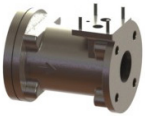
ams
Instrumentation & Control

1 ½" – SV1507 Al

2" – SV2035 Al

2" – SV2023 Al



2" – SV2043 St/St

3" – SV4636 Al

4" – SV4000 Al

INSTALLATION, OPERATING & MAINTENANCE MANUAL

# Servo Control Valves

TYPE: 1 ½", 2", 3" & 4"

# Contents



# 1. Safety Information

In the interest of safety it is strongly recommended by AMS-IAC Ltd that the following details receive strict attention.

**Fluorocarbon**

O-rings/seals containing fluorocarbons may become toxic if overheated.
Do not handle O-rings/seals if their material appears charred, gummy or sticky.

Use tweezers and wear neoprene or PVC gloves.

Do not touch adjacent parts with unprotected hands.

Neutralize adjacent parts with a solution of calcium hydroxide.

If the degraded material or adjacent parts touch the skin, do not wash off with water, seek immediate medical aid for possible contamination

Hydrofluoric acid in contact with skin has delayed symptoms of contamination. It is extremely toxic.

1) The Servo Valve(s) is used only with fluids stated as acceptable by AMS-IAC Ltd.
2) The Servo Valve(s), whilst in service, must not be subjected to pressures greater that the Maximum Working Pressure or tested to pressures greater than the Test Pressure as specified in the manual.
3) The Servo Valve(s) must be handled using the lifting handles where fitted, or in accordance with the manual.
4) The Servo Valve(s) must not be misused or handled in any way liable to cause damage.
5) The Servo Valve(s) must be inspected for any signs of damage prior to use e.g. cracks, damaged seals, seized or tight operating mechanisms.
6) The Servo Valve(s) must be subjected to a regular maintenance programme, either in accordance with the manual or as specified by AMS-IAC Ltd.

# Safety Information

7) Only technically competent personnel should repair or maintain the Servo Valve(s) and only parts supplied by AMS-IAC Ltd may be used.

8) Servo Valve(s) covered by warranty may not be modified in any way without prior written permission of AMS-IAC Ltd.

9) Servo Valve(s) not in service, must be stored in a clean area, and should not be subjected to excessive temperature, humidity, sunlight, or strong artificial light. Servo Valve(s) should be protected to prevent damage or the ingress of foreign matter.

10) Where applicable, attention should be drawn to dangers resulting from the generation of static electricity in Servo Valve(s) flow lines. We strongly recommend account is taken of PD CLC/TR 50404:2003.



# 2. Introduction

**Note:** This Installation, Operating and Maintenance Manual covers the installation operation and maintenance of the basic in-line servo valve only and is not intended to cover in detail the many available pilot operating devices i.e. electrical solenoids, pressure regulators, flow regulators etc. that may be fitted to control the valve.

Pilot control devices are generally required to be repaired and maintained by AMS-IAC Ltd.

**2.1** All sizes in the range of Servo Valves manufactured by AMS-IAC Ltd work on the same principle using the line pressure to operate the valve under the control of a pilot that interprets a flow signal. They are available in Aluminum Alloy with Stainless Steel trim and some of the smaller sizes are available in all Stainless Steel. When used as 'ON – OFF' devices, they may be controlled by electric, hydraulic, pneumatic or manual signal. They may also be made to modulate to keep a constant line pressure either upstream or downstream in which case they can use a spring, gas or liquid pressure as a reference.

**2.2** In many cases more than one function may be combined by manifolding pilots together. An example of a combined pilot would be where it is desired to keep a constant pressure in the line but sometimes, as in an emergency, it is necessary to close the line completely. In such a case as this, the valve would be fitted with a manifold that connected to a pressure regulator pilot in series with a solenoid or hydraulic pilot to close the valve when required.

The configuration of the basic valve can be seen in Figs.1 and 2, but actual construction varies with size. In all cases the flow passes through the valve in a streamline pattern around the cylinder and piston which control the opening and closing of the valve head. This gives a high CV factor and enables common parts to be used in different sizes of valve. Similarly, pilots are common to all sizes except for electric operation where smaller simpler solenoids can be used on the smaller sizes of valve.

