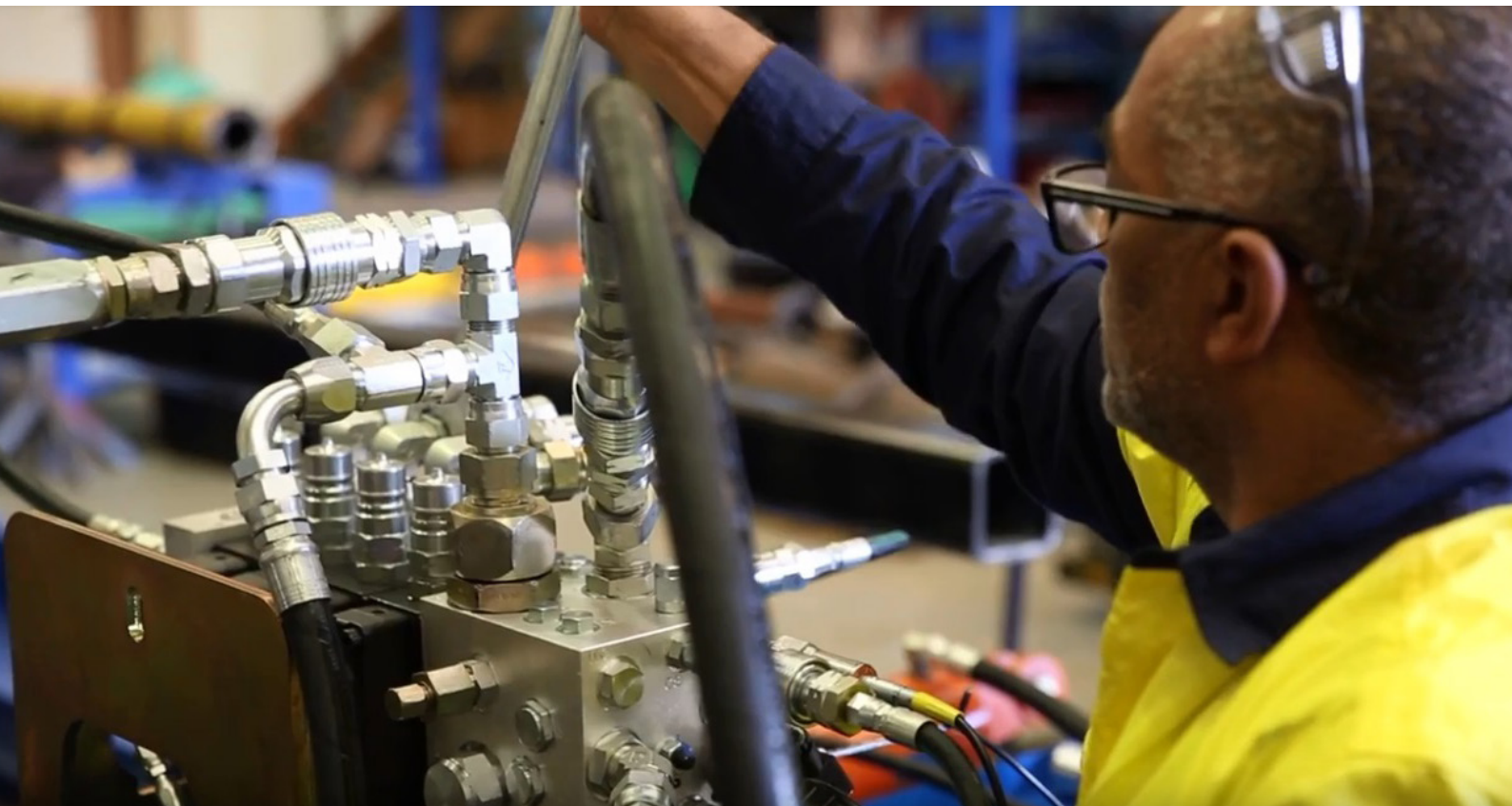
BERENDSEN
FLUID POWER

THE COMPLETE **GUIDE**

WHAT'S WRONG WITH YOUR HYDRAULIC PUMP?

