en **Service manual**

L 507-1259

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Preface

Notes for the user

This service handbook is designed for trained specialists of the Liebherr organisation and their dealers.

This service handbook contains special knowledge for repairing Liebherr construction machines. Basic specialist knowledge on electronics, hydraulics, mechanics and engine technology is not contained in this service handbook. Therefore specialized training and qualifications are necessary. Liebherr recommends participation in the Liebherr training program for construction machines.

In this service handbook you will find information on:
- Special tools
- Technical data
- Maintenance intervals and maintenance tasks
- Testing and adjustment tasks
- Structure and function descriptions
- Removal and installation tasks
- Circuit diagrams, hydraulic plans and technical drawings

You will find information on controls and operation in the operating instructions. Information on spare parts are in the spare parts catalogue. Please observe the local accident prevention laws.

Technical changes are reserved.

Warning symbols

	This is the warning symbol. It warns you of potential injuries. To prevent injury or death, carry out all the measures identified by this warning symbol.

The warning symbol always appears together with the signal words
DANGER
WARNING
CAUTION

	**DANGER**	Indicates a hazardous situation that will immediately lead to serious or fatal injury if it is not avoided.
	**WARNING**	Indicates a hazardous situation that may lead to serious or fatal injury if it is not avoided.

	**CAUTION**	Indicates a hazardous situation that may lead to minor or moderate injury if it is not avoided.
	ATTENTION	Indicates a hazardous situation that may lead to damage if it is not avoided.

Structure of warnings

Warnings in this document are structured as follows:

WARNING
Here you will find information about the type and source of danger.
Here you will be informed about possible consequences of not paying attention to the warning.

▶ Here you will be called on to take measures to avoid the dangerous situation.

Other designations

Symbol	Meaning
	**Note** Indicates useful tips and information.
▶	This symbol means: Carry out a task.
☐	This symbol means: Requirements must be fulfilled.
▷	This symbol means: Results of a task.
-	This symbol indicates a list.

Symbols

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010.1.1 General safety instructions

1. Familiarise yourself with the **"operating manual"** before starting up the machine.
   Make sure that you are in possession of and have read and understood additional instructions applicable to any special equipment installed on your machine.
2. Only expressly authorised personnel may operate, service or repair the machine.
   Observe the legal minimum ages.
3. Only trained or instructed personnel may operate the machine. Clearly assign responsibility for operation, rigging, maintenance and repair work.
4. Clearly establish the driver's responsibilities (also with respect to traffic regulations) and authorise him to refuse to carry out unsafe instructions from third parties.
5. Personnel undergoing training, instruction or who are not yet fully qualified may only be allowed to work on the machine under constant supervision by an experienced person.
6. Now and again check that your personnel are working safely and are aware of possible dangers in observance of the **"operating manual"** .
7. Wear safe working clothes when working on the machine.
   Do not wear rings, wristwatches, ties, scarves, unbuttoned jackets, loose clothing or similar garments, as they can become caught in the machinery and cause injury.
   Certain tasks require safety goggles, safety boots, hard hats, gloves, reflective vests, ear protection etc.
8. Ask the site manager about any special safety regulations in force on the site.
9. Do not hold onto the steering column, the control panel or the control levers when getting on or off the machine.
   You might inadvertently trigger movements which could lead to accidents.
10. Never jump down from the machine. Use the steps, ladders and platforms provided for getting on and off.
11. Keep all handles, steps, rails, gangways, platforms and ladders free from oil, grease, mud snow and ice. This reduces the risk of slipping, tripping up or falling.
12. Familiarise yourself with the emergency exit through the right cab door and/or the rear window.
13. Unless there are other instructions, perform maintenance and repair work as follows:

    Procedure:
    - Park the machine on firm, level ground and lower the working attachment to the ground.
    - Move all control levers to neutral.
    - Shut down the engine and take out the ignition key.
14. Before starting any work on the hydraulic circuit, you must also press the working hydraulics lockout button and actuate all pilot control units (joystick and pedals) in both directions in order to reduce the control pressure and accumulated pressure in the operating circuits. You must then reduce the internal tank pressure.
15. Lock the working hydraulics to prevent accidental actuation before leaving the driver's cab.
    Lock the working hydraulics in accordance with the instructions in the **"operating manual"**.

