

No.OM-103E-R2

AIR OPERATION ACTUATOR
(TD/TS/TSH SERIES)
OPERATION MANUAL

— CONTENTS—

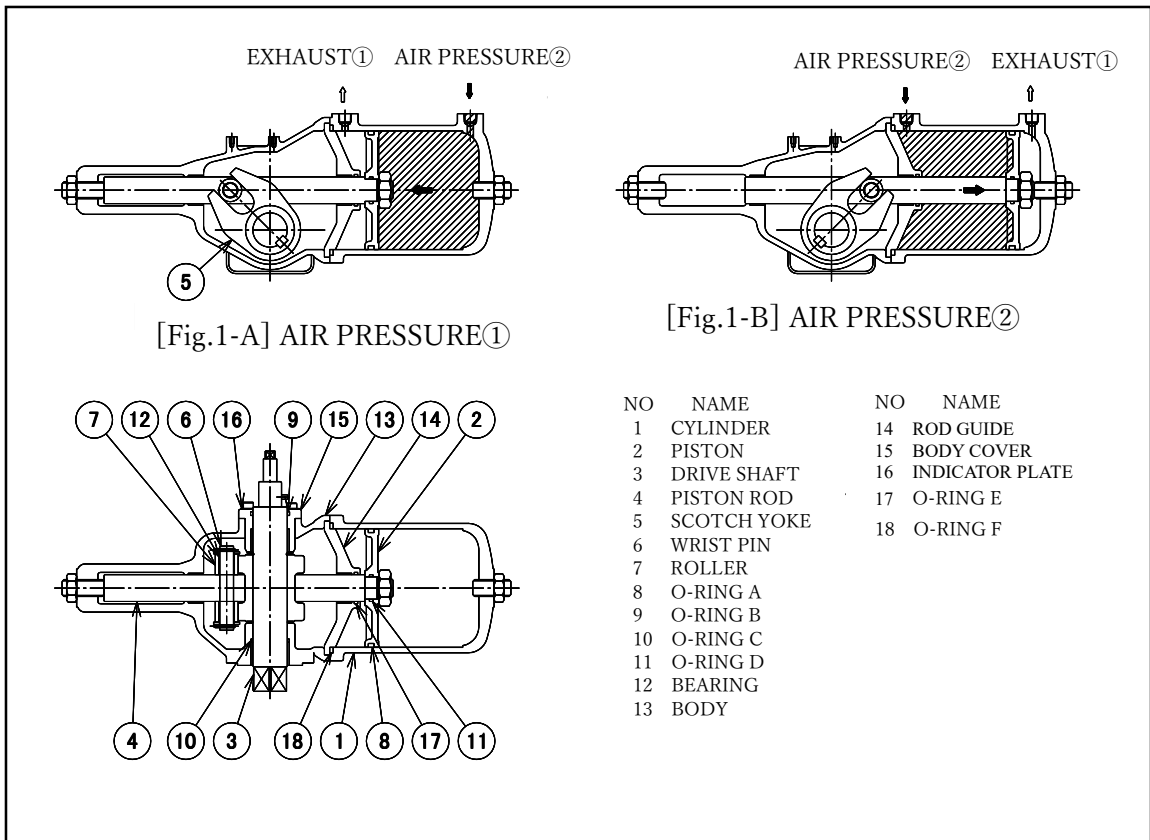
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1. Construction and Operating Principle

1.1 Double Acting Type (TD Type) [Fig.1]

Operation air pressure pressurizes piston (Part No.2) inside cylinder (Part No.1) and the linear motion generated by moving stroke of the cylinder is converted to rotational motion of the drive shaft via piston rod (Part No.4), wrist pin (Part No.6), bearing (Part No.12), roller (Part No.7) and scotch yoke (Part No.5).

At the moment when the operation air pressure is induced into the right air chamber (the oblique-lined zone in Fig.1-A) of the cylinder through the air inlet (1), the piston moves leftward to allow counterclockwise rotation of the drive shaft and the air is exhausted from the air chamber located at piston leftside through the air out (2). Furthermore, the operation air pressure which is fed into the left air chamber (the oblique-lined zone in Fig. 1-B) by pressurizing the air from the air inlet (2) allows rightward movement of the piston, whereby the drive shaft is rotated clockwise.

