

LECTURE 27 – SERVO VALVES

FREQUENTLY ASKED QUESTIONS

1. Define a servo valve

Servo valve is a programmable orifice. Servo valve is an automatic device for controlling large amount of power by means of very small amount of power and automatically and continuously correcting the performance of a mechanism

2. How do servo valves differ from proportional control valves

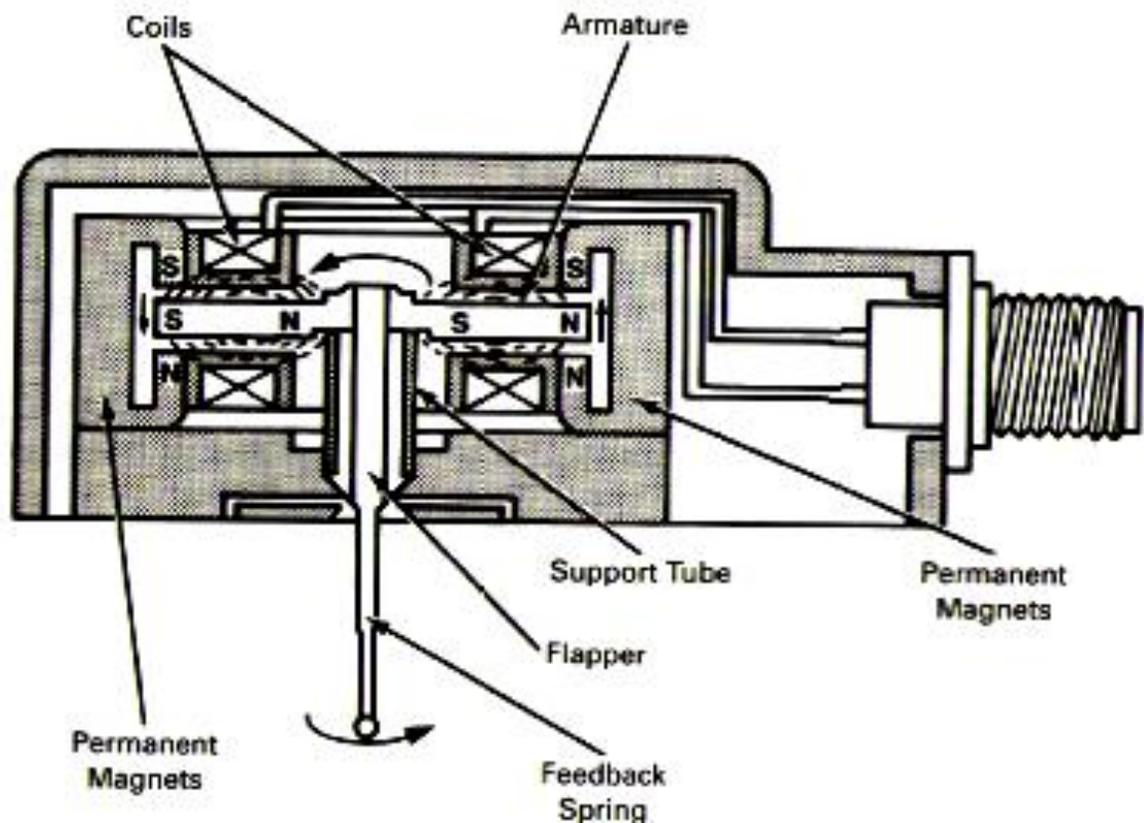
A comparison of proportional valves and servo valves is given in the Table . Proportional valves are less accurate, but they cost less. They are not used for closed loops control, there is no feedback of the output to change the setting of the valve.

