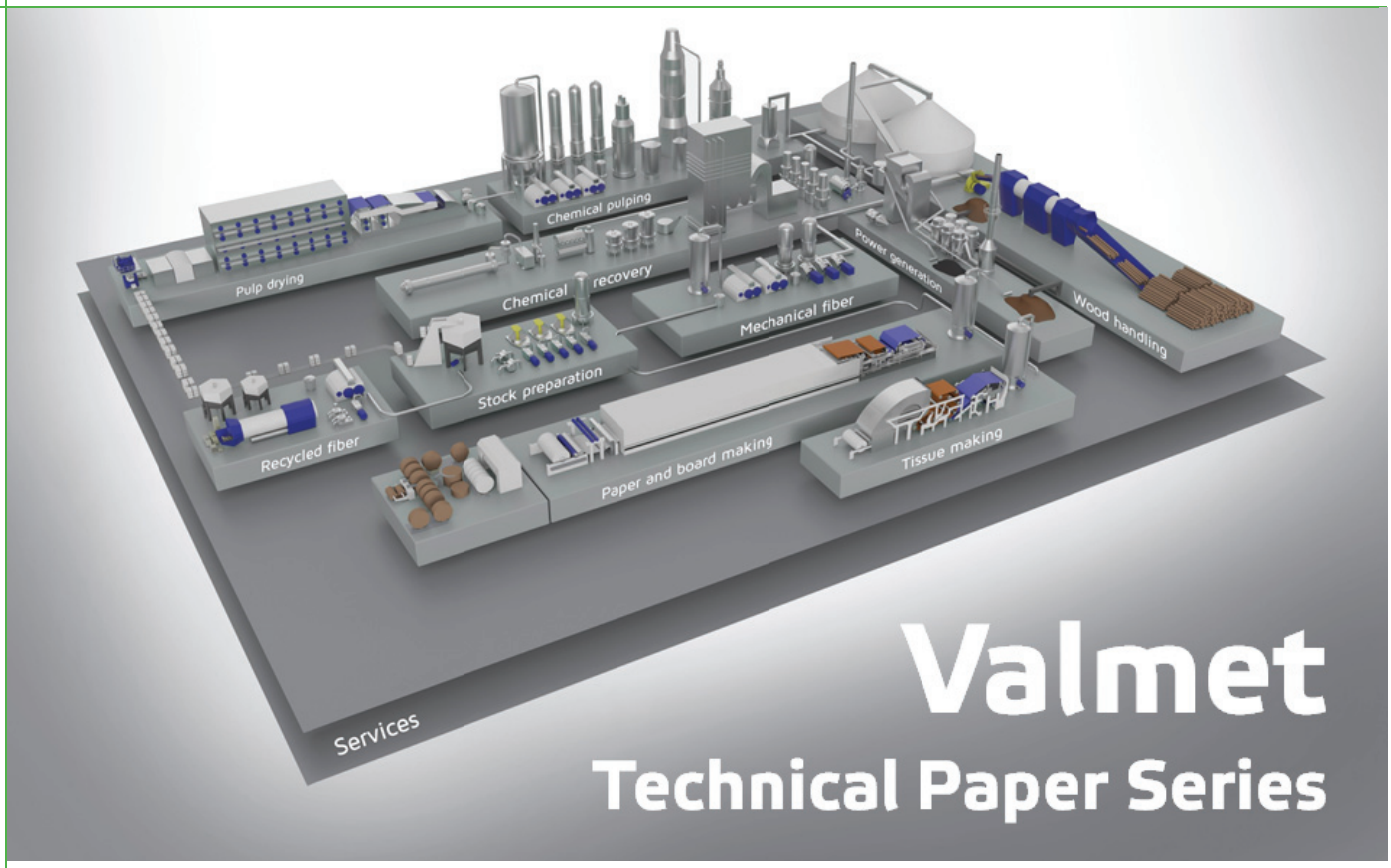

Maintenance Tips – Fluids

Executive Summary

Pneumatic and hydraulic controls perform a vital role in literally every operational control function of a pulp, paper, board or tissue machine. Improved process efficiency results from proper maintenance of fluids control devices.

There are hundreds of different fluids control circuits on a typical paper machine, using literally thousands of pneumatic and hydraulic control devices. The control devices are located everywhere in the machine room. They are housed in floor mounted control benchboards, frame mounted and auxiliary control cabinets and panels. In some cases, they are also surface mounted to nearby framing or a suitable building location.

This white paper presents safety and general reminders for fluids maintenance, as well as some practical tips and extensive troubleshooting charts.

