

Parker Jet-Pipe® Servovalves

Care and handling guide

aerospace
climate control
electromechanical
filtration
fluid & gas handling
hydraulics
pneumatics
process control
sealing & shielding



ENGINEERING YOUR SUCCESS.

The care and handling of Parker Jet-Pipe® servovalves

Introduction

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This publication describes Parker's Jet-Pipe® electrohydraulic flow control servovalves. This device will provide flow that is proportional and directional to an electric input current.

The servovalve is composed of two major parts: the valve, which is a precision, close-tolerance, matched spool and sleeve; and the electrical force motor called a torque motor. Combining an electrical device (torque motor) with a mechanical device (spool and sleeve) with a mechanical feedback spring results in a servovalve that provides an output flow precisely proportional to input current.

To achieve high precision in performance, exacting levels of manufacturing are required to assure the proper size and fit of the valve components. In service, the valve components must maintain their relative positions and condition to assure continued operation within requirements.



Principle of operation of the Jet-Pipe[®] servovalve

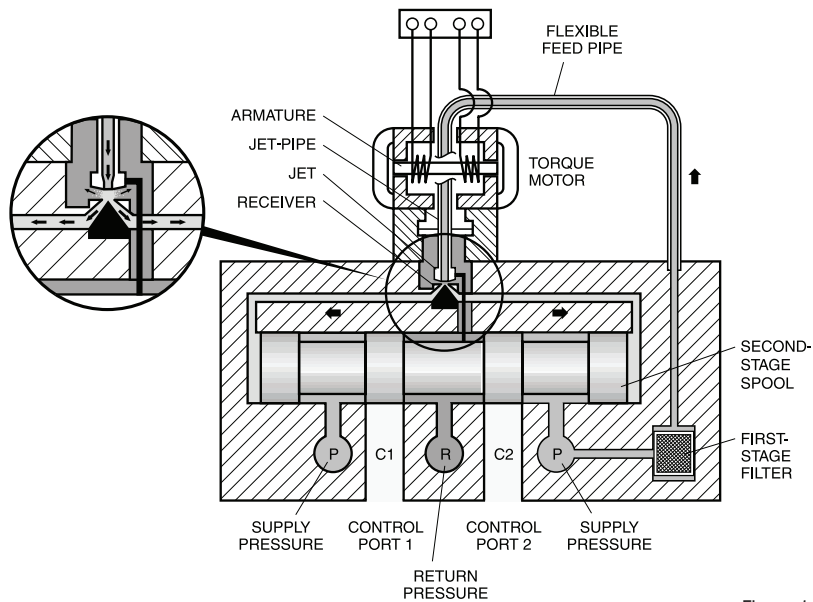


Figure 1

A contemporary four-way servovalve is illustrated in Figure 1. This unit is shown in the neutral or null position. Supply pressure is applied to the pressure port and to the jet-pipe (usually one common supply connection). Jet-pipe flow is directed into a flow divider or receiver. At the null positions, flows and pressures are equal in the passageways leading to the ends of the spool, thus there is no net force pushing the spool in either direction.

Upon application of an electrical signal to the torque motor, the armature deflects (as shown in Figure 2), causing the jet-pipe to displace and direct the jet flow into only one of the two receiver ports. The flow into one receiver passageway acts upon one end of the spool, causing the spool to move. The spool movement results in one cylinder port being opened to the supply port and the other cylinder port being opened to the return port.

As the spool moves it acts upon the feedback spring, which in turn pulls the jet-pipe back over the receiver null position (illustrated in Figure 2). This balance between input current, spool position, and feedback spring force results in a particular flow to be passed for each particular input signal to the servovalve.

When the polarity of the input signal changes, flow from the other cylinder port results.

Servovalves are used to accomplish many tasks. Most commonly they are mounted on linear or rotary actuators so that they will transform the electrical command signal into linear or rotary motion output of the actuator. Quite often this concept is used for position control of a machine platform.

