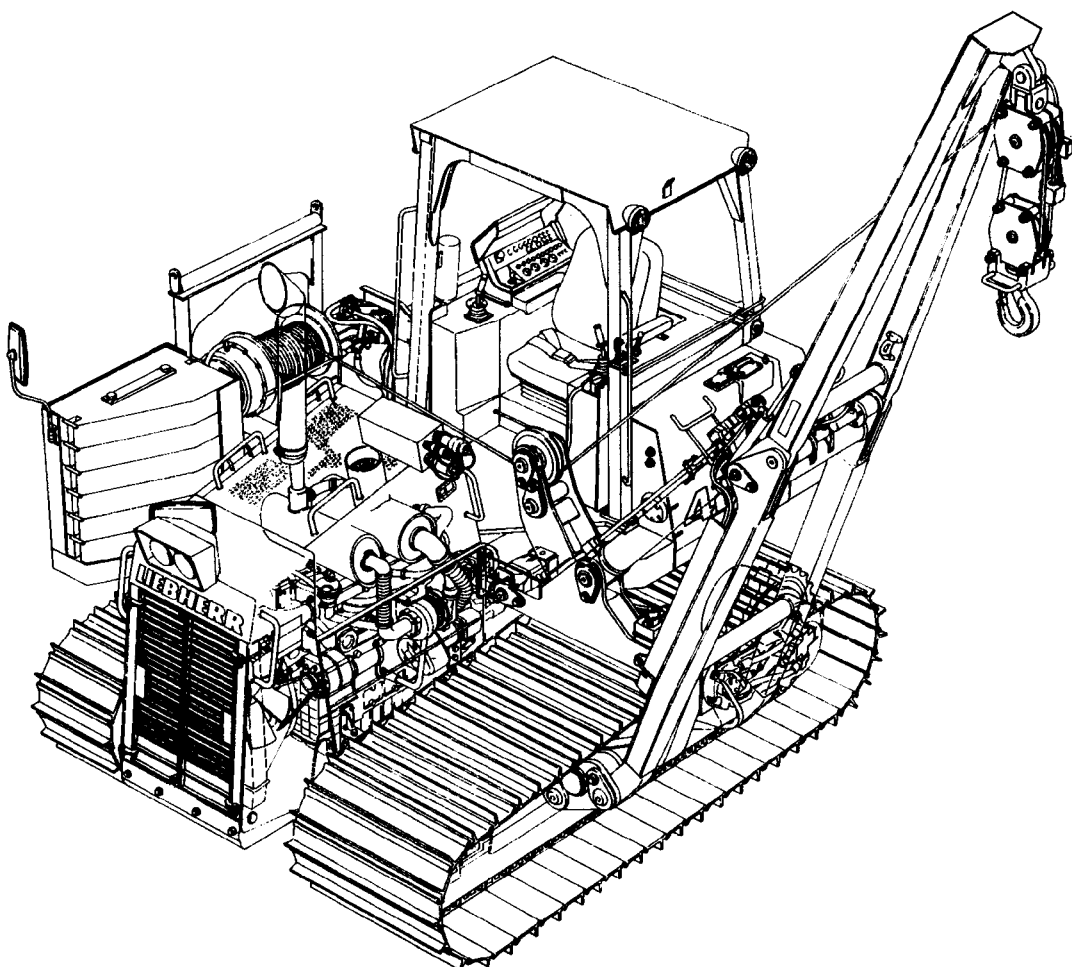


OPERATION- AND MAINTENANCE MANUAL

RL 22B Litronic



FOREWORD

This manual has been written primarily for the operator of this **LIEBHERR** machine and for its maintenance personnel.

This manual contains:

- Safety information
- Operating instructions and guidelines
- Maintenance guidelines
- Instructions and guidelines for special attachments / optional equipment.

This manual should be given to the operator and maintenance personnel who should read it carefully at regular intervals and before operating or servicing the machine, before performing any of the following tasks:

- **Operation**, including set up, troubleshooting during operation, removal of production debris, service, removal of oils, lubricants, fuels and operating fluids,
- **Maintenance**, including inspection, upkeep and/ or
- **Transportation**.

Reading this manual will familiarize the operator with his **LIEBHERR** machine and prevent problems due to improper operation.

Following the operation and maintenance guidelines by maintenance personnel will:

- increase reliable service,
- increase service life expectancy of your **LIEBHERR** machine and
- reduce repair costs and downtime.

The Operation and Maintenance Manual is part of the machine. Keep a copy of this manual in the glove compartment in the operator's cab to assure that it can be consulted and referred to at any time.

Any existing federal, state and local safety requirements and regulations governing accident prevention and environmental safety must be added to this Operation and Maintenance Manual.

In addition to the guidelines given in this Operation and Maintenance Manual, all safety and accident prevention regulations applicable to the country and job site you operate in, including any technical rules and regulations to assure safe and proper operation must be followed.

This Operation and Maintenance Manual includes the necessary information to operate and maintain your machine. If you need any additional information and / or clarification, please contact Liebherr's Technical Documentation, Customer Service School or Service Department.

We hope you will understand that **LIEBHERR** cannot honor warranty claims resulting from improper operation, inadequate maintenance, use of wrong, unauthorized oils, lubricants, fuels and operating fluids and /or from disregard of safety information and guidelines.

LIEBHERR reserves the right to reject any warranty claims, service contracts or agreements established by **LIEBHERR** or any of its dealers without prior notice, if any other than Original **LIEBHERR** part or parts sold by **LIEBHERR** are being or have been used for maintenance and repairs.

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OPERATION AND MAINTENANCE MANUAL - PIPE LAYER

ISSUE 12 / 98
ID. NO.: 9084172
VALID FOR: RL 22B from S/N 281 / 3000



We recommend that you fill in the following information in the space provided as soon as you receive your machine.

This information will also be helpful when ordering parts.

Machine S/N - PIN:

Year / Model: **CE**

Delivery date:

* This information is found on the data tag of your machine, on the left front of the main frame.

Manufacturer:

LIEBHERR Werk Telfs GMBH
 Hans Liebherr - Straße 35,
 A - 6410 / TELFS / Austria

Issued test certification:

- CE
- GOST



Under extreme working conditions, the maintenance intervals may have to be reduced as compared to the intervals listed in the maintenance guidelines.

Use ear protection when operating the machine.