Safety and general practice reminders

Only trained personnel should perform maintenance or add new devices. This includes familiarity with the machine being worked on (safety issues, design and operation, and control circuits). Refer to applicable sections in the relevant equipment operating and maintenance manuals as well as mill procedures.

- As a general rule, both hydraulic and pneumatic systems must be locked out and depressurized before starting maintenance or repair work on any fluid system.
- Never by-pass safety features, such as guards or interlocks.
- Before shutting down the system, familiarize yourself with the mill's lock out procedures.
- Before depressurizing circuits, make sure that all loads are in the lowered position or are mechanically secured.
- Always begin a hydraulic system shutdown by stopping the pumps.

  Next, close the applicable isolation valves in the system (before performing the maintenance or repair).

  After stopping the pumps, and before starting any maintenance or repair work, lock the motor starters for the electric motors so that there is no chance of anyone accidentally starting them. If there are no lockable motor starters, remove the motor fuses. Put your name on secured locks and removed fuses. Never remove someone else's lock-out tags.
- Always begin pneumatic system shutdown by closing the hand valve which isolates the system from the mill air supply. Next, bleed trapped air from the circuit.
- Verify that there is no pressure in the system, such as in pressure accumulators, air receivers, pipelines, or actuators which need to be depressurized.
- Use appropriate tools and methods for repair and maintenance work.
- Avoid spilling oil on the floor. Clean up any oil spills immediately.
- Before removing a valve:
  - If a valve has manual override controls, release any remaining pressure between the valve and actuator. Bleed off pressure repeatedly in both directions.
  - Close the shut-off valve to the valve panel.
- Use appropriate gaskets or suitable sealing compound to seal threaded connections in the system, as required.
- Do not use cotton rags or other lint cloth. When changing a cylinder, plug hose ends to keep impurities out. Always pay attention to cleanliness when servicing hydraulic or pneumatic systems.

- Re-tighten disconnected pipe and hose couplings immediately after maintenance work. Prior to finishing the maintenance work, verify that all connections that have been serviced or repaired are tight. Re-tighten as necessary.
- Before energizing the system, make sure that no one else is in the vicinity of the machine, and no other maintenance work is in progress. Never remove anyone else's lock-out tags. When starting the pumps, maintain a safe distance from the areas where maintenance or repair work took place.
- Before opening isolation valves, make sure that no one is working between the machine components. System pressurization may cause machine components to move unexpectedly.
- Once the system is pressurized, test the repaired component. Check for leaks. If any are found, the system may need to be depressurized again to repair them. Do not tighten leaky fittings under pressure.

WARNING:

Hydraulic and pneumatic systems are under high pressure. Do not test for hydraulic or pneumatic leaks with your hands. Use another material (i.e., wood, cardboard, etc.) to avoid risk of injection of hydraulic fluid or air under the skin. Seek emergency help for any injuries.

- Make sure that all signs and notices attached to the machine or instrument components are in place and clean.
- Keep instrument boxes and cabinets closed.

General troubleshooting principles

Familiarity with Circuits

When troubleshooting fluid circuits, it is important to have a full understanding of all circuit components and the relationships between them. Therefore, the first step in troubleshooting any circuit should be to study the circuit diagrams and the fluid section of the equipment's maintenance manual.

Once you have a full understanding of a malfunctioning circuit, you can begin to isolate the cause of the malfunction by checking the performance of each component.

Pressure Settings

Always check the operating pressures first. Some pressure settings are specified on the circuit diagrams.

If a specification is unavailable, set the pressure to the lowest level that will allow adequate performance of the system, without exceeding the maximum rating of the components.

Electrical Controls

Most fluid circuits have at least two operating modes (i.e.: extend/retract or raise/lower). Each operating mode requires that the solenoid valves in the circuit be in a specific state (energized or de-energized). The text associated with each circuit diagram explains which valves should be energized and which should be de-energized. This information, combined with the applicable electrical drawings should help you determine whether all the conditions have been met for a particular operating mode. If the conditions have not been met, or other controls are malfunctioning, correct that problem first, and then proceed to check the fluid components themselves.

Trouble Indications

Trouble is indicated whenever circuit performance deviates from normal. As a result, the best way to learn how to recognize trouble is to become familiar with the normal operation of each circuit. Some general guidelines for recognizing trouble indications are as follows:

- Excessive heat means trouble. A warmer than normal tank return line on a relief valve indicates operation at relief valve setting. Hydraulic fluids which have too low a viscosity will increase the internal leakage of components and increase the heat rise.
- Typically, if oil temperature exceeds 140 °F (60 °C), check the cooling system. If no cooling system fault is found, locate and replace any devices showing reduced volumetric efficiency. Monitor the temperatures of different devices to detect major leaks.
- Excessive noise could mean wear, misalignment, cavitation, or air in the fluid. Contaminated fluid can cause a relief valve to stick or chatter. These noises may be the result of contamination, excessive viscosity, low reservoir level, or leaking suction or pressure lines.

