Series 252 Servovalves
Product Information

011-182-906 J

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Introduction

The MTS Series 252 Servovalves regulate the rate and direction of hydraulic fluid flow to and from a hydraulic actuator. They are designed for use with actuators requiring 3.8 to 227 L/min (1 to 60 gpm) of fluid flow.

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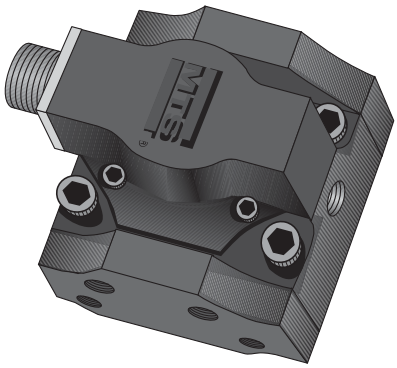
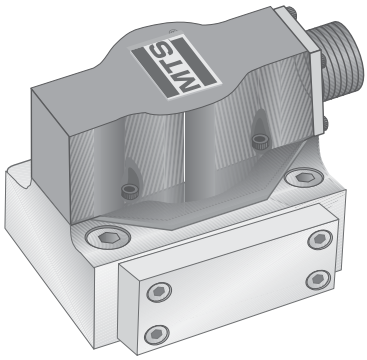


Revision C



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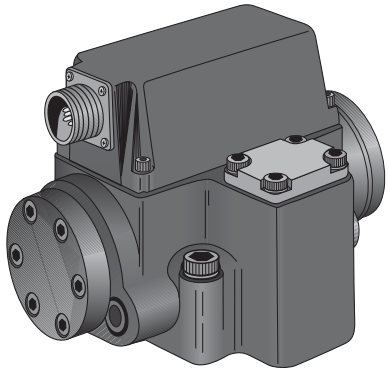


Series 252.3x Servovalve

Series 252.2x/4x Servovalve

Note *The Series 252.2x/4x Servovalves are available in two versions. Both versions are interchangeable and have similar specifications.*

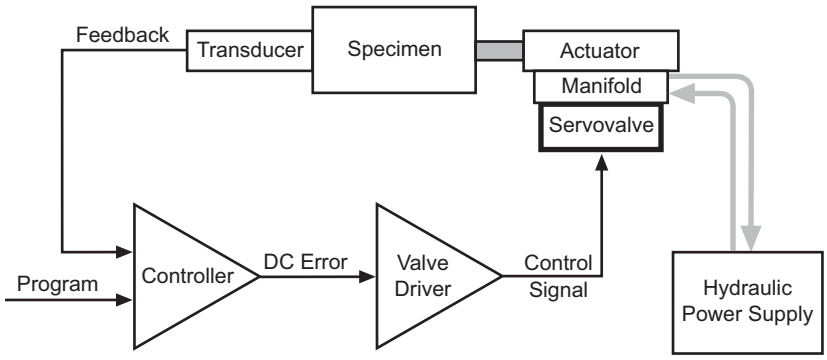
What you need to know

MTS Systems Corporation assumes that you know how to use your controller. See the appropriate manual for information about performing any controller-related step in this manual's procedures. You are expected to know how to perform the following procedures.

- Turning hydraulic pressure on and off
- Selecting a control mode
- Manually adjusting the actuator position
- You should have experience installing or servicing servohydraulic equipment.

Functional Description

The heart of a servohydraulic system is the servovalve. It is the final control element in most MTS closed-loop systems. The servovalve responds to command signals generated by the software and processed by the controller and output through the valve driver module. The servovalve regulates the direction and flow of the hydraulic fluid entering the actuator from the hydraulic pressure ports. The direction that the spools move determines the direction of fluid flow to the actuator. A pressure difference is what causes the fluid to move.



Typical Closed-Loop System

Control signal

In a closed-loop hydraulic system, the servovalve uses the control signal from an electronic control device (controller) to operate a valve that regulates the movement of a hydraulic actuator.

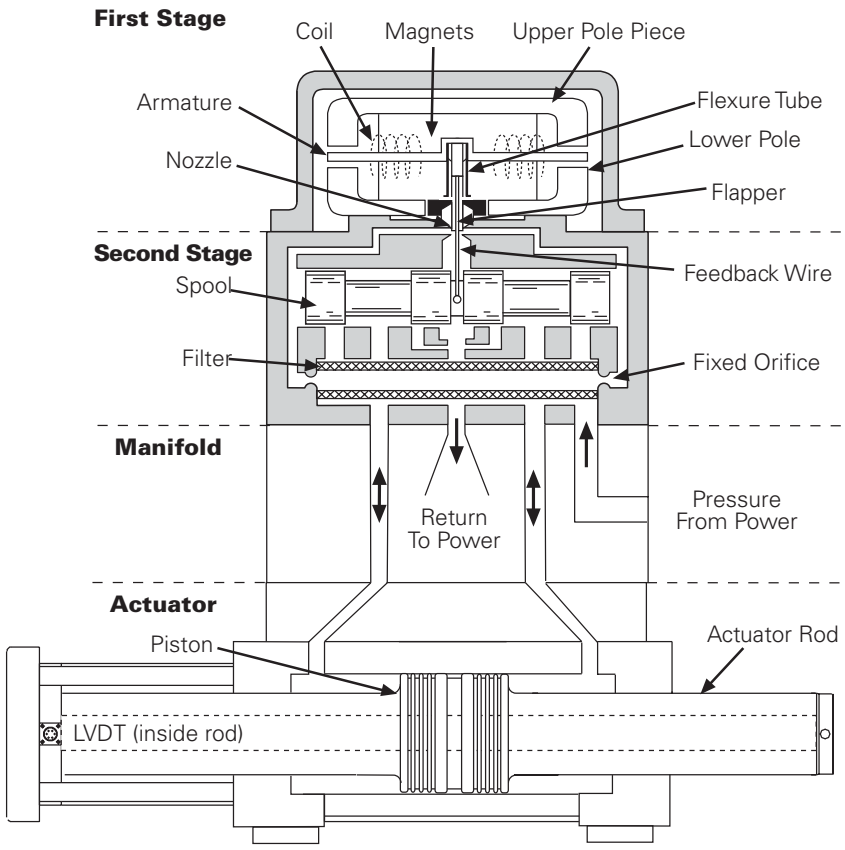
The control signal is created by comparing the program command signal (the desired actuator position) and the feedback signal from a transducer (the actual actuator position). Any difference between the two is called DC error, which is the command to the servovalve to supply hydraulic fluid to the actuator until the desired actuator position is achieved.

Servovalve at rest

The servovalve's controlling element is the torque motor, which receives an electrical input from the controller. A flapper is attached to the armature of the torque motor. The flapper moves from side to side as the armature moves in response to control signals from the controller. The flapper assembly is mechanically attached to the armature. There are two nozzles, one on each side of the flapper.

Because the nozzle-flapper valve is the first control point of hydraulic fluid, it is called the first stage. As long as there is no command for actuator motion, the flapper is centered between the two nozzles.

