

en

Service manual
Hydraulic excavator
R920 - R925

1 Document identification

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2 Product identification

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Manual no.

User:

Address of copyright owner

Preface

1 General

This manual contains technical data, design and functional descriptions as well as instructions for the operation and the adjustment of machine settings. The document includes a number of drawings, functional schematics and detailed views of units and assemblies of **Liebherr hydraulic excavators**.

The documentation has been designed to support customer support services, but does of course not replace proper technical training and qualification of the user, and participation in Liebherr operator training courses.

General basic technical information is not included in this manual. For operating instructions and information on spare parts, please refer to the separate documentation.

During all work on the machine, strictly adhere to the relevant accident prevention and safety regulations.

2 Symbols used in this manual

Tasks and procedures that are associated with specific dangers are accompanied by safety instructions. The safety instructions are graded according to the severity of the risk and are identified with the terms **DANGER**, **CAUTION** and **NOTE**.

These terms are used in combination with the following symbols:



Danger!

Warning referring to a danger where there is a high probability of death or serious injury to operators, unless the prescribed safety measures are taken.



Caution!

Warning relating to dangers that might lead to injury or damage to the machine, unless the prescribed safety measures are taken.



Note!

This symbol accompanies instructions and tips regarding the operation, maintenance and repair of the equipment. If adhered to, the service life of the machine can be prolonged and/or procedures are made easier.

- This symbol precedes entries in a list.
 - This symbol precedes entries in a sub-list.
- ☐ This symbol identifies «Pre-condition MUST be fulfilled».
- ▶ This symbol indicates a single procedure in a sequence of procedures.
 - ↪ This symbol indicates a result of an action.

3 Regulations

This service manual has been exclusively compiled for internal use by the registered machine owner.

It may not be reproduced or made available to third parties without the explicit written consent of Liebherr who retains all rights in this document.

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This service manual shall be amended without prior notice to reflect new technical developments and machine series. Liebherr reserves the right to make minor technical changes to the machines that might not be reflected in the accompanying documentation.

Depending on the series development, the service manual shall be revised in electronic format. Changes and amendments are listed in group 010.010.

This manual might be complemented by additional service information sheets issued by Liebherr.

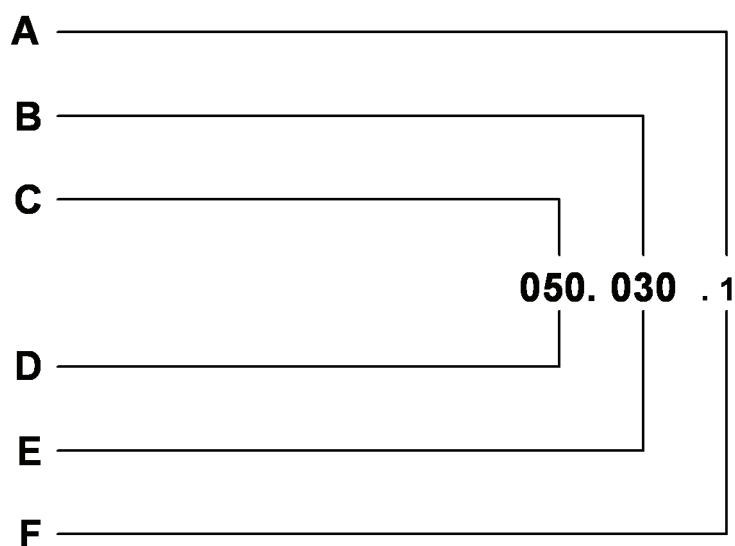
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We hope that the information in this documentation aimed at improving the servicing of Liebherr hydraulic excavators is of use to you.

4 Document layout

In order to make it easy for users to find specific information regarding revised or amended documents, each page is identified as follows:



A Page number

B Subgroup

C Main group

D Cooling system

E Fan control

F Page

The main groups are listed in the main group directory.

The subgroups are listed on the first page of each main group section. The subgroup list also includes the machines and serial numbers to which the subgroup is relevant.

In the event of minor changes, we will send you the amended page showing the current date.

If an existing subgroup is completely revised and re-edited, the new version will be assigned a new subgroup number.

Introduction	010
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Additions and updates in the service manual



Note!

We need your help to continually improve our documentation. Please e-mail us with your comments, ideas and suggestions for improvement: documentation.lfr@liebherr.com.

1 Update 05/2021

	Chapter	Type of modification	Affected machines
New	All	Addition of the machine R925 1444	R925
Modified	190.190	LiDAT remote diagnosis system	R920 - R925

2 Update 09/2020

	Chapter	Type of modification	Affected machines
Modified	130.XXX	Wear limits for track components	R920 - R924

3 Update 12/2019

	Chapter	Type of modification	Affected machines
revised	030.060	Adjustment checklist and adjustment procedure	R920 - R924
revised	040.410	Two half sealing rings replaced by a full sealing ring	R920 - R924
revised	110.150	Addition of the new display	R920 - R924
revised	130.460	Wear limits for rollers	R920 - R924
revised	160.060	Addition of service codes	R920 - R924
revised	180.010	Addition of „Checking function of slewing brake“	R920 - R924
new	190.008	Safety requirements	R920 - R924
revised	200.005	Updating the machine software	R920 - R924

4 Update 03/2019

	Chapter	Type of modification	Affected machines
new	140.010	Repair welding guideline	R920 - R924

Update 06/2018

	Chapter	Type of modification	Affected machines
revised	180.050	Tilting clearance measuring procedure	R920 - R924

5 Update 06/2018

	Chapter	Type of modification	Affected machines
revised	130	Update of track chain types and values	R920 - R924
new	190.055	Small flow circuit	R920 - R924

6 Update 12/2017

	Chapter	Type of modification	Affected machines
new	010.025	Link on Liebherr service documentation \ General \ Liebherr standards	R920 - R924
revised	030.060	Adjustment checklist and adjustment procedure	R920 - R924
new	060.020	Depressurising a hydraulic system	R920 - R924
revised	110	New index of electrical diagrams	R920 - R924
revised	200.250	Master module	R920 - R924
revised	200.530	Sculi – access to the variables	R920 - R924

