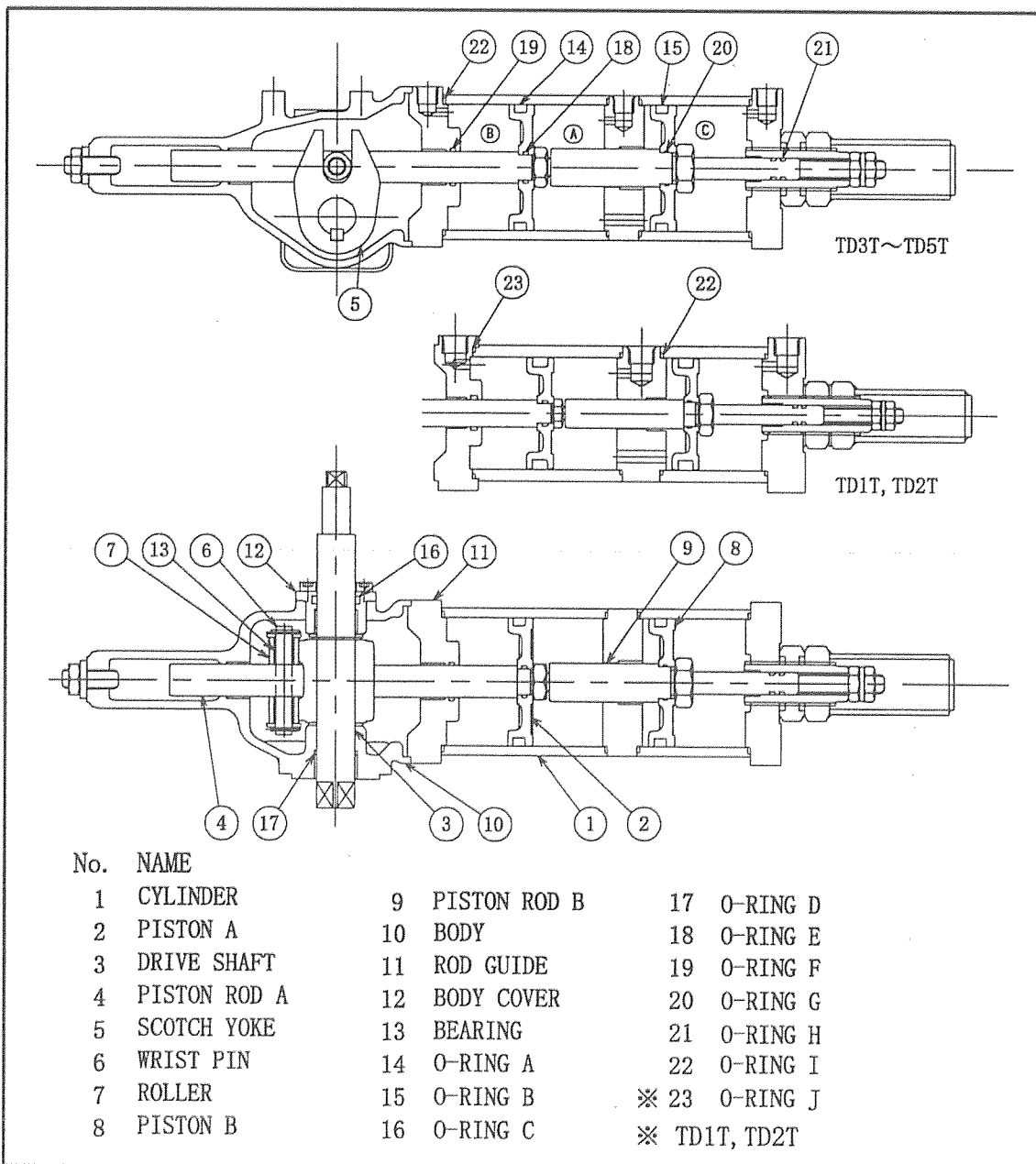
1. Construction and Acting Principle

1.1 Double acting type (TDT Type) [Fig.1]

Operation air pressure pressurizes piston A (part No.2) inside cylinder (part No.1) and linear motion generated from moving stroke of the piston is converted to rotary motion of drive shaft (part No.3) via piston rod A (Part No.4), wrist pin (Part No.6), bearing (part No.13), roller(part No.7), and scotch yoke (part No.5).

When the operation air pressure is applied to the cylinder (A), the piston A moves to the left, whereby the drive shaft is rotated counterclockwise. When the operation air pressure is fed into the cylinder (B), the piston A moves to the right, whereby the drive shaft is rotated clockwise.

Further, the piston B (part No.8) moves together with piston rod B (part No.9) jointed thereto, whereby the drive shaft is rotated counterclockwise. In this



