

# INSTRUCTION MANUAL FOR CONTROL VALVES

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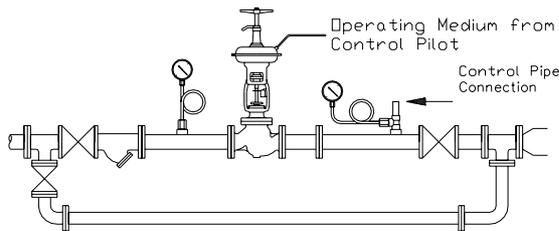
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**CONTROLS, INC.**

## SECTION I : 2-WAY CONTROL VALVE

### A. INSTALLATION

**1. Valve Body:** Set control valve in the horizontal line of piping in an accessible location with the arrow on the side of the valve body in the direction of fluid flow. Upright positioning of control valve is preferable for ease of maintenance.



<Fig. 1> Typical installation

Work spaces around the control valve body are to be provided sufficiently for easy removal or reinstall of parts during maintenance.

**Caution:** Piping systems are to be flushed thoroughly with sufficient amount of water or air prior to installation of control valve body and strainer to prevent possible damage on the internals by foreign materials after commissioning.

**2. Strainer:** To be installed between the inlet block valve and control valve. In case other strainer is installed upstream line, this strainer may be deleted.

**3. Isolation valves:** Stop valves (and gauges if necessary) in inlet and outlet lines are to be installed to provide means for checking, adjustment or emergency maintenance during operation.

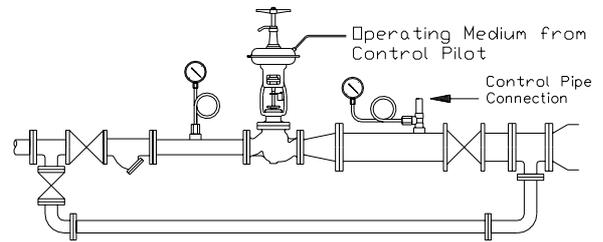
**4. Bypass valve:** Set a bypass around the control valve for emergency use when the control valve needs to be isolated.

**5. Air tubing:** Connect air tubing between the controller and diaphragm actuator or the valve positioner (if one is in use). Maximum allowable operating pressure for diaphragm actuators is 4 kg/cm<sup>2</sup> (60 psig).

**6. Piping for large pressure drop:** Recommended piping for the compressible fluids with large pressure drop (control valve outlet pressure equals 25% or less of inlet pressure) across the control valve is as follows:

- Expand outlet pipe to twice the control valve inlet pipe size. Use tapered expander.

- Connect sensor impulse pipe for controller ahead of outlet stop valve and at least 2' to 3' downstream from the end of expander.



<Fig. 2> Typical control valve layout for control of compressible fluids at 25% or less of inlet pressure

### B. OPERATION

**1. Isolation:** Close inlet and outlet stop valves.

**2. Movement check:** Check if control valve responds properly through rated travel in relation to the changes in operating pressure in the diaphragm. Rated travel is shown by the position of the indicator on the valve stem relative to the indicator plate scale on the yoke.

**3. Manual operation:** Manually operate control valve fitted with manual operating devices through the rated travel range to check freedom of movement. Return manual operating devices to its stand-by position.

**4. Commissioning:** Place control valve in operation in accordance with the operating instructions provided with controller or other operating device.

### C. MAINTENANCE

To reduce maintenance time refer to proper drawing and follow the steps shown below for applicable maintenance.

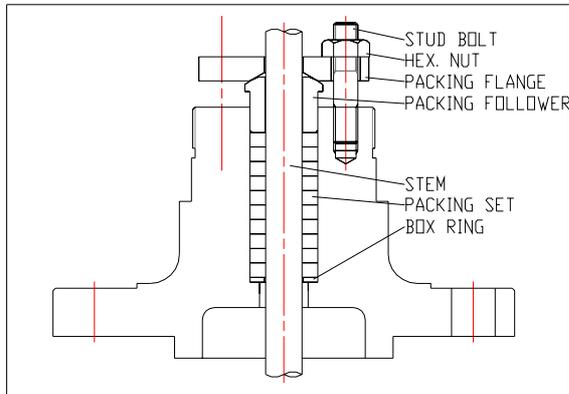
**1. Renewing packing set** (See Fig. 4~7 in appendix):

(1)**Replacement:** Renew the valve stem packing if control valve has been in service beyond normal maintenance interval with packing showing signs of wear. Wear will be indicated by leakage which can not be corrected by minor tightening of packing flange.

**Caution:** Over-tightening of the packing flange can cause erratic operation of the valve.

**Note:** Where graphite packing is used, additional packing can be installed to overcome minor leakage without dismantling the control valve.

Close the inlet and outlet stop valves and check that valve body is not under pressure. Remove nuts and lift packing flange and packing follower in sufficient height on the valve stem to apply the split packing around diameter of valve stem. Lower packing follower over the new packing, lower packing flange and tighten sufficiently with nuts to stop leakage (See Figure 3)



<Fig. 3> Packing set

(2)**Adjustment:** During start-up some leakage may be observed. Do not readjust packing - allow at least 15 minutes for pressure/temperature stabilization to occur. If leakage continues adjust a maximum of 1/6 turn at a time. If pressure is raised considerably, the packing may leak slightly. Do not readjust - leakage will stop when new pressure/temperature stabilization is reached.

(3)**Break-in:** For best results, it is recommended that after packing installation and adjustment the valve to be fully stroked approximately 20 times to break-in the packing and reduce stem friction.

## 2. Disassembly of diaphragm actuator from valve body (See Figure 4 ~ 7 in appendix)

(1) **Preparation:** Close inlet and outlet stop valve and relieve all pressure from piping involved. Remove all compression from adjusting spring <31>.

(2) **Disengagement of plug from the seat ring:**

**[Direct Type]** Relieve air pressure from diaphragm of actuator. Remove tubing from the diaphragm casing <37>.

**[Reverse Type]** Supply sufficient air to the actuator diaphragm to keep plug <13> from touching seat ring <12> while disengaging valve stem <26> from the actuator stem <28>.

(3) **Separation of stems:** Loosen hex. nut <17>. Use wrench on stem flats and turn valve stem <26> out of actuator (upper) stem until both stems are separated. Remove the tubing from diaphragm case1 <35> for Air to Open (Reverse) Type Valves.

(4) **Remove yoke from bonnet:** Remove the lock nut holding the actuator to the bonnet and lift off the actuator.

## 3. Disassembly of valve body assembly (See Fig. 4~7)

(1) **Removal of actuator:** Remove actuator from valve body assembly as previously described in disassembly of diaphragm actuator from valve body assembly.