7 Update 04/2017

	Chapter	Type of modification	Affected machines
new	060.010	Description of the Positive Control system	R920 - R924
revised	060.110	New index for hydraulic schematic	R920 - R924
new	080.220	Pilot control unit / joystick	R920 - R924
revised	110.250	Uppercarriage - main cable set - new index for electrical schematics	R920 - R924
new	150.400	Removing and installing the stick to the boom	R920 - R924
new	200.200	CAN data transmission	R920 - R924
new	200.250	Master module	R920 - R924
new	200.260	CAN input and output modules	R920 - R924

8 Update 11/2016

010.010.2

R920 - R925


	Chapter	Type of modification	Affected machines
revised	060	Overview of hydraulic symbols	R920 - R924
new	080	Gear pumps AP212, PHP	R920 - R924
new	160	Operator's cab, heating and air conditioning	R920 - R924
new	180	Slewing ring	R920 - R924
revised	190	Medium pressure circuit	R920 - R924
new	190	Hydraulic hammer return filter	R920 - R924
new	190	LiDAT	R920 - R924
new	190	GPS system	R920 - R924
new	190	Auxiliary heater	R920 - R924
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new	200	Updating the machine software	R920 - R924
new	200	Connection to Sculi	R920 - R924
new	200	Sculi - access to the variables	R920 - R924

1 Safety warnings

1.1 Information on these instructions

1.1.1 Representation of warning messages

Warning symbol

	The warning symbol warns of potential dangers. Obey all measures marked with this symbol to avoid injury or death.
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Tab. 1: Warning symbol

Grading of warning messages

The grading of warning messages is defined by following signal words:


DANGER
WARNING
CAUTION
NOTICE

Definition of warning levels

	DANGER	Indicates an immediately hazardous situation which, if not avoided, will result in death or serious injury.
	WARNING	Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
	CAUTION	Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
	NOTICE	Indicates a hazardous situation which, if not avoided, could result in property damage.

Tab. 2: Warning levels

1.1.2 Graphic symbols in these instructions

Symbol	Meaning
	Note Identifies useful information and tips.

Symbol	Meaning
□	Precondition Identifies conditions for subsequent action steps.
▶	Required action Identifies action steps.
▷	Result Identifies results of one or more action steps.
–	Enumeration Identifies individual items of a list.

Tab. 3: Symbols

1.2 Intended use

1.2.1 Laws, rules, guidelines and safety regulations

To ensure safe operation:

- Ask work site manager for safety regulations at place of use.
- Adhere to safety regulations at place of use.
- Adhere to traffic regulations.
- Adhere to valid guidelines from insurers (for example employers' professional liability insurance companies, accident insurance et cetera).
- Avoid working methods that can endanger safety.
- Adhere to all intervals specified for recurrent checks and inspections in this operator's manual.

1.2.2 Intended use

The hydraulic excavator is used to remove, load, transport and unload various materials.

In addition, the tunnel excavator is used to clean the quarry face and mill crevices and shafts.

To ensure intended use:

- Adhere to operator's manual.
- Adhere to maintenance manual.
- Adhere to maintenance intervals.
- Adhere to specifications in the technical data.
- To work, install working tool (for example backhoe bucket, grapple, loading shovel).
- When moving machine with loaded goods, adhere to safety stipulations ([For more information see: 1.6.9 Load-lifting work, page 21](#)).
- Exclusively lift loads with prescribed, attached and functioning safety equipment.
- Make sure that machines in underground operation (mining and tunnelling) are equipped with components for reducing exhaust emissions.
- Adhere to individual country's requirements for underground operation.
- For special uses use special working attachments and if necessary special safety equipment.

- Exclusively mount and use special working attachments with approval and as per stipulations of manufacturer of basic machine.

**Note**

- ▶ Any other use or use beyond the stated use is improper use.

1.2.3 Foreseeable misuse

Do not use machine in following cases:

- Transport of persons without mounted and functioning safety equipment
- Lifting of persons without mounted and functioning safety equipment
- Work in explosive environment without corresponding and necessary equipment
- Work in contaminated environment without corresponding and necessary equipment
- Sweeping on side (with working attachment)
- Stamping
- Striking
- Lifting loads without suitable means
- Pulling and pushing of vehicles or objects without suitable towing attachments and brakes on machine

**Note**

- ▶ The manufacturer is not liable for damage caused by improper use.

1.2.4 Operating conditions

Ambient temperature	-20 °C to 40 °C
Relative humidity	max. 95%

Tab. 4: Operating conditions

Danger to life

Operation during thunderstorms or storms

- If possible stop operation before a thunderstorm or storm.
- Put working attachment on the ground in flattest position possible.
- Secure machine correctly.
- Close window.
- Shut off diesel engine or electric motor immediately.
- Turn ignition key to position **0**.
- Make sure there are no persons in area around machine.

Lightning strike

- Remain in operator's cab.
- Do not leave machine until all component are voltage-free.

Contact with high voltage cable

- Do not move machine and working attachment.
- Remain in operator's cab.
- Do not leave machine until all component are voltage-free.

- Make sure that all persons stay away from the machine and the high voltage cable.
- Have voltage switched off.

Damage

Incorrect operation in operating conditions deviating from intended use

- Equip machine according to operating conditions.

Following operating conditions deviate from intended use:

- Dust intensive applications
- Contaminated areas
- Lower or higher ambient temperatures

Incorrect operation in corrosive environment or with corrosive material

- Regularly clean machine to remove corrosive materials (for example salt, phosphate, fertiliser).
- Treat metallic surfaces with conservation wax if necessary.
- Derust, prime and repaint damaged and corroded steel parts.
- Make sure that piston rods of hydraulic cylinders are coated completely with an oil film.
- If piston rods are not coated completely with an oil film: Retract and extend piston rods along the entire stroke.
- If it is not possible to retract and extend the piston rods along the entire stroke: Clean and conserve piston rods.

1.2.5 Disposal

Danger to life

Unapproved disposal of gas containers and pressure vessels

- Before disposal, completely depressurise pressure vessel.
- Before disposal, professionally empty pressure vessel.
- Adhere to safety instructions of pressure vessel manufacturer.