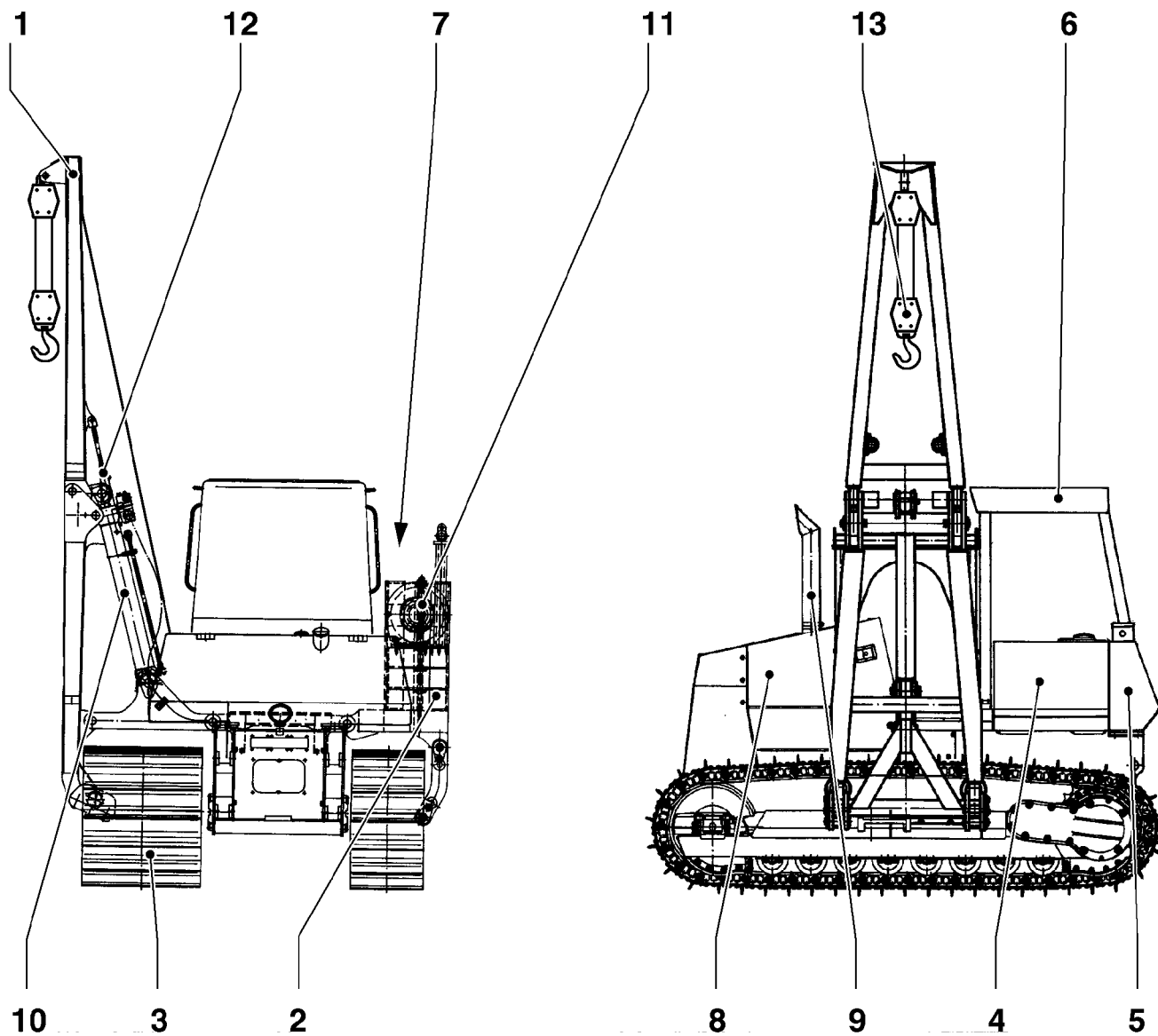
Some drawings and photographs in this manual may show details which are different from our machine. Improvements in design may cause changes in your machine not reflected in this manual. We reserve the right to make technical changes. Manuals are reviewed and reprinted periodically to include such design changes.

The following guidelines will not expand LIEBHERR's general business conditions regarding warranties and liability.

This manual is intended for the sole use of the machine owner. No part of this publication, technical or otherwise, may be reproduced or copied in any form or by any means without our written permission. All rights reserved.

1. TECHNICAL DATA

1.1 MAJOR MACHINE COMPONENTS



- 1 Boom
- 2 Counterweight
- 3 Travel gear
- 4 Hydraulic tank
- 5 Fuel tank
- 6 Operator's cab / ROPS roof
- 7 Battery box

- 8 Covers
- 9 Diesel engine with pump assembly
- 10 Lift cylinder / boom
- 11 Cable winch
- 12 Installation cylinder
- 13 Hook block

Technical Description

Pipe layer

RL 22 B
Litronic®

Engine output 97 kW/132 HP

Lifting power, max. 21,200 kg/46,700 lb

Operating weight 20,500 kg/45,200 lb



LIEBHERR

The Better Machine.

The decisive economic factors of the RL 22 B Litronic:

1. The Liebherr diesel engine:

- high operating availability
- low engine speed
- low fuel consumption
- low emissions

2. The hydrostatic travel drive:

- constant high efficiency
- optimal overload protection
- excellent precision steering
- stepless adjustable speed
- exact straight travel
- high manoeuvrability all the way up to counter-rotation on the spot.

3. The innovative track frame concept:

- low ground pressure even loaded
- high stability
- excellent climbing ability
- low shock loads

4. The economical working attachments:

- hydraulically driven winch
- hydraulic boom adjustment
- the standard working hydraulics can be used to drive a pipefacing machine or a welding generator.

5. The practical and comfortable working environment:

- optimal visibility of the working area
- single joystick control
- optical warning devices