(2)**Removal of bonnet:** Remove bonnet hex. Nuts <4>. Lift off bonnet assembly including plug <13> from the body <1>.

### (3)Disassembly of bonnet and valve body:

Remove plug<13>, packing follower <7> and old packing set <16>. Remove bonnet gasket <14>, lantern ring [DP Series] or cage [DG Series] <2>, seat ring <12> and seat gasket <11>. If necessary, remove seat ring by forcing a wooden dowel into seat bore and lifting.

## 4. Cleaning

(1) **Cleaning of component parts:** Clean all parts thoroughly. Polish stem with crocus cloth. It should be smooth and free of scratches especially in the packing area. Use approved non-residue forming solvent for cleaning. Wipe dry with clean cloth.

(2) **Inspection:** Inspect all parts and replace any excessively worn out or damaged part.

(3) **Replacement of parts:** Install a new graphite packing set as shown on packing installation sketch Fig. 3. See previous section on renewing packing set. The packing follower <7> has a long wearing life which under normal usage should not require replacement. However, if damaged or worn out, the packing follower and/or the bonnet <3> must be replaced. The bonnet gasket <14> and seat gasket <11> should be replaced each time the valve body assembly is disassembled for cleaning.

## 5. Reassembly of Valve Body & Actuator

(1) **Valve body:** Insert seat ring <12>, with raised face upward, into the bore of the body and place the lantern ring <2> [DP Series] or the cage <2> [DG Series] on the seat ring <12>. Seat ring must be correctly seated in place.

(2) **Bonnet assembly:** Applying light pressure and turning motion assemble plug stem <13> into the bonnet assembly <3>. Fix stud bolts to the valve body flange.

(3) **Bonnet on valve body:** Place bonnet gasket <14> in the body recess and install the bonnet assembly on top of the valve body. Apply hex. nuts <4> to stud bolts <5> and tighten firmly and evenly until the bonnet and valve body flanges almost touch each other.

(4) **Position indicator:** Place the indicator <18> and hex. nut <17> on to the valve stem.

(5) **Diaphragm actuator on bonnet:** Place the yoke and actuator assembly on top of the bonnet, and turn it clockwise, watching the valve stem, to connect the valve stem to the actuator stem. During this time the valve stem must be kept standstill to prevent the valve plug from being scratched or damaged. And then,

For **[Direct type]**, tightly fasten the yoke by turning the lock nut <6> clockwise using tightening tools.

For **[Reverse type]**, connect controlled air line to the diaphragm chamber, lower the yoke to the minimum by supplying air slightly, and tightly fasten the yoke by turning the lock nut <6> clockwise using tightening tools.

(6) **Packing flange:** Fasten the packing flange <8> properly with two packing nuts <9>. Excessive tightening should be

(7) **Stem length adjustment for “Open” or “Close” position**

**[Direct type]:** With wrench on flats of valve stem turn the stem <26> clockwise until it does not move upward. Tighten nut <17> for firmly fixing indicator <18> to upper stem <28>. The position of indicator <18> at this point is "Open" position, and this must match with "O" marking on the indicator plate scale <27>.

**[Reverse type]:** Lift the plug by turning the valve stem counterclockwise using tool, and lower the stem by depressurizing the diaphragm chamber. Lower the valve stem by turning clockwise until it touches the seat ring. Then lift the stem again by slightly introducing air to the diaphragm chamber, turn the valve stem clockwise one-quarter turn, and then fix the valve and actuator stems by tightening the hex. nut <17> firmly. The position of indicator <18> at this point is "Close" position, and this must match with "C" marking on the indicator plate scale <27>.

**Caution:** Avoid to turn the plug stem when plug is on seat to prevent the plug from being damaged.

**Note:** The 1/4 turn toward the seat ring provides the positive closing force required to obtain tight valve closure in single ported valves. In all cases be sure to make this final adjustment.

## 6. Setting valve travel

### **[Direct type]**

(See Figure 4 and Figure 6 in Appendix I)

(1) **Adjustment of actuator spring preload:**

Connect controlled air line to diaphragm case connector. Supply 0.4kg/cm<sup>2</sup> (6psig) of air pressure to the diaphragm of actuator. Adjust the preload of actuator spring <31> by turning adjusting nut <19> until indicator <18> just starts to move at an air pressure of approx. 0.4 kg/cm<sup>2</sup> (6 psig). Actuator spring preload adjustment can be made either with or without pressure in valve body. Once correct adjustment is made, no further adjustment is necessary.

(3) **“Close” position:** Supply 2.0 kg/cm<sup>2</sup> (30psig) of operating pressure to actuator diaphragm. Check and confirm if the valve fully closes at this pressure.

(4) **Connection of tubings:** Reduce air pressure from actuator diaphragm and reconnect operating medium tubing from control pilot, instrument, or loading device to the diaphragm case.

### **[Reverse type]**

(See Figure 5 and Figure 7 in Appendix I)

(1) **Adjustment of actuator spring preload:** Supply approx. 0.4 kg/cm<sup>2</sup> (6 psig).of air pressure to the actuator diaphragm chamber. Adjust the preload of actuator spring <31> by turning adjusting nut <19> until the indicator <18> just starts to move when the air pressure is raised above 0.4 kg/cm<sup>2</sup> (6psig). Actuator spring preload adjustment can be made either with or without pressure in valve body. Once correct adjustment is made, no further adjustment is necessary.

(2) **“Open” position:** Supply 2.0 kg/cm<sup>2</sup> (30psig) of operating pressure to actuator diaphragm. Check and confirm if the valve fully closes at this pressure.

(3) **Connection of tubings:** Reduce air pressure from actuator diaphragm and reconnect operating medium tubing from control pilot, instrument, or loading device to the diaphragm case.

