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Service Manual

Crawler Dozers

PR 712 - 752



LIEBHERR

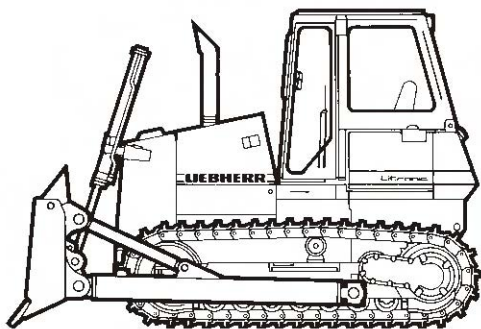
Service Manual

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Crawler Dozers
SERIES **2**
Litronic

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Issue 01/2004



Book No.: -----

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For your information


This manual contains technical data, descriptions of design and function, repair and adjustment guidelines as well as numerous drawings, functional views and illustrations

LIEBHERR - crawler dozers (PR), crawler loaders (LR) or pipelayers (RL).

This manual should simplify competent customer service of our products, does however, not replace expert and qualified training and an attendance of our factory schools.

Information which is in trade considered basic knowledge is not included. Operation and spare parts information can be found in separate manuals.

The manual will be updated as necessary when changes occur in series.

 This symbol is used in the manual for very important notes.

During the activities on the machine, accident prevention regulations and safety guidelines must be strictly observed.

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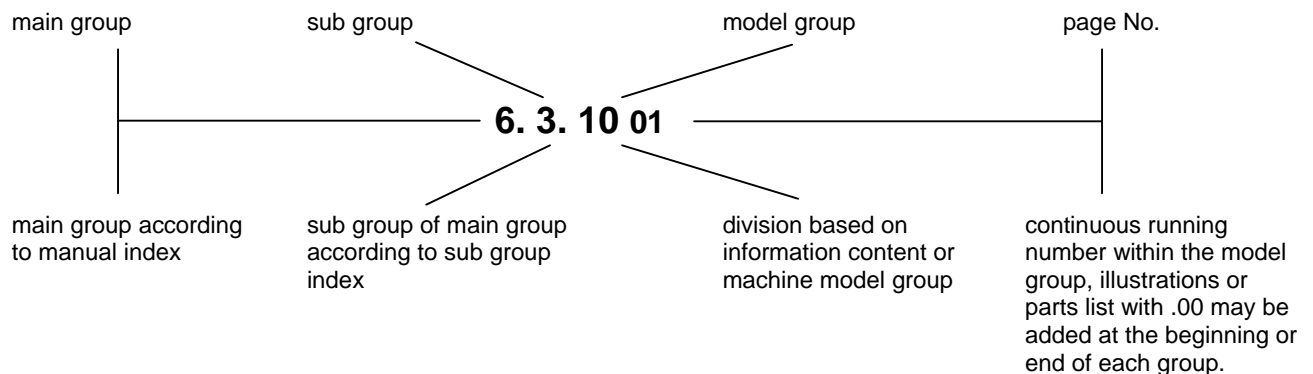
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We reserve the right to make changes of technical details on the machine in comparison to the information and drawings in this manual.

Printed and published by
LIEBHERR-Werk Telfs GmbH., Service -Training Department.

Explanation of structure (page numbers)

In order to find specific information and add supplements more easily, the following numbering system is being used:



Updated pages retain the same page number, but receive a more recent date when mailed. Supplements have a new number. If the page is only valid for a certain machine model group, it will so be indicated on the page.

We hope that with the enclosed information we have taken yet another step to improve the service on the LIEBHERR - crawler dozers, crawler loaders and pipelayers.

LIEBHERR-Werk Telfs GmbH.
Service-Training Dept.

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1. Prior and during the performance of tests, adjustments, and repairs, the following guidelines must be followed :

- Any type of work may only be performed by **qualified personnel** or under the supervision of such personnel.

Qualified personnel are persons who - based on specialized training and experience - have sufficient knowledge in the general area of earthmoving equipment and the specific technology of LIEBHERR machines. They must also have knowledge of all applicable laws and general work protection regulations, accident prevention regulations, guidelines and generally approved rules concerning technology, and be able to evaluate if earthmoving equipment is safe to operate and if the necessary work can be performed without endangering themselves or third persons.

- Never operate a machine with a raised cab or canopy! The machine may only be operated with a lowered and secured cab or canopy.
- Always adhere to the LIEBHERR adjustment values when performing adjustment work.
- When performing a Delivery Inspection on a machine, the operator(s) must be trained using a current Operation and Maintenance Manual. The safety guidelines in that manual must be particularly observed and followed as listed.
- The same **safety guidelines must also be observed** when performing repair work. On the other hand, there are instances of specific repair and/or maintenance which, in the judgement of qualified personnel, require steps and procedures other than as specified in the safety guidelines. In such event, qualified personnel or individuals performing said work under the supervision of such personnel, should assure that additional safety precautions necessary to insure the safety of those involved in the repair are taken. Such items of repair and/or maintenance include, but are not limited to, the following :

- It may be necessary to open the side engine compartment doors while the engine is running for diagnostic and/or component adjustment reasons.

In such event, care should be taken to assure that the engine compartment doors are fully secured from unexpected and/or unintended closing during the diagnostic and/or adjustment work effort. Care should also be exercised to assure that there will be no inadvertent or unintended contact of any part of the body with any moving and/or heated parts of the engine. Along these lines, loose clothing, scarves, open jackets, ties and jewelry should be avoided.