# 3. Specification

| | |
|---|---|
| **Nominal Sizes** | 1 ½", 2", 3" and 4" |
| **Flanges** | 1 ½" & 2" BS10 Table E (Optional ANSI / ASME Class 150)<br>3" & 4" ANSI / ASME Class 150 |
| **Body Material** | Aluminum Alloy (Optional 2" version in Stainless Steel 316L) |
| **Seal Material** | Nitrile or Viton |
| **Max. Working Pressure** | 150 Psi (10 Bar) |
| **Max. Rate of Flow** | 1 ½" – 80 gpm UK (364 l/min)<br>2" – 130 gpm UK (600 l/min)<br>3" & 4" – 1000 gpm UK (4500 l/min) |
| **Max. Working Temperature** | +80°C |
| **Min. Working Temperature** | -20°C (Providing no water is present in the system) |



# 4. Prinicples of Operation

**4.1** While the construction of the 11/2 and 2 inch sizes differs slightly to the larger 3 and 4 inch sizes, the configuration is similar, refer to Figs.1 and 2. It will be seen that the flow path through the valve is very smooth giving a low pressure loss , i.e. a high CV factor. This is because the actuating piston controlling the main valve head is mounted in a streamline casing in-line with and surrounded by the fluid flow.

**4.2** The valve body is shaped to give a constant cross–sectional area with no sharp bends, as an aid to keeping pipe losses low. The streamline casing is supported on three webs which enable a port to be drilled from the outside of the valve to connect with the inside of the casing or cylinder. A second port through the valve body wall enables a connection to be made with the downstream side of the valve. Line pressure is fed to the cylinder by means of a metering hole in the valve head.

**4.3** From the illustrations, it will be seen that the valve is controlled by a pilot that connects the two ports. These ports terminate at an interface that is common for all pilots and all sizes of valves to enable any size of valve and any pilot to be married together. A solenoid pilot is shown in the diagrams to simplify the explanation of how the valve is controlled.

**Static condition (See Fig. 1)**

**4.4** With no liquid flowing and with the pilot closing the connection between the two ports at the pilot interface, the piston assembly is held in the closed position by the return spring with the rubber sealing ring in the main valve head against the seating face in the inlet body. Fluid also fills the cylinder by way of the hollow piston rod.

As pressure is applied to the piston, the load on the main valve head is resisted by the same pressure acting on the inner side of the piston through the hollow piston rod. Since the piston is of a greater area than the main valve head, the assembly is pressed harder against its seating as the pressure rises.

# Principles of Operation

**Flow condition (See Fig. 2)**

**4.5** When the pilot opens the connection between the two ports, fluid from the cylinder can escape downstream and the pressure in the cylinder is lowered, because the control jet in the piston rod limits the quantity of fluid entering the cylinder from the pipeline. With the load reduced on the piston, line pressure overcomes the return spring and lifts the main valve head from its seat. Flow now commences passed the valve head into the annular passage around the cylinder and so to the outlet flange.

**Shut-off condition (See Fig. 1)**

**4.6** When the pilot closes the connection between the two ports, fluid can no longer flow downstream from the cylinder and the cylinder becomes a closed chamber. Since line pressure is still applied through the control jet the pressure in the cylinder builds up and the piston assembly becomes balanced except for the return spring. This imparts a linear motion to the piston assembly to close the valve. As the valve closes a pressure drop is generated across the valve head and so the pressure on the open or downstream side of the piston is reduced enabling the main piston to increase its load on the valve head and so assist in closing the valve throat. It is now back to the static condition with the pressure maintaining a tight seal.

**Shut-off condition when valve fitted with regulator pilot**

**4.7** When in the regulating mode, the pilot controls the amount of opening in the passage so that the pressure in the cylinder is maintained to just balance the return spring and also position the piston assembly to give the required pressure drop across the valve head.



# Principles of Operation

As conditions change, the pilot modulates to adjust the pressure in the cylinder to the value required to maintain the set point. For example, if a pressure regulator is maintaining a downstream pressure and the flow is increased, the pressure drop across the main valve head will rise (the higher flow requires less restriction for the same pressure drop) thus lowering the downstream pressure.

This pressure is reacting on the pilot diaphragm and the control spring will move the diaphragm assembly down and so open the pilot port allowing the cylinder pressure to fall. This allows the valve head to open further and so reduce the restriction causing downstream pressure to fall.

