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General operating instructions for assembly, commissioning and maintenance

1.1 General information and the purpose of this document

This operating and maintenance manual provides only general information regarding the assembly, operation and maintenance of systems and components from HAWE Hydraulik SE. The documentation for individual components and the operating and maintenance manual of the specific complete system must also always be observed.

Proper operation and maintenance substantially increases the service life of hydraulic components and systems and significantly contributes to functional reliability.

Supplementary applicable guidelines

- VDI 3027 "Initial operation and maintenance of oil-hydraulic systems"
- DIN 24346 "Hydraulic systems"
- DIN EN ISO 4413 "Hydraulic fluid power - General rules and safety requirements for systems and their components"

2 Assembly

2.1 Basic preparation

- Check stored parts for completeness and possible shipping damages.
- Check that the delivered components are complete and undamaged.

Note

Dirt must not enter the power pack. Otherwise, the power pack may be damaged.

- Ensure the power pack is completely clean.
- Keep all pipes, hose lines, fittings and couplings of the power pack clean.
- Carry out all work on the power pack in a clean environment.
- Clean hands and clothing before working on the power pack.

- Before installation: Clean the outer surfaces of the power pack (tank, lines, motor etc.) and then continue to keep them clean.
- Carry out the assembly in a clean workspace.
- Dirt or moisture must not enter the hydraulic fluid.
- Always close open connections with a protective cover, even if the connections are only open for a short time.
2.2 Preparing for assembly and commissioning

- Always use the standard lifting lugs and transport equipment.
- Valve contact surfaces must be level. For flangeable valves, the contact surface must also be clean and free of scratches and correspond to the prescribed surface finish.
- Tighten the fastening screws equally with the specified torque. This prevents undesirable tension and subsequent malfunctions.
- Select pipes, hoses and fittings/flanges in the correct pressure stage (wall thickness, material). Only use a seamless precision steel tube.
- Observe the installation information from the fitting manufacturer. This prevents external leakages on the connection points.
- Hemp or Teflon (PTFE) tape must not be used! State of the art, widely available assembly material makes hemp or Teflon (PTFE) tape definitely superfluous!
- Route pipe and hose lines correctly and according to the applicable standards. Avoid mechanical tension or chafing of the hoses on other components without fail.
- Fill oil tank with the correct hydraulic fluid (also see Oil recommendations: D 5488/1). Ensure that the hydraulic fluid corresponds to the required cleanliness level.

**Note**
- The system and all components, in particular the seals, must be suitable for the hydraulic fluid.
- The absolute fineness of the filter must be at least the same as the filter installed in the system.
- Fill the hydraulic fluid through the system filter or a mobile filter station, up to the top marking of the fill level monitor.

- Charging hydraulic accumulators

**Note**
Hydraulic accumulators are subject to the safety regulations that apply locally to the installation location.
- Use only nitrogen as filling gas.
- Depressurise the system on the oil side. Fill with nitrogen until the gas pre-load pressure \( p_0 \) specified in the documentation is reached.
- Installation types for accumulators:
  - Diaphragm accumulators can be installed as desired.
  - Bladder accumulators are preferably installed vertically with an oil connection underneath.
  - Piston type accumulators are almost always installed vertically.

**Danger**
Risk to life due to hydraulic accumulators potentially exploding if they are not filled correctly!
- Risk of serious injury or death.
  - The maximum operating pressure, filling pressure and temperature range of the hydraulic accumulator must be suitable for the operating conditions.
  - Fill hydraulic accumulators only with \( \text{N}_2 \) (nitrogen).
  - Only use suitable filling and testing devices.

