

en

Service manual

Crawler dozer

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Foreword

Notes for the user

This Service manual is intended for trained specialist staff in the Liebherr organization and its dealers.

The Service manual provides specific knowledge for the maintenance of Liebherr construction machinery. Basic technical knowledge of electrics, hydraulics, mechanics and Diesel engine technology are not detailed in this Service manual. A subject-based, qualified training is therefore necessary. Liebherr recommends participation on the Liebherr Training program for construction machinery.

In this Service manual you find information about:


- Special tools
- Technical data
- Maintenance intervals and maintenance tasks
- Adjustment procedure
- Design and functional descriptions
- Removal and installation tasks
- Wiring diagrams, hydraulic schematics and technical drawings

For information relating to control and operation refer to the operator's manual. For information relating to spare parts refer to the Spare parts catalog. Observe the locally applicable accident prevention regulations.

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Subject to technical changes.


Designation of safety advice

	This is a warning sign. Warns of possible danger of injury. Follow all measures, which are marked with this warning sign to avoid injuries or death.
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The warning sign always appears in connection with the signal words

DANGER
WARNING
CAUTION

	DANGER	indicates an immediate dangerous situation which will lead to death or serious bodily injury if it is not prevented.
	WARNING	indicates a dangerous situation which could result in fatal or serious bodily injury if it is not prevented.

	CAUTION	indicates a dangerous situation, which could result in slight or medium-grade bodily injuries if it is not prevented.
	NOTICE	indicates a dangerous situation which could result in material damage if it is not prevented.

Structure of warning notes

Warning notes in this document are structured as follows:







WARNING

Here you find information about the type and source of the danger. Here you are information about possible consequences, if you ignore the warning note.









► Here you are asked to take measures to avoid the dangerous situation.

Additional designations





Symbol	Meaning
	Note indicates useful information and tips.
	This symbol means: perform task.
	This symbol means: prerequisite must be met.
	This symbol means: result of a task.
-	This symbol identifies a listing.

Symbols

Colour legend for the hydraulic schematics

Colour	Line thickness	Name
 	Thick or thin	High pressure
 	Thick	Tank line
 	Thin	Leak oil line
 	Thin	Supply pressure or pilot pressure to the pilot control unit

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Colour	Line thickness	Name
	Thin	Control pressure or pilot pressure from the pilot control unit
	Thick	Enclosed oil
	Thick	Operating pressure
	Thin	Load sensing pressure

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010.1 Safety instructions

010.1.1 General safety instructions

1. Please familiarize yourself with **operator's manual** before putting machine into service.
Make sure that you have obtained, read and understand any additional instructions relating to special accessories for machine.
2. Only explicitly authorized personnel may operate, maintain or repair the machine.
Observe the permissible minimum legal age limit!
3. Use only trained or instructed personnel, clearly determine the responsibility of the personnel for operation, set up, maintenance and repairs.
4. Determine machine operator responsibility (also in regards to traffic regulations) and allow him to refuse unsafe instructions from third persons.
5. Do not allow any person either still to be trained or already in training to operate or work on machine unless under constant supervision and guidance of an experienced instructor or operator.
6. Check and observe any person working or operating machine at least periodically if they observe safety instructions and guidelines given in **operator's manual**.
7. Always wear proper work clothing when operating or working on machine. Avoid wearing rings, watches, ties, scarves, open jackets, loose clothing, etc. There is a danger of injury, as they can get stuck or be pulled in.
Prescribed for specific tasks: safety glasses, safety shoes, safety helmet, work gloves, reflective vest, ear protection, ...
8. Consult supervisor at jobsite for special safety instructions and regulations.
9. When entering and exiting the machine, maintain three-point contact.
10. When entering or exiting, never use joysticks as handholds.
This could trigger inadvertent movement of machine and cause serious accidents.
11. Never jump off the machine. When climbing on or off machine, use intended steps, ladders and catwalks and handles. Use both hands for support and face machine.
12. Keep steps, ladders and handles free of oil, grease, mud, snow and ice. These precautions will minimize the danger of slipping, stumbling or falling.
13. Make yourself familiar with emergency exit.
14. If no other instructions are given, proceed as follows for maintenance and repair work.