- It may be necessary for purposes of performing repairs, adjustments and/or troubleshooting to start the engine of the machine and to actuate the travel drive with the cab or canopy tilted. Such should never be done unless the machine has been raised completely off the ground and supported properly and according to all applicable guidelines.

However, this procedure can only be performed by a factory certified service mechanic.

Following please find the **Safety Guidelines** as listed in the present Operation and Maintenance Manual. Liebherr reserves the right to update any Operation and Maintenance Manual, including but not limited to the revision or addition of safety guidelines. It is, therefore, strongly recommended to also **consult the latest Operation and Maintenance Manual** of the machine involved.

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2. SAFETY GUIDELINES

(Abstract of the Operator and Maintenance Manual Issue 10 / 94, printed later than 2/12/94)

Working with earthmoving machinery may be dangerous, it could result in injury or death if proper precautions were not taken by you, the operator and / or maintenance personnel. We urge you to read these safety notes repeatedly and carefully, and to observe them to prevent danger and accidents.

This is especially important for any personnel that only works on the machine occasionally, such as during set up and / or maintenance.

Careful adherence to the below listed safety information will insure safe operation and maintenance and potentially prevent personal injury to yourself and others and possible damage to your machine.

Important safety notes are used throughout the Operation and Maintenance Manual, such as DANGER, CAUTION and / or NOTE, to emphasize important or critical instructions.

In the Operation and Maintenance Manual, these safety notes are defined as follows:

DANGER

Denotes an extreme intrinsic hazard which could result in a high probability of death or serious injury if proper precautions are not taken.

CAUTION

Denotes a reminder of safety practices or direct attention to unsafe practices if proper precaution are not taken, which could result in personal injury and / or damage or destruction of the machine.

NOTE

This symbol is used to describe operational and maintenance procedures which should be followed to keep your machine operational and insure long service life and / or to facilitate certain operating procedures.

In addition to these instructions, you must follow additional safety regulations applicable to your work environment and job site, any federal, state and local laws governing travel on public roads and highways, and any guidelines issued by trade and professional associations.

2.0.1 PROPER AND INTENDED USE

With the standard dozer attachment, the machine may only be used to loosen, move and dump dirt, gravel, broken rocks, or other similar material.

Other use for which this machine is not designed, such as breaking rocks, demolishing buildings, driving piles, transporting personnel, etc. are considered to be improper and unsafe use. Neither the manufacturer nor the dealer can be held responsible for any damage or accident resulting from such or any other unauthorized use of the machine. Any risk in improperly using this machine is the responsibility of the user.

Never use this machine in a special application unless it is equipped with the appropriate attachment and safeguards, and supplied with specific operating and safety guidelines and/or decals.

The proper and intended use also includes the strict adherence to the operating and maintenance guidelines issued in this Operation and Maintenance Manual and careful adherence to inspection and maintenance schedules and guidelines.

2.1 DECALS ON THE MACHINE

Several safety decals are attached to the machine. They must be strictly observed to prevent death or serious injury. The decals and the location of the decals on the machine are shown in the Operation and Maintenance Manuals. (Please use them for more information).

These safety decals must be checked regularly to ensure they are still complete and legible.

Missing or illegible safety decals must **always** be replaced immediately.

2.2 GENERAL SAFETY GUIDELINES

- Study the Operation and Maintenance Manual before operating or working on the machine.
 - Make certain that you have additional information for the special attachments of your machine, read it and make sure you understand it.
- Only trained and authorized personnel may operate, maintain, service or repair this machine.
 - Make sure you are aware of the permissible minimum operator age, as stated by law.
- Utilize only trained or specially trained personnel, make sure that everybody is aware of the person / persons responsible for the operation, installation of attachments, maintenance and repair of the machine.
- Determine the responsibility of the operator, (to include adherence to traffic regulations) and permit him to refuse to carry out unsafe instructions or practices given by a third person.
- Do not allow any personnel, either still to be trained or already in training, to work on the machine unless that person is under the constant supervision of an experienced instructor or operator.
- Periodically, check to see if all persons observe all safety guidelines and work cautiously, as noted in the Operation and Maintenance Manual.
- Always wear proper clothing when operating or working on the machine.
 - Avoid wearing rings, watches, bracelets, ties, scarves, open jackets, loose clothing such as unbuttoned or unzipped jackets, etc. they are dangerous, could get caught in the machinery and could cause serious injury!
 - Wear the proper safety equipment for certain work, such as safety glasses, safety shoes, hard hats, gloves, reflective vests, ear protection.
- Consult your employer or supervisor for specific safety equipment requirements and safety regulations applicable to the job site.
- Never use the safety lever, control levers or joysticks as handholds. This could trigger inadvertent movement of the machine and cause serious accidents.
- Never jump off the machine! Climb on and off the machine only by using the steps, rails and handles provided. When climbing on or off the machine, use both hands for support and face the machine.
- Keep operator's cab, catwalks, steps, handrails and handles clean and free from oil, grease, mud, snow and ice. These precautions will minimize the danger of slipping, stumbling or falling.
- Familiarize yourself with the emergency exit route through the right cab door.
- If no other instructions were given, proceed as follows for maintenance and repairs:
 - Park the machine on firm and level ground and lower the attachment to the ground.
 - Bring all operating and control levers into neutral position.