16. Secure all loose parts of the machine.
17. Never start up a machine without first making a thorough tour of inspection and checking if any warning signs are missing or illegible.
18. Observe all signs with warnings or safety instructions.
19. Special safety apparatus must be fitted to the machine for certain applications. If this is the case, only work with this apparatus fitted and in working order.
20. Do not make any modifications, extensions or conversions to the machine with possible safety implications without the approval of the supplier. This also applies to installing and adjusting safety apparatus and valves, as well as to welding load-bearing components.
21. Avoid standing near the diesel engine while it is running. People that have a pacemaker must not stand next to the diesel engine while it is running (minimum distance 50 cm).
22. Do not touch live components of the solenoid controlled unit pumps on their electrical connections.

010.1.2 Instructions on preventing crushing injuries and burns

1. Do not work under the attachment if it is not resting on the ground or supported.
2. Do not use any ropes or chains which are damaged or which have insufficient load bearing capacity.
   Wear protective gloves when handling wire ropes.
3. When working with the attachment, never align the boreholes with your fingers, instead, use a suitable mandrel for this purpose.
4. Make sure no objects come into contact with the fan when the engine is running.
   Objects which fall or project into the fan will be thrown back out or destroyed and could damage the fan.
5. When the machine is near operating temperature, the engine cooler system is hot and pressurised.
   Do not touch parts carrying cooling water.
   This can lead to burns.
6. Only check the coolant level once the cap on the expansion tank has cooled down enough to touch.
   Carefully open the cap to let out excess pressure.
7. When running at or near the operating temperature, the engine oil and hydraulic oil are hot.
   Avoid touching hot oil or parts which carry oil.
8. Wear goggles and safety gloves when working on the battery.
   Avoid sparks and naked lights.
9. Never let anyone move the bucket or other working attachments into position by hand.
10. Any time you open the engine compartment, prevent the compartment doors from falling shut using the struts provided.
11. Before starting up the machine, close and lock the engine compartment doors and the battery compartment cover.
12. Never lie under the machine when it is raised using the working attachment, unless the undercarriage is securely supported using wooden beams.
13. Avoid touching hot surfaces and liquids. This can lead to burns.

010.1.3 Instructions on preventing fires and explosions

1. When refuelling, the engine must be turned off. Switch off the auxiliary heater, if installed.

2. Do not smoke. Avoid naked flames when refuelling or where batteries are being recharged.
3. Always follow the instructions in the **"operating manual"** when starting the engine.
4. Check the electrical system.
   Immediately eliminate all faults such as loose connections, worn cables or burnt out fuses and bulbs.
5. Do not carry combustible fluids on the machine outside the tanks provided.
6. Regularly check all lines, hoses and bolted connections for leaks and damage.
7. Repair the leaks immediately and replace the damaged components.
   Oil escaping from leaks can easily cause fires.
8. Make sure that all brackets and protective plates are properly installed to prevent vibrations, abrasion and heat build-up.
9. Starting agent (ether) is a particularly dangerous fire hazard.
   Never use ether starting agent near head sources, naked lights (such as cigarettes) or in poorly ventilated spaces.
10. Do not use starting agents containing ethers to start diesel engines with preglow or flame glow systems.
    Otherwise there is a risk of **"Explosion"** !
11. Familiarise yourself with the location and use of fire extinguishers and find out about fire alarm and firefighting facilities on site.

010.1.4 Safety instructions for start-up

1. Each time you start up the machine, make a thorough tour of inspection.
2. Check the machine for loose bolts, cracks, wear, leaks and deliberate damage.
3. Never start up a damaged machine.
4. Make sure the damage is rectified immediately.
5. Ensure that all hoods and covers are closed and locked. Check that all the warning and instruction signs are in place.
6. Clean the windows and interior and exterior mirrors, and secure the doors and windows against inadvertent movement.
7. Make sure no-one is working on or underneath the machine. Warn any bystanders before you start up the machine.
8. After getting into the driver's cab, adjust the seat, the inside and outside mirrors, the control lever and the seat belt so that you can work comfortably.
9. Sound insulation equipment on the machine must be in place during operation.