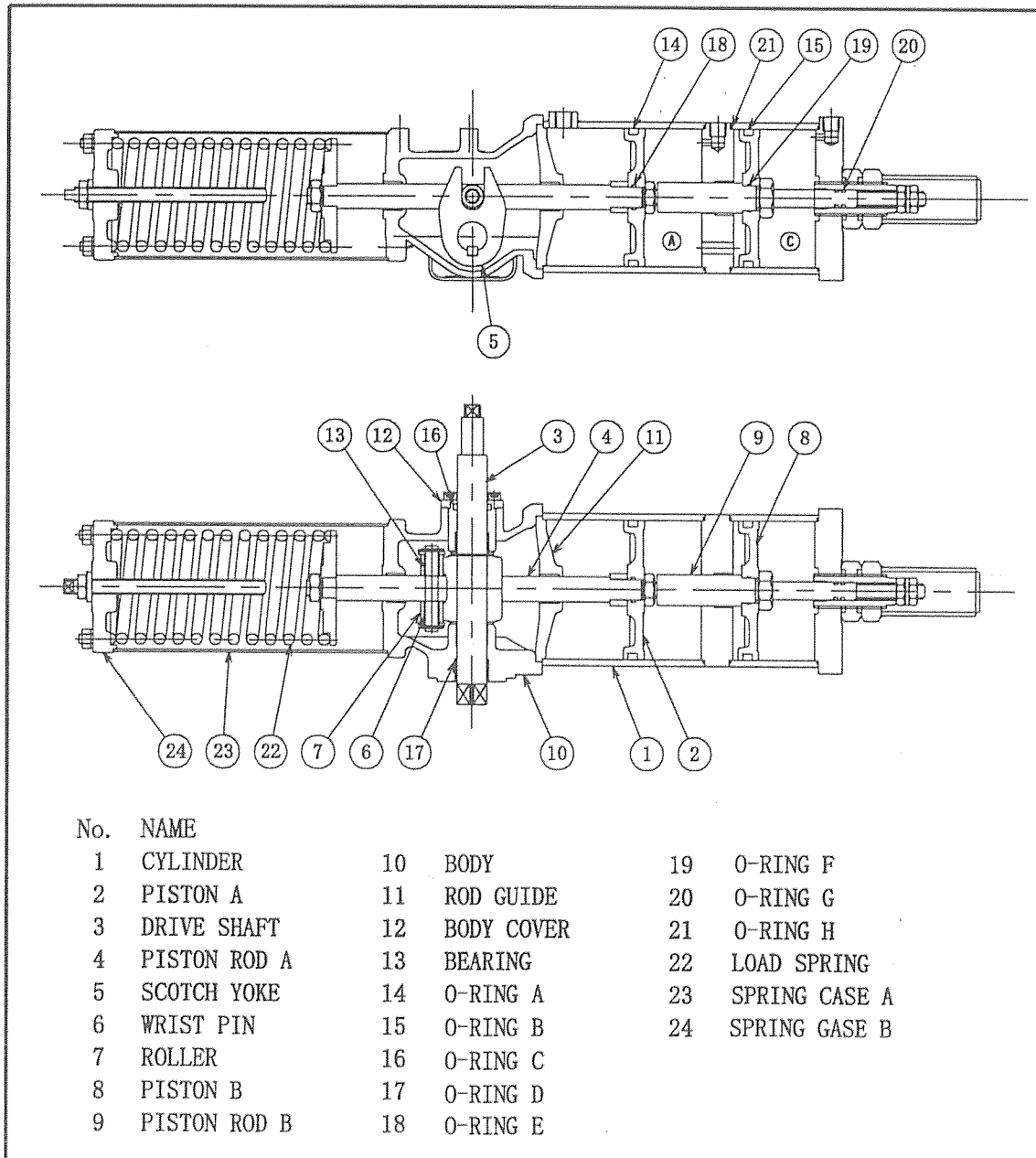
[FIG.1] Double Acting Type (TD1T~TD5T)

condition, the piston B moves to the left when operation air pressure is applied to cylinder (C), then serving to set the medium opening angle.
Refer to [Figure-1] for the acting sequence flow.

1.2 Single Acting Type (TST Type) [Fig.2]

When operation air pressure is applied to cylinder A, piston A (part No.2) moves to the left, whereby drive shaft (part No.3) is rotated counterclockwise to shrink load spring (part No.22). When the operation air pressure has come to nil, the drive shaft is rotated clockwise by restorative power of the load spring.

Further, piston B (part No.8) moves together with piston rod B (part No.9) jointed thereto and it moves to the left when the operation air pressure is applied to cylinder C, then serving to set the medium opening angle.
Refer to [Figure 2] for the acting sequence flow.



[Fig. 2] Single Acting Type (TS1T~TS5T)

2. Acting Sequence

2.1 Double acting type (TDT Type) [Fig. 1]

(1) Valve full open

Operation air flows in from air port (2) by current feed into SV1 and from air port (1) by current feed into SV2 power ON, whereby the drive shaft (part No.3) is rotated counterclockwise to fully open the valve.

(2) Valve medium open

The operation air is exhausted from air port (2) by non current feed into SV1, with the current feed into SV2 kept, and the operation air flows in from air port (3), whereby the drive shaft turns by about half turn clockwise to open the valve at medium opening degree.

(3) Valve full close

Operation air is exhausted from air port (1) by non current feed into SV2, with non current feed into SV1 kept, whereby the drive shaft is rotated clockwise to fully close the valve.

2.2 Single acting type (TST Type) [Fig. 2]

(1) Valve full open

Operation air flows in from air port (2) by current feed into SV1 and from air port (1) by current feed into SV2 power ON, whereby the drive shaft (part No.3) is rotated counterclockwise to fully open the valve.

(2) Valve medium open

The operation air is exhausted from air port (2) by non current feed into SV1, with the current feed into SV2 kept, and the drive shaft turns by half turn clockwise by restorative power of the spring to open the valve at medium opening degree.

(3) Valve full close

Operation air is exhausted from air port (1) by non current feed into SV2, with non current feed into SV1 kept, whereby the drive shaft is rotated clockwise to fully close the valve.

3. Operation Air Piping Procedure

3.1 Required air capacity

Calculate the require air capacity before air piping connection to the actuator. Less air capacity, if less, could cause the valve not to actuate. Where an air tank is used, set the tank pressure in the range of 5 to 7kgf/cm²G.

3.2 Air consumption in the cylinder

Air consumption in the cylinder is air discharge rate per minute of the actuator.

$$Q = V (P + 1) n \times 1/60$$

Q : Air consumption per minute (N Lit./min)

V : Cylinder capacity (Lit.) [1 cycle] (Refer to [Table-2])

P : Supply pressure (kgf/cm²G)

n : Piston reciprocals per hour (1 reciprocal = 1 cycle)

When calculating compressor capacity, air receiver capacity, etc., include a margin of 30% or more in the usual air capacity, considering air leak and loss from the pipeline and accessories.

3.3 Where mounting of instruments at our side is indicated from user

The actuator of standard specification is not provided with instruments, but drip-proof type solenoid valve/ explosion-proof type solenoid valve, drip-proof type limit switch/explosion-proof limit switch , silencer, speed controller and pressure reducing valve with filter are available as options. User is requested to specify and order the drip type and explosion-proof type instruments and devices according to the application environment.

The standard air pipes are polyvinylchloride-covered aluminum pipe (DECABON, made by Nitta Belt Co.,Ltd.). Tensioning abnormally and bending them at acute angle could result in damage of them.

The actuators are shipped with the ball valves normally opened from our shop (but some of single acting type actuators are shipped with the ball valves closed.). After the ordered actuators were delivered to you, you are requested to verify compliance thereof with your specification.

3.4 Where instruments are mounted at your side

Perform the instrument piping in reference to the Flow Sheet in [Fig.3] and [Fig.4] .

