

## Achieving Smoother Operation in Dynamic Accumulator Charging Circuits

### Introduction

HydraForce offers valves that are well suited to the unique needs of Dynamic Accumulator Charging Circuits which are commonly used in conjunction with Load Sense Steering Units. These systems are common on various types of heavy machinery including wheel loaders, telehandlers, road graders and other machines requiring a hydraulic braking system. These circuits require a delicate balance between the priority flow steering and braking sections of the application, while simultaneously allowing excess flow to be diverted to tank or various auxiliary functions.

### Charging Circuit Operation

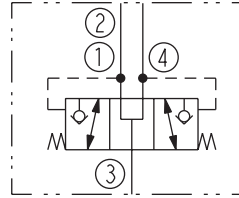
A typical circuit provides priority flow for the steering orbital while maintaining a predetermined range of pressure in the accumulator(s), to ensure adequate supply of oil for the brakes.

A load-sensing priority-type valve (EC16-42) works with the steering orbital to ensure the correct amount of flow and pressure based on steering speed (rpm). A pilot-unloading valve (UP10-40) senses the accumulator pressure to maintain a constant pressure range in the accumulators. When the accumulator pressure drops to the minimum pressure, the UP10-40 closes momentarily which blocks the load-sense line, forcing oil into the accumulators. Once the high pressure setting is reached, the UP valve opens to unload the load-sense signal back to tank (via the steering orbital). The EC valve senses downstream of the control orifice so the oil flow into the accumulator is compensated, resulting in a steady charge rate regardless of loads upstream or downstream.

These circuits typically incorporate the use of dual hydraulic brakes (left/right, forward/rear) for either a tighter turn radius, or just to stop the machine. For redundant safety requirements, many circuits require two accumulators. With roughly equal pressure in the two accumulators, the LS10-41 valve stays in the neutral or center position. If one of the accumulators loses oil rapidly (due to a hose failure), the LS10-41 shifts over to protect the good accumulator.

ANSI (American National Standards Institute) standards require that the accumulators must be able to hold enough burst pressure to allow the brake pedal to be depressed seven times prior to losing its charge. This ensures that the volume of oil in the accumulator is able to fill the brake piston a minimum of seven times with a single charge. This is necessary because the pressure in the accumulator (typically 1000-2500 psi) is constantly dropping which affects the unloading pilot valve. Typically the charge rate for an accumulator in this application will be one second at a flow rate of 3 to 4 gpm.

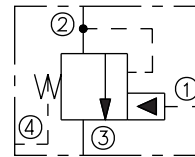
### LS10-41 Load Shuttle Valve [Go to LS10-41 prod. info.](#)



A screw-in, cartridge-style inverted shuttle valve, which can be used to help protect against brake or steering failure in the event of loss of pressure in either one of two accumulators.

If one accumulator fails, the LS10-41 will shift over to protect the good one. All ports are connected in neutral. When pressure at one of the two load ports exceeds the other, the poppets shuttle to give priority flow and pressure to the port with the highest load. Ensure that the charging rate is kept below 4 gpm. Note: Port 1 should be blocked.

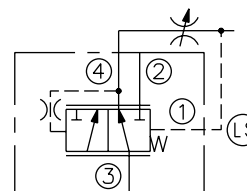
### UP10-40 Piloted Unloading Valve [Go to UP10-40 prod. info.](#)



A screw-in, cartridge-style, remote sequence, piloted unloading valve with optional fixed unload/reload pressure ratios of 60%, 70% or 80%, for use in accumulator-type hydraulic systems. In its

steady state, the UP10-40 blocks flow from ports 2 to 3. On attainment of a pre-determined pressure at port 1, the spool shifts to allow flow from 2 to 3. The spring chamber is vented to port 4. If pressure at port 1 drops to a level below the ratio established reload value, the valve will close, blocking flow from 2 to 3.

### ECxx-42 Priority-Type, Pressure Compensating Valve with Load Sense [Go to ECxx-42 prod. info.](#)



A screw-in, cartridge-style, priority-on-demand, pressure-compensating element intended to provide priority flow in required amount while allowing excess flow to be used for auxiliary functions.

The EC16-42 is a priority-type valve delivering pump flow at port 3. Port 4 will deliver required priority flow regardless of load pressure. Excess flow exits at port 2. Port 1 is the load sense port.

All ports may be fully pressurized. While the ECxx-42 is static, it can provide a dynamic signal to the steering unit.