Unapproved disposal of refrigerant

- Have refrigerant disposed of by refrigerant recycling point.
- Adhere to safety data sheet of refrigerant during disposal.

Environmental pollution

Unapproved disposal of machine

- Make sure that the individual elements of the machine are disposed of correctly after the service life.
- Dispose of elements of machine in line with valid country-specific waste disposal guidelines and relevant valid laws.
- Remove fuels, operating fluids and lubricants from all components before disposal.

- Collect and store fuels, operating fluids and lubricants in suitable containers before disposal.
- Adhere to instructions of relevant manufacturer when disposing of fuels, operating fluids and lubricants.
- Have fuels, operating fluids and lubricants disposed of by old oil recycling point.
- Have metal parts disposed of by metal recycling point.
- Have plastic parts disposed of by plastic recycling point.
- Have rubber parts disposed of by rubber recycling point.
- Have electronic components disposed of by electronics recycling point.

1.3 Description of staff

1.3.1 Personal protective equipment

Operators, assistants and maintenance staff are responsible for the following:

- Wearing personal protective equipment
- Regular cleaning and care of protective equipment
- Immediate replacement of damaged parts of protective equipment

The protective equipment consists of following elements:

- Protective helmet
- Safety glasses
- Hearing protection
- Breathing equipment
- Protective gloves
- Warning clothing (reflective, in signal colour)
- Safety boots
- Special protective clothing
 - To prevent burns
 - To prevent freezing
 - To prevent acid burns
 - To prevent stabbing and cutting injuries

1.3.2 Requirements for staff

- Make sure that exclusively authorised and trained persons operate, maintain or repair the machine.
- Make sure that all persons operating, maintaining or repairing the machine have the specified minimum age.
- Make sure that staff training involves theoretical information (technology and safety) and practical training on the machine.
- Make sure that the staff have read and understood the operator's manual and supplied documentation.
- Make sure that staff undergoing training, education, instruction, or a general apprenticeship exclusively work on the machine under constant supervision by an experienced person.
- Regularly check safety-aware and danger-aware working of staff.
- Clearly specify staff responsibility for operation, set-up, maintenance and repair work.

1.3.3 Operating company

Responsibility

The operating company has following tasks:

- Make sure that exclusively trained staff operate the machine.
- Make sure that exclusively trained staff maintain the machine.
- Check qualification of persons in handling the machine.
- Authorise activities of persons in handling the machine.
- Define competences and responsibilities for all persons involved in handling the machine.
- Have following staff continuously supervised by an experienced person.
 - Staff undergoing training
 - Staff undergoing education
 - Staff undergoing instruction
 - Staff undergoing a general apprenticeship
- Provide all persons tasked with handling the machine with the necessary protective equipment.
- Check safety-aware work of staff at regular intervals.
- Check danger-aware work of staff at regular intervals.
- Make sure that machine is operated in flawless, safe condition.
- If flaws affecting safety occur: Immediately decommission machine.
- Perform inspections of machine prescribed by Liebherr punctually.
- Perform nationally mandated inspections of machine punctually.
- Adhere to national legal specifications on provision of machines and tools by the employer (hazard assessment and risk assessment conducted by the operator).
- Report every accident with the machine to Liebherr.
 - Involving serious injuries
 - Involving major damage
- Allow Liebherr staff unrestricted access to machine in connection with the product monitoring obligation.
- Create shift plan for machine.
- Clearly specify staff responsibility (operation, set-up, maintenance and repair work).
- Make sure that no retrofitting is performed on machine without consultation of the manufacturer.
- Exclusively use original Liebherr spare parts.

1.3.4 Operator

Responsibility

The operator has following tasks:

- Read operator's manual.
- Read supplied documentation.
 - Operator's manuals for components
 - Operator's manuals from third party manufacturers
 - Additional instructions
- Wear personal protective equipment.
- Operate machine as intended.
- Avoid working methods that can endanger safety.
- Adhere to safety regulations at place of use.
- Report all changes to machine that affect safety to operating company.
- If it is no longer possible to work safely: Immediately stop operating machine.
- Exclusively perform retrofittings of machine after consultation with manufacturer.

- Exclusively use original Liebherr spare parts.

Requirement

The operator has following qualification and skills:

- Has completed the legally specified minimum age.
- Is physically and mentally capable of operating the machine safely.
 - Satisfactory eyesight
 - Satisfactory hearing ability
 - Quick reactions
- Has the authorisation necessary for operation of machine.
- Is able to estimate distance, height and gaps.
- The operator has the necessary education (theoretical and practical) for the following:
 - Handling the machine type
 - Attaching
 - Spotting
 - Handling fire extinguishing equipment
- Knows all means of escape in an emergency.
- Is not under any physical or mental impairment that limits one of the prescribed requirements.
- Is not under the influence of alcohol.
- Is not under the influence of drugs.

1.3.5 Maintenance staff

Responsibility

The maintenance staff has following tasks:

- Read operator's manual.
- Read supplied documentation.
 - Operator's manuals for components
 - Operator's manuals from third party manufacturers
 - Additional instructions
- Maintain machine for safe and reliable function.
- Perform all prescribed maintenance tasks.
- Wear personal protective equipment.
- Adhere to safety regulations at place of use.
- Report all changes to machine that affect safety to operating company.
- Exclusively perform retrofittings of machine after consultation with manufacturer.
- Exclusively use original Liebherr spare parts.

Requirement

The maintenance staff has following qualification and skills:

- Has completed the legally specified minimum age.
- Is physically and mentally capable of maintaining the machine.
 - Satisfactory eyesight
 - Satisfactory hearing ability
 - Quick reactions
- Has the authorisation necessary for maintenance of machine.
- Is able to estimate distance, height and gaps.
- Has knowledge of the machine and the hazards.
- Knows all procedures and precautions for maintenance.
- Has knowledge of handling special tools for maintenance and repair.

- Is not under any physical or mental impairment that limits one of the prescribed requirements.
- Is not under the influence of alcohol.
- Is not under the influence of drugs.