As downstream pressure builds up the diaphragm load again balances the control spring when the set point is reached, but the valve head is now in a new position to suit the changed conditions. Since the diaphragm reacts to any changed conditions as they change, the main valve also modulates the correct amount to counter the changes and so keep the outlet at the set point.

# Principles of Operation

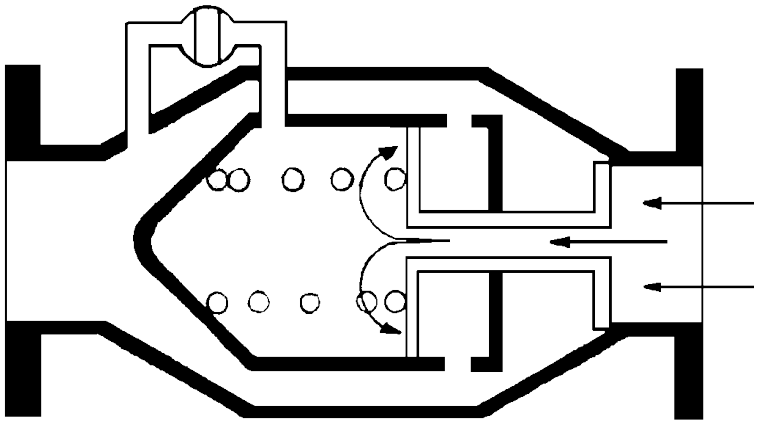


Fig 1 Valve Closed

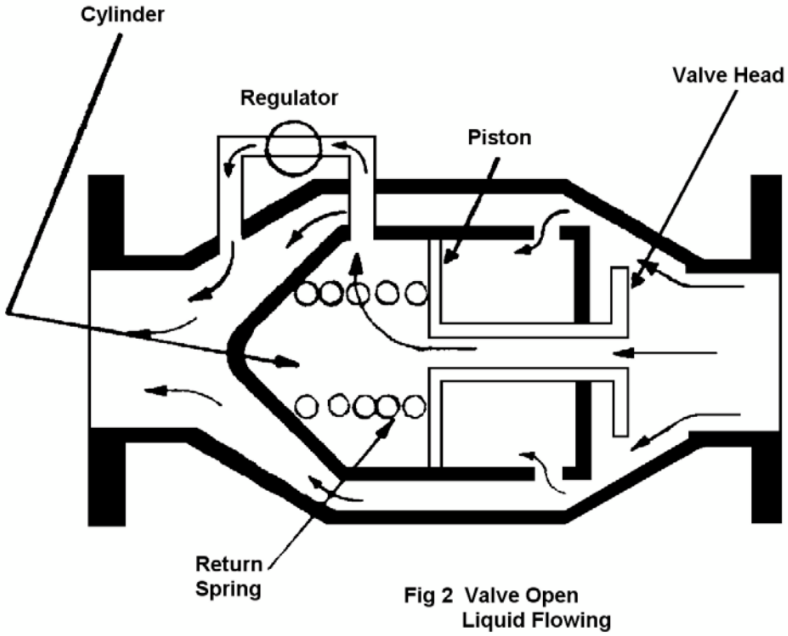



Fig 2 Valve Open
Liquid Flowing

# 5. Installation & Commissioning

**WARNING:** Failure to adhere to the following instructions may result in serious damage to the valve which may lead to a major leakage.

Where a failure of this equipment would cause a dangerous situation AMS-IAC recommend that a system of feedback is incorporated into the system into which it is installed.

**Example 1** – If this control valve is to be used as a pressure control device then a pressure relief device is to be installed in the pipework downstream of the control valve.

**Example 2** – If this control valve is to be used as part of a tank filling system then a high level alarm is to be installed in the tank which is being filled.

If there is a danger that a pressure spike caused by rapid shut--off of this equipment may cause ignition by shock waves or compression, AMS-IAC recommend that a form of protection is incorporated into the pipeline system i.e. a shock alleviator.

If this equipment is to be used in a designated hazardous area and is fitted with an electrical solenoid, that solenoid must be connected with an appropriate ATEX approved conduit entry.

**5.1** The flanges on the servo valve are supplied drilled to either BS10 Table E or ANSI/ASME Class 150. All models of this range of valves may be installed in any attitude providing the arrow cast on the outside of the valve body is pointing in the direction of flow in the pipe. Pipework adjoining the servo valve is to be supported, restrained and guided as necessary to ensure that the valve is not subjected to torsional or bending stresses imposed by adjoining pipework system.