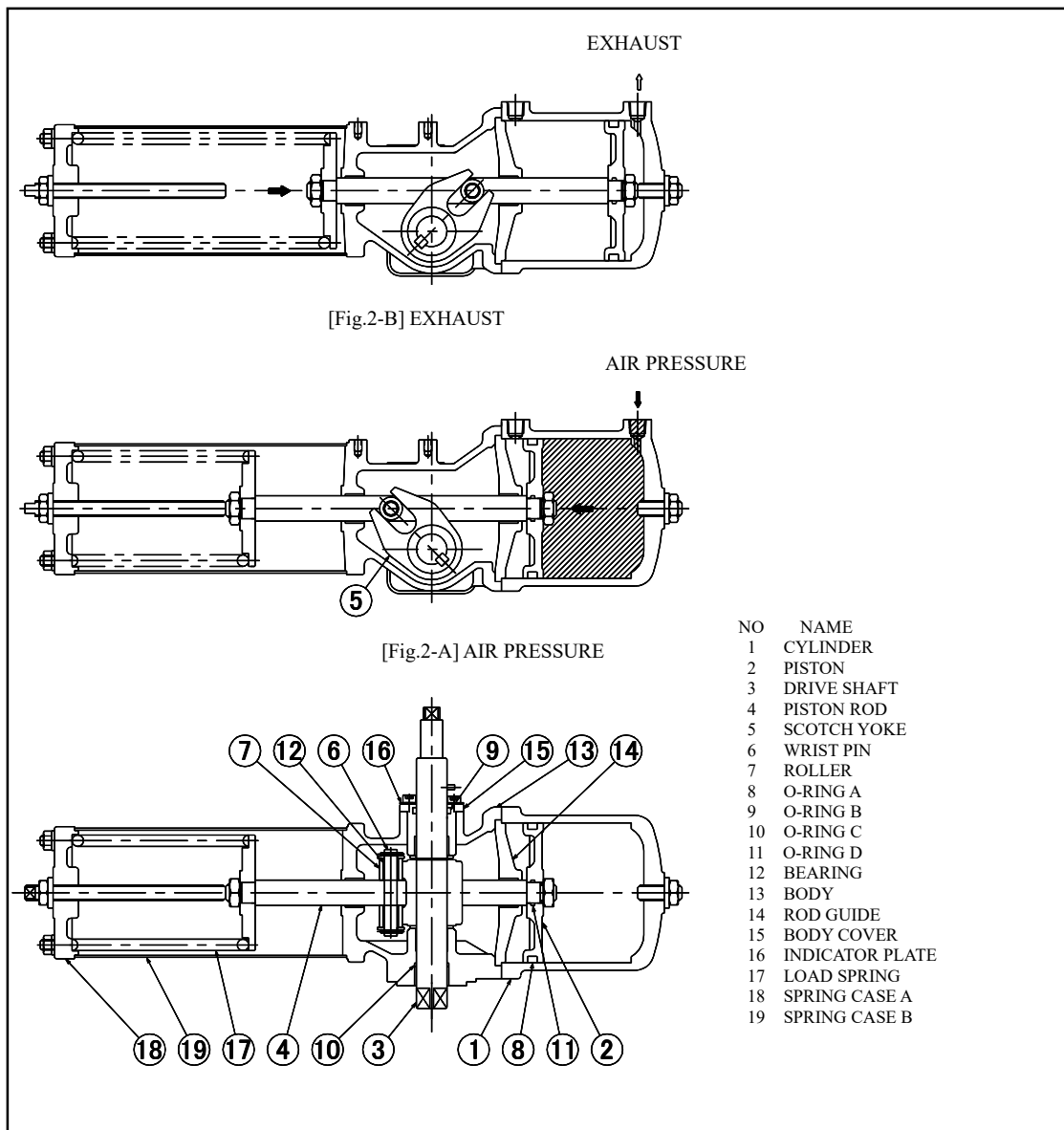


[Fig. 1] Double Acting Type(TD Type)

1.2 Single-acting Type (TS Type) [Fig.2]

Where operation air pressure is induced through air inlet (1), the oblique-lined zone in Fig.2-A moves similarly to the double-acting type, allowing counterclockwise movement of the drive shaft (Part No.3), whereby load spring (Part No.17) is compressed.

When the operation air pressured is reduced to 0 value, the drive shaft is rotated clockwise by reaction force of the load spring to return the valve to the condition (Fig.2-B) before air-operated.



[Fig.2] Single-acting Type (TS Type)

1.3 Single-acting Type with manual handle (TSH type) [Fig.3]

1.3.1 Operation by air

When operation air pressure is induced through air inlet (1) similarly to the single acting type (TS type), the oblique-lined zone in Fig.3-A moves similarly to the double-acting type, allowing counterclockwise rotation of the drive shaft (Part No.3), whereby the load spring (Part No.11) is compressed.

