# Hydraulic System Maintenance Checklist

## Introduction

### Importance and individuality of hydraulic maintenance schedules

The best schedule for preventive maintenance of individual machines can only be determined over time by understanding the usage and operating conditions of the various hydraulic components. For example, an industrial piston pump might only need to be replaced after 10,000 hours of full load running while a mobile pump might need replacing after 1000 hours of full-load operation. The difference is primarily due to design and operating conditions although good maintenance and fluid quality will have a major effect.
Therefore the following schedules are intended as guidelines. Experience and operating conditions will determine actual schedules. Refer to OEM datasheets for specific maintenance instructions.

## General Maintenance: e.g. Start-up, daily, continuous running.

### Visual inspection checks

- Review service books for any recorded incidence.
- Ask previous operators about any in-service or maintenance issues.
- Condition of hoses for wear, damage, scuffing, seepage.
- Evidence of external damage to components or equipment.
- Reservoir fluid levels.
- Reservoir fluid temperature.
- Evidence of fluid leaks or weeping.
- Pressure gauges reading normal.
- Filter clogging indicators.
- Evidence of air breather debris/clogging.
- Cylinder rod pitting, damage, or rust.
- No unusual noises from pumps, valves, and actuators.
- Ensure surfaces, components, and drip trays are clean.

(Learn about contamination at www.e4training.com/hyd_princip/contam1.php
Hoses, filters and fitting at www.e4training.com/menuancillary1.php)

### Contamination and test meters

- Fluid contamination levels if a continuous meter is fitted.
- Timing sequence changes.
- Pipework temperatures including heat exchangers.
- Visible changes or anything unusual.)

(Learn about measurement and instrumentation at www.e4training.com/menuinstrument1.php)

### Reporting

Record all non-conformities in the maintenance record book.

# Filter element replacement checklist:

## Preparations

- Review service books for the last change date.
- Check new element part number and rating against original and specification.
- Check element rating against circuit or system requirements.
- Prepare tools, drip tray, and lint-free cloths.
- Prepare area against loss of fluid into the environment.

## Safety checks

- Power unit or supply must be isolated and tagged out.
- System loads safely isolated or supported.
- Accumulators and pressurised tanks vented.

(Learn about the risks of fluid power at www.e4training.com/hyd_maint/fluid_risk1.php)

## Filter element replacement

- Thoroughly clean the outside surfaces of all components to be worked on.
- Break the fluid siphon by cracking lines, if no check valves are present.
- Remove filter bowl and extract dirty element.
- Examine fluid quality for damage, keep sample for later comparison/analysis.
- Check filter debris for signs of contamination source or components starting to fail.
- Clean filter bowl and connections with a lint-free cloth.
- Check seals and connection threads for damage.
- Install new element and replace bowl.
- Re-open all isolators that were closed for maintenance.
- Check reservoir fluid levels.
- Restart system following the start-up procedure.
- Update service book details.

(Learn about the risks of fluid power at www.e4training.com/hyd_ancillary/filters1.php)

# Periodic Maintenance: e.g. weekly, monthly

## Preparations

- Review service books for historical data.
- Check hose replacement dates in hose register.
- Check instrumentation is within calibration periods.
- Faimiliarise yourself with the equipment maintenance manuals and procedures.
- Faimiliarise yourself with the circuit drawing, operation, and components.
- Prepare area against loss of fluid to protect the environment.
- Prepare tools, drip tray, and lint-free cloths.
- Thoroughly clean equipment, components, and pipework.

## Baseline recordings

- Start a new maintenance record sheet. Note the ambient temperature plus key parameters such as the following measurements and observations.
- Check all connections for fluid leaks, moisture, or seepage. Mark any loose connections with clear lines that show the current nut vs fitting angle.
- Measure fluid cleanliness to ISO 4406 or equivalent.
- Measure the pressure and temperature ranges under steady-state, normal, and worse case operating conditions. Ensure readings stay within the component and system design limits.
- Check the equipment is being operated within the manufacturer's specified operating limits.
- Look/listen for any unusual noises, irregularities, or operational issues.
- Compare operation, sequence, or timings with previous data.
- Check pressures levels on gauges or at every test point.
- Record electronic feedback signals or other monitoring devices.
- Measure pump, case drain, electric motor, valves, solenoids, and pipework surface temperatures looking for suspect hot spots.
- If fluid aeration is suspected or sharp, cavitation-style cracking heard around the pump then inspect the reservoir for air bubbles or fit a clear suction hose.
- Test emergency stop buttons operation and location
- Measure electric motor current in all 3 phase legs
- Write down all measurements and observations clearly.

(Learn about measurement and instrumentation at www.e4training.com/menuinstrument1.php)

## Safety checks

- Complete/review appropriate risk assessment.
- Ensure power unit or supply is isolated and tagged out.
- Ensure system loads are safely isolated or supported.
- Check all accumulators and pressurised systems vented.