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- Turn the engine off and leave the ignition key in contact position.
 - Actuate the operating lever / joystick several times to relieve pressure in the hydraulic lines.
 - Bring all operating and control levers into neutral position.
 - Place the safety lever in the full down position before leaving the machine.
 - Remove the ignition key.
- Before any work on the hydraulic circuit, you must also - with the ignition key in contact position - actuate all servo controls (joysticks and foot pedals) in both directions to relieve pressure in the servo and hydraulic system. Then relieve the hydraulic tank pressure.
 - The safety lever must always be placed in the full down position before leaving the cab.
 - Secure all loose parts on the machine properly.
 - Never operate a machine until you have performed a complete walk around inspection. Also, check if all warning decals are on the machine and if all of them are legible.
 - Check and follow all instructions given on the warning and safety decals.
 - This machine can only be utilized in the special applications if equipped with the appropriate attachment and safeguards, and if supplied with specific operating and safety guidelines and/or decals.
 - Never change, add or modify anything on the machine which could influence the safety of the machine without explicit written permission from the manufacturer. This also applies to the installation and adjustment of safety devices and valves as well as for any welding on load carrying machine parts or sections.
 - Never install any attachments or parts without LIEBHERR's permission.

2.3 CRUSHING AND BURN PREVENTION

- Never work underneath the attachment unless it is safely placed on the ground or properly blocked and supported.
- Never use damaged or insufficient load carrying devices, such as chains, ropes, ... Always wear gloves when handling wire ropes.
- When working on the attachment, never align bores with your fingers, always use proper alignment tools when installing, changing or servicing attachments.
- When the engine is running, make sure that no objects touch the radiator fan. Rotating fans will swirl and throw out objects which can become very dangerous and, in addition to damaging the fan, they can cause severe injury to yourself and others.
- Avoid contact with components containing coolant. At or near operating temperature, the engine coolant is hot and under pressure and could cause severe burns.
- Check coolant level only after the radiator cap is cool enough to touch. Remove the radiator cap slowly to relieve pressure.
- Do not allow your skin to come into contact with hot oil or components containing hot oil. At or near operating temperature, engine and hydraulic oil is hot and can be under pressure.
- Always wear safety glasses and protective gloves when handling batteries. Make sure there are no sparks and open flames in the vicinity.
- Never permit anyone to hand-guide the attachment to its proper position.
- Secure the engine compartment doors in open position to avoid unwanted closing.
- Insure that all engine and battery compartment doors are closed and locked before operating the machine.

- Never work underneath the machine if the machine has been raised with its attachment. Prior to working underneath, the machine and/or its attachment must always be properly blocked and supported with wooden blocks. Do not use steel on steel support.

2.4 FIRE AND EXPLOSION PREVENTION

- Always shut off the engine before refueling.
- In addition, the heater must also be turned off before refueling.
- Never smoke or allow an open flame in refueling areas and / or where batteries or flammable material are being charged or stored.
- Always use the proper engine starting procedure, as described in the Operation and Maintenance Manual.
- Check the electrical system frequently. Correct any defects, such as loose connections, chafed wiring, or burnt out fuses and bulbs immediately.
- Never store or carry any flammable fluids on the machine, except in the storage tank intended for machine operation.
- Regularly check all components, lines, tubes, and hoses for oil and fuel leaks and/ or damage. Replace or repair damaged components immediately. Oil and fuel leaks can cause fires!
- Be certain that all clamps, guards and heat shields are installed. These components prevent vibration, rubbing and heat build up. Install tie wraps to fasten hoses and wires as required.
- Cold start ether is extremely flammable! Never use cold start ether near heat sources, open flames, or near anyone who is smoking cigarettes! Use only in well ventilated areas and as directed!
- Never use the flame glow plug or preheat system when you use an ether cold start aid. Danger of explosion!
- Know the location of the fire extinguishers, make sure you know how to use them properly. Check out the location of where to report a fire and inform yourself about fire fighting capabilities on the job site before you start to work.

2.5 MACHINE START UP SAFETY

- Before starting the machine, perform a thorough walk around inspection.
- Visually check the machine for loose bolts, cracks, wear, leaks, and any evidence of vandalism.
- Never start or operate an unsafe or damaged machine.
- Be certain that all defects are taken care of immediately.
- Make sure that all covers and doors are closed and locked. Check if all warning and safety decals are on the machines, make sure that all of them are legible.
- Clean all windows and mirrors, secure all doors and windows to prevent any inadvertent movement.
- Always enter the cab through the left door. Use the right door only in emergencies.

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- Make sure that no one is on or under the machine. Warn all personnel in the surrounding area on the job site before operating the machine.
- After entering the cab, adjust the operator's seat, the rear view mirror, the arm rests and the seat belt as well as seat belt tethers. Be certain that all controls can be reached so you can work comfortably.
- All noise level protection devices on the machine must be operational during operation.
- Never operate a machine without a cab or canopy.

2.6 ENGINE START UP SAFETY

- Before starting the engine, check all indicator lights and instruments for proper function. Place all operating and control levers into neutral position.
- Before you start the engine, warn any personnel in the surrounding area by sounding the horn.
- Start the machine only while seated in the operator's seat, and with the seat belt secured.
- If no other instructions were given, follow the engine starting instructions as outlined in the **Operation and Maintenance Manual**.
- Start the engine and check all indicator lights, gauges, instruments and controls.
- Start the engine only in a well ventilated area. If necessary, open doors and windows to assure sufficient fresh air supply. Warm up the engine and hydraulic system to bring engine and hydraulic oil to operating temperature, as low oil temperatures cause the machine to be unresponsive.
- Check that all attachment functions are operating properly.
- Move the machine slowly and carefully into an open area and check all travel and brake functions, the steering function as well as the turn signals and lights.