Component Replacement Notes

- If the actuator has failed, start troubleshooting from the actuator and work toward the power unit components.

If the actuator does not receive sufficient oil flow or pressure, start troubleshooting at the power unit and work toward the actuator.

- New valves must be adjusted and locked or tuned to the settings given for the position concerned.
- On computerized systems, use the help and maintenance screens to locate and identify possible hydraulic operating problems.

Hydraulic drift troubleshooting tips

A hydraulic cylinder is experiencing drifting under load. You suspect the piston seal and/or the directional valve is leaking. How can you tell which one is the problem?

If there are shutoff valves on the cylinder, you could shut both of them. If you observe that the load does not drift, you might assume that the piston seals are OK.

However, even if the piston seals were totally gone, the load would still not drift. The reason for this is fluid flows from the high to low pressure side of the piston and equalizes at some pressure higher than the supply pressure was. Equal pressures on unequal areas (cap end greater than rod end area), results in a force that holds the load in place. So the cylinder could still be the problem.

Another thing to check if the cylinder is suspect is temperature of the cylinder. Wherever there is a leak or pressure drop with no work taking place, heat is generated. Therefore, you can feel the cylinder piston area or oil lines for warm oil.

CC hydraulic unit troubleshooting tips

These tips are excerpted from Valmet training sessions for operators and maintenance personnel. For the latest training offerings, contact Rick Heitke at richard.heitke@valmet.com.

Controlled Crown roll hydraulic units (**Figure 1**) have pumps for three main functions: high-pressure pumps to control shell deflection through hydrodynamic or hydrostatic load shoe bearings; lubrication pumps to lubricate shell load shoes, rotating bearings and to control temperature; and scavenger pumps to return oil to the hydraulic unit. Pump failures will lead to product quality defects and production loss. The following are troubleshooting tips to keep your CC roll hydraulic units running reliably.

The pump is not delivering fluid properly.

The pump may be driven in the wrong direction of rotation. Stop the pump to prevent seizure. Check the rotation of the pump as indicated by the arrow on the pump body.

The drive shaft is broken or the shaft key is sheared. Remove the pump from its mounting and inspect. Repair as necessary.

Intake pipe is blocked or the oil viscosity is too heavy to prime. Drain the system. Add clean fluid of the proper viscosity. Filter the oil as recommended. Check the filter for cleanliness. Check the oil temperature in the reservoir.

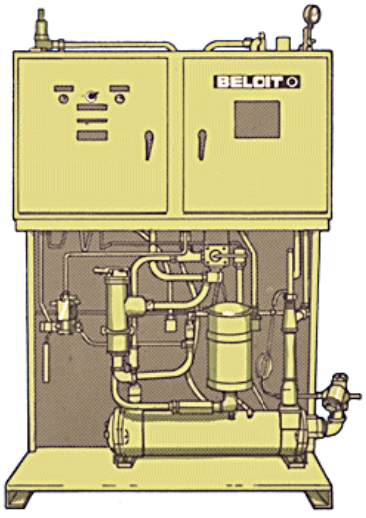

Figure 1. Hydraulic unit failures lead to poor quality and lost production.

Intake has air leaks. Check the intake connections. Tighten securely.

The pump is not priming. Loose connection in the outlet line. Bleed the air until hydraulic fluid flows.

Fluid level is too low. The reservoir fluid level must be above the opening of the intake pipe. Check the system on start up to make sure that it is filled to the proper level.

The hydraulic system pressure is too low.

Relief valve is set too low. Use a pressure gauge to adjust the relief valve.

Worn pump parts are causing extreme internal leakage. Replace the rotor sets and take the required corrective steps after examination of the pump parts.

The pump is making excessive noise.

The intake strainer/pipe is clogged or restricted. The pump must receive intake fluid freely or cavitation occurs. Drain the system, clean the pipes and clean or replace the strainer. Add new fluid and strain properly.

The pump has defective bearings. Replace the bearings and inspect the pump shaft.

Air leaks at the pump intake pipe joints or shaft seal. Pour fluid on the pipe joints and shaft seal while listening for a change in sound. Tighten the joints and replace seals as necessary. Check the shaft journal for scoring at the seals and replace as necessary.

Drive for the pump is wrong. Make sure that the motor is running at the correct speed.

The coupling is misaligned. Check the bearing or bushings and seals. Replace as necessary and align the shafts. Allowable misalignment is .005 inch.

