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SERVICE BULLETIN

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BULLETIN NO .: E0087
SECTION: Hydraulics (12)
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SUBJECT: TROUBLESHOOTING HYDRAULIC SYSTEMS

Industry demands that mobile heavylift equipment be highly maneuverable with low operating costs, have availability and productivity, and be capable of operating in all weather conditions. The two points of AVAILABILITY and PRODUCTIVITY depend largely on a preventative maintenance program that is established by the end-user. We realize that hydraulics are only a small segment surrounding total vehicle maintenance. However, it does play a significant part and will cause serious breakdowns when a malfunction appears. Teamwork and ingenuity are necessary components in any hydraulic system, so we will examine some helpful tips on troubleshooting hydraulic systems.

Preventive maintenance can mean POST MORTEM or PERFORMING MACHINES. Two highly underrated benefactors in any successful maintenance program are the vehicle operator and lube men or oiler. Careful operators and conscientious lube men play a distinct role in keeping any piece of equipment performing with high productivity and availability.

Proper hydraulic maintenance can only result from a basic knowledge of the system design, system operation and the components used to build the system. Most manufacturers and suppliers produce service instructions and troubleshooting charts. Take time to become familiar with each manufacturer's and supplier's recommendations.

First analyze the problem. Study the symptoms, use common sense and organize a test procedure. Most manufacturers design test ports in key locations to shortcut troubleshooting. Learn where they are and how to use them.

A good way to forestall hydraulic problems is by constant visual inspections of your equipment. Watch for any signs of leakage. Check your reservoir regularly, not only the fluid level, but actually examine the fluid. If the oil has a milky appearance, it is probably saturated with air or water. In either instance, your system is in for trouble. Cut open your hydraulic filters and check them for metal cuttings or any foreign material. Many times serious downtime can be forestalled by simply reading your filters like a newspaper. Also, a hydraulic system has to breathe, so be sure your breathers are clean and free of contaminates.

Check for kinked, damaged or flattened hoses and tubes. These conditions will restrict flow and can ruin a pump or create unwanted heat. A jerky or erratic cylinder means something is wrong, such as a bent stem, swollen or dented cylinder barrel, loose piston nut or insufficient oil in the hydraulic reservoir.

Heat is highly detrimental to any hydraulic system. When the maximum temperature of a hydraulic system exceeds 150° F, several malfunctions can occur. The most basic is the system will only operate about 60% of its design capabilities or not at all. Oxidation is accelerated, and tests have shown that below 135° F oil oxidizes very slowly. The rate of oxidation approximately doubles for every 18°F increase in temperature. It is estimated that the working life of most oil is decreased by 50% for every 15°F rise in temperature above 140°F. A good maintenance man will feel fluid conductors and key components of the system to make sure there are no hot spots. Hot spots are highly damaging to a hydraulic system. Breakdown of oil due to overheating is serious, and is generally easy to detect. It looks dark and smells burned. The most common cause of heat is a low oil supply in the reservoir.

Hearing is also a valuable tool that can be used by a good troubleshooter. High frequency vibrations are extremely damaging to any hydraulic system. Numerous things cause vibrations such as faulty reliefs, faulty valves, loose hose and tube clamping devices. Many engines will create extreme vibrations at certain RPM's. Simply changing the idle RPM will many times eliminate cracks in tubing flares, keep nuts from coming loose and in many cases, stop O-ring leaks. Undue vibrations have been known to break weldments and other components and should be corrected.

A "shot-like sound" you hear when a water tap is closed quickly is called "water hammer". This is caused by the sudden stoppage of moving liquid. The hydraulic surge created by this condition increases with the speed at which the liquid is moving. A pressure surge can go as high as four times the normal working pressure. This can cause extreme physical damage top fluid conductors and other components in a system. A shock wave travels at the speed of sound in hydraulic fluid, and normal hydraulic gauges are not capable of recording these shock waves or pressure surges.

Other sources of vibrations and shock are improper equipment use, damaged relief valves, or any other component which no longer has its design characteristics. If a valve is late in opening for any reason, excessive pressures are generated in the system within a fraction of a second. Band-aid installations using undersize hose, elbows, or fittings downstream from a relief valve, can restrict flow and change relief valve performance.

