



CONTROLS SUPPLY CHAIN  
VALVES ACTUATORS INSTRUMENTATIONS

## Instruction Manual

# MIL 81000

## Three - Way Control Valves



Purchase Order No : \_\_\_\_\_



The following instructions should be thoroughly reviewed and understood prior to installing, operating or performing maintenance on this equipment. Throughout the text, safety and/or caution notes will appear and must be strictly adhered to, otherwise, serious injury or equipment malfunction could result.



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**Note: Easily replaceable Pressure gauges for Air sets and externally mounted Pressure gauges of positioners are normally dismantled, separately packed and bound to the actuator yoke as a precaution against transit damages. This may be noted while opening the boxes.**

**Warning: Do not lift large size valves by the actuator. Lifting lugs provided on the actuators are for lifting the actuator alone.**

## 1. Introduction

The following instructions should be thoroughly reviewed and understood prior to installing, operating or performing maintenance on this equipment. Throughout the text, safety and/or caution notes will appear and must be strictly adhered to, otherwise, serious injury or equipment malfunction could result.

MIL has a highly skilled Aftermarket department available for start-up, maintenance and repair of our valves and component parts. Arrangements for availing their service can be

made through your local representative or Aftermarket department. In addition, a regularly scheduled training program is conducted at our plant, to train customer service and instrumentation personnel in the operation, maintenance and application of MIL Control Valves and Accessories. Also when performing maintenance, please ensure that only original MIL replacement parts are used. When specifying parts, always include Serial Number of the valve.

**Caution: Skilled service personnel to be engaged for start up, maintenance and repair of the valve.**

**Caution: Always use original MIL replacement parts while performing maintenance.**

## 2. General

MIL 81000 series valve is designed specifically for the control of flow and temperature where mixing or diverting service is required in process control industries. This is accomplished with the help of its three way body construction. Combining body construction has two separate inlets and one outlet which involve mixing of two streams into single one. Diverting body construction has a single inlet and two separate outlets where fluid from single stream gets

divided into two proportionately.

These installation and maintenance instructions apply to all sizes and ratings of the MIL 81000 series control valves regardless of the type of trim used. Recommended spare parts required for maintenance are listed in parts reference of page 15. The model number, size, rating and serial number of valve are shown on the identification tag located on the actuator. Refer to Figure 1 to identify valve nomenclature.

## 3. Unpacking

**Warning: Care must be exercised when unpacking the valve to prevent damage to the accessories and component parts. Should any problems arise, contact your local representative or MIL Aftermarket department. Do not remove end protection cover before installation.**

## 4. Installation

**Caution: Before installing the valve in the line, clean piping and flush the line to remove all foreign material such as welding chips, scale, oil, grease or dirt. End flange gasket surfaces must be thoroughly cleaned to ensure leak proof joints.**

Three-way control valves are most commonly used on either combining or diverting service. On combining service, the three-way valve has

two inlet ports and one outlet, and is used to combine two fluids in variable proportions. On diverting service, the three-way valve is used to split one inlet stream into two outlets, or the incoming flow can be entirely diverted to one or the other of the two outlet ports. As shown in the illustrations opposite, these valves should be installed with flow tending to open both ports. The principle advantage of this flow direction is inherent stability.

Three-way valve ports are marked “C” for common, “L” for lower and “U” for upper.

### Numbering System

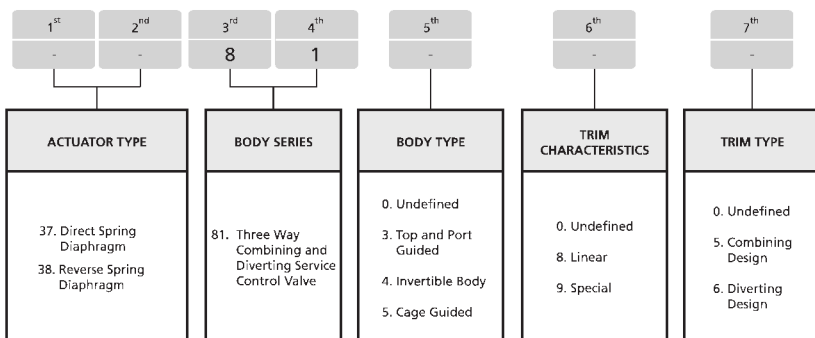


Figure 1

Each of these letters is stamped on its respective connection to facilitate correct installation. Before placing the valve in the pipeline, clean the line thoroughly of all dirt, welding chips,