- Connect the drive motor to the power supply.
- Connect electromagnetic valves and sensors to the power supply.
### 3 Initial operation

#### 3.1 First test run

- The test run may only be carried out by technically qualified personnel from the machine manufacturer or by maintenance personnel.
- Release the pressure on all pressure control valves (pressure reducing and pressure-limiting valves) and also the pressure controllers of variable pumps and set to the minimum value. Sealed TÜV pressure-limiting valves are exempt.
- Open shut-off valves and throttle valves as wide as possible.
- Briefly start the drive motor to verify that the rotating direction is conforming the specification of the pump.
- Verify that all valves are in their desired position (acc. to the hydraulic circuit plan).
- Fill pump housing with hydraulic fluid. This prevents bearings and power unit components from running dry.
  (also see the relevant operating and maintenance manual for the pump).
- Briefly start the power pack and observe that no unusual noise can be detected.
- Bleed the hydraulic system:
  Carefully loosen top screw fittings or dedicated bleed screws, but do not remove them.
- The bleeding process is complete when the hydraulic fluid flows out without bubbles. At this point, re-tighten fittings/screws. Also switch the pump motor on and off again several times.
- Rinse the system:
  Perform all the functions of the hydraulic system a few times without load until the they run smoothly and in the pre-defined time.
- Once the operating oil temperature has been reached (at least 40°C), check the system under load. To do this, slowly raise the pressure to the set point while constantly monitoring the pressure gauge.
- Check the surface temperature of pumps and motors (max. 80°C).
- Monitor hydraulic fluid level and re-fill hydraulic fluid if required.
- Check proper setting/function of all safety and pressure limiting valves either by external load or abrupt deceleration of the application.
- Check for external leaks.
- Switch off drive.
- Check and retighten all mounting screws, fittings etc. with the specified torque, even if no leaks are visible.

⚠️ **Danger**  
**Risk to life due to hydraulic accumulators potentially exploding if they are not filled correctly!**  
Risk of serious injury or death.
- The maximum operating pressure, filling pressure and temperature range of the hydraulic accumulator must be suitable for the operating conditions.
- Fill hydraulic accumulators only with N₂ (nitrogen).
- Only use suitable filling and testing devices.

⚠️ **Caution**  
**Risk of injury due to pressurised parts.**  
Risk of minor injury.
- Release the pressure in the system before re-tightening screws and valves.
Questions for the next work steps

- The following questions must be answered with "no" before the next steps:
  - Have the changing pressure loads indicated inadequate fitting of pipelines?
  - Have the changing loads resulted in chafing of the hose lines on other components?

Functional check of the complete system:

- Compare measured values with the standard or maximum permissible values.
- Check the reached adjustment and rotation speeds against the targets.
- Re-adjust the control units if required.

- The following observations point to inadequate bleeding. Repeat the bleeding process in the following cases:
  - Jerky movements or adjustment speeds are not reached.
  - Foam forms on the surface of the hydraulic fluid.
- Check the operating temperature regularly.

3.2 Initial operation of complex systems or systems with several simultaneous consumer movements

When commissioning such systems, it is often necessary to take multiple measurements (e.g. multiple pressures, electrical signals, routes, speeds, flow rates etc.) at different measuring points simultaneously. The mutual influence or the targeted interaction of the consumers should be monitored with this.

These measurements and therefore optimisation cannot generally be carried out with conventional measurement devices (such as pressure gauges, thermometers, electrical multimeters etc.). This applies to systems such as machine tools, crane controls, machines with electro-hydraulic controls and others.

HAWE Hydraulik therefore recommends contacting the service department of the system manufacturer.