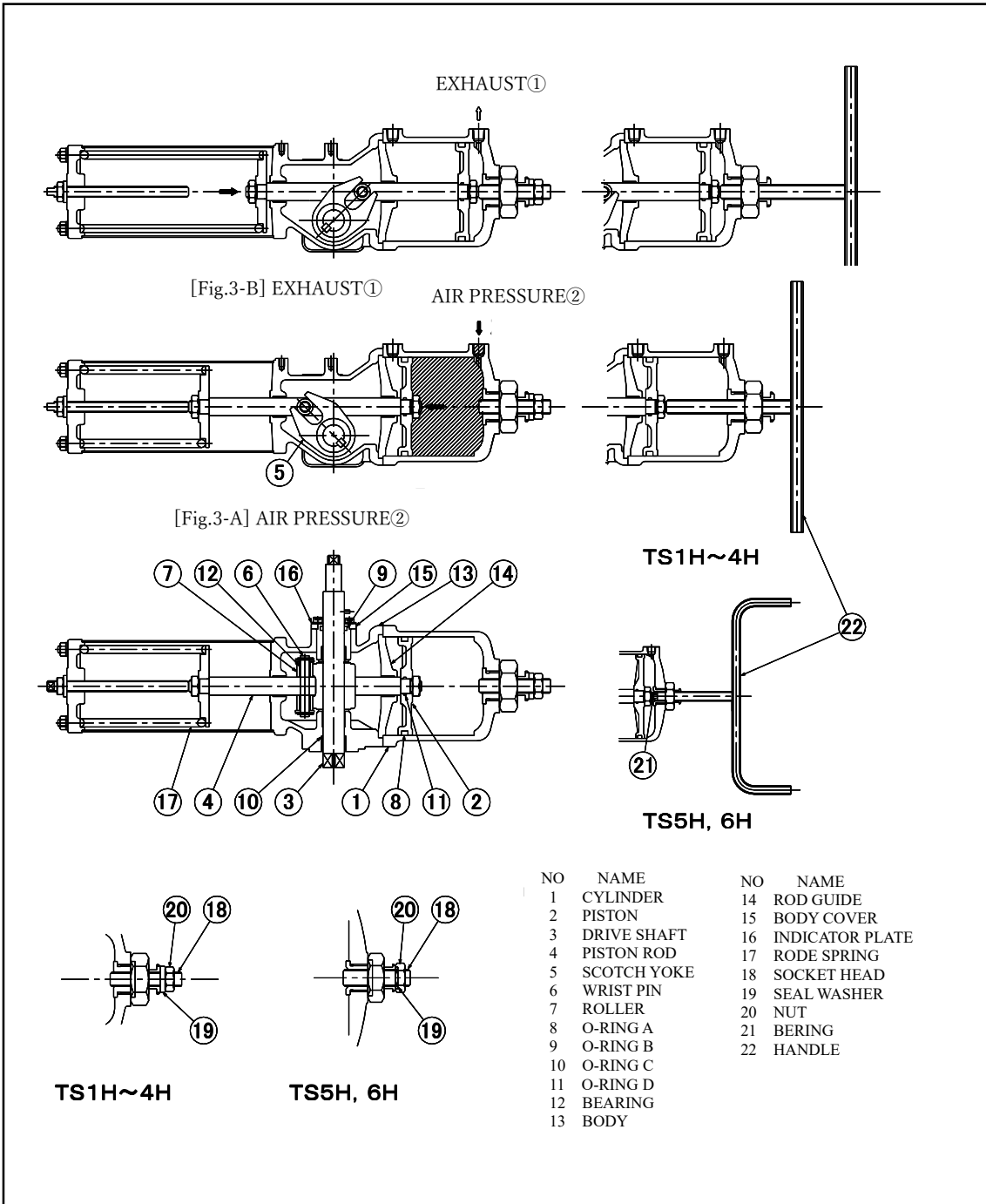
When the operation air pressured is reduced to 0 valve, the drive shaft is rotated clockwise by reaction force of the load spring to return the valve to the air pressure- operated condition (Fig.-B)

1.3.2 Operation by manual handle

Follow the operation sequence given below.

- (1) When air remains inside the cylinder (Part No.1), stop air feed completely and make directional change of the solenoid valve.
- (2) Be sure to check complete purge-out of the air.
- (3) Apply a match make to the hexagon socket head set screw (Part No.18) for the stopper so that the stopper can be set in same position after manual operation.
- (4) Unscrew and remove the nut (Part No.20), seal washer (Part No.19), and hexagon socket head screw (Part No.18).
- (5) Be sure to check that no foreign matter is adhered to the threaded portion of the manual handle (Part No.22). Remove it if adhered.
- (6) Be sure to check that the threaded portion and screw end of the manual handle (bearing (Part No.21) for TS5H and TS6H) are properly greased. If the grease amount is inadequate, apply further coat of grease to them.
The recommended grease brand is **Shell Alvania Grease EP-2** or other equivalent.
- (7) Clockwise turn of the manual handle (Part No.22) rotates the drive shaft (Part No.3) counterclockwise.
- (8) When shifting to air operation mode from manual handle operation, remove the manual handle (Part No.22) and store it in a bag after checking that it is free from adhesion of foreign matter.
- (9) Restore the hexagon socket head set screw (Part No.18), seal washer (Part No.19) and nut (Part No.20) so that the match marks on them match each other.

