SERIES 256 SERVOVALVE
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SECTION I
INTRODUCTION

Figure 1-1. Series 256 Servovalve

1.1 FUNCTIONAL DESCRIPTION

The MTS Series 256 Servovalve (shown in figure 1-1) is a high performance, three-stage servovalve used as the final control element in an MTS testing system. They react to an electrical input signal by opening in a direction and an amount determined by the polarity and magnitude of the input signal current. The Series 256 servovalve consists of a small MTS Series 252 Servovalve (pilot stage) and a large spool (main stage). The Series 252 Servovalve is a nozzle-flapper type with a torque-motor-driven first stage. The second stage of the Series 252 Servovalve and the third (main) stage, each contain a four-way spool similar to the one shown in figure 1-2. Position of the third stage spool is measured by an LVDT (linear variable displacement transformer). Figure 1-2 shows a single-stage four-way spool valve connected across a hydraulic actuator. The spool is shown in the hydraulic null position (i.e., the control ports are blocked and fluid is not allowed to flow). When a command signal causes the spool to move off of center, a pressure path will be open to one end of the actuator cylinder, and a return path will be opened to the opposite end.
1.2 SPECIFICATIONS

Table 1-1 lists the specifications for the Series 256 Servovalves. Specifications are subject to change without notice. Contact MTS for verification of critical specifications.

Table 1-1. Series 256 Servovalve Specifications

<table>
<thead>
<tr>
<th>Operating supply pressure</th>
<th>3000 psi (20.7 MPa)(^1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature range</td>
<td>-65°F to +275°F (-53°C to +135°C)</td>
</tr>
<tr>
<td>Seals</td>
<td>Buna -N Standard(^2)</td>
</tr>
<tr>
<td>Maximum input signal</td>
<td>25 mA (series)</td>
</tr>
<tr>
<td></td>
<td>50 mA (differential)</td>
</tr>
<tr>
<td>Current (per coil)</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td></td>
</tr>
<tr>
<td>256.05-01/02</td>
<td>16 lb (7.26 kg)</td>
</tr>
<tr>
<td>256.09-01/02</td>
<td>16 lb (7.26 kg)</td>
</tr>
<tr>
<td>256.18-01/02/05</td>
<td>23 lb (10.43 kg)</td>
</tr>
<tr>
<td>256.25-01/02/05</td>
<td>45 lb (20.41 kg)</td>
</tr>
<tr>
<td>256.40-01/02/05</td>
<td>100 lb (45.36 kg)</td>
</tr>
</tbody>
</table>

\(^1\)Higher operating supply pressures up to 5000 psi (34.5 MPa) are available on request (contact MTS for further information)

\(^2\)Special seals are available on some Series 256 models (contact MTS for further information)
Table 1-1. Series 256 Servo Valve Specifications (continued)

<table>
<thead>
<tr>
<th>LVD T excitation</th>
<th>20 V p-p at 10 kHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>LVD T impedance</td>
<td>200 Ω minimum at 10 kHz</td>
</tr>
<tr>
<td>LVD T sensitivity</td>
<td>0.21 V/V per 0.100 inch (2.54 mm) stroke</td>
</tr>
<tr>
<td>Coil resistance</td>
<td>80 Ω</td>
</tr>
<tr>
<td>Filtration level</td>
<td>3 microns absolute (pilot stage)</td>
</tr>
<tr>
<td></td>
<td>25 microns absolute (main stage)</td>
</tr>
</tbody>
</table>

1.3 FLOW RATINGS

Table 1-2 lists the flow rating for the Series 256 Servo Valve under static conditions. Table 1-3 list the flow ratings under dynamic conditions.

Table 1-2. Series 256 Servo Valve Static Performance

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Rated Flow</th>
<th>Nominal Null Flow Gain</th>
<th>Nominal Null Pressure Gain</th>
<th>Null Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(gpm)</td>
<td>(l/min)</td>
<td>(gpm/% stroke)</td>
<td>(l/min/% stroke)</td>
</tr>
<tr>
<td>256.05A</td>
<td>50</td>
<td>190</td>
<td>0.5</td>
<td>1.9</td>
</tr>
<tr>
<td>256.09A</td>
<td>90</td>
<td>340</td>
<td>1.6</td>
<td>6.0</td>
</tr>
<tr>
<td>256.18A</td>
<td>180</td>
<td>680</td>
<td>2.8</td>
<td>10.6</td>
</tr>
<tr>
<td>256.25A</td>
<td>250</td>
<td>950</td>
<td>4.2</td>
<td>16.0</td>
</tr>
<tr>
<td>256.40A</td>
<td>400</td>
<td>1500</td>
<td>7.7</td>
<td>29.0</td>
</tr>
</tbody>
</table>

¹Flow ratings are for 1000 psi (6.9 MPa) pressure drop across the servo valve. Higher flows are available at higher pressure drops.