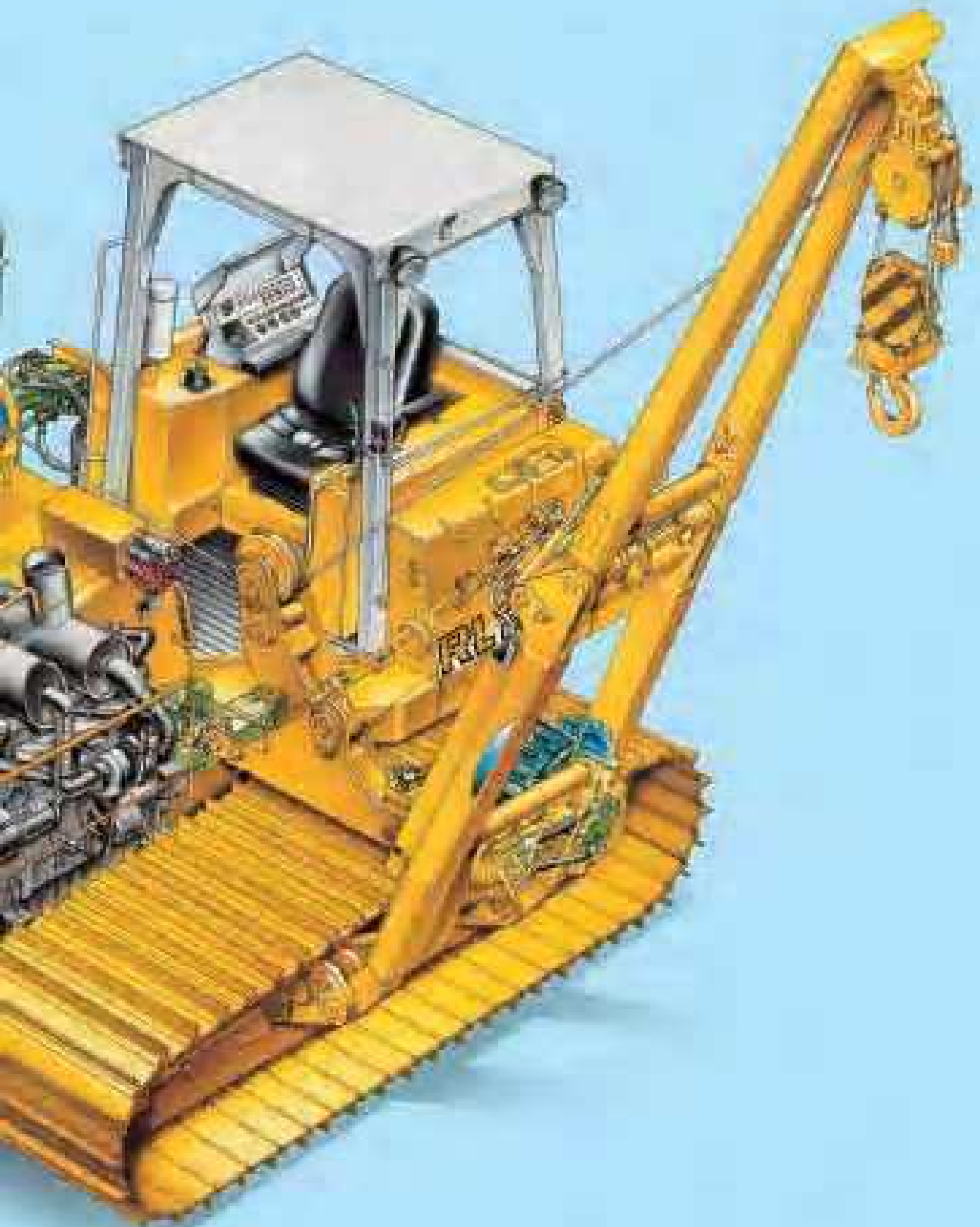
6. Mobility -

The RL 22 B with folding boom:

- mounting and dismounting of the machine without auxiliary devices
- dimensions allow easy transportation on public roads
- easy job site transfer without dismounting the working attachment
- ready for transport within 3 minutes



The advantage: total economical efficiency.



Functional design.

The pipelayer RL 22 B Litronic is a versatile machine, which meets all requirements for pipe-laying applications. This machine is conceived for applications requiring lifting capacity of up to 21,200 kg/46,700 lb.

A special feature of the RL 22 B Litronic is its asymmetric track frame, which is equipped with extremely wide track pads on the load side. This increases stability and maintains a low ground pressure even with load, ensuring safe working conditions on porous ditch edges.

The machine's extremely low center of gravity due to the working components integrated in the track frame (hydraulic motor and final drive) and its high ground clearance provides the machine optimal terrain manouverability.

The heart of the RL 22 B Litronic is a turbocharged Liebherr diesel engine with an output of 97 kW/132 HP. The sturdy Liebherr diesel engines with low emissions are very economical through their low specific fuel consumption.

Safe operation.

A decisive factor in pipelaying is precise control and the possibility to correct the machine's position. The RL 22 B Litronic's tracks are driven independently through the hydrostatic drive. The machine can accelerate and decelerate steplessly forwards and in reverse. The RL 22 B Litronic travel drive is controlled and monitored wear free by the Litronic system. Straight travel is ensured regardless of ground conditions as the speed of both tracks are continuously adjusted.

Thereby, the machine can lay pipes precisely along the ditch. Just one joystick controls all travel drive functions giving the operator freedom to concentrate on the work at hand. ROPS and FOPS are integrated into the cab to protect the operator. Rollover bars are thus unnecessary yielding optimal visibility of the working environment.



The versatile machine: effective pipelayi

**The working environment.
Functional control through a
single joystick.**



ng.

Welding and pipe facing.

With regards to economy, it is more important than ever for a construction machine to be in operation as many hours as possible each year. What could be better than using a pipe layer for additional tasks in pipelaying applications.

Through their innovative concept, Liebherr can equip the RL 22 B with a few additional attachments and turn it into the ideal machine for welding and pipefacing applications.

Welding

The RL 22 B Litronic load sensing working hydraulics can also be used for driving a welding generator - no additional diesel engine is required. Noise emissions are thereby reduced, fuel consumption is improved and maintenance of additional components is eliminated. The pipe layer boom can be equipped with a jib for a welding tent.

Pipefacing.

The RL 22 B Litronic was also designed as a basic machine for pipefacing. The special component for this task can also be driven by the installed working hydraulics. The hydrostatic travel drive and the single joystick control ensure precise and exact placement of pipes. The easy and inexpensive alternative to operate the RL 22 B Litronic as a pipefacing machine adds an important aspect to its functionality.



Welding generator.

The welding generator is powered by the pipelayer's nominal output.



Great economy: through versatile utilization.



Pipefacing.
The hydrostatic travel drive and the single joystick control allows exact placement of pipes.



Pipe transportation.

The track frame with cushioned suspension is the ideal prerequisite for transporting pipes from storage to the job site. The track frame absorbs ground shocks through the integrated pivot shaft and equalizer bar reducing vibrations to the operator, the machine and the attached load.

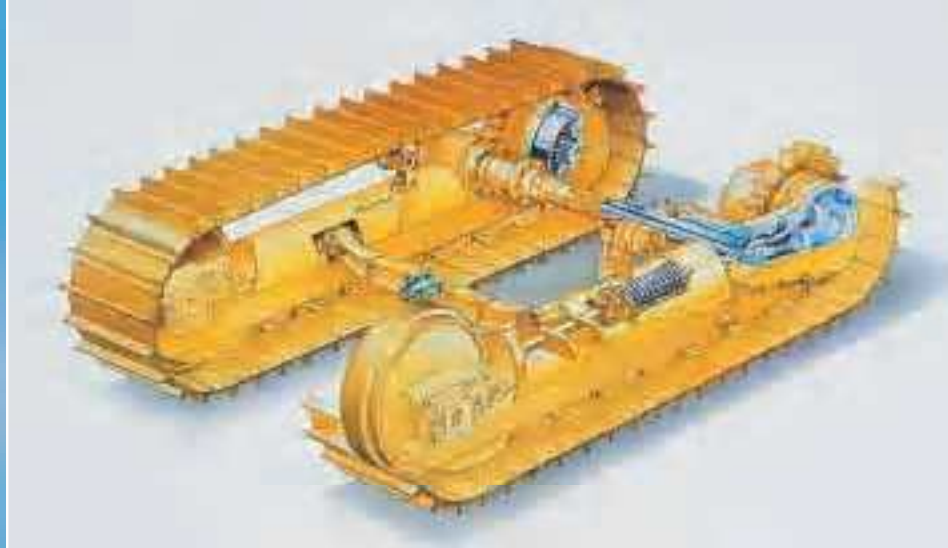
The stepless acceleration up to maximum speed provides the RL 22 B Litronic with smooth travel with low cycle times. The electronically controlled hydrostatic drive enables pick up, transportation and placement of pipes.

The pipe can be picked up and placed gently with the hydraulically driven winch and boom.



The machine for transportation: Safe and

The track frame concept.
The track frame's cushioned suspension absorbs impacts reducing vibrations to the operator and the machine.



easy.

Quick transportation.