*After complete reassembly of the valve as an automatic valve, clockwise turn of its manual handle rotates the ball counterclockwise.



[Fig.3] Single-acting Type with manual handle (TSH Type)

2. Operation Air Piping Procedure

2.1 Required air flow rate

Calculate the required air flow before connecting the air pipeline to the actuator.

The supply air flow less than the required rate would cause actuating failure of the valve.

Where an air tank is used, preset the tank pressure to 0.49 to 0.69MPaG.

2.2 Air consumption of cylinder

Air consumption of the cylinder is air discharge rate per minute of the actuator in the case when the actuator actuates around n-cycles per hour.

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

Q : Air consumption per minute (N litre / min)

V : Cylinder capacity (L) [one reciprocal] see Attachment-1)

P : Supply pressure (MPaG)

n : Cycles of piston moving strokes per hour (1 cycle = 1 reciprocation)

Calculate the required capacities of compressor and air receiver with a margin of 30% or more against the normal capacities, considering leakage and loss from the air pipeline and pipe fittings.

2.3 Where installation of instruments at our side is specified;

The standard actuator specifications does not include installation of instrumentation, but the following are optionally offerable ; drip-proof solenoid valve / explosion-proof solenoid valve, drip-proof limit switch /explosion-proof limit switch, silencer, speed controller, and pressure reducing valve with filter.

Specify and order the drip-proof type and explosion-proof type when deemed as necessary according to the operating environment.

Each valve unit is shipped, with the ball valve opened, from our Plant (but the single acting type shipped with its ball valve closed.). You are requested to check if this is per your specification.

2.4 Where instruments are installed at your side;

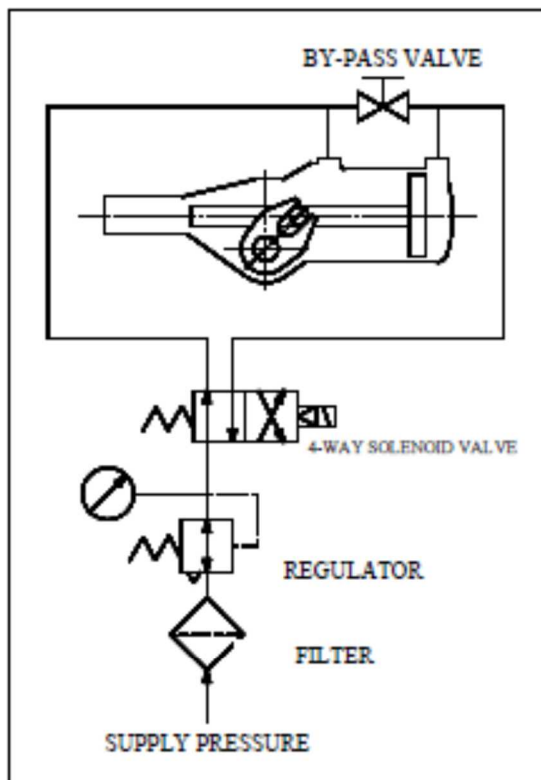
Perform the related instrument piping in reference to the flow sheets in Figs.4 to 7.

2.5 Precautions for instrument piping

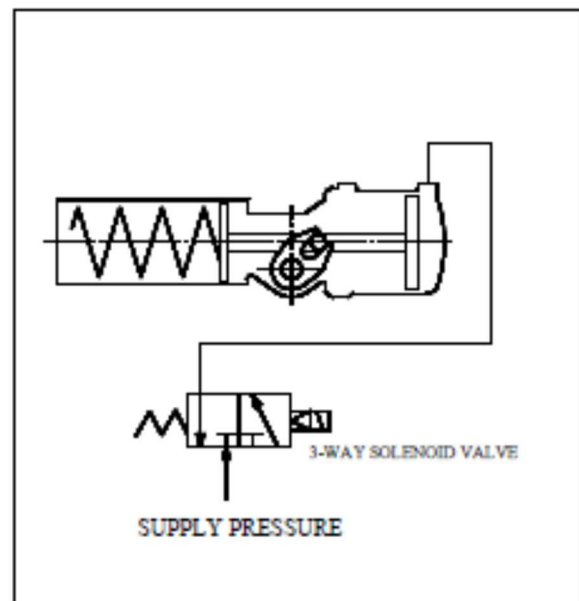
- (1) Feed operation air via a proper filter for complete filtration of water content, oil content and other foreign matter.
- (2) After installation of each device, apply flushing to it for complete removal of dust, mist, chips, etc. therefrom. (Further, the flushing pressure to be applied shall be higher than the maximum operating pressure of each device.)
- (3) The actuator can be mounted in any direction, but mount filter and oiler in

vertical position.