scale, oil or grease and other foreign material. If valve connections are smaller than size of pipe, swaged nipples or reducing fittings should be used rather than bushings. If valve has a finned bonnet, do not insulate bonnet.

## 5. Air Piping

Unless otherwise specified, the connection to the actuator tubing shall be 1/4" NPT or 1/2" NPT. Use the tubing equivalent or higher to the connection size. Refer MIL valve specification sheet of respective valves for more details. All

connection joints should be free of leaks.

**Warning : Do not exceed supply pressure indicated on tag plate located on the yoke of the actuator.**

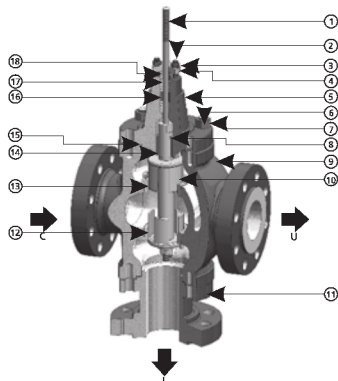
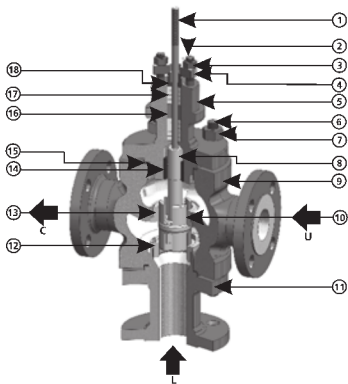
## 6. Body Disassembly

### 6.1 Disassembly - 81385 combining

**Caution: New packing & gaskets sets should be on hand before disassembling the valve, since it is recommended that new packing & gaskets be used during reassembly.**

Access to the internal components of the body should be accomplished with the actuator removed. To remove the actuator from the body, refer to the appropriate actuator instructions.

**Warning: Prior to performing maintenance on the valve, isolate the valve, vent the process pressure, shut off supply and signal air lines to the actuator. In addition, it is recommended that the bonnet, body and bottom flange be marked in relation to each other so that the same orientation can be maintained during reassembly.**



Part No.	Part Name
1	Plugstem
2	Packing Flange Stud
3	Packing Flange Nut
4	Packing Flange
5,9	Bonnet, Body
6	Body Stud
7	Body Nut
8	Plug Pin
10	Plug

Part No.	Part Name
11	Bottom Flange
12	Lower Seat Ring
13	Upper Seat Ring
14	Guide Bush
15	Body Gasket
16	Packing Spacer
17	Packing
18	Packing Follower



1. Apply sufficient air pressure to the actuator to position the plug just off the upper seat (13).
2. Remove nuts (6), bottom flange (11) and body gasket (49).
3. With smaller valves, loosen stem locknuts, turn them down the plug stem (1) and lock them, with a wrench applied over the locknuts, turn the plug stem (1) out of the actuator stem. With larger valves, remove the split stem connector.
4. Unscrew drive nut and remove actuator from the valve.
5. Remove locknuts and travel indicator. Loosen packing flange nuts (3) and turn plug stem down and out of the packing box.
6. Remove plug from the valve body. Examine plug and seat rings for wear and grind the seating surfaces (see Pages 5 and 6) if necessary.
7. Remove nuts (7), bonnet (5) and gasket (15) from the valve body.
8. Remove old packing (14) with lantern ring (16) from the top of the bonnet.
9. Threaded seat rings are set up tightly when assembled and are usually in service for years before replacement, so that it is often difficult to remove them. To facilitate removal, fabricate a special seat ring wrench to engage the seat ring lugs and attach it to a shock wrench. If rings are exceptionally stubborn, the application of

heat or penetrating oil may assist in removal.