The pump shaft seal is leaking.

The seal is worn or damaged. Replace the seals.

There is excessive pressure on the seals. Check for restrictions or excessive length of line on externally drained pumps. Internal drain pumps should be drained to the inlet side with no more than 10-psi pressure.

The pump has excessive heat (> 400 ºF, 205 ºC) compared with the hydraulic lines.

Too much thrust on the pump bearings. The pump shaft must not be out of line more than .005 inch with the motor shaft. The shaft end gap should be 1/8-inch minimum.

The fluid temperature is too high. The pump should be shut down immediately after comparing pump, inlet line and reservoir temperatures. If the pump is excessively hot, it should be overhauled.

Notice: Maintenance on the hydraulic system and roll depend to a great extent on the timely attention that the filters receive.

The hydraulic unit reservoir

The reservoir (**Figure 2**) is usually the largest item on the unit and makes up part of the framework. The reservoir contains a cover plate, which should be kept in place except when inspecting or refilling. The life of any hydraulic system depends on keeping contaminates out of the oil. This is hard to do with the cover plate removed.

The reservoir for the unit must be large enough to handle all of the oil contained in the roll if there is a situation that requires the roll be completely drained. The reservoir should be cleaned and inspected for corrosion and other damage yearly, or more frequently as needed.

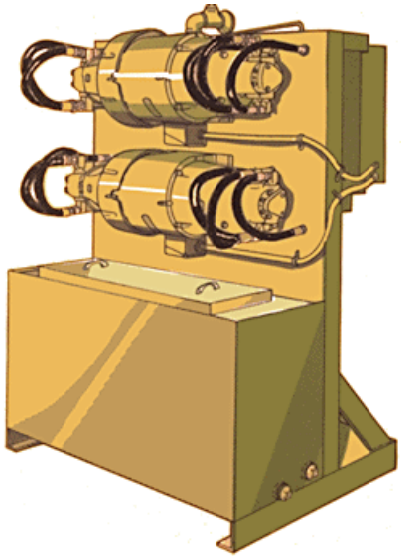

Figure 2. Clean and inspect hydraulic reservoir for corrosion annually.

Elevated temperature troubleshooting tips

Hydraulics are used throughout the papermaking operation. They are very reliable but occasionally develop problems. One such problem is elevated oil temperature.

Most hydraulic systems (except hot oil calenders) should run at about 120 °F (50 °C). When the oil temperature exceeds 140-160 °F (60-70 °C), oxidation and varnishing occur with resulting deposits in the oil. These deposits can get stuck in the small orifices of proportional valves, directional valves and oil filters. When this occurs over an extended period, the oil will need to be replaced. For every 18 degrees increase in oil temperature, oxidation rate doubles and the service life of that oil can go from 100,000 hours to 10,000 hours - an order of magnitude drop in oil lifetime.

Some sources of high oil temperature include:

- pressure drop that is not performing any work (pressure relief valve, pressure control valve, flow control valve, leaking directional valve)
- worn out pump
- lack of cooling capacity
- plugged heat exchanger
- too many bends in piping
- leaking cylinder piston seals
- plugged filters
- air in oil

Oil should be tested periodically to determine the condition of the oil. The goal of hydraulic systems is to keep the oil clean, cool and dry to get the longest oil life possible.

Case Study - Controls upgrade improves performance and reliability, and eliminates obsolescence

The hydraulic press loading valves in the manifold located in the basement below a paper machine in the northern USA were due for replacement. But when mill stores went to purchase new valves, they found that the model they needed was now obsolete and no longer available. Now what?

The mill called in Valmet to help determine a good path forward. It was noted in discussions that not only were the valves of 1970's vintage, but the entire press loading control system for the paper machine was of the same vintage (**Figure 3**). That realization helped to raise the next logical question, were there other press loading components that should be considered for upgrade?

Figure 3. The press section at the mill included obsolete and malfunctioning 1970's era controls.

A Valmet engineer experienced in press sections and related controls came to the mill to examine the press and help to determine the scope of the upgrade necessary for the machine's press loading

hydraulics. The mill maintenance manager expressed concern that by simply replacing the hydraulic valves, the mill would only "be doing half the job."

Machine operators were having a number of problems that could be directly linked to the 1970's era press hydraulic control system. Not only were the valves obsolete (**Figure 4, left**) but the existing original hydraulic control system was quite obsolete as well.

Due to limitations of the existing control system, proper and reliable nip impressions could not be obtained. Also, during machine start-up, when the operators had the former running and then applied loading to the presses, the former stretcher pressure would decrease causing instability in the system and sheet breaks. The operators were forced to make continuous adjustments to the press loadings because the set point would not remain steady. In addition, the 1970's era control system had no troubleshooting capabilities.