At the same time, pressurized hydraulic fluid entering the valve is applied equally to both sides of the spool, which does not move. This is the second stage.



Functional Diagram

Moving the spool

A command from the controller causes the armature to rotate clockwise or counterclockwise (depending on the polarity of the command). The command causes the flapper to block one of the nozzles which diverts hydraulic flow to that end of the spool. The spool moves and opens hydraulic pressure to one control port and the return line to the other control port. The control ports are connected to each end of the actuator.

Stopping the spool

The feedback wire works like a spring. The spool moves until the feedback wire torque equals the torque from the magnetic forces. This causes the flapper to move back toward the centered position. The spool stops at a position where the feedback wire spring torque equals the torque input current of the command. The spool position is proportional to the input command current.

Although the pressures are equal on both sides of the spool (so the spool is no longer moving), control flow from the servovalve keeps the actuator moving.

Stopping actuator movement

When the actuator has moved the desired amount, the valve drive command decreases to zero. Hydraulic fluid flow to the actuator stops, and so does the actuator.

Applications

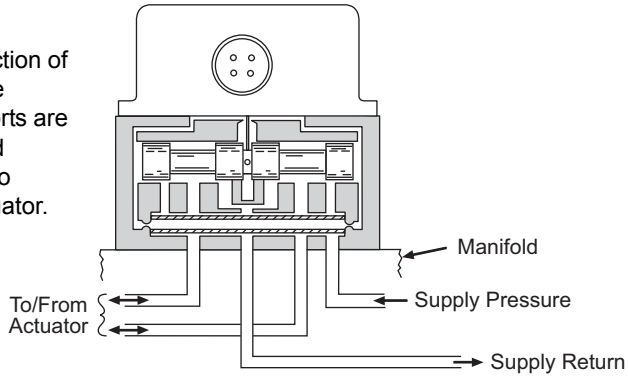
Servovalves are suitable for a variety of applications. They may be mounted directly to a linear or rotary actuator, or single or dual servovalves may be mounted to a manifold, which in turn is mounted to an actuator. The following paragraphs illustrate how the 252 Servovalve is used:

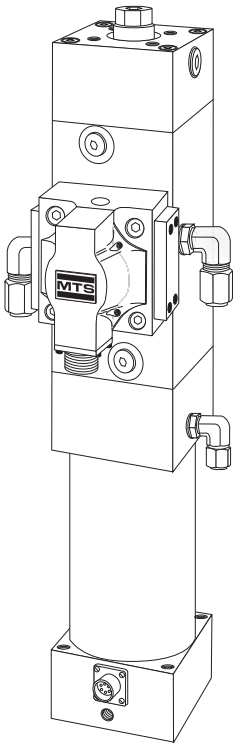
- Single servovalves
- Dual servovalves
- Three-stage servovalves

Single servovalves

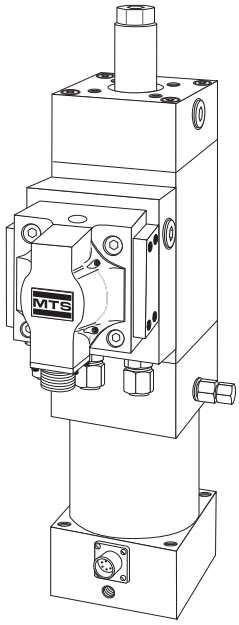
Single servovalves may be mounted to a manifold or directly to an actuator. The purpose of a manifold is to adapt the ports of the servovalve to the ports of the actuator.

This is a cross section of a single servovalve showing how its ports are aligned. A manifold realigns the ports to match a given actuator.





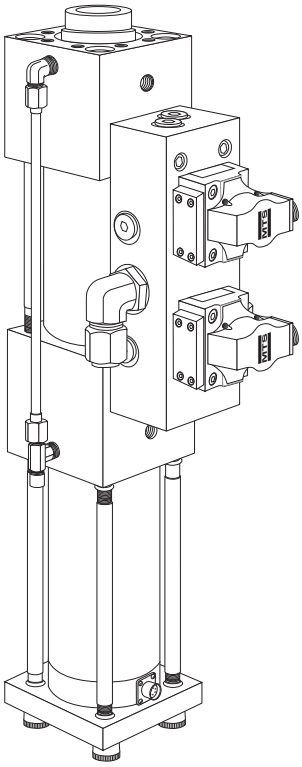
Direct Mounting

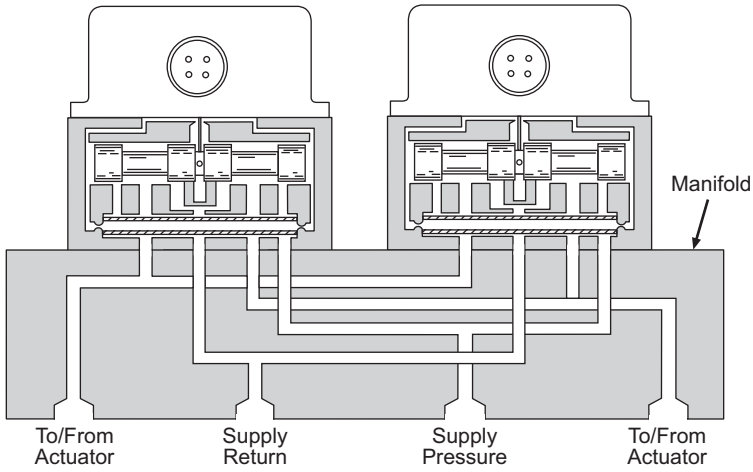


Manifold Mounting

Dual servovalves

Dual servovalves are sometimes mounted to a manifold. The manifold is a metal block that connects the ports of each servovalve to the ports of the actuator. Mounting two servovalves to a manifold doubles the flow rate.



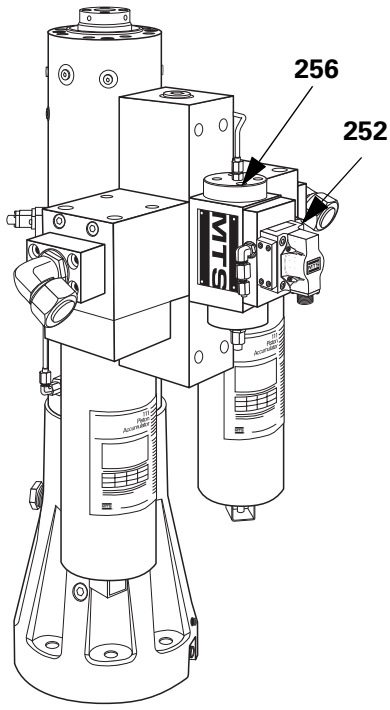


This is a cross section of dual servovalves mounted to a manifold.

Three-stage servovalves

A small (252) servovalve may be mounted to a larger (256) servovalve, enabling the fluid flow from the smaller one to be used to move the spool of the larger one. This configuration enables the control signal to effectively regulate a flow rate substantially greater than the full-flow rating of the smaller servovalve.