3.5 Precautions in instrument piping

- (1) Supply the compressed air through a filter for complete removal of water content, oil content, and other foreign matter therefrom.
- (2) Before mounting each device, don't fail to apply flushing to it for complete removal of dust, mist, chips, etc. (Further, keep the flushing pressure at less than maximum operating pressure of each device.
- (3) The actuators can be mounted in any direction, but mount filter and oiler in vertical position.
- (4) Regarding the operation air directional solenoid valves, use

4-port solenoid valve for the double acting type and 3-port solenoid valve for the single acting type (Use of 4-port solenoid valve is allowed. But in this case plug one of 4 ports with a blind plug.).

(5) After completion of the piping connection, increment the air pressure from 0 kgf/cm²G up to required operating pressure (Standard 4kgf/cm²G) using a pressure reducing valve. At the same time, check that no air leaks from each pipe joint.

(6) Use the actuators at an environment of -15°C to +80°C.

4. Manual operation

Avoid manual operation of the single acting type (TST Type), because the spring contained therein is hazardous due to its reaction force.

For manual operation of the double acting type (TDT Type), follow the sequence given below (4.1 ~ 4.3).

4.1 Where solenoid valve is provided with manual button

Where supply air pressure remains inside, open/close the solenoid valve by operating the manual valve. Where no supply air pressure remain inside, operate the connector connected to the solenoid valve using a spanner, while operating the manual button.

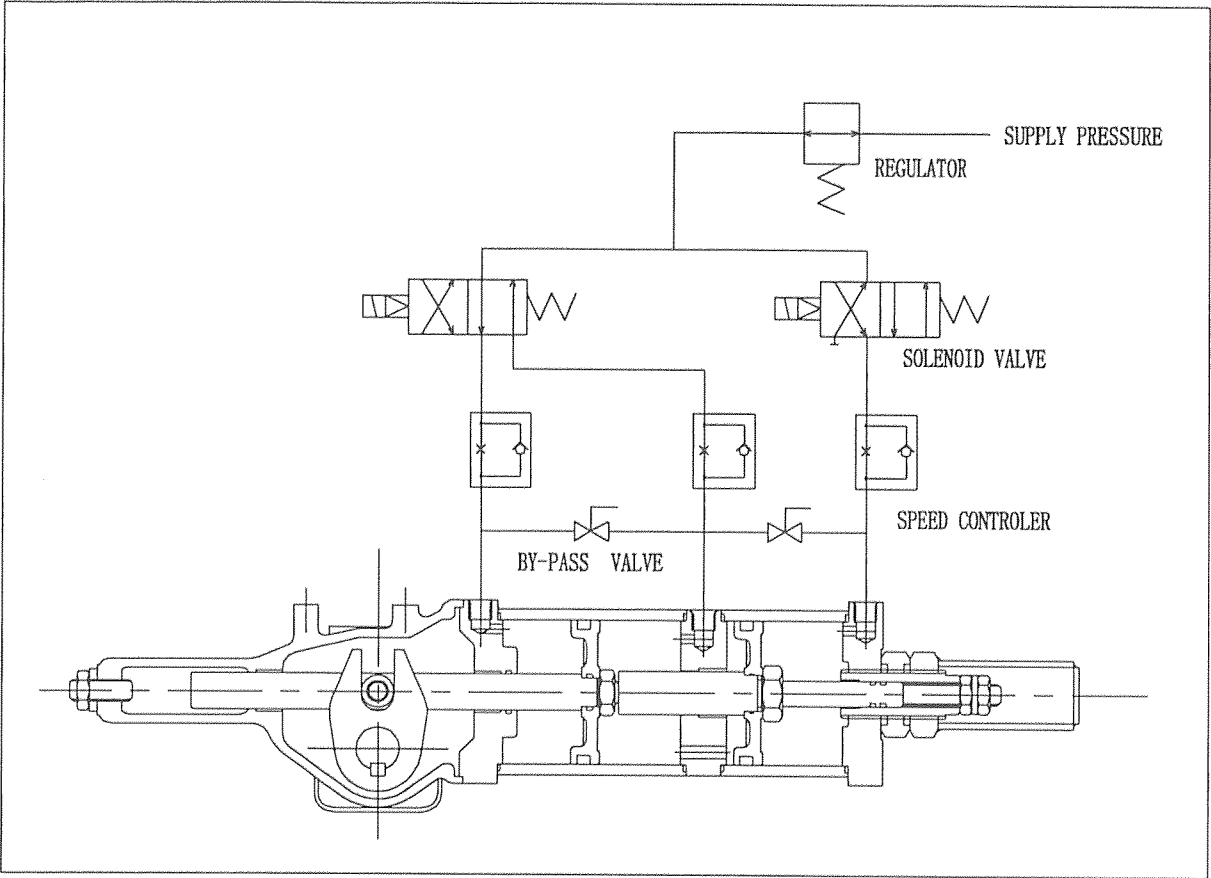
4.2 Where bypass valve is provided

Open the bypass valve (in reference to Fig. 3) and operate the connector connected to the valve using a spanner. After manual operation, close the bypass valve.