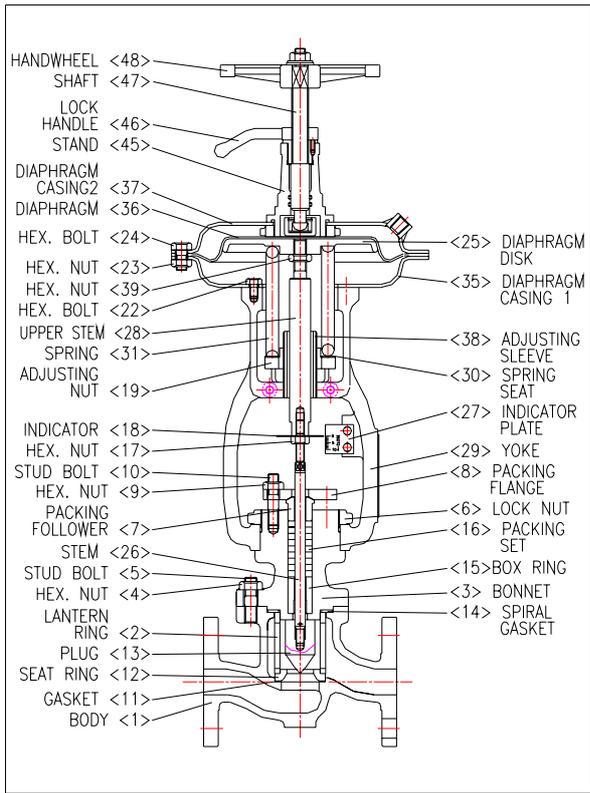


FIG.4 ~ DP SERIES : AIR TO CLOSE(DIRECT) TYPE ACTUATOR AND VALVE BODY ASSEMBLY

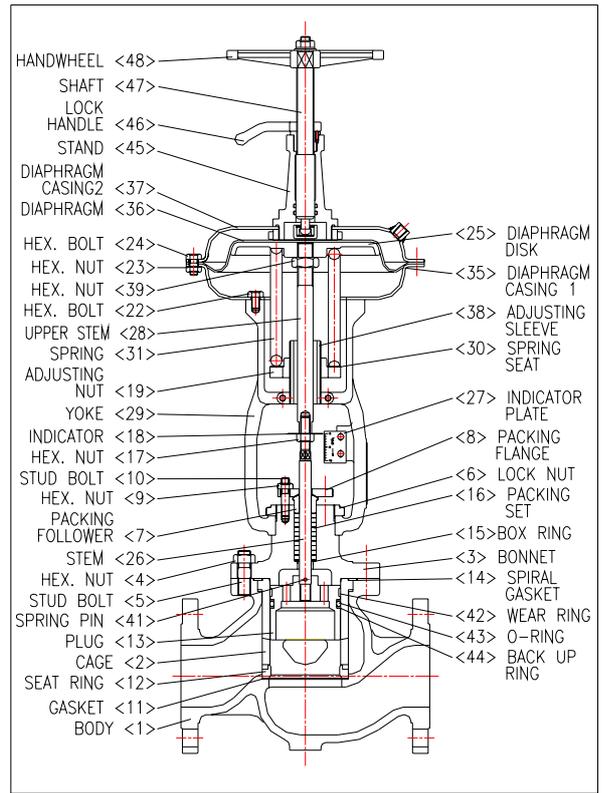


FIG. 6 ~ DG SERIES : AIR TO CLOSE(DIRECT) TYPE ACTUATOR AND VALVE BODY ASSEMBLY

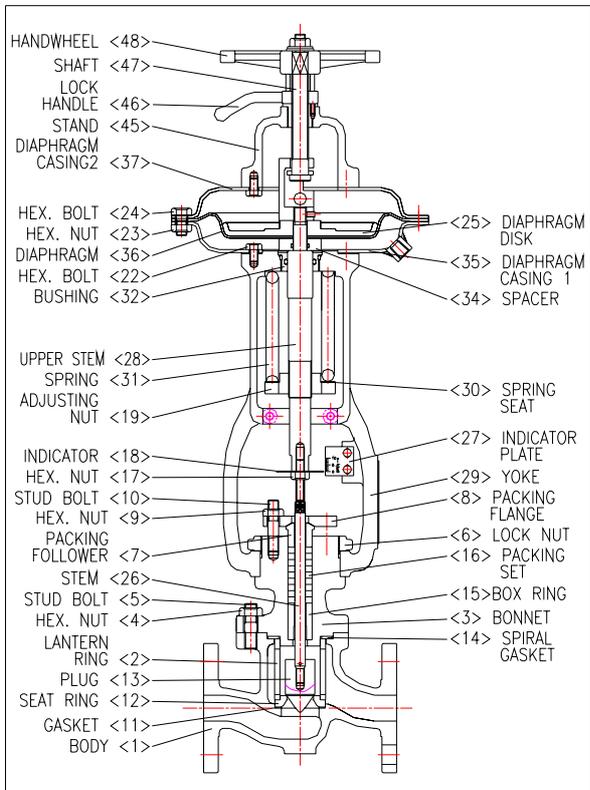


FIG.5 ~ DP SERIES : AIR TO OPEN(REVERSE) TYPE ACTUATOR AND VALVE BODY ASSEMBLY

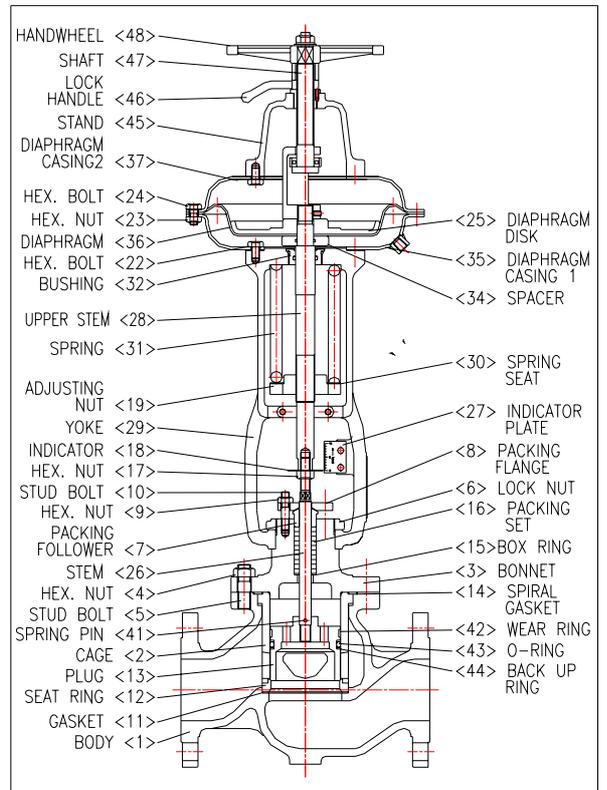


FIG. 7 ~ DG SERIES : AIR TO OPEN(REVERSE) TYPE ACTUATOR AND VALVE BODY ASSEMBLY

## SECTION II : DIAPHRAGM ACTUATOR

### A. ACTATOR

#### [Direct type]

Direct acting actuators are normally used where opening of valves is required on loss of air pressure. The actuator spring preload required to seat valve plug varies according to the valve size and maximum pressure drop.

#### 1. Disassembly

(1) Remove all compression from actuator spring<4> by unscrewing spring adjuster<3> downward.