Procedure:

- Park the machine on solid and level ground.
 - Bring all control levers to neutral position.
 - Switch parking switch to park position.
 - Turn engine off and pull ignition key.
 - Actuate control levers several times to relieve pressure in servo lines.
 - Bring all control levers to neutral position.
15. Before working on hydraulic circuit, with engine turned off and with ignition key in contact position, move all pilot controls (joysticks and pedals) in both directions to relieve servo pressure and remaining back pressures in working circuits. Then release internal hydraulic tank pressure.
 16. Before leaving operator's seat, switch parking switch to Park position.
 17. Secure all loose parts on machine.
 18. Never operate a machine without a complete walk around inspection. Check if all warning signs are on the machine and if they are all legible.
 19. Observe all signs with danger and safety instructions.

20. For special applications, this machine must be equipped with specific safety devices. In this case, use the machine only if they are installed and functioning.
21. Never make any changes or additions and modifications on machine, which could affect safety, without obtaining explicit approval from manufacturer / supplier. This also applies to installation and adjustment of safety devices and safety valves as well as to any welding on load carrying parts.
22. Avoid staying near running Diesel engine. Persons with a pacemaker may not stay near a running Diesel engine (minimum distance 50 cm).
23. Do not touch current carrying components on electrical connection of solenoid valve controlled injection pumps (Unit Pumps) when Diesel engine is running.

010.1.2 Safety instructions for crushing and burn prevention

1. Never work underneath attachment as long as it is not safely resting on ground or properly supported.
2. Never use damaged or insufficient tackle (such as cables, chains, ..). Always wear work gloves when handling wire cables.
3. When working on attachment, never align bores with your fingers, always use a suitable alignment tool.
4. When engine is running, make sure that no objects touch fan. Any objects falling or protruding into fan will be thrown out or destroyed and can damage fan.
5. Avoid skin contact with hot surfaces and fluids. There is a danger of burns.
6. Check coolant level only after cap of expansion tank is cool enough to touch. Turn cap carefully to relieve pressure.
7. At or near operating temperature, engine and hydraulic oil are hot. Do not allow hot oil or oil-bearing parts to touch skin.
8. Always wear safety glasses and work gloves when handling batteries. Avoid sparks and open flames.
9. Never permit anyone to hand guide attachment into proper position.
10. Check if open door position of engine compartment door is ensured by gas cylinder.
If function is not ensured, then problem must be remedied immediately.
11. Before operating machine, close and lock all engine compartment doors and covers.
12. Never lay underneath machine unless machine is properly and safely supported.

010.1.3 Safety guidelines for fire and explosion prevention

1. Engine must be turned off when refueling.
In addition, heater must also be turned off before refueling.
2. Do not smoke and avoid open flames when refueling and where batteries are charged.
3. Always start engine as described in “**operator’s manual**”
4. Check electrical system. Correct any defects, such as loose connections, chafed wiring or burnt out fuses and bulbs immediately.
5. Never store flammable fluids on machine except in appropriate storage tanks.
6. Regularly inspect all lines, hoses and fittings for leaks and damage. Repair any leaks immediately and replace damaged components.
Any oil escaping from leaks can easily cause a fire.
7. Be certain that all clamps and protective guards are properly installed to prevent vibration, rubbing and heat build up.

8. Starter fluid (ether) is especially flammable! Never use cold start ether near heat sources, open flames (for example cigarettes) or in insufficiently ventilated areas.
9. Never use flame glow system or preheat systems when using cold start ether! (Danger of explosion)
10. Know location of fire extinguishers, make sure you know how to use them properly and check out location of where to report a fire and inform yourself about fire fighting capabilities before you start to work.

010.1.4 Safety instructions for machine start up

1. Before starting the machine, always perform a thorough walk-around inspection.
2. Visually check the machine for loose bolts, cracks, wear, leaks and intentional damage.
3. Never start or operate a damaged machine.
4. Make sure to correct any problems immediately.
5. Make sure that all hoods and covers are closed and locked. Check if all warning and reference signs are on the machine.
6. Clean all windows and mirrors, secure all doors and windows to prevent inadvertent movements.
7. Always enter and leave the machine using the ascending aids provided.
8. Make sure that no one works on or under the machine. Warn all persons in the surrounding area before operating the machine.
9. After entering the cab, adjust the operator's seat, the mirrors, the arm rests and the safety belt so that you can work comfortably.
10. The noise protection devices on the machine must be in protective position during operation.
11. Never operate the machine without the operator's cab or canopy.

