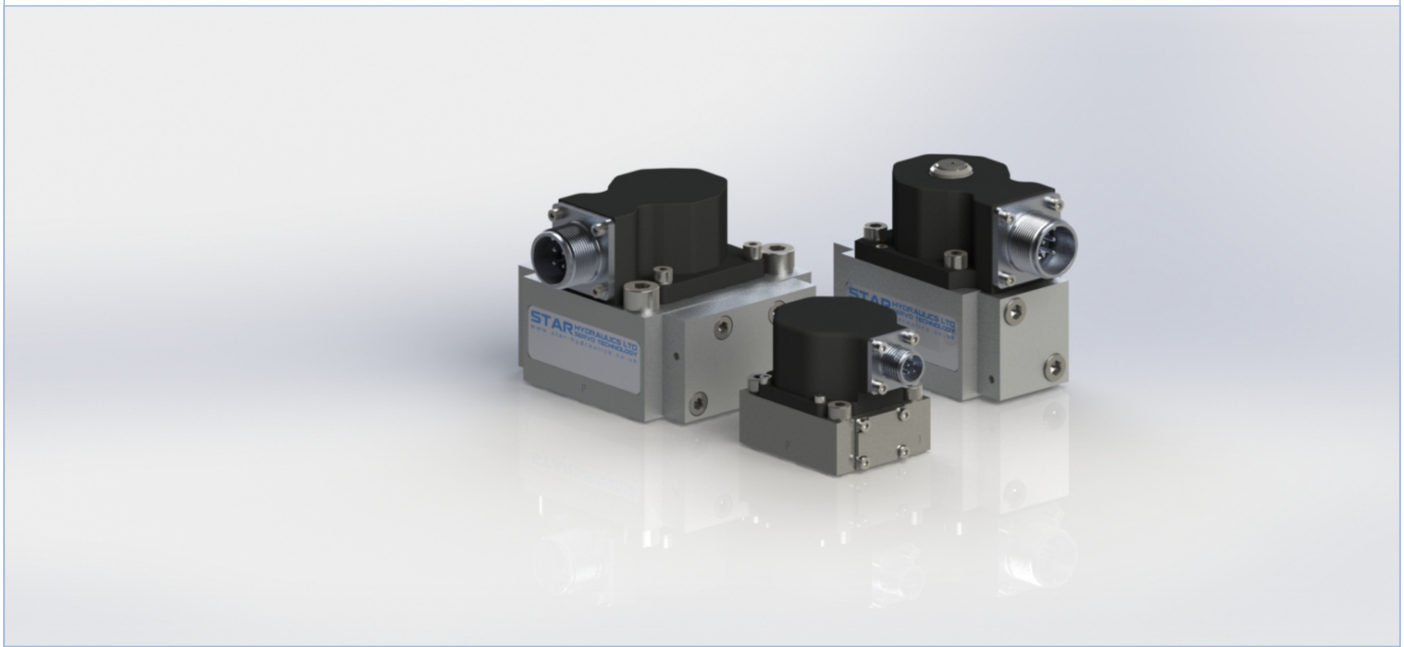
STAR

2-Stage Servo Valve
Nozzle Flapper, Mechanical Feedback
Design and Operation



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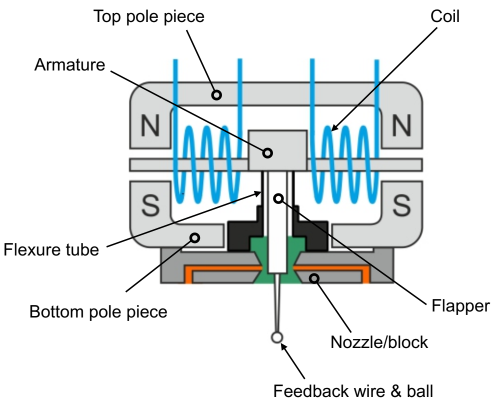
First Stage (Torque Motor)



The armature and flapper are rigidly fixed perpendicular to each other and are connected to the nozzle block via the flexure tube.

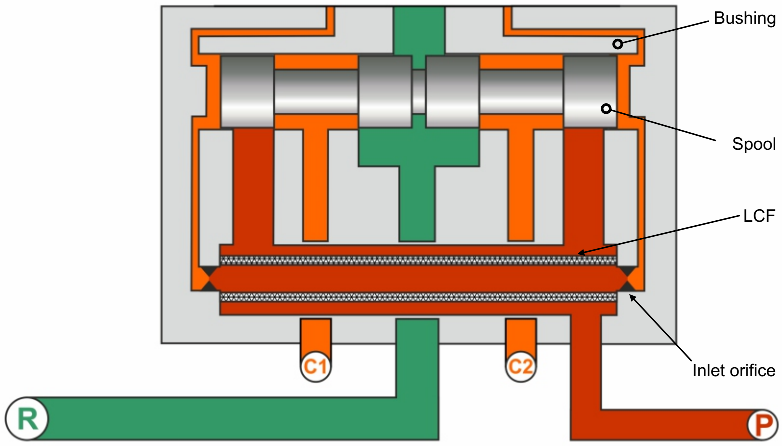
The flexure tube has an extremely thin wall section and as such will flex about a pivot point when a small force is applied to either end of the armature. This movement is translated to the flapper which sits equidistance between a pair of nozzles thus creating two variable orifices. The flexure tube also serves as a mechanical seal.