Warning
Danger of injury and material damage due to incorrect installation, operation and maintenance!
Risk of serious injury or death.
- Ensure that the power pack is installed, operated and maintained by qualified and trained specialist personnel only.
- Before staff work on the power pack, ensure they are trained and instructed by the manufacturer.
- Please note that incorrect installation, operation and maintenance may result in material damage.
3.3 Most frequent mistakes during initial operation

- Insufficient cleanliness during assembly.
- Valves are strained or fitted with the incorrect torque.
- The hydraulic fluid was not filtered or the required cleanliness level was not complied with.
- The hydraulic system was not checked before commissioning.
- Hydraulic fluid has leaked during subsequent conversion.
- System parts were not bled or were insufficiently bled.
- Pressure-limiting and safety valves were set too closely above the operation pressure (closing hysteresis is not observed).
- The flow direction that is sometimes predetermined in valves was not complied with.
- Loud mechanical noise, particularly from the pump, was ignored.
  Possible causes of mechanical noise:
  - Cavitation
  - Leaking suction line
  - Pump and motor incorrectly adjusted
- The switching hysteresis of mechanical pressure switches that is dictated by design was not considered when setting the pressure switch.
- Hydraulic pump housing and hydraulic motor housing were not filled with hydraulic fluid before commissioning.
- The technical adjustment values were not documented or the correct standard values are missing.
- Adjusting spindles were not secured/locked or sealed.
- Insufficient qualification of staff.
HAWE power packs and components have been designed to enable fault-free operation over a long service life. However, regular maintenance will need to be planned and carried out, taking into account the length of time for which the power packs and components are switched on, their switching frequency, the potential consequences in the event of a failure and the availability or guarantee time required.

Instructions in addition to the general operating and maintenance manual must also be observed (see Chapter 7, "Con-current documents").

The standard DIN 31051 defines the following tasks under the generic term "maintenance":

- Inspection
  - Identifying and assessing the actual status.
  - Clarifying how and why the depletion of the so-called wear reserve is continuing.

- Maintenance
  - Preserving the target status.
  - Taking precautions to ensure that the depletion of the wear reserve is kept as low as possible during continuous operation through appropriate maintenance work.

- Repair
  - Re-establishing the target status.
  - Rectifying functional restrictions, malfunctions and replenishing the wear reserve. Inspection, maintenance and repair work often overlap in practice and are not so strictly separated as defined in accordance with standards.
4.1 Inspection

Regular tasks to be carried out are recorded in the so-called maintenance or inspection lists. In this way, employees with different qualifications can carry out individual tasks reliably.

The most important tasks for the inspection:

- Checking the hydraulic fluid level in the tank.
- Checking the cleanliness/condition of the hydraulic fluid.

**Note**
A check without a laboratory test is only able to provide a rough estimate of the condition of the hydraulic fluid. The following indicate that the condition is poor:
- Milky cloudiness in the hydraulic fluid.
- Darker appearance than when it was filled.
- Sediment in the fluid reservoir.
- A smell of burnt oil.

- Checking the visual clogging indicators of filters or differential pressure switches during operation (if present).
- Checking the hydraulic fluid temperature during operation (usually <60°C, max. 80°C).
- Checking pressures and adjustment speeds.
- Checking for external leakage (visual check).
- Checking the pipeline system for loose fittings and hoses for chafing.

**Caution**
Risk of injury from damaged pipes and hose lines.
Risk of cuts.
- Immediately replace any damaged pipes and hose lines.

**Warning**
Slip hazard due to escaping hydraulic fluid puddles!
Risk of minor or serious injury.
- Remove hydraulic fluid using suitable binding agents.
- Dispose of binding agents according to local regulations.

- Checking hydraulic accumulators (visual check).
- Checking the electrical supply lines of the motor, solenoid valves, sensors, pressure switches etc. (visual check).
4.2 Maintenance

An overview of inspection and maintenance intervals can be taken from table 1 in Chapter 7, "Con-current documents".

The most important maintenance work

- Checking hydraulic fluid and replacing if necessary.
  - The permissible period of use depends on the operating conditions (e.g. tank size, number of throttle points), but particularly on the average operating temperature. 80°C should be the maximum value (lower for hydraulic fluids with water content) (+10K equates to a service life reduction of 50%).
  
  - Mixing different types of fluids may lead to undesirable chemical reactions such as sludge formation, resinification or similar. If the hydraulic fluid needs to be changed, it is essential to contact the oil manufacturer and to flush the system thoroughly.