NOTE

All values listed are typical of Series 256 Servo valves operated at the recommended hydraulic fluid filtration levels (see specifications). Hysteresis is less than 0.6%, typically 0.1%. Threshold is less than 0.1%, typically 0.05%.
Table 1-3. Series 256 Servovalve Dynamic Performance

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Rated Flow(^1) (gpm)</th>
<th>(L/min)</th>
<th>Pilot Flow(^1) (gpm)</th>
<th>(L/min)</th>
<th>Full Flow Frequency(^2) (Hz)</th>
<th>90° Phase Signal(^3) (Hz)</th>
<th>Spool Stroke Rise Time (tr)(^4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>256.05A-01</td>
<td>50</td>
<td>190</td>
<td>1</td>
<td>3.8</td>
<td>60</td>
<td>110</td>
<td>5</td>
</tr>
<tr>
<td>256.05A-02</td>
<td>50</td>
<td>190</td>
<td>2.5</td>
<td>9.5</td>
<td>110</td>
<td>110</td>
<td>5</td>
</tr>
<tr>
<td>256.09A-01</td>
<td>90</td>
<td>340</td>
<td>1</td>
<td>3.8</td>
<td>30</td>
<td>120</td>
<td>9</td>
</tr>
<tr>
<td>256.09A-02</td>
<td>90</td>
<td>340</td>
<td>2.5</td>
<td>9.5</td>
<td>80</td>
<td>130</td>
<td>4.6</td>
</tr>
<tr>
<td>256.18A-01</td>
<td>180</td>
<td>680</td>
<td>1</td>
<td>3.8</td>
<td>75</td>
<td>120</td>
<td>7.6</td>
</tr>
<tr>
<td>256.18A-02</td>
<td>180</td>
<td>680</td>
<td>2.5</td>
<td>9.5</td>
<td>130</td>
<td>130</td>
<td>5</td>
</tr>
<tr>
<td>256.25A-01</td>
<td>250</td>
<td>950</td>
<td>1</td>
<td>3.8</td>
<td>10</td>
<td>80(^5)</td>
<td>36(^5)</td>
</tr>
<tr>
<td>256.25A-02</td>
<td>250</td>
<td>950</td>
<td>2.5</td>
<td>9.5</td>
<td>18(^5)</td>
<td>100(^5)</td>
<td>15(^5)</td>
</tr>
<tr>
<td>256.25A-05</td>
<td>250</td>
<td>950</td>
<td>5</td>
<td>19</td>
<td>25(^5)</td>
<td>100(^5)</td>
<td>12(^5)</td>
</tr>
<tr>
<td>256.40A-01</td>
<td>400</td>
<td>1500</td>
<td>1</td>
<td>3.8</td>
<td>4(^5)</td>
<td>40(^5)</td>
<td>65(^5)</td>
</tr>
<tr>
<td>256.40A-02</td>
<td>400</td>
<td>1500</td>
<td>2.5</td>
<td>9.5</td>
<td>9(^5)</td>
<td>75(^5)</td>
<td>26(^5)</td>
</tr>
<tr>
<td>256.40A-05</td>
<td>400</td>
<td>1500</td>
<td>5</td>
<td>19</td>
<td>12(^5)</td>
<td>110</td>
<td>13</td>
</tr>
</tbody>
</table>

Notes:

1 With a 1000 psi (6.9 MPa) pressure drop across the Servovalve.

2 Refer to Figure 1-3. The data is derived from typical Model 256 Servovalves driven with an MTS Model 406 (Option D) Valve Controller with "rate" compensation. A constant sine wave level was directed to the valve controller.

3 At ±10% spool stroke.

4 Refer to Figure 1-4.

5 These are estimated values. All others values are typical.
1.4 PERFORMANCE CHARACTERISTICS

The flow-frequency performance curves shown in figure 1-3 indicate the relative performance capability of the servovalves within the 256 series. The curves are for servovalves driven by a sine wave program at the indicated frequency between ± full stroke, with a 1000 psi (6.9 MPa) pressure drop across the servovalve.

Servovalve performance at higher frequencies (where curves are shown dashed) is a function of variables introduced by system components, actuator response, and characteristics of the load or specimen.

NOTE

Performance is with a 3000 psi (20.7 MPa) pressure supplied and a 1000 psi (6.9 MPa) pressure drop across the servovalve.

Figure 1-3. Series 256 Servovalve Performance Curves.
Refer to table 1-3 for rise time

Figure 1-4. Series 256 Servovalve - Step Response
SECTION II
SERVICE

This section describes the maintenance requirements for the Series 256 Servovalve. Except for changing of the filter element and the mechanical null adjustment, further disassembly, inspection, or repair of the pilot stage 252 servovalve is not recommended and may void the servovalve warranty. Apart from changing the Linear Variable Displacement Transformer (LVDT) core, (which is the only field serviceable item) inspection and cleaning of the main stage is possible, but generally not required or recommended. Procedures for the disassembly and inspection of the main stage are contained in this section.