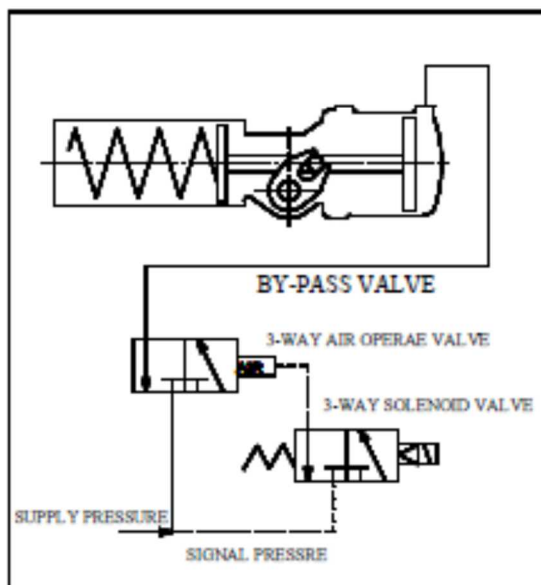
- (4) For the solenoid valve intended to change over operation air flow, select a 4-port solenoid valve for the double-acting type and 3-port solenoid valve for the single acting type respectively. (4-port solenoid valve may be used instead of 3-port valve, subject to plugging of one port by a blind plug.)
- (5) After piping connection, boost the air pressure to the required operation pressure (standard valve : 0.39MPaG) from 0 MPaG by means of pressure reducing valve. And check that each pipe joint is free from air leakage.
- (6) Use each valve under an operating environment where temperature ranges from -20°C to +80°C.



[Fig.4] Double Acting

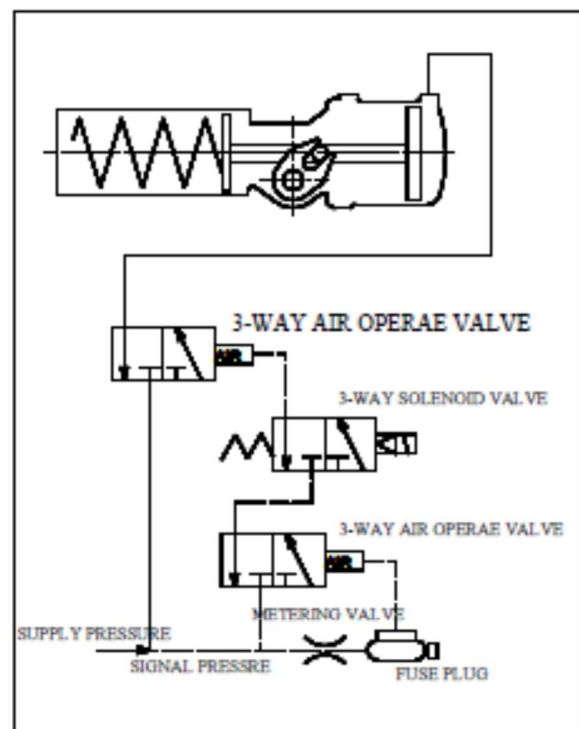


[Fig.5] Single Acting



[Fig.6] Single Acting

For electric current is cut off.
For supply pressure is cut off.



[Fig.7] Single Acting

For electric current is cut off.
For supply pressure is cut off.
For atmosphere high-temp.

3. Manual Mode Operation

Avoid manual operation of the single- acting type (TS Type) because it is dangerous due to the spring contained therein. Where manual operation is inevitably required, select TSH type with single-acting manual handle. (For manual mode operation sequence, see Para.1.3.2.)

For operation of the double -acting type, follow the sequence given below.

3.1 In the case of solenoid valve with manual button

When supply air is available, open and close the valve using the manual button of the solenoid valve.

When no supply air is available, operate the valve and the connector using a spanner wrench, while operating the manual button of solenoid valve.

3.2 In the case with bypass valve

Open the bypass valve (See Fig.4) and operate the valve and connector using a spanner wrench. Close the bypass valve after end of manual mode operation.

3.3 With no manual button and bypass valve

When supply air is available, shut off the air fed line to the cylinder and disconnect two air connectors of the actuator. Thereafter, operate the valve and the connector using a spanner wrench.

