MOOG

TECHNOLOGY FOCUS

Helping design engineers work smarter everyday

THREE KEYS TO SPECIFYING LONG LIFE SERVO VALVES

Moog Mechanical Feedback Servo Valve

The servo valve plays a critical role in the performance of a hydraulic positioning, velocity or pressure control application. Moog Mechanical Feedback Servo Valves incorporate a feedback mechanism that precisely determines the position of the spool in the valve and stops it at a position that is proportional to the electrical input of the valve. This technological breakthrough revolutionized the industry and has made Moog synonymous with servo valves more than 60 years later.

With so many servo valves designs for such a wide range of industrial applications, it can be increasingly difficult to pinpoint the characteristics that contribute to high performance over a long life above one billion cycles. In fact, the design, manufacturing and construction methods of the servo valve can make a significant difference in the overall life expectancy.

INCREASING THE LONGEVITY OF SERVO VALVES

With rising operational costs and increasing pressure on design engineers to achieve greater results in machine performance, it is critical to evaluate each component's impact on the total lifecycle cost of the machine.

There are three keys to increasing longevity, minimizing unplanned downtime and ensuring reliable performance in servo valves. These include:

- use of carbide ball on the feedback mechanism
- use of ball-in-hole design in the spool
- use of brazing to bond the ball to the wire

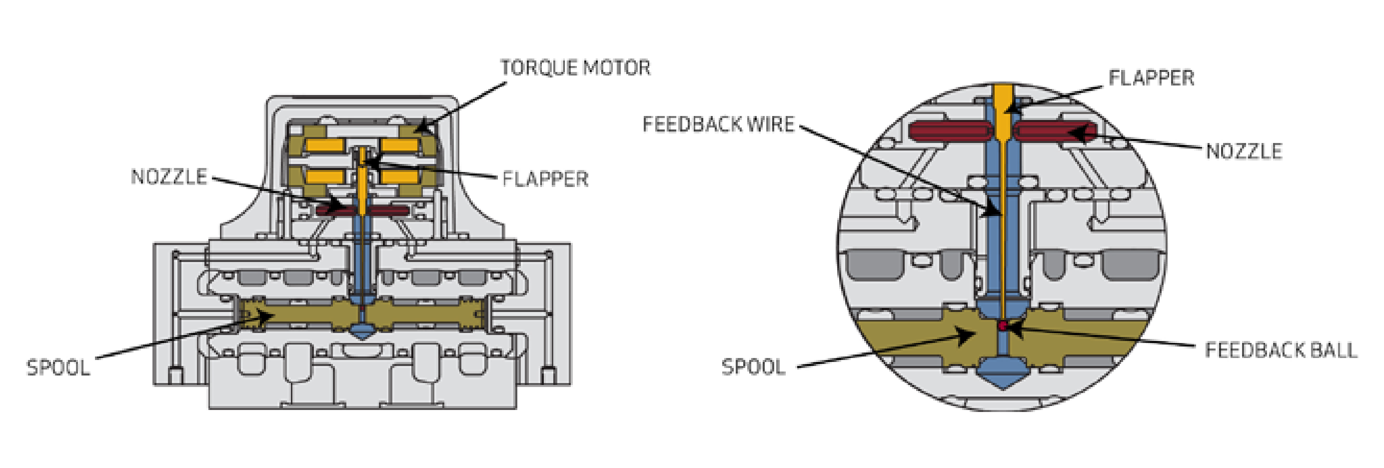
KEY 1: CARBIDE BALL CONSTRUCTION

Premature wear of the ball in the feedback mechanism is a common issue with stainless steel materials. Carbide and sapphire materials have been introduced to replace stainless steel and provide extended protection to the ball.

In fact, Moog R&D evaluated the wear characteristics of a steel, carbide and sapphire ball by subjecting each to one billion test cycles in a controlled environment with clean hydraulic fluids and steady temperatures. While the steel ball revealed significant wear, the results confirmed that carbide and sapphire ball did not show any signs of wear.

STEEL CARBIDE SAPPHIRE

After one billion test cycles, stainless steel ball exhibits visible wear. Carbide and sapphire do not. Moog uses the carbide ball due to its proven performance and long life. The carbide material also has the advantage of enabling the feedback mechanism wire to be bonded with a brazing process, providing even greater reliability in industrial environments.



Moog Mechanical Feedback Servo Valve (G761 Series) Cutaway with Ball-in-Hole Technology

KEY 2: BALL-IN-HOLE DESIGN

While "ball-in-slot" design was the industry standard for more than 40 years, Moog developed carbide "ball-in-hole" technology to maximize the longevity and reliability of Moog Servo Valves. This design breakthrough reduces concentrated contact of the ball with the spool at any one point on the surfaces—a process that radically improves the overall life expectancy of the servo valve by eliminating wear in the spool.

Moog engineers found that after one billion cycles in a controlled environment, ball-in-slot designs showed visible wear marks in the spool slot, while the ball-in-hole configuration exhibited no signs of wear.

In addition, further investigation concluded that "adhesive wear" (slow spool rotations between 1 and 4 RPM) cause the most significant damage to ball-in-slot designs, yet have minimal effect on the ball-in-hole configuration.

Today, more than 95% of all Moog Mechanical Feedback Servo Valves have been converted to ball-in-hole technology due to its superior performance and extended lifetime in industrial applications.

For more information, download our white paper on the designing of long life servo valves at **http://www.moogservovalves.com/WhitePaper** or visit www.moog.com/industrial

KEY 3: BRAZING IN THE MANUFACTURING PROCESS

Brazing is a specialized soldering process that joins the carbide ball and stainless steel wire at temperatures above 450 °C (842 °F). This manufacturing process is only possible with carbide—not sapphire—and is critical in enabling the ball to withstand both high temperatures and deterioration from chemicals in the hydraulic fluids.

Tests show that the epoxy used as to join the feedback mechanism ball and wire in sapphire ball-based mechanisms can break down even within normal operating temperatures between -17.7 °C (0 °F) to 71 °C (160 °F).

LOOK TO MOOG FOR SERVO VALVE LONGEVITY

The selection of carbide material as ball on the feedback mechanism, the incorporation of ball-in-hole spool design and the integration of brazing to bond the carbide ball to wire are essential for long life and reliability of servo valves.

All three innovations are the result of a dedicated research and development capability spearheaded by Moog engineers with years of experience and an unsurpassed reputation for developing motion control solutions for the world's most complex manufacturing challenges.

Moving forward, feedback mechanism design will continue to evolve as advanced microprocessing and digital control algorithms add new possibilities for functionality and longevity. Look to Moog experts to keep you on top of these developments.

Technology Focus: MFB Servo Valves
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