## 6.2 81386 diverting

1. Apply sufficient air to the actuator to raise the plug so that the bottom plug is just off the seat (13, 12).
2. With smaller valves, loosen stem locknuts, turn them down the plug stem (5) and lock them. With a wrench applied over the locknuts, turn the plug stem out of actuator stem. With larger valves, remove the split stem connector. Remove locknuts and travel indicator.
3. Unscrew drive nut and remove actuator from the valve.
4. Remove nuts (7), bonnet (5), bottom flange (11) and body gaskets (15).
5. Remove old packing (17) with lantern ring from the top of the bonnet.
6. Apply a wrench to the machined flats located on the upper guide section of the plug to prevent the plug from rotating, then remove plug locknuts. Detach lower skirt and plug gasket. Remove upper skirt and shank from the valve body. Note: The upper skirt is welded to the shank. Examine plug and seat rings for wear and grind the seating surfaces (see Pages 5 and 6) if necessary.
7. For seat ring removal, refer to Step 9 of Disassembly - 81385 combining.

## 7. Maintenance & Repair

### 7.1.Lapping Seats

If, after long service, valve leakage becomes excessive, a hand operation called lapping is necessary. In order to facilitate this operation, the plug and seat ring seating surfaces should be free of large scratches or dents and the contact surfaces of the seats should be as narrow as possible. This may require dressing both parts in a lathe: The seating surfaces make an angle of 60° with the axis of the plug. (Except special cases such as seat leakage required is smaller than 0.01 % of max. Cv).

For the lapping operation, a good grade of fine grinding compound is required. The compound is applied at several spots equally spaced around the periphery of the ring. Assemble the entire valve body including the packing for the lapping operation (excluding the bottom flange of the diverting valve). The bonnet (and bottom flange of the combining valve) fastened temporarily to the body, less gasket, serves as a guide during the lapping operation. To facilitate lapping,

screw a drilled and tapped rod with a T-handle onto the top of the valve stem and secure with a locknut. As an alternative, drill a hole through a small flat piece of steel and fasten to the plug stem with two locknuts. Before lapping, plug and stem must be "true" (see pinning operation). Lapping is accomplished by rotating the plug in short oscillating strokes. After 8 or 10 strokes, the plug should be lifted and turned 90° before repeating the operation. This intermittent lifting is important to keep the plug and seat ring concentric during lapping.

It is advisable to mix a small quantity of lubricant such as graphite with the grinding compound. This will slow the cutting rate and avoid tearing the seating surface.

The amount of lapping required depends on the materials of construction, condition of the seating surfaces and accuracy of machining. If a short period of lapping does not visibly improve

seating, there is usually no advantage in continuing as too much lapping may result in rough seats or small ridges on the plug or seat ring. The only remedy is replacement of one or both parts. When lapping a new plug and rings, begin with arse compound and finish with fine. Old (used) parts should only be lapped with a fine grade of compound.

## 7.2.Packing Box

Packing box maintenance is one of the principal actions in routine servicing. Tightness of the packing is maintained by packing compression. Compression is achieved by evenly tightening the packing flange nuts (3) against the packing flange (4). Care must be taken not to over tighten as this could prevent smooth operation of the valve. If all compression is used up and the valve leaks, then new packing is required. The packing is available as a set of lower and upper packing. The height of the lower and upper packing set is same for standard packing. Due to the difference in the height for Eco-lock packing, the packing sets are labeled as lower packing and upper packing. The upper packing set will be larger than lower packing set for Eco-lock.

**Note: While replacing packing, replace the upper packing set completely**

**Caution : Valve must be isolated and the pressure vented before performing packing box maintenance.**

Proceed as follows :

- Disconnect the actuator stem from the valve to maintain a gap to insert the packing set
- Loosen and remove packing flange nuts (3).
- Raise packing flange (4), and packing follower (5) up the valve stem.