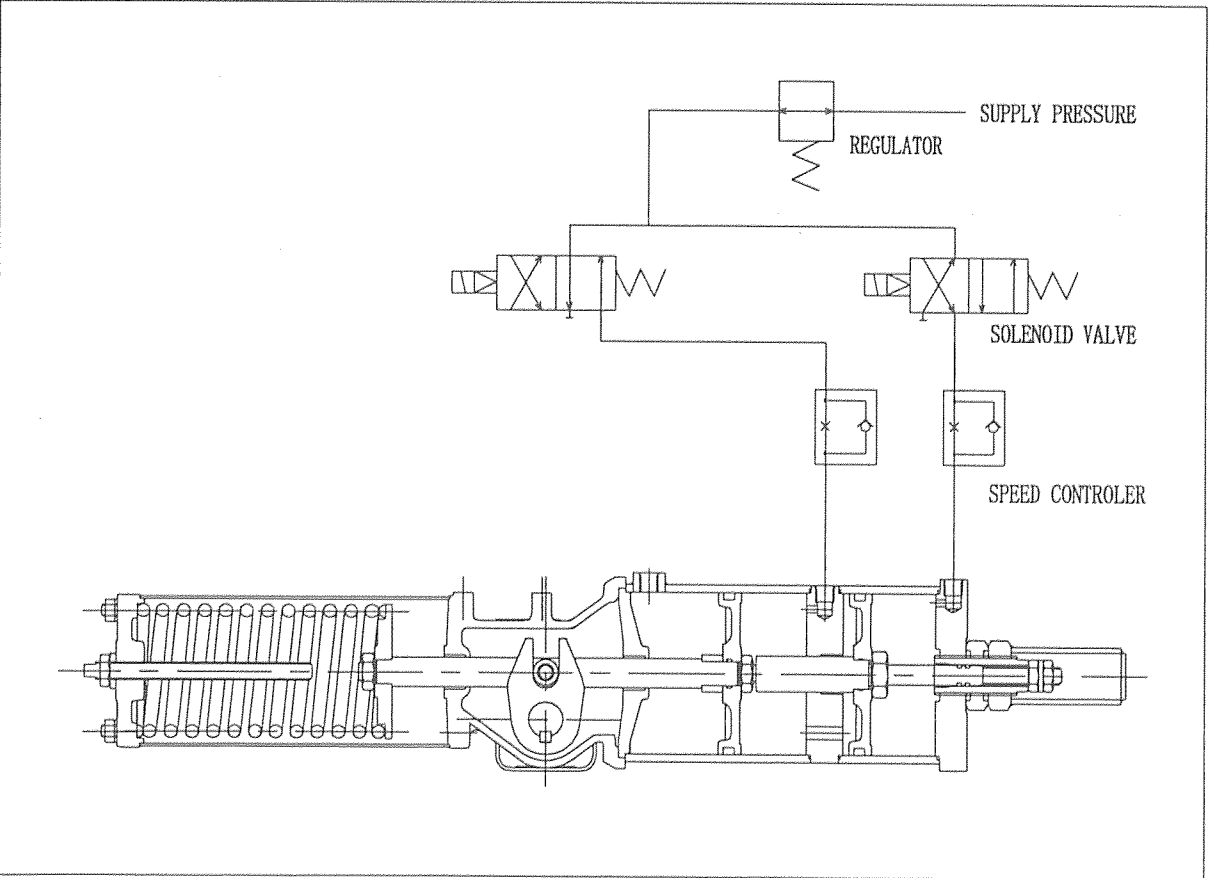
4.3 Where solenoid valve is not provided with manual button and bypass valve

When supply air pressure remains inside, shut off the supply air line to the cylinder and disconnect three connectors from the air port of the actuator. Thereafter, operate the connector connected to the valve using a spanner.

When no supply air pressure remains inside, disconnect the three connectors from the air port and operate the connector connected to the valve using a spanner.



[Fig. 3] Air Piping Procedure (Double Acting Type)



[Fig. 4] Air Piping Procedure (Single Acting Type)

5. Check Points Prior to Operating

5.1 Double acting type (TDT Type)

- (1) Operate the actuator in manual mode to check the ball valve for smooth actuating. (In the case manual operation is unavailable, gradually raise the operating pressure up to 50 thru 80% of the specific operating pressure.)
- (2) Check that the supply air pressure has reached the specific pressure (standard pressure 4kgf/cm²G) .

5.2 Single acting type (TST Type)

- (1) Gradually raise the operating pressure up to 3kgf/cm²G to check the ball valve for smooth actuating. (Caution: For the single acting type (TST Type), avoid manual operation because the spring contained therein is hazardous due to its reaction force.)
- (2) Check that the supply air pressure has reached the specific operating pressure (Standard 4kgf/cm²G).

6. In-operating Cautions and Maintenance

- (1) Periodically remove drains from the air filter.
- (2) Both of the TDT and TST Types use special lubrication oil. Hence, these types in normal use require no oiler.
- (3) Check that the operating pressure is kept at the specified value (standard 4kgf/cm²G).
- (4) Check the specific check items periodically.

7. Overhaul and Reassembly Sequence

When overhauling the actuator for check and repair, follow the overhaul and reassembly sequence given hereunder.

7.1 Double acting type (TDT Type)

7.1.1 Overhaul

- (1) Overhaul the actuator at a dust-free place.
- (2) Apply "match mark" to each portion to be overhauled.
- (3) Overhaul piston-A, -B (part No.2 and 8) and drive shaft (part No. 3) with good care not to damage the sliding surfaces, O-ring, etc., in reference to [Fig.1].

7.1.2 Reassembly

- (1) Before reassembling, clean all the actuator components.
- (2) Reassemble the actuator at a clean place to avoid inclusion of foreign matter.
- (3) Apply coat of specific lubrication oil (Nippon Grease: NIGLUB A

No.1 or other equivalent) to cylinder (part No.5) internal, piston-A, -B (part No.2, 8) , drive shaft (part No.3), yoke (part No.5) and O-ring.

- (4) Assemble up the overhauled components so the stamped match marks match each other in reference to [Fig.1], with good care not to damage the sliding portions, O-ring, etc.
Further, apply coat of liquid packing (THREE BOND 1104 or other equivalent) between body (part No.10) and body cover (part No.12) and between body (part No.10) and rod guide (part No.11).
- (5) Check whether the actuator actuates smoothly at pressure of 0.5kgf/cm²G, throughout its full stroke.

7.2 Single acting type (TST Type)

<WARNING> A strong spring is built as compressed in the TST Type actuator and this spring could jump out due to its reaction force. Therefore, remove the spring case with good care for jump-out of the spring, where removed.

In overhauling, release completely the internal air pressure in advance.

7.2.1 Overhaul

- (1) Overhaul the actuator at a dust-free place.
- (2) Apply "match mark" to each portion to be overhauled.
- (3) Prepare long screws and spring pins of dimensions shown in [Table-1] on next page.
- (4) Unscrew one nut and subsequently one stud bolt. (Refer to [Fig.5].)
- (5) Screw one long screw (prepared in (3)) in the threaded hole from where the stud bolt was unscrewed, and lock it with lock nut.
- (6) Drive one spring pin (prepared in (3)) in the pin hole of the said long screw to thereby prevent loose of the long screw.
- (7) By repeating the above sequence, replace remaining stud bolts (4 pieces altogether) with the long screws and lock them with lock nut at the spring case side. After that, drive the spring pin in each long screw.
- (8) Loosen the nuts alternately and, when no more reaction force generates from the spring, dismount spring case A (part No. 23), spring case B (part No.24) and spring (part No.22) in sequence. After that, unscrew the long screws.
- (9) Overhaul piston-A,-B (part No.2, 8) and drive shaft (part No.3) with good care not to damage the sliding portions, O-ring, etc., in reference to [Fig.2].