**5.2** All servo valves have flat face flanges and must only be installed against mating flat faced flanges, using suitable full face gaskets.

# Installation & Commissioning

**5.3** Before putting into service, all air is to be expelled from the pipeline and from the valve assembly.

**5.4** Fluid flow will push all air from the valve and chamber, but regulator units if fitted will require bleeding. Regulator units have bleed screws fitted from which air can be initially expelled; final bleeding may be carried out while fluid is flowing.



# 6. Maintenance

**6.1** The frequencies recommended below are a minimum, however, local company instructions must be observed.

**6.2 Daily**

Carefully inspect the unit for signs of damage or leaks. Defects must be rectified immediately or the unit withdrawn from service.

**6.3 Six Monthly**

Carry out a complete operational check.

**6.4 Four yearly**

Valve is to be stripped and examined as described in section 7, servicing.

**6.5 Seal Renewal**

| In service | Dynamic seals | Annually |
|---|---|---|
| In storage | Static seals<br>All seals | Every two years<br>Every three years |

# 7. Servicing Basic Servo Valves

### 7.1 1½" and 2" Servo Valve Versions

**Dismantling (Refer to Fig. 3)**

i) Remove the relevant pilot operating device from the servo valve.

ii) Liquid will also be trapped in the cylinder and the valve should be tipped over in a drip tray and the valve head depressed several times to expel the liquid.

iii) Remove 2 off ¼" UNC csk screws from inlet flange face.

iv) Separate the two parts of the main body (Valve body and Chamber), taking care to retain the gasket.

v) Remove spirolox retaining ring and withdraw the base cap, spring and valve head assembly from the valve body. Carefully place the components onto a clean working area.

**Inspection**

i) Thoroughly clean all metal parts.

ii) Inspect the valve head for signs of indents or scratches which can affect the valve performance, if any signs of damage is found to the valve head then it should be returned to AMS-IAC for a repair assessment.

iii) The main cylinder bore should have particular attention as any roughness or score marks will quickly damage a new seal. Small scratches may be polished out.

iv) Remove and replace the external distributor seal (AMS-IAC PN: SV332) on the valve head assembly ensuring that the seal is correctly fitted and is seated correctly on the valve head body.





v) Inspect the valve head seal (AMS-IAC P/N: SV94) for signs of damage or wear, if damage or wear is found then the complete valve head assembly must be returned to AMS-IAC for replacement as special tooling is required to complete the operation.

vi) Remove and replace the Base Cap O-Ring seals (AMS-IAC P/N: 18035 & 18039).

**Re-assembly**

i) Lightly grease the external distributor seal using silicon grease and reinstall the valve head into the valve body, the seal must be installed in the correct orientation, i.e. with the heel of the seal against the valve head with the sealing lip outermost.

ii) Push the valve head until it is completely installed into the valve body.

iii) Install the spring (AMS-IAC P/N: SS17 1½" Valve, SS67 2" Valve) in to the valve body so that it is seated in the valve head spring groove.