When no supply air is available, disconnect two air inlet connectors and operate the valve and connectors using a spanner wrench.

4. Starting Precautions

4.1 Double-acting type (TD type)

(1) Check the ball valve for smooth action by manual operation (Where manual operation is unavailable, slowly raise the operating pressure to 50-80% of the required pressure.).

(2) Check that the air pressure is as specified (Standard ; 0.39MPaG).

4.2 Single-acting type (TS type)

(1) Check the ball valve for smooth acting while slowly raising the air pressure up to 0.29MPaG.(Further, avoid manual operation of the single acting type (TS type) because it is dangerous due to a spring contained therein.)

(2) Check that the air pressure is as specified (Standard : 0.39MPaG).

4.3 Single-acting type (TSH type)

(1) Check the ball valve for smooth acting by manual handle operation (where no manual operation is available, slowly raise the air pressure up to 0.29MPaG)

(2) Check that the air pressure is as specified (Standard : 0.39MPaG)

5. In-operation Cautions and Maintenance

- (1) Periodically make complete drain out of air filter.
- (2) TD/TS type use lubrication oil (Shell Alvania Grease EP-2), usually requiring no oiler.
- (3) Check that the air pressure is as specified (Standard : 0.39MPaG)
- (4) Check each component periodically.

6. Overhaul and Reassembly Procedure

When overhauling the actuator for check and repair, follow the sequence given below.

6.1 Double-acting type (TD type)

6.1.1 Overhaul

- (1) Do overhaul at a mistless place.
- (2) Apply a match mark to each of the components and portions to be overhauled.
- (3) Where required, overhaul piston (Part No.2) and drive shaft (Part No.3) in reference to Fig.1, with good care not to damage the sliding portion and O-ring.

6.1.2 Reassembly

- (1) Clean all the components before assembling up.
- (2) Do the assembly work at a clean place to avoid inclusion of foreign matter.
- (3) Apply coat of lubrication oil. (Shell Alvania Grease EP-2 or other equivalent) to cylinder (Part No.1) internal, piston (Part No.2), drive shaft (Part No.3), scotch yoke (Part No.5) and O-ring respectively.
- (4) Assemble up the overhauled components in sequence so that the match marks thereon match each other, in reference to Fig. 1 and with good care not to damage the sliding parts, O-ring, etc. Further, apply proper coat of liquid packing (THREE BOND 1104 or other equivalent) between body (Part No.12) and body cover (Part No.15) and between body (No.13) and rod guide (Part No.14).
- (5) Check the valve for smooth acting throughout full stroke at pressure of 0.05 MPaG.

6.2 Single-acting type (TS type)

<WARNING> TS type actuator contain therein a strong spring as compressed.

Overhauling the actuator could result in hazard of jump-out of this spring. Therefore, exercise special care when removing the spring case.

Before overhauling, completely purge the air pressure out of the actuator.

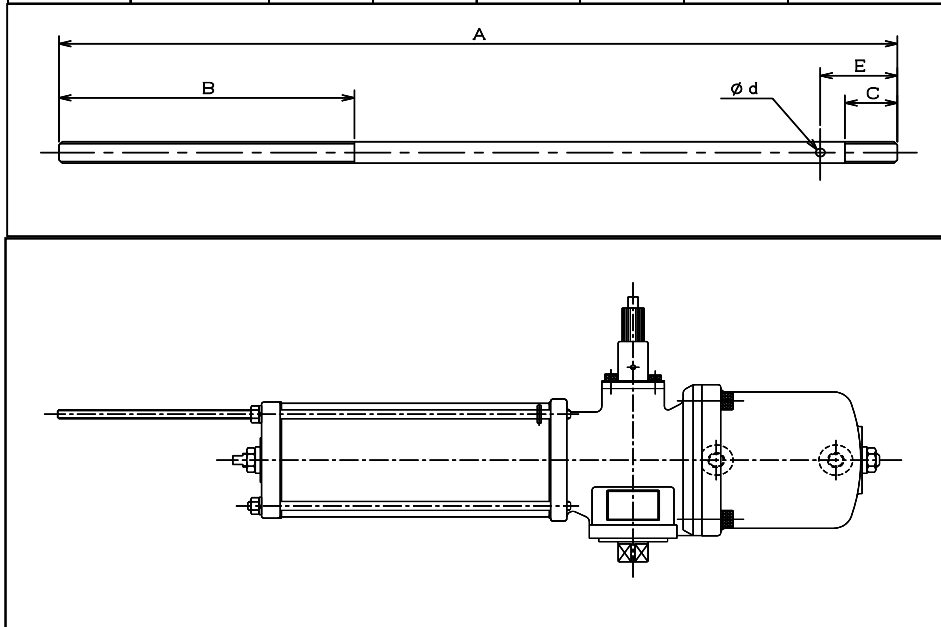
6.2.1 Overhaul

- (1) Do overhaul at a mistless place.
- (2) Apply match mark to all the components to be overhauled.
- (3) Prepare long screws and spring pins of dimensions as shown in Table on next page.