2.1 MAIN STAGE LVDT ADJUSTMENT

If the servovalve has been disassembled or misadjusted to the extent that controlled operation of the actuator in stroke or load control is not possible, calibration of the main stage spool LVDT may be necessary. If the actuator can be operated in STROKE control, the adjustment will be minor and can be accomplished by the procedure contained in the appropriate valve controller device product manual. Equipment required will be a digital voltmeter.

To adjust the main stage LVDT, perform the following procedure.

1. Remove power from the system (electrical and hydraulic).

2. Remove the specimen or any fixtures from the actuator.

3. Connect a digital voltmeter between the (Servovalve) LVDT DC signal and ground. (Refer to appropriate device product manual controlling the servovalve for connector locations.)

4. Apply power to the system (electrical and hydraulic).

5. Reduce hydraulic output pressure to 500 psi (3.45 MPa), (refer to hydraulic power supply manual).

NOTE

Step 6 may be accomplished by adjusting the Set Point control.

6. Move the actuator back and forth between the extreme displacement positions without contacting anything.

7. Observe the voltage output. With the spool at hydraulic null (zero flow), output of the LVDT should be nearly zero. When the main stage spool moves from one extreme of its travel to the other, the LVDT output should change from a predetermined voltage (typically 10 V), through zero, to an equal voltage of the opposite polarity.

NOTE

If the LVDT is badly out of adjustment, polarity reversal may not occur.
8. Adjust the LVDT by loosening the LVDT locknut and screw the LVDT into or out of the servovalve, to provide the required response through null (see figure 2-1).

9. Tighten the locknut hand tight and observe the voltage to make sure the setting does not change while tightening the LVDT locknut.

Table 2-1. Series 256 Bolt Torque Requirements

<table>
<thead>
<tr>
<th>BOLTS (QTY)</th>
<th>256.05</th>
<th>256.09</th>
<th>256.18</th>
<th>256.25</th>
<th>256.40</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPOOL STOP (8)</td>
<td>35 lbf-in. (3.95 N-m)</td>
<td>35 lbf-in. (3.95 N-m)</td>
<td>35 lbf-in. (3.95 N-m)</td>
<td>108 lbf-in. (12.20 N-m)</td>
<td>108 lbf-in. (12.20 N-m)</td>
</tr>
<tr>
<td>DRAIN END CAP (4)</td>
<td>108 lbf-in. (12.20 N-m)</td>
<td>108 lbf-in. (12.20 N-m)</td>
<td>108 lbf-in. (12.20 N-m)</td>
<td>35 lbf-ft (47.45 N-m)</td>
<td>35 lbf-ft (47.45 N-m)</td>
</tr>
<tr>
<td>LVDT END CAP (4)</td>
<td>108 lbf-in. (12.20 N-m)</td>
<td>108 lbf-in. (12.20 N-m)</td>
<td>108 lbf-in. (12.20 N-m)</td>
<td>35 lbf-ft (47.45 N-m)</td>
<td>35 lbf-ft (47.45 N-m)</td>
</tr>
<tr>
<td>MAIN STAGE MOUNTING (4)</td>
<td>35 lbf-ft (47.45 N-m)</td>
<td>35 lbf-ft (47.45 N-m)</td>
<td>35 lbf-ft (47.45 N-m)</td>
<td>80 lbf-ft (108.46 N-m)</td>
<td>80 lbf-ft (108.45 N-m)</td>
</tr>
<tr>
<td>PILOT STAGE MOUNTING (4)</td>
<td>18 lbf-ft (24.40 N-m)</td>
<td>18 lbf-ft (24.40 N-m)</td>
<td>18 lbf-ft (24.40 N-m)</td>
<td>18 lbf-ft (24.40 N-m)</td>
<td>18 lbf-ft (24.40 N-m)</td>
</tr>
</tbody>
</table>

Figure 2-1. Bolt Locations
2.2 PILOT STAGE MECHANICAL NULL ADJUSTMENT

The following procedure describes the mechanical null adjustment on the pilot stage servovalve (Series 252). The null adjustment positions the servovalve spool so that there is minimal actuator movement with no control signal. It is strongly suggested that this procedure be read in its entirety to familiarize the user with the hazards that can be encountered when performing this procedure. Perform the servovalve mechanical null adjustment only after the electronic balancing procedure has been performed and the results are judged unsatisfactory. (See the appropriate product manual for the electronic balancing procedure.)

No specimen should be mounted between the actuator and the reaction surface. The actuator must be able to move its full displacement in either direction without contacting anything.

*** WARNING ***

The following procedure is potentially dangerous and may cause serious injury to personnel and/or damage to the equipment due to sudden and abrupt actuator movement. Ensure that all tools are removed from the path of the actuator rod and that all personnel are clear of the actuator rod.

NOTE

Depending on the device controlling the servovalve select the control mode that corresponds to displacement control. (Refer to the appropriate product manual for selection of displacement control.)

