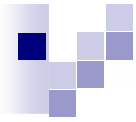


Hydraulic Maintenance & Troubleshooting

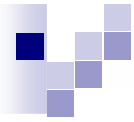
**PRESENTED BY
NORMAN KRONOWITZ**





Introduction

- Welcome to the CMA/Flodyne/Hydradyne's Hydraulic Troubleshooting presentation.
- We will introduce many aspects of troubleshooting hydraulic systems and will share information that will help you to better understand and enhance the operation of your hydraulic equipment.



Agenda

- Mentally Prepare
- Documentation
- Starting the process
- Predictability
- System Isolation
- Pumps
- Overheating
- Actuators
- Valves
- Accumulators
- Questions and answers

MENTALLY PREPARE

- Use Safety Equipment
- Apply General Safety Rules
- Lockout / Tag-out
- Work with a partner
- Be Afraid of Hydraulic accumulators
- Have Complete Documentation





Obtain Documentation and Determine a Direction

- Obtain all Hydraulic and Electrical Schematics pertaining to the equipment
- Manuals on the machines operation
- Determine your starting point based on the symptoms.



Starting the Process

- Understand the machine sequence and operation
- What is the machine doing or not doing?
- Intermittent or continuous
- Smell, feel, listen, touch and see
- Machine running slow or fast
- Pressure low or high
- Shock, banging, vibration



Predictability

Expect a result – Be predictive

- Every time an adjustment is made predict what should happen.
- Every time you shift a valve predict what will happen.
- If your predication is correct continue troubleshooting.
- If your predication **IS NOT** correct find out why.
- **DO NOT MAKE A CHANGE JUST TO SEE WHAT WILL HAPPEN.**
- You must make a predication **especially when working with a partner!**



Isolating Portions of the System

Isolating portions of the circuit is a good way to identify the area of concern.

- Lacking pressure? - Try to isolate the hydraulic system from the rest of the system by blocking the pressure source. Close a ball valve, disconnect a line and plug, etc.
- Lacking flow - The flow is taking the path of least resistance. Isolate portions of the circuit, check all ball valves/safety valves, listen to relief valves, feel for heat, etc.

Pump Troubleshooting

- Flow and Pressure
- Excessive Noise
- Overheating
- Leaking



Flow and Pressure

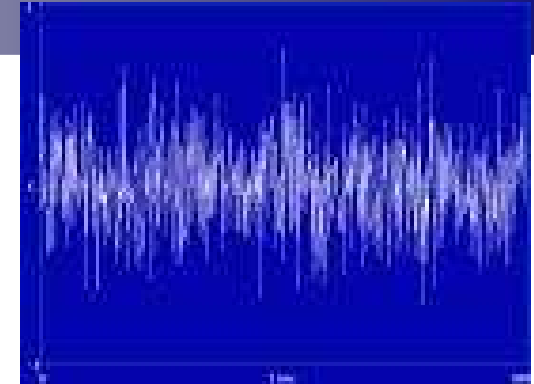


- Hydraulic pumps create flow not pressure
- Resistance to flow creates pressure
- Flow determines actuator speed
- Pressure determines actuator force
- Fluid will always take the path of least resistance.
- When Fluid moves from an area of high pressure to an area of low pressure (pressure drop) without performing work heat is generated.

Symptom: Noisy Pump

Cavitation? (pump starving for fluid) Damaged pump?

Reasons/Possible solutions might be:



- Inlet Strainer clogged - Remove or replace inlet strainer
- Examine inlet pipe for any obstructions
- Examine inlet pipe to ensure that the connections are tight and that the proper sealant/o-rings were used at all connections. If air is being drawn into the pump through these points, the pump will cavitate. Repair loose connections with proper sealant or replace damaged inlet line.
- Wrong fluid being used - viscosity too high or operating temperatures are too low thus causing the viscosity to increase.
- Excessive drive speed
- Reservoir design incorrect with no baffles, too shallow or oil level too low thus causing a vortex in the reservoir and inducing air into the pump inlet.
- Plugged or dirty filler breather element on reservoir
- Worn or damaged shaft seal on pump, check shaft for misalignment.
- Aeration of fluid in the reservoir. Return lines above the oil level.
- Contamination or high heat. Monitor ISO cleanliness codes and temps.