- (4) Unscrew off one nut and one stud bolt. (See Fig.8)
- (5) Screw a prepared long screw into the stud bolt hole (stud bolt unscrewed in step (4)) and lock it with the same nut.
- (6) Drive a spring pin in the long screw pin hole to prevent the long screw from loosening.
- (7) Thus, replace four stud bolts with long screws in sequence and, thereafter, drive spring pin with the spring case fixed with nuts.
- (8) Loosen the nuts alternately and, when reaction force of the spring comes to zero, remove the spring case-A, spring case-B and spring in sequence. Thereafter, unscrew the long screws.
- (9) Overhaul piston (Part No.2) and drive shaft (Part No.3) in sequence in reference to Fig.2, with good care not to damage the sliding portion, O-ring, etc.

[Table] List Parts used for overhaul of spring case

MODEL	LONG BOLT						SPRING PIN 4 PCS
	SCREW	A	B	C	ϕd	E	
TS1/TS1H	M6 × P1.0	270	110	9	$\phi 3$	20	3 × 16
TS2/TS2H	M6 × P1.0	310	145	13	$\phi 3$	25	3 × 16
TS3/TS3H	M8 × P1.25	410	180	16	$\phi 3$	25	3 × 16
TS4/TS4H	M10 × P1.5	640	310	19	$\phi 4$	30	4 × 28
TS5/TS5H	M12 × P1.75	730	295	22	$\phi 4$	35	4 × 28
TS6/TS6H	M16 × P2.0	880	380	28	$\phi 4$	40	4 × 28



[Fig.8] Single - Acting Type

6.2.2 Reassembly

- (1) Clean all the components before assembling up.
- (2) Do assembly work at a clean place to prevent inclusion of foreign matter.
- (3) Apply coat of lubrication oil (Shell Alvania Grease EP-2 or other equivalent) to cylinder (Part No.1) internal, piston (Part No.2), drive shaft (Part No.3), skirt choke (Part No.5) and O-ring respectively.
- (4) Assemble up the overhauled components in sequence so that the match marks thereon match each other, in reference to Fig.2 and with good care not to damage the sliding parts, O-ring, etc. Further, apply proper coat of liquid packing (THREE BOND 1104 or other equivalent) between body (Part No.13) and body cover (Part No.15), between body (No.13) and rod guide (Part No.14), and between the spring case B (Part No.19) and spring case A (Part No.18) / body (Part No.13).
- (5) Check the valve for smooth acting throughout full stroke at pressure of 0.29MPaG.

7. Change of Actuator Mounting Direction and three-way Valve Flow Direction

When change must be made to the actuator mounting direction and three - way valve flow direction due to the changed specification, follow the sequence given below.

7.1 Change of actuator mounting direction

- (1) Disconnect the air pipeline from the actuator not to allow incidental starting of the actuator in the case of single - acting type (TS/TSH type), the spring could work when the operation pressure is reduced to 0 during change work. This is hazardous.
- (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 at pitch of 90 deg.)
- (4) Tighten the bolts after checking the actuator drive shaft lower for smooth fit in the connector.
- (5) Reconnect the air pipeline to the actuator and slowly raise the air pressure up to 50 to 80% of the required operation pressure to check the actuator for smooth actuating.

7.2 Change from AIRLESS CLOSE [OPEN] to AIRLESS OPEN [CLOSE]

- (1) Disconnect the air pipeline from the actuator not to allow incidental starting of the actuator in the case of single-acting type (TS/TSH type), the spring could work when the operation pressure is reduced to 0 during change work. This is hazardous.
- (2) Check that the valve is in CLOSE [OPEN] and, thereafter, unscrew the bolts fixing the actuator to the yoke to separate the actuator from the yoke.

- (3) Shift the valve to OPEN [CLOSE] position using a spanner wrench and set the actuator in such a condition.
- (4) Tighten the bolts after checking the actuator drive shaft lower for smooth fit in the connector.
- (5) Reconnect the air pipeline to the actuator and slowly raise the air pressure up to 50 to 80% of the required operation pressure to check the actuator for smooth actuating.