7.2.2 Reassembly

- (1) Before reassembling, clean all the actuator components.
 - (2) Reassemble the actuator at a clean place to avoid inclusion of foreign matter.
 - (3) Apply coat of specific lubrication oil (Nippon Grease: NIGLUB A No.1 or other equivalent) to cylinder (part No.1) internal, piston-A, -B (part No.2, 8) , drive shaft (part No.3), yoke (part No.5) and O-ring.
 - (4) Assemble up the overhauled components in the reverse sequence of overhaul so the stamped match marks match each other in reference to [Fig.1], with good care not to damage the sliding portions, O-ring, etc.
Further, apply coat of liquid packing (THREE BOND 1104 or other equivalent) between body (part No.10) and body cover (part No.12) ,body (part No.10) and rod guide (part No.11), and spring case B (part No.24) and spring case A (part No.23)and body (part No. 10) respectively.
 - (5) Check whether the actuator actuates smoothly at pressure of 0.5kgf/cm²G, throughout its full stroke.
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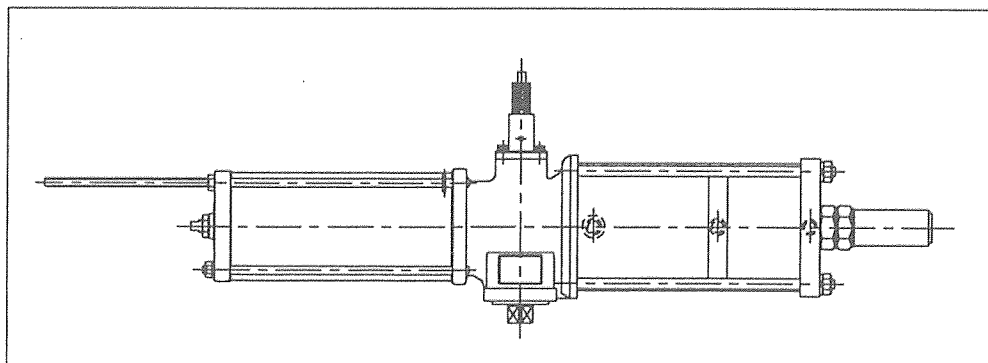
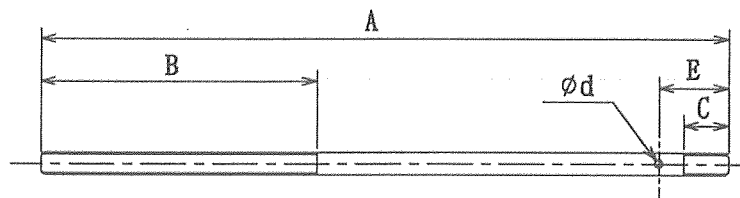
8. Change of Actuator Installing Direction

For changing the actuator installing direction, follow the sequence given hereunder.

- (1) Disconnect the air pipeline from the actuator not to allow incidental start of the actuator during the change work. Especially in the single acting type (TST Type), if the operating pressure comes to nil during the change work the spring could react hazardously.
- (2) Unscrew the bolts fixing the actuator to the yoke to separate the actuator from the yoke.
- (3) Set the actuator at an intended change position. (possible to change the position at 90-deg pitch.)
- (4) Tighten the said bolts after checking the actuator drive shaft bottom and connector for smooth insertion.
- (5) Reconnect the air pipeline and gradually raise the operating air pressure up to 50 thru 80% of the specific pressure to check the actuator for smooth actuating.

[Table.1] Long Screws and Spring Pins of Dimension

Type	Long Screws 4 pieces						Spring pins 4 pieces
	screw	A	B	C	ϕd	E	
TS1T	M 6 P1.0	270	110	9	$\phi 3$	20	3 \times 16
TS2T	M 6 P1.0	310	145	13	$\phi 3$	25	3 \times 16
TS3T	M 8 P1.25	410	180	16	$\phi 3$	25	3 \times 16
TS4T	M10 P1.5	640	310	19	$\phi 4$	30	4 \times 28
TS5T	M12 P1.75	730	295	22	$\phi 4$	35	4 \times 28



[Fig.5] Single Acting Type (TST Type)

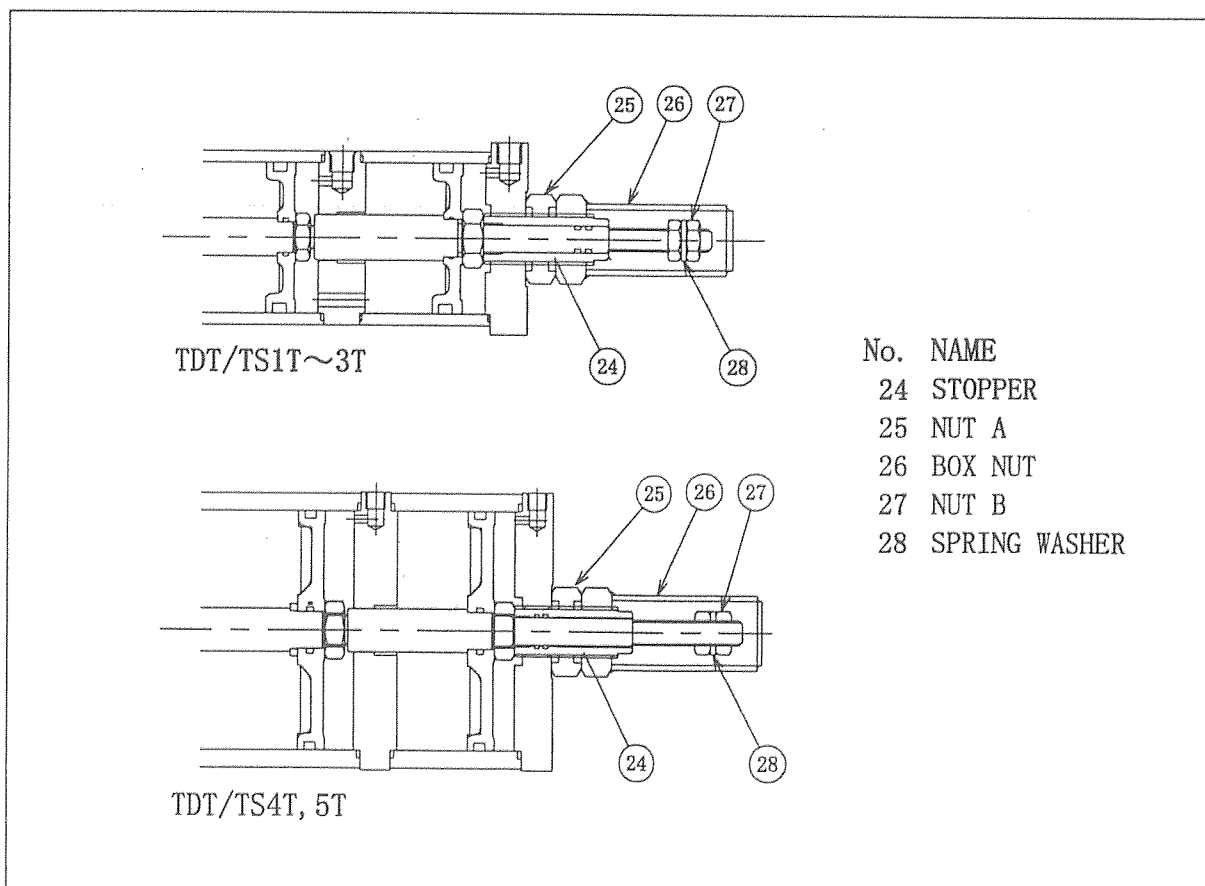
9. Medium Opening Angle Adjusting Procedure

