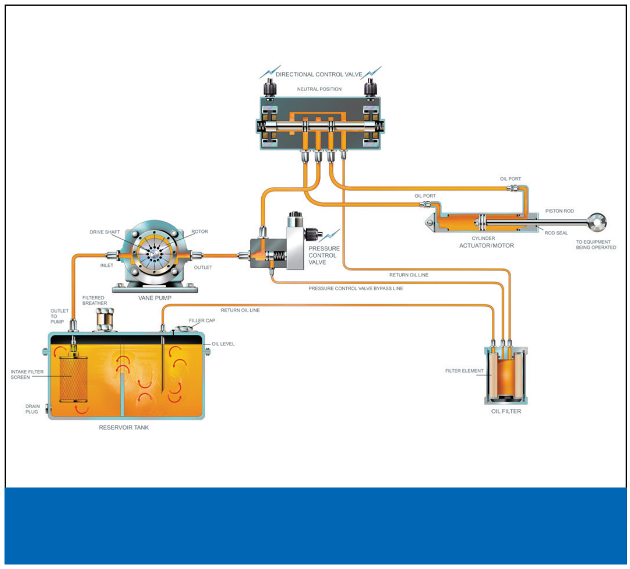
Technical Topic

Hydraulic System Care & Maintenance

Background

Hydraulic machines power the moving parts of many kinds industrial machines by applying the force of a fluid under pressure. Some systems are very small, simple and straight-forward to very large, high pressure systems with a complex array of servo valves and pumps. No matter the size or complexity, proper maintenance of BOTH the system and the hydraulic oil is crucial in maximizing uptime and reducing repair costs.



Hydraulic Fluid Care

Hydraulic fluids are the life blood of the hydraulic system. The hydraulic fluid transmits pressure and energy, seals close-clearance parts against leakage, minimizes wear and friction, removes heat, flushes away dirt and wear particles, and protects surfaces against rusting. Conventional petroleum (mineral) oils are normally used in hydraulic systems, but fire-resistant, synthetic, and biodegradable fluids are used in other situations.

There are four key objectives that are essential to gaining optimum service life of hydraulic fluids:

Control the Temperature — Heat develops in the fluid as it is forced through the pumps, motor tubing, and relief valves. In conventional systems, excessive temperatures will oxidize the oil and can lead to varnish and sludge deposits in the system. Conversely, running the temperature too low will allow condensation in the reservoir and increase the likelihood of pump cavitation.

Typical industrial hydraulic system temperatures often range between 110 to 150ºF. Mobil hydraulic system temperatures can operate up to 250ºF. Selection of the proper grade of hydraulic oil is critical to ensure cold start, high temperature protection and to obtain the optimum system efficiency. Keep systems which operate on a water based fluid below 140ºF to prevent the water from evaporating.

The deposits caused by oil degradation can plug valves and suction screens and cause high-tolerance servo valves to seize and/or operate sluggishly. To allow heat to radiate from the system, keep the outside of the reservoir clean and the surrounding area clear of obstructions. Make sure the oil cooler is functioning properly and keep air-cooled radiators free of dirt. Normal temperature drop for most oil coolers is 5 to 10ºF. Reservoirs should be filled to the proper level to allow enough fluid residence time for the heat to dissipate and to shed water and dirt.

In modern equipment using servo valves, oil degradation can be even more damaging. High pressure (up to 4000 psi), high temperatures, and small reservoirs stress the fluid. With minimal residence time and high pressures, entrained air bubbles can cause extreme localized heating of the hydraulic fluid. This results in nitrogen fixation that, when combined with oil oxidation, can form deposits which will plug oil filters and cause servo valves to stick.

Keep Systems Clean — Even new systems may be contaminated and should be cleaned before use. Prevent contaminants such as dirt, water, cutting fluids, and metal particles from entering the system around the reservoir cover, openings for suction and drain lines, through breather fill openings, past piston rod packing, and through leaks in pump suction lines.

Keep the Fluid Clean — Keeping hydraulic fluids clean begins with good storage and handling practices. To prevent contamination before use, store new fluid in a protected area and dispense it in clean, DEDICATED containers. Clean the fill cap before removing it to add hydraulic fluid. On critical NC systems, use quick disconnect hoses and filter all oil added to the reservoir through a 5 micron filter.

Full-flow filters designed into the system keep the fluid clean while in service. These filters are often forgotten and go into bypass mode, thus allowing dirty oil to circulate. Inspect fluid filters frequently and change or clean them before they go into bypass mode. Portable filters will supplement permanently installed filters and should be constantly rotated from system to system **regardless if you think the system requires filtering or not**. Systems should be filtered long enough to pass the total volume of oil through the filter at least 10 times. Portable filters should be used when transferring new oil from drums or storage tank to a system — especially for NC machines.

