

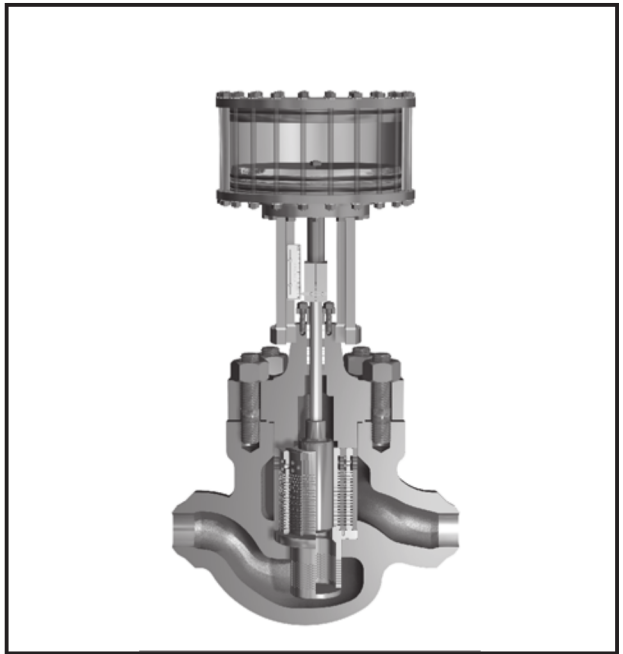


CONTROLS SUPPLY CHAIN
VALVES ACTUATORS INSTRUMENTATIONS

Instruction Manual

MIL 91000

Multi-Path, Multi-Stage 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.



CONTROLS SUPPLY CHAIN

VALVES ACTUATORS INSTRUMENTATIONS



TABLE OF CONTENTS

1.	Introduction	2
2.	General.....	3
3.	Unpacking	3
4.	Installation.....	3
5.	Air Piping	4
6.	Valve Disassembly.....	4
	6.1 Body Disassembly.....	4
	6.2 Plug Disassembly.....	4
7.	Maintenance & Repair.....	5
	7.1 Packing Box.....	5
	7.2 Repair of Seating Area.....	6
	7.3 Plug Stem Pinning.....	7
8.	Body Reassembly.....	8
	8.1 Plug Cage Assembly.....	8
	Part List.....	11
	Typical Multi-stage Designs.....	12

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 91000 Matrix valve. 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 factory, to train your service and instrumentation personnel in the operation and maintenance. Also when performing

maintenance, please ensure that only MIL replacement parts are used.

Note :When specifying parts, always include unique serial number punched on the tag plate of the valve.

Caution: Skilled service personnel to be engaged.

Caution: Always use original MIL replacement parts including soft parts like gasket, packing etc. while performing maintenance for start up, maintenance and repair of the valve. Any damage of soft parts in control valve may lead to its total failure.

2. General

These installation and maintenance instructions apply to all sizes and ratings of the MIL 91000 series multi-stage, multi-path control valves. Refer numbering system Table 1 for valve nomenclature and choose appropriate maintenance procedure. The following instructions for installation and maintenance are compiled to assist personnel in performing most of the maintenance required on the MIL 91000 series control valves. Recommended spare parts required for maintenance are listed in parts list

of page 11. The model number, size, rating and serial number of valve are shown on the identification tag located on the actuator. Special supplements or addendums to this instruction manual may be required for special engineered products developed to meet specific customer requirements. For actuator and other valve accessories, please refer respective instruction manuals. If maintenance is followed carefully, it will reduce maintenance time.

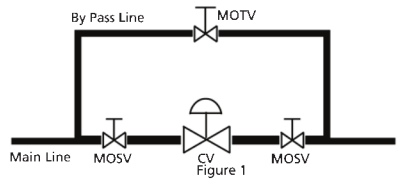
3. Unpacking

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 at factory. Do not remove end protection cover before installation.