1.3.6 Electrical engineer

Responsibility

The electrical engineer has following tasks:

- Read operator's manual.
- Read supplied documentation.
 - Operator's manuals for components
 - Operator's manuals from third party manufacturers
 - Additional instructions
- Maintain and repair machine for safe and reliable function.
- Perform all prescribed maintenance tasks and repair work.
- Isolate main circuit breaker of power supply system and secure it against switching on again.
- Clearly define and label working position.
- Wear personal protective equipment.
- Use adapted tools.
- Adhere to safety regulations at place of use.
- Report all changes to machine that affect safety to operating company.
- Exclusively perform retrofittings of machine after consultation with manufacturer.
- Exclusively use original Liebherr spare parts.

Requirement

The electrical engineer has following qualification and skills:

- Has completed the legally specified minimum age.
- Is physically and mentally capable of maintaining the machine.
 - Satisfactory eyesight
 - Satisfactory hearing ability
 - Quick reactions
- Has the authorisation necessary for maintenance and repair of machine.
- The electrical engineer has following skills:
 - Is able to estimate distance, height and gaps.
 - Is able to assess work correctly.
 - Is able to recognise dangers.
 - Is able to take safety measures.
- Has knowledge of the machine and the hazards.
- Knows all procedures and precautions for maintenance.
- Has knowledge of handling special tools for maintenance and repair.
- Is not under any physical or mental impairment that limits one of the prescribed requirements.
- Is not under the influence of alcohol.
- Is not under the influence of drugs.

1.3.7 Refrigeration technician

Responsibility

The refrigeration technician has following tasks:

- Read operator's manual.
- Read supplied documentation.

- Operator's manuals for components
- Operator's manuals from third party manufacturers
- Additional instructions
- Maintain and repair machine for safe and reliable function.
- Perform all prescribed maintenance tasks and repair work.
- Isolate battery main switch of power supply system and secure it against switching on again.
- Clearly define and label working position.
- Wear personal protective equipment.
- Use adapted tools.
- Adhere to safety regulations at place of use.
- Report all changes to machine that affect safety to operating company.
- Exclusively perform retrofittings of machine after consultation with manufacturer.
- Exclusively use original Liebherr spare parts.

Requirement

The refrigeration technician has following qualification and skills:

- Has completed the legally specified minimum age.
- Is physically and mentally capable of maintaining the machine.
 - Satisfactory eyesight
 - Satisfactory hearing ability
 - Quick reactions
- Has the authorisation necessary for maintenance and repair of machine.
- The refrigeration technician has following skills:
 - Is able to estimate distance, height and gaps.
 - Is able to assess work correctly.
 - Is able to recognise dangers.
 - Is able to take safety measures.
- Has knowledge of the machine and the hazards.
- Knows all procedures and precautions for maintenance.
- Has knowledge of handling special tools for maintenance and repair.
- Is not under any physical or mental impairment that limits one of the prescribed requirements.
- Is not under the influence of alcohol.
- Is not under the influence of drugs.

1.3.8 Rigger

Responsibility

The rigger has following tasks:

- Wear personal protective equipment.
- Choose correct and undamaged slinging gear.
- Correctly attach slinging gear to load or lifting accessory.
- Correctly remove slinging gear from load or lifting accessory.
- Grant approval for movement or accompaniment.

Requirement

The rigger has following qualification and skills:

- Has completed the legally specified minimum age.
- Is physically and mentally capable of attaching loads.
 - Satisfactory eyesight
 - Satisfactory hearing ability
 - Quick reactions

- Has the authorisation necessary for attaching loads.
- The rigger has following skills:
 - Is able to estimate distance, height and gaps.
 - Is able to estimate mass distribution and load distribution.
 - Is able to operate radio units.
 - Is able to give clear instructions on radio units.
 - Is able to guide a load.
 - Is able to ensure safe movement of load and machine.
- The rigger has the necessary education (theoretical and practical) for the following:
 - Selecting the suitable slinging gear
 - Attaching slinging gear
 - Securing to prevent unintended disengaging of slinging gear
 - Avoiding damage to slinging gear
 - Spotting
 - Applying all necessary signal signs
- Is not under any physical or mental impairment that limits one of the prescribed requirements.
- Is not under the influence of alcohol.
- Is not under the influence of drugs.

1.3.9 Spotter

Responsibility

The spotter has following tasks:

- Wear personal protective equipment.
- Forward signals from rigger to operator.
- If the spotter is the only person for this purpose: Give instructions to operator.

Requirement

The spotter has following qualification and skills:

- Has completed the legally specified minimum age.
- Is physically and mentally capable of directing persons.
 - Satisfactory eyesight
 - Satisfactory hearing ability
 - Quick reactions
- Has the authorisation necessary for giving signal signs.
- The spotter has following skills:
 - Is able to estimate distance, height and gaps.
 - Is able to operate radio units.
 - Is able to give clear instructions on radio units.
 - Is able to guide a load.
 - Is able to ensure safe movement of load and machine.
- The spotter has the necessary education (theoretical and practical) for the following:
 - Spotting
 - Applying all necessary signal signs
- Is not under any physical or mental impairment that limits one of the prescribed requirements.
- Is not under the influence of alcohol.
- Is not under the influence of drugs.

1.4 Protective devices on the machine

1.4.1 Safety lever or folding console

Danger to life

Unwanted movements of machine

- Before leaving operator's seat pull up safety lever or folding console.
- Do not use safety lever as handle.
- Do not use control elements (for example folding console, joystick) as handle.

1.4.2 Operator's cab

Danger to life

Unapproved working method

- Put on safety belt before starting work.
- Make sure that changes in the operator's cab (for example installation of accessories) do not restrict the operator's workspace.

Injuries

Objects in the operator's cab

- Remove objects that are not necessary for the work from the operator's cab.
- Stow and fasten objects that are necessary for the work before starting.
- Make sure that objects carried do not protrude into the operator's workspace.

1.4.3 Height-adjustable operator's cab

Danger to life

Persons in the danger zone

- Make sure there are no persons in the danger zone under the operator's cab.
- Keep your distance from moving parts when the operator's cab is moving down.