010.1.5 Safety precautions during start-up

1. Before starting, check that all control lamps and instruments are working properly.
2. Move all control levers to neutral.
3. Before starting the engine, briefly sound the horn to warn anyone else in the vicinity of the machine.
4. Only start the machine when sitting in the driver's seat.
5. Unless otherwise instructed, start the engine in accordance with the instructions in the **"operating manual"** .
6. Start the engine and then check all display and monitoring equipment.
7. Only run the engine in enclosed spaces when there is sufficient ventilation.
   If necessary, open the windows and doors to ensure adequate fresh air.
8. Run the engine until both it and the hydraulic oil are at operating temperature.
   Low oil temperatures lead to sluggish performance.
9. Check that the attachment controls are working properly.

10. Carefully drive the machine to open ground and check the service brake, the steering, the signals and lighting.

010.1.6 Instructions for safe working

1. Before starting work, familiarise yourself with the features of the site, as well as any special regulations and warning signals.
   The working environment includes obstacles in the working area and on access roads, the firmness of the terrain and any protective barriers to prevent the public from entering the site.
2. Always keep a safe distance from overhangs, drops, slopes and unsafe terrain.
3. Be especially careful with variable terrain conditions, poor visibility and changeable weather.
4. Find out where the supply pipes to the site are, and be especially careful when working near them. If necessary, notify the relevant authorities.
5. Keep a safe distance away from overhead power lines.
   When working near overhead power lines, keep the attachment well away from them.
   - There is a risk of **"fatal injury"** .
   - Find out about the safety clearances to be observed.

   If the machine comes into contact with live power lines:
   - Do not get out of the machine.
   - If possible, move the machine to a safe distance away from the danger area.
   - Warn any bystanders not to approach or touch the machine.
   - Arrange for the power to be switched off.
   - Only get out of the machine when you are sure that the power line you have touched or damaged has been switched off.
6. Before driving or working with the machine, check that the accessories are safely stowed away.
7. When driving on public roads, paths and spaces, observe the traffic regulations, and make sure the machine is in a fit condition to use public roads if this is not already the case.
8. Always switch on the lights in darkness and poor visibility.
9. Do not take passengers on the machine.
10. Only work seated and wearing a safety belt.
11. Report any malfunctions and make sure that any necessary repairs are carried out immediately.
12. Take personal care to ensure that no-one is endangered when the machine starts moving.
13. Before starting work, check the brake system as instructed in the **"operating manual"** .
14. Never get out of the driver's seat when the machine is still in motion.
15. Never leave the machine unattended with the engine running.
16. When driving the machine, lower the working attachment to the transport position and carry the load as close as possible to the ground.
17. Avoid movements which could cause the machine to tip over.
    If the machine does start to tip over or slide sideways, put down the attachment immediately and point the machine downhill.
    Wherever possible, work up or downhill and not sideways to the slope.
18. Drive carefully on rocky or slippery terrain and on slopes.
19. Only drive downhill within the permitted speed limit, otherwise you could lose control of the machine.
    The engine must be running at the rated speed and you should only reduce the travel speed using the pedals.

Shift down to a lower gear before reaching the slope. Do not wait until you are actually on it.

20. When loading a truck, insist on the driver getting out of his cab, even if it is protected against stone impact.
21. When performing work such as demolition work, clearance and crane operation, always use the protective equipment provided for these specific tasks.
22. Have someone direct you when vision is restricted and whenever else it is necessary.
    Only let one person give you signals.
23. Only allow experienced personnel to sling loads and direct crane drivers.
    The person giving directions must remain in sight of the operator or at least be in spoken contact with him.

010.1.7 Safety instructions for driving on slopes

1. On downward slopes, always drive carefully and never at top speed, as you could otherwise lose control over the machine.

   Travel speeds:
   - Never exceed the speed limits specified in the **"operating manual"**.
   - Exceeding the maximum speed causes the permitted limits to be exceeded for all rotating parts, including the drive motor, the drive shaft, all gears including axles and ultimately the engine itself.
2. Before driving onto a slope, therefore select a travel range (gear) in which you can safely negotiate the whole slope without endangering yourself, the machine and other people.
3. Also, take your foot off the gas pedal when driving onto a slope.

