Servovalve Service Intervals

Some customers have asked how often MTS servovalves need to be serviced. The answer is, if the hydraulic fluid is in good condition and kept clean to MTS recommendation, servovalves should last a very long time without needing any service. The importance of fluid cleanliness cannot be over-emphasized in servovalve maintenance.

Dirty or silt-laden fluid is the major cause of servovalve problems. In general, fluid cleanliness should meet ISO 16/13/9 standards. However, it does not seem worthwhile to have fluid much cleaner than this level for most applications.

If the findings show that the valves must be serviced sooner than that, the most likely problems will be clogged filters and varnished valve spools—issues which are related once again to fluid cleanliness. The table below identifies MTS control limits for precision hydraulic fluids used in our test systems.

Characteristic	Normal	Borderline	Unsatisfactory
Viscosity at		(low) 183-193	(low) <183
100°F (38°C) SUS	215-240	(high) 256-276	(high) >276
Particle count	ISO 16/13/9	ISO 17/15/11	ISO 18/16/13
Water, % by weight	<0.05	0.05-0.1	>0.1
Iron, ppm*	<30	30-50	>50
Silicon, ppm*	<15	15-30	>30
Copper, ppm*	<40	40-100	>100
TAN mg KOH/gm	<1.4	1.4-2.6	>2.6
Ultra Centrifugation	1-3	4-6	7-8
Oxidation, A/cm	<3	3-4	>4

IDENTIFYING PERFORMANCE DEGRADATION

Performance degradation in MTS servovalves can occur for many reasons. For example, in MTS Series 252 Servovalves, the common failure modes are: sticky spools, external leakage, ball slop, and high null leakage. A sticky spool is usually caused by fluid contamination or silting that results in erratic valve behavior. External leakage, on the other hand, indicates a failed O-ring or fractured flexure tube. These can be identified immediately.

Ball slop is caused by clearance between the feedback ball and the spool slot. It can cause sinusoidal waveform distortion, but it is less detectable when running random waveforms. MTS Series 252 servovalves will last over a billion full-stroke cycles before there will be any noticeable feedback ball wear. At 25 HZ and constant use, that amounts to more than fifteen months of constant full-stroke use.

The last problem, high null leakage, is caused by the servovalve metering edges rounding off in use and thus increasing leakage when the spool is at null position. Rounded metering edges will lower null pressure gain, increase null flow gain, and increase the system damping ratio. This does not adversely influence system performance, other than wasting energy, and most of the wear occurs early in the valve life.

Series 256 servovalves are less prone to problems. A Model 252 Servovalve is used in the pilot-stage, but here it encounters much less spool travel, thus reducing wear on the feedback wire and increasing service life. The main stage of a Series 256 valve has hydrostatic bearings on the spool, eliminating wear on this critical part. The metering edges of a Series 256 valve will erode somewhat from new condition, but again, this wear will be seen as an increase in null leakage.

In some applications, due to limited pump capacity, high null leakage of the servovalve may cause low supply pressure, but this is rare. Null leakage only has an effect when the spool is at null. It does not increase flow when the valve is metering flow at any off-null positions.

Series 257 Servovalves are generally used in high-frequency systems. It is important to warm up a Series 257 servovalve before starting a test. Servovalve galling may happen if the servovalve or system runs into instability for a certain period of time (a minute) without proper warm-up. Voice coil resistance should be checked every six months and changes trended with its baseline measurements.