A pipelayer in the RL 22 B Litronic class frequently changes job sites. Here, Liebherr also presents a unique concept. With folding boom and counterweight, no auxiliary devices are required for assembly or disassembly of the machine. Just the hydraulic boom has to be folded in, which can be done by the operator alone. The pipelayer with folding boom is ready to be loaded and moved.



More flexibility: with quicker job site tran



sfer.



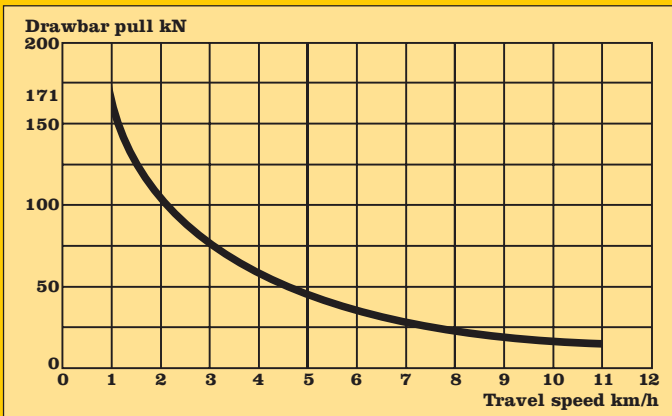
Engine

Liebherr Diesel engine	D 924 T-E
Output per ISO 9249	97 kW (132 HP) at 2000 RPM
Displacement	6.7 l (409 cu.in)
Bore/stroke	122/142 mm (4.8/5.59 in)
Design	4 cylinder in-line, water-cooled, turbo-charged engine, individual cylinder heads, wet cylinder bushings, maintenancefree drive for fan and water pump
Injection	direct fuel injection with distributor injection pump, mechanical regulator
Fuel filtration	prefilter with water separator and fine filter micro element
Air filtration	combustion air pre-filter with automatic dust ejection, dry air filter system with main and safety element
Lubrication	pressurized lubrication system with main flow filters and integrated oil cooler, deep oil pan for inclinations, engine lubrication to an inclination of up to 45° to each side
Operating voltage	24 V
Alternator	55 A DC
Starter	6.6 kW (9 HP)
Central fuse box	35 A



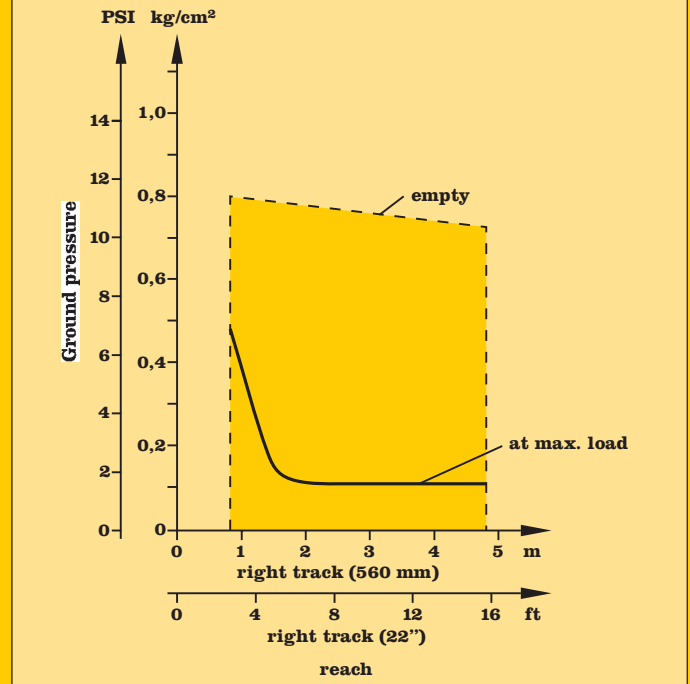
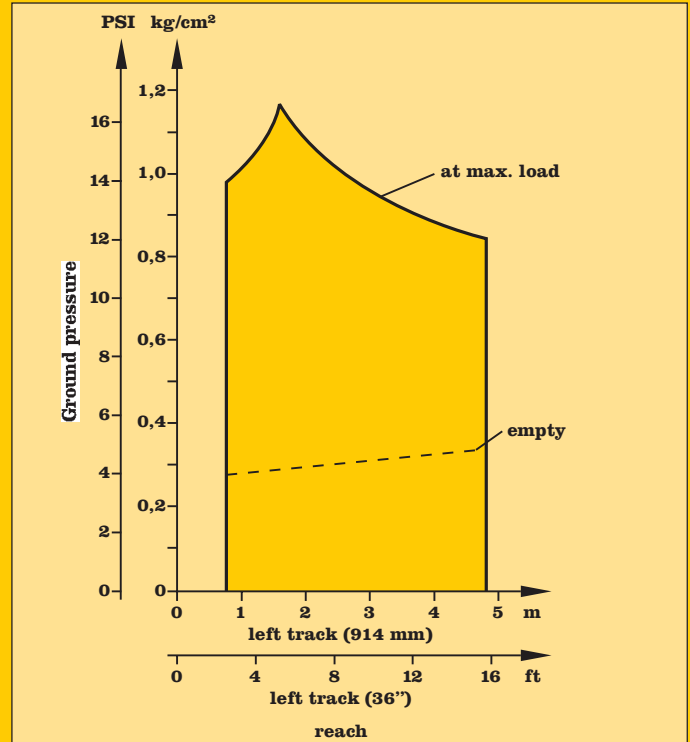
Travel Drive

Design	independent hydrostatic drive of travel gear
Pump flow	max. 154 l/min (40 gpm)
Max. pressure	adjusted to 420 bar (6090 PSI)
Travel speed	0 - 11 km/h (0 to 6.8 mph) infinitely variable, forward and reverse
Steering	hydrostatic
Service brake	hydrostatic
Parking/emergency brake	automatic multi disc brake in final drives
Cooling system	hydraulic oil cooler with separate cooling circuit with gear pump and front mounted cooler
Filter system	cartridge fine filters in the cooling circuit
Final Drive	2-stage planetary reduction gear



Track Frame

Design	maintenance-free crawler travel gear
Mount	fixed over pre-mounted support axles and bridge
Chains	sealed, chain tension via spring loaded tensioner and hydraulic cylinders, single grouser pads
Chain links	47
Sprockets	9 replaceable segments
Track rollers	8
Carrier rollers	2
Ground contact area	4.31 m ² (6,680 sq.in.)
Ground pressure	0.48 kg/cm ² (6.83 PSI)



Technical Data



Travel Control

1 Joystick lever	with electronic control for all travel functions: travel direction, speed, steering and counter-rotation
Low speed range	for the total joystick deflection range for the travel speed from 0 - 5 km/h (0 to 3.1 mph)
Electronic engine speed sensing control	electronic regulation assures a constant balance between travel speed and necessary drawbar pull through engine speed sensing avoiding engine overload, even in partial load range
Straight line travel	electronically controlled
Parking/emergency brake	automatically applied after the joystick lever is put in neutral position
Safety lever	inactivates complete travel and working hydraulic circuit and automatically activates parking brake
Emergency shut off	push button on instrument panel immediately activates parking and emergency brake