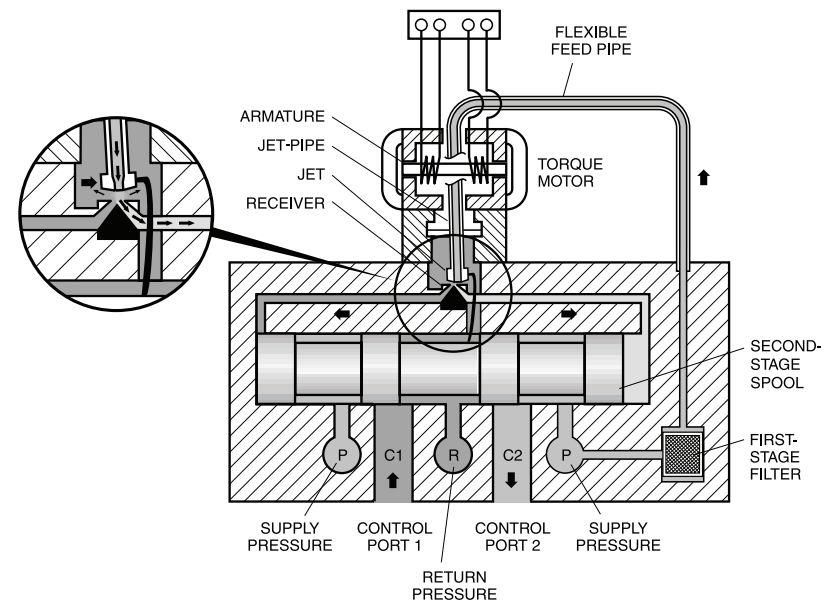


Figure 2

A clean system can prolong servovalve life

Like most hydraulic system components, all servovalves like to be used with a fluid free of excessive particle contamination as well as a reasonable chemical composition to avoid chemical erosion.

It is difficult to generalize in describing how clean a system should be due to the great variance between requirements with different applications. One guide that can be generally used is document AS4059, published by SAE International. This document, titled *Aerospace Fluid Power - Cleanliness Classification for Hydraulic Fluids*, classifies varying levels of contamination. Servovalves have been found to operate quite satisfactorily in systems with a contamination level equal to, or below AS4059, Class 7, which corresponds to the following:

AS4059	
Particle Size Range - Microns	Class 7 Particle Quality (100 ML Sample Size)
5 to 15	32,000
15 to 25	5,700
25 to 50	1,012
50 to 100	180
Over 100	32

In terms of filtration, a well-maintained system with a filtration of 10 micron nominal and 25 micron absolute has been found to be satisfactory in most applications.

Fluid chemical composition should be monitored as well as the fluid and system manufacturer recommendations followed to maintain the proper chemical composition.

Two other areas should receive particular attention. On new system start-up, flush the system thoroughly prior to installation of servovalves. Defective servovalves with very low operating time are returned after having been installed in a new system. These units are found with jammed spools due to trapped chips, weld slag, plastic tape, etc. This system contamination was built into the system between the filtration and servovalve and probably could have been removed by prior flushing.

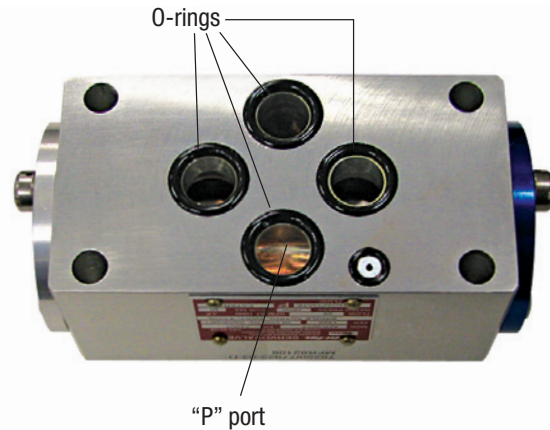
When an element of the system has a failure that is suspected to have caused the generation of contamination, flush the system and service the filtration system.

Installation

Servovalve fluid connections are usually made through the use of face seals. Seal grooves are located in the surface of the servovalve body which interfaces with the manifold. The o-rings provided with the servovalve when shipped are suitable for installation.

Prior to mating the servovalve to the manifold, inspect the o-rings to be sure they are not cut and are clean. Be sure the o-rings are in place.

Old seals should not be used a second time as they usually have taken a set unique to their first installation and are susceptible to leaking upon reinstallation.



The mating surface must be flat within .001 inch and the surface finish which mates with the o-ring seals should be 32 rms finish maximum. Be sure the manifold surface is clean and free of loose chips or dirt that could enter any of the fluid passages or prevent the servovalve from being properly mated to the manifold surface.