1. Select the displacement control on the controlling device.

2. Set RESET switch on the device controlling the servovalve to OUT.

3. Turn on system power (electrical and hydraulic).

4. Monitor the feedback signal of the controlled variable with a digital voltmeter and adjust the SET POINT control for zero output.

5. Allow the actuator to warm up for approximately one half hour, by applying a 5 V, 0.1 Hz sine wave command signal.

6. After the warm up period, turn the SPAN control to zero and press PROGRAM STOP on the control panel or control unit.

7. Monitor the difference between the D.C. ERROR signal and the Servovalve LVDT feedback signal. If the difference:

   A. Is less than 50 mV the pilot valve does not need adjustment. Proceed to step 21.

   B. Is greater than 50 mV signal, proceed to step 8.
8. Reduce system pressure to LOW pressure. Maintain pilot pressure at normal operating pressure.

9. Fit a 3/32 inch hex key into the adjustor pin socket (see figure 2-2).

*** WARNING ***

The following step is potentially dangerous and may cause serious injury to personnel and/or damage to the equipment due to sudden and abrupt actuator movement. Ensure that all tools are removed from the path of the actuator rod and that all personnel are clear of the actuator rod.

10. Remove the pilot stage drive cable.

![Diagram](image)

Figure 2-2. Mechanical Null Adjustor Pin

**CAUTION**

Step 11 involves turning the adjustor pin in order to minimize actuator movement. If the pin does not turn using very little force, STOP. Excessive torquing may shear off the adjustor pin eccentric. Perform step 12.
11. Slowly rotate the adjustor pin until the pressure hose pulses or the actuator rod begins to move. Then rotate the pin in the opposite direction until the hose pulses or the actuator reverses direction. Position the adjustor pin for minimum actuator movement.

NOTE

Step 12, and steps 13 through 20 are to be performed, only if the adjustor pin does not turn. After performing step 12, if the adjustor pin still does not turn using a small amount of force, proceed to step 13.

12. Reduce pilot pressure to low pressure; (refer to the appropriate hydraulic power supply manual) repeat step 11.

13. Remove power from the system (electrical and hydraulic).

14. Remove the hex key and fit a 3/8 offset wrench over the self-locking nut (see figure 2-2).

15. Insert a torque wrench with a 3/32 hex key head adapter.

16. Loosen (but do not remove) self-locking nut.

17. Turn the adjustor pin until the mark is pointing to the base of the servovalve (see figure 2-2).

18. Tighten the self-locking nut until 10-12 lbf-in. of torque is needed to turn the adjustor pin, ensuring that the mark remains pointing to the base of the servovalve.

19. Remove the torque wrench and offset wrench.

20. Perform steps 1-11.

21. Remove power from the system (electronical and hydraulic).

22. Reconnect the pilot drive cable.

2.3 PILOT STAGE FILTER ELEMENT REPLACEMENT

The Series 256 Servovalve uses a Series 252 Servovalve for a pilot stage. Under normal operating conditions, the stainless steel filter used in the Series 252 Pilot Stage Servovalve should be replaced only if system performance has deteriorated and the cause has been determined to be the filter.
NOTE

A filter kit containing all necessary parts, including the filter element, is available from MTS. Order MTS part number 328442-01 for all 252.2X servovalves.

When replacing the filter element, care should be exercised to prevent dirt or other contaminants from entering the servovalve body, filter passages, or the manifold ports. To replace the pilot stage filter element perform the following procedure.

1. Turn off electrical and hydraulic power to the system. Ensure that the residual hydraulic pressure in the system has fallen to zero by cycling the SET POINT control on the unit controlling the servovalve until the actuator stops moving.

2. Remove the pilot stage servovalve from the main stage (refer to the pilot stage servovalve removal procedures in section III of this manual).

CAUTION

The main stage ports should be covered as soon as the servovalve is removed. Perform the filter replacement in an environment that is as clean as possible to prevent hydraulic fluid contamination.

3. Install a servovalve cover plate over the main stage ports to prevent the loss or contamination of system hydraulic fluid.

4. Remove the five socket head cap screws from each end cap using a 5/32 inch allen wrench (see figure 2-3). Remove the end caps.

5. Remove the inlet orifices from the filter tube, by threading a 2-56 screw into the inlet orifice assembly and pulling on the screw.

6. Remove and inspect the O-rings from the inlet orifice; replace if necessary.

NOTE

Some Series 252.2X Servovalves may have an optional filter port on the null adjustment end of the servovalve body. In this case, the filter tube is in this hole and a plug is in the normally used filter port.

7. Carefully remove the filter tube from the servovalve body.

8. Inspect the filter tube for foreign matter, or for damage to the filter tube mesh. Also, inspect the inlet orifices for damage or foreign matter and replace if necessary.

9. Carefully insert the new filter tube into the servovalve body.
10. Install the inlet orifices with their associated O-rings.