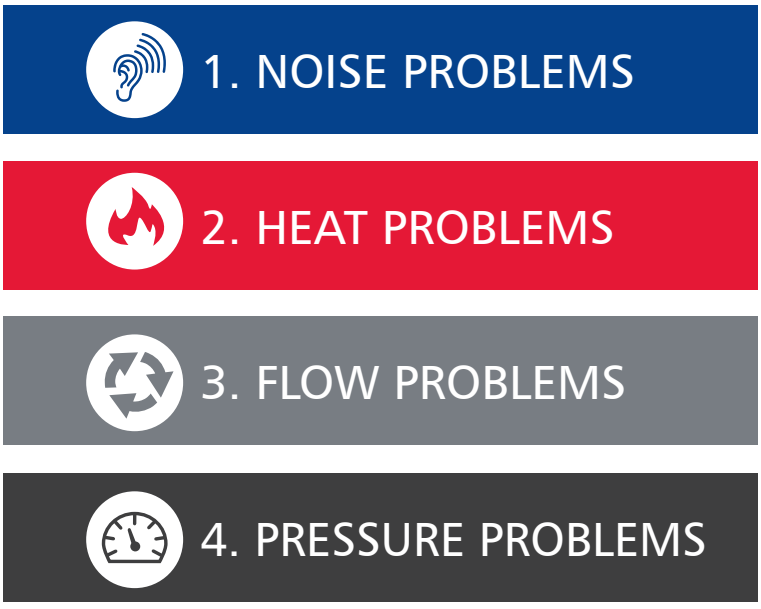
UNDERSTANDING NOISE, HEAT, FLOW AND PRESSURE PROBLEMS



INTRODUCTION UNDERSTANDING THE 4 MAIN PUMP PROBLEMS

This guide has been created to help you to pinpoint possible hydraulic pump problems. In it, we outline the 4 most common pump issues and provide you with more information about the contributing factors and underlying causes. While this is not intended to be an exhaustive manual, it will help you to narrow down pump problems so you can take the right steps to resolve your issue.

The 4 main pump issues covered by this guide:



Berendsen Fluid Power is a nationwide hydraulics leader that stocks and supplies a wide range of hydraulic pumps from major manufacturers including Eaton and Danfoss. In addition, our repair centres across Australia perform repairs and refurbishment to all hydraulic pump types. If you need more information, or if you'd like to enquire about a pump repair, please contact us.

WHAT KIND OF NOISE ARE YOU HEARING?	POSSIBLE CAUSE
STEADY WHINE AND RATTLING?	**YOUR PUMP MAY BE CAVITATING**
ERRATIC WHINE?	**YOU MAY HAVE AIR IN YOUR FLUID**
MECHANICAL WHINE?	**YOU MAY HAVE MISALIGNED COUPLING**

Cavitation is a destructive condition whereby excessively low inlet fluid pressure causes cavities to form in the fluid and rapidly implode, leading to metal erosion and damage to pump internal surfaces. Cavitation is recognisable by the sound it produces. If the cavitation is mild it will emit a steady high-pitched whining sound. If more severe, a pronounced rattling sound may be heard.

The whining noise caused by air leaks is more erratic in nature. This is due to the uneven distribution of the air in the hydraulic system. Unlike cavitation, which forms vapour bubbles at the pump inlet, air enters the pump along with the fluid in an inconsistent manner through a loose fitting in the suction line or from low oil level in the reservoir. Thus, the sound often changes as the machine operates.

Aerated oil causes many problems including:

- ✓ Sluggish or erratic actuator performance
- ✓ Reduced pump efficiency and accelerated component wear.
- ✓ Damage to seals.
- ✓ Excessive heat and increased fluid contamination.