Cavitation also causes vibrations in the system that will put a pump into a state of hydraulic shock. If there is no back pressure a pump will sound as if you were pumping marbles and you can hear them rattling. When back pressure is present the pump emits a shrill whine that will have you wearing ear plugs.

Cavitation is related to vapor pressure and oil density. In the classical theory of cavitation, during the collapse of the vapor bubbles, the liquid flows radially inward until motion is stopped and rebound occurs. Estimated pressures at rebound can reach as high as 78,000 psi. The local temperature can reach several thousand °F. Aeration and cavitation act very much alike in hydraulic systems. Cavitation is harmful to pumps in two ways: It interferes with lubrication and destroys metal surfaces.

Basic causes of cavitation are: low reservoir levels, air in the oil, restricted or plugged suction lines and filters, cold oil, leaks at the suction side of pump and foaming oil, to name a few.

Contamination is introduced in a system by: carelessness, low oil level, high pressures, cheap oil, water in the oil, heat-damaged breathers and poor maintenance intervals. Checking for proper oil level, cleanliness and proper maintenance will avoid major problems.

A common attitude toward minor leaks is to ignore them for the time being, rather than repair them. A small leak can result in far more extensive damage and expense than simply replacing the lost oil. Leaks enhance a greater potential for contaminating from constant adding of oil, and any leak in a pump suction line or a bad pump seal can also be the entry point for air and solid particle contaminates. Contamination is the most common single cause of pump failures. 85% of premature pump replacements is due to contamination. Excessive contamination in a hydraulic system results in accelerated wear in all areas of high frictional contact.

Cold weather operation is essential in many areas. Use the proper cold weather oil, such as; Aero HFA, Univis J-43, ON 600, Mobile DTE-11, or an equivalent. Cold oil becomes thick, or worse, won't pour at all. The pour point should be at least 20°F below minimum start-up temperature. Proper seizure, with possible internal scoring or shaft breakage, can occur quickly with cold oil.

Gear pumps can withstand a certain amount of cavitation on startup, however, jogging the pump will minimize cavitation tendencies in severe cold. There will be no cavitation damage as long as the pump is not pressurized and there is enough oil for lubrication. It is a good idea to cycle all the various functions to circulate the oil throughout the system and it will not destroy the seals through mechanical shocks. Do not force oil over the relief valve if you hear or suspect that the pump is cavitating. It is a bad practice to add kerosene or diesel fuel to hydraulic oils. It can change the aniline point of the oil and may soften or swell the seals. Reservoir heaters, proper warm-up procedure, and the right oil keeps your units performing in any weather.

A major catastrophe to be avoided by the alert serviceman is the failure of a newly installed pump immediately after installation. The most common causes are: bottomed reliefs, or failure to reopen a shutoff valve. Don't be caught with a half-shafted or three minute pump. Unscrew your main relief before starting your unit, and if you have shutoff valves, hang the ignition keys on the shutoff valve when you shut the valve off. Clean your system thoroughly, change your filters requlary and don't let them become so contaminated they go over bypass and eliminate filtration period.

Excessive noise, temperature, shock and vibrations, together with oil leaks, are danger symptoms. Heed your warning signals; the key to troubleshooting any hydraulic system is familiarity. Take time to acquaint yourself with the systems functions, and by getting into the middle of things, you won't have a machine graveyard. Instead, you will have highly productive equipment performing with a high availability.

The following information is “general” and will apply to all hydraulic systems:

PROBLEM	REMEDY
1. Air in system	Cycle system to purge
2. Insufficient Oil supply	Fill to required level
3. Pump bearings worn out	Replace
4. Pump and/or coupling worn out	Replace
5. Pump squealing can be caused by Items (1) or (2) as stated above.	
6. Chattering relief valves control valves, etc.	May be caused by broken springs

MOMENTARY DROP OF LOAD WHEN VALVE PLUNGER IS ACTUATED:

PROBLEM	REMEDY
1. Scored or worn check valve	Replace plunger or seat
2. Check valve plunger held off its seat	Clean system. Check for foreign matter.
3. Broken check valve spring	Replace
4. Overcenter valve bypassing	Replace

PUMP TAKES TOO LONG TO RESPOND OR FAILS TO RESPOND:

PROBLEM	REMEDY
1. Low oil supply	Fill to required level
2. Insufficient relief valve pressure	Reset to correct pressure setting
3. Pump worn or damaged	Inspect, repair or replace

LOSS OF MOTION OR NO MOTION IN SYSTEM:

PROBLEM	REMEDY
1. Low oil level due to leakage	Examine hydraulic lines, etc., for leaks and correct
2. Oil viscosity too heavy	Use oil recommended
3. Air leak in pump inlet passage	Inspect pump line mountings for leakage and correct
4. Broken pump driveshaft, PTO shaft or adapter.	Replace or repair
5. Pressure relief valve plunger leaking or defective.	Check for foreign matter on valve seat or broken plunger
6. Pump not rotating	Check for broken pump driveshaft, PTO shaft or adapter. Replace
7. Pump worn out	Replace
8. Control lever linkage broken	Replace
9. Broken hydraulic lines	Replace
10. Broken relief valve spring	Replace

LOAD SLOWLY DROPS:

PROBLEM	REMEDY
1. Oil leaking by valve plunger	Repair
2. Oil bypassing from holding side to opposite side of piston.	Repair
3. Oil leaks at fittings or in cylinder connecting lines	Check hydraulic systems
4. Overcenter valve bypassing	Replace

OIL HEATING UP:

PROBLEM	REMEDY
1. Foreign matter lodged between the relief valve plunger and relief valve seat.	Inspect and remove foreign matter
2. Using light oil in a hot climate	Drain and refill with proper oil
3. Dirty oil	Drain, flush and refill
4. Oil level too low	Fill to required level
5. Insufficient relief valve pressure	Reset to correct pressure setting
6. Relief pressure too high	Reset to correct pressure setting
7. Pump worn (slippage)	Replace or repair

OIL FOAMING:

PROBLEM	REMEDY
1. Air leaking into suction line from tank to pump.	Tighten all connections
2. Incorrect oil	Drain and refill with proper oil
3. Oil too low	Fill to required level

PUMP LEAKAGE:

PROBLEM	REMEDY
1. Pump gaskets defective	Replace gasket

STICKING VALVE PLUNGER:

PROBLEM	REMEDY
1. Scored or burred bands in plunger ports	Repair or replace
2. Mounting or tie bolts too tight	Loosen and retighten to proper torque
3. Detent poppets worn or damaged	Replace
4. Dirt or foreign matter	Clean valve
5. Warped valve plunger	Replace
6. Linkage too tight or out ofadjustment	Adjust linkage

SLOW MOTION IN THE HYDRAULIC SYSTEM CAN BE CAUSED BY ONE OR MORE OF THE FOLLOWING MALFUNCTIONS:

1. Pump wearing out.
2. Partially clogged pump inlet.
3. Air leak in pump inlet.
4. Pressure relief valve plunger leaking.
5. Badly scored relief valve plunger seat.
6. Aerated oil supply.
7. Worn or scored piston packing.
8. Inside diameter of cylinder tube scored.
9. Linkage to valve plunger bent.

ASSEMBLY PROCEDURES

1. The most important practice to observe is cleanliness. Serious damage can result quickly from foreign material in a system.
2. Seal all reservoir openings after cleaning. Periodic cleaning and oil changes should be a part of every maintenance program.
3. When a hydraulic system is opened, plug or cap all ports to keep out dirt and moisture laden air; keep them capped until reassembled.
4. Use air to clean fittings.
5. Examine fittings, hoses and tubes to be certain there are no scale, nicks, burrs or dirt present.
6. Ream pipe and tube ends to prevent material from restricting flow or causing turbulence.
7. Never use high pressure fittings on inlet lines; they are smaller in inside diameter and can restrict flow.
8. No scarfing or welding should be done in areas where hydraulic systems are open in any way.
9. Teflon tape is useful to seal pipe threads; particularly when a joint has been broken. When using teflon tape or pipe sealing compound, leave the first two threads (inward) bare.
10. Don’t use teflon tape or pipe compound on straight threads.
11. Use grease liberally on splines at assembly to increase life.
12. In the assembly of components, a coat of clean hydraulic oil aids initial lubrication until the system is well primed. Petroleum jelly or grease are oil soluble and can be used to stick parts together if desired.

For questions or concerns, please contact Allied Systems Company Service Department at (503) 625-2560.