Symptom: Noisy Pump

Fixed displacement or Pressure compensated

Normal wear

If pump is fixed displacement, it may be:

- Worn or sticking vanes
- Worn ring
- Worn or faulty bearings
- Worn or damaged gears

■ If pump is pressure compensated, it may:

- Have worn Internal parts. Vanes, rotary group, bearings, causing internal leakage.
- If your pump has a case drain line a quick check for inefficiency is to remove the case drain line and drop it into a bucket.
- While the pump is in compensation, monitor how much fluid is coming from the case drain line. It should be within the catalog characteristics.
- If more than 10% of the pumps maximum output is going over the case his would indicate that the pump requires rebuild or replacement.
- Inefficiencies or internal leakage will show signs of high heat. Temperature readings at the pump during a morning start-up will help to identify the source of the heat and determine I leakage/inefficiencies thus indicating need pump replacement



System Overheating?

- Determine the source
- What is too hot?
- Is the pump overheating?
- Is a valve or actuator overheating?
- General overheating





Symptom: Over heating of system

What is the maximum temperature for a hydraulic system?

For safety, efficiency, and oil quality, temperatures above 140 degrees F are not recommended for industrial hydraulic equipment.

Oil that is too hot will degrade rapidly, drop in viscosity and can lead to accelerated component wear and poor system performance. A broken hose or leak in a line can seriously burn someone.

Causes of overheating systems:

- Contamination causing wear of components thus creating internal leakage of the component and higher operating temperatures.
- Relief valve misadjusted.
- Compensator on pump may be set higher than the relief valve in the system.
- Flow control valves may be set improperly.
- Water supply feeding heat exchanger may be shut-off or has insufficient flow or temperature for cooling.
- Heat exchanger may be clogged or water modulating valve may have failed.
- If an air to oil heat exchanger is in the system the cooling fins may need to be cleaned or electric motor or starter may have failed.
- Ambient air temperature may have increased and can no longer supply sufficient cooling media. Inadequate ventilation or area of room size may have changed.
- Incorrect fluid used in hydraulic system
- Defective pump (See Noisy pump)

Actuators not functioning?

■ Cylinders

1. Speed
2. No Movement
3. Insufficient force



■ Hydraulic motors

1. Speed
2. No Movement
3. Insufficient torque



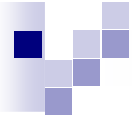


Symptom: Actuator fails to move

Reasons and possible solutions:

Note: Usually when an actuator doesn't move the problem is not the actuator.

- Directional valve not shifting.
- Electrical failure, bad solenoid, limit switch, PLC etc.
- Insufficient pilot pressure (if dual stage valve check pilot and drain configuration especially if valve has just been replaced).
- Look at any check valves or back pressure valves required to provide pilot pressure.
- System operating pressure too low (see low or erratic pressure)
- A valve elsewhere in the system is allowing flow to be diverted to the reservoir
- Interlock device not actuated
- Mechanical bind on machine or actuator (improper mounting of actuator).
- Faulty pump
- High heat – viscosity too low
- Previous contamination damage/high heat has caused component fatigue, wear and failure.
- Worn/damaged actuator (cylinder or hydraulic motor blow-by or internal leakage).



Suggestions:

If you think that it may be internal leakage:

- Take temperature readings on the system and on both sides of actuator. Actuator may be bypassing internally due to worn seals.
- Extend cylinder fully and disconnect rod end port connection. If fluid is continuing to flow from rod end port the cylinder has internal leakage and requires rebuild or replacement. If no leakage is present connect the line, retract the cylinder and remove cap end connection to check for same on opposite end/
- Note: Depending on the seal design it is possible for a cylinder to leak in one direction and not the other. A cylinder that leaks internally typically will drift in the extend direction because of the area differences on the piston even when mounted vertically rod up.
- If you experience this type of drifting the issue is probably the actuator and you should start your troubleshooting here.

Valves Not Functioning?