Implement Hydraulic

Hydraulic system	on demand (load sensing) control, swash plate type displacement pump and pressure cut-off for hoist winch and adj. boom cylinder drive
Max. pump flow	max. 156 l/min (41 gpm)
Pressure limitation	adjusted to 280 bar (4060 PSI)
Control valve	2 spool segments
Filter system	return filter with magnetic rod in hydraulic tank
Control	single servo-assisted joystick lever for hoist winch and adj. boom cylinder, safety lever prevents inadvertent movement, free fall device makes it possible to lower the load in case of danger



Working Attachment

Hoist winch	driven by variable flow hydraulic pump, control valve block and variable oil motor. Brake valve helps to sensitively lower the load over total speed range, when the control lever is in neutral, a spring-loaded disk brake holds the load safely in any position
Drum diameter	248 mm (10")
Drum length	349 mm (1' 2")
Flanged wheel diameter	416 mm (1' 4")
Cable diameter	16 mm (5/8")
Cable length	55 m (180 ft)
Hook block	3 sheave
Hook speed in 1. cable position	up - 33 m/min. stepless (0 to 108 ft) down 0 - 33 m/min. stepless (0 to 108 ft) free fall control
Safety device	
Adjustable boom control	through hydraulic cylinder, the lifting and lowering speed of the boom and the hook block can be changed steplessly, drives are fully independent and can be actuated at the same time. A check valve keeps the boom leakage free in any position and prevents uncontrolled boom drop in case of loss of pressure

Adjustable boom cylinder

Piston diameter	120 mm (4.5")
Rod diameter	60 mm (2.5")
Stroke	1080 mm (3' 4")

Boom Design

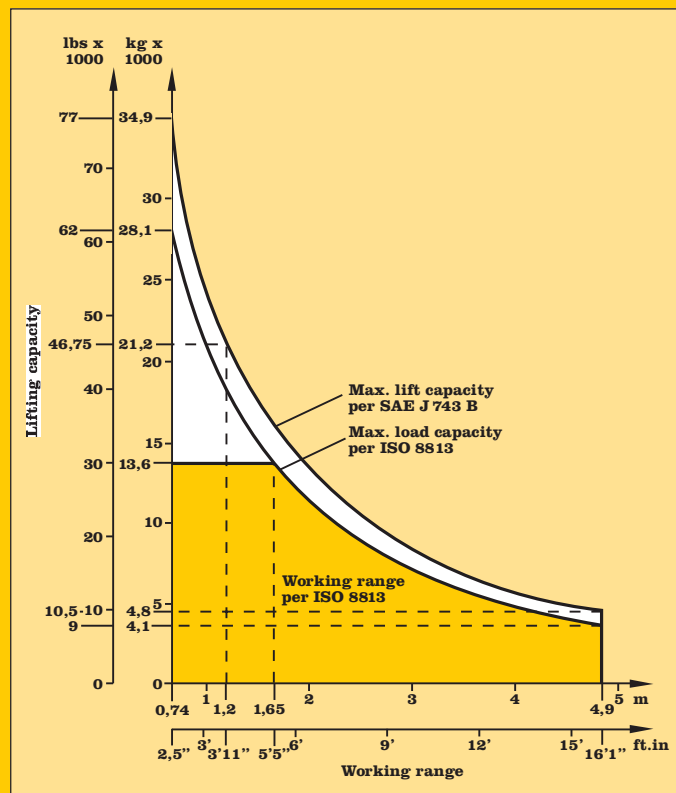
box-type welded structure made of highly resilient, grain refined steel

Fixed boom length 4740 mm (15' 7") welded box sectioned

Hinged boom length 4740 mm (15' 7") welded box sectioned

center hinge for transport, in working position, hinge is hydraulically locked, it is folded in or out by an auxiliary cylinder, hook block does not have to be removed for transport

Counterweight installed on the right hand side of the machine. It serves as the base for the hoist winch. Fixed mounted weight 2850 kg (6300 lbs.), 6 individual weights, each 430 kg (950 lbs.), total weight 5400 kg (11,900 lbs.) removable



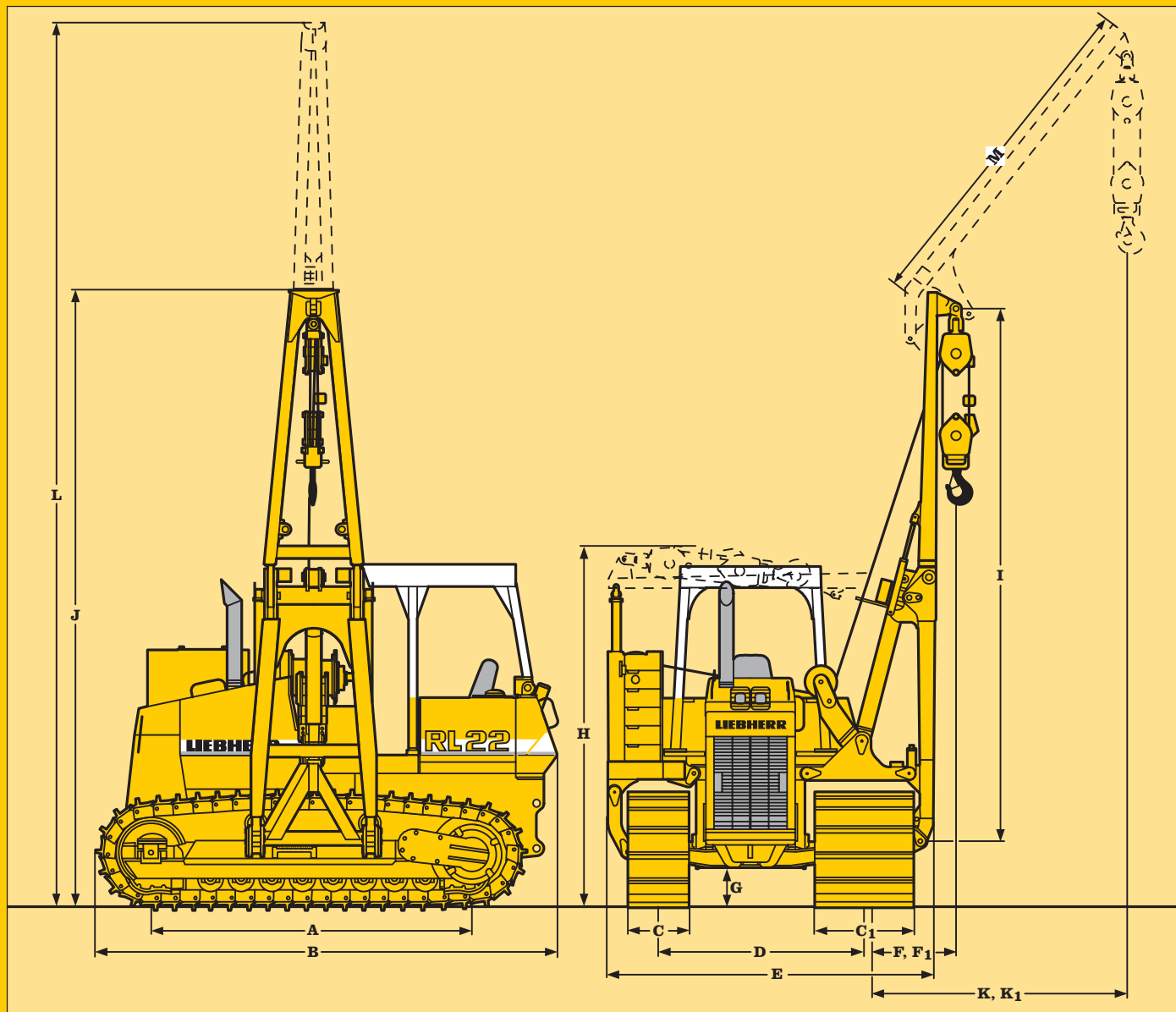
Operator's Platform

Mount	resiliently mounted
Operator's seat	fully adjustable swing seat, adjustable to operator weight
Monitor	comprehensive instrument panel on the right hand side of the operator's seat