4. Installation

- 4.1 Before installing the valve in the line, clean piping and valve of all foreign materials such as welding chips, scale, oil, grease or dirt.
- 4.2 The valve must be installed so that the controlled fluid will flow through the valve in the direction indicated by the flow arrow located on the body.
- 4.3 To allow for inline inspection, maintenance and removal of the valve without service interruption, provide a manually

operated stop valve on each side of the control valve and a manually operating throttling valve in the bypass line. (See Fig.1)



Body Series	Plug Type	Trim Characteristic	Cage Type
<p>91: Multi-stage, Multi-path, Anti-cavitation</p>	<p>0. Undefined 1. Unbalanced 2. With Static Seal Ring 3. With Pressure-energised Polymeric Seal Ring(Static) 5. With Metallic Seal Ring 6. With Polymeric Seal Ring 9. With Graphite Seal Ring</p>	<p>0. Undefined 1. Inline 2. Angle</p>	<p>0. Undefined 1. Axial Flow 2. Radial Flow</p>

Table 1 Numbering System



5. Air Piping

Air piping shall be as per the specification of air filter.

6. Valve Disassembly

The first step is to remove actuator, accessories & pneumatic/electrical connections. Access to the internal components of body should be accomplished with the actuator removed. To carry out this operation, refer instruction manual for actuator.

Caution: New gaskets, packing & seal ring (in case of balanced valves) should be on hand before disassembling the valve, since it is recommended that new gasket, packing & seal ring are to be used during reassembly.

Caution: Prior to performing maintenance on the valve, isolate the valve, vent the process pressure and shut off air supply and signal air or electrical lines to the unit.

6.1 Body Disassembly[Refer Figure 5(a) & 5(b)]

- A. Remove packing flange nuts (3) then remove packing flange (4) and packing follower (5).
- B. Remove body stud nuts (11).
- C. Separate bonnet flange (12)[for special construction only as given in Fig 5(b) & 5(c)] from body(17) through the bonnet(8).

Note: It is suggested that two tapered pieces of flat stock be inserted at the bonnet-to-body joint, 180° apart to simplify initial separation of the bonnet from the body. Two heavy screwdrivers placed 180° apart could also be utilized. Pressure should be applied evenly to prevent the bonnet from binding on the stem or cage.

- D. Push the plug stem (1) down so that the plug is on the seat (15) and slowly remove the bonnet (8) ensuring that the plug stem (1), plug (15) and cage (16) remain in the body (17).
- E. Ensure that exposed part of stem (1) is

Warning: Do not use air supply pressure greater than specified on tag plate located on the yoke of actuator.

- F. Remove packing (7) packing spacer / lantern ring (6) and guide bush (9) from the bonnet (8).
- G. Lift the plug (15) with stem (1) from the body(17).

Caution: Care must be taken to avoid damage to the guiding portion of the plug (outside diameter) and the seating area.

- H. Remove body gasket(13) / Ener seal ring(13)[for special construction as given in Fig 5(b) & 5(c)] from the bonnet(8)and body (17).
- I. Lift the clamping cage (21) and cage S/A (16) from the body(17).
Two threaded holes, 180° apart are provided in cage S/A for easy removal.

Caution : Care must be taken to avoid damage to the guiding area of the cage inside diameter.

- J. Remove the seat ring (18).
Two threaded holes, 180° apart are provided in seat ring(18) for easy removal.

Note : It is recommended to use new gaskets (Ener seal rings) each time the valve is dismantled. In case of emergency, if new gaskets are not available, care must be taken to preserve the old gaskets for re-use. And it must be replaced with new gasket as soon as possible.

- K. Clean and inspect all components for excessive wear or damage.



Note : Inspect all guiding, seating and sealing surfaces. Metal guiding and seating surfaces must be free of scratches, dents, nicks, etc. Since new gaskets are to be used during reassembly, old gaskets should be discarded. Replace all excessively worn or damaged parts. After determining the maintenance required, refer to the appropriate section of this instruction manual.

7. Maintenance & Repair

The purpose of this section is to assist maintenance personnel by suggesting methods of component inspection and maintenance, which is largely dependent on the tools and machine shop equipment available.

Caution: If a valve needs frequent maintenance, please consult MIL with current operating parameters for checking valve selection. Process conditions should be stabilized and determined accurately in case they were not correctly anticipated when original valve was selected.

Each section should be completely read and understood before proceeding.

7.1. Packing Box (Figure 2)

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 (7) is required.