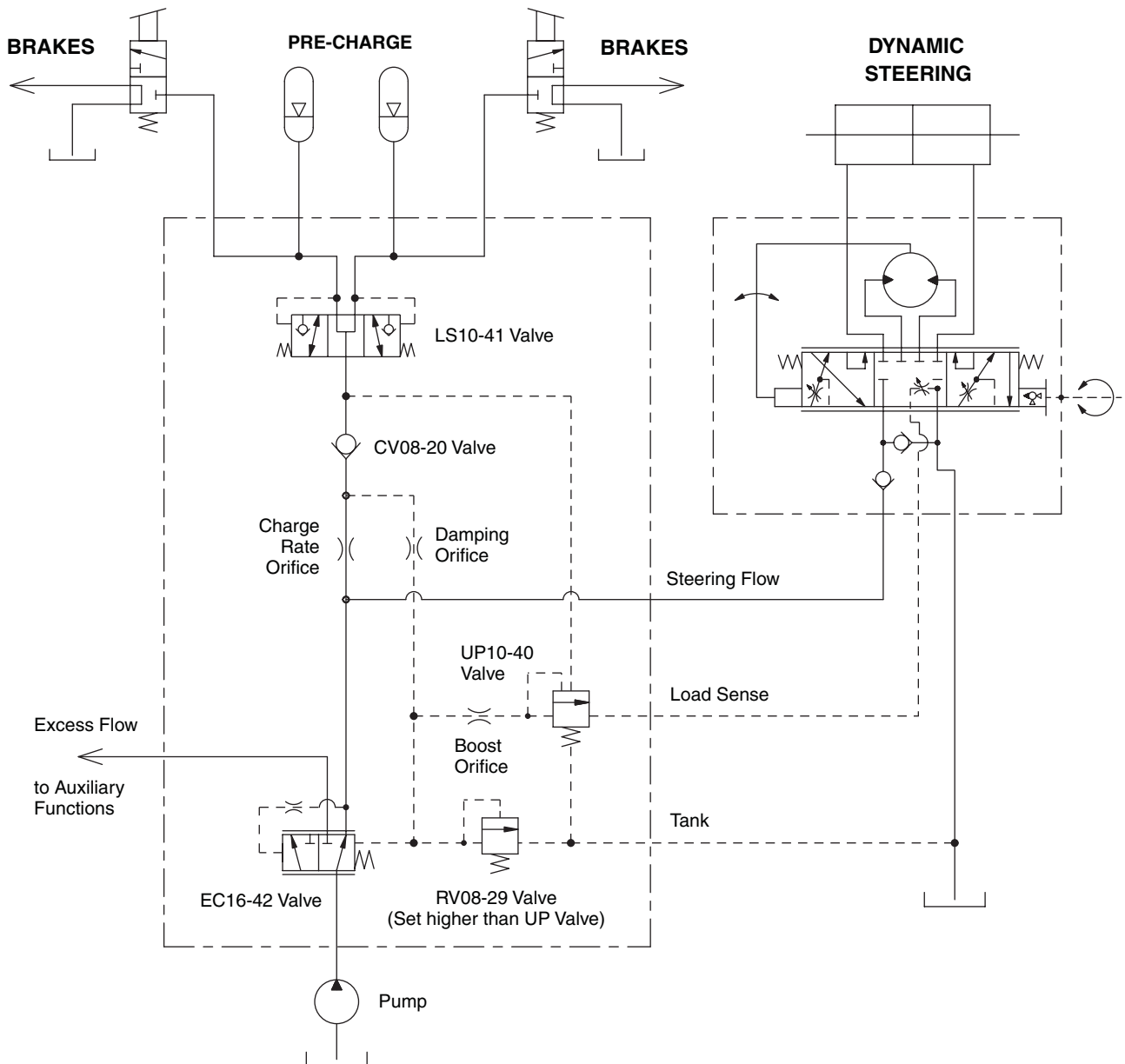
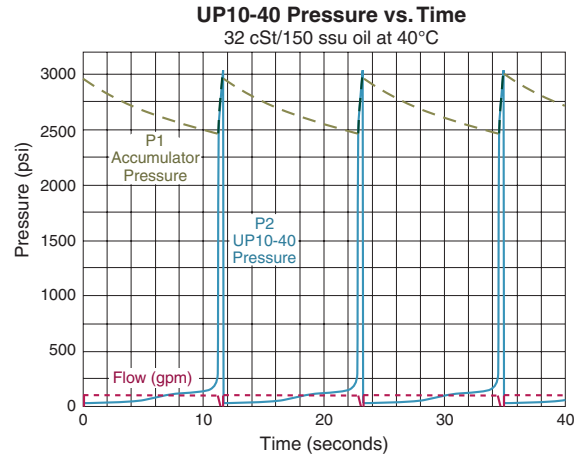
The benefit in these circuits is the ability to provide a pressure-compensated charge rate while sensing downstream. The advantage of sensing downstream from the load is that the charge rate is smoother than compensating upstream. At least a small charge is required in the accumulator at all times. When the system is in neutral the EC valve vents to tank via the steering unit.