Where adjustment of the medium opening angle is required, follow the sequence given hereunder, in reference to [Fig.6].

This medium open position can be set up to 45-deg position maximum, assuming FULL CLOSE position "0 deg" and FULL OPEN position "90 deg".

9.1 Double acting type (TDT Type)

- (1) Disconnect the air pipeline from the actuator not to allow incidental start of the actuator during the adjust work.
- (2) Unscrew the box nut (part No.26), with nut A (part No.25) kept tightened (locked) so stopper (part No.24) does not displace. (If the stopper displaces, it would cause FULL CLOSE position to fluctuate correspondingly.)
- (3) Loosen nut B (part No.27) and retighten it at any optional position. Shifting the nut B to the left allows the medium opening angle to approach toward FULL CLOSE position and shifting the same nut to the right allows the angle to approach 45-deg MEDIUM OPEN position.
- (4) After that, start the actuator to check the adjusted medium open position.
- (5) After completion of the adjustment, retighten the box nut for locking.



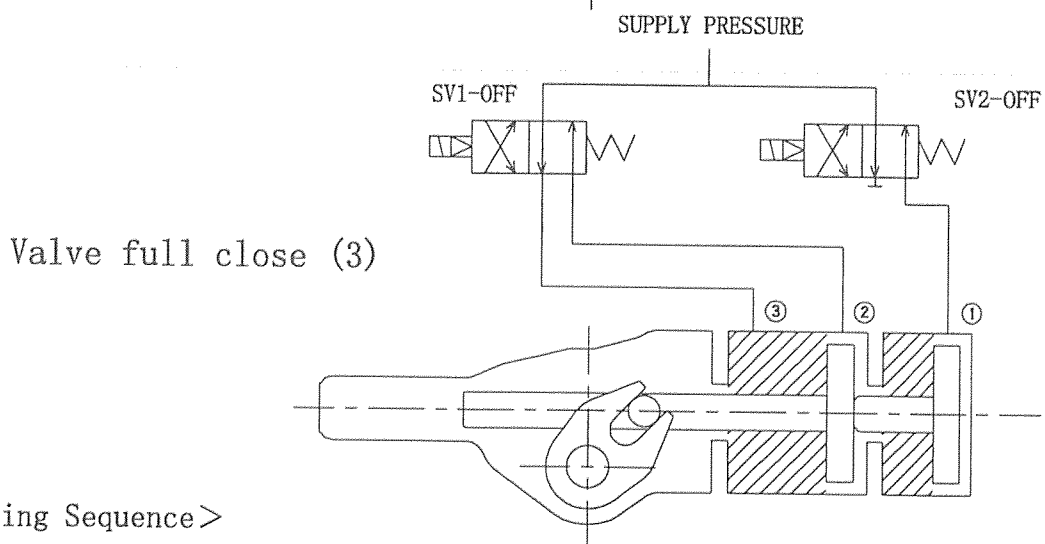
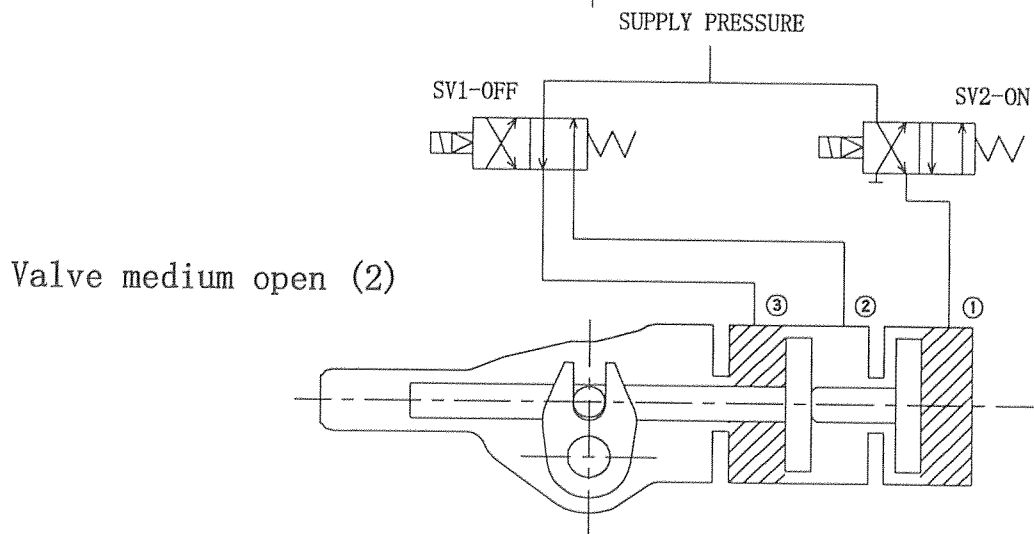
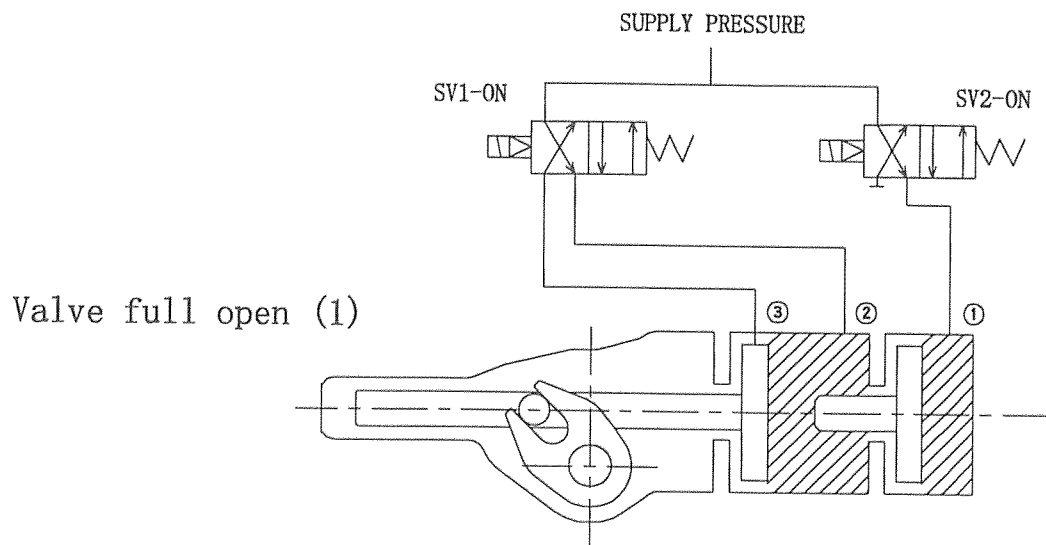
[Fig.6] Detail Drawing In Box Nut