11. Replace the end caps on the servovalve. Lubricate the socket head cap screws with a light film of hydraulic fluid and install in the servovalve. Tighten the socket head cap screws to 85 lbf-in. (9.60 N-m) torque.

12. Remove the cover plate from the main stage and install the pilot stage servovalve (refer to pilot stage servovalve mounting procedure in section III of this manual).

13. Turn on system power (hydraulic and electrical).

14. Apply low hydraulic pressure to the servovalve so that the hydraulic fluid will fill the filter cavities gradually.
2.4 MAIN STAGE MAINTENANCE

The 256 Servo valve is susceptible to damage from contaminated hydraulic fluid. Hydraulic fluid should be checked regularly and replaced if necessary (refer to the hydraulic power supply product manual). If it becomes necessary to remove the servo valve, ensure all open ports are properly covered to avoid contamination.

Before starting the main stage maintenance procedures it is recommended that the user note the following caution.

**CAUTION**

During the main stage disassembly and assembly use caution to avoid 1) bending of the LVDT core assembly, 2) getting any dirt into the manifold ports or the servo valve or 3) damaging any of the milled surfaces.

2.4.1 MAIN STAGE DISASSEMBLY

1. Loosen the screws holding the pilot valve to the main stage to permit air to enter the pilot ports. If this is not done, suction will inhibit removal of the main stage spool.

2. Note the number of threads showing on the LVDT body (typically 1 to 1 3/4). Loosen the locknut and remove the LVDT. Remove the LVDT end cap and write "LVDT side" near the exposed end of the servo valve manifold (generally the end on which the serial number is stamped).

**NOTE**

Spool stops fit very tight into the bore. If it is not possible to remove the spool stop by pulling, remove the drain end cap and push the spool against the LVDT side spool stop. Tap the end of the spool lightly to ease the spool stop out of the bore. Restrain the spool so that it does not slip down the bore when the spool stop is removed.

3. Remove the screws retaining the spool stop to the manifold. Remove the spool stop.

**CAUTION**

It may be necessary to support the spool at both ends. Otherwise the spool may bind in the bore and may damage the metering edges, if any pressure is applied.

4. Remove the spool by pulling on the LVDT core. (Do not pull hard.) It should be possible to separate the spool from the manifold with little or no difficulty.

5. Remove the other spool stop.
2.4.2 **MAIN STAGE INSPECTION**

To inspect the main stage proceed as follows.

**NOTE**

Field repair of main stage is generally not practical, contact MTS if repair is necessary.

1. Examine the internal spool-contacting edges and surfaces and the external edges, and surfaces of the spool for nicks and burrs. Milled surfaces should be perfectly smooth.

2. Dip the spool in clean hydraulic fluid and insert it into the manifold. The serial number on the spool must be at the serial number end of the manifold.

3. Slide the spool back and forth by means of the LVDT core. It should slide free without catching.

4. Inspect the O-rings on the transducer assembly retainers and install new ones if damaged.

5. Inspect the metering edges of the LVDT core and the inside edges of the servovalve manifold.

2.4.3 **MAIN STAGE ASSEMBLY**

To assemble the main stage of the servovalve perform the following procedure.

**CAUTION**

Tape one end of the spool port so the spool does not slide through. Do not bang the edges of the spool against the inside edges of the servovalve manifold.

**NOTE**

On 256.05 Servovalves place one shim over each end of the spool.

1. Dip the spool in clean hydraulic fluid and insert it into the servovalve manifold.

**NOTE**

Spool stops are interchangeable between the ends of a particular servovalve body. Spools and/or spool stops are not interchangeable between different servovalve even though they may appear to fit.
NOTE

Spool stops for a 256.18 servovalve must be installed so that the flat portion of the outside diameter of the spool stop lines up with the pilot port in the bore. If assembly is incorrect, the spool will still move freely, but performance will be severely reduced.

2. Slide the spool far enough out of the non-S/N end of the servovalve body to permit putting a spool stop on the stub end of the spool. With a spool stop on the stub end, use the spool as a guide to slide the spool stop into the servovalve body. Install and tighten the spool stop screws. (See table 2-1 for torque values).

3. Repeat the above procedures for the other spool stop.

4. Using the dial indicator, adjust the LVDT core (by gently bending) so that the total indicator runout is 0.003 in. or less.

5. Install the drain end cap on the servovalve (see table 2-1 for torque values).

6. Install the LVDT end cap on the servovalve (see table 2-1 for torque values).

CAUTION

Turning the LVDT body in too far may cause damage to the core when hydraulic pressure is applied.

7. Install the LVDT body and tighten the LVDT locknut hand tight. The same number of threads should be showing as noted in step 2 of paragraph 2.4.1

Figure 2-4. Main Stage Assembly/Disassembly
2.5 MAIN STAGE LVDT CORE

Three different styles of LVDTs (shown in figure 2-5) may be used on the Series 256 Servovalves. The numbers 1, 2 and 3 in figure 2-5 coincide with the numbers in the LVDT Style column of table 2-2. They have identical sensitivities (v/v), phasing, and mechanical threads. The cores extend different lengths beyond the end cap and these lengths are shown in table 2-2. Refer to MAIN STAGE DISASSEMBLY/ASSEMBLY procedures for LVDT core removal/replacement.