Be sure the servovalve is oriented on the manifold so that the “P” port is over the supply pressure port in the manifold.

The screws furnished with the servovalve are to retain the shipping plate and are not designed for use in servovalve installation.

Therefore, they must not be used to mount the servovalve. Bolts in accordance with or similar in strength and design to NAS-1352 should be used.

Bolts should be tightened in an alternating pattern evenly to 15 to 17 inch-lbs.

These bolts should never be loosened when the system is pressurized. Should there be a face seal failure, it is always useless to apply additional torque to attempt to stop the flow or leakage from the failed seal, and this could result in a needless replacement of the servovalve body.

Servovalves are sold with a variety of electrical connections and usually can be classified as either an electrical connector (screw or bayonet) or lead wires (pigtail).

A proper mating connector should be used with the attaching wires to assure a complete and reliable electrical connection. The connector receptacle on the servovalve carries an internal seal which maintains the hermetic seal of the torque motor area. If the receptacle is disturbed, the integrity of the hermetic seal is in doubt and could allow contamination of the torque motor and subsequent servovalve failure.

The torque motor is a magnetic device and is very susceptible to contamination and mishandling. Should the torque motor cover or electrical receptacle be disturbed, it is quite easy to damage the servovalve by contaminating the torque motor.

All modifications to allow temporary electrical connections are best performed without removal of the electrical receptacle from the servovalve.

Removal of lead wires from the servovalve results in the same exposure to possible damages as the electrical receptacle. If in doubt about the wiring hookup, contact the system manufacturer or Parker Control Systems Division.



Servovalve with lead wire (pigtail) electrical connection



Servovalve with electrical connector (screw or bayonet) connection

Maintenance

Replacement of the internal strainer is the only maintenance action that can be performed on the servovalve in the field.

The strainer assembly for most servovalves consists of an orifice, an o-ring at the front of the strainer, the strainer, and an o-ring at the back of the strainer. Usually the strainer is located in the mounting surface of the servovalve. The configuration may be slightly different for larger servovalves such as the Parker Control Systems Division model 450. Strainer replacement must be performed with the system depressurized.

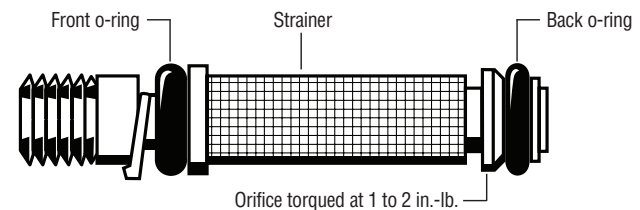
When replacing the strainer assembly, work in a very clean area and take every precaution to avoid introducing any contamination into the strainer cavity of the body. Any such contamination introduced between the new filter and the jet-pipe could seriously disable the valve.

When removing the strainer assembly, it is often best to hold the servovalve so that the strainer is removed in a downward direction. This will allow fluid drainage to carry any loose contamination out of the strainer cavity.

The replacement strainer kit includes a removal tool. When the old strainer is removed, inspect the strainer to assure that the orifice is still intact. If the orifice has been retained in the body cavity, use the tool in the replacement kit to remove the orifice. Do not attempt to use a screwdriver for this purpose; serious damage can result to the strainer cavity sealing surfaces.

When ordering replacement strainer kits be sure to give the model number and part number of the servovalve to assure the proper kit is provided.

When assembling the strainer assembly into the servovalve, the strainer should be screwed into the threaded strainer cavity until it seats (usually about 2-1/2 turns). Then back the strainer off until the holes for lockwire in the strainer end plug line up with the lockwire slots in the servovalve housing (usually about 1/8 turn). Install the lockwire so that it is retained within the adjoining groove and doesn't project into the manifold surface and cause interference or damage between the valve and manifold.



Field repair

Quite often servovalves are mounted in complicated control systems and the source of system problems can be one of many components, including servovalves. One good way to determine if a particular component is the source of the problem is to substitute the suspect unit with one of known good performance. Once a troublesome servovalve has been identified, only the following repair actions can be taken in the field:

- Strainer replacement (previously described)
- Manifold face seal replacement
- Backflushing

Manifold face seal replacement is performed simply by removing the servovalve from the manifold, and replacing the old interface o-rings with new o-rings and reinstalling of the servovalve. Again, when replacement seals are ordered, please note which model and part number servovalve is involved.