7.3 Change of three-way valve flow direction (See attachment - 4)

- (1) Disconnect the air pipeline from the actuator not to allow incidental starting of the actuator in the case of single-acting type (TS/TSH type), the spring could work when the operation pressure is reduced to 0 during change work. This is hazardous.
- (2) Unscrew the bolts fixing the actuator to the yoke to separate the actuator from the yoke.
- (3) Watch the groove on valve stem upper to check valve flow direction and move the stem to a position of flow direction to be changed.
- (4) Check the actuator for rotational direction (clockwise or counterclockwise) and set the actuator at an intended change position.
- (5) Tighten the bolts after checking the actuator drive shaft lower for smooth fit in the connector or stem.
- (6) Reconnect the air pipeline to the actuator and slowly raise the air pressure up to 50 to 80% of the required operation pressure to check the actuator for smooth actuating.

8. Trouble Shooting

Phenomenon	Check items or possible causes	Corrective action
(1) No specified air pressure in actuator	(1) Compressor, air pipeline, pressure reducing valve, solenoid valve, etc. normal?	Repair
(2) Specified pressure available in actuator, but actuator fails to work	(1) Bypass valve opened or closed?	If opened, close it.
	(2) Inclusion of foreign matter in ball seat?	Overhaul the valve to replace ball seat.
	(3) When actuator is separated from the valve and fails to work at 0.05MPaG or the required pressure (single-acting :0.29MPaG)	Overhaul the actuator. Replace parts (But the single- acting type is hazardous because it contains spring therein.) Follow the overhaul procedure on P8.
	(4) When actuator is separated from the valve and the valve works at below the required torque ; (Valve actuating torque differs depending on model, size and fluid applied. Feel free to contact us for any inquiry.)	Re-adjust valve and actuating mounting yoke.
	(5) When actuator is separated from the valve and the valve fails to work at below the required torque value:	Overhaul the valve for repair. Raise the feed pressure to the actuator or reselect actuator size.

[Attachment-1] Cylinder Capacity List

UNIT[cm³]

Type	Air-supply①	Air-supply②	1 cycle
	V ₁	V ₂	V = V ₁ + V ₂
TD1	80	80	160
TD2	160	160	320
TD3	390	380	770
TD4	960	960	1920
TD5	2500	2400	4900
TD6	4800	5000	9800
TD7	10500	9000	19500
TD8	22000	19500	41500
TD9	43500	37500	81000
TS1	180	Spring Acting	180
TS2	300		300
TS3	730		730
TS4	1950		1950
TS5	5100		5100
TS6	10600		10600
TS7	23000		23000
TS8	49000		49000

[Attachment-2] Weight List

UNIT[kg]

Double acting type (TD Type)								
TD1	TD2	TD3	TD4	TD5	TD6	TD7	TD8	TD9
2.5	4	8	16.5	34	70	145	255	480

Single acting type (TS Type)							
TS1	TS2	TS3	TS4	TS5	TS6	TS7	TS8
4.5	8	15.5	36.5	82	180	370	690

Single acting type with manual operation (TSH Type)						
TS1H	TS2H	TS3H	TS4H	TS5H	TS6H	TS7H
4.5	8	16	37.5	84	183	400

[Attachment-3] O-ring Size

Parts No.	NO. REQD	use point	Double acting type (TD Type)								
			TD1	TD2	TD3	TD4	TD5	TD6	TD7	TD8	TD9
8	1	PISTON	P42	P48A	P70	P100	P145	P185	P235	P290	P385
9	1	DRIVE SHAFT	P14	P18	P24	P32	P45	P60	P65	P80	P100
10	1	DRIVE SHAFT	S14	S18	S24	S32	S45	G60	S65	S80	G100
11	1	PISTON ROD	P9	P10	P16	P24	P29	P32	P35	P40	P50
16	1	PISTON ROD	P12	P14	P20	P28	P35	P40	P50	P60	P80
17	1	CYLINDER	G52	G62	G85	G115	G160	G205	Gs255	Gs310	G405

Parts No.	NO. REQD	use point	Single acting type (TS / TSH Type)							
			TS1	TS2	TS3	TS4	TS5	TS6	TS7	TS8
8	1	PISTON	P60	P70	P100	P145	P205	P275	P350	P435
9	1	DRIVE SHAFT	P14	P18	P24	P32	P45	P60	P65	P80
10	1	DRIVE SHAFT	S14	S18	S24	S32	S45	G60	S65	S80
11	1	PISTON ROD	P9	P10	P16	P24	P29	P32	P35	P40

[Attachment-4] Three-way ball valves Assemble Type

DOUBLE ACTING	TD		TD	
	counter clockwise	clockwise	clockwise	counter clockwise
SINGLE ACTING	TS/TSH		※TSR (REVERSE SPRING)	
	Air to counter clockwise	Air less clockwise	Air to clockwise	Air less counter clockwise
T-PORT				
L-PORT				