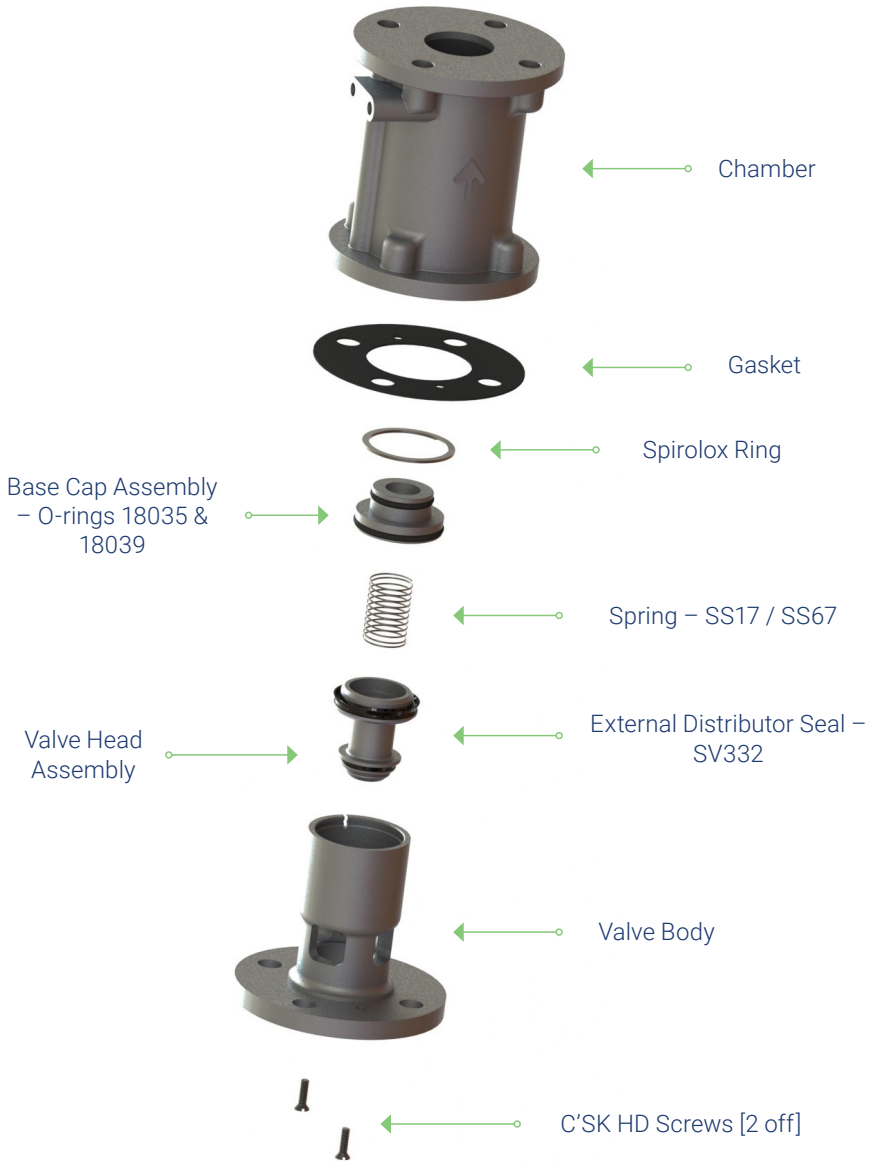
iv) Install Base Cap Assy into the valve body ensuring correct orientation.

v) Compress the Valve Head, spring and Base Cap in the valve Body and install the Spirolox retaining ring, ensuring that it seats firmly in the groove on the Body.

vi) Install a new gasket (AMS-IAC P/N: 1 ½" SV101, 2" SV129) over the valve body.

vii) Insert the valve body and gasket into the chamber.

viii) Install and tighten the 2 off ¼" UNC csk screws, do not over tighten.






Servicing Basic Servo Valves

### 7.2 3" and 4" Servo valve versions

**Dismantling valve (Refer to Fig. 4)**

i) Remove the relevant pilot operating device from the servo valve.

ii) Liquid will also be trapped in the cylinder and the valve should be tipped over in a drip tray and the valve head depressed several times to expel the liquid.

iii) Remove the 12 off ½" UNC bolts, nuts and washers around main valve body.

iv) Gently ease the valve inlet casing from the main valve body, removing the O-ring.

v) Turn the valve body vertically so that it is sat on the outlet flange.

vi) Remove 3 off ¼" UNF cap head screws and washers retaining the valve head assembly to the valve body.

vii) Carefully remove the valve head assembly and spring from the valve body; place the components onto a clean working area for further dismantling.

**Valve head dismantling (Refer to Fig. 5)**

i) Remove the spirolox ring (Ring 1) from the valve head shaft.

ii) Carefully remove the main piston and cylinder cover from the valve head shaft, ensuring to catch the facing washer which is between the two components.

iii) Remove the external distributor seal from the main piston.

iv) Remove the spirolox ring (Ring 2) located internally on the valve head shaft and withdraw the control jet.

v) Remove the O-ring from the valve head shaft.

vi) Remove the spirolox ring (Ring 3) from the front of the valve head, and remove the seal retainer and square section seal.