The solution – a hydraulic controls upgrade

After further analysis and discussion with the mill, Valmet upgraded the hydraulic control system. After completing the upgrade, a new custom valve rack (**Figure 4, right**) is in place that makes maintenance and troubleshooting much easier. All obsolete components have been upgraded to current models with the latest control technology and safety features.

The mill has a new Human/Machine Interface control featuring first-out logic and user friendly control screens offering operators enhanced and simplified control of the system (**Figure 5**). A duplex filter system was also installed for the manifold supply oil to ensure a good clean supply of oil.

The mill changed out a sticky proportional valve after the upgrade and the procedure which used to take up to 4 hours or more, took less than 40 minutes. Nip impressions of the various press nips are now readily done and reliable. Breaks due to stretcher unloading have been eliminated and the entire system is now easy to troubleshoot, thus reducing down time. Press loading is now steadily running with closed loop control and the mill has set a production record after the upgrade was installed.

Overall, mill personnel are very happy with the results of the upgrade to their press section. According to the maintenance manager, the equipment is easier to access, operate and maintain – and that makes for happy operators and maintenance personnel!

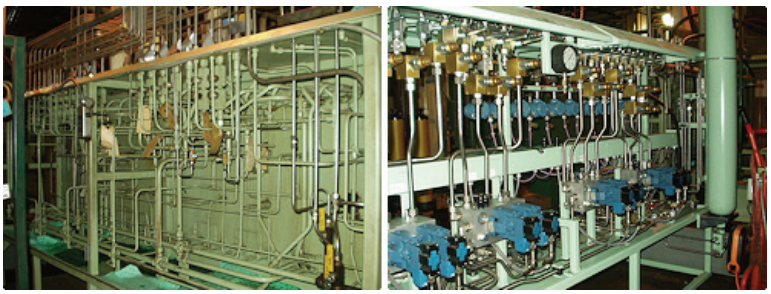

Figure 4. The original (left) valve panel was replaced with a modern (right) panel.

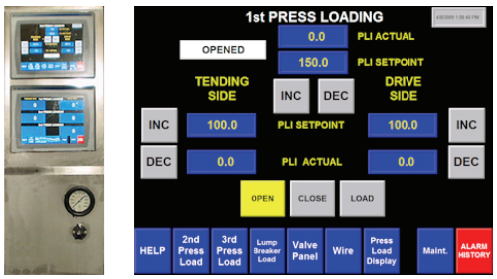

Figure 5. The new HMI control panels (left) include a comprehensive set of machine control and monitoring screens such as that shown on the right.

Hydraulic Troubleshooting Charts

The following troubleshooting guides cover five categories of trouble. Possible causes and remedies are listed for each type of trouble. Causes are listed in order of probability; remedies are listed adjacent to the associated cause.

Abnormal/Excessive Noise

Source/Symptom	Possible Problem	Recommended Action
Pump	• Cavitation	• Replace dirty strainers. • Clean clogged inlet line. • Clean reservoir breather vent. • Change to proper pump drive motor speed.
	• Air in fluid	• Tighten leaky inlet connection. • Fill reservoir to proper level. • Bleed air from system. • Replace pump shaft seal.
	• Coupling	• Tighten coupling. • Check condition of seals and bearings.
	• Pump worn or damaged	• Repair or replace.
Motor	• Coupling misaligned or loose	• Re-align coupling. • Check condition.
	• Motor worn or damaged	• Repair or replace.
Mechanical vibrations	• Misaligned, loose coupling	• Re-align coupling and remove any unnecessary clearances.
	• Vibration of pipes	• Tighten pipe clamps and add more clamps where necessary.
Relief valve	• Improper setting	• Install pressure gauge and adjust to correct valve setting pressure. Make sure setting is not too close to operating pressure or to another valve setting.
	• Valve worn or damaged	• Repair or replace.

Excessive Heat

Source/Symptom	Possible Problem	Recommended Action
Pump	• Pump worn or damaged	• Repair or replace.
Relief	• Incorrect setting	• Install pressure gauge and adjust to correct setting pressure.
Flow losses between pressure and return sides	• Pressure set improperly • Defective valve function or damaged seals	• Set pressure to the diagram rating. • Repair or replace.
Insufficient cooling	• Cooling water system unavailable • Deposits in cooling water system	• Make cooling water available. • Clean cooling water strainer and equipment.
Tank Heater	• Heater on too much	• Check program for proper command. • Check disconnect for proper operation.
Viscosity too low	• Oil damaged • Water contamination • Improper oil	• Drain and refill with fresh oil • Find and repair water source then drain and refill with fresh oil. • Drain and refill with fresh oil.