A metallic or mechanical whine could be an indication that the alignment between the pump and motor is not concentric - leading to excessive vibration, noise, temperature increases, and increased wear on shafts and bearings. The pump should be aligned in all orientations. Check that the angle of alignment is correct in horizontal and vertical planes. Also verify that the centrelines of the pump and motor are aligned to avoid parallel misalignment.

WHAT KIND OF NOISE ARE YOU HEARING?	POSSIBLE CAUSE

MECHANICAL ROAR?

YOUR PUMP MAIN BEARING MAY BE WORN OR DAMAGED

A mechanical sound is usually an indication of badly worn internal parts. Any grinding, scraping, rough running pump sounds should be treated as an indication of serious internal wear. In such cases, the pump must be disassembled, inspected and overhauled by a trained technician. Worn components must be replaced and in some cases machining work must be performed to restore the pumps internal surfaces.

STEADY HISSING?

YOUR RELIEF VALVE MIGHT BE SET TOO LOW

Relief valves are designed to keep system pressure from reaching dangerously high levels. Hydraulic systems are not usually designed to dump flow across their relief valves continuously. A hissing sound and excessive localised heat is an indication that a relief valve is bypassing flow at high pressure.

ERRATIC WHISTLING OR HISSING?

YOUR RELIEF VALVE MAY BE WORN OR DAMAGED

A whistling sound or erratic hissing from a relief valve often suggests that they are improperly adjusted or stuck open. Slamming of actuators, stalls and excessive heat generation are the early symptoms of problems with these valves.

PROBLEM

IS THE PUMP ITSELF OVERHEATING?

Have you noticed a temperature increase that is localised to the pump itself (without affecting other parts of the circuit)? This heat is likely related to the mechanical condition or operation of the pump. Review the possible causes on the right.

POSSIBLE CAUSE

YOUR FLUID MAY BE TOO HOT

As hydraulic fluid circulates through your hydraulic system it both produces heat by doing work and transports that heat away from working components. However, if the heat dissipation is inadequate, or if the hydraulic oil does not have the right heat dissipation properties, then it can overheat. Build-up of dirt, debris and clogged hydraulic filters can also affect a system's ability to dissipate heat and lead to hydraulic fluid becoming too hot, leading to loss of fluid viscosity and reduced lubrication and pump efficiency.

YOUR PUMP MAY BE CAVITATING

Cavitation is the rapid formation and implosion of air cavities in the hydraulic fluid which creates a vast amount of heat. That is because the oil implodes with such violence that it can generate temperatures of up to 2700 degrees C at the point of implosion! Cavitation compromises the lubrication properties of the oil, and the excessive heat is extremely damaging to hoses and seals and metal components, which expand and wear.

YOU MAY HAVE AIR IN YOUR FLUID

Aeration occurs when air makes its way into the system via air leaks at points like pump seals, pipe fittings and unions. Air generates heat when compressed, so aeration increases the heat load on the hydraulic system. Aeration accelerates degradation of the fluid and causes damage to system components through loss of lubrication, overheating and burning of seals. High fluid temperature can also cause damage from inadequate lubrication as a result of excessive thinning of the oil.

PROBLEM

IS THE PUMP ITSELF OVERHEATING?

Have you noticed a temperature increase that is localised to the pump itself (without affecting other parts of the circuit)? This heat is likely related to the mechanical condition or operation of the pump. Review the possible causes on the right.

POSSIBLE CAUSE

YOUR RELIEF VALVE MAY BE SET TOO HIGH

If the pump in use is too powerful for the demands of the application, the relief valve may dump the unused pressure continuously back into the reservoir. This continuous unloading converts pressure to heat, which inevitably results in overheating of the pump. Check to ensure your pressure relief valve is set at the correct level as recommended by the manufacturer. If you cannot achieve the correct setting without an increase in pressure, the pump may be incorrect for the application.

THERE MIGHT BE EXCESSIVE LOAD ON YOUR PUMP

When a load is lifted hydraulically, potential energy is stored in the load. Release of the load usually involves non-regenerative throttling, which generates heat. If your pump is overheating, check for work load in excess of circuit design.