# Servicing Basic Servo Valves

**Inspection**

i) Thoroughly clean all metal parts.

ii) On the 4” servo valve (SV4000) inspect the tapered needle in the valve body for signs of signs of indents or scratches, if any sign of damage is found then the tapered needle should be replaced (AMS-IAC P/N:SV4072).

iii) Remove the tapered needle by inserting a small Ø3mm bar through the tommy hole and unscrew the tapered needle from the valve body.

iv) Use Loctite 542 sparingly on the threads of the replacement tapered needle before installing.

v) The main cylinder bore should have particular attention as any roughness or score marks will quickly ruin a new seal. Small scratches may be polished out.

vi) There must be no damage to the valve seating in the valve inlet casing, if any signs of damage is found to the valve inlet casing then it should be returned to AMS-IAC for a repair assessment.

vii) Inspect the control jet bore for signs of score marks, if any signs of damage is found then the control jet should be replaced (AMS-IAC P/N: 3” SV4146, 4” SV4011).

**Re-assembly – Valve head (Refer to Fig. 5)**

i) Discard all O-rings and seals and replace with new ones during reassembly.

ii) Install a square section seal (AMS-IAC P/N: SV 4171) onto the valve head ensuring it is seated correctly.

iii) By hand press the Seal Retainer onto the square section Seal.

iv) Install the spirolox ring (Ring 3) onto the Valve Head so that it holds the Seal Retainer tight against the Seal.



# Servicing Basic Servo Valves

v) Coat the O-ring (AMS-IAC P/N: 18019) with silicon grease and install into the small groove on the Valve Head shaft.

vi) Install the Control Jet into the valve head internally, so that it seats on the inner shoulder of the valve head shaft.

vii) Fit a spirolox ring (Ring 2) into the shaft to hold the Control Jet in position against the inner shoulder.

viii) Slide the cylinder cover onto the valve head shaft.

ix) Install an external distributor seal (AMS-IAC P/N: SV4066) to the main piston, the seal must be installed in the correct orientation, i.e. with the heel of the seal against the piston with the sealing lip outermost.

x) Install the facing washer (AMS-IAC P/N: SV4059) onto the valve head shaft ensuring correct orientation i.e. the washer should seat over the shaft shoulder.

xi) Install the main piston onto the valve head shaft so that it seats against the facing washer.

xii) Install the spirolox ring (Ring 1) onto the valve head shaft so that it retains the main piston against the facing washer.

**Re-assembly Valve (Refer to Fig. 4)**

i) Place the valve body vertically so that it seats on the outlet flange.

ii) Install a spring (AMS-IAC P/N: SS48) over the taper needle (if fitted) so that it seats into the recess in the Valve body.

iii) Install the valve head assembly onto the valve body, carefully sliding the assembly over the tapered needle (if fitted). Care should be taken to ensure that the spring is compressed evenly.

iv) Install the 3 off ¼” UNF cap head screws and washers to retain the valve head assembly to the valve body.

v) Coat the O-ring (AMS-IAC P/N: 18041) with silicon grease and install the O-ring onto the valve body.