Parameter	Proportional Hydraulic valve	Electro hydraulic servo valve
Valve lap	Overlap spool, causing a 'dead zone' On either side of the null position	Zero or underlap valve spool. No dead zone
Response time for valve spool to move fully over	40-60 ms	5-10 ms
Maximum operating frequency	Approx. 10 Hz	Approx. 100 Hz
Hysteresis	Without armature feedback approx. 5% With armature position feedback approx. 1%	Approx. 0.1%

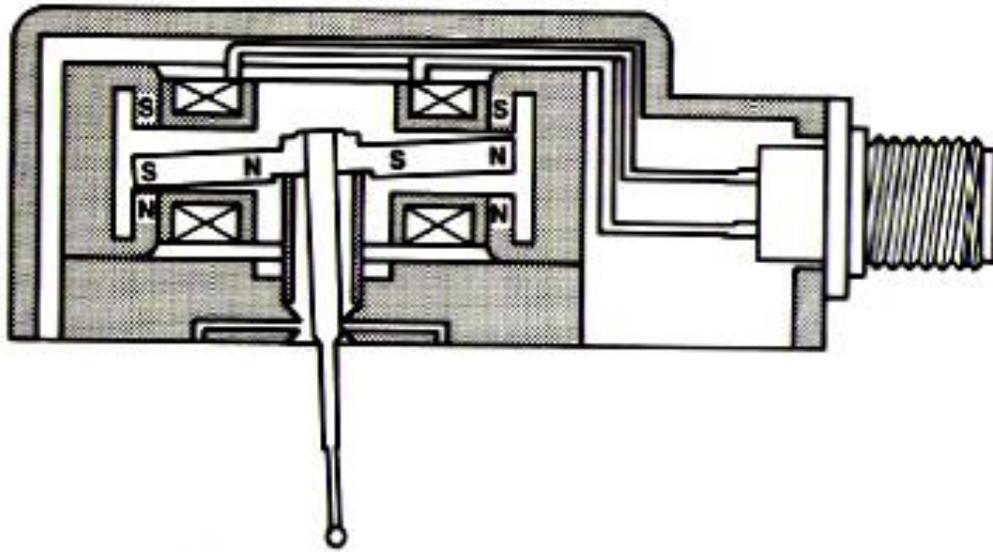
3. Explain the operation of torque motor

A torque motor is illustrated in Figure1 given below. Torque motor is a simple electromagnetic device consisting of one or two permanent magnets, two pole pieces, a ferromagnetic armature, and two coils. The permanent magnet polarize the upper and lower pole pieces, so that they

present equal and opposite magnetic fields. Torque motors are very low power devices operated on low-voltage DC power. The armature is mounted at its midpoint so that it is free to rotate through a very limited arc either clockwise or counterclockwise. The ends of the armature are extended into the gaps between the pole pieces. The magnetic field holds the armature in a neutral position. The two coils surround the arms of the armature to form two small electromagnets.

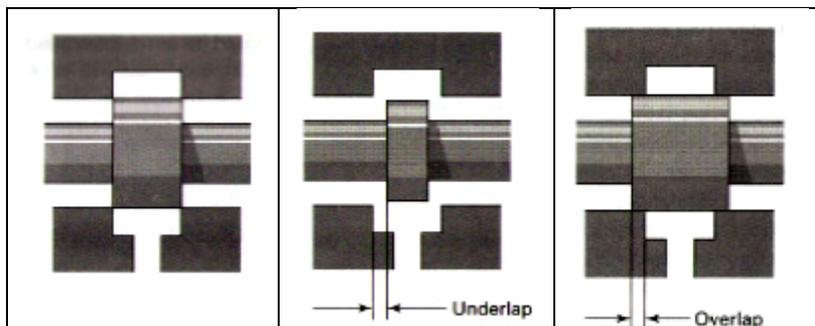


When a current is passed through the coils, a magnetic field is generated. The polarity of the field depends on the direction of the current flow. In Figure 2 the current flow has caused the left end to become the South Pole and right end to become the North Pole, resulting in counter clockwise rotation of the armature.



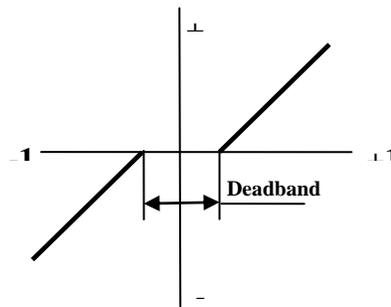
4. Define underlap, overlap, and line to line in the context of servo valve spools.