YOUR PUMP MAY BE WORN OR DAMAGED

As pumps wear, the internal leakage or “slippage” increases. On fixed displacement pumps this leakage flows from the high-pressure outlet back through the pump to the low-pressure inlet. In a pressure compensated pump this flow is forced out through the case drain. As this occurs fluid is taken from a high pressure to a low pressure without doing any mechanical work thereby creating heat. In addition, as valves wear they develop leakage paths that allow high-pressure oil to leak to a low-pressure port creating heat. Keep a log of the hours on your pump and be aware of the service intervals. Inspect the pump and overhaul or replace if necessary.

PROBLEM

IS YOUR HYDRAULIC FLUID GETTING TOO HOT?

In some cases, a pump may experience an increase in temperature as a result of hydraulic fluid that is compromised or contaminated.

POSSIBLE CAUSE

YOUR SYSTEM PRESSURE MAY BE TOO HIGH

System pressure is often adjusted to deal with other hydraulic issues such as sluggish performance. However, your hydraulic system is designed with a specific pressure setting in mind. Increasing the pressure may cause several negative effects, including increased heat production.

YOUR RELIEF VALVE MAY BE SET TOO HIGH

Pressure relief valves are there to ensure pressure does not rise beyond prescribed limits. If your relief valve is set incorrectly, it will not open soon enough and pressure will increase, which generates significant heat. This can have a detrimental effect on many parts of your system and contributes to fluid degradation, loss of lubrication and lower viscosity.

YOUR FLUID MAY BE DIRTY

Contaminated fluid has a reduced capacity for heat dissipation and can also lead to blocked fluid filters and strainers, which may allow low pressure leading to cavitation and increased heat build-up.

YOUR FLUID MAY BE LOW

Low fluid levels can lead to oil starvation, which leads to metal-on-metal friction, increased heat and increased wear. If fluid levels in reservoirs are allowed to drop, pump inlet ports can become exposed and this presents an increased risk of aeration of the oil leading to loss of lubrication, heat generation due to air pressurization and depressurisation. Check fluid levels for all stages of operation - ensure there is sufficient fluid in the reservoir when the cylinders are fully extended.

PROBLEM

IS YOUR HYDRAULIC FLUID GETTING TOO HOT?

In some cases, a pump may experience an increase in temperature as a result of hydraulic fluid that is compromised or contaminated.

SOLUTION

YOU MAY HAVE THE INCORRECT FLUID VISCOSITY

Viscosity is the measure of a fluid's resistance to flow. It is commonly thought of as thickness, or resistance to pouring. Hydraulic fluid viscosity influences important performance parameters including power transmission, lubrication and heat dissipation. Low viscosity increases the risk of internal leakages and negatively affects the efficiency of pumps and motors. High viscosity can cause problems such as sluggish movement, increased mechanical friction, heat generation and cavitation. Ensure the hydraulic fluid you use is correct for the operating conditions and requirements of your system.

YOUR FLUID COOLING SYSTEM MAY BE INADEQUATE OR FAULTY

The design of any hydraulic system must allow oil to dissipate heat in order to operate efficiently. Some systems may do this with an oil reservoir or heat exchanger or combination of both. If the system design does not allow for sufficient heat dissipation or if the system is clogged or faulty, this will result in the fluid becoming overheated.

Assess the design of your hydraulic circuit and, if necessary, install an oil cooler or increase the oil reservoir capacity. Check for obstructions to airflow around the reservoir, such as a build-up of dirt or debris. Inspect the heat exchanger and ensure that the core is not blocked. Check the performance of all cooling circuit components and replace as necessary.

YOUR SYSTEM MAY BE TOO WORN

Heating of hydraulic fluid in operation is caused by inefficiencies. Inefficiencies result in losses of performance, which means energy is lost as heat instead of converted to force. That heat needs to go somewhere. Worn pump, valve, motor, cylinder or other components decrease efficiency and increase internal friction, which all contributes to an increase in oil temperature. Inspect overhaul and replace components if necessary.