010.1.8 Parking safely

1. When possible, always park the machine on flat, firm ground.
   If you have to park on a slope, use wheel wedges to prevent the machine from moving.
2. If the machine has articulated steering, engage the articulation lock.
   This only applies to wheel loaders with articulated steering.
3. Lower the digging attachment so that it is lightly anchored in the ground.
4. Move all control levers to the neutral position and engage the parking brake.
5. Shut down the engine in accordance with the instructions in the **"operating manual"** .
6. Lock the working hydraulics before leaving the driver's cab.
   Lock the working hydraulics in accordance with the instructions in the **"operating manual"**.
7. Lock up the machine, take out all keys and secure it against unauthorised use and vandalism.

010.1.9 Transporting the machine safely

1. Only use suitable transport equipment and lifting gear with sufficient load capacity.
2. Park the machine on flat ground and use wedges to secure the tracks or wheels.
3. If necessary, dismantle the working attachment for the duration of transport.
4. The ramp for driving onto the low-bed truck must not be steeper than 30° and should be covered with wooden boards to prevent slipping.
5. Clean the machine tracks or wheels of snow, ice and mud before driving onto the ramp.

6. Before driving on, secure the upper carriage to the undercarriage with the locking pin.
   Procedure: does not apply to wheel loaders.
7. Align the machine precisely with the loading ramp.
8. Attach the hand lever to the pedals for sensitive driving.
   Procedure: does not apply to wheel loaders.
9. Have someone give signals to direct the driver.
   Drive carefully onto the ramp and then on to the transport vehicle itself.
10. Have wedges ready to prevent the machine from rolling back when driving on.
11. Tilt the attachment in and drive onto the ramp.
    Keep the attachment close to the loading area.
12. After driving on, lower the working attachment onto the loading area.
    Apply the articulation lock (this only applies to wheel loaders with articulated steering).
13. Secure the machine and the remaining individual components against slipping using chains and wedges.
14. Relieve the pressure lines, take out the ignition key, lock the cab door and side panels, and get out of the machine.
15. Acquaint yourself with the route before transport, especially as regards the width, height and weight limits you will encounter.
16. Make a special note of any overhead power lines, bridges and tunnels along the route.
17. Apply the same care when driving off.

    Procedure:
    - Remove all chains and wedges.
    - Start the engine in accordance with the instructions in the **“operating manual”**
    - Carefully drive off the loading area using a ramp.
    - Keep the attachment close to the ground.
    - Have someone give you directions.

010.1.10 Towing the machine safely

1. Always observe the correct procedure as described in the operating manual**operating manual**.
2. The machine may only be towed in exceptional circumstances, for example to move it away from a dangerously exposed position for repairs.
3. Before pulling or towing the machine, check that all attachments and towing equipment are safe and secure.
4. The rope or bar used for towing must have sufficient tensile strength and be fastened to the holes provided on the front section.
   In no event are damage or accidents resulting from towing covered by the manufacturer’s guarantee.

   Instructions on towing by rope:
   - Make sure no-one is near the taut rope when towing.
   - Keep the rope taut and avoid kinks.
   - Carefully pull the rope taut.
   - Sudden jerks can cause a slack rope to tear.
5. When towing, keep to the prescribed transport position, speed limit and route.
6. When starting the machine up again, follow the instructions in the **“operating manual”** .

010.1.11 Measures for ensuring safe maintenance

1. Never attempt maintenance and repair work unless you are qualified to do so.

2. Observe the prescribed periods for regular checks and inspections or those specified in the **"operating manual"**.
   A suitably equipped workshop is absolutely necessary in order to perform repair work.
3. The table at the end of this **"operating manual"** states exactly who may carry out each job.
   The jobs listed under **"daily / weekly"** in the maintenance schedule can be carried out by the driver or by service personnel.
   The other jobs may only be carried out by suitably qualified specialist staff.
4. Spare parts must meet the technical requirements specified by the manufacturer. This is guaranteed if you use genuine spares. Spare parts which do not meet the manufacturer's technical specifications can impair the safety and reliability of the machine.
5. Wear safety overalls for maintenance work. Certain jobs not only require a hard hat and safety boots, but also goggles and safety gloves.
6. Keep unauthorised persons away from the machine during maintenance.
7. Set up an extended cordon around the maintenance area as necessary.
8. Notify the operating personnel before starting repairs or other special jobs. Nominate a supervisor.
9. Unless otherwise specified in the **"operating manual"** carry out all maintenance work on the machine on firm, level ground with the engine off.
10. Afterwards always re-tighten any bolts loosened during maintenance and repair work.
11. If safety equipment has to be dismantled for rigging, maintenance and repair work, it must be re-installed and checked as soon as the job is finished.
12. When undertaking maintenance jobs, especially under the machine, attach a warning sign marked **"DO NOT SWITCH ON"** to the ignition where it is clearly visible. Take out the ignition key.
13. Before starting maintenance or repairs, clean any oil, fuel or service fluids from the machine, especially connections and bolted joints. Do not use abrasive cleaning agents. Use fibre-free cloths.
14. Before welding, burning and sanding, clean any dust from the machine and the area around it, and ensure adequate ventilation.
    Otherwise there is a risk of **"Explosion"** !
15. Before cleaning the machine with water, steam jet (high-pressure cleaner) or other cleaning agents, cover or tape up all openings where water, steam and cleaning agent may not penetrate for safety reasons.
    Electric motors, control cabinets and battery compartments are at particular risk.