Incorrect Flow

Source/Symptom	Possible Problem	Recommended Action
No flow	• Pump not receiving fluid • Pump motor not operating • Pump-to-drive • Pump motor rotation incorrect	• Replace dirty strainers. • Clean clogged inlet line. • Clean reservoir breather vent. • Repair or replace. • Check for damaged pump or drive. • Replace and align sheared coupling. • Reverse rotation.

Incorrect Flow (cont.):		
Source/Symptom	Possible Problem	Recommended Action
	• Directional valve in wrong position • Entire flow passing • Damaged pump	• Check position of manually-operated valves. • Check electrical circuit for solenoid-operated valves. • Adjust relief valve over relief valve setting. • Check for damaged pump or drive. • Replace and align coupling.
Low flow	• Flow control set too low • Relief valve or unloading valve set too low • Variable displacement mechanism malfunctioning	• Adjust. • Adjust. • Check pump compensator. • Repair or replace.
Excess flow	• Flow control set too high	• Adjust.
Flow losses between pressure and return sides	• Maximum pressure set too high • Pressure valve cannot close due to dirt or foreign particles • Cylinder tube, piston, or seal damaged • Seal damaged due to incompatible materials	• Re-adjust pressure setting per diagram. • Clean system. • Repair or replace parts. • Repair or replace damaged part. • Replace seals that fit the system or change the hydraulic fluids to fit the seals.

Incorrect Pressure

Source/Symptom	Possible Problem	Recommended Action
No pressure	• Dirty pump strainers	• Replace. • Clean clogged inlet line.
	• Pump motor not operating	• Repair or replace.
	• Pump-to-drive coupling sheared	• Replace and align coupling.
	• Pump motor rotation incorrect	• Reverse rotation.
	• Directional valve in wrong position	• Check position of manually-operated valves. • Check electrical circuit for solenoid-operated valves.
	• Entire flow passing over relief valves	• Adjust relief valve setting.
	• Damaged pump	• Check for damaged pump or drive. • Replace and align coupling.
Low Pressure	• Reducing valve set too low	• Adjust.
	• Reducing valve worn or damaged	• Repair or replace.
	• Relief valve or unloading valve set too low	• Adjust.
	• Variable displacement mechanism malfunctioning	• Check pump compensator. • Repair or replace.
	• Pump, valve, motor, cylinder, or other component worn/damaged	• Repair or replace.
	• Water contamination	• Drain, flush and refill.

Incorrect Pressure (cont.):		
Source/Symptom	Possible Problem	Recommended Action
Erratic	• Air in fluid	• Tighten leaky connections. • Fill reservoir to proper level. • Bleed air from system.
Excess pressure	• Reducing valve or unloading valve set too high • Variable displacement mechanism	• Adjust. • Check pump compensator. • Repair or replace malfunctioning unit.

Faulty Operation

Source/Symptom	Possible Problem	Recommended Action
No movement	• No pressure or flow • Limit device / sequence device inoperative or improperly set. • Mechanical bind not operating • Cylinder or motor damaged • Low flow	• See troubleshooting guides for **incorrect flow** and **incorrect pressure**. • Check mechanical, electrical and/or hydraulic limits and sequence devices. • Adjust, repair, or replace. • Locate and repair bind. • Repair or replace. • See troubleshooting guide for **incorrect flow**.
Slow movement	• Fluid viscosity too high • Insufficient pressure • Lack of lubricant • Cylinder or motor damaged	• Fluid may be too cold or dirty. • Check heating/cooling system. • Change to clean fluid of correct viscosity. • See troubleshooting guide for **incorrect pressure**. • Lubricate machine ways or linkage. • Repair or replace.

Faulty Operation (cont.):		
Source/Symptom	Possible Problem	Recommended Action
Erratic movements	• Erratic flow • Air in oil • Improper pressure	• See troubleshooting guide for **incorrect flow**. • See troubleshooting guide for **air in oil**. • See troubleshooting guide for **incorrect pressure**.

Foaming Oil

Source/Symptom	Possible Problem	Recommended Action
Tank	• Oil level in tank too low	• Add oil as required.
Suction line	• Cracked or leaking suction line	• Repair or replace.
Improper or degraded oil	• Inadequate anti-foaming agent	• Replace with proper oil.

Directional Control Valve Position not Changing

Source/Symptom	Possible Problem	Recommended Action
Coil not picking up	• Electric failure	• Fix electric failure and check mechanical spool motion.
Valve spool stuck	• Impurities between spool and bore • Throttle set too tight between the main and pilot valve of the two coil solenoid valve	• Replace valve if necessary. • Set the throttle at the correct rating

Directional Control Valve Position Not Changing (cont.):		
Source/Symptom	Possible Problem	Recommended Action
Proportional valve not responding	• Valve not receiving set value from program • Set value received but valve not responding	• Locate and fix electric failure. • Replace the proportional valve.