Table 2-2. LVDT Core Data

<table>
<thead>
<tr>
<th>LVDT STYLE</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>MFG MTS P/N</td>
<td>Collins 076482-01</td>
<td>Collins 333364-03</td>
<td>Kavlico 333364-03</td>
</tr>
<tr>
<td>RATED STROKE</td>
<td>±.150 (3.81 mm)</td>
<td>±.250 (6.35 mm)</td>
<td>±.250 (6.35 mm)</td>
</tr>
<tr>
<td>OVER STROKE</td>
<td>±.030 (0.762 mm)</td>
<td>±.030 (0.762 mm)</td>
<td>±.030 (0.762 mm)</td>
</tr>
<tr>
<td>SERVOVALUE</td>
<td>core extension from spool end</td>
<td>core extension from spool end</td>
<td>core extension from spool end</td>
</tr>
<tr>
<td>MODEL NO.</td>
<td>in inches ±0.030</td>
<td>in inches ±0.030</td>
<td>in inches ±0.030</td>
</tr>
<tr>
<td>256.05</td>
<td>1.310 (33.27 mm)</td>
<td>1.530 (38.86 mm)</td>
<td>1.660 (42.16 mm)</td>
</tr>
<tr>
<td>256.09</td>
<td>1.310 (33.27 mm)</td>
<td>1.530 (38.86 mm)</td>
<td>1.660 (42.16 mm)</td>
</tr>
<tr>
<td>256.18</td>
<td>1.310 (33.27 mm)</td>
<td>1.530 (38.86 mm)</td>
<td>1.660 (42.16 mm)</td>
</tr>
<tr>
<td>256.25</td>
<td>1.530 (33.27 mm)</td>
<td>1.750 (44.45 mm)</td>
<td>1.880 (47.75 mm)</td>
</tr>
<tr>
<td>256.40</td>
<td>---</td>
<td>1.620 (41.14 mm)</td>
<td>1.750 (44.45 mm)</td>
</tr>
</tbody>
</table>

Figure 2-5. LVDT Cores
2.6 TROUBLESHOOTING GUIDE

The troubleshooting guide in table 2-3 provides the symptom, probable cause, and remedy for some common servovalve malfunctions that may be encountered in the pilot stage or in the main stage.

Table 2-3. Troubleshooting Guide

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Probable Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>PILOT STAGE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output flow obtained from one control port only. (Main stage is hardover. Does not respond to electrical command signal.)</td>
<td>Plugged inlet filter element</td>
<td>Replace filter element</td>
</tr>
<tr>
<td>Poor main stage response. (Servovalve output lags electrical command signal.)</td>
<td>Partially plugged filter element</td>
<td>Clean and/or replace inlet orifices (or filter element). Check for dirty hydraulic fluid in system.</td>
</tr>
<tr>
<td>High Null Bias. (High input current required to maintain main stage stationary.)</td>
<td>Incorrect (mechanical or electrical) null adjust-ment. Partially plugged inlet orifice assembly. Partially plugged filter element.</td>
<td>Readjust null. Clean inlet orifices. Clean or replace filter element and check for dirty hydraulic fluid in the system.</td>
</tr>
<tr>
<td>MAIN STAGE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actuator follows changes in command, but floats slowly around command position (hunting).</td>
<td>No feedback from slave stage. Operating pressure to low.</td>
<td>Check on servo-controller for LVDT signal. Increase pressure to at least 500 psi.</td>
</tr>
</tbody>
</table>
Table 2-3. Troubleshooting Guide (Continued)