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

6.2 Plug Disassembly

A. Plug Stem Disassembly.

(Model 91100, 91200, 91500, 91600 & 91900)

The valve plug stem (1) is screwed and pinned into valve plug (15). To disassemble the stem (1), hold the valve plug rigidly, taking care not to damage the guiding surfaces. Disassemble the plug stem pin (14) from assembly. By means of flats or using a nut and counter-nut on the end of the stem (1), unscrew the stem from the plug taking care not to apply bending moment which could deform it.

Proceed as follows:

- A. Loosen and remove packing flange nuts (3).
- B. Raise packing flange (4), and packing follower (5) up through the valve stem(1).
- C. By means of a hooked instrument, remove packing (7) ensuring not to damage the sealing surfaces of the packing box or plug stem(1).
- D. Replace correct amount of packing (7) above and below the spacer(6).

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

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.

- E. For Eco-lock type packing (7), do not change the sequence of packing arrangement. The packing is available as a set of lower packing and upper packing. Use the packing as a set only.

Note: MIL Eco-lock packing (Figure 2) is a high performance system to keep fugitive emissions within allowable limits. The packing is provided with the lower packing and upper packing as a set.



Caution: For Eco-lock packing, lower and upper packing to be replaced as a set only. It consists of 'V' and double 'V' packing rings with varying density, which is designed to prevent fugitive emission from packing effectively.

- F. Replace packing follower (5) and packing flange(4).
- G. Replace and tighten packing flange stud (2) & nut (3).

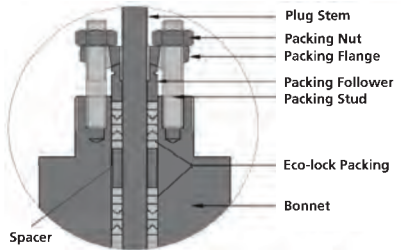
Caution: Do not over-tighten.

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

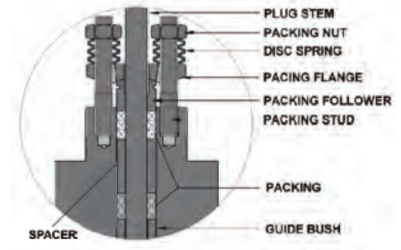
Note: In an emergency, string packing may be used as a temporary repair only. It must be replaced with the correct packing as soon as possible.

Note: If rings are not skive cut, packing ring replacement may require disconnecting the plug stem from the actuator stem and removal of the actuator.

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 2).



Eco-Lock Packing
Figure 2



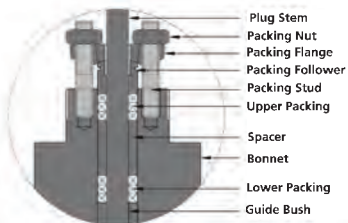
Spring loaded packing (Optional)

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

7.2 Repair of Seat Area (Lapping of seats)

Lapping is the process of working the valve plug (15) against the seating area, with an abrasive, to produce a close fit. When the valve leakage becomes excessive, lapping becomes necessary. The plug (15) and seat ring (18) surfaces should be free of large scratches or dents and the contact surface should be as narrow as possible. This may require dressing both the part in a lathe. The seat surface of plug (15) is at 45° and that of the seat ring (18) is at 47° both from the vertical axis of valve.

For lapping operation, a good grade of fine grinding compound is required. The compound should be mixed with a small amount of lubricant such as graphite. This will slow the cutting rate and prevent tearing of seat surface. Ensure that both the grinding compound and the lubricant are compatible to the service fluid. The amount of lapping required depends on the material, condition of the seating surface and accuracy of machining etc. If a short period of



Standard Packing



lapping does not visibly improve the seating, there is no advantage in continuing further, as too much lapping may result in rough seats. Then the only remedy is replacement or re-machining of one or both the parts, when lapping new plug (15) and seat ring (18) begin with medium compound and finish with fine.

Lapping procedure as follows:

- A. Insert the seat ring (18) in the body (17).
- B. Apply grinding compound at several spots equally spaced around the seating area of the seat ring (18).
- C. Insert the cage (16) to the body (17).
- D. Insert the plug (15) with plug stem (1) from the top carefully until it is seated.
- E. Place the bonnet (8) through the body studs(10).