Computer Alarm Messages

Computerized control systems usually have alarm screens which record alarm messages. The following table lists some recommended actions to take to resolve common hydraulic alarms.

ALARM MESSAGE	RECOMMENDED ACTION
Pressure Filter Blocked (identified by pump)	• Replace old filter with new filter insert.
Pressure Filter Blocked for Circulation Pump	• Replace old filter with new filter insert.
Circulation/Filter Pump Fault MCC Circulation/Filter Pump Stopped & Main Pumps Running	• Motor output gives alarm to control desk if that pump is not running.
Return Filter Blocked	• Replace old filter with new filter insert.
Hydraulic Unit Temperature High	• Check cooling pump operation. • Check the cooler water strainer. • Check water thermostat operation. • Check that none of the pressure relief valves were set too low. If required, correct the setting.
Hydraulic Oil Level Low Hydraulic Oil Level Low - Pumps Stopping	• Determine what is causing the drop in oil level. Add clean oil. The pumps will stop automatically if the level drops to the shutdown level.
Pump Fault MCC or Standby Pump Fault MCC (identified by pump)	• Motor output gives alarm to control desk if that pump is not running.

Pneumatic troubleshooting Charts

The following charts cover common problems with the actuator or pneumatic valves. These charts are intended as a starting point for troubleshooting since it is impossible to include all possibilities. If one of the following situations exists, work through the source and remedy lists as possible causes. Re-check operation after checking each source before trying another source.

Actuator Moving Abnormally Slow

Source/Symptom	Possible Problem	Recommended Action
Excessive air choke	• Flow control valve incorrectly adjusted	• Readjust the valve.
	• Plugged air silencer	• Replace or clean silencer.
	• Air leak or squeezed tube	• Repair air leak or tube.
	• Plugged filter	• Replace air filter.
	• Damaged cylinder or seal	• Replace cylinder or seal.
Pressure too low	• Damaged or incorrectly adjusted pressure regulator valve	• Replace regulator or readjust rating as shown in drawing.
	• Plugged filter	• Replace filter.
	• System leaks	• Fix leaks.
	• Directional or other valve open due to dirt or failed pilot circuit	• Locate damaged part and clean or replace it.
	• Cylinder pipe, piston, or seal damaged	• Repair or renew damaged parts.

Filter/Regulator/Lubricator Unit

Source/Symptom	Discussion/Recommended Action
Air leak at regulator	A continuous air leak from the small vent hole in the regulator bonnet indicates a leaky main bonnet or diaphragm. Repair parts should be ordered at once and the regulator should be scheduled for repair. Overhaul kits with diaphragm and seals are available for most standard regulators. IMPORTANT: • Replace diaphragm or seals as soon as possible after the leak is discovered. A complete failure of the diaphragm might apply full house pressure to the pneumatic system. This may cause some solenoid valves to shift by themselves, creating a safety hazard to personnel and equipment.
Pressure problems Filter Problems	If the diaphragm is cracked or broken, a high velocity air leak at the vent hole will occur. Replace the diaphragm. Clean or replace the filter element regularly. When over-contaminated, the filter element will create a pressure drop which may affect system operation. Drain condensate from the filter bowl before it rises above the baffle. Otherwise, air turbulence may pick up the water and carry it downstream into the pneumatic system. If condensate requires frequent draining, install an automatic drain. Use filter elements with the appropriate rating to protect cylinder barrels and other smooth surfaces from harmful contaminants.

Directional Control Valve not Changing Position

Source/Symptom	Possible Problem	Recommended Action
Coil not picking up	• Electric failure	• Fix electric failure and check mechanical spool movement.
Valve spool stuck	• Impurities between spool and sleeve • Valve pilot not working	• Replace valve. • Replace or clean piloting part.

Directional Control Valve not Changing Position (cont.):		
Source/Symptom	Possible Problem	Recommended Action
Proportional valve not responding	• Valve not receiving set value from program • Set value received but valve not responding	• Locate and fix electric failure. • Replace the proportional valve.