Machine tipping

- On slopes, travel with lowered operator's cab.

Injuries

Falling from operator's cab

- Close cab door before raising and adjusting operator's cab.
- If operator's cab is raised: Make sure that cab door is closed.

Damage to operator's cab and machine

Collision with obstacles

- Make sure there are no obstacles in the range of movement of operator's cab.
- Exclusively adjust operator's cab when machine is at a standstill.
- Move operator's cab to upper park position before starting travel.
- Move slowly to end positions (upper or lower park position) using automatic mode.

1.4.4 Tip over protective structure (TOPS)

Danger to life

Damaged falling object protective structures

- Do not put machine into service with damaged falling object protective structures.
- Do not put machine into service with deformed falling object protective structures.
- Do not use falling object protective structures with structural changes.
- Do not use repaired falling object protective structures.
- Do not perform welding on falling object protective structures.
- Do not cut or saw falling object protective structures.
- Do not drill falling object protective structures.

Exceeding of total weight

- Make sure that operating weight of machine (see identification plate) is not exceeded.
- Make sure that the machine does not exceed the operating weight with heavy working tools.
- Make sure that the machine does not exceed the operating weight after changing the working attachment.
- Make sure that the machine does not exceed the operating weight with add-ons or after retrofitting.

1.4.5 Roll over protective structure (ROPS)

Danger to life

Damaged falling object protective structures

- Do not put machine into service with damaged falling object protective structures.
- Do not put machine into service with deformed falling object protective structures.
- Do not use falling object protective structures with structural changes.
- Do not use repaired falling object protective structures.
- Do not perform welding on falling object protective structures.
- Do not cut or saw falling object protective structures.
- Do not drill falling object protective structures.

Exceeding of total weight

- Make sure that operating weight of machine (see identification plate) is not exceeded.
- Make sure that the machine does not exceed the operating weight with heavy working tools.
- Make sure that the machine does not exceed the operating weight after changing the working attachment.
- Make sure that the machine does not exceed the operating weight with add-ons or after retrofitting.

1.4.6 Falling object protective structures (FOPS and FGPS)

Danger to life

Damaged falling object protective structures

- Do not put machine into service with damaged falling object protective structures.
- Do not put machine into service with deformed falling object protective structures.
- Do not use falling object protective structures with structural changes.
- Do not use repaired falling object protective structures.
- Do not perform welding on falling object protective structures.
- Do not cut or saw falling object protective structures.
- Do not drill falling object protective structures.

1.5 Emergency equipment on the machine

1.5.1 Emergency exit (standard)

Danger to life

Incorrect labelling

- Make sure that all information signs are present.
- Make sure that all information signs are legible.

Incorrect equipment

- Make sure that emergency hammer is present.
- Make sure that position of emergency hammer is known.

1.5.2 Fire extinguisher (option)

Danger to life

Incorrect behaviour

- Make sure that all fastening points of fire extinguishers on the machine are known.

- Make sure that everyone is able to operate the fire extinguishers.
- Make sure that everyone knows the local fire alarm possibilities.
- Make sure that everyone knows the local fire-fighting possibilities.
- Make sure that the source of fire is accessible.
- Before starting, unlock all locks of hoods and doors of machine.

1.5.3 Emergency command devices of machine

Depending on equipment, machine has following emergency command devices:

- Emergency stop device
- Emergency cut-off device
- Emergency brake

Danger to life

Defective emergency command devices

- Make sure that all emergency command devices are functioning correctly.
- Regularly check all emergency command devices for function.
- Have defective emergency command devices repaired immediately.

Damage to machine

Incorrect use of emergency command devices

- Exclusively use emergency command devices if there is immediate danger.

1.5.4 Emergency stop function of machine

Damage to diesel engine

Incorrect use of emergency stop equipment

- Exclusively use emergency stop equipment if there is immediate danger.
- If emergency stop equipment has been activated: Let diesel engine run in idle mode for a few minutes after next start.

1.6 Safe operation

1.6.1 Intoxicants

Danger to life

Physical and mental impairment

- Make sure that no persons working on or with the machine are under the influence of drugs.
- Make sure that no persons working on or with the machine are under the influence of alcohol.

- Make sure that no persons working on or with the machine are under the influence of medication.
- Make sure that no persons working on or with the machine are overtired.
- Make sure that no persons working on or with the machine are exhausted.

1.6.2 Dangerous fuels and operating fluids

Injury

Incorrect handling

- Adhere to safety instructions on handling oils, greases and chemical substances.
- In case of hot lubricants and fuels put on personal protective equipment.

Environmental damage

Incorrect disposal

- Dispose of lubricants and fuels safely and in eco-friendly manner.
- Adhere to guidelines applicable to disposal.

1.6.3 Transporting machine

Danger to life

Machine tipping

- Make sure that the transport vehicle is authorised for the machine weight and machine size.
- Do not manoeuvre while driving on ramps.
- Before driving on ramps, clean mud, snow and ice off tyres or travel gear.
- Make sure that a spotter is available if necessary.
- Exclusively use load-bearing and stable loading ramps to load machine.
- Make sure that width and angle of ramps match the gauge and climbing ability of machine.

Incorrect transport

- Park machine on level ground during preparation for transport (disassembly, cleaning).
- Secure machine to prevent rolling away.
- Apply parking brake.
- Pull out ignition key.
- Leave operator's cab.
- Close all doors (for example operator's cab, trim).
- Make sure that nobody is on the machine during transport.
- Make sure that the road to be travelled is known.
- Make sure that all applicable limitations for width, height and weight are known.
- Drive carefully under electric cables and bridges.
- Drive carefully through tunnels.