Service Fluids

Fuel tank	310 l (82 gal)
Cooling system	52 l (14 gal)
Engine oil	18 l (5 gal)
Gear box	2,5 l (0,6 gal)
Hydr. tank	178 l (47 gal)
Final drives, each	13 l (3,5 gal)



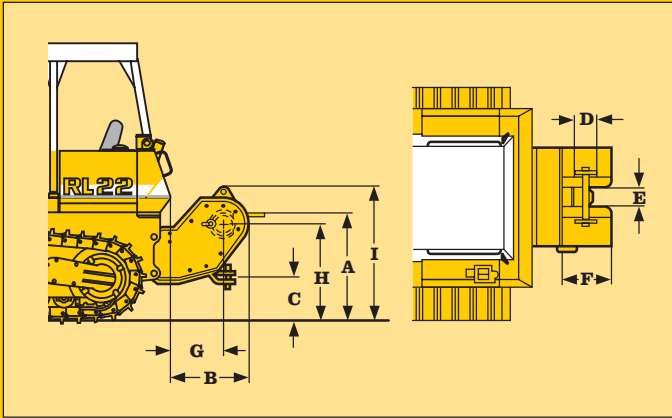
	mm/ft-in
A Track on ground	2925/ 9' 7"
B Total length (track length)	4175/13' 8"
C Ground pad width - right hand side	560/ 24"
C1 Ground pad width - left hand side	914/ 36"
D Track gauge	1882/ 6' 2"
E Transport width	2980/ 9' 9"
F Hook radius, min.	735/ 2' 5"
F1 Hook radius, max.	4810/15' 9"
G Ground clearance	370/ 1' 3"
H Transport height	3265/10' 2"
I Boom length	4740/15' 7"
J Total height, max.	5490/18' 0"
K Hook radius w. boom head member, min.	2485/ 8' 2"
K1 Hook radius w. boom head member, max.	7770/25' 6"
L Total height w. boom head member, max.	8084/26' 6"
M Length boom head member	3000/ 9'10"

Basic Machine Contents

- Pipe layer RL 22 with Liebherr Diesel engine D 924 T-E
- Chain D5B, single grouser track pads 914/560 mm (36"/24") 47 links, sealed
- Canopy
- Hoist winch
- Counter weight 5,400 kg (11,900 lb)
- Installation kit for boom
- Boom fixed, hinged 4,740 mm (15' 7")

Dimensions

Cable winch

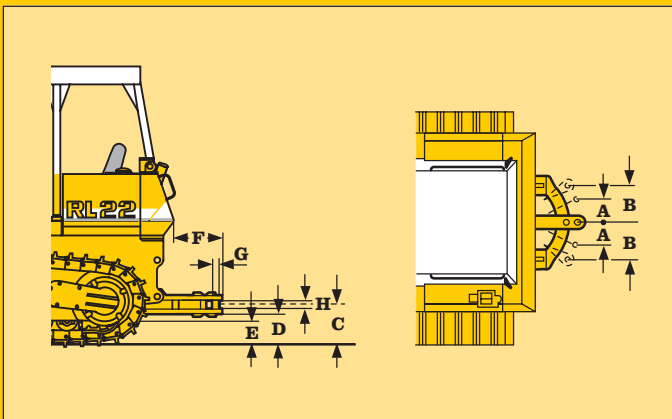


Pulling power, max.:	300 kN (30.6 t)/67,500 lb
Cable speed:	0 - 96 m/min. (0 - 315 ft)
	stepless
Cable thickness:	22 mm (7/8")
Cable length:	50 m (164 ft)
Weight:	1200 kg (2650 lb)

Dimensions

	mm/ft-in
A Height, cable run	1140/3' 9"
B Added length	670/2' 2"
C Height, towing device	530/1' 9"
D Drum diameter	210/ 8.5"
E Coiling width	230/ -9"
F Flange diameter	460/1' 6"
G Radius, drum center	440/1' 5"
H Height, drum center	1025/3' 4"
I Total height	1355/4' 5"

Swinging drawbar



Movable version	
Weight:	200 kg (441 lb)

Dimensions

	mm/ft-in
A Off-center, min.	230/ 9"
B Excentre, max.	439/1' 5"
C Hook height	439/1' 5"
D Ground clearance	
Lower edge of tow hook	364/1' 2"
E Ground clearance	
Tow hook suspension	317/1' 0"
F Added length	375/1' 3"
G Pin diameter	45/ 1.5"
H Jaw width	90/ 3.5"

Attachments

Basic machine

	Standard	Option
Towing hitch rear	●	
Towing lug front	●	
Battery compartment lockable	●	
Filling with oil SAE 10		●
Filling with oil SAE 30		●
Refuelling pump electrical		●
Belly pans heavy duty	●	
Cold start device ether		
Cold start device glow plug	●	
Radiator coarse mesh	●	
Radiator guard 2-piece, hinged	●	
Liebherr Diesel engine	●	
Fan - hydraulically driven		
Fan - gear drive	●	
Fan guard		●
Engine oil cooler	●	
Engine doors perforated		●
Engine doors hinged, lockable	●	
Lugs for crane lifting		●
Bumper front	●	
Special paint		●
Fuel water separator	●	
Fuel water separator with electric heater		●
Air filter dry-type, dual step	●	
Precleaner with automatic dust ejector	●	
Preheater for engine electric		●
Tool kit in batteries compartment	●	

Travel drive

Parking brake automatic	●	
Function control automatic	●	
Control - single lever	●	
Load limit control electronic	●	
Travel control electronic	●	
Travel control 2-speed	●	
Hydrostatic travel drive	●	
Emergency stop	●	
Oil cooler	●	
Final drives planetary gears	●	
Safety lever	●	

Undercarriage

Track shoes extreme service (ESS)		
Track frame closed	●	
Sprocket segments bolt-on	●	
Master link 2 piece		●
Track guide center part		●
Tracks oil lubricated		●
Undercarriage standard	●	
Pivot shaft separate	●	

Electric system

Starter motor 6,6 kW	●	
Starter motor 9 kW		
Working lights rear 2 units	●	
Working lights front 2 units	●	
Working lights side 2 units	●	
Battery main switch electric	●	
Batteries, heavy duty cold start	●	
On-board system 24 V	●	
Alternator 55 V	●	
Alternator 80 A		
Back-up alarm		●
Horn	●	