2.7 MACHINE OPERATING SAFETY

- Make sure you are aware of any special circumstances on the job site, make sure you are familiar with any special guidelines and warning signals. Familiarize yourself with the job site before starting to work, any special hindrances and obstacles influencing operation or movement, the ground conditions, and any special protection required to secure the job site from public highway traffic.
- Always keep a safe distance from overhangs, walls, drop offs and unstable ground.
- Make sure you are especially aware of changing ground conditions, visibility or weather conditions.
- Make sure you know the location of utility lines. Be aware of underground cables, gas and water lines. You must be especially careful when working near supply lines. If necessary, contact the appropriate utility company for information and location of utility lines.
- Keep sufficient distance from electrical lines with the attachment, avoid working near high voltage electrical lines.
 - **DANGER OF LOSS OF LIFE!**
 - You must inform yourself of proper distances to assure your safety while working.
- If you do touch an electrical line with the attachment or machine, proceed as follows:
 - DO NOT leave the machine!
 - If possible, move the machine a sufficient distance away from the danger area.
 - Warn all personnel in the surrounding area not to come close to the machine and/or touch the machine.
 - Instruct somebody to turn the electrical power off.
 - Do not leave the machine until you are assured that the electrical line which has been touched or damaged is no longer energized, and the power has been turned off!

- Before moving or working, make sure you always check that the attachments can be operated safely.
- When travelling or moving the machine on public roads, highways, or properties, make sure to observe all applicable laws, rules and regulations. After moving a machine it may become necessary to reassemble it and to bring it back to proper operating conditions.
- Always turn on the light if visibility is poor or as dusk approaches.
- Never allow another person to ride along on the machine.
- Always work while seated in the operator's seat and with the seat belt secured.
- In the event the machine should tip, remain in the operator's seat, with the seat belt securely fastened. Experience has shown that it is safer to remain in the cab in the event of an overturn.
- Report any functional problems or defects immediately, and make sure that all necessary repairs are completed before resuming operation.
- Be certain that no one is endangered by moving the machine.
- Do not get up from the operator's seat as long as machine is still moving.
- Never leave the machine unattended, with the engine running.
- When traveling, make sure that the attachment is in transport position and keep the load as close to the ground as possible.
- Avoid any working movement which could cause the machine to tip or overturn. However, if the machine does begin to tip or slide or slip on a grade, immediately lower the attachment and load to the ground and turn the machine downhill. If possible, work downhill or uphill, never sideways on a slope!
- Always move slowly on rocky, rough or slippery ground or on a slope.
- Always adapt your travel speed to working conditions.
- Never travel on slopes that exceed the maximum permissible gradeability.
- Never travel downhill at maximum speed, always at low speed to prevent loss of control. The engine must be at high idle and the speed must be reduced by preselecting the low speed range. Always change to the low speed range before reaching the slope, never move onto a slope and then change the speed range.
- When loading a truck, the truck operator must leave the cab, even if the cab is FOPS protected.
- The machine must always be equipped with proper protective devices designed for specific purposes. The machine must be equipped with proper protection when it is utilized in demolition work, land clearing, crane operation, etc.
- Always have another person guide you if visibility is restricted. Always take signals from one person only.
- Utilize only experienced personnel to attach loads and direct operators. The person giving signals must be visible to the operator or be equipped with a two way radios.
- When using a two way radios or Citizens Band radios (CB), the safety lever must be in the full down position.

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2.8 MACHINE PARKING SAFETY

- Park the machine only on firm and level ground. If it becomes necessary to park the machine on a grade, it must be properly blocked with wedges to secure it and prevent any unintentional movement.
- Lower the attachment to the ground and lightly anchor it in the ground.
- Bring all operating levers and controls into the neutral position, place the safety lever in full down position and turn the engine off, as outlined in the Operation and Maintenance Manual, before you leave the operator's seat.
- Lock the machine, remove all keys and secure the machine against vandalism and unauthorized use.
- Never park the machine in such a way as to block access to entrances, exits, ramps, fire hydrants, etc.

2.9 MACHINE TRANSPORTING SAFETY

- Use only safe transportation with adequate carrying capacity.
- If necessary, remove part of the attachment for transport.
- Never use a ramp that is steeper than 30° to move the machine onto a transporting vehicle, the ramp should be covered with wooden planks to prevent slipping.
- Before moving onto the ramp, remove any snow, ice and / or mud from chains or wheels.
- Align the machine with the ramp.
- Use another person as a guide to signal you, the operator. Move very slowly and carefully towards the ramp and the transporting vehicle.
- Raise the attachment and move onto the ramp. Hold the attachment as close as possible to the trailer platform.
- After the loading procedure, lower the attachment onto the trailer platform.
- Secure the machine and all remaining parts with chains and wedges to prevent any slipping or movement during transport.
- Relieve pressures from hydraulic lines and hoses, remove the ignition key, lock the cab and all covers before leaving the machine.
- Carefully check out the transporting route beforehand, check any regulations regarding width, height and weight.
- Make sure that there is enough clearance underneath all bridges and underpasses, utility lines and tunnels.
- During off-loading, use the same care and caution as during the loading procedure. Remove all chains, wedges and blocks. Start the engine as noted in the Operation and Maintenance Manual. Carefully move from the trailer platform down the ramp. Hold the attachment as close as possible above the ground. Use a guide to signal you.