Keep an Oil Analysis Program — OEM's generally specify that system hydraulic oil be drained annually. However, with an effective oil analysis program, you can safely increase that interval while at the same time provide yourself with an "early warning" of possible mechanical problems.

At minimum, check your critical and large volume hydraulic systems at least annually by oil analysis. Semi-annual or even quarterly sampling intervals may be required for extremely critical machines. Consult your ExxonMobil lubrication engineer and machine OEM for the best sampling interval and the parameters you should be testing. Also, please refer to our Technical Information Sheet titled "Oil Analysis — The Basics" for a more in-depth discussion on this topic.

Hydraulic System Care

Hydraulic system maintenance is just as important, and directly related to, hydraulic oil maintenance. All the filtering and analysis done on a hydraulic oil would be meaningless and futile if the system itself is in a shambles.

A 10 Point Check — A lubrication technician or operator responsible for hydraulic system maintenance should, at minimum, perform the following 10 point checklist as part of a routine weekly "quick scan" of a hydraulic system:

1. Check fluid levels. Add oil (if needed) via portable filtration (if available). DO NOT MIX OILS! Use the same oil brand and viscosity grade that is being used in the system.
2. Inspect breather caps, breather filters and fill screens — DO NOT punch holes in screens in order to expedite adding oil.
3. Check filter indicators and/or pressure differential gages.
4. Visually inspect all system hoses, pipes, pipe connections for leaks and frays. Hydraulic fluid leakage is a common problem for industrial systems. Excessive leakage is an environmental and safety hazard, increases waste streams and oil consumption, and, if ignored, can reduce the system capacity enough to overheat the system.
5. Check system temperature via built-in thermometers or hand-held infrared detectors. Normal temperature range for most systems is 110-140ºF. If temperatures are high, check cooler operation and relief valve settings.
6. Visually inspect the inside of the reservoir for signs of aeration (via the fill hole using a flashlight). Aeration is a condition in which discrete bubbles of air are carried along in the stream of oil as it enters the pump. Visual signs of aeration in the reservoir are generally foaming and/or little whirlpools taking small gulps of air into the suction strainer. Causes of aeration include: low fluid levels; air leaks in the suction line; low fluid temperature; fluid is too viscous to release air or maintain suction at the pump; or faulty shaft seals. When air leaks are suspected on the suction line, smothering these points with oil will usually pinpoint the leaks by creating a marked change in pump noise. A pump ingesting air sounds as if it were gargling marbles.
7. Listen to the pump for the signs of cavitation. Cavitation is slightly more complicated than aeration, but bares some similarities. Cavitation occurs when air is released from the hydraulic oil during momentary depressurization at the pump suction and then imploded onto metal surfaces upon discharge. These implosions are extremely destructive to pump surfaces. A cavitating pump will emit a high-pitched whine or scream. Causes of cavitation are the same as those of aeration with the exception of suction side air leaks. How do you discern aeration from cavitation? One way is to install a vacuum gage on the suction side and make sure the pressure is equal too or greater than that prescribed by the pump manufacturer. Foaming in the reservoir is usually the telltale sign of aeration.
8. Inspect a small sample of fluid for color, signs of contamination and odor. Keep in mind that visual inspection is limited in that it will only detect signs of excess contamination.
9. Scan electrically controlled servo valves with an infrared thermometer. High valve and solenoid temperatures (over 150ºF) usually indicate the valve is sticking.
10. Scan the electric drive motor with for housing hot spots and rotor bearing temperatures using an infrared thermometer.

Fluid Change-Out Recommendations — These are the proper steps to follow when changing the hydraulic fluid in a system.

1. **Drain the system while the fluid is hot to keep contaminants in suspension.
2. Empty fluid from cylinders, accumulators and lines that might not drain properly.
3. Mop, siphon, or pump out oil left in the reservoir.
4. Wipe reservoir clean with lint free rags and remove rust and free paint.
5. Replace or clean filter elements and strainers and clean filter housings.
6. Refill the system with new fluid making sure to vent high points.
7. Restart and check system for proper operation.

***For systems that exhibit high deposit, sludge and/or varnish formation: a petroleum based cleaner (such as Mobil System Cleaner) may be required. Follow manufacturers recommendations.*

Safety Precautions

Hydraulic systems operate under very high pressures. Shut the system down and relieve system pressure before opening any part of the system that is under pressure. Do not allow spray from any high pressure leak to contact any part of the body, as serious injection injuries may result. Pumps, valves and motor may become hot; be cautious of incidental contact between bare skin and hot surfaces. Keep hands and clothing away from moving parts of the system.

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