Operator's cab

	Standard	Option
Operator's seat 6-way adjustable	●	
ROPS-canopy	●	
ROPS/FOPS-cab sound suppressed		●
Protective grid for canopy rear		

Instruments - Indicators

Battery charging	●	
Hour meter	●	
Electronic control	●	
Speed range	●	
Engine oil pressure	●	
Water temperature	●	
Oil pressure cooling circuit	●	
Oil level final drives	●	
Fuel level	●	
Contamination hydraulic filter	●	
Contamination air filter	●	
Cold start Diesel engine	●	

Implement hydraulic

Control group boom	●	
Control group hoist winch	●	
Control group rear winch		●
Control group generator 75 kVA		●
Control group generator + pipe facing		●
Variable flow pump, load sensing	●	
Oil filter with strainer in hydraulic tank	●	
Hydraulic servo control	●	

Attachments

Drawbar rear hinged		●
Drawbar rear rigid		●
Boom 2-piece foldable 4750 mm		●
Boom single piece 4750 mm		●
Boom single piece 6000 mm		
Boom single piece 7000 mm		
Boom single piece 7320 mm		
Boom jib		●
Counter weight		●
Rear winch		●

2. GENERAL SAFETY INFORMATION

Working with earth moving machinery can be dangerous, it could result in injury or death if proper precautions are 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 works on the machine only 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 this manual, such as **DANGER**, **CAUTION** or **NOTE**.

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

DANGER

Denotes and 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 directs 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 or maintenance procedures which should be followed to keep our machine operational and to insure long service life and /or to facilitate certain operating procedures.

In addition to these instructions you must follow the 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 or professional associations.

2.0.1 PROPER AND DESTINED USE

With the standard pipe layer attachment, the machine may only be used to lift and place pipes and pipe assemblies as well as to lift machinery, which is to be used during construction of a pipe line.

For these procedures, suitable and tested attachment elements must be used.

In addition, this machine may be used to pull devices and equipment used during normal pipe laying construction tasks.

Any other use above and beyond the destined use is not considered to be destined use. The manufacturer/ dealer will not be responsible for any damage resulting from such or any other unauthorized use and the user alone must carry those risks.

Machines used in special applications are subject to additional special conditions and guidelines and, among other things, must be equipped with special safety devices.

Proper and destined use also includes observance of Operation and Maintenance Manual Guidelines issued in this Operation and Maintenance Manual and careful adherence to inspection and maintenance schedules and guidelines.

2.1 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 minimum permissible operator age, as stated by law.
- Utilize only trained or specially instructed 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 give 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.
- Periodicaly, 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 an 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 when entering or leaving the machine. This could trigger an inadvertent movement of the machine and cause a serious accident.
- 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, steps, handrails and handles clean of oil, grease, mud, snow and ice. These precautions will minimize the danger of slipping, stumbling or falling.
- 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.

- Turn the engine off and leave the ignition key in contact position.
 - Actuate the operating levers / joysticks 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 the pressure in the servo and hydraulic circuits. Then relieve the internal hydraulic tank pressure.
 - The safety lever must always be placed in the full down position before leaving the cab.
 - Properly secure all loose parts on the machine.
 - Never operate the 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.
 - For special applications, the machine must be equipped with specific safety devices. Do not operate the machine unless they are installed and functioning properly.
 - 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 LIEBHERR's explicit permission.

2.2 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 or cables.
- 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 unless the machine is properly blocked and supported.

2.3 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.

2.4 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 operation 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 machine and make sure that all of them are legible.
- Clean all windows and mirrors, secure doors and windows to prevent any inadvertent movement.
- Always enter and leave the cab through from the left over the chain. Always use the appropriate handles.
- 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 arms rests and the seat belt as well as set 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 when operating the machine.
- Never operate the machine without a cab or canopy.

2.5 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.

2.6 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 moving on public highways, roads or areas, make sure you observe all applicable rules and regulations for on road travel. If necessary, bring the machine to proper operating condition.
- Always turn on the lights 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, with the seat belt secured.

2. GENERAL SAFETY INFORMATION

- 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 the 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 top 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 the travel speed to working conditions.
- Never travel on slopes that exceed the maximum permissible gradeability of the machine.
- Never travel downhill at maximum speed, always at low speed to prevent loss of control. The engine must be at nominal speed 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 into a slope and then change the speed.
- 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 two way radios.
- When using a two way radio or Citizens Band radio (CB), the safety lever must be in the full down position.

2.7 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.
- Bring all operating levers and controls into 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.

2.8 MACHINE TRANSPORTING SAFETY

- The boom must be folded in for transport.
- Use only safe transportation and tackle 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 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 transport vehicle.
- Secure the machine and all remaining parts with chains and wedges to prevent 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 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 the machine from the trailer platform down the ramp. Use a guide to signal you.

2.9 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.

2.10 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 Operation and Maintenance Manual. To perform any repairs, make sure you have the proper tools.
- Maintenance work should be performed according to the chart at the end of this Operation and Maintenance Manual. It is also noted who should or may perform what type of work. The operator

2. GENERAL SAFETY INFORMATION

should only perform items marked OM on the Maintenance and Inspection schedule. 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 / or gloves.
- Keep unauthorized personnel from the machine during maintenance and repair work.
- Secure the maintenance area, as necessary.
- Inform service personnel if any special task or maintenance work is required. Appoint a 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 be raised only if the machine is parked and the engine is turned off! Before raising the cab, make sure that 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 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 loosed, are retightened.
- If it becomes necessary to remove any safety devices during set up, 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 underneath the machine, attach an easily visible warning sign '**DO NOT OPERATE**' 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. Use only lintfree cloths.
- Never use flammable fluids to clean the machine.
- 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 systems), or other cleaning fluids, cover or tape all openings, make sure no water, steam or cleaning fluids enters these openings for safety and functional reasons. Electric motors, switch boxes, and battery compartments are especially vulnerable.
 - Make sure that during the 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 cleaning the machine, 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 handling of oils, greases, and other chemical substances.
- Make sure to dispose of any operating and service fluids as well as replacement parts property, and in an environmentally sound manner.
- Be careful when handling any hot service or operating fluids (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, 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 load carrying capacity.
 - **Do not allow anybody to work or remain underneath a suspended / raised load!**
- Do not use damaged or insufficiently strong ropes. Always wear gloves when handling wire ropes.
- Only experienced personnel may attach loads and signal the operator. The person used as guide must be visible by the operator or must 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 on the machine 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, walkways, catwalks, and ladders etc. are always free of dirt, snow and ice.
- When working on or changing any part of the attachment, make sure that the attachment is properly supported. Never use metal on metal supports.
- Never work underneath the machine unless it is properly supported with wooden supports.
- 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 with wedges to prevent any movement. The attachment must be brought into proper maintenance position.
- Only experienced, 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 and the engine has been turned off. Then, with the ignition key in contact position, acute all servo controls(joysticks and foot pedals) in both directions to release any servo pressure and to release all pressures in the working circuit. Release the tank pressure by slowly opening the bleeder valve.
- 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 starting any repairs, you also must make sure that all air pressures are relieved in any of the systems you need to gain access to: to be certain, refer to description of various components and groups and assemblies.
- Route and install all hydraulic and air pressure lines properly. Mark and check all connections to prevent any mix ups. All 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 spare 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 direct 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 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 or with the electrical power supply, turn the machine off immediately.