010.1.5 Safety instruction for start up

1. Before starting machine, check all indicator lights and instrument for proper function. Bring all control levers into neutral position.
2. Before starting engine, alert any nearby personnel that machine is being started by sounding horn.
3. Start machine only from operator's seat.
4. If no other instructions were issued, start engine according to guidelines in **operator's manual**.
5. Start engine and check all indicators, gauges, instruments and controls.
6. When operating in enclosed spaces, run engine only if there is sufficient ventilation. If necessary, open doors and windows to ensure sufficient fresh air supply.
7. Bring engine and hydraulic oil to operating temperature, low oil temperatures cause controls to be sluggish.
8. Check that control for attachment functions properly.
9. Move machine carefully into an open area and check all travel functions, check travel brake, steering function as well as turn signals and lights.

010.1.6 Safety guidelines for working

1. Before starting to work, familiarize yourself with the peculiarities of the job site, as well as the special regulations and warning signals. Part of the surrounding area includes, for example, the obstacles in the working or traffic area, the load bearing capacity of the ground and special protection required to secure the job site from public highway traffic.

2. Always keep a safe distance to overhangs, edges, embankments and unstable ground.
3. Be particularly cautious of changing ground conditions, unfavourable visibility and changing weather.
4. Familiarize yourself with location of power lines on jobsite and work particularly careful in their vicinity. If necessary, inform the responsible authorities.
5. Maintain a safe distance from electrical overhead lines. When working near electrical overhead lines, do not allow attachment too come close to wires.
Risk of fatal injury!
Inform yourself about required safety distances.
6. **If you do touch a high voltage power line, proceed as follows:**
 - Do not leave the machine!
 - If possible, move the machine a sufficient distance away from the danger zone.
 - Warn all personnel in the surrounding area not to come close to the machine and not to touch the machine.
 - Instruct someone to turn the electric power off.
 - Do not leave machine until you are assured that electric wire, which has been touched or damaged is no longer energized and power has been turned off!
7. Before moving machine or working with machine, always make sure that equipment is safely secured.
8. When travelling on public roads, highways or properties, always observe valid traffic regulations and, if necessary, first bring machine into proper condition to meet federal and local highway standards.
9. Always turn on lights if visibility is poor or as dusk approaches.
10. It is strictly prohibited for anyone to ride along on machine.
11. Operate machine only when seated and with safety belt fastened.
12. In even that machine should tip over, remain seated with seatbelt secured. Experience has shown that it is safer to remain in cab in event of an overturn.
13. Report any functional problems or defects, make sure that all necessary repairs are completed immediately.
14. Personally make sure that no one is endangered by moving the machine.
15. Never leave the operator's seat as long as the machine is still moving.
16. Never leave machine unattended while engine is running.
17. When moving loads, keep load as close as possible to ground.
18. Maximum permissible incline and side slope of machine depends on installed attachment as well as on ground conditions!
19. Avoid any working movements which could cause machine to tip over. However, if machine does begin to tip or slide, lower attachment immediately and turn machine downhill. If possible, always work downhill or uphill, never sideways on a slope.
20. Always move slowly and carefully on rocky or slippery ground or on a slope.
21. Always adapt the travel speed to the working conditions.
22. Never travel on slopes which exceed the maximum permissible gradeability.
23. Travel downhill only at low travel speed, maximum 4 km/h, to prevent loss of control over machine. Engine must run at high idle speed and speed must be reduced by selecting lower speed range. Never switch into lower travel speed range while already driving downhill, always switch before approaching slope.
24. For terrain which is difficult to gain an overview of and whenever necessary, ask for assistance of a guide. Have only one person signal you.
25. Danger of accidents due to restriction of vision for large machines! Take suitable measures to ensure a safe working application of machine on construction site.
26. Exclusively permit experienced personnel to secure loads and signal crane operator. Signaller must position himself within view of operator or be in voice contact with him.