The Series 252 Servovalve provides the first two stages of the Series 256 Servovalve (a three-stage servovalve).



Specifications

This section lists the specifications for the Series 252 Servovalves.

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Parameter	Specification
Maximum operating pressure	31 MPa (4500 psi)*
Minimum operating pressure	1.4 MPa (200 psi)
Operating temperature range	-40°C to +135°C (-40°F to +275°F)
Revision G only	-20°C to +135°C (-40°F to +275°F)
Rated full-flow input signal current	25 mA (series) 50 mA (differential) 50 mA total (parallel)
Coil resistance	80 ¾ per coil
Seals	Viton
Weight	
252.2X/.4X Revision C **252.2X/.4X Revision G** **252.3X**	1.03 kg (2.3 lbs) 0.97 kg (2.1 lbs) 3.5 kg (7.5 lbs)
Hydraulic Fluid†	Mobil DTE® 25 or Shell Tellus® 46

* Higher operating pressures, up to 35 MPa (5000 psi), are available on request. Contact MTS for further information.

† Do not mix different types or brands of hydraulic fluid. Mixing different hydraulic fluids can create contaminants and degrade fluid additives. For information on hydraulic fluid, contact MTS Systems Corporation

Flow Ratings

The following table lists typical flow ratings for the Series 252 Servovalves.

Model Number*	Full-Flow Rating†	90° point at 10% Command	Null Flow‡
252.21	4.0 l/min (1.0 gpm)	230 Hz	1.10 l/min (031 gpm)
252.22	9.5 l/min (2.5 gpm)	230 Hz	1.44 l/min (0.40 gpm)
252.23	19.0 l/min (5.0 gpm)	230 Hz	2.27 l/min (0.60 gpm)
252.24	37.0 l/min (10.0 gpm)	170 Hz	2.27 l/min (0.60 gpm)
252.25	56.0 l/min (15.0 gpm)	160 Hz	2.27 l/min (0.60 gpm)
252.31	93.0 l/min (25.0 gpm)	80 Hz	5.56 l/min (1.47 gpm)
252.32	151.0 l/min (40.0 gpm)	60 Hz	5.56 l/min (1.47 gpm)
252.33	227.0 l/min (60.0 gpm)	50 Hz	8.33 l/min (2.20 gpm)
252.41	4.0 l/min (1.0 gpm)	300 Hz	1.10 l/min (0.31 gpm)
252.42	9.5 l/min (2.5 gpm)	280 Hz	1.44 l/min (0.40 gpm)
252.43	19.0 l/min (5.0 gpm)	280 Hz	2.27 l/min (0.60 gpm)

* The Model 252.3x servovalves can be converted to external pilot pressure in the field (with auxiliary port). The 90° point is at 10% command.

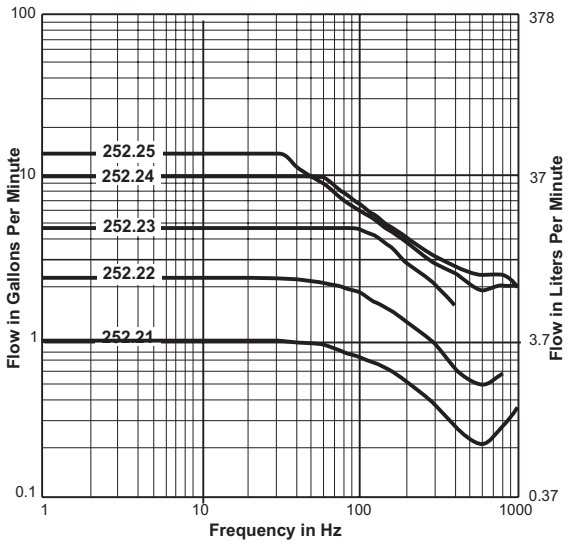
† Flow ratings are for 1000 psi (7 MPa) pressure drop across the servovalve. Higher flows are available at higher pressure drops.

‡ The maximum internal null flow is specified at 3000 psi (21 MPa). The null flow at the first stage is 0.20 gpm (0.76 l/min) for all Series 252 Servovalves.

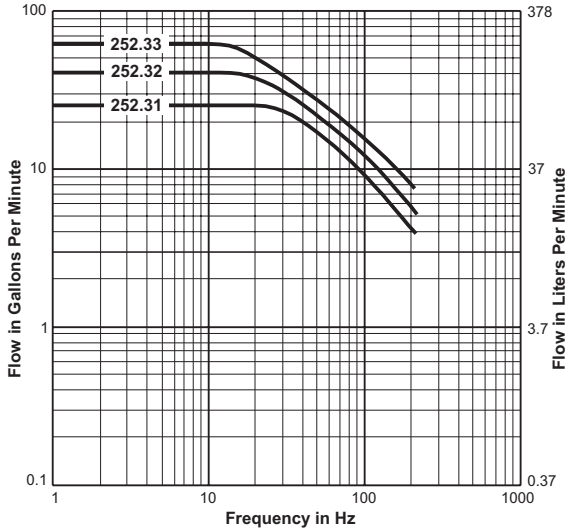
Performance Characteristics

The flow versus frequency performance curves shown in the figures in this section. They indicate the typical performance capabilities of the servovalves at various frequencies. The curves are derived by driving the servovalve at the indicated frequency with a sine wave control signal and ± full current to the coil.

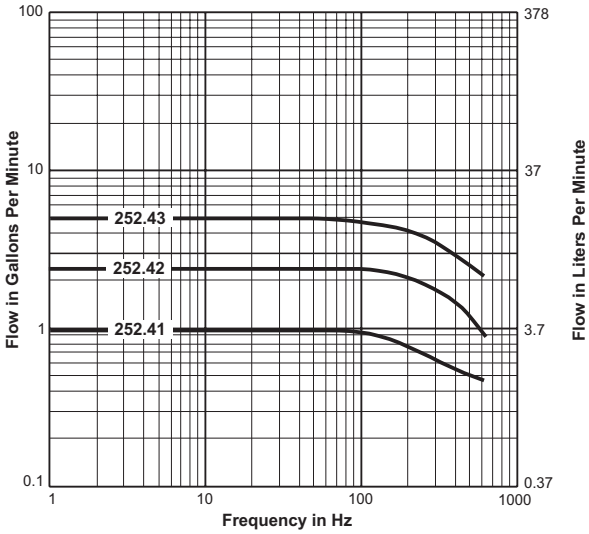
Note *Performance in the following graphs are with 21 MPa (3000 psi) pressure supplied and 7 MPa (1000 psi) pressure drop across the servovalve.*