(2) Remove nuts<15> and bolts<14> from upper diaphragm case<25>.

(3) Remove upper case<25>, fixer<18> and diaphragm<7>. To examine, clean or replace parts other than diaphragm<7>, remove diaphragm disc<16>, actuator spring<4>, spring seat<2> and adjusting nut<3> from adjusting sleeve<17>.

#### 2. Reassembly

(1) Clean and lubricate adjusting sleeve threads.

(2) Replace parts and install new diaphragm.

(3) Tighten nuts and bolts evenly.

#### 3. Installation of the actuator

Refer to "Reassembly" of 2-way control valves"

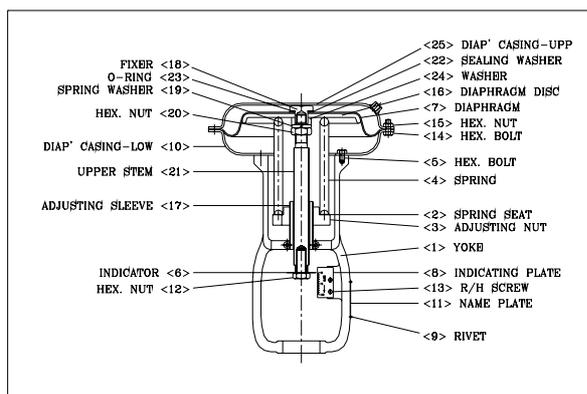
**Note:** maximum allowable actuator diaphragm air pressure is 4 kg.cm<sup>2</sup> (60 psig) for all sizes.

#### 4. Adjustment of the valve travel

Refer to "Setting valve travel" of 2-way control valve.

#### 5. Adjustment of actuator spring preload

Refer to "adjustment of actuator spring preload" for 2-way control valves.



<Fig. 8 > Direct acting actuator

#### [Reverse type]

Reverse acting actuators are normally used where closing of valves is required on loss of air pressure. The actuator spring preload required to seat valve plug varies according to the valve size and maximum pressure drop.

#### 1. Disassembly

(1) Remove compression from actuator spring<4> securing actuator stem<22> with wrench.

(2) Dismantle upper diaphragm case<24> and hand operating device (if fitted) from actuator as described in instructions.

(3) Remove the diaphragm disc<23>, diaphragm and spacer<18>.

(4) Remove stem<22> and remove bushing<16> from yoke<1>.

(5) Remove bolts<5> and lower diaphragm case<10>

(6) Examine gasket<17>. Replace gasket if necessary to obtain an air-tight seal.

(7) Clean all metal parts. Remove any rust, dirt or sharp edges that might damage stem seal.

(8) Lubricate spring seat<2>, spring adjusting nut<3> and actuator stem<22> threads with anti-seize lubricant.

#### 2. Reassembly

Install parts in reverse order. When reassembling, place a block under the actuator stem to hold the stem high enough.

#### 3. Installation of actuator

Refer to "Reassembly" of 2-way control valves"

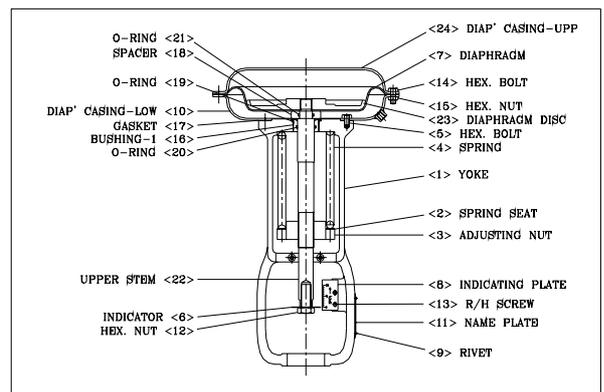
**Note:** maximum allowable actuator diaphragm air pressure is 4Kg.cm<sup>2</sup> (60psig)

#### 4. Adjustment of the valve travel

Refer to "Setting valve travel" of 2-way control valve.

#### 5. Adjustment of actuator spring preload

Refer to "adjustment of actuator spring preload" for 2-way control valves.



<Fig. 9 > Reverse acting actuator

## B. TOP MOUNTED HAND OPERATING DEVICE (HOD)

### [Direct type]

#### 1. Disassembly

(1) Remove nuts and bolts from upper diaphragm case<1>. Lift off case with HOD attached on it.

(2) Remove set screw<8>, lock nut<14> under cover and lift off stand from upper diaphragm case<1>.

(3) Remove nut<11>, washers<10, 13>, handwheel<5> and lock handle<2>.

(4) Dismantle shaft from stand<3>.

(5) Remove set screw<12> and bushing<6> from stand<3>.

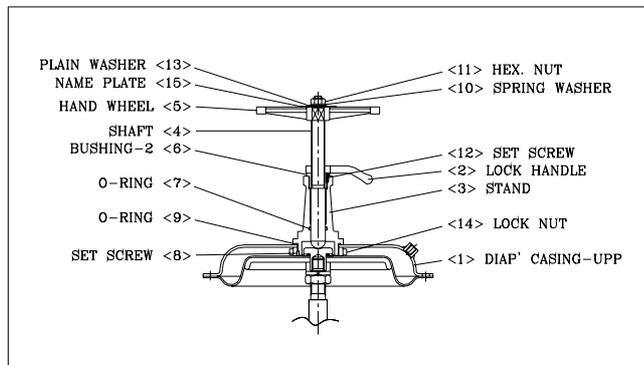
Clean all parts and replace any that are worn out or damaged.

#### 2. Lubrication of parts

Apply a good grade of anti-seize lubricant to the tightening bolts and the screws on manual shafts. Also apply a small amount of this lubricant to bushing threads. Lubricate O-ring with silicon grease.

#### 3. Reassembly

Install parts in reverse order.



<Fig. 10> HOD (Direct acting type)

### [Reverse type]

#### 1. Disassembly

(1) Remove nut<11>, washers<10, 13>, handwheel<5>, pipe<14> and lock handle<2>.

(2) Screw shaft down top of bushing threads.

(3) Dismantle shaft<4> from lifter<1> by moving stand<3> horizontally.

(4) Remove bolts<9> and stand<3> from upper diaphragm case<18>.

(5) Remove shaft<4> and bearing<7> from stand<3>.

(6) Remove set screw<12> and bushing<7> from stand<3>.