010.1.7 Safety instructions for parking the machine

1. Park machine only on firm and level ground. If it becomes necessary to park the machine on a grade, it must be properly blocked and secured with wedges to prevent any unintentional movement.
2. Lower working attachment and lightly anchor working attachment on ground.
3. Bring all control levers to neutral position, switch parking switch to park position and turn engine off according to Operating instructions before leaving operator's seat.
4. Lock the machine, remove all keys and secure the machine to prevent unauthorized use and vandalism.
5. Never park machine in such a way as to block access to entrances, dock ladders, fire hydrants, etc.

010.1.8 Safety instructions for transporting machine

1. Use only suitable transport devices and lifting devices with sufficient load carrying capacity.
2. Park the machine on level ground and block the chains or wheels with wedges.
3. If necessary, remove parts of working attachment for duration of transport.
4. When loading a machine on a transport vehicle, be sure that the stipulated ramp incline angle is not exceeded and the ramp is covered with wooden planks to prevent slipping.
5. Before moving onto ramp, clean chains or wheels of machine, remove any snow, ice or mud.
6. Align machine with loading ramp.
7. Use a guide to signal machine operator. Drive onto ramp and onto transport vehicle very carefully.
8. Secure machine and remaining parts with chains and wedges to prevent them from slipping.
9. Relieve pressure from hydraulic lines and hoses, remove ignition key, lock cab and all covers before leaving machine.
10. Carefully check out transport route beforehand, especially in regards to width, height and weight limitations.
11. Check that there is enough clearance underneath all electrical lines, bridges, underpasses and in tunnels.
12. During unloading procedure, proceed with same caution as during loading procedure.
Procedure:
 - Remove all chains and wedges. Start engine as outlined in operator's manual.
 - Carefully drive off loading platform down ramp.
 - Have another person guide and signal you.

010.1.9 Safety instructions for towing machine

1. Always follow the correct procedure according to the instructions in the **operator's manual**, refer to section "Towing the machine".
2. The machine may only be towed in exceptional circumstances, for example to move the machine from a dangerous area for repair.
3. If the sun gears are removed, the machine starts to roll by itself from an incline of 2°. Before removing and installing the sun gears, secure the machine to prevent it from rolling off.
4. If the sun gears are removed, the service brake and parking brake are without function.

5. Before pulling or towing, check all towing and pull devices for safety and stability.
6. The rod, which is used to tow the machine must be adequate to pull the machine and must be connected to the appropriate bores and towing devices. Damage or accidents which occur when towing machine cannot be covered by manufacturer's guarantee under any circumstances.
7. During towing procedure, keep within required transport position, permissible speed and distance.
8. When returning machine to operation, proceed only as outlined in operator's manual.
9. After the towing procedure, re-establish the series condition of the machine.

010.1.10 Safety instructions for maintenance

1. Never perform any maintenance or repairs for which you are not qualified or you do not understand.
2. Observe stated intervals or time periods for repeat checks and inspections as outlined in operator's manual. Always use appropriate tools to carry out maintenance work.
3. Chart in this operator's manual defines exactly who must or can carry out which type of work. Operator can exclusively carry out work marked in maintenance and inspection schedule with by "maintenance staff". Remaining tasks can exclusively be carried out by specialist staff with appropriate training.
4. Spare parts must meet technical requirements set forth by manufacturer. This is always ensured by using original spare parts. Spare parts, which do not meet technical requirements of manufacturer can impact safety and function of machine.
5. Always wear safe work clothing when performing maintenance. For certain work, safety glasses and work gloves are required, in addition to a hard hat and safety shoes.
6. Keep unauthorized personnel away from machine during maintenance.
7. Secure a wide-ranging area for service, as necessary.
8. Inform operator before carrying out any special task or maintenance work. Appoint one supervisory person.
9. If not otherwise noted in this operator's manual, carry out all maintenance work on machine on firm and level ground, with engine turned off.
10. Operator's platform can exclusively be tilted when machine is at a standstill and engine is turned off! When tilting operator's platform forward or backward, there can be no personnel within tilt range. Work under tilted operator's platform may only be carried out if machine is at a standstill and after placing safety support bar. Machine can **NOT** be started or driven with a tilted operator's platform. Leave parking switch in park position!
11. During maintenance and repairs, make sure you always tighten any loosened screw connections.
12. If it becomes necessary to remove any safety devices during set up, maintenance and repairs, safety devices which were removed must be reinstalled immediately after completion of maintenance and repair work and then be inspected for proper function.
13. Before any maintenance and repair work, especially when working under machine, attach an easily visible "**DO NOT TURN ON**" warning sign to ignition switch. Pull ignition key off.
14. Before any maintenance and repairs, clean machine, especially connections and fittings to remove oil, fuel or cleaning substances. Never use aggressive cleaning substances. Use exclusively lint-free cleaning cloths.
15. To clean machine, never use flammable cleaning fluids.
16. Before any welding, cutting and grinding, clean machine and surrounding area of dust and flammable substances and assure adequate ventilation.