252.2X



252.3X

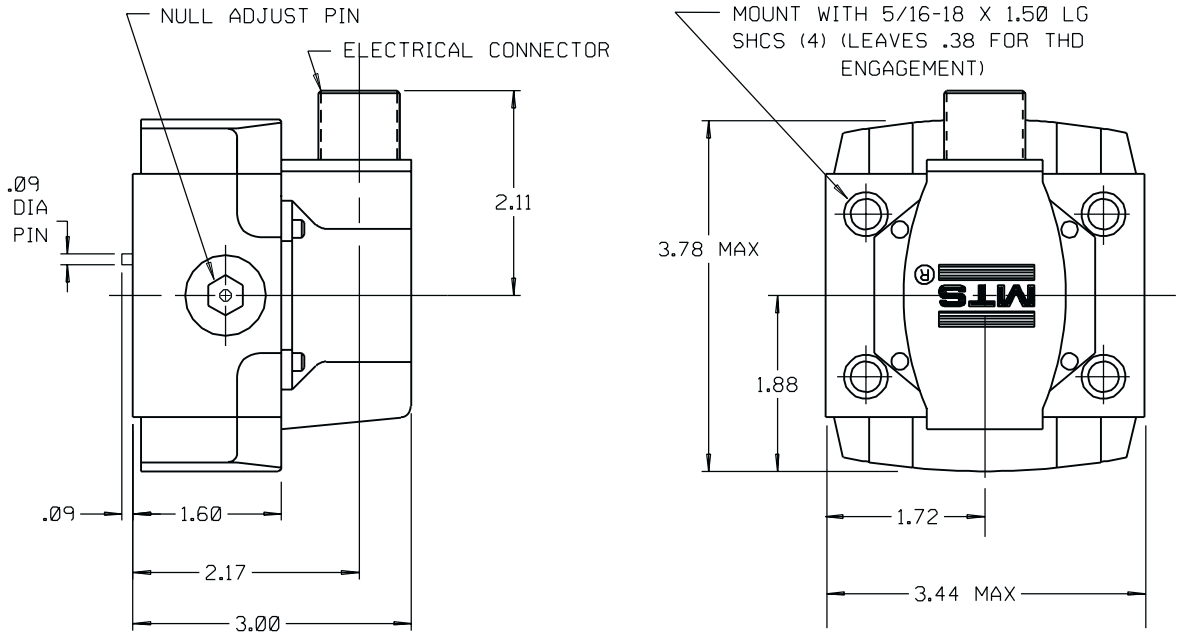


252.4X

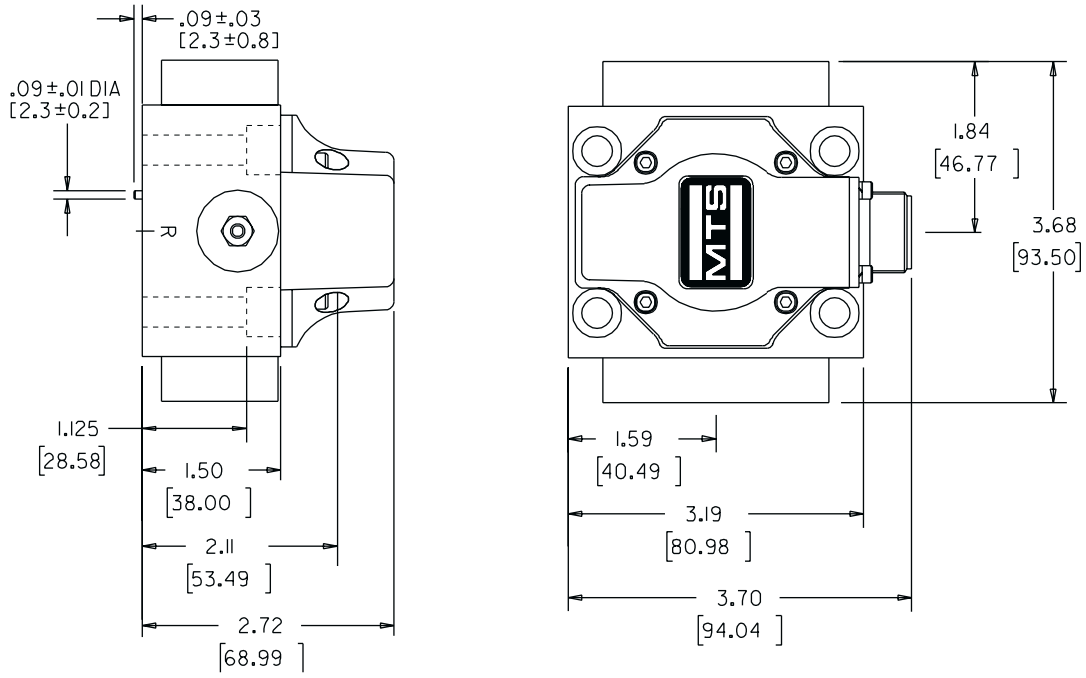
Flow versus Frequency Performance Curves

Dimensions

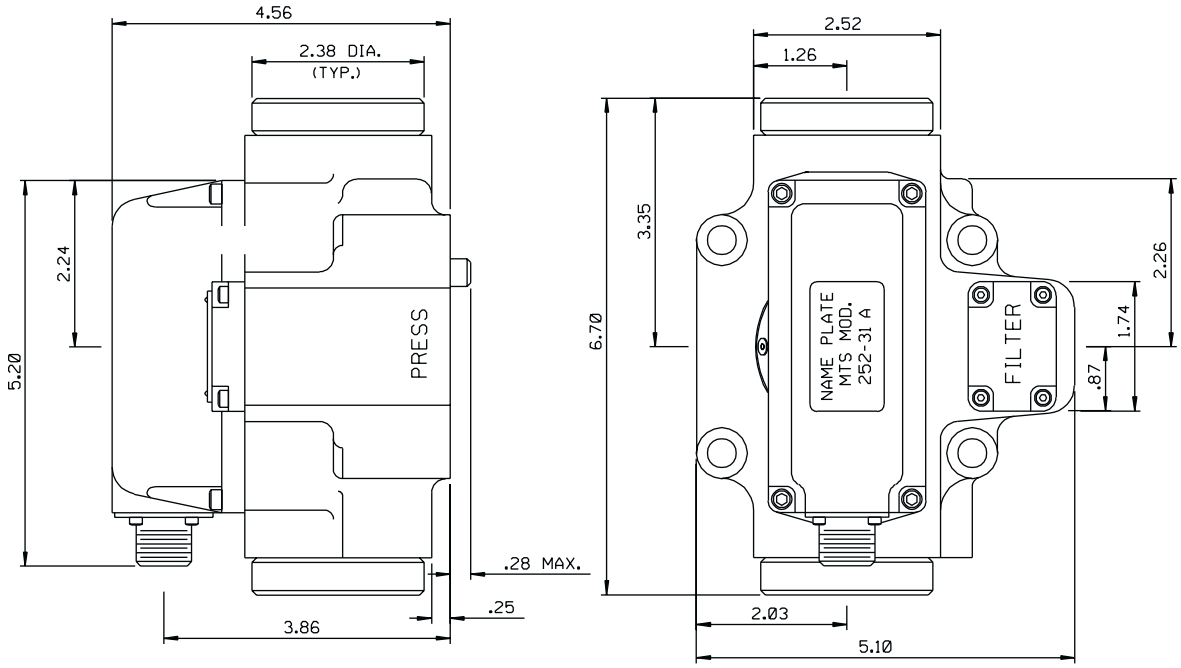
The following show the dimensions of the Series 252 servovalves.