1.6.4 Access to machine

Injury

Incorrect entry and exit

- Uppercarriage and undercarriage are positioned so that steps and ladders are aligned with each other.
- Clean dirt, oil, ice and snow from steps, ladders, anti-slip mats, handrails and handles.
- Enter and exit carefully on muddy roads, ice, snow, traffic on access roads and in narrow conditions.
- Regularly check steps, ladders, anti-slip mats, handrails and handles and have them repaired if necessary.
- Before entering machine, clean mud, grease, ice and snow from shoes and climbing aids.
- Put on gloves for secure grip.
- Do not climb up or down using tyres, wheel hubs, rims or track chains.
- When exterior influences (for example wind) make opening and closing the door more difficult: Always guide door with your hand.
- Make sure that the opened or closed door has engaged properly.
- If the machine is still moving: Do not stand up from the operator's seat.
- Never jump off machine.
- Enter and leave the machine exclusively using the access system.
- Do not use control elements as handles.
- Keep your face towards machine during entry and exit.
- Make sure you always have two hands and a foot or two feet and one hand in contact with the access system.
- After entering the operator's cab, find out about emergency exit.

If the machine has an operator's cab elevation:

- Climb until the door is reached.
- When you reach door handle with your free hand: Open door.
- Continue climbing.

Adhere to safety instructions on entry and exit in operator's manual of complete machine:

- If the uppercarriage is mounted on a support.
- If the machine is part of a system.
- If the uppercarriage is mounted on a pontoon or rail guide system.

1.6.5 Machine danger zone

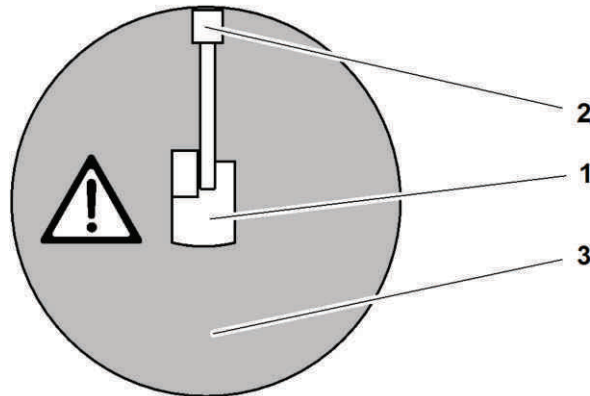


Fig. 9: Machine danger zone (view from above)

- | | | | |
|---|-----------------------------|---|-------------|
| 1 | Machine | 3 | Danger zone |
| 2 | Reach of working attachment | | |

Danger to life

Unapproved presence in danger zone

- Make sure there are no persons in danger zone.

1.6.6 Visibility

Danger to life

Insufficient visibility

- Make sure that persons approach machine from the front and within operator's field of vision.
- Make sure that persons contact the operator before approaching the machine.
- Make sure that no obstacles impair visibility in the working area.
- Use viewing devices to observe environment of machine if necessary.
- Use viewing devices if necessary to observe areas around the machine that cannot be seen directly.
- Exclusively perform rotary motions if visibility is sufficient.
- Position working attachment so that sufficient visibility is ensured.
- Avoid travelling in reverse whenever possible.
- Work with spotter if visibility is restricted.
- Agree on which hand signs to use.
- If necessary communicate via radio.
- Make sure that spotter is outside danger zone.
- In conditions of poor visibility use illumination in accordance with the applicable regulations.
- Exclusively use sun visors if field of vision is not restricted.

Incorrect operation

- Comply with national regulations regarding sufficient visibility in the operator's cab.

- Before operation, check viewing devices for function, cleanliness and correct setting.
- Adjust mirrors so that the best possible all-round visibility is guaranteed.
- Immediately repair defective viewing devices or have them replaced.
- Clean dirty cab windows.
- Avoid covering of visual aids by working attachment.

Damage

Incorrect changes

- Make sure that modifications to the machine do not impair visibility.
- Perform risk analysis again.
- Test machine according to current standards.
- Test machine according to regulations applicable at place of use.
- Depending on test result, take appropriate action.
- Inform operator about modifications.

1.6.7 Protection against vibration

Injuries

Incorrect working method

- Use machine, working attachment and working tool adapted to the task.
- Check condition of machine (tyre pressure, brakes, steering, mechanical connections, ...).
- Make sure that operator's seat is functioning.
- Adjust operator's seat to weight and size of operator.
- Adjust shock absorption to weight and size of operator.
- Do not use jerky movements to steer, brake, accelerate and shift gears.
- Do not use jerky movements to move and load working attachment.

Incorrect travel

- Adapt speed to route.
- Drive slowly on rough terrain.
- Drive around obstacles and very rough terrain.
- Travel longer distances (for example on public roads) at an appropriate (moderate) speed.

Incorrect working environment

- Remove large rocks and obstacles.
- Fill up channels and holes.
- Keep machines to hand for creating and maintaining suitable terrain conditions and calculate sufficient time.

Damage

Increased travel mode

- If machine is driven a lot: Stipulate use of special auxiliary systems for travel mode.
- Regulate speed to prevent swaying.

1.6.8 Operation of machine

Danger to life

Incorrect place of use

- Make sure that load capacity value of ground is sufficient.
- Do not exceed maximum inclination angle of machine while working.
- Do not exceed maximum inclination angle of machine when driving on ramps (side inclination).
- Make sure that ground offers sufficient grip.
- Adhere to safety gap from live overhead cables.

Incorrect use

- When working in following areas, adhere to the laws, regulations and rules applicable at the place of use.
 - Explosive area
 - Flammable area
 - Areas with underground lines (gas, electricity)
- Make sure that machine is equipped with components for exhaust gas reduction when in closed spaces (for example tunnel, hall) in non-explosive environment.
- Clean machine regularly to remove flammable residues (for example dust, wood scraps).

Incorrect handling of electrical system

- Make sure there are no persons with a pacemaker in the vicinity of the running diesel engine.
- Before working on electrical system, make sure that affected parts are voltage-free.
- Before working on electrical system, make sure that neighbouring parts are isolated.
- Have work on electrical systems performed exclusively by a qualified electrician.

Injuries

Incorrect protection

- If there is a risk of falling objects (particularly during log clamp operation): Exclusively use machines with suitable protective structures.
- If there is a risk of objects penetrating the operator's cab (particularly during log clamp operation): Exclusively use machines with suitable protective structures.
- If machine is used in toxic environment: Insert filters approved for the use in air conditioning.
- If machine is used in dust-intensive environment: Insert filters approved for the use in air conditioning.