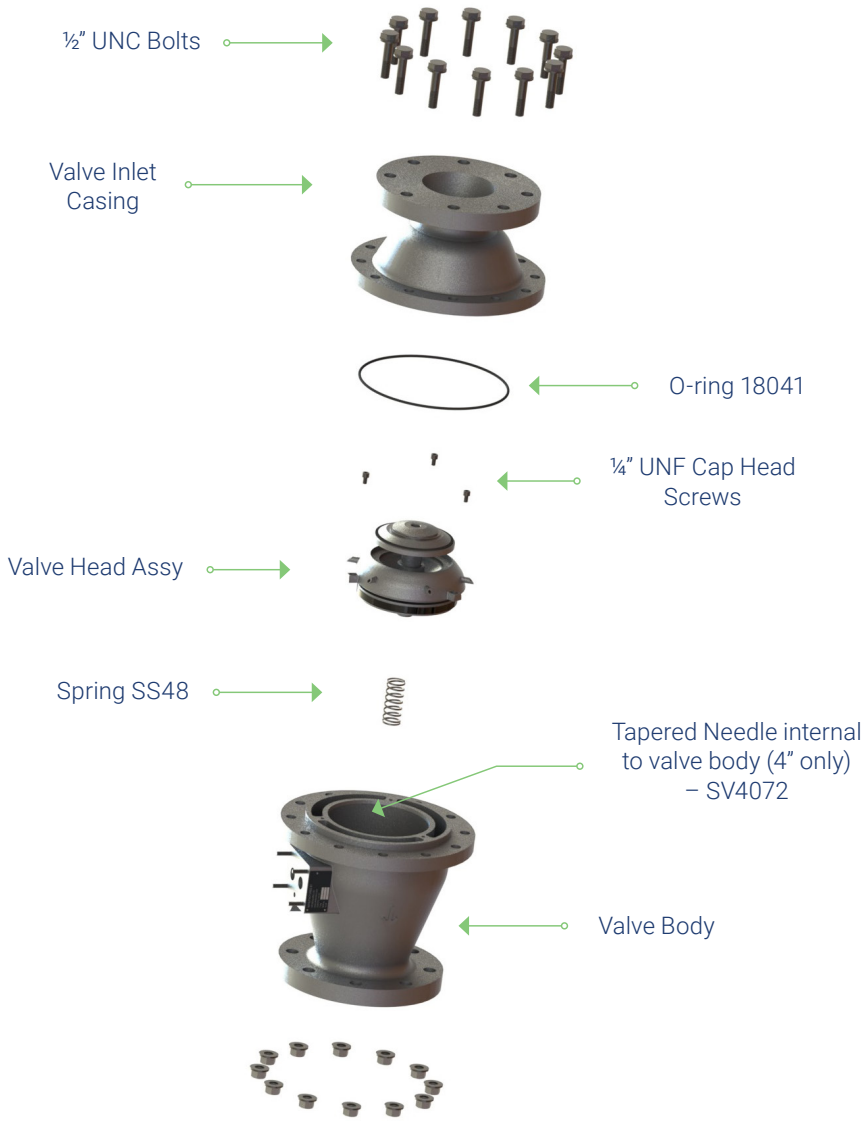
vi) Install the valve inlet casing onto the valve body, taking care not to dislodge the O-ring.

vii) Install the 12 off ½" UNC bolts, nuts and washers around main valve body and tighten to the specified torque rating of 10Nm.