Caution: Ensure that the seat ring, cage, plug and bonnet are properly aligned.

- F. Using 4 body nuts (11) spaced equally apart fasten the bonnet (8) with bonnet flange (12) [For special construction as given in Fig 5(b) & 5(c)] to the body (17) using only slight pressure and tighten evenly.

Caution: Do not tighten the nuts fully. The bonnet is used temporarily for guiding purpose.

- G. Insert 2 or 3 packing (7) into the packing box to assist in guiding the stem (1) and plug (15) during lapping.
- H. Screw a drilled and tapped rod with T handle on the plug stem (1) and secure with a lock nut.
- I. Apply slight pressure on the stem (1); rotate the same in short oscillating strokes in one direction so as to lap the seating area uniformly. Repeat this procedure 8-10 times.

Note: Intermittently the plug is to be lifted and turned through 90°, before repeating the procedure 'I'. This lifting and turning is essential to keep the plug and seat concentric during lapping.

- J. After completion of the lapping, the seating area and plug (15) must be cleaned off all lapping compound in preparation for reassembly.

7.3 Plug- Stem Pinning

The plug stem S/A consists of a shaft (plug stem) threaded into the plug and pinned. To replace either the plug (15) or the stem (1), it is necessary to drill / drive out the pin and unscrew the stem (1) from the plug (15). Valve plug and stem (1) assemblies are normally supplied as a complete assembly in which case the installation involves no problem. Lap the plug and seating area and assemble the valve. If it is necessary to replace the plug, it is recommended to replace the stem (1) too. If the old stem (1) is used, it is necessary to determine whether the stem (1) is long enough since the stem (1) will require cutting in order to get a new pinning point.

Caution: While pinning is being performed, care must be taken not to damage the seating surface as well as guiding area.

To install a new stem (1), the following procedure is to be followed:

- A. Using a drift punch, drive out the old pin (14).

Note: If it is necessary to drill out the pin, a drill bit somewhat smaller than the pin should be used and the remainder of the pin is driven out.

- B. Unscrew the stem (1) from the plug (15) (counterclockwise).
- C. Screw the new stem (1) solidly into the plug (15).

Note: This can be checked by measuring the depth of the pilot recess in the lug and making a reference mark on the stem at the same distance from the thread. When properly assembled, the reference mark should be flushed with the end of plug section.



- D. Place the plug stem (1) assembly on a V block and using a suitable size drill bit, drill the stem (1) using the hole in the plug as guide.
- E. Remove any burr from the plug (15) by making a small counter bore.
- F. Select correct size of pin (14), apply a small amount of grease on to it and press it into the hole.

Note: The pin must be recessed approximately 1.5 mm below the plug surface.

- G. After the plug (15) has been pinned, it should be placed in a lathe or V block to ensure it is running 'true'. If it is not, strike the plug with soft-faced mallet to straighten. In case of the plug stem (1) with shoulder, this step is not necessary.

8. Body Reassembly

After completion of required maintenance, the valve should be re-assembled as per the following procedure:

Note: If any of the following step is completed during the maintenance, proceed to the next.

Caution : Any lubricant or sealing compound used should be compatible to the service fluid.

- A. Ensure that all the seating, gasket sealing and guiding surfaces are clean and free from any dirt, scale or burr.
- B. Install the seat gasket (19) in the seat ring (18) and assemble into the body (17). Insert the cage into the body (17).
- C. Insert the plug (15) into the cage (16). Refer 8.1.
- D. Slowly and squarely insert the bonnet (8) over the plug stem (1) into the body (17) with body gasket (13) / ener seal ring (13) [for special construction as given in Fig 5(b) & 5(c)] in position and place bonnet flange (12) above bonnet.

Note: Based on construction, some design may have bonnet flange (refer Fig 5(b) & 5(c)). Please ensure that the lip facing is towards down while inserting ener seal ring (13) into the bonnet.

