Drill Rigs

Application Notes

Fluid Power in Motion

Solutions for Drill Rigs.

Eaton has the products and capabilities to provide complete system solutions for your application needs. World class hydraulic components, electronic controllers and software are just part of the value Eaton brings to make your applications deliver the power, in fluid power. Tough applications require the experience and knowledge that Eaton can provide and this application information will help you get started. Contact your Eaton representative for further information or visit us on-line at www.hydraulics.eaton.com.

Drill Rig Applications

Drilling platforms rely on hydraulics to provide the power to turn and push their drill heads through a variety of tough materials and often, in very tough environmental conditions. From deep sea to backwoods, drill rigs provide the punch to get the tough jobs done.

When designing systems for these machines, it is important to recognize and plan for a potential issue associated with this type of application.

Potential Issue:

The transmission pump that drives the drill motor may be damaged by excessive case flow during specific portions of the machine's duty cycle where energy may be stored up from torsional twist of the drill shaft.

Affected Machine Cycles:

- When the drill pipes snap loose while unscrewing them.
- When the drill suddenly gets loose in the course of drilling in hard ground conditions.
- When a stalled drill is reversed rapidly.

Detailed Hydraulic Impact:

During normal operation, the drill pipe will experience a twisting or "wrap", acting like a large torsional spring. The energy stored in the multiple pipe length can suddenly release (as described above) and drive the motor as a pump producing an instant flow surge. The motor's intake pressure drops instantaneously. With pressure going below the minimum charge requirement, the motor's shuttle valve shifts immediately getting rid of all remaining charge pressure. The pump is then left with virtually no charge pressure and de-strokes toward a zero flow condition.

If the pump's cylinder block is in a position where 5 pistons out of 9 are in line with the pressurized kidney, the flow surge coming from the motor would hit the pump causing its cylinder block to lift and flood the housing. With drain capacity not sufficient to handle the flow surge, the internal pressure may increase enough to crack the pump housing.

Suggestions:

- To ensure that possible issues are understood and controlled, high-speed transducers can be installed on the motor at prototype start up to monitor the rapid changes of pressure in the most severe conditions stated above.
- Recorded pressure rises below 80,000 psi/sec should not be an issue.
- For pressure rises between 80,000 and 100,000 psi/sec, different attempts can be made to limit the impact on the pump as follow:

1. Hoses can be used instead of steel tubing between the motor and the pump to provide more "compliance".
2. Velocity fuses with bypass flow controls can be installed close to the motor (see schematic). The flow fuse should be a fast responding type and set to the maximum flow that the loop will encounter. The bypass flow control should be set to maintain a minimal flow to the pump (after an eventual surge cut-off by the velocity fuse, it might have to be reset by reversing the motor slowly before reverting to drilling)
3. Fast acting cross relief logic valve arrangements can be used with a distant pilot stage to add capacitance and dampen response (see schematic).

- For pressure rises above 100,000 psi/sec, consult your Eaton representative.

Hydraulic Functions

Functions typically driven and operated by the hydraulic system:

- Drilling Head
- Main Feed Cylinder
- Mast Slides
- Mast Lift
- Hydraulic Hammer
- Hoist
- Auxiliary Functions
- Cooling Fan Drive

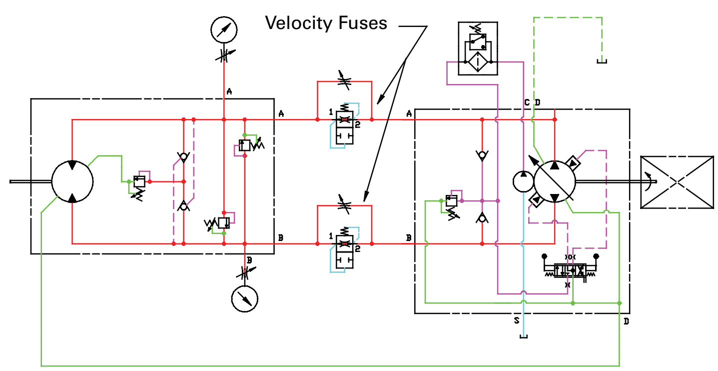
Product families typically used for hydraulic systems

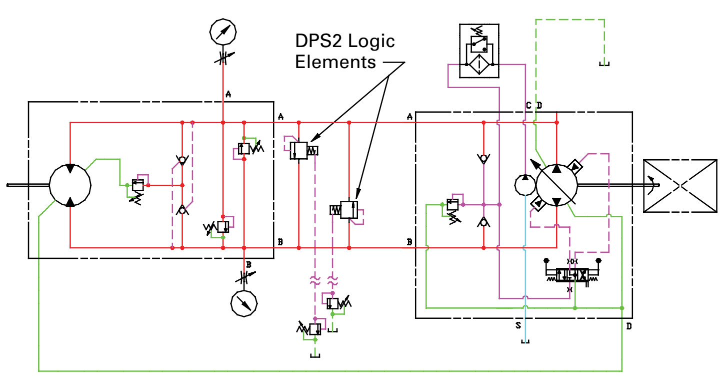
- Axial Hydrostatic Variable Piston Pump and Motor
- Tandem Axial Open Circuit Piston Pumps
- Load Sensing Proportional Directional Valve (Hydraulic or Electronic Piloted)
- SICV Manifold Blocks
- Multiple Sections Solenoid Valve Bank
- Multiple Sections Manual Valve Bank
- Hydraulic or Electronic Remote Controls
- LSHT Motors
- High Performance Filters and Breather
- Gear Pump
- Multiple Hose Products
- Filtration Products

Basic formulae for sizing*

Pump Output Flow	(GPM) = RPM x Displ (cid) x Vol Eff / 231
	(LPM) = RPM x Displ (cc) x Vol Eff / 1000
Pump Input Power	(HP) = GPM x PSI /(Tot Eff x 1714)
	(KW) = LPM x Bar / (Tot Eff x 598)
Hydraulic Motor Speed	RPM = GPM x Vol Eff / (Disp (cid) x 231)
	RPM = LPM x Vol Eff / (Disp (cc) x 1000)
Hydraulic Motor Torque	(inlb) = PSI (delta) x Disp (cid) x Mech Eff / 6.283
	(N-m) = Bar (delta) x Disp (cc) x Mech Eff / 62.83
Cylinder Force	(lbs) = Area (square inches) x PSI
	(N) = Area (square mm) x Bar x 10
Cylinder Speed	(in/min) = GPM x 231 / Area (square inches)
	(mm/min) = LPM x 1000 / Area (square mm)

Typical Circuits





*** The following calculations may also need to be considered with regards to sizing:**

- Basic formulae are general in nature and do not take into account efficiency losses for individual components.
- System Hp calculations under all operating conditions
- Power range calculation
- Mechanical and volumetric efficiencies
- Product life
- Cooling capacity
- System pressure drop calculations
- Line flow velocity calculations

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