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### Typical Dynamic Accumulator Charging Circuit

In a typical Dynamic Accumulator Charging Circuit, the EC16-42 valve provides pressure-compensated flow to the dynamic steering valve the majority of the time. The UP10-40 valve near the compensator allows the priority flow to the steering unit to allow continuous changes in steering. Occasionally the steering function and the accumulators need to work together, which is when the UP10-40 is vital. The load sense line of the circuit allows the primary steering section of the circuit to operate effectively. When steering bottoms out, the RV08-29 opens. This allows the EC16-42 to shift, diverting flow to auxiliary functions of the circuit.

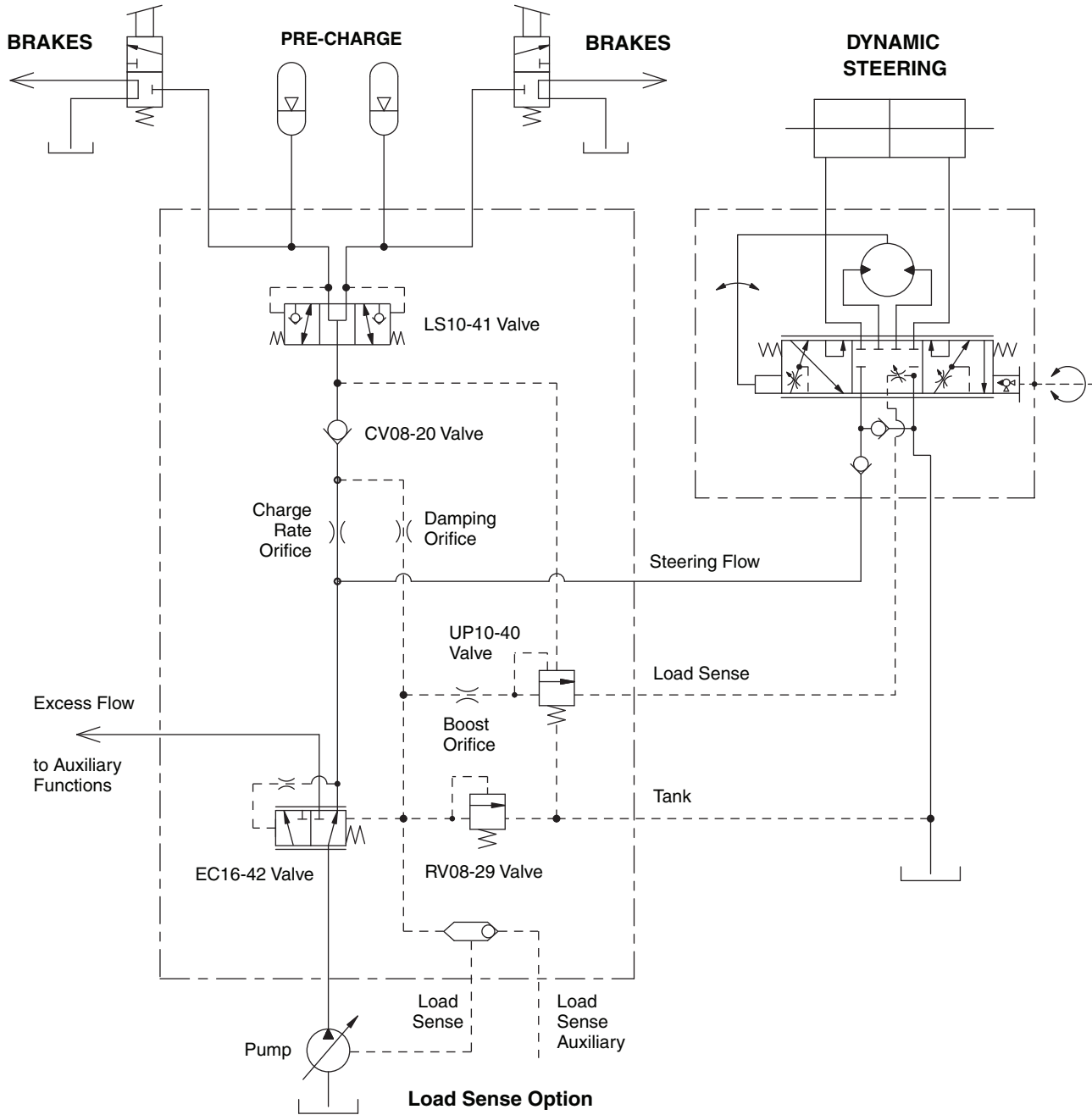
The graph to the right shows the relationship between the UP10-40 operation and both the pressure drop and fill time in the accumulator.



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### Alternate Dynamic Accumulator Charging Circuit

In this variation of a dynamic accumulator charging circuit, by adding the LS08-30 load shuttle valve, this circuit can be used with a variable displacement load sense pump..



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