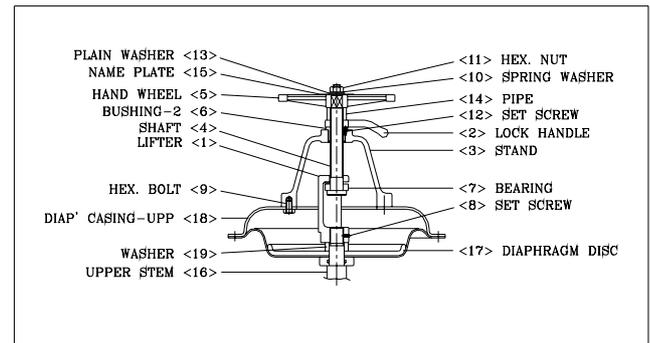
Clean all parts and replace any that are worn or damaged.

#### 2. Lubrication of parts

Coat handscrew with a good grade of anti-seize lubricant. Also apply a small amount of this lubricant to bushing threads.

Lubricate the bearing with silicon grease.

#### 3. Reassembly

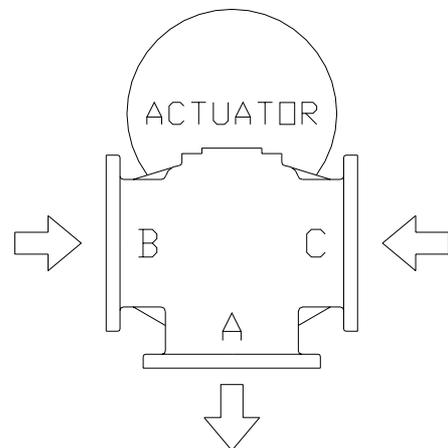


<Fig. 11> HOD ( Reverse acting type )

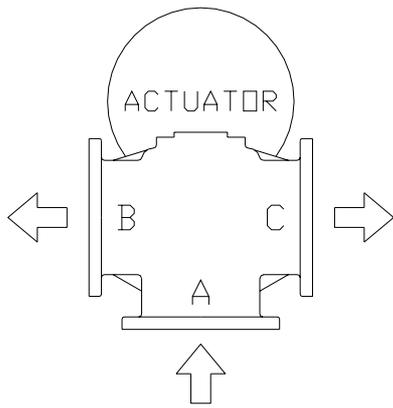
Install parts in reverse order.

## SECTION III: 3 WAY CONTROL VALVE (Rotary Type)

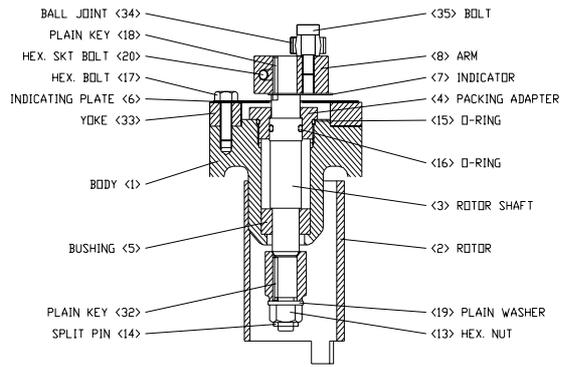
3-Way rotary valves may be used for either converging or diverging service. The valve may be installed in any position in an accessible location allowing sufficient space around the valve for easy removal or installation of parts during maintenance work.



<Fig.12> Converging (Mixing)



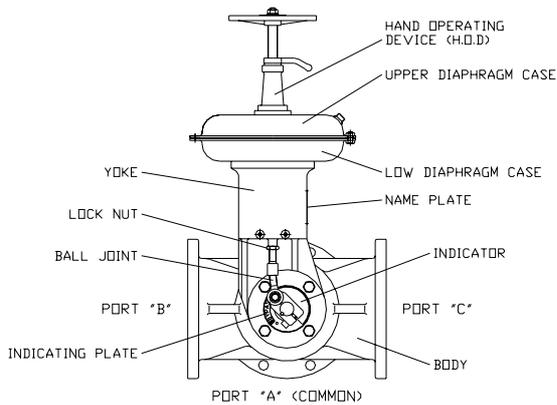
<Fig.13> Diverging (Dividing)



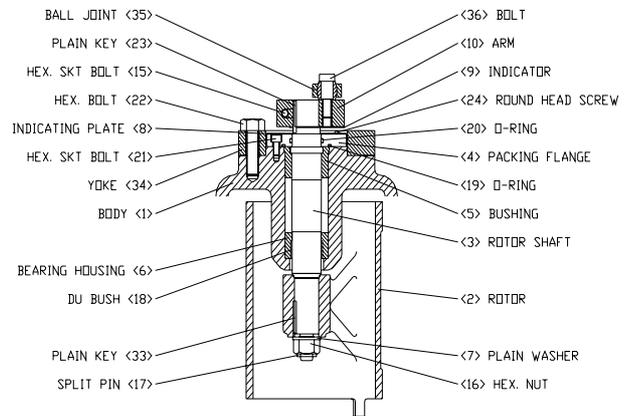
<Fig.16> Valve Body with internal parts, 100A (4'')~150A (6'') size

## A. INSTALLATION

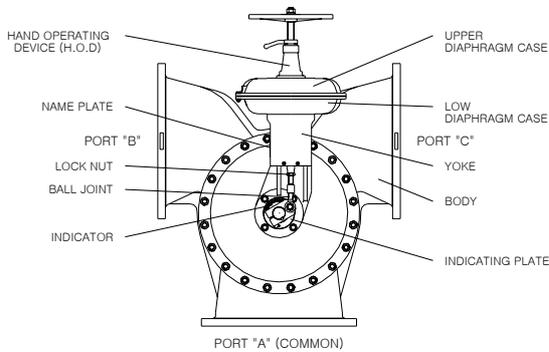
**1. Cleaning of pipe line:** Blow or flush out pipe line thoroughly before installing control valve.



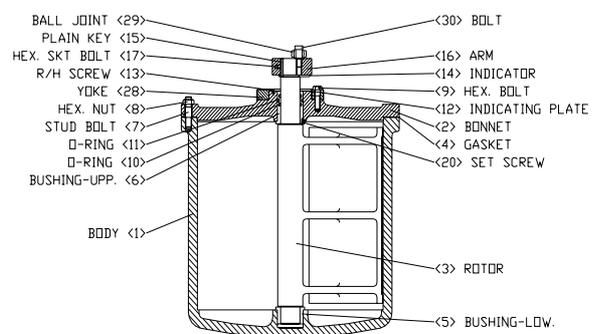
<Fig.14> Valve Body with Actuator 100A (4'') ~ 450A (18'') size



<Fig.17> Valve Body with internal parts, 200A (8'')~450A (18'') size



<Fig. 15> Valve Body with Actuator 500A (20'') ~ 600A (24'') size



<Fig.18> Valve Body with internal parts, 500A (20'') ~ 600A (24'') size

## B. OPERATION

**1. Pre-check:** Close inlet and outlet stop valves. Check for rated rotation of valve in relation to air pressure changes in the air chamber of the diaphragm actuator. Check if indicating plate coincides with the rotation of the rotor.