(Learn about the risks of fluid power at www.e4training.com/hyd_maint/fluid_risk1.php)

## Typical maintenance requirements

- Replace fluid filter elements and examine debris for traces of early component failure.
- Replace air breather filter elements and note clogging levels.
- Check and clean the strainer in the cooling water pipe (if fitted).
- Tighten all loose connections observing the fitting manufacturer instructions. Replace elastomer seal (if fitted) or with a new fitting (preferably an appropriate, modern leak-free design) if leaks persists.
- Check age (manufacture date on side) and condition of hydraulic hoses. Replace any hose with signs of wear, cracks or aging.
- Check hose guarding and/or tethering system.
- Check actuators for signs of wear. Particularly cylinder rods, seal, and pivots. Plus motor shafts and seals.
- Check flexible couplings for excessive play, wear, or signs of misalignment.
- Check accumulator pre-charge pressure.
- Check valves, solenoids, and pipe clamps, etc are secure with fixings tight.
- Readjust and reset all control valves that show inconsistencies or drift in the baseline tests. Always check the equipment maintenance manuals and component datasheets as every machine will have different set-up and operating settings.
- Check bolt torque in key areas such as pumps, electric motors, actuators, etc.
- Check limit switch actuators and mountings for tightness or damage
- Check guarding and safety barriers in place and secure.
- Check wire tightness at the terminal strip and wire routings are secure and undamaged.
- Record all maintenance observations and activities in the service book.

(Learn about hydraulic maintenance at www.e4training.com/hyd_maint/ with training exercises at www.e4training.com/Hydraulic_projects/skidmaint1.php. Learn about components at www.e4training.com/hydraulic_valves/)

## Planned Maintenance: e.g. 6 monthly, annually, during shutdowns

Scheduled maintenance shall follow all of the steps listed in the periodic maintenance including the following additional actions.

- Send a fluid sample to the manufacturer or fluid testing service to check for contaminants and wear. The oil sample should be analyzed for viscosity, wear metals, particle count and the neutralization value.
- If the fluid condition is poor and needs to be replaced. Drain the power unit fluid reservoir and thoroughly clean inside the tank.
- If the fluid is to be re-used, make sure to drain and store it in clean containers.
- When re-filling the reservoir, make sure to filter the new or re-used fluid through an appropriately rated filter.
- Pumps may be changed against running hours or PQ test results. (Learn about pumps at www.e4training.com/hydraulic_pumps/)
- If operating times are slow, measure/compare case drain flow under consistent operation with 'appropriate' flow meter or over time into a bucket.
- Check the pump and motor flexible drive couplings.
- If the servo, or high-performance proportional valves require service, notify the component manufacturer or a service engineer authorized by that manufacturer to perform maintenance.
- Check the condition of the hydraulic system by testing all hydraulically actuated components.

### Final release test

- Follow the start-up procedure before restarting equipment (Learn about start-up procedures at www.e4training.com/hyd_maint/operate1.php).
- Repeat the baseline tests to ensure the machine is working within approved limits
- Record measurements and observations in maintenance record book.

# Hydraulic Maintenance Key Factor Overview

The following are often the most important factors for ensuring a long and reliable operation.

## Fluid Cleanliness

Fluid contamination is generally accepted as the most common cause of breakdowns in hydraulic systems. Use an ISO 4406 inline particle counter to monitor fluid cleanliness. Analyse the dirt particles to find out what is failing and potentially why.

**Dirt gets in** via the air breather and cylinder rods. Use a good air filter, keep cylinder rods retracted and the environment clean, when possible. Heavy duty operation (outside manufacturer's spec) can cause internal wear, which creates dirt, that leads to more wear. Breaking the circuit for maintenance etc will allow dirt into the system so keep to a minimum.

**Take dirt out** by regularly checking filter clogging indicators and changing filter elements before their efficiency reduces too much.

## Fluid Quality

Good fluid lubricity and hydrostatic film thickness are vital for maintaining reliable operation. These can be damaged by the using the wrong fluid, high temperatures, high shear forces , or elevated air or water content. Always make sure the fluid operates within the correct temperature/viscosity range for the each component.
Change fluid based on condition rather than age
Do NOT mix fluids, although if the type of fluid is changed then a small amount of mixing (<5%) due to residues inside of the drained pipework, should be acceptable.

## Leakage

Hydraulic fluid leakage should NOT happen in modern industrial or mobile equipment. Leakage is an environmental and safety hazard as well as an unnecessary expense. Always follow the manufacturer's instructions when retightening leaking fittings or re-pipe with modern, leak-free fittings if leakage persists. Replace elastomer seals if seepage or moisture is visible and always check the date of manufacture of new seals.

## Control valves

Don't remove relief valves to check settings; it only lets dirt in.
If only one system is showing evidence of poor performance then identify the relevant valve and measure individual pressure and flow valves to diagnose issues.

## Condition monitoring

Modern condition monitoring sensors can constantly monitor equipment operation and help spot potential issues early. Analyse data if available or consider fitting sensors if not.

## Education and training

It's vital to have well-trained staff who are familiar with the equipment and operating procedures required.