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Probable Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sluggish actuator response.</td>
<td>Excessive leakage or silting of pilot stage servovalve.</td>
<td>See pilot stage troubleshooting.</td>
</tr>
<tr>
<td></td>
<td>Valve controller gain set too low.</td>
<td>Check and adjust Valve controller gain.</td>
</tr>
<tr>
<td></td>
<td>No feedback from slave stage.</td>
<td>Check servo-controller for LVDT signal.</td>
</tr>
<tr>
<td></td>
<td>Pilot stage filter partially plugged.</td>
<td>See pilot stage troubleshooting.</td>
</tr>
<tr>
<td></td>
<td>System pressure line filters dirty.</td>
<td>Clean or replace line filters.</td>
</tr>
<tr>
<td></td>
<td>Slave spool leakage too high.</td>
<td>Check spool leakage it should be less than 3% of maximum spool stroke (see flow ratings).</td>
</tr>
<tr>
<td>Actuator goes to full-stroke and cannot be controlled.</td>
<td>No positive or negative DC supply voltage on front panel of the controller.</td>
<td>Check fuses on rear panel of the controller.</td>
</tr>
<tr>
<td></td>
<td>No LVDT excitation voltage.</td>
<td>Check for 10 V p-p on front panel jacks of the transducer conditioner.</td>
</tr>
<tr>
<td></td>
<td>Cables connected wrong or defective.</td>
<td>Check for 80 ohms between pins A and B and 80 ohms between C and D on the pilot stage connector.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check for 21 ohms primary resistance between pins A and C and 7 ohms secondary resistance C and D on the LVDT cable.</td>
</tr>
<tr>
<td>Symptom</td>
<td>Probable Cause</td>
<td>Remedy</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------------------------------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>Excessive noise.</td>
<td>1. Return line pressure too low.</td>
<td>1. Raise return line pressure to 60-100 psi.</td>
</tr>
<tr>
<td></td>
<td>Pilot valve squealing.</td>
<td>Dither set too high.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Return to MTS.</td>
</tr>
<tr>
<td>Spool oscillation (erratic).</td>
<td>Hydraulic fluid contamination.</td>
<td>Clean and flush system.</td>
</tr>
<tr>
<td>Spool oscillation (periodic).</td>
<td>Excessive inner loop gain.</td>
<td>Check and adjust valve controller/LVDT signal.</td>
</tr>
</tbody>
</table>
SECTION III
INSTALLATION

3.1 SERIES 256 SERVOVALVE MODEL NUMBER REFERENCE AND COVER PLATE NUMBER

Table 3-1 describes how to read a Series 256 Servovalve model number (see figure 3-1). Table 3-2 lists the part number of the cover plate used (if the servovalve is to be removed from the system), to protect the hydraulic fluid from contamination. Do not apply system hydraulic pressure with a cover plate installed, they are not intended to withstand high system pressure.

Figure 3-1. Series 256 Servovalves

Table 3-1. Model Number Reference

<table>
<thead>
<tr>
<th>Model 256,XX A -- XX</th>
<th>Pilot Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>05 = 50 gpm (190 l/m)</td>
<td>00 = no pilot</td>
</tr>
<tr>
<td>09 = 90 gpm (340 l/m)</td>
<td>01 = 1 gpm (3.8 l/m)</td>
</tr>
<tr>
<td>18 = 180 gpm (680 l/m)</td>
<td>02 = 2.5 gpm (9.5 l/m)</td>
</tr>
<tr>
<td>25 = 250 gpm (950 l/m)</td>
<td>05(^2) = 5 gpm (19 l/m)</td>
</tr>
<tr>
<td>40 = 400 gpm 1500 l/m</td>
<td></td>
</tr>
</tbody>
</table>

\(^1\)Flow rated at 1000 psi drop across the Servovalve.
\(^2\)Available on Model 256.40A Servovalve only.
Table 3-2. Series 256 Servovalve Cover Plate Numbers

<table>
<thead>
<tr>
<th>SERVOVALVE MODEL</th>
<th>COVER PLATE PART NUMBER</th>
<th>FLOW RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>GPM</td>
</tr>
<tr>
<td>256.05</td>
<td>A327119-01</td>
<td>50</td>
</tr>
<tr>
<td>256.09</td>
<td>A327119-01</td>
<td>90</td>
</tr>
<tr>
<td>256.18</td>
<td>A332068-01</td>
<td>180</td>
</tr>
<tr>
<td>256.25</td>
<td>A335608-01</td>
<td>250</td>
</tr>
<tr>
<td>256.40</td>
<td>A335832-01</td>
<td>400</td>
</tr>
</tbody>
</table>

3.2 PILOT STAGE SERVOVALVE MOUNTING

The following procedure is used when mounting the pilot stage (Series 252 Servovalve) to a Series 256 Servovalve.

Do not apply electrical or hydraulic power to the system until instructed to. If this procedure is being performed to replace an existing servovalve ensure that the residual pressure in the system is at zero.

1. Remove the servovalve cover plate or existing servovalve from the main stage.

2. Ensure that the O-rings between the pilot stage servovalve and main stage are lubricated with a light film of hydraulic fluid and are in their correct position.

3. Fit the pilot stage servovalve onto the main stage, lining up the locating pin (see figure 3-2).

![Diagram of 252.2X Servovalve Locating Pin]

Figure 3-2. Servovalve Locating Pin.

4. Mount the pilot stage servovalve to the main stage using the four #5/16-18 x 1-1/2 in. mounting screws. Lubricate with a light film of hydraulic fluid, and tighten the mounting screws, (refer to table 2-1 for torque values).
5. Connect all hydraulic supply and return lines.

6. Make all electrical connections between the servo valve and the controller.

*** WARNING ***

Steps 6 and 7 require that the operator turn on system power and apply hydraulic pressure to the servo valve. Keep all personnel clear of the actuator, when performing these steps. Possible injury may occur due to abrupt, extremely fast actuator rod movement. Ensure that the error signal as monitored from the device controlling the servo valve is at zero before applying hydraulic pressure. (Refer to the appropriate product manual for additional information.)