Model 252.2x/4x Servovalve Dimensions (Revision C)



Model 252.2x/4x Servovalve Dimensions (Revision G)



Model 252.3x Servovalve Dimensions

Installation

The servovalve can be installed on an actuator or a Series 256 Servovalve. This section includes the following:

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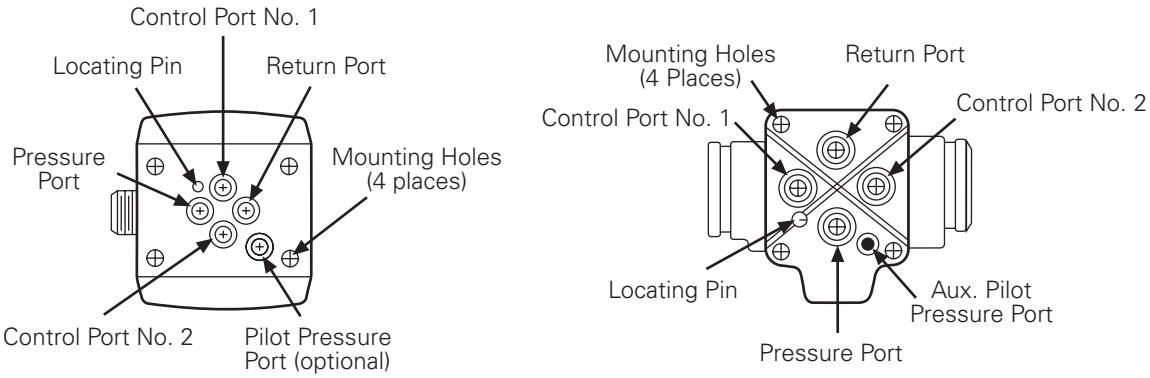
Servovalve Installation

The actuator has a manifold that aligns the hydraulic ports of the servovalve with the hydraulic ports on the actuator. Almost all servovalves are installed onto an adapter manifold. A servovalve may be installed onto an actuator only if the servovalve ports align with the ports of the actuator.

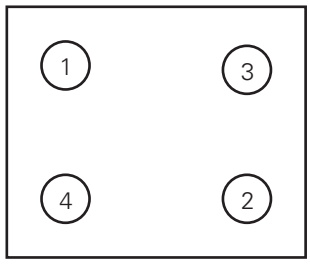
1. Ensure that system hydraulic pressure has been reduced to zero before proceeding. To do this, turn off the hydraulic power unit and exercise the actuator until it stops moving. Turn off electrical power at the controller.
2. Remove the servovalve protective cover plate (attached to the bottom of the servovalve). If replacing the servovalve, remove the cover plate from the actuator.
3. Ensure that the O-rings between the servovalve and actuator, manifold, or secondary servovalve are lubricated with a light film of hydraulic fluid and are in their correct position.
4. Position the servovalve on the actuator, manifold, or secondary servovalve, aligning the locating pin on the servovalve with the locating hole on the actuator, manifold, or secondary servovalve. The servovalve cannot be installed without proper alignment. See the following figure for the location of the locating pin.



Servovalve Locating Pin

Note *The 252.2X and 252.4X servovalves use four 5/16-18 x 1-1/2 in. mounting screws and the 252.3X servovalve uses four 3/8-16 x 1-3/4 in. mounting screws. As the screws are successively tightened, those previously tightened will lose clamping force. Continue tightening until all screws are at the specified torque.*

5. After lubricating the mounting screws with a light film of oil, tighten each one until it is firmly seated. Using the sequence shown, tighten the socket head screws to 6.8 N·m (5 lbf·ft).



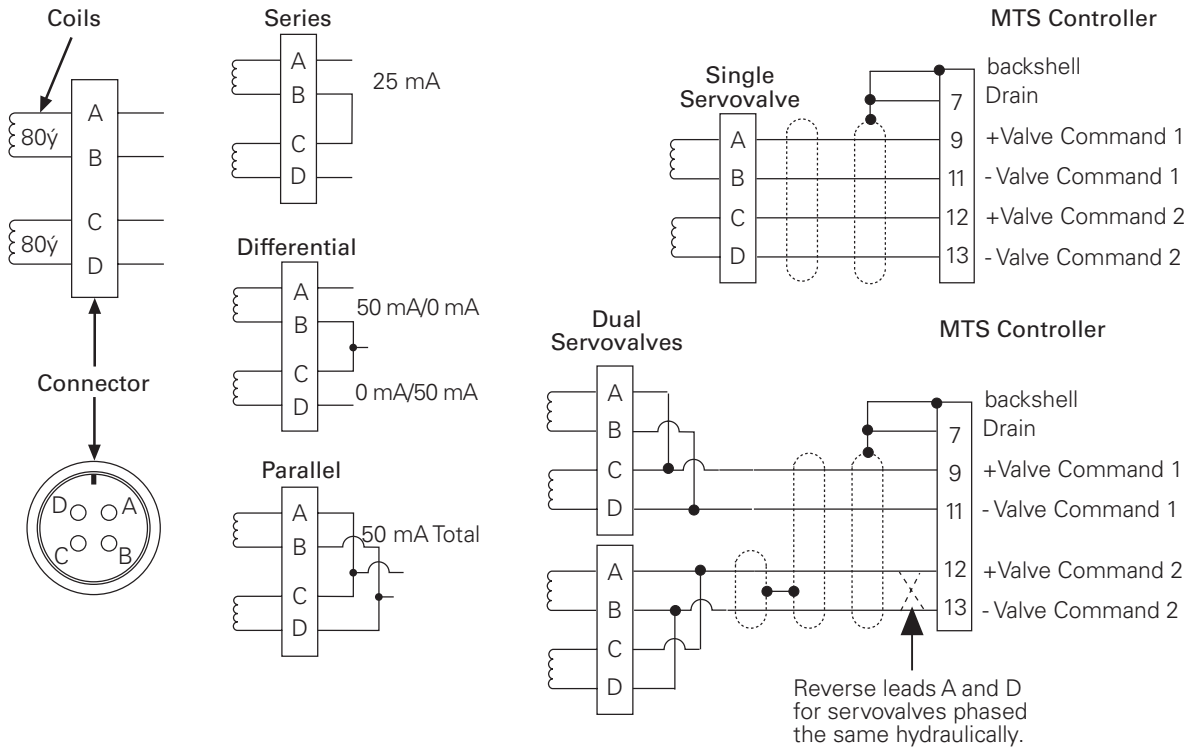
   - Continue using the pattern and tighten the socket head screws to a final torque of 26 N·m (19 lbf·ft) for 252.2X and 252.4X servovalves.
   - Continue using the pattern and tighten the socket head screws to a final torque of 47 N·m (34 lbf·ft) torque for 252.3X servovalves.

