

Servo-mechanical Electrohydraulic Control for Compact Loaders

Background

Manual Control

Straight-forward manual hydraulic controls have long been used in construction machines. Using them requires a high degree of familiarity with the machine and its operating characteristics. The speed and quality of the work they can achieve depends much on the operator's skill and finesse. When using manual hydraulic controls, the operator benefits from direct feedback and can adjust his/her approach to the work in real time.

Hydraulically Piloted Control

The development of smaller machines like skid-steer loaders, backhoes, and compact excavators drove a greater need for design flexibility and hydraulically piloted control schemes became commonplace even in larger machines. With these types of controls, a lever or joystick and pilot valve in the cab operated the main control valve remotely by pilot pressure. Common complaints of the technology include poor accuracy and repeatability, high hysteresis (commonly 10-25%), inefficiency (due to pilot flow), and sluggishness in cold climates. These drawbacks can make the technology less than user friendly.

Electrohydraulic (EH) Control

As controls evolved, EH control was widely adopted because it solved some—not all—of the performance issues associated with hydraulically piloted control, and allowed more sophisticated control schemes. Moving the piloting element to the main control valve simplifies plumbing, reduces potential leak points, and increases both efficiency and responsiveness. EH control enables features like:

- Tuning/deadband compensation
- Control ramping
- Load compensation
- Electronic self-leveling
- Return-to-dig
- Electronic cylinder cushion
- Autonomous control

While EH control gave machine designers much more flexibility, operators still lamented the loss of feedback and responsiveness.

The Breakthrough: HydraForce Servo-mechanical EH Control

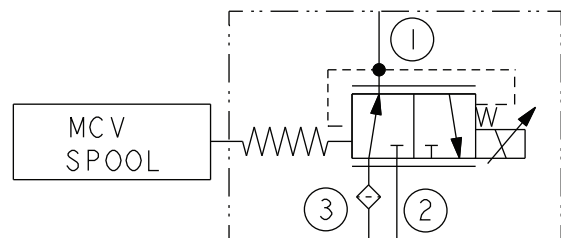
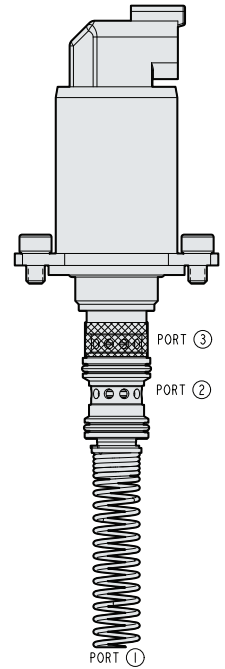
Building on the successes of EH control, HydraForce engineers set out to improve operator experience by tackling the responsiveness and repeatability issues still present in the technology. At the root of these complaints are two basic factors:

- The multistage control chain (operator input/electronic joystick/hydraulic pilot stage/main control spool).
- The lack of position feedback to close the control loop.

EH control does typically close the loop on control current in the pilot stage, but controlling for current still leaves the system open to variation.

Servo-mechanical Control

What is needed is a closed-loop control based on *position* feedback. HydraForce's new EHPV90-G33 ElectroHydraulic Pilot Valve enhances EH control with a unique mechanical feedback mechanism. Now the main control spool is mechanically connected to the pilot element just like the operator's hand is connected directly to the control lever with manual control. The feedback spring communicates the spool position to the pilot element virtually eliminating hysteresis and deadband.



For detailed information and specifications, visit www.hydraforce.com or contact your local HydraForce representative at www.hydraforce.com/distributors/world.htm

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Proven Technology Made Better

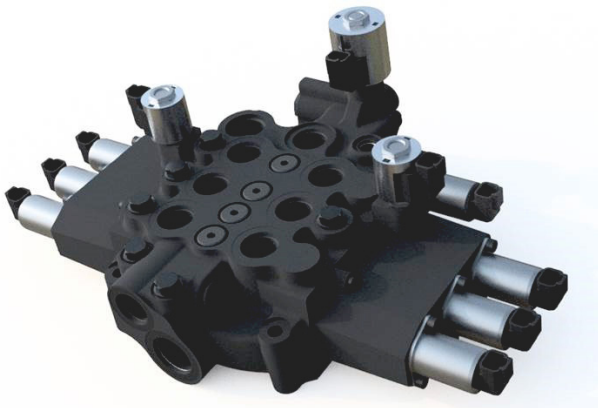
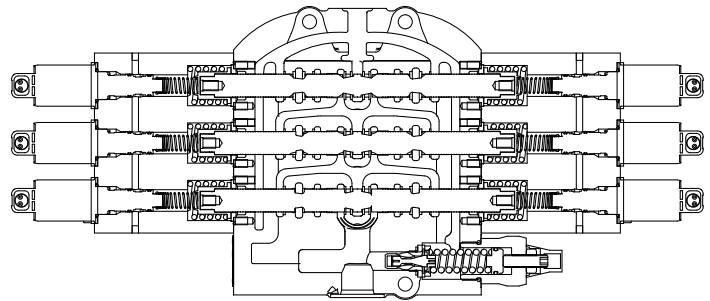
HydraForce EHPV is built on our proven EHP platform. HydraForce EHPV ElectroHydraulic Pressure Reducing valves provide highly accurate pressure control to pilot devices throughout the mobile equipment industry. EHPV adds mechanical feedback that communicates between the control and controlled device. The configuration achieves flow-force correction of the piloted spool and allows both ends to remain pressurized, stiffening the system and improving stroke response. EHPV performs favorably even compared to EH valves with LVDT position sensing, displaying hysteresis below 3% and response of 65 ms.



EHPV mechanical feedback couples the pilot and piloted elements to increase position accuracy and response.

A Full Main-Control Valve for Compact Loaders

Paired with a three-section monoblock from Roquet Hydraulics S. L. of Barcelona, Spain, HydraForce can now offer a complete main control solution for skid-steer and compact loaders including boom, bucket, and auxiliary functions. This complete main control includes a function interlock valve for safety, main pump and work port reliefs, boom float feature, and bolt-on PbS® boom suspension.



Keep the Load in the Bucket with PbS® Pressure-balanced Suspension

The main control valve can also be equipped with HydraForce's patented PbS pressure-balanced boom suspension. PbS offers a more responsive load-adaptive suspension for compact loaders. Using the patented HPB08-E40 externally piloted pressure reducing/relieving valve, the suspension is able to dynamically match accumulator pressure to the bucket load using pump flow as a source instead of robbing fluid from the cylinder.



HPB08-E40 pressure-balanced accumulator charge valve adapts to changing load providing seamless activation and preventing cylinder drift.

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