**2. Normal service:** Put the control valve in normal operation in accordance with the instructions supplied with pressure or temperature controller.

## C. MAINTENANCE

### 1. Disassembly

**Preparation:** Close inlet and outlet stop valves and relieve pressure from the piping involved. Disconnect tubing from the actuator.

**Important:** Note the position of the arm in relation to the indicating plate so that the arm could be located in the same position when reassembling the valve.

#### [100A (4") ~ 450A (18")]

(1) **Dismantle actuator:** Remove bolt<35> from ball joint<34>. Remove hex. bolts<17> from yoke<33> and lift off actuator.

(2) **Dismantle rotor<2> from rotor shaft<3>:** Remove split pin<14> from lower end of rotor shaft<3>. Using a socket wrench and extension remove hex. nut<13> and plain washer<19> from rotor shaft<3>. (Hold arm<8> with wrench to prevent rotor shaft<3> from turning.) Carefully remove rotor from rotor shaft. Remove plain key<32> from rotor shaft<3> if key is loose.

(3) **Disassembly of body components for insp. and replacement :** Loosen arm<8>, hex. socket bolt<20> and remove arm<8>, hex. socket bolt<20> and indicator<7>. Remove plain key<18> from shaft<3>. Before removing rotor shaft<3> check for shaft bearing wear by moving shaft<3> from side to side. Shaft<3> should be a snug fit. Any excessive movement indicates that bearings are worn out and should be replaced. Lift rotor shaft<3> upward out of actuator end of valve body<1>. If replacement is necessary due to O-ring leakage, remove O-ring<16> from rotor shaft<3>. Clean rotor shaft<3> recesses.

#### [100A (4") thru 150A (6")]

Remove indicating plate<6> and unscrew packing adaptor<4> with O-ring<15> from valve body<1>. Remove bushing<5>.

#### [200A (8") thru 450A (18")]

Remove round head screw<24>, indicating plate<6>, hex. socket bolt<37>, packing flange<4> with O-ring<15>, bushing<5>, bearing housing<38> with bearing<39>.

#### [500A (20") ~ 600A (24")]

(1) **Dismantle actuator:** Remove bolt from ball joint<29>. Remove hex. bolts<9> from yoke<28> and lift off actuator.

(2) **Remove arm<16> and indicating plate<12>:** Loosen arm<16>, hex. socket bolt<17> and remove arm<16>, hex. socket bolt<17> and indicator<14>. Remove plain key<15> from shaft<3>. Remove round head screw<13> and indicating plate<12>.

(3) **Remove rotor<15>:** Remove hex. nuts<8>, stud bolts<7> and bonnet<2> with bushing<6>. Remove rotor<3>.

### 2. Cleaning

Clean all parts in an approved solvent and remove any incrustations from metal parts with 320 Grade Aluminum Oxide cloths. Bore of body must be clean and smooth. Replace any worn or damaged parts. It is recommended that all O-rings be replaced with new parts. After cleaning, check bearing recesses so as not to interfere or be damaged when rotor shaft is inserted down through bearings during reassembly.

### 3. Replacement of actuator diaphragm

Remove compression from actuator adjusting spring. Remove hex. nuts and hex. bolts from upper diaphragm case. Lift off case and remove diaphragm. Position new diaphragm over diaphragm disc. Re-place upper diaphragm case and tighten hex. bolts and hex. nuts alternately and evenly.

### 4. Adjustment of actuator spring preload

With no pressure in valve body adjust actuator adjusting spring compression so that rotor just starts to move when 0.4kg/cm<sup>2</sup>(6 psig) air is applied to diaphragm of actuator.

**Note:** For complete Actuator Maintenance see Instruction 10/0.5.6 for Hand Operating Devices, 10/0.5.10 for Direct Acting Actuators and 10/0.5.11 for Reverse Acting Actuators.

### 5. Reassembly

#### [100A (4") ~ 450A (18")]

(1) Install bushing<5> and a new O-ring<16> in rotor shaft upper groove. Carefully lower rotor shaft with assembled part into body bore. Screw packing adaptor<4> with O-ring<15> into body<1> threads and tighten. [For 100A (4") thru 150A (6")]

Install bearing housing<6> with bearing<39> and bushing<5>. Carefully lower rotor shaft<3> into body bore. Place packing flange<4> with O-ring<15> over end of rotor shaft<3>. Bolt packing flange<4> to body. Screw indicating plate to body<1> [For 200A(8") thru 450A(18")]

(2) Install plain key<18> in rotor shaft<3> groove. Install indicator<7> and arm<8> over end of shaft<3> in the same position as when it was removed. Tighten hex. socket bolt<20>.

(3) Align plain key<32> in rotor shaft and install rotor in the same position as when it was removed. Hold rotor in place and install plain washer<19> and hex. nut<13>. Hold arm<8> with wrench and tighten hex. nut<13>. Insert split pin<14> through hole in rotor shaft<3>. Spread end of pin to lock pin in place.

(4) Re-place actuator over body<1> and fix indicating plate<6> to yoke<34> with hex. bolts<17>. Attach ball joint<34> to arm<8> with bolt<35> and tighten bolt. [For 100A(4") thru 150A(6")]

Re-place actuator over body and tighten hex. bolts<17>. Attach ball joint<34> to arm<8> with bolt<35>. [For 200A(8") thru 450A(18")]

#### **[500A(20")~600A(24")]**

(1) Re-place rotor<3> and bonnet<2> with bushing<6>.

(2) Tighten hex. bolts<7> and hex. nuts<8>. Fix indicating plate<12> with screw<13>.

(3) Install plain key<15> in rotor<3> groove. Install indicator<14> and arm<16> over end of shaft<3> in the same position as when it was removed. Tighten hex. socket bolt<17>.

(4) Align plain key<15> in rotor shaft<3> and install rotor in the same position as when it was removed

(5) Re-place actuator over body<1> and tighten hex. bolts<9>. Attach ball joint to arm<16> with bolt<30> and tighten bolt.

**Note:** If length of ball joint was disturbed during maintenance it may be readjusted by loosening hex. nut, and with rotor and arm properly aligned the ball joint may be shortened or lengthened by removing bolt and screwing ball joint either in or out of actuator stem threads until rotor covers port. Re-place bolt and tighten.