Air Valves

Source/Symptom	Discussion/Recommended Action
Low voltage problems	Applying low voltage to an AC solenoid valve will cause the solenoid coil to draw high inrush current continuously and burn out, because there won't be enough magnetic force to seat the armature of the valve. Causes of low voltage include high resistance connections; and low voltage on the control transformer that powers the circuit.
Voltage transients	Solenoid burnout may be caused by high transient voltages that break down coil insulation, causing short circuits to ground. This problem is most common where solenoids are connected to voltage sources that supply motors and other inductive loads. Switching such loads on and off can cause very high voltage peaks that will be seen by all components in the circuit. The remedy is to isolate the solenoid circuits. Use 120 V control circuits and observe good grounding practices. Electrical filter networks may also be used.
AC hum	If the solenoid noise level is very high and occurs each time the solenoid is energized, operate the manual override to check to see that the armature is seating. If the noise decreases, it indicates incomplete solenoid motion. Clean all moving parts and check for correct voltage supply. Extremely loud AC hum can be caused by a broken part within the solenoid. In this case, replace the solenoid.
Valve spool stuck	The armature may be held unseated because a valve spool won't shift. The solenoid will draw high inrush current for too long a time and burn out. A metal-to-metal spool-type valve may be varnished in place, or dirt may prevent the spool (and the solenoid armature) from shifting. Repair or replace.

Air Valves (cont.):	
Source/Symptom	Discussion/Recommended Action
Temperature problems	Solenoid failure can be expected when a valve is operated above its rated temperature. Insulation may fail, causing shorts to ground or shorts between turns of the coil. If ambient temperatures are too high, consider moving the valve or using a pilot-actuated valve with a remote pilot valve.

Air Cylinders

Source/Symptom	Discussion/Recommended Action	
Drift	Piston seal leaks can cause a cylinder to drift from its normal position. To check the seal, pressurize one side of the piston and observe leakage from the opposite side. Virtually no air should leak past pistons equipped with soft seals. Replace seals as needed. Other circuit leaks can cause a cylinder to drift. Check for leaks through the directional control valve (internally and externally) and in connecting lines. Fix leaks as needed.	
No movement	• Pressure too low	• Check pressure at cylinder to make sure it meets circuit requirements.
	• Piston seal leak	• Operate valve to cycle cylinder. • Observe fluid flow at valve exhaust ports at end of cylinder stroke. • Replace piston seals if flow is excessive.
	• Scored cylinder bore	• Replace necessary parts. • Eliminate contaminants from air supply.
Erratic movement	• Load misalignment	• Re-align cylinder and load.
	• Large difference between static and dynamic friction	• Install flow control valves to provide back pressure to control stroke.

Air Cylinders (cont.):		
Source/Symptom	Discussion/Recommended Action	
Cylinder body seal leak	• Loose tie rod	• Repair or replace.
	• Excessive pressure	• Repair or replace.
	• Pinched or extruded seal	• Repair or replace.
	• Seal deterioration-soft, gummy	• Repair or replace.
	• Seal deterioration-hard, brittle. Usually due to temperature extremes.	• Repair or replace.
	• Seal deterioration-wear	• Repair or replace.
Rod gland seal leak	• Torn or worn seal	• Examine piston rod for dents, gouges or score marks. Repair or replace. • Check gland bearing for wear. Repair or replace.
	• Pinched or extruded seal	• Replace gland seal.
	• Seal deterioration-soft, gummy	• Check compatibility of seals with lubricant. • Replace with new seals.
	• Seal deterioration-hard, brittle. Usually due to temperature extremes.	• Replace seals and shield cylinder from temperature extremes.
	• Seal deterioration-wear	• Replace seals.

Air Cylinders (cont.):		
Source/Symptom	Discussion/Recommended Action	
Contamination in circuit	• Sealing compound inside fittings	• Protect fittings during storage. • Follow proper sealing procedures. • Disconnect cylinder from circuit and attempt to clear debris from lines by aggressive air blast.
	• Improperly filtered feed pipes	• Evaluate circuit design, consider adding pre-filters.
	• Burrs inside piping components	• Components and/or piping not protected during repairs and/or storage. • Disconnect cylinder from pipes and remove burrs. Clear remaining debris from lines with aggressive air blast.
	• Seals extruding from excessive pressure	• Troubleshoot cause for excessive pressure and make changes to prevent. • Re-set seals if possible, otherwise clean and re-seal.
	• Generally excessive dirt in circuit	• Wipers or boots were not used on cylinders where needed. Evaluate circuit design, consider adding wipers or boots to cylinders.

This white paper combines technical information obtained from Valmet personnel and published Valmet articles, technical manuals and papers.

Valmet provides competitive technologies and services to the pulp, energy and paper industries. Valmet's pulp, paper and power professionals specialize in processes, machinery, equipment, services, paper machine clothing and filter fabrics. Our offering and experience cover the entire process life cycle including new production lines, rebuilds and services.

We are committed to moving our customers' performance forward.