6. Connect the four-pin electrical cable from the controller to the servovalve.
7. Turn on electrical and hydraulic system power.
8. Apply low hydraulic pressure to the servovalve so that the hydraulic fluid gradually fills the filter cavity.
9. Apply high hydraulic pressure and check for leaks at the servovalve hydraulic connections and at the base of the servovalve.

Cable Connections

The following figure shows the connector wiring for the servovalve. The correct wiring configuration is determined by the requirements of the device used to control the servovalve. See the appropriate controller manual for information on servovalve connections. Common MTS cables include:

- For a single 252 servovalve, part number 397006-xx
- For dual 252 servovalves, part number 397007-xx



Wiring Diagrams

Configuring the 252.3X Servovalve for Five Ports

The Series 252.3X Servovalve can easily be changed from four to five ports. The fifth port provides hydraulic pressure to the spool even when station pressure is removed. The following procedure describes how to open the fifth port and block a secondary port to the filter.

The five port configuration can be changed back to a four port configuration. Use the following procedure as a guideline to remove the plug in the secondary filter port and install it into the fifth port on the bottom of the servovalve.

1. **Turn the hydraulic pressure off.**

   Ensure that system hydraulic pressure has been reduced to zero before proceeding. To do this, turn off the hydraulic power unit and exercise the actuator until it stops moving. Then, turn off electrical power to the controller.

2. **Open the 5th port**

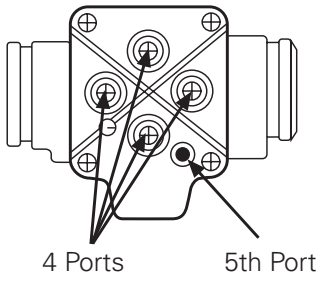
   A. On a new servovalve, remove the protective cover plate (attached to the bottom of the servovalve).

   On an existing servovalve, remove the servovalve from its mounting.

   B. Use a 1/8 inch Allen driver to remove the Allen screw covering the fifth port.

   C. Inside the port, use a threaded screw driver (#2 -56) to connect to the inner plug.

   D. Pull the threaded plug out of the fifth port.



3. **Remove the filter**

   E. Remove the four socket head screws and washers that secure the filter cover plate to the filter housing. See “Replacing the Filter Element” on page 22

   F. Remove the filter cover plate.

   G. Remove the filter plug by threading one of the socket head screws, removed in Step E, into the filter plug and pulling it out of the filter housing.

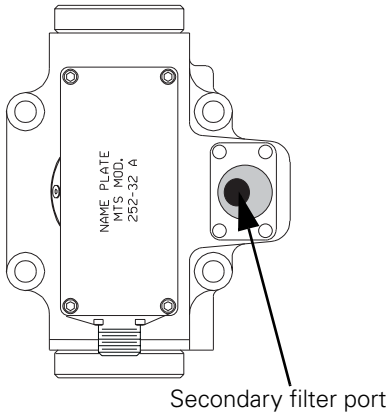
   H. Remove the filter.

4. **Close the secondary filter port.**

   A. Use the threaded screw driver (#2 -56) to connect to the plug. Push the plug into the secondary port until it seats into the port.

   B. Remove the threaded screw driver from the plug.

   C. Use a 1/8 inch Allen driver to install the Allen set screw removed in Step B into the secondary filter port.

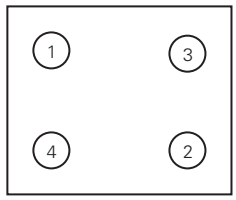


5. **Reassemble the filter.**

   A. Lightly lubricate the filter O-ring with clean hydraulic fluid and insert the filter into the housing.

   B. Lightly lubricate the filter plug O-rings with clean hydraulic fluid and install the filter plug.

   C. Secure the filter cover plate to the housing using the four socket head screws and washers removed in Step E. Tighten each socket head screw until it is firmly seated against the filter cover plate. Using the sequence shown here, tighten the socket head screws to 14 N·m (10 lbf·ft). Continue using the sequence and tighten the socket head screws to a final torque of 34-41 N·m (25-30 lbf·ft).



   D. Turn on electrical and hydraulic system power.

   E. Apply low hydraulic pressure to the servovalve so that hydraulic fluid will gradually fill the filter cavity.

   F. Apply high hydraulic pressure and check for leaks at the servovalve hydraulic connections and at the base of the servovalve.

Maintenance

Maintaining the Series 252 Servovalves typically involves changing the filter element (Series 252.3X only) and setting the mechanical null adjustment. Except for these procedures, further disassembly, inspection, or repair of the servovalve is not recommended and may void the servovalve warranty.

MTS does not recommend changing the 35-micron filter element in the Series 252.2X/.4X Servovalve (revision C). MTS hydraulic power supplies filter the system hydraulic fluid at 3-microns absolute. The system filters will trap most solid particle contaminants. If servovalve performance has deteriorated and the cause has been isolated to the servovalve filter, return the servovalve to MTS for service.

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Replacing the Filter Element

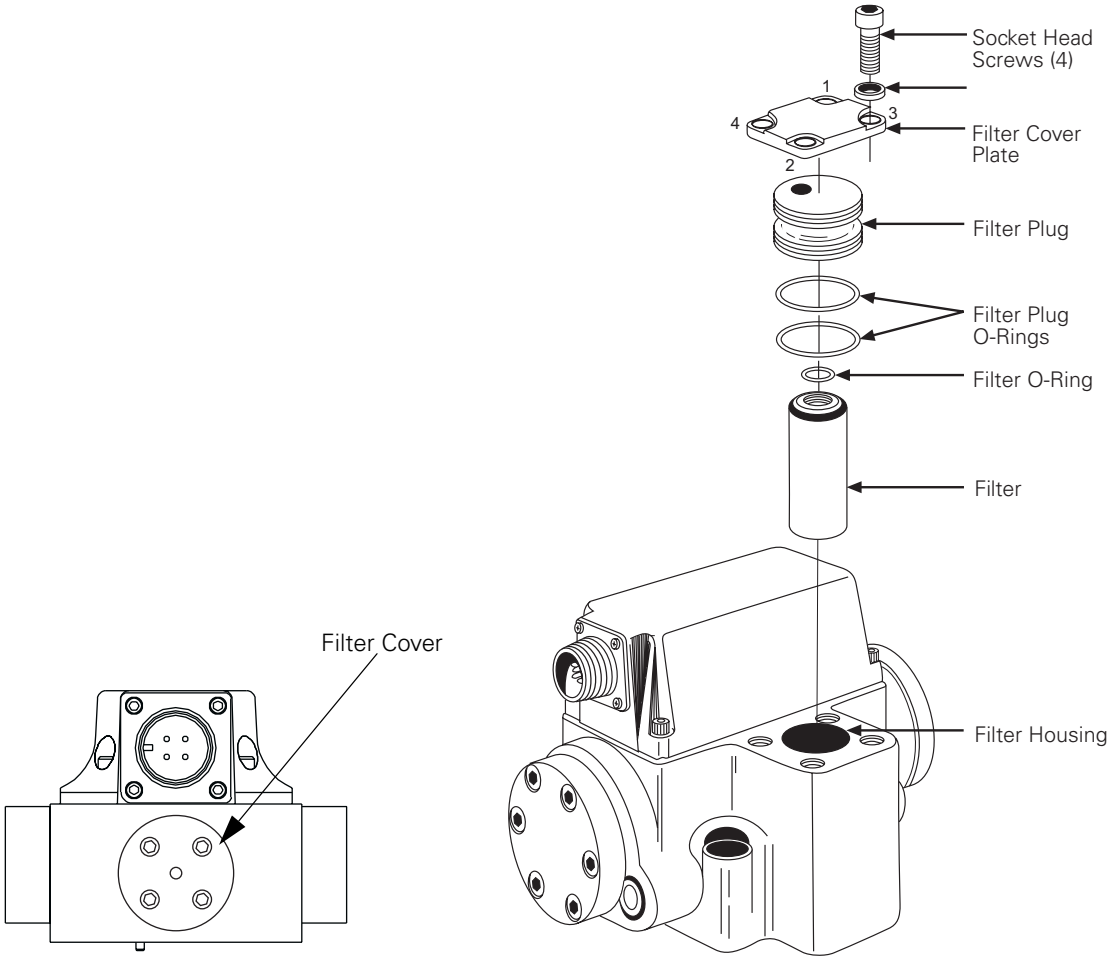
Under normal operating conditions, the 20-micron stainless steel filter used in the servovalve should be replaced only if servovalve performance has deteriorated. Ensure that other possible causes of poor performance, such as plugged system filters and/or hydraulic power supply wear, have been eliminated before replacing the servovalve filter.