2.10 MACHINE TOWING SAFETY

- Always follow the correct procedure: Refer to the Operation and Maintenance Manual section "Towing the machine".
- Tow the machine only in exceptional cases, such as removing the machine from a dangerous area.
- Be sure that all towing and pulling devices, such as cables, hooks etc. are safe and adequate.

- The cable or towing bar, which is used to tow the machine must be adequate to pull the machine and must be connected to the appropriate bores and couplers. Any damage or accident which is the direct result of towing this machine is expressly excluded from the manufacturer's and/or LIEBHERR's warranty.
- Never allow anyone to stand near the cable or on the machine while pulling or towing.
- Keep the cable tight and free of kinks.
- Carefully pull the cable tight, do not jerk! A sudden jerk can cause a slack cable to snap.
- When towing, keep the machine straight and maintain, permissible speed and route.
- When returning the machine to operation, proceed as stated in the Operation and Maintenance Manual.
- After the towing the machine, and before continuing operation, be certain to return the machine to a safe operating condition.

2.11 MACHINE MAINTENANCE SAFETY

- Never perform any maintenance or repairs for which you are not qualified or you do not understand.
- Any maintenance / inspection should be performed in the intervals noted in the Maintenance Guidelines. To perform any repairs, make sure you have the proper tools.
- Maintenance work should be performed according to the chart at the end of the Operation and Maintenance Manual. It is also noted who should or may perform what type of work. The operator should only perform items marked OM on the maintenance and inspection chart. The remaining work should only be performed by trained personnel.
- All spare parts must conform to the technical requirements set forth by the manufacturer. This is only assured by using Original LIEBHERR spare parts.
- Always wear proper and safe work clothing. For certain jobs, in addition to hard hats and safety shoes, additional safety equipment is required, such as safety glasses and gloves.
- Keep unauthorized personnel from the machine during maintenance and repair work.
- Secure the maintenance area, as necessary.
- Inform operators if any special tasks or maintenance work is required. Appoint one supervisory person to assure that this work has been done properly.
- Perform all maintenance work with the machine parked on firm and level ground and with the engine turned off, unless otherwise specified in the Operation and Maintenance Manual.
- The cab may only be raised if the machine is parked and the engine is turned off! Before raising the cab, make sure no personnel is within the proximity of the cab. Always secure the raised cab with the safety bar before working under the raised cab. The machine may **NEVER** be moved when the cab is raised! The safety lever must always remain in the full down position!
- After any maintenance and repair work on the machine, make sure that all screw connections or fittings, which had to be loosened, are retightened.

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- If it becomes necessary to remove any safety devices during maintenance and repair, the safety devices which were removed, must be reinstalled immediately and then be inspected for proper function.
- Before servicing the machine, especially when working under the machine, attach an easily visible "**DO NOT OPERATE**" sign to the ignition switch. Remove the ignition key.
- Before any maintenance or repair, clean off any oil, fuel or service fluids from connections and couplings. Do not use any harsh cleaning fluids.
- To clean the machine, do not use flammable fluids.
- Before any welding, cutting or grinding, clean the machine and surrounding area of dust, and assure adequate ventilation.
 - Otherwise, there is a **DANGER OF EXPLOSION!**
- Before cleaning the machine with water, steam (high pressure cleaning system) or other cleaning fluids, cover or tape all openings, make sure no water, steam or cleaning fluid enters these openings for safety or functional reasons. Electrical motors, switch boxes and battery compartments are especially endangered.
 - Make sure that during cleaning work, the temperature sensor of the fire warning system and sprinkler system do not come in contact with the hot cleaning fluid, or the sprinkler system could be actuated.
 - After the cleaning procedure, remove all covers and tape.
 - After cleaning the machine, check all fuel, engine oil, and hydraulic lines for leaks, for loose connections, for chafed or damaged areas.
 - All problems must be remedied immediately.
- Adhere to the product safety instructions issued for the handling of oils, greases and other chemical substances.
- Make sure to dispose of any operating and service fluids as well as replacement parts properly and in an environmentally sound manner.
- Be very careful when handling any hot component or fluid on the machine as there is the **DANGER OF BURNS AND SCALDING**.
- Use combustion motors and fuel operated heaters only in areas with adequate ventilation. Before start up, make sure that the ventilation is adequate. Follow and adhere to any local guidelines and instructions pertaining to the present job site.
- Perform any welding, cutting or grinding work on the machine only if this work has been explicitly authorized, as there can be a danger of fire or explosion.
- Do not try to lift heavy parts. Always use appropriate lifting aids and devices with sufficient carrying capacity.
 - To lift spare parts and component assemblies for replacement on the machine, they must be securely mounted and secured onto the lifting devices, to prevent accidents. Use only suitable and flawless lifting devices, as well as hooks, ropes, slings, shackles etc. with sufficient lifting capacity.
 - **Do not allow anybody to work or remain underneath the lifted load!**
- Do not use damaged or insufficient wire ropes. Always wear gloves when handling wire ropes.
- Only experienced personnel may attach loads and signal the operator. The person used as a guide must be visible by the operator or be in direct voice contact with the operator via a two way radio.
- When installing parts higher up or when working overhead, always use safe scaffolding or ladders suited for this purpose! Do not step on any parts to get closer to the working area. You must wear safety belts or similar safety equipment when working higher up. Make sure all handles, steps, walk ways, cat walks, and ladders, etc. are always free of dirt, snow and ice.
- When working on or changing any part of the attachment, for example when changing the teeth, make sure that the attachment is properly supported. Never use metal on metal supports.