9.2 Single acting type (TST Type)

- (1) Disconnect the air pipeline from the actuator not to allow incidental start of the actuator during the adjust work.
In the case of the single acting type (TST Type), if the operating air pressure comes nil during the adjust work, the spring reacts hazardously.
- (2) Unscrew the box nut (part No.26), with nut A (part No.25) kept tightened (locked).
- (3) Loosen nut B (part No.27) and retighten it at any optional position. Shifting the nut B to the left allows the medium opening angle to approach toward FULL CLOSE position and shifting the same nut to the right allows the angle to approach 45-deg MEDIUM OPEN position.
- (4) After that, start the actuator to check the adjusted medium open position.
- (5) After completion of the adjustment, retighten the box nut for locking.

10. Trouble Shooting

Phenomena	Check items or possible causes	Corrective actions
(1) No specified pressure in actuator	(1) Compressor, air pipeline pressure reducing valve, solenoid valve, etc. normal?	Repair them as necessary.
(2) Specified pressure is fed into actuator, but it fails to start.	(1) Bypass valve not in open?	Close it, if opened.
	(2) No inclusion of foreign matter in ball seat?	Overhaul the valve to replace ball seat.
	(3) Separate actuator from valve. In case the actuator fails to actuate at 0.5kgf/cm ² G or specific pressure. (Single acting at 3kgf/cm ² G)	Overhaul actuator to replace necessary parts. (However, the single type is hazardous because of spring contained therein Follow the overhaul sequence on page 7.)
	(4) Separate actuator from valve (but the case the valve actuates at specific actuating torque and less.) (The valve actuating torque differs depending on model, size and fluid. Contact us for the detail.)	Re-adjust valve to actuator coupling yoke.
	(5) Separate actuator from valve (but the case the valve fails to actuate at specific operating torque and less)	Over and repair the valve. Increase supply pressure to actuator or reselect actuator size.