- Completely drain the hydraulic fluid at operating temperature and dispose of it properly.
- Heavily aged or contaminated system fluid is not improved when new hydraulic fluid is added.
- Only fill via the system filters or via filters that have at least the same deposition rate as the installed filters.
- Take oil samples regularly and test them for particle type, size and quantity. Document values.
- Checking the settings for system and control pressure.
- Documenting any pressure corrections.
- If the power pack needs to be readjusted repeatedly in order to get back to the intended pressure:
  - indication of the wear of the pressure valve. Checking the pressure control valve and replacing if necessary.
- Looking for leakages in the pipe system.

Caution
Risk of injury due to pressurised parts.
Risk of minor injury.
- Release the pressure in the system before re-tightening screws and valves.

Note
Leakages at connection points which are sealed with deformable seals (O-rings, moulded sealing rings etc.) cannot usually be resolved by re-tightening (observe the permissible torque) because in such cases these sealing elements are either destroyed or hardened. The sealing elements must be replaced with new ones.

- Checking the function of control and monitoring elements (pressure gauges, pressure switches, etc.).

Caution
Danger of burning due to hot metal surfaces on the power pack, particularly on the power pack tank, electric motor, valve blocks and valves.
Risk of minor injury.
- Wear protective gloves.
- Allow the power pack to cool down before touching it.
- Disconnect the power supply before touching the heating element.
4.3 Repair

Identifying and locating causes of damage

Troubleshooting

- Successful troubleshooting within a hydraulic system is largely based on detailed knowledge of the assembly, the operation and the interaction of the individual components.

- All essential documentation files should be available. The ability to read hydraulic or electro-hydraulic schematics is generally required in order to understand these files.

- Correctly functioning measurement devices (thermometer, electrical multimeter, industrial stethoscope, stopwatch, tachometer etc.) are indispensable tools.

Corrective action

- Ensure the highest degree of cleanliness during all work. Clean the workspace before loosening fittings.

- Defective devices should generally not be repaired on site because usually the tool required will not be available or the required level of cleanliness will not be obtained in order for the repairs to be carried out properly.

- The aim should be to only replace entire components on site, or at least parts that can be tested individually. As a result downtimes are minimised, troubleshooting is simplified and hydraulic fluid losses are kept to a minimum.

- It is important to clarify whether the malfunction of the repaired/replaced component could result in the risk of damage occurring in the hydraulic circuit due to increased metal abrasion or even debris.

- After the actual damage is rectified, it should be clarified whether there was a primary cause for the malfunction (e.g. filter fineness was too low, inappropriate maintenance intervals etc.). This primary cause must then be resolved.
Disassembly and disposal of the power pack may be carried out by qualified staff only.

Decommissioning the power pack as old equipment: Comply with the currently applicable laws and regulations regarding disposal.

Caution
Danger of burning due to hot metal surfaces on the power pack, particularly on the power pack tank, electric motor, valve blocks and valves.
Risk of minor injury.
- Wear protective gloves.
- Allow the power pack to cool down before touching it.
- Disconnect the power supply before touching the heating element.

Note
recommends the following for disposal of power packs by refuse type:
- Mixed scrap: valve bank, valve control, control block
- Electronic waste: switch box, pump housing with motor, heating element
- Scrap iron: Metal frame, accumulator (unpressurised), gear pump
- Waste oil: hydraulic fluid

If the components cannot be disposed of by separate refuse types, the entire power pack may be disposed of as mixed scrap.
However, the hydraulic fluid must be drained beforehand. Dispose of the hydraulic fluid as waste oil.