    Further procedure:
    - Make sure that during cleaning work on the machine housings, the temperature sensors for the fire alarm and extinguisher systems do not come into contact with hot cleaning agent. Otherwise the fire extinguishing system could be activated.
    - After cleaning, completely remove the covers and tape.
    - After cleaning, check all fuel, engine oil and hydraulic oil lines for leaks, loose connections, abrasion and damage.
    - Repair any defects immediately.
16. Follow the safety instructions for the product in question when handling oil, grease and other chemical substances.
17. Dispose of spare parts and consumables in a safe, environmentally sound manner.
18. Take care when handling hot operating and auxiliary materials (danger of burns and scalding).
19. Only operate combustion engines and fuel-powered heaters in sufficiently ventilated rooms. Before starting the engine inside a building, make sure the room is well ventilated. Follow the local regulations in force at the site.

20. Only carry out welding, burning and grinding work when it is expressly allowed, as otherwise you may cause fires or explosions.
21. Do not try to lift heavy parts. Only use suitable equipment with sufficient load capacity.

    Procedure:
    - When replacing individual parts and larger assemblies, carefully fasten and secure them to the lifting gear so that no danger can arise.
    - Only use suitable lifting gear in perfect order, and slinging equipment with sufficient load capacity.

    Keep out from under suspended loads.
22. Do not use ropes which are damaged or of insufficient load bearing capacity. Wear protective gloves when handling wire ropes.
23. Only allow experienced personnel to sling loads and direct crane drivers. The person giving directions must remain in sight of the operator or at least be in spoken contact with him.
24. When carrying out fitting work above head height, use the safety climbing aids and working platforms provided or equivalent. Do not use parts of the machine for climbing. Wear a safety harness when working at height. Keep all handles, steps, rails, gangways, platforms and ladders free from dirt, snow and ice.
25. When working on the attachment (for example replacing teeth), make sure it is properly supported. Avoid direct metal-to-metal contact.
26. Never lie under the machine when it is raised using the working attachment, unless the undercarriage is securely supported using wooden beams.
27. Always support the machine on blocks, so that it cannot become unbalanced by any shift in weight. Avoid metal-to-metal contact.
28. Only trained specialist staff may perform work on the chassis, brake and steering systems.
29. If you have to repair the machine on a slope, secure the wheels with wedges. Move the working attachment to the maintenance position and engage the articulation lock.
30. Only personnel with the requisite skills and experience may work on hydraulic equipment.
31. Wear protective gloves when looking for leaks. Under pressure, a thin jet of liquid can pierce the skin.
32. Never release hydraulic lines or bolts before setting down the working attachment and shutting down the engine.
    Before starting any work on the hydraulic circuit, you must also press the working hydraulics lockout button and actuate all pilot control units (joystick and pedals) in both directions in order to reduce the control pressure and accumulated pressure in the operating circuits. You must then reduce the internal tank pressure.
33. Regularly check all hydraulic oil lines, hoses and bolted connections for leaks and visible damage. Repair all damage immediately. Oil escaping under pressure can cause injury and fires.
34. Before beginning repair work, depressurise the system sections and pressurised lines (hydraulics, compressed air) which are to be opened, as instructed in the assembly descriptions.
35. Lay and fit hydraulic and compressed air lines in the proper manner. Do not switch the connections. Fittings, as well as the length and quality of the hose lines, must match the manufacturer's requirements.
    Only use Liebherr spare parts.
36. Replace hydraulic hose lines at appropriate intervals, even if there are no apparent defects which may impair safety.
37. Work on the machine's electrical equipment may only be carried out by a qualified electrician or by instructed persons under the direction and supervision of a qualified electrician, in accordance with the recognised electrical engineering rules.