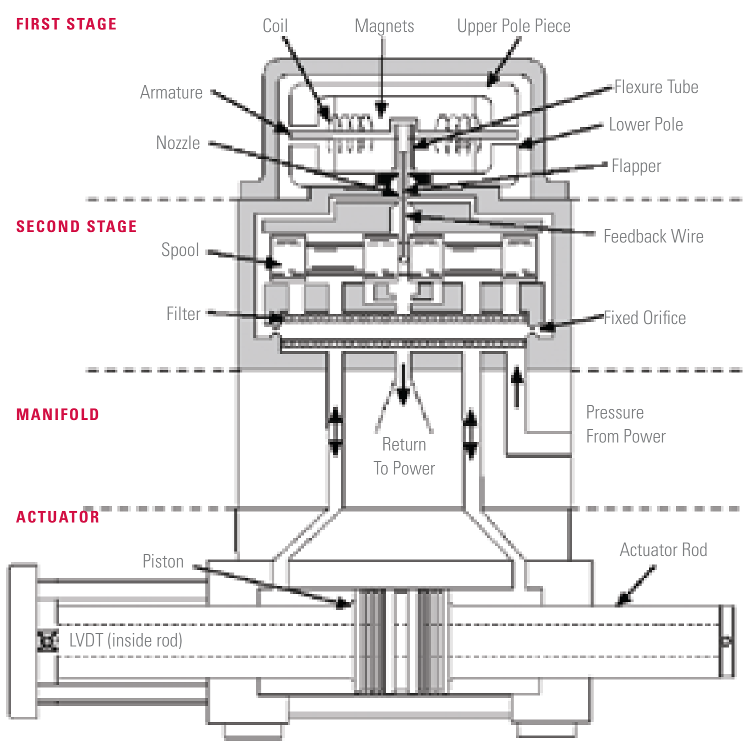
SERVOVALVE INSTABILITIES

Often customers talk about system “whistling,” “squealing,” “squeaking,” “squawking,” “irregularly moving,” “jerking,” “jittering,” “servovalve unstable,” and “return hose slapping.” While we may not be able to explain everything, we do know how to solve most of these issues, and, how to reduce the annoyance to an acceptable level.

The typical scenario for servovalve whistling is that the system pressure is on and the actuator is not moving, and the system is under control. A high pitch noise can be heard around the system’s servovalve. Source of the whistling noise: high-speed leakage flow through servovalves metering edges, which is intentionally and carefully made to zero lap. Simply increasing the return line pressure will reduce or eliminate the noise.

If you are hearing system squeaking or squawking that is synchronized with actuator movement, this is created when the servovalve spool moves across the null position, and fluid flow in the return line cannot stop due to fluid inertia. This can cause cavitations in the return line and the noise. Again, the solution is to increase the return line pressure.

The servovalve is the heart of the servohydraulic system. It is the final control element in most MTS closed-loop systems.



ACTUATOR JERKING, IRREGULARLY MOVING, OR SERVOVALVE JITTERING

Irregular movements in the actuator or servovalve can be traced to many sources. If the fluid is not clean, contaminants in the fluid clog the gap between the flapper and nozzles in servovalves temporarily and causes the servovalve and actuator to jerk. The fluid cleanliness should be kept to ISO 16/13/9, or, at least, the servovalve nozzle flapper stage should be kept to this level.

Servovalves are not perfect; for example, hysteresis, and threshold will show if a small actuator is used with a high flow servovalve, or in the case of a Series 256 Valve, the pilot stage is too big for the output stage. The best system design is to select the smallest servovalve for the actuator that meets the performance requirements.

Servovalve null will shift with changes in supply pressure and return pressure. Again, a high-flow servovalve paired with a small actuator will have low disturbance rejection. Any changes in return pressure and/or supply pressure will cause the actuator or spool to move. Sometimes lowering pilot supply pressure and retuning the system can be an effective way to improve system disturbance rejection.