- Never work underneath the machine if the machine has been raised with its attachment. Prior to working underneath, the machine and/or its attachment must always be properly blocked and supported with wooden blocks.
- Always block the machine in such a way that any change in the center of gravity will not endanger its stability. Never use metal on metal supports.
- Only authorized, trained personnel may work on the travel gear, brake and steering system.
- If the machine must be repaired while parked on a slope, the track chains or wheels must be blocked to prevent any movement with wedges. The attachment must be brought into proper maintenance position.
- Only authorized personnel who have received specialized training may work on the hydraulic system.
- Always wear gloves when checking for leaks. Never check for leaks with your bare hands. A thin stream of fluid escaping from a small hole can have enough force to penetrate the skin.
- Never loosen any hydraulic lines or connections until the attachment has been lowered to the ground, the engine has been turned off (with the ignition key in contact position) all servo controls (joysticks and foot pedals) have been actuated in both directions to release any servo pressure and to release all pressures in the working circuit, and the tank pressure has been released by slowly opening the bleeder screw.
- Regularly check all hydraulic lines, hoses, and connections for any leaks and damage. Any defects must be repaired immediately. Any escaping fluid can cause serious injuries and fire.
- Before beginning any repairs, you also must make sure all air pressures are relieved in any of the systems you need to gain access to; to be certain, refer to the description of the various component groups and assemblies.
- Route and install all hydraulic and air pressure lines properly. Mark and check all connections to prevent any mix ups. All the fittings, including length and quality or type of hoses used must match the requirements set forth by the manufacturer.
- For that reason, use only **Original LIEBHERR replacement parts**.
- Replace hydraulic hoses and lines in regular intervals, as stated, even if no defects can be seen.
- Work on electrical components of the machine may only be performed by a certified electrician or by a person working under the guidance and supervision of such an electrician, and according to electro-technical procedures, rules and regulations.
- When working on the electrical system or before any arc welding on the machine, the battery cables must be disconnected. Always disconnect the negative ("-" minus) terminal first, and reconnect it last.
In addition, **before any welding, always remove the electronic box.**
- Use only Original fuses with the same amperage. In case of problems in the electrical power supply, turn the machine off immediately.
- Inspect / check the electronic components of the machine regularly. Repair any problems or defects, such as loose connections or chafed wires and replace any burnt out fuses and bulbs immediately.
- If any work is necessary on energized, voltage carrying parts, a second person must be utilized to disconnect the main battery switch or emergency off switch in case a problem should arise. Rope the working area off with a red/white safety chain and a warning sign. Use only insulated tools!

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- When working on high voltage carrying components or sections, turn off the power supply, then connect the supply cable to the ground wire and use the grounding rod to ground these parts, such as the condenser, for example.
- Check the disconnected parts first to see if they are really voltage free, ground them and then close them off. Insulate the neighboring, voltage carrying parts.

2.12 SAFETY GUIDELINES TO BE OBSERVED WHEN WORKING ON THE ATTACHMENT

- Never work underneath or on the attachment unless it is securely placed on the ground or it is properly blocked and supported to keep it from drifting or falling.
- When replacing or changing any part of the attachment, such as blade, cutting edges, teeth, etc., never use metal on metal supports.
- Never try to lift any heavy parts. Always select and use appropriate lifting devices with sufficient lifting capacity.
- When handling wire ropes, always wear gloves!
- Do not disconnect any lines or hoses or remove fittings, caps or covers while the hydraulic system is pressurized. Always lower the attachment, shut the engine off and release all pressures: with the ignition key in contact position, move all servo controls (joysticks and foot pedals) into both directions to release the servo pressure and any pressure remaining in the hydraulic circuit, then release the tank pressure by turning the bleeder screw.
- After completion of all maintenance and repairs, make sure that all lines and hoses and fittings are properly connected and retightened.
- Removing or installing steel pins with a hammer can be very dangerous. Metal chips can cause injury. Always wear gloves and safety glasses!
- Always use the appropriate tools for the job (such as pin pullers, punches, etc.).

2.13 SAFETY GUIDELINES TO BE OBSERVED WHEN LOADING A MACHINE WITH A CRANE

- Lower the attachment to the ground.
- Place all operating and control levers into neutral position.
- Turn the engine off, as described in the Operation and Maintenance Manual and place the safety lever in the full down position before you leave the operator's seat.
- Securely close all doors, covers and hoods.
- Utilize only experienced personnel to attach loads and direct the crane operators. The person giving signals must be visible by the operator or be equipped with a two way radio.
- Install the shackles and hooks to the appropriate and designated brackets / bore holes on the machine.
- Make sure the length of the lifting device is sufficient.
- Carefully lift the machine.
- **DANGER! Make sure nobody is near or underneath the lifted machine !**
- When you place the machine back in service, proceed according the guidelines given in the Operation and Maintenance Manual.