PROBLEM

DOES YOUR PUMP HAVE LOW FLOW?

POSSIBLE CAUSE

YOUR FLOW CONTROL COULD BE SET TOO LOW

Flow control determines the amount of flow delivered by the pump. Check this first to rule out the most obvious cause of low flow. Check to see that it is set to the correct level for the application.

YOUR RELIEF VALVE MAY BE SET TOO LOW

Relief valves control the pressure build-up in the pump. Should it be set too low it will open and allow pressure to escape, reducing the flow from the pump. Check to see your relief valve is set within prescribed limits.

FLOW MAY BE BY-PASSING VIA A PARTIALLY OPENED VALVE

Damaged or faulty valves may be creating relief paths or unintentionally directing flow to other parts of the system. Check the position of all your system valves. Inspect for wear or damage. Replace or overhaul damaged valves if necessary.

THERE MAY BE AN AIR LEAK IN THE SYSTEM

As discussed elsewhere in this guide, air leaks cause several performance issues including increased heat, noise and erratic pressure. There are several ways that air can make its way into your system. These include loose connectors, air leaks in suction lines or an insufficient supply of oil to pump from the reservoir or as a result of lines and hoses that are too small.

PROBLEM

DOES YOUR PUMP HAVE LOW FLOW?

POSSIBLE CAUSE

YOUR MOTOR RPM MAY BE TOO LOW

Pump flow is (in part) determined by the rate at which the pump turns. If your motor is unable to turn the pump at the required speed, the pump will be unable to develop the required flow. Check the motor specifications and replace it with the correct unit if necessary.

YOUR PUMP MAY HAVE EXCESSIVE SLIPPAGE

Slippage refers to internal leakage of hydraulic fluid through the tiny gaps between pump components such as vanes and gears. When a pump is new the tolerances are very tight and very little fluid can get between these moving parts. As the pump wears, these gaps grow larger and eventually more and more fluid is able to pass through the gaps. This slippage reduces the performance and efficiency of the pump, which has an effect on its flow.

PROBLEM

DOES YOUR PUMP HAVE NO PRESSURE?

POSSIBLE CAUSE

YOUR DIRECTIONAL CONTROL COULD BE SET INCORRECTLY

You'd be surprised how often the directional control is changed by other people or changed inadvertently. Before you start unbolting things, check the position of manually operated controls and check the electrical circuit on solenoid operated controls.

YOUR PUMP MAY NOT BE RECEIVING FLUID

Check to ensure adequate fluid flow to your pump. There are many factors such as restrictions and blockages which could contribute to poor fluid flow.

- ✓ Air leak in suction line
- ✓ Air present in the pump at start-up
- ✓ Insufficient supply of oil in pump
- ✓ Clogged or dirty fluid filters
- ✓ Clogged inlet lines or hoses
- ✓ Blocked reservoir breather vent
- ✓ Low oil in the reservoir

YOUR PUMP DRIVE MOTOR MAY NOT BE OPERATING

Check to ensure that your pump drive motor is turning over and is developing the required speed and torque. In some cases, misalignment can cause binding of the drive shaft, which can prevent the motor from turning. If this is the case, correct the misalignment and inspect the motor for damage. If required, overhaul or replace motor.

YOUR PUMP COUPLING COULD BE SHEARED

Check to ensure the pump to motor coupling is undamaged. A sheared pump coupling is an obvious cause of failure, however the location of some pumps within hydraulic systems makes this difficult to check so it may go overlooked.

PROBLEM

DOES YOUR PUMP HAVE NO PRESSURE?

POSSIBLE CAUSE

YOUR PUMP DRIVE MOTOR COULD BE REVERSED

In some cases, incorrect pipe routing between control valve and the motor can reverse the direction of flow from the drive motor. Check the circuit to determine the piping is installed correctly.