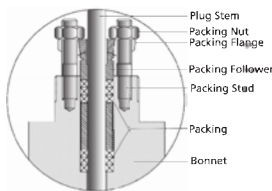


Figure 2

Standard Packing Box

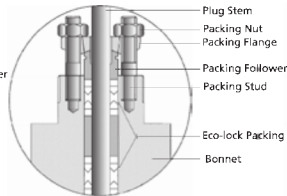


Figure 3

Eco-Lock

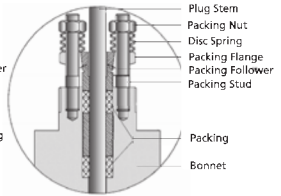


Figure 4

Standard Packing Box With Live Loading

**Note: They may be taped in place to keep them out of the way before proceeding.**

- By means of a hooked instrument, remove packing (7) ensuring not to damage the sealing surfaces of the packing box or plug stem.
- Replace packing (7) referring to Figure 9 for correct amount of packing to place above the spacer.

**Note : Assemble and compress rings one at a time into packing box. If rings are skive cut, the skive cut of each packing ring must be placed about 120 degrees apart.**

**Note: For any type packing do not change the sequence of packing arrangement. Use the packing as a set only.**

**Note: MIL Ecologk packing (Fig 10) is a high performance system to keep fugitive emissions within allowable limits. The packing is provided with the inner packing and outer packing as a set. It consists of V and double V packing rings with varying density, which is designed to prevent fugitive emission from the packing effectively.**

**Caution: For Eco-lock packing, inner and outer packing to be replaced as a set only.**



- F. Replace packing follower (5) and packing flange (4).
- G. Replace and tighten packing stud nuts (3).

**Caution: Do not over-tighten.**

- H. Put valve back in service and tighten packing only as much as is necessary to stop leaking.

**Note: In an emergency, string packing may be used as a temporary repair only. It must be replaced with the correct packing as soon as possible.**

**Note: A spring loaded follower assembly is used to maintain a constant load on the packing, and is necessary for thermal cycling applications. As the definition of thermal cycling can vary, and processes are potentially subject to unpredicted thermal gradients. Both standard and Eco-Lock systems are available with the spring loaded follower (Figure 11).**

**Caution: Packing box should be clean and free of burrs, rust, and any foreign matter. Parts can be cleaned with denatured alcohol.**

### 7.3.Lubrication

For some applications, packing boxes are designed for use with a lubricator. The lubricator is provided with a ball check valve and an isolating valve to prevent back flow of the process fluid. The lubricator should be kept filled with the specified lubricant and turned in firmly but not tightly. One or two turns of the lubricator once every two weeks should suffice to provide the desired seal lubricants may be ordered through the Customer Services at our MIL Plant.

### 7.4.Plug Stem Pinning

Valve plug and stem assemblies are normally furnished as a complete assembly in which case the installation involves no problems. It is necessary only to lap the seats and assemble the valve.  
If necessary to assemble plug and plug stem, it is

better to use a new stem as the original pin hole in an old stem prevents satisfactory results and might seriously impair the strength of the assembly. If an old stem must be used, the plug end of the stem should be cut off just above the old pin hole and the stem rethreaded the original amount. This will shorten the stem but there is usually enough adjustment in the actuator stem to compensate. If, however, the thread engagement in the actuator stem is less than the diameter of the plug stem, the plug stem should be discarded.

**Caution : While pinning is being performed, the seating surface and plug guide of the plug must not be damaged.**

The old pin may usually be removed by driving it out with a punch. If necessary to drill it out, a drill somewhat smaller than the pin should be used and then the remainder of the pin driven out.