7. Turn on system electrical power and zero the Error signal.

8. Apply low hydraulic pressure to the servo valve so that the hydraulic fluid will fill the filter cavities gradually.

9. Apply high pressure and check for leaks.

3.3 PILOT STAGE SERVOVALVE REMOVAL

The following procedure should be used when removing the pilot stage servo valve from the main stage for any reason (i.e., replacing the servo valve, replacing the filter).

1. Turn off electrical and hydraulic power to the system. Ensure that residual pressure in the system has fallen to zero by cycling the set point back and forth until the actuator stops moving.

2. Disconnect the control cable from the pilot stage servo valve.

3. Remove the four #5/16-18 x 1-1/2 in. mounting screws used to secure the pilot stage servo valve to the main stage. Remove the pilot stage servo valve.

CAUTION

Cover the manifold ports and the pilot stage servo valve with the correct cover plate (see table 3-2) as soon as the servo valve is removed to prevent possible damage due to fluid contamination.

4. Cover the pilot stage servo valve and the main stage manifold ports.
3.4 MAIN STAGE SERVOVALVE REMOVAL

To remove the main stage servovalve from the system, perform the following procedure after the removal of the pilot stage.

1. Disconnect the LVDT control cable.

CAUTION

In the steps that follow, exercise care to prevent dirt from entering the open ports and fittings while the servovalve is removed (refer to table 3-2 for the part number of the cover plate to use when removing the servovalve).

2. Disconnect the pilot pressure, pilot return and drain lines.

3. Remove the four mounting bolts from the main stage manifold, while carefully supporting the manifold. Set the O-ring seals aside in a clean area.

4. Immediately cover the open ports on the manifold and actuator with the appropriate cover plate. (Refer to table 3-2 for cover plate part numbers.)

5. To reinstall the servovalve, reverse the above procedure. Make sure the O-rings are lubricated and properly placed. Lubricate the mounting screws and tighten (in 15 lbf-ft steps) to the proper torque.

3.5 ELECTRICAL CABLE CONNECTIONS

Figure 3-3 illustrates the typical electrical connection that is made between the Series 252 Servovalve and controllers used in the system. Figure 3-4 through figure 3-7 illustrates the typical electrical connections that may be made between the servovalve LVDT and the controlling device.

When a 256 Servovalve is used with a 442, 443, 406, 450, or 439 Controller, pilot stage drive cable connections are made from the connector at the rear of the controller to the servovalve. The cables shown in figure 3-3 through 3-7 use No. 18 AWG wire with a 600 volt S0 neoprene jacket such as Western Wire Bronco 66 or equivalent.
Figure 3-3. Pilot Stage 252 Servo valve Drive Cable Connections

Figure 3-4. LVDT Feedback Cable Connection (406 Controller)
Figure 3-5. LVDT Feedback Cable Connection (44X Controller)

Figure 3-6. LVDT Feedback Cable Connection (450 Controller)
Note: Leads may be reversed for proper phasing.

Figure 3-7. LVDT Feedback Cable Connection (439.11 Controller)
SECTION IV
THEORY OF OPERATION

As the final control element in a servohydraulic test system, the MTS Series 256 Servovalve reacts to an electrical input signal by porting hydraulic fluid in a direction and amount determined by the input signals polarity and magnitude.

The 256 Servovalve consists of a three stages of operation (see figure 4-1). The first stage is the torque motor stage, which consists of coils, an upper and lower polepiece, an armature, and two magnets. Its purpose is to covert the electrical input signal into a physical movement of the armature.

The second stage spool position is controlled by a mechanical feedback system. When an input signal is applied to the coils of the torque motor, it displaces the flapper, generating a pressure differential between the two nozzles as well as at the ends of the second stage spool. The pressure differential causes spool displacement. As the spool moves, it applies a counter torque to the feedback spring. When the torque in the feedback spring equals the torque developed by the motor, the differential pressure on the ends of the spool equalizes and the spool stops moving. A state of equilibrium exists. Hence, second stage flow is directly proportional to input current. Second stage flow drives the third or main stage spool.

The third stage is similar to the second stage except that it is a much larger four-way spool valve and its position is monitored by electronic feedback provided by the LVDT and controlled by the valve command to the first stage. The LVDT shown at the end of the main spool in figure 4-1, provides an output voltage proportional to spool position. This signal is returned to the controlling unit where it is compared with the dc error signal. The controlling unit senses the difference between dc error and the main stage LVDT output and alters control current to the torque motor in the first stage.

Torque motor action drives the second-stage spool in the direction and by the amount required to properly position the main-stage spool, in proportion to the dc error signal. When the main-stage spool is open, dc error is reduced by corrective servo action in the main control loop. When dc error reaches zero, servo action in the inner loop closes both spools and the controlled variable remains at a constant level.
Figure 4-1. Series 256 Servovalve (Cutaway View)