- Otherwise there is a **DANGER OF EXPLOSION!**
17. Before cleaning machine with water, steam (high pressure cleaner) or other cleaning fluids, cover / tape off all openings whose safety and function could be affected by infiltration of water, steam or cleaning fluid.
Electric motors, switch boxes and battery compartments are especially endangered.

Further procedure:
 - Make sure that temperature sensor of fire warning system and fire extinguisher do not come in contact with hot cleaning fluids when cleaning operator's cab. Otherwise they could trigger fire extinguishing system.
 - After cleaning, completely remove covers and tapes.
 - After cleaning machine, check all fuel, engine oil, hydraulic oil lines for leaks, loose connections, chafing and damage.
 - Fix any defects immediately.
 18. Adhere to product safety instructions issued for handling of oils, greases and other chemical substances.
 19. Ensure safe and environmentally friendly disposal of operating and service fluids as well as exchange parts.
 20. Be very careful when handling any hot components or service fluids on machine as there is a danger of burns and scalding.
 21. Operate combustion engines and fuel operated heaters exclusively in sufficiently ventilated areas. Before starting machine in a closed area, make sure ventilation is sufficient. Always follow all regulations valid for current job site.
 22. Perform any welding, cutting or grinding work on machine exclusively if this work has been explicitly authorized, as there can be a danger of fire or explosion.
 23. Operator's cab windows are made of safety glass. Damaged operator's cab windows must always be replaced immediately.
 - Exclusively safety glass can be used for operator's cab windows.
 - Use exclusively Original Liebherr spare parts.
 24. Do not attempt to lift heavy parts. Use suitable lifting devices with sufficient load carrying capacity.

Procedure:

- When replacing individual parts and larger components, attach and secure them carefully to lifting devices to avoid any danger.
 - Use exclusively suitable and technically sound lifting devices as well as load tackle with sufficient load carrying capacity.
 - **Do not allow anyone to work or remain underneath suspended loads.**
25. Do not use damaged or insufficiently sized ropes or cables. Always wear work gloves when handling wire cables.
 26. Exclusively permit experienced personnel to secure loads and signal crane operator. Guide must position himself within view of operator or be in voice contact with him.
 27. When working overhead during installation work, use appropriate safe access ladders and working platforms. Never use machine parts as access aids. Wear a harness / anti-fall guards when working in great heights. Keep all handles, steps, railings, platforms, ladders free of dirt, ice and snow.
 28. When working on attachment, make sure it is safely supported. Never use metal on metal support.
 29. Never lay underneath machine unless machine is properly and safely supported with wooden beams.
 30. Always support machine in such a way that any shifting weight will not endanger stability of machine and avoid metal to metal contact.
 31. Exclusively specially trained specialist staff can work on travel gears, brake and steering system.