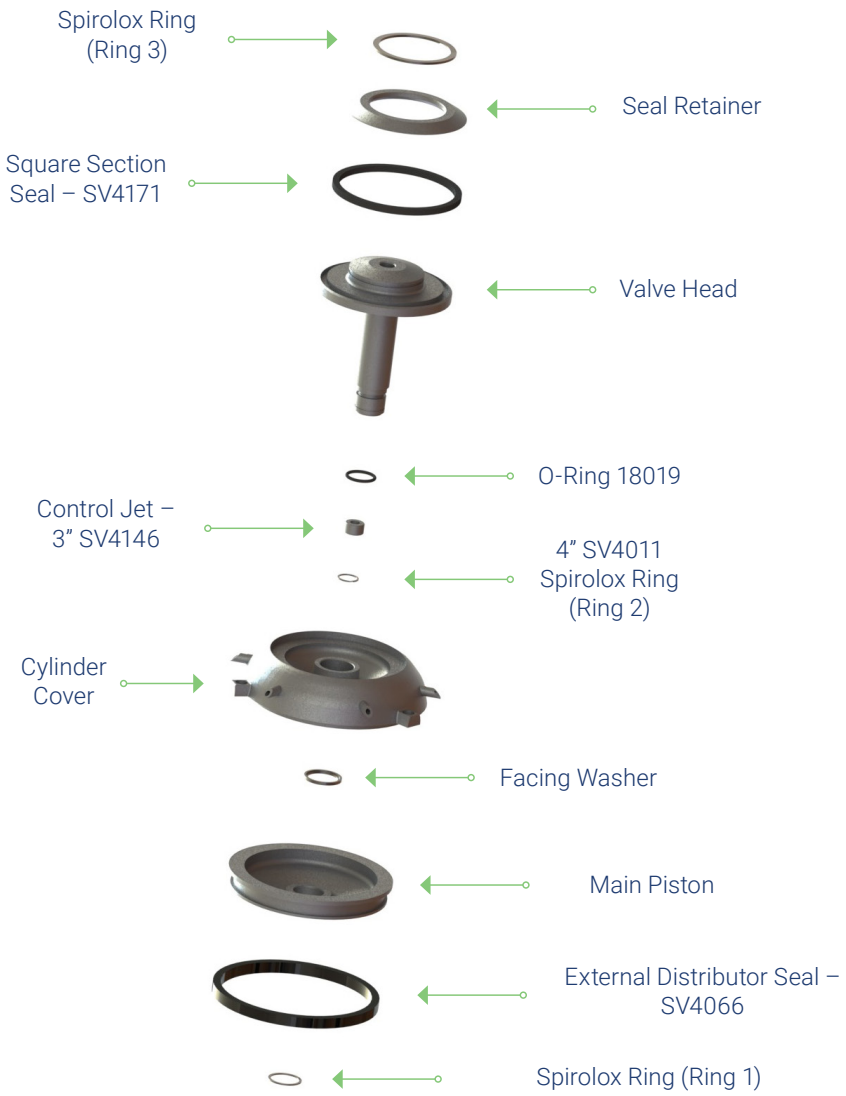
Servicing Basic Servo Valves

**Fig 4. 2"/4" Servo valve exploded view**



# Servicing Basic Servo Valves

**Fig 5. 2”/4” Servo valve head exploded view**




# 8. Functional Testing (all Servo Valves)

After servicing the servo valve it is advisable to perform a hydraulic functional test to ensure correct operation.

i) Fit a test flange and hydraulic test equipment to the servo valve inlet flange.

ii) Carefully fill the valve body with water via the pilot operating device port located on the centre line of the valve (ensuring all trapped air is expelled.

iii) Once filled fit a suitable blanking plate to the pilot operating device ports.

iv) Apply 15 Psi (1 Bar) test pressure and ensure no leaks are present, if none are found increase the pressure to 150 Psi (10 Bar) for a 10min duration and check that no leaks are present around the servo valve outlet flange.

v) Once testing is complete bleed the pressure slowly from the test equipment and remove all blanks and test equipment.

vi) Drain all water from the servo valve and leave to dry before re-fitting to the system.

vii) Refit any pilot operating devices previously removed during the dismantling procedure.

# 9. Repairs and Servicing

AMS-IAC Ltd offers a full valve overhaul service and valve repair from our workshop, or on-site through authorised contractors. The service includes replacement of any damaged parts, replacement of seals, cleaning of the valve body and valve head internally, replacement of washers, nuts and bolts and functionality test.

The workshop overhaul includes a pressure test of the reassembled Servo Valve(s) and 12 months warranty.

For a price and further information contact our Sales team on +44 (0)1726 839909.

# 10. Spares (Servo Valves Only)

### Complete Units

| | |
|---|---|
| **SV1507** | 1 ½" Aluminium Servo Control Valve with BS10 Table E Flanges – ½" BSPT Ports |
| **SV2023** | 2" Aluminium Servo Control Valve with BS10 Table E Flanges – 4 bolt mounting port |
| **SV2035** | 2" Aluminium Servo Control Valve with BS10 Table E Flanges – ½" BSPT Ports |
| **SV2043** | 2" Stainless Steel Servo Control Valve with BS10 Table E Flanges – 4 bolt mounting port |
| **SV4636** | 3" Aluminium Servo Control Valve with ANSI Class 150 Flanges – 4 bolt mounting port |
| **SV4000** | 4" Aluminium Servo Control Valve with ANSI Class 150 Flanges – 4 bolt mounting port |

### Spares

| Valve Type | Spares Available |
|---|---|
| **1 ½" Service Kit** | Spring – AMS-IAC P/N: SS17<br>External Distributor Seal – AMS-IAC P/N: SV332<br>Base Cap O-ring – AMS-IAC P/N: 18035<br>Base Cap O-ring – AMS-IAC P/N: 18039<br>Gasket – AMS-IAC P/N: SV101 |
| **2" Service kit** | Spring – AMS-IAC P/N: SS67<br>External Distributor Seal – AMS-IAC P/N: SV332<br>Base Cap O-ring – AMS-IAC P/N: 18035<br>Base Cap O-ring – AMS-IAC P/N: 18039<br>Gasket – AMS-IAC P/N: SV129 |
| **3" Service Kit** | Square section Seal – AMS-IAC P/N: SV4171<br>Valve Head O-ring – AMS-IAC P/N: 18019<br>External Distributor Seal – AMS-IAC P/N: SV4066<br>Control Jet – AMS-IAC P/N: SV4146<br>Spring – AMS-IAC P/N: SS48<br>Main Assy O-ring – AMS-IAC P/N: 18041 |
| **4" Service Kit** | As above replacing Control Jet with – AMS-IAC P/N: SV4011 |

For part no listed above please contact our Sales team on +44 (0)1726 839909.

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