- Pressure Controls
- Directional Controls
- Flow Controls





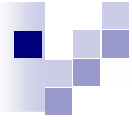
Symptoms: Low or Erratic Pressure

Reasons and possible solutions:

- Pressure control setting too low (relief, compensator, reducing valve, etc.)
- Contaminates in fluid or high heat/low viscosity.
- Worn or sticking relief valve.
- Dirt/debris stuck and holding a relief or other valve partially open.

Suggestions:

- Check cleanliness of fluid and act accordingly.
- Take temperature readings at the various valves to identify a noticeable temperature rise (possible internal leakage).
- Put your hand on valve to feel or listen for leakage.
- If the valve discharges to tank, disconnect the tank line and connect a hose from the valve, feeding into a bucket. Start system and measure the leakage. Act accordingly to repair or replace the valve



Symptoms: No pressure!

Reasons and possible solutions:

- Unit not running or pump in reverse direction.
- Low oil level or no oil.
- Drive coupling is damaged or disconnected.
- Full pump volume by-passing through a faulty valve or actuator.
- Suction line of pump obstructed or disconnected
- A manual valve may be shifted diverting volume to tank or a solenoid valve may be unintentionally energized/shifted or not shifted due to an electrical problem. PLC?
- Check all possible valves with a volt meter or manual over-ride if available

Note: Don't get stuck on the hydraulics as many times the problem you are experiencing may be mechanical or electrical.



Symptoms: Slow or Erratic Feed Rate

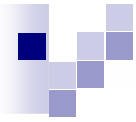
Reasons and possible solutions:

- Air or water in the fluid will typically produce a milky appearance.
- Low fluid level.
- Viscosity of the fluid is too high or temperature is too low
- Contamination.
- Internal leakage through a valve or actuator.
- Dirt/debris stuck and holding a valve partially open.
- Worn/Inefficient pump.
- Pump drive speed too low.
- Faulty or dirty flow control or other feed related valve.

Mechanical...misalignment, sticky, warped, or binding ways, bent bracket or other mechanical failures.

Suggestions:

- Check level, color, quality and cleanliness of fluid and act accordingly.
- Take temperature readings at the pump, pump case, and various valves to identify a noticeable temperature rise (possible internal leakage).
- Put your hand on valve to feel or listen for leakage.
- If the valve discharges to tank, disconnect the tank line and connect a hose from the valve, feeding into a bucket. Start system and measure the leakage. Act accordingly to repair or replace the valve.



Hydraulic or Electrical ?

Often an electrical issue will affect the hydraulic operation.
Don't get focused on a hydraulic problem until you have also reviewed electrical issues such as:

- No or low voltage at a solenoid valve due to a defective limit switch, misadjusted limit switch, PLC output, power supply, transformer or no control power.
- What has changed?
- A change to the PLC program, a limit switch or other electrical component recently replaced?



Proportional & Servo valves and Drivers

- Valves may have on-board electronics or be controlled by an amplifier or motion control device.
- Proportional and servo valves are current driven using “Pulse Width Modulation”
- Before troubleshooting a proportional or servo valve obtain documentation for the valve and control.
- Shielded wire is required for the valve to operate without interference (electrical noise).
- Proportional and servo valves are controlled with either a current or voltage command to the valve or control device.
- Often the problem is not the valve but the amplifier, PLC, feedback device or broken wire.
- What has changed? Ask Questions?



Accumulators

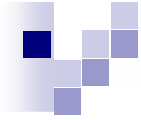
- Why is the accumulator in the system?
- Nitrogen pressure **CAN NOT** be measured while system is running
- Potential to unexpected discharge
- Use your senses and **ASK QUESTIONS !**



Most Important Tools

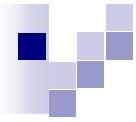
- **Eyes**
- **Ears**
- **Hands**
- **Nose**
- **Use your senses**

ASK QUESTIONS !



Where to Get More Information

- Other training sessions
- Books, Trade magazine articles, Internet, etc..
- Consulting services, other sources
- Call us anytime!



This guide cannot cover all details or all variations in equipment nor can it provide for every possible condition/solution of cause and effect.

Feel free to contact us should further information be required.
We're always happy to help!