Attached to the flapper is the feedback wire which is also a spring, the feedback ball locates in a slot in the main stage spool. In the Star Premier Range of servo valves the ball is made from Sapphire to ensure long life performance.

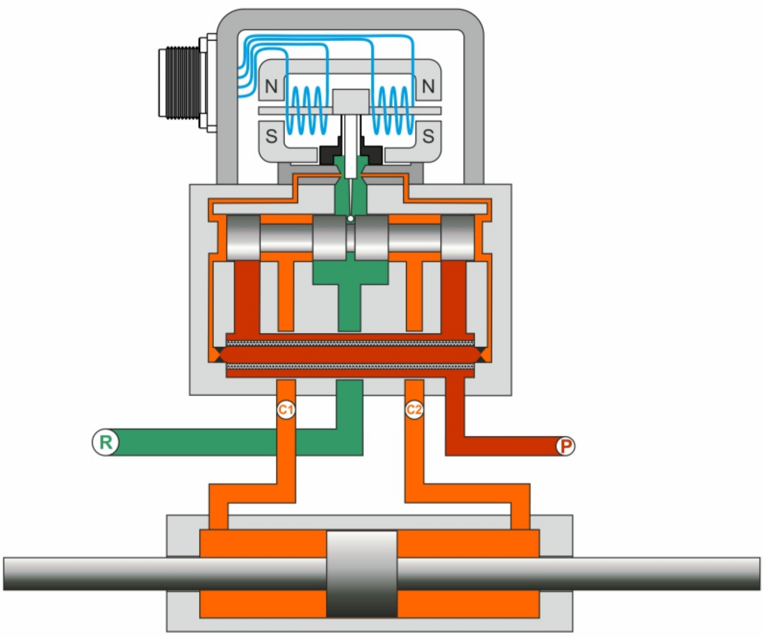
Second Stage

Flow/pressure are controlled by a sliding spool which is matched within a few microns to the bushing bore. The four lands of the spool are critically cut to four ports in the bushing to ensure both low leakage and idealised output characteristics.

Also housed in the main stage are the inlet orifices and last chance filter (LCF).



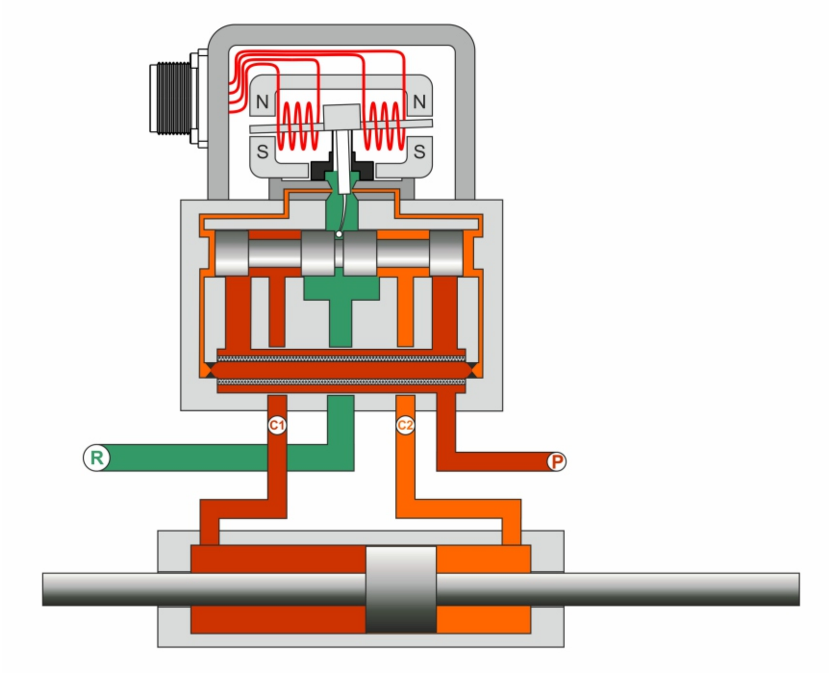
Operation



The main pressure port supplies both the first and second stages in 4 port design valves.