- E. Evenly tighten the body nuts (11)
- F. Slide the guide bush (9) over the top of the plug stem (1) dropping it to the bottom of the packing box.
- G. Insert the lower packing (7), spacer or lantern ring (6) and upper packing.
- H. Install the packing follower (5), packing flange (4), and packing nuts (3) to be finger

tightened. Refer section 7.1.

- I. Replace the actuator to the body and assemble the plug stem (1) to the actuator stem.

8.1 Plug and Cage Assembly

Caution: Ensure that any recommended lubricant or sealing compound is compatible with the process fluid. If not, substitutes must be used.

- A. **Plug & cage assembly for 91100 series valves without ener seal ring (20) (unbalanced type).**
 - 1. Slide the cage (16) over top of plug-stem sub assembly.
 - 2. Lower plug (15) and cage (16) into the body until they rest squarely on the seat ring (16).
- B. **Plug & cage assembly for 91200 series valves with ener seal ring (20) (balanced type) (Figure 3.a)**
 - 1. Insert the cage into the body & on the seat. Place the ener seal ring (20) with the lips facing upwards.
 - 2. Place the clamping cage (21) over the main cage. Then put plug with stem (1) into cage until it rests squarely on seat ring (18). Care should be taken not to damage the seal ring (20).
- C. **Plug & cage assembly for 91500 series valves with metallic seal ring.(Figure 3.b)**
 - 1. This valve has metallic seal rings. Inner ring has a straight cut while the outer ring has a staggered cut. To insert the

Caution: For valves with ener seal ring (91200), do not slide cage over the plug.



rings into plug groove, open the ring by hand and slide them along the plug without damaging any of the parts. Assemble the inner & outer rings separately 180° apart. Slide the cage (16) over top of plug-stem sub-assembly. Care to be taken not to damage the seal rings.

- Lower plug (15) and cage (16) into the body until they rest squarely on the seat ring (18).

D. Plug & cage assembly for 91600 series valves with PTFE seal ring (Figure3.b)

- This valve has inner elastomeric backup ring and outer PTFE ring. Insert the backup ring into the plug groove. Slide the PTFE seal ring along the plug until it slips into the groove. Slide the cage (16) over top of plug-stem sub-assembly. Care to be taken not to damage the seal rings .
- Lower plug (15) and cage (16) into the body until they rest squarely on the seat ring (18).

E. Plug & cage assembly for 91900 series valves with graphite seal rings.(Figure 3.b)

- This valve has outer graphite and inner backup metallic (D3) seal rings. Insert the backup ring (which has a straight cut on it) on the plug groove and then insert the graphite ring over the backup ring. Note that the cuts on each ring should be positioned approximately 180° apart. New graphite seal rings are available as complete ring. It must be split at a single point by a sharp blade at 45 deg, to facilitate easy insertion of the piston ring into the plug groove.

Caution: Care should be taken as the graphite ring is fragile.

- Slide the cage over the plug (15) and stem (1) sub assembly. Care should be taken not to damage the piston rings Ensure below points in body assembly for all models
- Place seat gasket (19) in position.
 - Ensure that the packing (7), spacer / lantern ring (6) and guide bush (9) are removed from the bonnet (8).
 - Position bonnet (8) over the valve so that the packing studs (2) are positioned across the flow path.

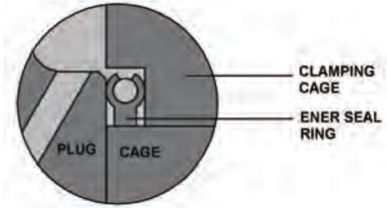


Figure 3.a : 91200

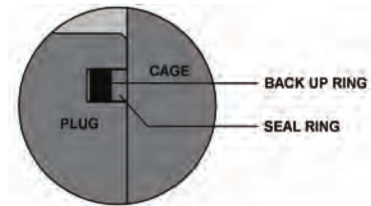


Figure 3.b : 91502/91602/91902

- Slowly and squarely, lower the bonnet (8) over the plug stem (1) & body studs (10) into bolting position.
- Apply a light coat of a lubricant, to body stud threads and the bearing surface of the body stud nuts (11).
- Evenly tighten body stud nuts (11) in the sequence as given in Figure 4.
- Slide guide bush (9) over top plug stem (1), dropping it to the bottom of the packing box.
- Insert packing (7) and spacer / lantern ring (6). Determine correct quantity of packing required after disassembly and ensure it after re-assembly.
- Insert packing follower (5), flange (4) and nuts (3). Packing flange nuts should be finger tightened (see paragraph 7.1).
- For actuator assembly and plug stem (1) adjustment, proceed to the actuator instruction manual.