Incorrect refuelling

- Do not touch fuels with your skin.
- Do not inhale fuel vapours.

Incorrect maintenance

- Make sure there are no persons in danger zone.
- Park machine and secure to prevent rolling or driving away.
- Park machine on level, firm ground.
- Park machine with lowered working attachment.
- When searching for leaks in the hydraulic system wear protective gloves.
- Exclusively search for leaks in the hydraulic system with cardboard or similar material.
- Do not weld or solder hydraulic accumulators.
- Do not perform mechanical work on hydraulic accumulators.
- Make sure that the permanent labelling of the hydraulic accumulators (operating data) is kept visible.

Crushing injuries

Unexpected movements of machine

- Make sure there are no persons in danger zone.
- Park machine and secure to prevent rolling or driving away.

Unintended closing of access doors

- Secure access doors by inserting the securing mechanisms.

Incorrect lifting accessories

- Exclusively use undamaged lifting accessories.
- Make sure that load capacity value of lifting accessories is sufficient.

Incorrect work clothing

- Wear protective gloves when handling wire ropes.

Incorrect work equipment

- Exclusively align bores with suitable pin.

Burns

Incorrect maintenance

- Shut off engine before any maintenance or repair.

Hot pressurised engine cooling system

- Do not touch coolant and parts carrying coolant.
- Let the cover and parts carrying coolant cool down.

Incorrect heat protection

- Make sure that all holders and protective shields against vibration, chafing and heat build-up have been installed correctly.

Incorrect charging of battery

- Do not smoke.
- Avoid naked flames.
- Wear safety glasses.
- Put on protective gloves.

Incorrect handling of flammable liquids

- Exclusively transport flammable liquids on the machine in the designated tanks.
- Make sure that no oil squirts out of leaks.
- Regularly check lines, hoses and screwed connections for leaks and damage.
- Immediately seal leaks.
- Immediately replace damaged parts.

Incorrect refuelling

- Before refuelling, shut off diesel engine.
- Before refuelling, switch off auxiliary heater (option).
- Do not smoke.
- Avoid naked flames.
- Do not touch fuels with your skin.
- Do not inhale fuel vapours.

Damage to machine

- Before placing machine under heavy load, make sure that machine is at operating temperature.

Environmental pollution

- When working in following areas, adhere to the laws, regulations and rules applicable at the place of use.
 - Areas at risk of water (for example bodies of water)
 - Sound-sensitive areas
 - Emission-sensitive areas

1.6.9 Load-lifting work

Danger to life

Machine tipping

- Make sure that machine is equipped for load-lifting work.
- Make sure that machine has safety equipment for load-lifting work.

Falling load

- Make sure that machine is equipped with line break safety on every hoist cylinder and stick cylinder.
- Make sure that the operator's cab contains a load chart.
- Exclusively use suitable slinging gear for load-lifting work.
- Exclusively tie down or loosen loads or stabilise them during transport with the help of another person.

1.6.10 Demolition work

Danger to life

Incorrect use

- Make sure that machine is equipped with additional counterweights corresponding to installed working attachment.
- Make sure that operator's cab is equipped with protective structure in line with FOPS specifications.
- Exclusively work above support height of machine on the ground.
- Avoid jerky movements and sudden stopping.
- Do not lift, move or hold loads with demolition attachment.
- Make sure that there is no rubble on the working attachment.
- Maintain sufficient gap between machine and demolition object.

Incorrect travel

- Position demolition attachment in safety position.
- Travel uphill: Align working attachment to the front.
- Travel downhill: Align working attachment to the back.
- Avoid travelling at right angle to slope.
- If travelling at right angle to slope is necessary: Align uppercarriage uphill.

Injuries

Incorrect use

- Adhere to safety instructions applicable in place of use.
- Make sure that Liebherr Demolition Control (LDC) reach limitation system is functioning.
- Make sure that demolition work is performed exclusively by experienced operators trained in use of LDC system.
- Do not use inertia of working attachment as additional force.
- Exclusively execute movements slowly and evenly with demolition attachment.

1.7 Safe work

1.7.1 Machines with electric drive

Danger to life

Hazardous voltage

- Have work on electrical systems performed exclusively by authorised specialist staff.
- When working on electrical system, observe the five safety rules.

Lightning strike

- Remain in operator's cab.

- Before entering or leaving the machine, make sure that the machine is voltage-free.

Electromagnetic field

- Make sure there are no persons with active medical devices (for example pacemakers) in the vicinity of machine.

Incorrect initial putting into service

- Exclusively have initial putting into service performed by Liebherr customer service.

Damage

Electromagnetic field

- Exclusively use suitable machines and devices in vicinity of machine.

Five safety rules for work on electrical system

Make sure that for work on the electrical system the following points are adhered to:

- Machine is isolated.
- Machine is secured against being switched back on.
- No voltage is detected.
- Machine is grounded and shorted.
- Neighbouring live parts are covered and cordoned off.

Notes on machine operation

Make sure the following preconditions are met:

- Persons in the work area are informed about dangers of electromagnetic field.
- Machine is properly connected to supply network.
- Machine is grounded.
- Feeder cable is correctly dimensioned.
- Protective conductor is correctly dimensioned.
- All cables and wires are secure.
- All safety signs are attached and legible.
- All electrical cabinets with a voltage above 50 V are closed and secured against being opened without authorisation.

Notes on working on electrical system

The following points apply for electricians:

- Electricians assess work properly.
- Electricians identify hazards.
- Electricians take safety measures.
- Electricians know the relevant national standards.
- Proof of documented qualification is possible.

Electricians have one of these qualifications:

- Training as an electrical engineer
- Training as an electrical technician
- Training as a master electrician
- Training as a specialist

Make sure the following preconditions are met:

- Opening electrical cabinet is possible exclusively for electricians.
- Work on electrical system is possible exclusively for electricians.
- Job is clearly defined and designated.
- Unqualified persons cannot reach the electrical system.
- Machine is isolated.
- Machine is secured against being switched back on.
- No voltage is detected.
- Machine is grounded and shorted.
- Neighbouring live parts are covered and cordoned off.