Prerequisites

You must have a filter kit that contains the necessary filter element replacement parts. The filter for the Series 252.3x Servovalves is MTS part number 032-844-101. Contact MTS Systems Corporation for the filter for the revision G Series 252.2x/4x Servovalves

Procedure

To replace the filter element, perform the following procedure. Care should be exercised to prevent dirt or other contaminants from entering the servovalve body, filter passages, or manifold/actuator ports. Refer to the following figure during the procedure.



Model 252.2x/.4x Filter LocationModel 252.3x Filter Assembly (Revision G only)

1. Ensure that system hydraulic pressure has been reduced to zero before proceeding. To do this, turn off the hydraulic power unit and exercise the actuator until it stops moving. Turn off electrical power to the controller.

   For the Series 252.2x/4x Servovalve proceed as follows:

   Note *This procedure only applies to revision G of the servovalve.*

   A. Remove the four socket head screws and washers that secure the filter cover plug.

   B. Thread one of the socket head screws, removed in Step A, into the filter cover plug and pull it out of the filter housing.

   C. Remove the filter disk.

   D. Lightly lubricate the filter with clean hydraulic fluid and insert the filter into the housing.

   E. Secure the filter cover plate to the housing using the four socket head screws and washers removed in Step A.

   For the Series 252.3x Servovalve proceed as follows:

   A. Remove the four socket head screws and washers that secure the filter cover plate to the filter housing as shown below.

   B. Remove the filter plug by threading one of the socket head screws, removed in Step A, into the filter plug and pulling it out of the filter housing. Remove the filter cover plate.

   C. Remove the filter plug O-rings from the filter plug.

   D. Remove the filter O-ring from the filter.

   E. Remove the filter.

   F. Lightly lubricate the filter O-ring with clean hydraulic fluid, install it on the replacement filter, and insert the filter into the housing.

   G. Lightly lubricate the filter plug O-rings with clean hydraulic fluid, install them on the filter plug and install the filter plug.

   H. Secure the filter cover plate to the housing using the four socket head screws and washers removed in Step A. Tighten each socket head screw until it is firmly seated against the filter cover plate. Using the sequence shown in the figure on page page 22, tighten the socket head screws to 4.5 N·m (40 lb·in). Continue using the sequence and tighten the socket head screws to a final torque of 9.60 N·m (85 lb·in).

2. Turn on electrical and hydraulic system power.

3. Apply low hydraulic pressure to the servovalve so that hydraulic fluid gradually fills the filter cavity.

4. Apply high hydraulic pressure and check for leaks.

Adjusting the Mechanical Null

This procedure describes how to adjust the mechanical null for the Series 252 Servovalve. The mechanical null adjustment aligns the servovalve spool to a position that allows little or no actuator movement when there is no control signal.

Prerequisites

MTS Systems Corporation recommends that you read this procedure before attempting to adjust the mechanical null. The mechanical null adjustment is quite sensitive, and you should be familiar with the hazards that can be encountered when performing the procedure.

Perform the servovalve mechanical null adjustment after the valve balancing procedure (electrical compensation) has been completed and the results are judged unsatisfactory.

During the servovalve mechanical null adjustment procedure, the actuator must be able to move through full displacement in either direction without contacting a reaction surface.

Valve balance adjustments

MTS controllers have an electronic mechanical null adjustment called valve balance. The valve balance adjustment is a convenient way to compensate for a servovalve that needs a mechanical null adjustment. The adjustment introduces an electrical offset signal that causes the servovalve to hold the position of the actuator when a zero command is issued.

⚠ WARNING

Do not perform the following procedure without clearing the path of motion of the actuator.

Sudden and unexpected actuator rod movement can cause serious injury to personnel and/or damage to equipment.

Ensure that all personnel, specimen/structures, and tools are away from the path of motion of the actuator (crush zone).

1. Exercising the Actuator

The actuator should be exercised to warm it up. Electrical and mechanical adjustments are more repeatable after the actuator is warmed up.

A. Select displacement control for the controller.

B. Disable the reset integrator or adjust the Reset control for zero.

C. Adjust the actuator for mid- displacement.

D. Turn on electrical and hydraulic system power.

E. Define a 50%, 0.1 Hz sine wave command and allow the actuator to warm up for approximately one-half hour.

F. After the warm up period, stop the test program.

2. **Checking for Actuator Movement**

   This task is a test to determine how to proceed.

   Disconnect the servovalve cable and observe the actuator rod.

   - If the actuator rod has no noticeable movement, the servovalve is at the null position and does not need to be adjusted. Proceed to Step 4.
   - If the actuator rod noticeably moves, the servovalve requires adjustment. Proceed to Step 3.

3. **Setting the Adjuster Pin**

This task describes the mechanical null adjustment procedure.

A. Insert a 3/32-inch hex key into the adjustor pin socket. See the following figure for the location of the adjustor pin.

⚠ CAUTION

Do not apply more than 12 lbf-in. (1.36 N•m) of torquing force to the adjustor pin.

Excessive torquing may shear off the adjustor pin eccentric.

If the pin does not turn using very little force, proceed to Step C of this task.

B. Slowly rotate the adjustor pin until the actuator movement is reduced to a minimum, and then go back to Step 2. If the pin does not turn using very little force, proceed to the next step.