The most common condition is the line-to-line (or zero overlap) spool. Here, the bandwidth exactly matches the port width. Overlapped spool have lands that are 0.5 to 5% wider than the ports. An underlapped spool has lands that are 0.5 to 1.5% narrower than the ports. This design is often referred to as “open center” although there really are no open-center servo valves.



5. Define deadband

It is defined as the current required to move the spool from the exact centered position to the position where the first flow output is seen. It is usually expressed in milliamps or percent rated current. Deadband is the result of the spool inertia, overlap, static friction, and any other forces that might impede the initial motion.



6. Define threshold

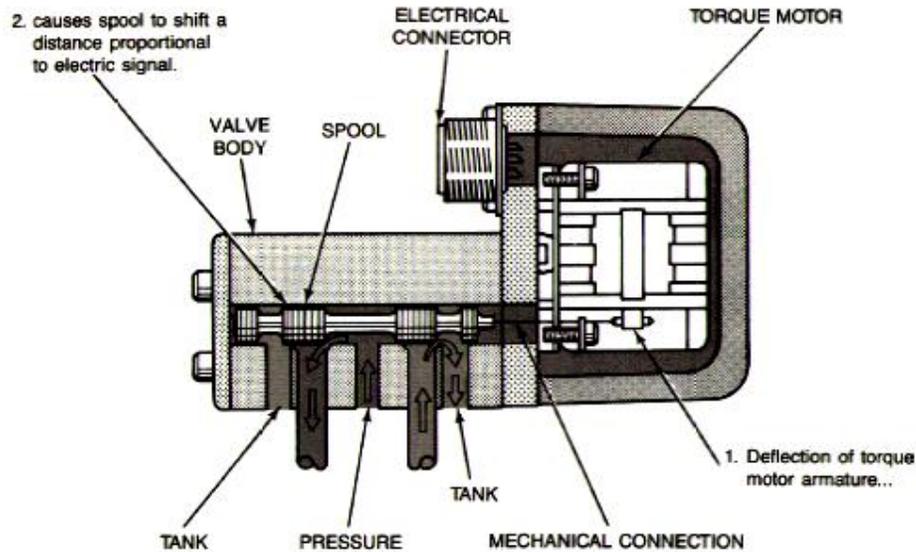
Threshold is the current that must be applied before a response is detected. Good quality two stage valves have a threshold less than 0.5% of the rated current.

7. Define hysteresis

In an ideal world, a unit of current input would produce a unit of valve output. This is not possible to achieve practically. Hysteresis is expressed as the percent difference in the rated current required to give the same output when approached from higher and lower inputs. For servo valves it is typically 1 to 2%. To overcome the problem of hysteresis, some controllers are designed so that the set point is always approached from the lower side. This requires a deliberate undershoot when approaching from the high side

8. List and define the types of hydraulic amplifiers

Figure below shows a single stage servo valve. The mechanical connection between the torque motor armature and the spool is a stiff wire. When there is no command input to the torque motor, the armature is in the neutral (nulled) position, which, in turn, causes the spool to be in the nulled position, and there is no flow through the valve. A clockwise deflection of the armature pushes the spool to the left, opening up flow path from P to B and A to T. a counterclockwise deflection opens P to A and B to T.



Single stage spool type servo

For higher flow rates, two-or even three-stage valve must be used. In this valves second and third stages are always sliding spools that are pilot operated from the previous stages. The first stage may use the sliding spool, but there are other designs, also.

9. Servo valves are usually rated at what pressure drop

Servo valves are generally considered to be high pressure devices. They are pressure rated at 3000 PSI. , although most are capable of operating at 5000 PSI or even higher.

10. Define gain.

Gain is defined as = output/input. Two gains are defined for servo valves. Flow gain and pressure gain.

11. Define Flow gain

It is defined as flow /input current. Flow gain is determined by measuring control flow versus input current. Flow gain in the null region may range from 50 % to 200 % of the expected gain based on the slope of the linear line.

12. Define pressure gain.

Pressure gain is defined as pressure/input current.