Body Bonnet Bolting Torque Requirement

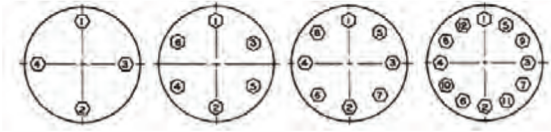


Figure 4

Valve Size	Stud Size	Torque Value	
		lb.ft	N.m
0.75	1" 8 UNC	200	270
1	7/8" 9 UNC	134	182
	1.25" 8 UNC	412	560
	1.5" 8 UNC	738	1000
1.5	1.25" 8 UNC	412	560
	1.5" 8 UNC	738	1000
2	1/2" 13 UNC	24	32
	1.25" 8 UNC	412	560
	1.5" 8 UNC	738	1000
2.5	5/8" 11 UNC	48	64
	1.25" 8 UNC	412	560
	1.5" 8 UNC	738	1000
3	1.5" 8 UNC	738	1000
4	1.5" 8 UNC	738	1000
	1.75" 8 UNC	1200	1630
6	1" 8 UNC	200	270
	2" 8 UNC	1830	2480
8 X 6	2.5" 8 UNC	3660	4965
8	2.5" 8 UNC	3660	4965
10	2.5" 8 UNC	3660	4965
12	2.75" 8 UNC	4965	6680

NOTE:

1. Tighten in increments until the required torque values are reached.
2. Torque requirements shown are for standard ASTM A193 Gr. B7 studs and ASTM A194 Gr. 2H nuts

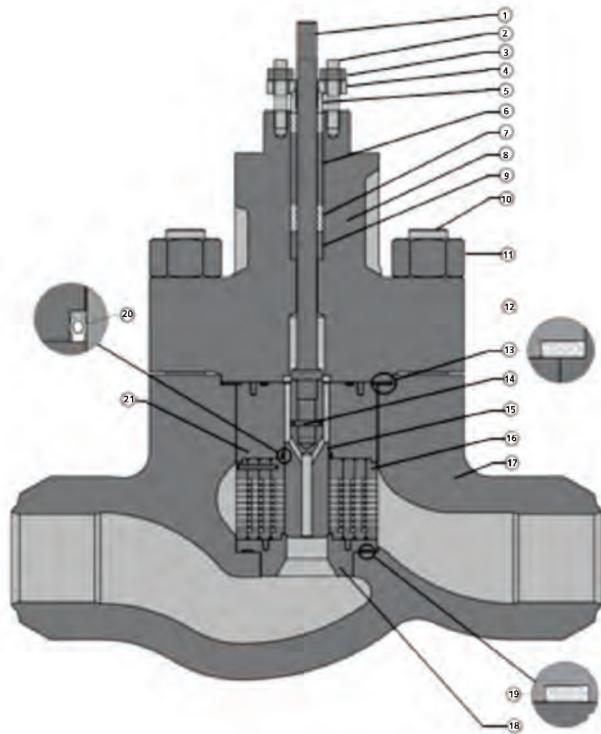


Figure 5(a) - MIL 91201 Balanced Radial design

Parts List

SL	PART NAME
1	Valve Plug Stem
2	Packing Flange Stud
3	Packing Flange Nut
4	Packing Flange
5	Packing Follower
6	Packing Spacer/lantern Ring
7	Gland Packing
8	Bonnet
9	Guide Bush
10	Body Stud
11	Body Nut

SL.	PART NAME
12	Bonnet Flange*
13	Body Gasket / Ener Seal Ring (Bonnet)* ^
14	Plug Pin
15	Valve Plug
16	Cage S/A
17	Body
18	Seat Ring
19	Seat Ring Gasket
20	Ener Seal Ring(plug)
21	Clamping Cage