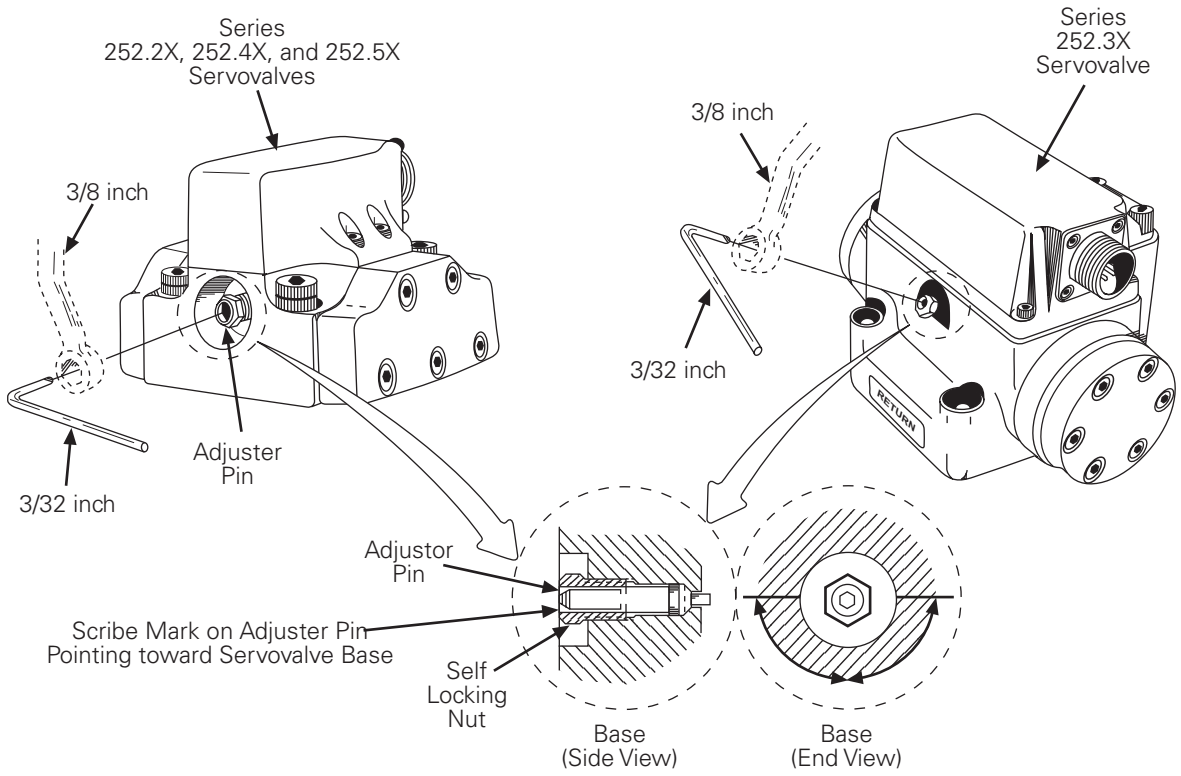
C. Reduce system pressure to low pressure (refer to the appropriate controlling device product manual). Slowly rotate the adjustor pin until the actuator movement is reduced to a minimum, and then proceed to Step 4. If the adjustor pin still does not turn, proceed to the next step.

D. Ensure that system hydraulic pressure has been reduced to zero before proceeding. To do this, turn off the hydraulic power unit and exercise the actuator until it stops moving. Turn off electrical power to the controller.

E. Remove the hex key and insert a 3/8-inch offset wrench over the self-locking nut.

F. Insert a torque wrench with a 3/32-inch hex key head adapter into the adjustor pin socket.

G. Using the offset wrench, loosen (but do not remove) the self-locking nut.



Mechanical Null Adjustor Pin

H. Turn the adjustor pin until the scribe mark on the adjustor pin is pointing toward the base of the servovalve.

I. Tighten the self-locking nut until 1.13 to 1.36 N·m (10 to 12 lb-in) of torque is needed to turn the adjustor pin, ensuring that the scribe mark remains pointing toward the base of the servovalve.

J. Remove the torque wrench and offset wrench.

4. Finishing the Procedure

This task completes the mechanical null procedure.

A. Ensure that the actuator is warmed up. If not, go to Step 1.

B. Remove hydraulic and electric power from the system.

C. Reconnect the servovalve cable.

D. Reapply hydraulic and electric power to the system.

E. See your controller manual to complete the valve balance procedure.

Troubleshooting Guide

The table below provides the symptom, probable cause, and remedy for some common servovalve malfunctions that may be encountered.

Before diagnosing a servovalve malfunction, ensure that:

- the servovalve is getting the proper command.
- the servovalve is getting full system pressure and flow.
- the hydraulic fluid in the system is clean.

Symptom	Probable Cause	Remedy
Output flow from only one control port **Actuator is fully extended/retracted, or hydraulic motor is rapidly rotating** **Does not respond to the command signal**	Plugged inlet filter element	Replace filter element (252.3X only)*
Poor response (the servovalve output lags command signal)	Partially plugged filter element	Clean inlet orifices or clean/replace filter element (252.3X only);* check for dirty hydraulic fluid
High null bias (a large valve balance adjustment at the controller is needed to maintain hydraulic actuator in stationary position)	Incorrect (mechanical or electrical) null adjustment	Adjust null
	Partially plugged inlet orifice assembly	Clean inlet orifices
	Partially plugged filter element	Clean/replace filter element (252.3X only);* check for dirty hydraulic fluid

* For a Series 252.2X or 252.4X Servovalve, return the unit to MTS.

Service

This section describes how to remove a Series 252 Servovalve from its mounting. If additional service is required, call your local MTS service representative.

Important ***This section describes service procedures that should be performed by a person who has experience servicing servohydraulic equipment. The procedures in this section require the load unit to be disassembled beyond what is needed for operation or maintenance.***

We assume you are familiar with all operating aspects of your system controller (electronic and software controls) and you are familiar with the hardware components of your system.

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Removing the Servovalve

Use the following procedure when removing the servovalve, replacing the filter, or flushing the system. This procedure applies to both single and dual servovalve configurations.

1. Ensure that system hydraulic pressure has been reduced to zero before proceeding. To do this, turn off the hydraulic power unit and exercise the actuator until it stops moving.
2. Disconnect the electrical cable from the servovalve.
3. If necessary, remove hydraulic power to the actuator.

Note *The 252.2X and 252.4X servovalves use four 5/16-18 x 1-1/2 in. mounting screws and the 252.3X servovalve uses four 3/8-16 x 1- 3/4 in. mounting screws.*

4. Remove the four mounting screws used to secure the servovalve to the manifold. Remove the servovalve.

CAUTION

Do not remove the servovalve unless the servovalve ports, actuator, manifold, or secondary servovalve ports can be quickly covered with protective cover plates.

Contaminants could enter the hydraulic ports and damage the servovalve and/or actuator.

After removing the servovalve, make sure that the servovalve ports for the actuator, manifold, and secondary servovalve ports are covered with protective plates as soon as possible.

5. Cover the servovalve and manifold ports with protective cover plates as soon as possible.
6. See “Installation” on page 15 for the procedure to install the servovalve.