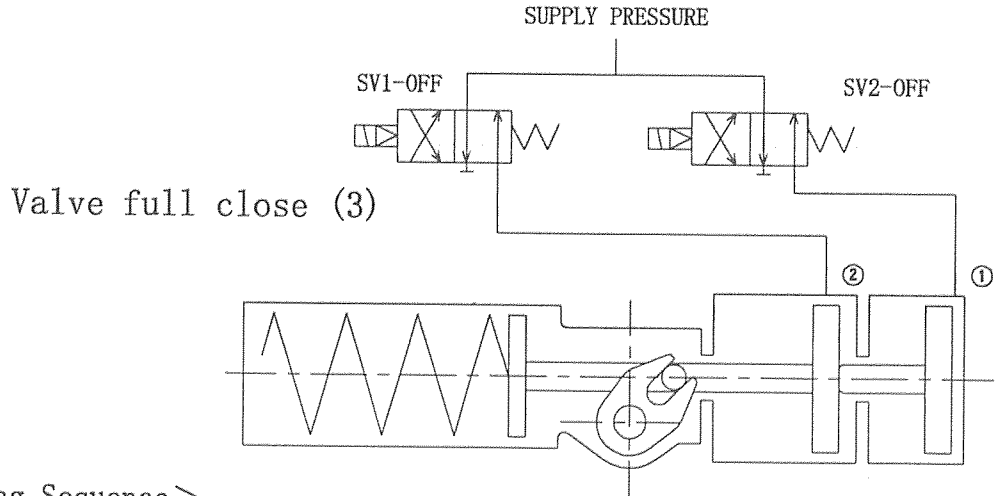
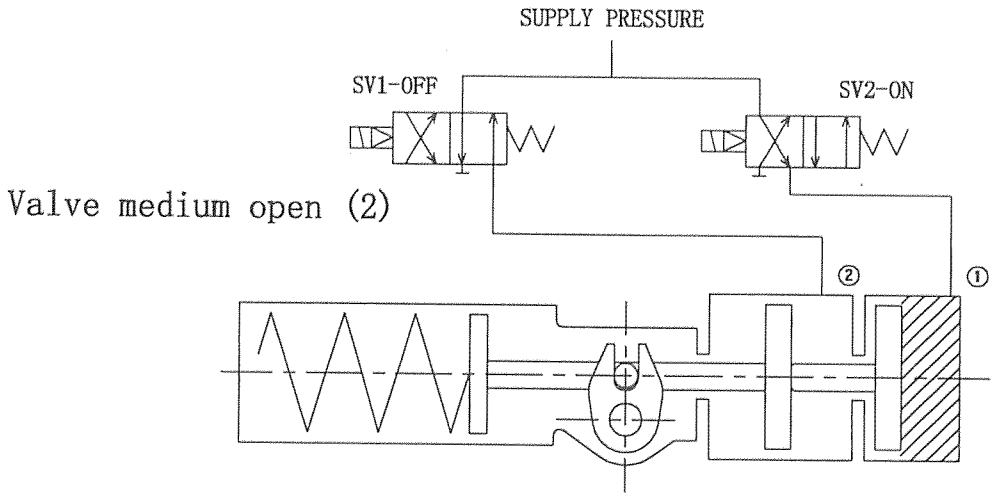
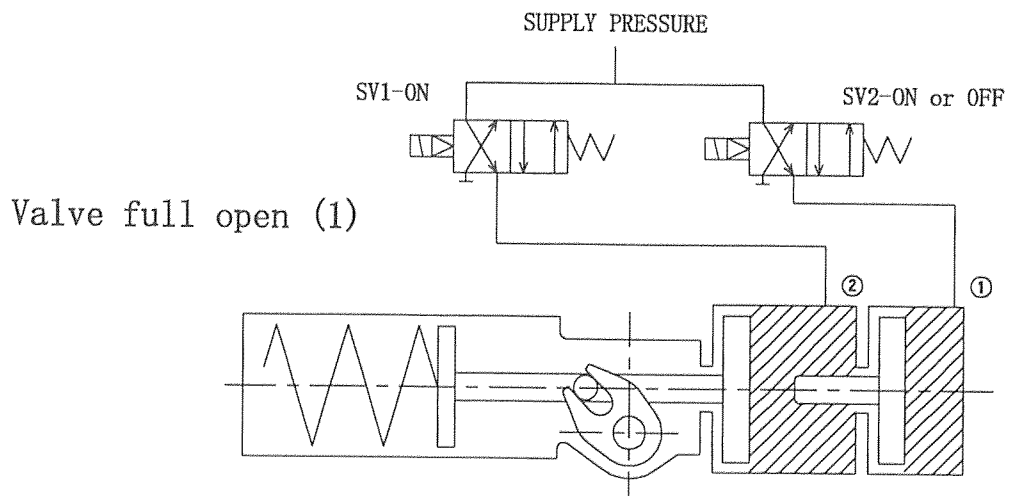


<Acting Sequence>

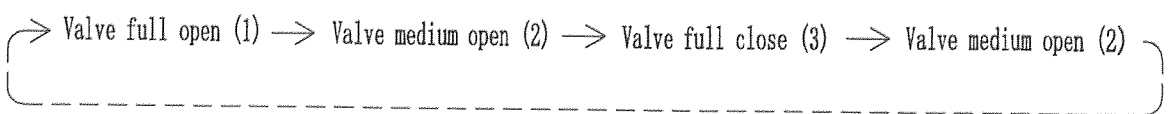


*Valve full close(3) → Valve medium open(2) is not acted

[Annexed Fig.1] Acting Sequence Flow (Double Acting Type)



<Acting Sequence>



※Action of air fail close is mentioned.
 In case air fail open, (1) is full close and (3) is full open.

[Annexed Fig.2] Acting Sequence Flow(Single Acting Type)

[Annexed Table.1] O-RING SIZE

No.	No. REQD	USING PLACE	Double Acting Type (TDT Type)				
			TD1T	TD2T	TD3T	TD4T	TD5T
14	1	PISTON A	P42	P48A	P70	P100	P145
15	1	PISTON B	P42	P48A	P70	P100	P145
16	1	DRIVE SHAFT	P14	P18	P24	P32	P45
17	1	DRIVE SHAFT	S14	S18	S24	S32	S45
18	1	PISTON ROD A	P9	P10	P16	P24	P29
19	1	PISTON ROD A	P12	P14	P20	P28	P35
20	1	PISTON ROD B	S12.5	S12.5	S20	P24	P31
21	2	PISTON ROD B	P7	P7	P10A	P18	P24
22	※	CYLINDER	S50	S60	S85	S112	Gs160
23	1	CYLINDER	S53	S65			

※ TD1T・TD2T- 3 Pieces, TD3T~TD4T- 4 Pieces

No.	No. REQD	USING PLACE	Single Acting Type (TST Type)				
			TS1T	TS2T	TS3T	TS4T	TS5T
14	1	PISTON A	P60	P70	P100	P145	P205
15	1	PISTON B	P60	P70	P100	P145	P205
16	1	DRIVE SHAFT	P14	P18	P24	P32	P45
17	1	DRIVE SHAFT	S14	S18	S24	S32	S45
18	1	PISTON ROD A	P9	P10	P16	P24	P29
19	1	PISTON ROD B	S12.5	S12.5	S20	P24	P31
20	2	PISTON ROD B	P7	P7	P10A	P18	P24
21	3	CYLINDER	S75	S85	S112	Gs160	Gs225

[Annexed Table.2] CYLINDER CAPACITY

Unit[cm³]

Type	CYLINDER (A)	CYLINDER (B)	CYLINDER (C)	※ 1 CYCLE
	V ₁	V ₂	V ₃	V = V ₁ + V ₂ + V ₃
TD 1 T	7 5	6 5	4 0	1 8 0
TD 2 T	1 5 5	1 4 0	8 5	3 8 0
TD 3 T	3 8 0	3 4 0	2 1 0	9 3 0
TD 4 T	9 5 0	8 5 0	5 5 0	2 3 5 0
TD 5 T	2 4 0 0	2 1 0 0	1 3 0 0	5 8 0 0
TS 1 T	1 6 5	Single Acting	9 5	2 6 0
TS 2 T	3 0 0		1 6 0	4 6 0
TS 3 T	7 3 0		4 2 0	1 1 5 0
TS 4 T	1 9 5 0		1 0 5 0	3 0 0 0
TS 5 T	5 1 0 0		2 8 0 0	7 9 0 0

※ 1 CYCLE …… Valve full open → Valve medium open → Valve full open