Note
- Do not release hydraulic fluid into the environment.
- Collect cleaning, operating and lubrication fluids and consumable materials in suitable containers and dispose of them according to local regulations.
Storing hydraulic fluids and hydraulic components

Storage conditions for hydraulic components depend primarily on the following factors:

- seals utilised, moistening with oil during the factory functional test

The storability of rubber materials is generally influenced by the following factors:

- Warmth, light, humidity, oxygen, ozone

As far as possible, components should be de-energised and without deformation when stored. A storage temperature range of 15 to 20°C is optimum. Relative humidity approx. 65% (+-10%). Exposure to direct sunlight or a light source with strong UV rays should be avoided.

Ozone-producing equipment (electric motors, high-voltage equipment) among other things must not be present in the storage room.

If seals are packaged in plastic bags, these should not contain any plasticisers and, if necessary, should be impermeable to UV light.

Details on storage of elastomers are also available in the following standards:

Hydraulic fluids can be stored for an unlimited period in sealed containers supplied by the manufacturer, as no chemical reactions take place. The presence of atmospheric oxygen, dust and moisture can lead to more or less rapid oxidation and resinification, depending on the type of oil and its additives.

A dark room with virtually constant temperature and humidity is recommended for storage of hydraulic components. The parts should be kept in a plastic bag to protect them from dust and continuous air exchange.

A functional test (manual override, dry switching) should be carried out at least once a year to ensure operation.

Safety-related components: A six-monthly functional test on site and a regular factory inspection including seal replacement every 2 years.

When the hydraulic components are stored as described above, the risk of corrosion is low. Most external parts of HAWE components are coated with a protective layer (galvanised, nitrided) and moistened with oil.
7 Con-current documents

- **Oil recommendations:** D 5488/1
- Specific product documentations e.g. product related service notes, hydraulic circuit plans, technical drawings, test protocols, technical supplements etc.

<table>
<thead>
<tr>
<th>Inspection- and maintenance intervals</th>
<th>During start</th>
<th>During standard operation always after</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>daily or permanent</td>
<td>1 week or 40 h</td>
</tr>
<tr>
<td>Hydraulic fluid</td>
<td></td>
<td></td>
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<tr>
<td>Filing level</td>
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<td>●</td>
</tr>
<tr>
<td>Service temperature</td>
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</tr>
<tr>
<td>Condition (fluid sample)</td>
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<tr>
<td>Change</td>
<td></td>
<td>●</td>
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<tr>
<td>Filter</td>
<td></td>
<td></td>
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<tr>
<td>Replacement/inspection of filters</td>
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<tr>
<td>without clogging indicator</td>
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<td></td>
</tr>
<tr>
<td>Monitoring of the clogging indicator</td>
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<td>●</td>
</tr>
<tr>
<td>Cleaning of the breather filter</td>
<td></td>
<td>●</td>
</tr>
<tr>
<td>Replacement of the drying filters</td>
<td></td>
<td>●</td>
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<tr>
<td>(silica gel)</td>
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<tr>
<td>Accumulator</td>
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<tr>
<td>Check gas pre-load pressure p₀,</td>
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<tr>
<td>check mounting</td>
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<td></td>
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<tr>
<td>Set values</td>
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<tr>
<td>Pressure-, flow valves, pump</td>
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<tr>
<td>controllers, monitoring devices</td>
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<tr>
<td>Cooler</td>
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<tr>
<td>Clean fluid/air-cooler</td>
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<tr>
<td>Other controls</td>
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<td>External leaks</td>
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<tr>
<td>Test equipment</td>
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<td></td>
</tr>
</tbody>
</table>

1) Inspection or maintenance intervals for operation < 500 h / year
Further information

HAWE Hydraulik supplies compact, energy-saving and durable hydraulic components and systems. These are characterised by the following, for example:

- Consistent use of steel (no parts exposed to pressure made of cast-iron or aluminium)
- Components designed for high pressures
- Compact design (requiring minimal space)
- Zero leakage or controlled minimal leakage
- Approved for special operating conditions (e.g. ATEX)

Further information on HAWE Hydraulik and our range of products can be found at:

HAWE global contact person: Addresses of offices and representatives (international).