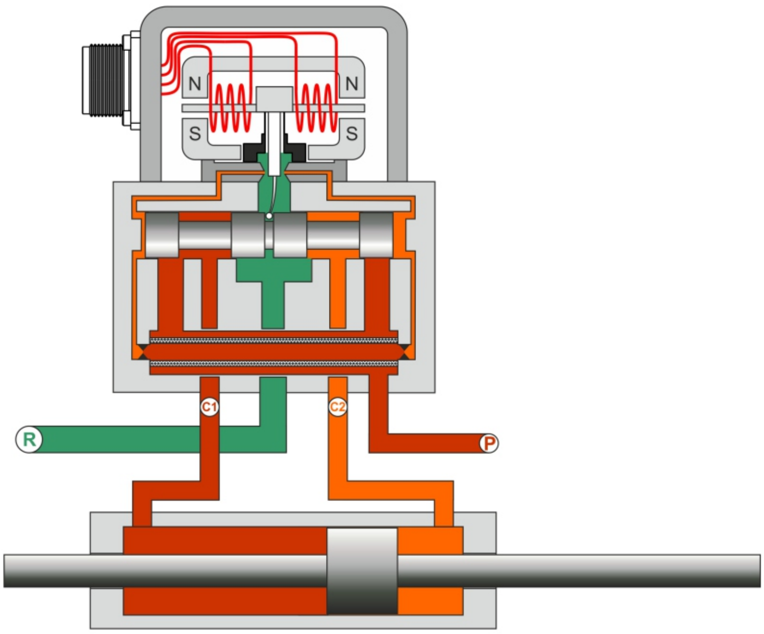
Fluid flows continuously through the LCF, through the matched pair of inlet orifices onto both ends of the spool, through the matched pair of nozzles before draining back to tank. With the flapper in the mid-position the pressure at the ends of the spool is approximately half supply pressure as the area of the inlet orifices equals the area of the nozzle to flapper gap.

With no electrical current passing through the coils the valve is mechanically positioned so that the valve output is at null, meaning that no or very little pressure differential exists between C1 and C2 ports.



Once an electrical signal is applied to the coils the armature is magnetised, polarity of the current will dictate the direction of rotation of the armature between the fixed poles of the top and bottom pole pieces. The magnitude of the current will control the level of deflection.

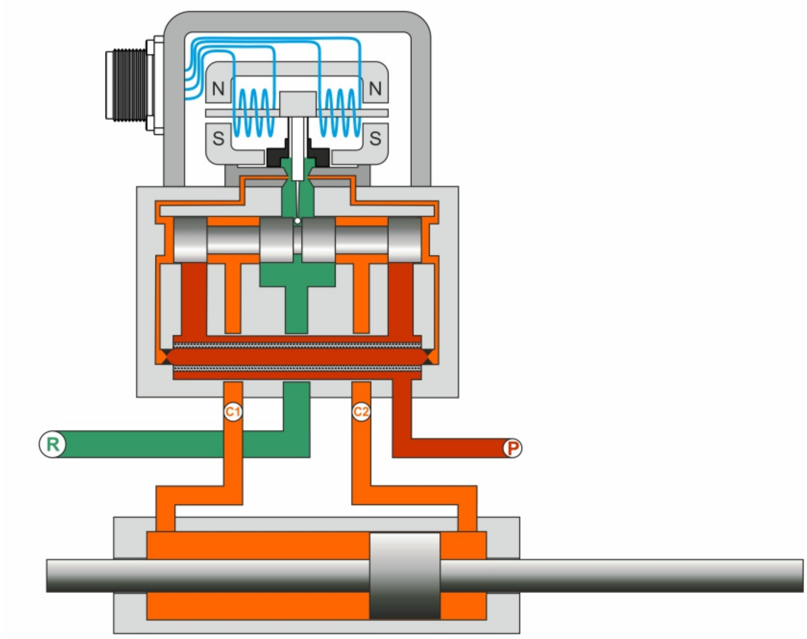
As can be seen in the diagram opposite this directional and proportional deflection of the armature moves the flapper and as it does creates a higher resistance to flow in the RH nozzle whilst also allowing more free flow in the LH nozzle. The changes in flow affect the pressure in the lines between the nozzle and orifices creating a differential from one side of the spool to the other, the resultant force acting on the RH side of the spool is greatest and so the spool rapidly moves towards the left.



The spool movement allows pressure from the supply line to enter the C1 port whilst the C2 port is vented to return. This differential is what applies the force to the actuator piston enabling drive to a load and rapidly accelerating it to a constant velocity.

The spool movement simultaneously applies load to the feedback wire. When the force at the feedback wire equals the force at the armature the flapper will return to the mid-position thus holding the spool at the biased position.

Displacement of the spool governs the level of flow passing to and from the control ports, rated input current is proportional to rated output flow.



Removal of the current to the coils returns the valve spool back to null.

Nearly all closed loop systems require the servo to have an immediate output versus input so the spool lap condition is critical so that no dead-band exists through null, so as not to induce lag or unwanted load transients.