**Load sensing with maximum pressure compensation.** Load sense controls are used to match pump flow and pressure to system demands, thus minimizing losses due to wasted horsepower. The pump automatically adjusts for changes in drive speed and load pressures to match the pump output flow to the load requirement. Since the pump load sense control will maintain a constant pressure drop across the main system throttling valve (directional control valve), the flow rate to the actuator will remain constant, independent of changes in load pressure and pump shaft speed.

The load sense control adjusts the amount of flow from the pump to maintain a given pressure differential through a throttling device independent of changes in pump drive speed and/or working pressure. This control changes the pump's displacement to match system flow and pressure which saves fuel and reduces heat generation. When system pressure reaches the set limit, the pressure compensator automatically destrokes the pump in order to avoid overpressurizing the line between the pump and throttle or opening pressure relief valves with consequently high losses.

**Load sensing:**

A similar control, which is becoming commonplace, is the *load sensing* control, sometimes called a power matching control, Figure 5. The single-stage valve is almost identical to the single-stage compensator control illustrated in Figure 2, but the spring chamber in load sensing is connected downstream of a variable orifice rather than directly to tank. The load-sensing compensator spool achieves equilibrium when the pressure drop across the variable orifice matches the 300-psi spring setting.

Any of three basic load-sensing signals control a load-sensing pump: *unloaded*, *working*, and *relieving*. In the unloaded mode, the lack of load pressure causes the pump to produce zero flow at bias (unload) pressure. When working, load pressure causes the pump to generate flow in relation to a set pressure drop, or bias pressure. When the system reaches maximum pressure, the pump maintains this pressure by adjusting its discharge flow.

Like the pressure-compensated pump, a load-sensing pump has a pressure-compensation control, but the control is modified to receive two pressure signals, not just one. As with pressure compensation, the load-sensing control receives a signal representing discharge pressure, but it also receives a second signal representing load pressure. This signal originates from a second orifice downstream from the first. This second orifice may be a flow-control valve immediately beyond the pump outlet, the spool opening of a directional control valve, or it may be a restriction in a fluid conductor.

Comparing these two pressure signals in the modified compensator section allows the pump to sense both load *and* flow. This reduces power losses even further, Figure 6. Output flow from the pump varies in relation to the differential pressure of the two orifices. Just as the pressure-compensated pump increased its discharge pressure by the amount required to run the pressure compensator, the load-and flow-sensing pump's discharge pressure typically is between 200 and 250 psi higher than actual load pressure.

Furthermore, a load-sensing pump can follow the load and flow requirements of a single circuit function or multiple simultaneous functions, relating power to maximum load pressure. This consumes the lowest possible power and generates the least heat.

**Operator control:**

If the variable orifice is a manually operated flow-control valve, the system can operate in a loadmatched mode at the direction of an operator. When the the flowcontrol valve opens, flow increases proportionally at a pressure slightly above load pressure.

Because the control senses pressure drop, and not absolute pressure, a relief valve or other means of limiting pressure must be provided. This problem is solved by using a load-sensing/pressurelimiting control. This control functions as the load-sensing control previously described, until load pressure reaches the pressure limiter setting. At that point, the limiter portion of the compensator over-ridesthe load-sensing control to destroke the pump. Again, the prime mover must have corner power capability.

*This information was excerpted from the* 2004-2005 Fluid Power Handbook & Directory.