38. Only use original fuses with the stated current ratings. If there are malfunctions in the electrical power supply, switch off the machine immediately.
39. Inspect and test the machine's electrical equipment regularly. Immediately rectify all faults, such as loose connections, scorched or worn cables or burnt out fuses and bulbs.
40. If you have to carry out work on live components, have a second person assist you, who can throw the emergency stop or main switch in an emergency. Cordon off the working area with a red and white safety chain and a warning sign. Only use insulated tools.
41. When working on high-voltage assemblies after they have been isolated from the power supply, short the supply cable and the components, such as capacitors, with an earthing rod.
42. First, check that the isolated parts are not live, connect them to earth and then short them. Isolate any neighbouring live parts.

010.1.12 Safety instructions for maintenance work on machines with hydro accumulators

1. Only qualified staff may carry out work on the hydraulic and pneumatic connections of the membrane accumulator.
   Serious accidents could result from inexpert fitting and operation.
   The hydraulic system must be depressurised before work can be carried out on it.
   Do not carry out any welding or soldering work on the membrane accumulator.
   There is a risk of explosion during welding or soldering work.
   The accumulator may burst during machining, resulting in the loss of the operating permit.
   Hydro accumulators may only be filled with nitrogen, not with oxygen or air - otherwise there is a **risk of explosion**.
   The accumulator can heat up, causing burns.
   Do not use membrane accumulators which have been damaged during transportation.
   New membrane accumulators must be filled with nitrogen before they are used. Remove the sealing caps on the fluid side.
   The minimum and maximum operating data are permanently marked on the membrane accumulator. The marking must remain visible.

010.1.13 Safety instructions for welding work on the machine

1. Keep to the following procedure during welding work on the machine.
   - Switch off the ignition.
   - Switch off battery main switch (if available).
   - Bring the ground of the welding machine as close as possible to the welding point.
   - Only specialized personnel may carry out welding.

010.1.14 Instructions for working safely on the working attachment

1. Do not work under the attachment if it is not resting on the ground or supported.
2. When replacing attachment components (signs, cutting edge, teeth) . . do not let metal rest on metal.
3. Do not try to lift heavy parts. Only use suitable equipment with sufficient load capacity.

4. Always wear gloves when working with wire ropes.
5. Never release hydraulic lines or bolts before setting down the working attachment and shutting down the engine.
   Before starting any work on the hydraulic circuit, you must also press the working hydraulics lockout button and actuate all pilot control units (joystick and pedals) in both directions in order to reduce the control pressure and accumulated pressure in the operating circuits. You must then reduce the internal tank pressure.
6. Ensure that all lines and threaded couplings are reconnected and re-tightened on completion of the job.
7. Be especially careful when removing or inserting bolts and pins made of hardened steel, as they can splinter, causing serious injury.
   Wear safety gloves and goggles.
   Whenever possible use special tools (such as mandrels, extractors, . . etc.)

010.1.15 Safety instructions for transporting the machine by crane

1. Lower the working attachment and tilt back the loading equipment to its limit.
2. Apply the articulation lock (this only applies to wheel loaders with articulated steering).
3. Move all control levers to the neutral position and engage the parking brake.
4. Shut down the engine in accordance with the instructions in the **“operating instructions”** .
5. Lock the working hydraulics before leaving the driver's cab.
   Lock the working hydraulics in accordance with the instructions in the **“operating instructions”**.
6. Lock all doors, covers and hoods on the machine.
7. Only allow experienced personnel to sling loads and direct crane drivers. The person giving directions must remain in sight of the operator or at least be in spoken contact with him.
8. Attach the lifting tackle to the lugs and bore holes provided on the machine.
9. Make sure the lifting tackle is long enough.
10. Carefully lift the machine.
11. **NOTICE! Keep out from under the machine when it is raised.**
12. When restarting the machine, proceed strictly according to the **“operating manual”** .