2.14 SAFETY GUIDELINES - HYDRAULIC LINES AND HOSES

- Hydraulic lines and hoses may never be repaired!
- All hoses, lines and fittings must be checked regularly, but at least 1 x per year for leaks and any externally visible damage! Any damaged sections must be replaced immediately! Escaping oil can cause injuries and fires!
- Even if hoses and lines are stored and used properly, they undergo a natural aging process. For that reason, their service life is limited.
 - Improper storage, mechanical damage and improper use are the most frequent causes of hose failures.
 - The service life of a hose may not exceed six years, including a storage period of not more than 2 years (always check the manufacturer's date on the hoses).
 - Using hoses and lines close to the limit ranges of permitted use can shorten the service life (for example at high temperatures, frequent working cycles, extremely high impulse frequencies, multi shift or around the clock operations).
- Hoses and lines must be replaced if any of the following points are found during an inspection:
 - Damage on the external layer into the inner layer (such as chaffings, cuts and rips);
 - Brittleness of the outer layer (crack formation of the hose material);
 - Changes in shape, which differ from the natural shape of the hose or line, when under pressure or when not under pressure, or in bends or curves, such as separation of layers, blister or bubble formation;
 - Leaks;
 - Non observance of installation requirements;
 - Damage or deformation of hose fittings, which might reduce the strength of the fitting or the connection between hose and fitting;
 - Any movement of hose away from the fitting;
 - Corrosion on fittings, which might reduce the function or the strength of the fitting;
 - Storage or service life has been exceeded;

When replacing hoses or lines, always use Original replacement parts.

- Route or install the hoses and lines properly. Do not mix up the connections!

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Hand signals are used when the operator of construction equipment has a restricted field of vision in the working area or in the direction of travel. The signals are designed for instant recognition to enable equipment operators to quickly follow operating instructions from spotters, flagmen, or other designated persons to improve safety.

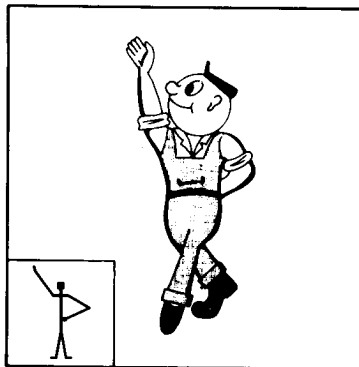
Signals should be given by one person only. This person should face the operator when giving signals and should be outside the danger zone.

In Germany, standard (DIN 2408) specifies clear hand signals which, if used throughout the industry, are designed to avoid misunderstandings between the signal person and the operator. Those standards do not apply if other signals are agreed upon or if other safety signal requirements exist. In any case, all hand signals should be agreed upon between the signaller and the operator.

1. **Hand signals** (Excerpt from DIN Norm 24 081)

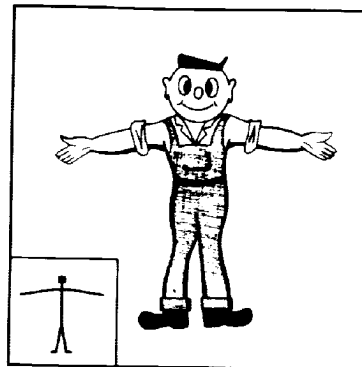
1.1 **General Signals**

Caution



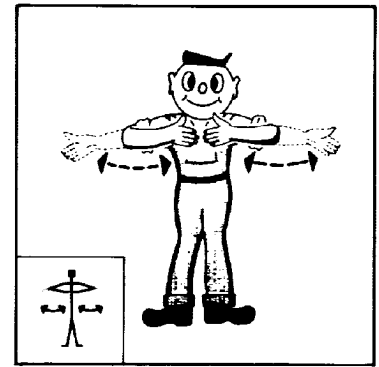
Raise one arm with open palm.

Stop



Extend both arms horizontally.

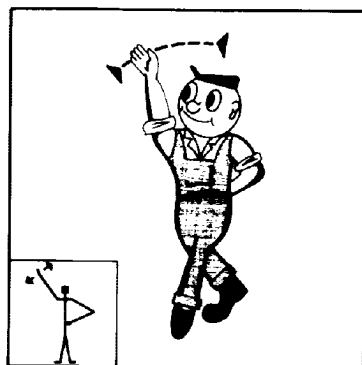
Stop! Danger



Extend both arms horizontally and move forearms in and out.

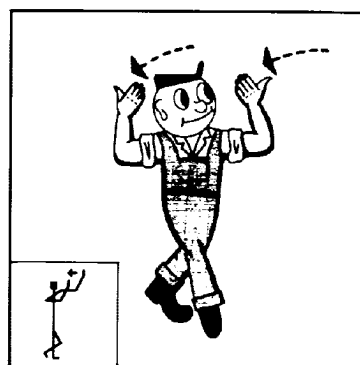
1.2 **Travel signals**

Start to travel



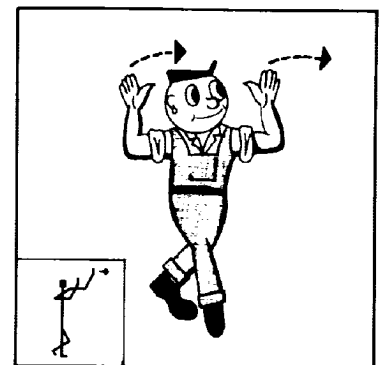
Move the raised hand with the palm pointing outward back and forth.

Travel slowly forward



Both arms raised and bent at elbow with palms pointing inward.

Travel slowly reverse



Both arms raised and bent at elbow with palms pointing outward.

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Benennung Description Dénomination

Hand Signals

for Construction Equipment

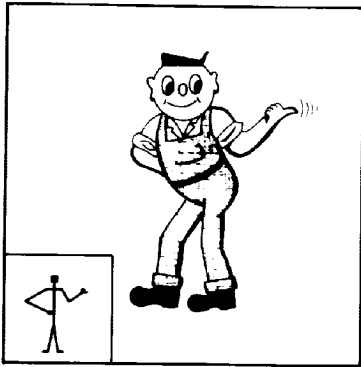
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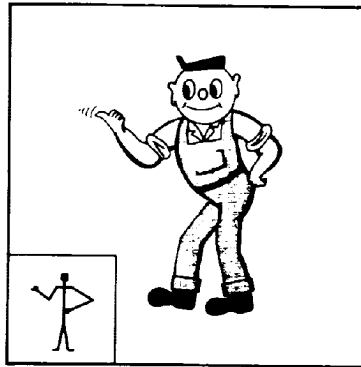
1.2.02.01

Travel - turn right



Point to the left with the left thumb.