#### **6. Changing valve action**

The valve action can be changed without removing the rotor or disturbing the line connections. To reverse the action remove the arm and rotate the shaft 180°. Turn the arm over so that the arm keyway aligns with the shaft key. Tighten hex. socket bolt. The port that is open will be shown on the indicating plate

## **SECTION IV: 3 WAY CONTROL VALVE (Globe Type)**

### **A. INSTALLATION**

#### **1. Valve location**

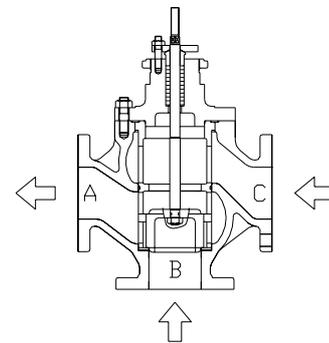
Install control valve in an accessible location. Connect supply and outlet pipe lines to the valve as described below. Control valve may be placed in any position but upright posture is preferable for ease of maintenance.

Connect operating medium tubing from control pilot, instrument or loading device to diaphragm chamber connection of control valve or to valve positioner. If one is in use.

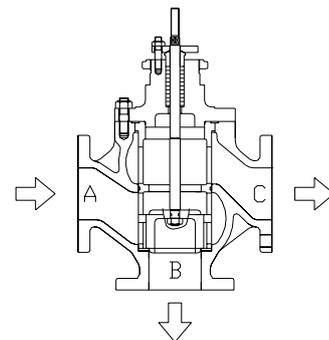
In converging (mixing) service two fluids are mixed to produce a third fluid. The valve has two inlet connections (marked "B" and "C") and one outlet connection (marked "A"). Connect supply lines to "B" and "C" connections and outlet to "A" connection. (See figure 1).

In diverging (dividing) service the valve has one inlet supply connection (marked "A") and two outlet connections (marked "B" and "C").

Connect supply line to "A" connection and outlet lines to "B" and "C" connections. See figure 2.



<Fig.19> Converging (Mixing)



<Fig.20> Diverging (Dividing)

## 2. Reassembly

Re-place internal parts. Install new diaphragm (35, 55, 85 and 135 in<sup>2</sup>), line up holes with those in lower diaphragm case, re-place upper diaphragm case on diaphragm.

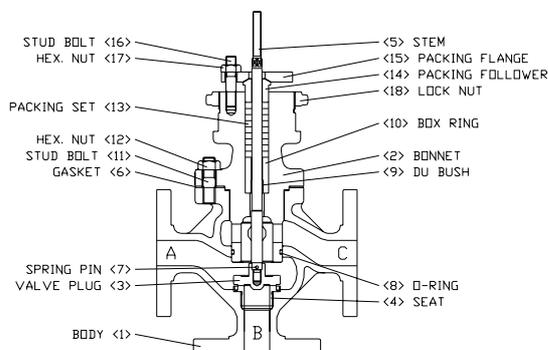
Assemble four bolts and nuts first (90° apart) and finger-tighten them. And then assemble the balances and tighten all the bolts and nuts evenly and alternately across the diaphragm case.

## 3. Considerations for preventing possible troubles

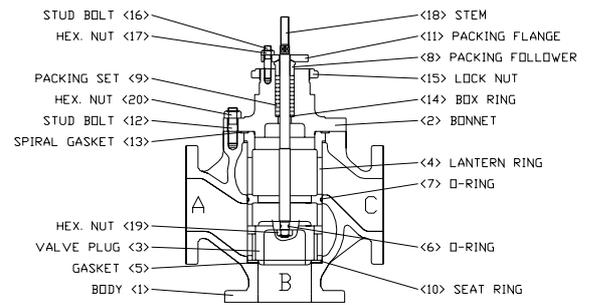
- (1) Provide removal space around the control valve for easy removal of parts during maintenance.
- (2) Blow or flush out pipe line thoroughly before installing control valve.
- (3) Protect control valve and following equipment with a Self-Cleaning Strainer.
- (4) Install stop valves and gages in inlet and outlet lines to provide means for checking process condition or equipment.

## B. OPERATION

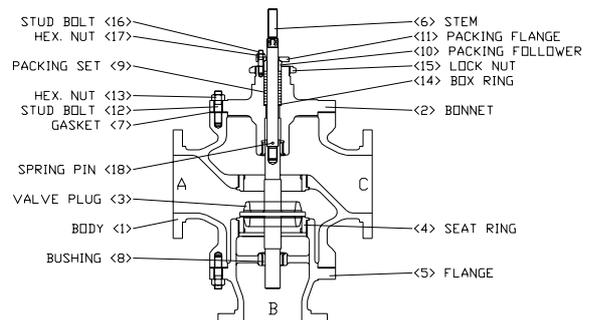
- (1) Close inlet and outlet stop valve.
- (2) Check that control valve responds properly through rated travel in changes in operating pressure on the diaphragm. Rated travel is shown by position of travel indicator on the valve stem relative to travel indicator scale on the yoke.
- (3) Manually operate control valves fitted with manual operating devices through rated travel to check freedom of movement.
- (4) Place control valve in operation in accordance with instructions furnished with controller or other operating device.



<Fig. 21> Valve body with internal parts, 25A (1")



<Fig. 22> Valve body with internal parts, 40A (1-1/2") thru 100A (4") size



<Fig. 23> Valve body with internal parts, 125A (5") thru 150A (6") size

## C. MAINTENANCE

### 1. Disassembly

- (1) Loosen stem nut. Unscrew the valve plug stem<5> from the actuator stem. Loosen and remove the lock nut<18>. Lift the actuator from the bonnet<2>.
- (2) Remove the stud bolt/nut<16, 17> from the bonnet<2>. Remove the stud bolt/nut<16, 17> from the packing flange<15>. Remove the packing flange<15>, packing follower<14>, packing set<13> and box-ring<10> with bearing<9>. [For 25A (1")]
- Remove the stud bolt/nut<16, 17> from the bonnet<2>. Remove the stud bolt/nut<16, 17> from the packing flange<15>. Remove the packing flange<15>, packing follower<14>, packing set<13> and box-ring<14>. [For 40A (1-1/2") thru 150A (6")]
- (3) Loosen the stud bolt/nut<11, 12> and remove the bonnet<12> and gasket<6> from the body<1>.
- (4) Lift the valve stem<5> carefully and pull upwards until the valve plug<3> comes out of the main body. Lift the seat<4> out of the main body<1>. [For 25A (1")]

Lifts the valve stem<18> carefully and pull upwards until the lantern-ring<4> comes out of the main body<1>. Remove the seat ring<4> and gasket<5> out of the main body<1>. Remove the valve plug<3> from the lantern-ring<4>. [For 40A (1-1/2") thru 100A (4")]

(5) Loosen the stud bolt/nut<12, 13> and remove the flange<5> and gasket<7> from the body<1>. Lift the valve plug<3> carefully and pull downwards until the valve stem<6> come out of the main body<1>. Remove the seat-ring<4> out of the main body<1>. Remove the seat-ring<4> and bushing<8> out of the flange<5>. [For 125A (5") thru 150A (6")]

## 2. Cleaning & replacement of parts

Clean all parts thoroughly, including the packing set. Use an approved, non-residue forming solvent. To remove encrusted materials use crocus or a very mild aluminum oxide cloth. Examine all parts. Replace any badly worn or damaged part.