010.1.16 Safe maintenance of hydraulic hoses and hose lines

1. Never attempt to repair hydraulic lines and hydraulic hoses.
2. All hoses, hose lines and threaded couplings must be checked regularly, at the very least once a year, for leaks and visible signs of damage.
   Replace damaged parts immediately. Oil escaping under pressure can cause injury and fires.
3. Even when properly stored and subjected to normal load, hoses and hose lines are subject to natural ageing. This limits their service life.
4. Improper storage, mechanical damage and excess strain are the main causes of damage.
5. Hose lines should not be used for longer than six years, including storage of no longer than two years (note the date of manufacture on the hoses).
6. Using the hoses close to their maximum strain can shorten their service life (e.g. high temperatures, frequent movement, extremely high impulse frequencies and multiple shift operation).
7. Hoses and hose lines must be replaced when inspections reveal the following.

Criteria:
- Damage to the outer layer penetrating to the inner layer (e.g. abrasion, cuts and cracks)
- Embrittlement of the outer layer (cracks in the hose material)
- Deformation of the natural shape of the hose or the hose line, both when pressurised and depressurised, or at bends, e.g. layer separation, blistering
- Leaks
- Failure to observe installation requirements
- Damage or deformation of the hose fittings, which reduces the strength of the fittings or the connection between the fitting and the hose
- Slippage of the hose out of the fitting
- Corrosion of the fitting, impairing its function and strength
- Exceeded storage time or service life

8. Only use genuine spare parts to replace hoses and hose lines.
9. Lay and fit hoses and hose lines in the proper manner. Do not switch the connections.

010.1.17 Roll-over protection structure (ROPS) and falling object protection structure (FOPS)

The machine is equipped with a cab that is designed to protect the driver in the event of rolling over (ROPS) and falling objects (FOPS).

010.1.17.1 Preventing accidents

Depending on the job and the way the machine is operated, hazards can arise even when the protective apparatus is intact. Avoid all unsafe working practices.

Note
Do not exceed the total machine weight

▶ When attaching tools and equipment, make sure that the total weight of the machine does not exceed the weight for which the roll-over protection system is certified. The roll-over protection structure cannot guarantee safety if the maximum permitted total machine weight (see type plate) is exceeded.

The following modifications to the machine can lead to the maximum total weight being exceeded:

– Using attachments that are too heavy
– Changing the working attachment
– Attachments or modifications to the machine

Never use a machine whose cab protection system (ROPS, FOPS) has been damaged.

Damage to the cab can be caused by the following operations and events:

– Welding, cutting or drilling holes
– Attaching brackets
– Deformation after an accident
– Falling objects

Structural modifications and any kind of repairs are prohibited.

010.1.17.2 Preventing injuries

The cab roll-over protection system can only protect the driver if he is wearing a safety belt.

Any modifications to the interior of the cab, such as installing accessories, may not impair the driver's working space.

Objects carried in the cab may not project into the driver's working space. Loose objects must be stored securely.

010.1.18 Attachments and accessories

1. Attachments and accessories produced by third-party manufacturers or those which have not been generally approved by LIEBHERR for installation or for external fitting may not be installed or fitted on the machine without prior written consent from LIEBHERR.
2. The appropriate technical documentation should be made available to LIEBHERR for this purpose.
3. When adding or converting equipment or tyres, the stability of the machine must be tested and ensured in accordance with **EN 474**.

010.1.19 Protection against vibrations

1. The vibrations to which mobile construction machines are subjected are mainly due to the way they are used.

   The following parameters in particular have a great effect:
   - Terrain conditions: bumps and potholes.
   - Operating methods: speed, steering, braking, use of the controls while driving and while working.
2. The amount of vibration depends to a large extent on the machine operator, because he determines the speed, gear ratio, working methods and distance covered.
   This results in a wide range of different vibrations for the same type of machine.
3. The machine operator can reduce overall vibration by following these recommendations:
   - Select a suitable machine, equipment and accessories for the job.
   - Use a machine equipped with a suitable seat (i.e. for earthworking machines, a seat which complies with EN ISO 7096).
   - Keep the seat in good repair and adjust the position and cushioning according to the height and weight of the driver.
   - Regularly check the suspension and adjustment mechanisms of the seat and make sure the seat is kept in the condition specified by the manufacturer.
   - Check the service condition of the machine, especially the tyre pressure, brakes, steering, mechanical connections etc.
   - Do not steer, brake, accelerate, shift gears or load the working attachment of the machine suddenly.
   - Adjust the speed of the machine to the distance to be driven in order to reduce vibrations.
     Slow down when driving over difficult terrain.
     Drive around obstacles and avoid difficult terrain.
   - Keep the area on which the machine is operated in a tidy condition.
     Remove any large rocks and obstacles.
     Fill in any trenches or holes.
     Have machines available to maintain good terrain and plan sufficient time to do so.
   - Travel over longer distances (e.g. public roads) at a suitable (medium) speed.