THE RELIEF VALVE COULD BE SET INCORRECTLY

It is possible that the entire flow could be passing over the relief valve, preventing the pressure from developing. Check that the relief valve is adjusted properly for the pump specifications and the application.

THE RELIEF VALVE COULD BE DAMAGED

If the pressure relief valve is set correctly, yet no pressure is being produced, it is possible that the valve itself may be at fault. Check to ensure the relief valve is not sticking open and preventing pressure development.

YOUR PUMP MAIN BEARING MAY HAVE FAILED

Seized bearings, or pump shafts and other internal damage may prevent the pump from operating all together. If everything else checks out, uncouple the pump and motor and check to see that the pump shaft is able to turn. If not, overhaul or replace the pump.

PROBLEM

DOES YOUR PUMP HAVE LOW PRESSURE?

POSSIBLE CAUSE

PRESSURE MIGHT BE ESCAPING VIA A 'RELIEF PATH'

Depending on the system design, some of your flow may be unintentionally routing back to the reservoir or another part of the system in such a way as to reduce pressure build-up. Check your system design to ensure correct routing.

YOUR PRESSURE RELIEF VALVE MAY BE SET INCORRECTLY

If your pressure relief valve is set too low, it may not allow the system to develop sufficient pressure. Check that your pressure relief valve is not set too low for the pump or the application.

YOUR PRESSURE RELIEF VALVE MAY BE DAMAGED

If your pressure relief valve is set correctly, but there's still no pressure, the relief valve may be sticking open. Inspect the valve and replace or overhaul if necessary.

YOUR PUMP, MOTOR OR ACTUATOR COULD BE DAMAGED

Low pressure could be caused by general worn components in all parts of the system. If you are experiencing unexplained low pressure, it's time to consider a complete overhaul.

PROBLEM

DOES YOUR PUMP HAVE EXCESSIVE PRESSURE?

POSSIBLE CAUSE

YOUR PRESSURE REDUCING VALVE COULD BE SET TOO HIGH

Check the pressure reducing valve or unloading valve to verify that it is set correctly for the pump and the application.

YOUR PRESSURE REDUCING VALVE MAY BE DAMAGED

If your pressure reducing valve is set correctly and you are still experiencing overpressure, the valve may be damaged. Inspect the valve for wear or damage and overhaul or replace if necessary.

PROBLEM

DOES YOUR PUMP HAVE ERRATIC PRESSURE?

POSSIBLE CAUSE

YOU MAY HAVE AIR IN YOUR FLUID

Free air plays havoc in hydraulic systems. Air is a compressible gas, while oil is an incompressible liquid. As air bubbles circulate through a system the pump will experience inconsistent pressure and momentary instances of oil starvation, leading to many problems.

YOUR PRESSURE RELIEF VALVE MAY BE WORN

If your pressure relief valve is opening at the wrong moment, or unable to contain the correct pressure, it may result in pressure spikes followed by rapid pressure decrease. Inspect the pressure relief valve and overhaul or replace if necessary.

YOUR HYDRAULIC FLUID MAY BE CONTAMINATED

Contaminated fluid can block filters, cause blockages in pipes and connectors and may cause valves to stick or to become damaged. Test your fluid contamination levels and follow the prescribed filter changing schedule. Replace contaminated fluid if necessary.

YOUR PUMP, MOTOR, ACTUATOR OR OTHER SYSTEM COMPONENTS COULD BE DAMAGED

General hydraulic system condition should be considered at all times. Damage to hydraulic motors, or hydraulic cylinders can cause internal or external leakages that may compromise the performance of the pump. External impact could result in bent shafts, cylinder rods or misaligned components - increasing friction. Sticking or juddering cylinders may result in pressure spikes that may appear as erratic pressure. Inspect the entire system for damage and repair or overhaul any components in need of attention.

PROBLEM

DOES YOUR PUMP HAVE ERRATIC PRESSURE?