Should the servovalve have no response, sluggish response, flow through only one cylinder port (port C1 or C2), or excessive flow through one cylinder port at null position, the strainer assembly is probably saturated with contamination. The strainer should be replaced and the servovalve tested for performance.

If the problem persists, it may be possible that an internal passage in the servovalve is plugged. It is possible to unplug the servovalve by backflushing.

Backflushing is accomplished by applying hydraulic pressure to the return port, with the strainer assembly removed from the servovalve assembly. In installations where the servovalve port and bolt pattern are symmetrical, the strainer assembly should be removed and the servovalve installed so it is rotated 180° on its manifold resulting in the servovalve return port “R” being connected with the

manifold “P” port. Apply up to 1500 psi to port “R” of the servovalve for several minutes. No electrical signal is necessary. Then remove the servovalve, reinstall the strainer, and retest in the system. If trouble persists, the unit cannot be field repaired. Should the servovalve show external leakage, the only field repair that can be accomplished is for external leakage from the manifold seals or the strainer seals.

Should the external fluid leakage come from other areas, the unit must be repaired at a service facility that is equipped with the proper tooling.

Typical performance problems, causes, and solutions

Problem	Cause	Solution
No response or reduced response	Strainer assembly clogged	Replace strainer assembly
	Fluid passage clogged downstream of the strainer assembly	Backflush
	Piston jammed	Return for service
	Open coil	Return for service
External leakage from manifold or strainer cavity	Failed seal, damaged manifold surface or seal groove	Replace manifold seals, replace strainer face assembly, or replace/rework valve body
External leakage from other areas	Failed seal	Return for service
Excessive return port leakage flow	Sleeve seal failure	Return for service
	Excessive wear of sleeve assembly	Return for service
Null shift low pressure gain	Fluid passage clogged	Backflush
	Impact damage	Return for service
	Excessive wear of sleeve assembly	Return for service

Repair don'ts

Don't tap the valve with tools. Tremendous forces can be generated with the simple tap of a hammer or wrench, which can damage a servovalve. If you suspect a stuck spool, any hammer tapping will cause more damage to the valve than good gained by unsticking the spool.

Never remove the spool end caps, as on most servovalves, this is an adjustment feature. Once the end cap is moved, the adjustment is lost and cannot be regained unless a servovalve test stand is used.

If you remove the end caps, do not try to force the spool out of its sleeve. It is internally retained. Forcibly removing the piston without proper tools can cause unrepairable damage to the sleeve, piston, and torque motor.

Never tape the torque motor cover, as there is very little clearance between the cover and torque motor. Any cover interference with the torque motor can cause out-of-specification performance.



Returning servovalves and service

When removing the servovalve from the system and where long lead wires are used, it is helpful to maintain the longest possible lead wire length rather than cutting lead wires very short. Unless users advise differently, short lead wires are replaced with new wires of original delivery length.

An appropriate shipping plate should be used to protect the manifold face of the servovalve during handling and shipment. Shipping plates and retaining hardware are on the servovalve when originally shipped and are available from Parker Control Systems Division for return shipments.

Servovalves being returned to Parker Control Systems Division should be packaged to prevent damage in shipping. Units should be separated when packaged to prevent any contact between servovalves.

To obtain service for your Parker Control Systems Division servovalve, send the unit to:

Parker Hannifin Corporation
Control Systems Division
2010 Waldrep Industrial Boulevard
Dublin, GA 31021
(478) 275-4030

When the unit is sent to Parker, please state the nature of the service you require and a telephone number where the sender can be reached. It is helpful to know the history of the operation of the unit. Please also provide the following information, if possible:

- Application
- Date of service start
- Date removed from service
- Hours per day average operation
- Nature of performance discrepancy
- User estimate of reason for defect

If any information regarding Parker findings is desired by the sender, note the request on the paperwork accompanying the unit when shipped to Parker.

Parker Hannifin Corporation
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Control Systems Division
2010 Waldrep Industrial Boulevard
Dublin, GA 31021
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www.parker.com