## 3. Reassembly

(1) Install the seat into the bottom of the main body<1>. Install the valve plug<3> over the seat<4>. Replace gasket<6>. Insert the bonnet<2> into main body. Be careful not to damage the O-ring<8>. Insert stud bolt<11> through the bonnet<2> and tighten. Insert box-ring<10> with bearing<9>. [For 25A (1")]

(2) Insert the gasket<5> and seat<10> into the bottom of the main body<1>. Insert the valve plug<3> into the lantern-ring<4>. Insert plug<3> and lantern-ring<4> assembly into main body<1>. Be careful not to damage the O-ring<7>. Replace spiral gasket<13>. Install bonnet<2> over main body<1> and lantern-ring<4> assembly and tighten the stud bolt. Insert box-ring<14>. [For 40A (1-1/2") thru 100A (4")]

Insert the seat-ring<4> into the middle of the main body<1>. Insert the valve plug<3> into the main body. Install the seat-ring<4> and bushing<8> in the flange<5>. Install the flange and the gasket<7> below the main body. Insert stud bolt<12> through the flange and tighten. Replace gasket<7>. Install bonnet<2> over main body<1> and tighten the stud bolt<12>. Insert box-ring<14>. [For 125A (5") thru 150A (6")]

(3) Insert packing set<13>, packing follower<14>. Install packing flange<15>. Insert stud bolt<16> through the packing flange<15> and hand tighten.

(4) Position actuator on bonnet<2>. Insert the lock nut<18> and tighten firmly.

(5) Lift the valve plug stem<6> and engage its threads with those of the actuator stem. Screws into actuator stem one to two diameters. Then adjust the control valve for starting pressure preload, rated travel and positive compression force.

## 4. Preload adjustment

(1) Connect controlled air line to diaphragm case connection.

(2) Supply 0.4kgf/cm<sup>2</sup> (6 psig) air pressure to actuator diaphragm.

(3) Compress actuator spring until travel indicator begins to move when the air pressure gets greater than 0.4 or 0.5kgf/cm<sup>2</sup>.

**Note:** The valve travel should be checked under actual operating conditions for rated travel. If the stem travel is less than full, some additional spring compression will be required.

(4) To compress spring, screw adjusting nut upward on both reverse and direct acting actuators.

## 5. Adjustment of valve travel range

In all cases full valve travel is mechanically predetermined by the distance between seats. Valves must be adjusted to make full contact with seat in either direction. In direct acting actuators spring force brings valve plug in contact with upper seat, air force with lower. In reverse acting actuators air force brings valve plug in contact with upper seat, spring force with lower.

### [Direct type]

(1) Screw valve plug stem upward into actuator stem until valve plug contacts upper seat.

(2) Connect air line to actuator. Supply sufficient air pressure to move valve plug slightly away from seat.

(3) Then turn valve plug stem one full turn further into actuator stem to make positive compression contact of valve plug with upper seat at rated travel.

(4) Tighten stem nut and travel indicator against actuator stem. Tighten packing flange bolts.

### [Reverse Type]

(1) Screw valve plug stem upward into actuator stem approximately one diameter (thickness of stem.)

(2) Connect air line to actuator. Supply 2.0kgf/cm<sup>2</sup> (30 psig) air pressure to actuator diaphragm to move actuator through full travel.

(3) Turn valve plug stem upward into actuator stem until valve plug contacts upper seat.

(4) Reduce air pressure on diaphragm to permit valve plug to move slightly off seat.

(5) Then turn valve plug stem one full turn further into actuator stem to make positive compression contact with upper seat at rated travel.

(6) Tighten stem nut and travel indicator against actuator stem. Tighten packing flange bolts

## SECTION V: TROUBLE SHOOTING

### A. 2-WAY CONTROL VALVE

Problem	Possible Cause	Remedy
Less than rated or no valve travel even though proper air pressure is applied to actuator diaphragm.	1. No air signal or incorrect air signal to actuator.	Check the controller and correct.
	2. Air leakage through the tube wall or connections	Check the piping system and repair.
	3. Rupture on the actuator diaphragm.	Replace diaphragm.
	4. Incorrect adjustment of actuator stem.	Readjust in accordance with instruction.
	5. Dirt or foreign matters restricting rotor movement	Disassemble valve, clean and polish trim parts.
Leakage around valve stem.	1. Wear or damage on the packing.	Replace packing.
	2. Extreme wear or damage on the valve stem.	Replace valve stem.
Erratic movement of plug despite stable air signal to the actuator diaphragm	1. Excessively large pressure drop across the valve	Check pressure drop Keep allowable pressure drop
Excessive leakage through the valve seat	1. Erosion, corrosion, or other damage on the valve seat.	Replace or repair as needed.
	2. Too large a pressure drop across the valve.	Check the actuator spring preload or the suitability of the actuator.
	3. Dirt or foreign matter impinging tight closure of valve plug.	Remove the dirt and polish the plug if needed.

### B. 3 WAY CONTROL VALVE

Problem	Possible Cause	Remedy
Less than rated or no valve travel even though proper air pressure is applied to the actuator diaphragm.	1. No air signal or incorrect air signal to the actuator.	Check the controller and correct.
	2. Air leakage through the tubing wall or connections	Check the piping system and repair as needed.
	3. Ruptured actuator diaphragm.	Replace diaphragm.
	4. Incorrect adjustment of ball joint	Readjust in accordance with instruction.
	5. Dirt or foreign matter restricting rotor movement	Disassemble valve, clean and polish rotor and valve body.
Incorrect port open when air is applied to the actuator.	1. Incorrect assembly of the valve	See "changing valve action"
Leakage around rotor shaft.	1. Damage on O-ring	Replace O-ring.
Erratic movement of rotor despite stable air signal to the actuator diaphragm.	1. Excessively large pressure drop across the valve.	Check pressure drop. Keep allowable pressure drop.