* Available for special axial construction only

^ Recommended Spare Parts

MIL 91000 - Typical Multi-Stage Designs

Typical Axial Flow Designs

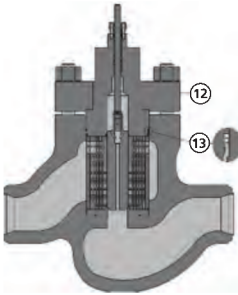


Figure 5 (b) MIL 91211 (6-Cage
Balanced type)
(Special type bonnet construction)

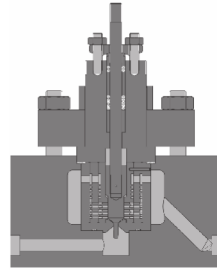


Figure 5 (c) MIL 91111 (3-Cage
Unbalanced type)
(Special type bonnet construction)

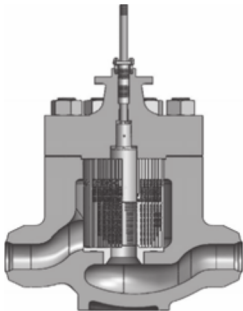


Figure 5 (d) MIL 91211 (8-Cage
Balanced type)

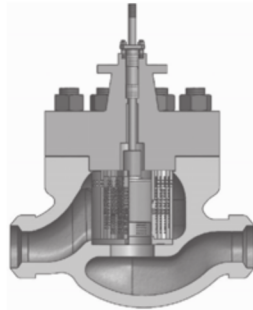


Figure 5 (e) MIL 91211 (5-Cage
Balanced type)

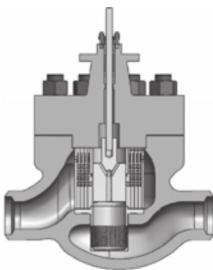


Figure 5 (f) MIL 91211
(5-Cage Balanced with Diffuser)

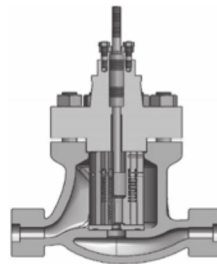


Figure 5 (g) MIL 91111 (3-Cage
Unbalanced type)

Typical Radial Flow Designs

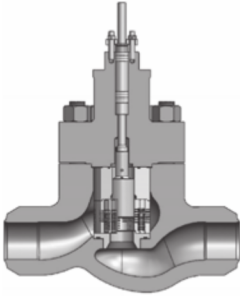


Figure 5 (h) MIL 91212 (3-Cage Balanced type)

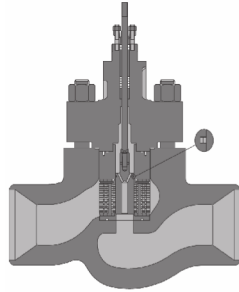


Figure 5 (i) MIL 91512/91612/91612 (4-Cage Balanced type)

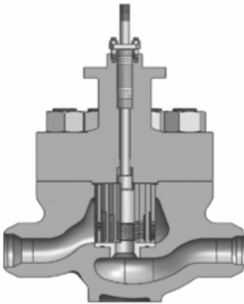


Figure 5 (j) MIL 91112 (4-Cage Unbalanced)
(For Steam/Gas service)

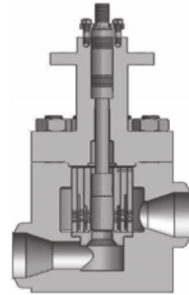


Figure 5 (k) MIL 91112 (3-Cage Unbalanced type)
(For Steam/Gas service)

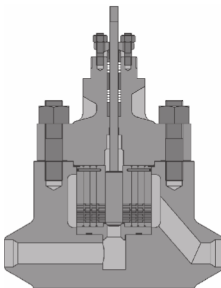


Figure 5 (l) MIL 91112 (4-Cage Unbalanced)
(Forged design)

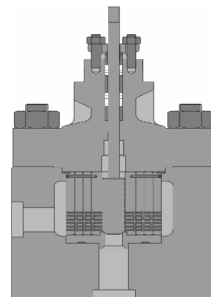


Figure 5 (m) MIL 91122 (4-Cage Unbalanced type)
(Forged design)