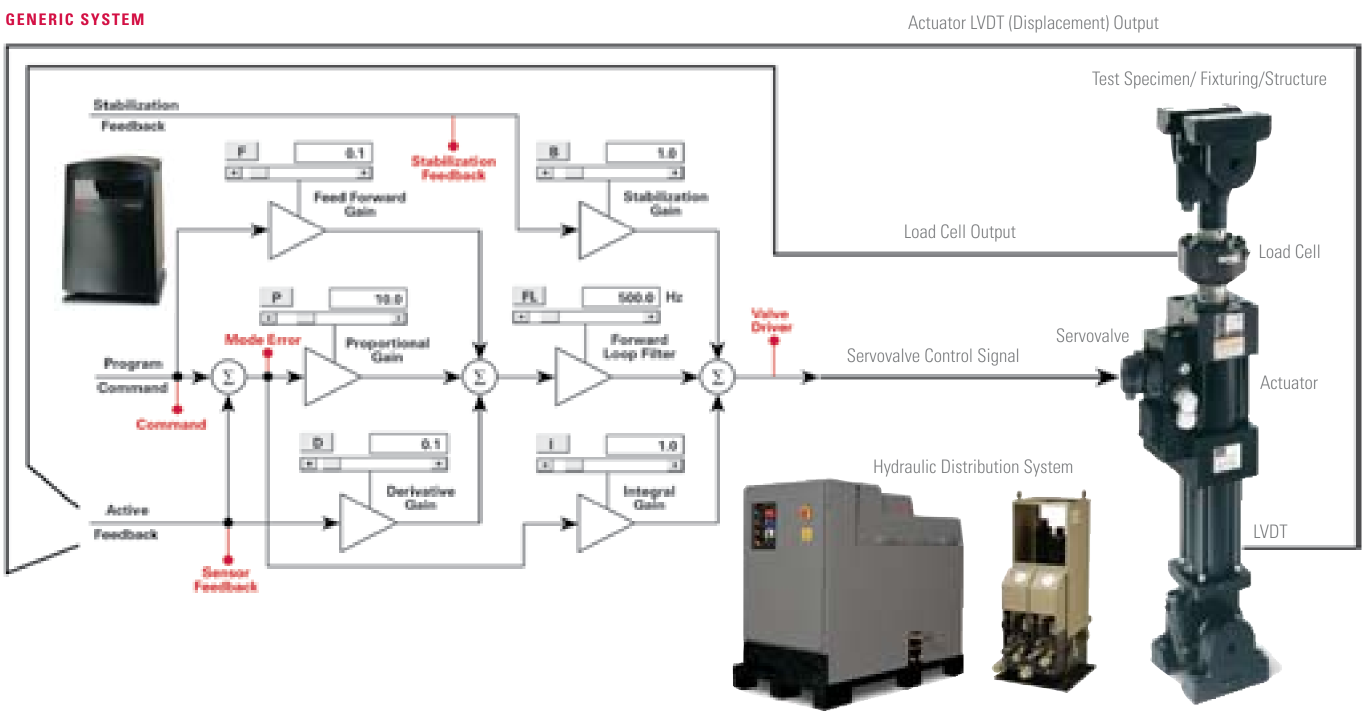
SERVOVALVE SQUEALING

For a three-stage valve, when the main stage supply pressure is off and pilot pressure is on, the response of the valve should be controlled by the inner loop gain and rate. Otherwise, the pilot stage and/or the main stage need to be returned and checked on the test bench. Here is what sometimes happens when a low-flow three-stage servovalve is used to control a large, long-stroke actuator. When the main stage supply pressure is on, the servovalve starts squealing. Servovalve spool oscillation can be seen on an oscilloscope, and tuning will not stop the squealing.

One possible source of this instability is mechanical or hydromechanical resonance. Re-orientating a Series 252 valve may cut off the mechanical feedback path by rotating the valve 90 degrees or 180 degrees. The Series 256 servovalve fluid column natural frequency can be changed by changing the pilot driving area, but this method involves experiments and a "non-standard" servovalve.

The squealing will go away very often by adding a piece of hose to C1 or C2 port of pilot stage (-4 or -6 size, 1 to 2 feet long). Many people have tried different methods: Redesigning the adapter manifold between pilot stage and main stage and adding fluid volume to C1 and C2 connection; adding a small accumulator to C1 or C2 port; or adding a filter in the controller. All have different degrees of success, but the hose seems to be the most simple and universal solution. Some people claim the instability may come back later at a different frequency.

GENERIC SYSTEM



PROBLEM AVOIDANCE AND LIFECYCLE EXTENSION

To allay these types of servovalve problematic behaviors, MTS recommends maintaining servovalve fidelity through precision hydraulics management. This includes having your lab's servovalves tested for performance characteristics after 7500 hours of use, assuming of course, that the fluid you use meets MTS recommendations. Essential to this maintenance is the monitoring of hard particle contaminants that lead to thread-body abrasion. Servovalves as well as hydraulic pumps are rapidly deteriorated by this form of contaminant.

Find out more about precision hydraulics management by browsing to www.mts.com/fluidcare; contact your local MTS field service technician; in the U.S. call 1-800-328-2255; fax 952-937-4515; or e-mail info@mts.com.

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