32. If machine must be repaired while parked on a slope, track chains or wheels must be blocked with chocks to prevent any movement. Bring working attachment into maintenance position.
33. Exclusively authorized personnel with specialized training and experience in hydraulics can work on hydraulic system.
34. Wear protective gloves when checking for leaks. Fluid escaping from a small hole can have enough pressure to penetrate skin.
35. Never loosen any hydraulic oil lines or fittings before attachment has been lowered and engine has been turned off. Then, with ignition key in contact position and parking switch in operating position, actuate all pilot controls (joysticks and pedals) in both directions to relieve servo pressure and back pressures in working circuits, and relieve internal tank pressure by releasing breather screw.
36. Regularly inspect all hydraulic oil lines, hoses and fittings for leaks and externally visible damage. Fix any defects immediately. Oil spray can lead to injuries and fires.
37. Before starting repair work, depressurise system sections and pressure lines to be opened (hydraulics, compressed air) in accordance with assembly descriptions.
38. Route and install hydraulic hoses and air pressure lines properly. Do not mix up connections. All fittings, including length and quality of hose lines must match specified requirements.
Use exclusively Liebherr replacement parts.
39. Replace hydraulic hoses and lines in regular intervals, as stated, even if no safety relevant defects can be seen.
40. Exclusively qualified electricians or trained personnel under guidance and supervision of a licensed electrician can work on electrical equipment of machine, according to electro-technical rules and regulations.
41. Exclusively use Original fuses with correct amperage. In case of problems in electric energy supply, turn machine off immediately.
42. Inspect and check electronic equipment on machine regularly. Correct any defects, such as loose connections, burnt or chafed wiring or burnt out fuses and bulbs immediately.
43. If any work is necessary on energized, voltage carrying parts, a second person must be utilized to disconnect emergency off or master switch in case a problem arises. Rope off work area off with a red and white safety chain and a warning sign. Use exclusively insulated tools.
44. When working on high voltage carrying components, turn off power supply, then connect supply cable to ground and use a grounding rod to ground these parts, such as condensers.
45. Check all disconnected parts first if they are really free of voltage, ground them and then short circuit them. Insulate adjacent, voltage carrying parts.

010.1.11 Safety guidelines for welding work on machine

1. Adhere to following procedure for welding work on machine:
 - Switch off ignition.
 - Turn battery master switch off (if present).
 - Attach earth of welding unit as close as possible to welding location.
 - Only authorized expert personnel is permitted to carry out welding work.

010.1.12 Safety guidelines for working on attachment

1. Never work underneath attachment as long as it is not safely resting on ground or properly supported.

2. When replacing or changing any part of attachment (such as blade, cutting edges, teeth etc.) never use metal on metal support.
3. Do not attempt to lift heavy parts. Use suitable lifting devices with sufficient load carrying capacity.
4. When working with wire cables, always wear gloves!
5. Never loosen any hydraulic oil lines or fittings before attachment has been lowered and engine has been turned off. Then, with ignition key in contact position and parking switch in operating position, actuate all pilot controls (joysticks and pedals) in both directions to relieve servo pressure and back pressures in working circuits, and relieve internal tank pressure by releasing breather screw.
6. After completion of all maintenance and repair work, make sure that all lines, hoses and fittings are properly connected and retightened.
7. Removing and installing tempered steel bolts and pins can be dangerous, metal chips can cause severe injuries.
Always wear gloves and safety glasses.
If possible, use special tools (such as mandrels, pin pullers, etc.).

010.1.13 Safety guidelines for loading machine with a crane

1. Remove boom and counterweight or bring into transport position.
2. Bring all control levers into neutral position.
3. Turn engine off as outlined in operating instructions and switch parking switch to park position before leaving operator's seat.
4. Close all doors, covers and hoods on machine properly.
5. Exclusively permit experienced personnel to secure loads and signal crane operator. Signaller must position himself within view of operator or be in voice contact with him.
6. Install shackles and hooks for suspension to appropriate and designated brackets or bore holes on machine.
7. Make sure suspension is of sufficient length.
8. Carefully lift machine.
9. **Do not allow anyone to work or remain underneath suspended loads.**
10. When returning machine to operation, proceed only as outlined in operator's manual.

010.1.14 Safety notes for maintenance of hydraulic hoses and hose lines

1. Hydraulic lines and hoses may never be repaired! This is strictly prohibited!
2. All hoses, hose lines and fittings must be checked regularly, but at least 1 x per year for leaks and any externally visible damage! Any damaged parts must be replaced immediately. Oil spray can lead to injuries and fires.
3. Even if hoses and hose lines are properly stored and used, they undergo a natural aging process. For that reason, their service life is limited.
4. Improper storage, mechanical damage and improper use are most frequent causes of hose failures.
5. Service life of a hose line may not exceed six years, including a storage period of a maximum of two years (always check manufacturer's date on hoses).
6. Using hoses and lines close to limit ranges of permitted use can shorten service life (for example at high temperatures, frequent working cycles, extremely high impulse frequencies, multi shift operation).
7. Hoses and lines must be replaced if any of following conditions are found during an inspection:

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Criteria:

- Damage to outer layer as far as intermediate layer (e.g. chafing, cuts and cracks).
 - Brittleness of outer layer (hose material cracking);
 - Deformations, which differ from natural shape of hose or hose line, when under pressure or not under pressure, or in bends, e.g. separation of layers, blisters or bubble formation;
 - Leaks;
 - Failure to follow installation instructions;
 - Damage or deformation in hose fittings, which reduce stability of fitting or connection from hose to fitting;
 - Hose slipping out of fitting;
 - Corrosion of fitting, which reduces function and strength;
 - Storage time or service life has been exceeded.
8. When replacing hoses and hose lines, use only Original spare parts.
 9. Route and install hoses and hose lines properly. Do not mix up connections.

010.1.15 Safety guidelines for maintenance work on machines with hydro accumulators

1. Only especially trained expert personnel may work on hydro accumulators.
2. Improper mounting and handling of hydro accumulators can cause severe accidents.
3. Do not operate damaged hydro accumulators.
4. Before working on hydro accumulators, relieve pressure in hydraulic system (hydraulic system including hydraulic tank), as described in these operating instructions.
5. Do not weld or solder on hydro accumulator and do not carry out any mechanical work.
Hydro accumulator can be damaged due to heat exposure and can rupture due to mechanical treatment. **THERE IS A DANGER OF EXPLOSION!**
6. Fill hydro accumulator only with nitrogen. When using oxygen or air, there is a **DANGER OF EXPLOSION!**
7. Accumulator housing can become hot during operation, there is a danger of burning.
8. New hydro accumulators must be charged to required pressure for application before use.
9. Operating data (minimum and maximum pressure) is marked permanently on hydro accumulators. Make sure that marks remain visible.

010.1.16 Roll over protection (ROPS) and falling object protection (FOPS)

Machine is equipped with an operator's cab, which provides overroll (ROPS) and falling objects (FOPS) protection for machine operator.

010.1.16.1 Avoid accidents

Dangerous situations can occur depending on application and method of operation, even with intact protective devices. Avoid all unsafe methods of operation.

**Note**

Overall weight of machine!

- ▶ At installation of attached tools and attachments make sure that overall weight of machine is below weight for which overroll protection was certified. Protective function of overroll protection is not longer ensured if maximum permissible overall weight of machine is exceeded (see Data tag).

Following changes on machine can cause maximum permissible overall weight to be exceeded:

- Use of attached tools which are too heavy
- Change of working attachment
- Additions or modifications on machine

A machine with a damaged cab protective system (ROPS, FOPS) may not be placed into operation.

Damage on operator's cab can be caused by following work and occurrences:

- Welding, cutting or drilling of holes
- Attaching fittings
- Deformation after an accident
- Falling objects

Structural changes or repair of any kind are prohibited.

010.1.16.2 **Avoid injuries**

Overroll protection of operator's cab protects operator only when he is wearing seatbelt.

Any changes in interior of operator's cab, for example as a result of installation of accessories, may not restrict working area of operator.

Any objects carried in operator's cab may not protrude into working area of operator. Loose objects must be stored safely.

010.1.17 **Equipment and attachment parts**

1. Equipment and attachment parts made by other manufacturers or those which were not approved by Liebherr for installation or attachment may not be installed on machine without prior written approval by Liebherr.
2. Liebherr must be provided with required technical documentation necessary for this purpose.

010.1.18 **Protection from vibrations**

1. Vibration impact on mobile construction machinery is usually result of manner of utilization. Especially following parameters have a significant influence:
Terrain conditions: unevenness and potholes;
Operating techniques: speed, steering, braking, control of operating elements of machine during travel as well as working.
2. Machine operator determines vibration impact to a large extent, as he himself selects speed, gear ratio, working manner and travel route. This results in a wide range of various vibration impacts for same machine type.
3. Full body vibration impact for machine operator can be reduced if following recommendations are observed:
Select appropriate machine, equipment parts and auxiliary devices for corresponding tasks.

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