1.7.2 Tunnelling machines

Danger to life

Lack of qualification

- Make sure that the operator has mastered the operation of the tunnelling machine.
- Make sure that the operator is trained in fire-fighting.

Fire and explosions

- Make sure that fire extinguisher functions correctly.
- Test fire extinguisher for function according to applicable regulations.
- Make sure that everyone has mastered operation of fire extinguishers.
- If necessary, use hydraulic liquids that are difficult to ignite.
- Contact Liebherr customer service.

Incorrect operation

- Adhere to safety instructions for tunnel construction sites.
- To avoid stone impact or flying sparks, adhere to working instructions.

1.7.3 Demolition machines

Danger to life

Unsuitable ground

- Make sure that machine does not sink.
- Check load capacity of ground.
- Check support surface of support.
- Remove obstacles from working area.

Incorrect use

- If machine is equipped with undercarriage with adjustable width: Extend side frames to the stop.
- If stability of machine is affected: Reduce reach and movement speed (even in restricted mode).
- Avoid reaching the shut-off limit of the LDC system.
- Adhere to reach limitation.
- Avoid aligning stick and boom in line.
- When working position stick close to the horizontal or at an angle to the boom.

- Do not lift machine with working attachment.

Damage to machine

Incorrect use of demolition attachment

- Exclusively use demolition attachment approved by Liebherr.
- Exclusively operate demolition attachment with closed windscreen or with front guard.
- Exclusively use hydraulic hammer to break stone, concrete and breakable materials.
- Exclusively operate hydraulic hammer in longitudinal direction of machine.
- Make sure that no cylinder is fully extended or retracted in hammer mode.
- Make sure that the stick is not in vertical position in hammer mode.
- Do not break concrete and rocks through movements of hydraulic hammer.
- Operate hydraulic hammer for maximum 15 s without interruption in one location.
- Do not move or lift objects with hydraulic hammer.
- Do not break rocks through falling force of hydraulic hammer.

Incorrect use

- Adhere to visual signals on the display and acoustic warning sounds.
- When the movements approach cylinder stops: Reduce speed of movements.
- Avoid lateral forces on working attachment through turning of uppercarriage.

1.7.4 Machine with turret

Danger to life

Unsuitable ground

- Make sure that machine does not sink.
- Check load capacity of ground.
- Check support surface of support.

Incorrect use

- Before operation, align machine to be horizontal.
- Make sure that uppercarriage is aligned parallel to undercarriage.
- Make sure that centre of gravity of the uppercarriage is over centre of undercarriage.
- If the uppercarriage is to be moved from travel position: Support machine.
- Keep raised load close to machine and move close to the ground.
- Avoid sudden braking or acceleration of working attachment.

Incorrect travel

- Drive slowly and carefully.
- Do not drive with raised load.
- Make sure that ground to be driven over is firm and level.
- Retract support legs after aligning uppercarriage.
- Adapt driving behaviour to higher centre of gravity of machine.
- Adapt speed to driving conditions.
- Drive slowly and carefully through narrow passages.
- Avoid sudden speed changes.

1.7.5 Machines with height adjustable cab

Danger to life

Persons in the danger zone

- Make sure there are no persons in the danger zone under the operator's cab.
- If operator's cab is being lowered: Keep distance from moving parts.

Machine tipping

- On slopes, exclusively travel with lowered operator's cab.

Injuries

Falling out of operator's cab

- Make sure that the cab door is closed during adjustment of operator's cab.
- Make sure that cab door is closed when in raised state.

Damage

Collision

- Make sure there are no obstacles in the range of movement of operator's cab.
- Exclusively adjust operator's cab when machine is stationary.
- Move operator's cab to park position before starting travel.
- Slowly approach park positions in automatic mode.
- Maintain sufficient distance from machine.
- Adjust operator's cab with caution.
- Exclusively switch off collision check in an emergency.

1.8 Safe maintenance

1.8.1 Spare parts

Danger to life

Incorrect spare parts

- Use original spare parts.
- Make sure that the spare parts meet the technical requirements specified by the manufacturer.
- After replacing parts, tighten loosened screw connections with prescribed tightening torque.
- Find prescribed tightening torque in supplied documentation.
- If the tightening torque is not prescribed by the supplied documentation: Find prescribed tightening torque in Liebherr factory standard.
- If the tightening torque is not prescribed by the Liebherr factory standard: Find tightening torque in valid DIN standard, EN standard or ISO standard.

1.8.2 Heavy parts

Danger to life

Incorrect handling

- Exclusively use machine for load-lifting with sufficient loading capacity.
- Exclusively use suitable and functioning lifting accessories with sufficient loading capacity.
- Make sure that no-one is underneath raised loads.
- Exclusively task qualified and experienced persons with the attaching of loads.
- Exclusively task qualified and experienced persons with the directing of operators.
- Make sure that the spotter can be seen by the operator.
- Make sure that spotter and operator are in voice contact if necessary.

Injury

Incorrect protective equipment

- Put on gloves when handling wire ropes.

1.8.3 Regular checks

Danger to life

Incorrect performance of checks

- Make sure that safety checks are performed regularly on the machine.
- Make sure that all checks are logged.
- Keep all logs.
- Make sure that all checks are performed by suitable, competent and authorised persons.
- Adhere to national regulations.

1.9 Modifications to the machine

1.9.1 Modifications, add-ons and retrofittings

Danger to life

Incorrect changes to the machine

- Have changes, add-ons or retrofittings that could affect safety approved by the manufacturer.
- Have installation and adjustment of safety equipment and safety valves approved by the manufacturer.
- Have welding work on load-bearing parts approved by the manufacturer.

- If attachment parts and add-on parts are not approved generally by Liebherr for installation or attachment: Do not attach or install attachment parts and add-on parts to machine without written approval from Liebherr.
- Send all technical documents required for approval to Liebherr.

Damage

- If attachment parts and add-on parts are supplied via the machine's hydraulic system: Make sure that different oil types are not mixed.

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