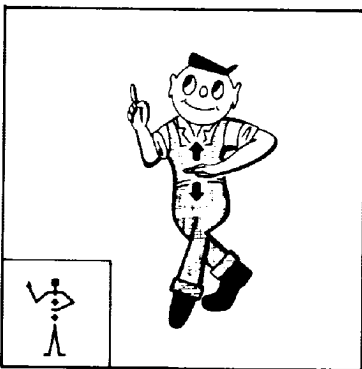
Travel - turn left



Point to the right with the right thumb.

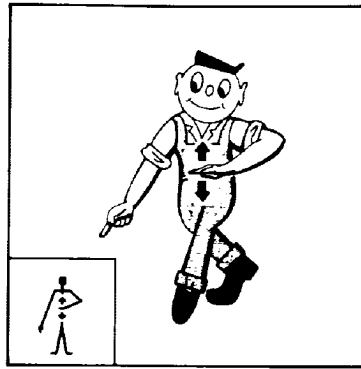
1.3 Working signals

Raise attachment



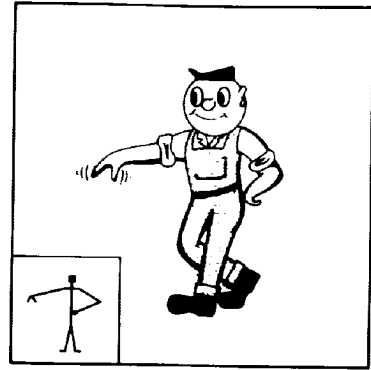
Point with the right index finger up and move the left hand up and down.

Lower attachment



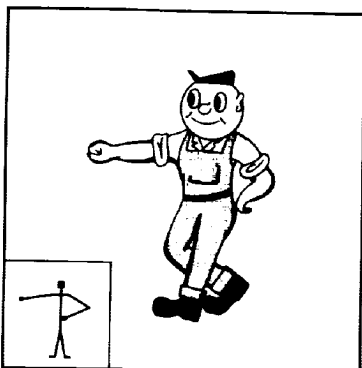
Point with the right index finger down and move the left hand up and down.

Open grapple (multi purpose bucket)



Hold one arm out horizontally with hand pointing down and half open.

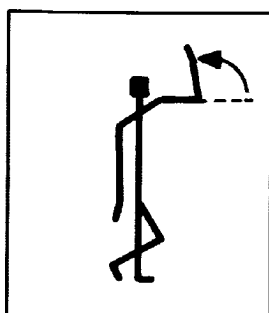
Close grapple (multi purpose bucket)



Hold one arm out horizontally with clenched fist.

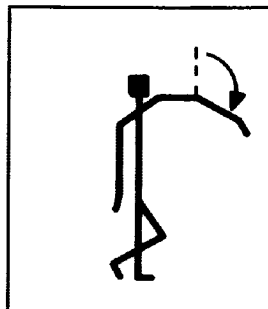
2. Additional, non-standardized hand signals

Tilt bucket in



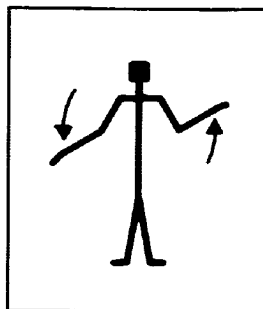
Raise and bend one arm with palm pointing inward.

Tilt bucket out



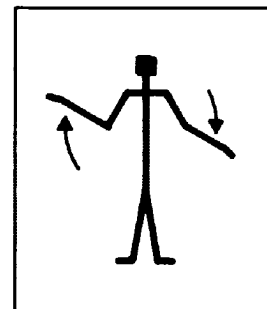
Lower and straighten bent arm with palm pointing outward.

Tilt left



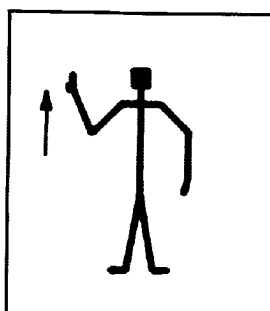
Both arms are slightly raised and bent. Raise left arm, lower the right arm.

Tilt right



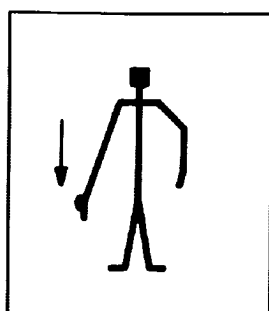
Both arms are slightly raised and bent. Raise right arm, lower left arm.

Increase engine RPM



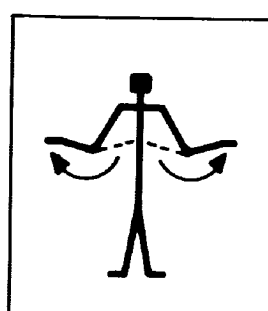
Point with the right thumb up, hand closed.

Decrease engine RPM



Point with the right thumb down, hand closed.

Shut off machine



Extend both forearms towards the side of the body.