**Caution: Do not mar the guide section of the plug by gripping in the jaws of a vice.**

For drilling, the plug should be placed with the guide section resting on a vee block. The stem must be screwed into the plug solidly before starting to drill. This can be checked by measuring the depth of the pilot recess in the plug (X in Figure opposite) and making a reference mark on the stem the same distance from the thread. When properly assembled, the reference mark should be flush with the end of the guide section. The stem can then be re-drilled through the old hole in the guide section, using first a pilot drill of suitable size and then a reamer drill to bring the hole to required size for the pin. After all burrs and sharp corners are removed from the edge of the hole, a small amount of grease should be applied before inserting the pin. The hole should be of such diameter that the pilot end of the pin can be pushed in by hand about 1/8" to 3/16". The easiest method of driving the pin is to press it in the jaws of a vice. Be sure the pin is recessed about 1/16" below the plug guide surface. After plug has been pinned, it should be placed in a lathe to see if it is running "true". If it is not, tap the plug with a mallet to straighten. Stem should be placed in "chuck" and plug should be tapped.



## 8. VALVE BODY REASSEMBLY

### 8.1.Reassembly-81385 combining

1. Before seat rings are installed, the seating surfaces in the body and bottom flange should be cleaned thoroughly. A thread lubricant such as John Crane Insoluble Plastic Lead No. 2 should be applied sparingly to the ring threads. The seat rings (2) should be brought up tight using the seat ring wrench. On 3/4"2" valves, tighten seat rings by hand using a ring wrench with T-handle. Larger seat rings may be tightened with a shock wrench.

**Caution: Avoid over tightening. Excessive torques will distort the seat ring with resulting leakage.**

2. Install gasket (15) in the top of the valve body.
3. Install the bonnet (5) on the body and tighten nuts (7). Tighten nuts evenly and in crisscross fashion to assure even gasket compression.
4. Replace the plug and stem assembly in the body pushing the plug stem through the packing box.
5. Insert new packing in the bonnet, first lower st of packing, then the lantern ring, then more packing rings to fill the packing box. Replace packing follower (10), packing flange (4) and packing flange nuts (3).
6. Install gasket (15) and bottom flange (11) Tighten nuts (7) evenly and in crisscross fashion to assure even gasket compression.
7. Replace actuator on the valve and tighten drive nut . If an air-to-retract actuator, apply air pressure to retract the stem before installing actuator on the valve.

### 8.2.Reassembly-81386 diverting

1. Install seat rings as per Step 1 of Reassembly-81385 combining.
2. Reassemble the upper skirt and shank, gasket, lower skirt and plug locknuts in the valve body.
3. Replace gasket (15), bottom flange (11) and tighten nuts (7).
4. To replace packing (17) in the bonnet (5), refer to Step 5 of Reassembly-81385 combining.
5. Install the bonnet on the body and tighten nuts (7). Tighten nuts evenly and in crisscross fashion to assure even gasket compression.

6. Replace actuator on the valve and tighten drive nut . If an air-to-retract actuator , apply air pressure to retract the stem before installing actuator on the valve.

### Plug stem adjustment Size 11 and 13 actuators

1. Push plug stem (1) down until the plug seats and replace locknuts and travel indicator (and locking plate on Size 13 actuators).
2. Air-to-extend actuator: Turn plug stem (1) into actuator stem until seating occurs. Apply sufficient air pressure to move the plug slightly. Turn plug stem one additional turn into the actuator stem and tighten stem locknuts. Note: Do not turn the plug when it is in contact with the seat or scoring will result. If necessary, adjust travel indicator scale .
3. Air-to-retract actuator: Turn plug stem (1) into actuator stem as far of it will go and release air pressure to the diaphragm. Turn plug stem out of actuator stem until plug is seated. Note: Do not turn the plug when it is in contact with the seat or scoring will result. Apply sufficient air pressure to move the plug up. Turn the plug stem out of the actuator stem one full turn and tighten locknuts. If necessary, adjust travel indicator scale .

### Plug stem adjustment Size 15 and 18 actuators

1. Push plug stem (1) down until the plug seats.
2. If an air-to-extend actuator, apply air pressure to extend the actuator stem to rated stroke plus 1/16" If an air-to-retract actuator, apply air pressure to retract the actuator stem approximately 1/16" .
3. Install stem clamp and travel indicator pointer. Tighten clamp nut. It may be necessary to raise or lower the actuator stem slightly to mate the threads of the actuator and plug stems with the clamp. The amount of thread engagement of both stems should be approximately equal. If necessary, adjust travel indicator scale .