POSSIBLE CAUSE

YOUR ACCUMULATOR COULD BE FAULTY

The role of the hydraulic accumulator is to absorb pressure ripples, and soften the impact of directional control or actuation. If your accumulator is defective or has lost charge, it may not perform this task consistently, leading to erratic delivery of pressure. Inspect the accumulator and overhaul or replace if necessary.

YOUR PUMP, MOTOR OR ACTUATOR MAY BE WORN

General system condition should always be considered. All components have a lifespan and - over time - components become less efficient, and produce more heat and friction. Erratic pressure may stem from a combination of different components that are not working optimally, or it may be the result of one worn bearing placing added load on the pump or motor. If your system is aging, or if you're simply not sure how well it has been maintained, then it may be time to consider a complete overhaul if your system is experiencing erratic pressure.

PUMP MAINTENANCE RECOMMENDATIONS

AVOIDING CAVITATION

As we have discussed throughout this guide, cavitation is a major enemy to pump performance and lifespan. Here are some tips to reduce the formation of these harmful cavities in your fluid.

1. Always ensure you maintain the correct oil level in the reservoir at all times during operation. Take into account the oil level drop when cylinders are extended.
2. Make sure that all shut-off valves are open, are of the proper type, and are allowing unrestricted flow.
3. Ensure all hoses are of sufficient diameter to allow adequate flow - so as to avoid oil starvation and avoid pressure drops.
4. Ensure all filters are replaced according to the prescribed maintenance schedule. Clogged filters will create an excessive pressure drop, which leads to cavitation.
5. Ensure adequate fluid flow from the reservoir. Pumps are designed to push fluid, not suck.

AVOIDING AERATION

Like cavitation, aeration is another damaging problem you will probably encounter in the life of your pump.

Here are some steps you can take to reduce the presence of air in your system:

1. Take care to bleed all the air from your system when filling or replacing fluid.
2. Check for leaking connections and secure them if necessary.
3. Fill the oil reservoir to the required level and ensure the reservoir level is sufficient at all times during operation - account for oil level drops as cylinders extend.
4. On mobile machines, pump reservoirs should be designed to mitigate sloshing, which can aerate your fluid.

PUMP MAINTENANCE RECOMMENDATIONS

AVOIDING OVERPRESSURISATION

Excessive pressure generates heat, which is damaging to hydraulic fluids. Keep in mind that pumps are designed to produce flow - not pressure! If your system design is such that pumps are required to overcome too much pressure to create the necessary flow, they will produce excessive heat and eventually fail.

With this in mind, here are some tips for avoiding this condition:

1. Ensure the pump is appropriate for the application. Don't turn up the pressure to compensate for a pump that is too small.
2. Ensure pressure relief settings are adjusted properly. In some cases, pumps are replaced and the pressure settings are not changed accordingly.
3. Follow the correct maintenance procedures for the rest of your machine or system. Don't turn up the pressure to compensate for sticking cylinders, or to overcome flow problems caused by clogged lines or filters.

AVOIDING FLUID CONTAMINATION

Fluid contamination is a major source of pump damage. Follow these recommendations to reduce contamination and prolong the performance and life of your pump.

1. Replace hydraulic filters according to the prescribed maintenance schedule.
2. Check possible entry points such as breather hoses or missing reservoir caps that may allow dirt or water to enter.
3. Make sure seals are in good condition so they do not allow contaminants to get into cylinders or motors.
4. Clean new parts thoroughly before installation. New parts such as hoses sometimes contain rubber and metal particles from manufacturing.
5. Take fluid samples and keep a record of contamination levels within your system so you will be aware of the pattern of contamination increases and can take preventative steps.
6. When you sample hydraulic fluid, do so at the same point each time to ensure consistency. However, do not take samples from stagnant points such as fluid reservoir drains or you will encounter inaccurate readings.
7. Take care to store hydraulic fluid carefully. Fluid will quickly become contaminated if containers are left open.
8. Filter hydraulic oil through a fine mesh before adding it to the hydraulic system to reduce contaminants.

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