- For machines which are often driven on open roads, use a special additional system (if available) to reduce vibrations during this type of use.
  If such systems are not available, control your speed to stop the machine from shaking.

010.1.20 See and be seen

010.1.20.1 Field of view

As a machine driver, you gain most of your information visually when working. To minimise risks to yourself and others while travelling and working, you must have adequate vision. Use the visual aids attached to the machine, such as mirrors and cameras. Take account of restrictions to your field of vision or blind spots.

You must follow national regulations relating to vision from the cab. For countries in the European Economic Area, standard ISO 5006:2006 describes the methods for measuring and evaluating the machine driver's field of vision. The field of vision is tested using standard equipment. Changes to the machine, e.g. from attaching or converting components, must not impair the driver's vision. If changes worsen the field of view, a test according to ISO 5006:2006, or the regulations applicable to the place of work, must be performed. Depending on the test result, appropriate measures must be taken. The machine driver must be informed of these changes.

010.1.20.2 Measures before and during operation

- Ensure that persons establish contact with the machine driver before approaching the machine.
- Check that the visual aids function properly, are clean and adjusted correctly.
- Visual aids must be adjusted to ensure the best possible all round vision.
- Clean the visual aids and the cab windows immediately if dirt affects vision.
- Have faulty visual aids repaired or replaced straightaway.
- Do not use sun visors if they restrict vision.
- Observe your surroundings continuously to spot potential hazards in good time.
- Avoid reverse travel where at all possible.
- Try to maintain direct vision: plan work so that your view of the working area is not blocked.
- Where visibility is restricted or if the visual aids are faulty, always have someone direct you. Agree hand signals and, with difficult tasks, also keep in voice contact (e.g. via radio).
- Use lighting when visibility is poor and as required by regulations.

010.2 Special tools for maintenance and repair work

010.2.1 Special tools, general

Designation	ID no.	Use	Remark
Antifreeze and battery tester	7408922	All wheel loaders	For checking the acid concentration (battery charge level) and antifreeze
Vacuum pump 24 volts	7408148	All wheel loaders	For preventing oil loss
Voltage transformer 12 volts to 24 volts	6905469	L506 - L514	For using the vacuum pump
Filling and testing device with case	8460226	All wheel loaders	For checking the hydro accumulators
Pressure gauge 0 - 40 bar	7361288	All wheel loaders	For checking the hydraulic pressure
Pressure gauge 0 - 600 bar	7361294	All wheel loaders	For checking the hydraulic pressure
Pressure gauge connection	7002436	All wheel loaders	Connection for pressure gauge
High pressure hose 1500 mm	7002475	All wheel loaders	High pressure hose for pressure gauge
High pressure hose 4000 mm	7009134	All wheel loaders	High pressure hose for pressure gauge
Drain hose	7005660	All wheel loaders	For draining oil via a drain valve
Drain piece	7402657	All wheel loaders	For the drain hose
USB dongle	10489591	All wheel loaders	For Sculi diagnostic software (SERVICE authorisation)
Diagnostic data cable (RS-232)	10035410	All wheel loaders	For Sculi diagnostics software (data connection between central control unit and laptop)
Adapter cable RS-232<>USB	693190714	All wheel loaders	For communicating with the wheel loader electronics if the notebook does not have an RS-232 interface.

Tab. 1: Special tools, general

010.2.2 Special tools for the diesel engine

Designation	ID number	Use	Remark
YANMAR SMARTASSIST	11485739	Engine	Diagnostic software
For more information on YANMAR SMARTASSIST see: Service Information LBH - 04-15-09/14			

Tab. 2: Special tools for the diesel engine