2. GENERAL SAFETY INFORMATION

- 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 switch in case a problem should arise. Rope off the working area with a red and white safety chain and a warning sign. Use only insulated tools.
- 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.

2.11 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.
- Never try to lift heavy parts. Always select and use appropriate lifting devices with sufficient lifting capacity.
- When handling wire ropes or cables, 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 pressured - 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 all lines, 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 punches, pin pullers).

2.12 SAFETY REGULATIONS FOR LOADING A MACHINE WITH A CRANE

- Remove the boom or bring it to transport position.
- Bring all control levers into neutral position.
- Turn the engine off, according to the Operation and Maintenance Manual, and move the safety lever in the down position, before leaving the operator's seat.
- Close all doors, covers and hoods.
- Only experienced, specially trained personnel may attach loads and signal the operator. The guide must be within the visibility of the operator or be in direct voice contact via a two way radio.
- Attach the lifting devices only to the brackets / bores on the machine, which have been installed for this purpose.
- Make sure the lifting devices are long enough.
- Lift the machine carefully!
- **CAUTION! Make sure that nobody is underneath the raised machine. This is strictly prohibited!**

- When putting the machine back in service, proceed as described in the Operation and Maintenance Manual.

2.13 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!

2.14 SAFETY NOTES WHEN WORKING WITH THE MACHINE

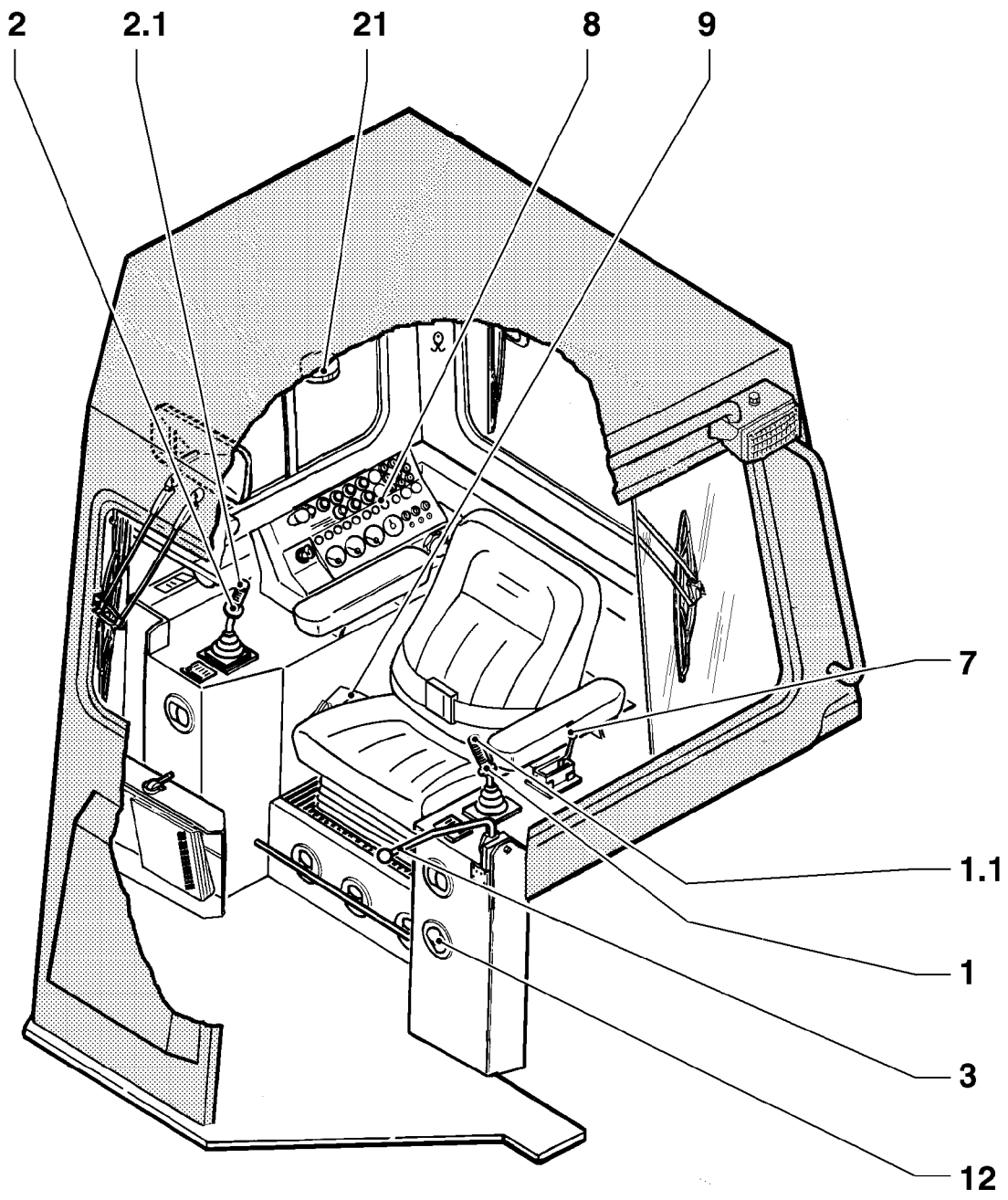
- Never permit a passenger on the machine. This is strictly prohibited!
- Never permit anybody to remain underneath the raised load!
- Loads must be attached in such a way that they cannot slip or fall out.
- Before attaching a load, you must check if the load can be lifted without restrictions.
- A load may only be attached by a person who is experienced and trained in this task.
- Any auxiliary personnel used to help guide the load or attach the load must remain within the visibility of the machine operator. They may not be positioned near a tensioned cable or rope. A safe distance of at least 1½ cable lengths must be observed.
- To attach the load, the person who is attaching the load may only approach from the side to the boom after the operator has given his approval. The operator may only approve this action, if the machine is at a standstill and the working attachment is not being moved.
- The operator may not move any loads over any persons on the ground.

2. GENERAL SAFETY INFORMATION ---

- The person attaching the load and any accompanying persons or helpers must wear appropriate protective gear (such as hard hat, protective gloves, ...).
- The operator must guide the load as close as possible to the ground to prevent it from swinging.
- The machine may only be driven with the suspended load if the travel route is level.
- Any shocks / jerks or sudden dropping of the load must be prevented. These movements could cause stress loads which could exceed the nominal load, affecting the safety of the attachment.
- A worn or damaged winch cable must always be replaced immediately with a new cable.
- Only stress tested tackle may be used for the lifting procedure.
- The hook block must be lowered to the ground or must be attached safely before the winch may be maintained, adjusted or repaired.
- Never use the machine to pull any loads which are stuck, even if the weight of the non-moving load would not exceed the permissible load capacity.

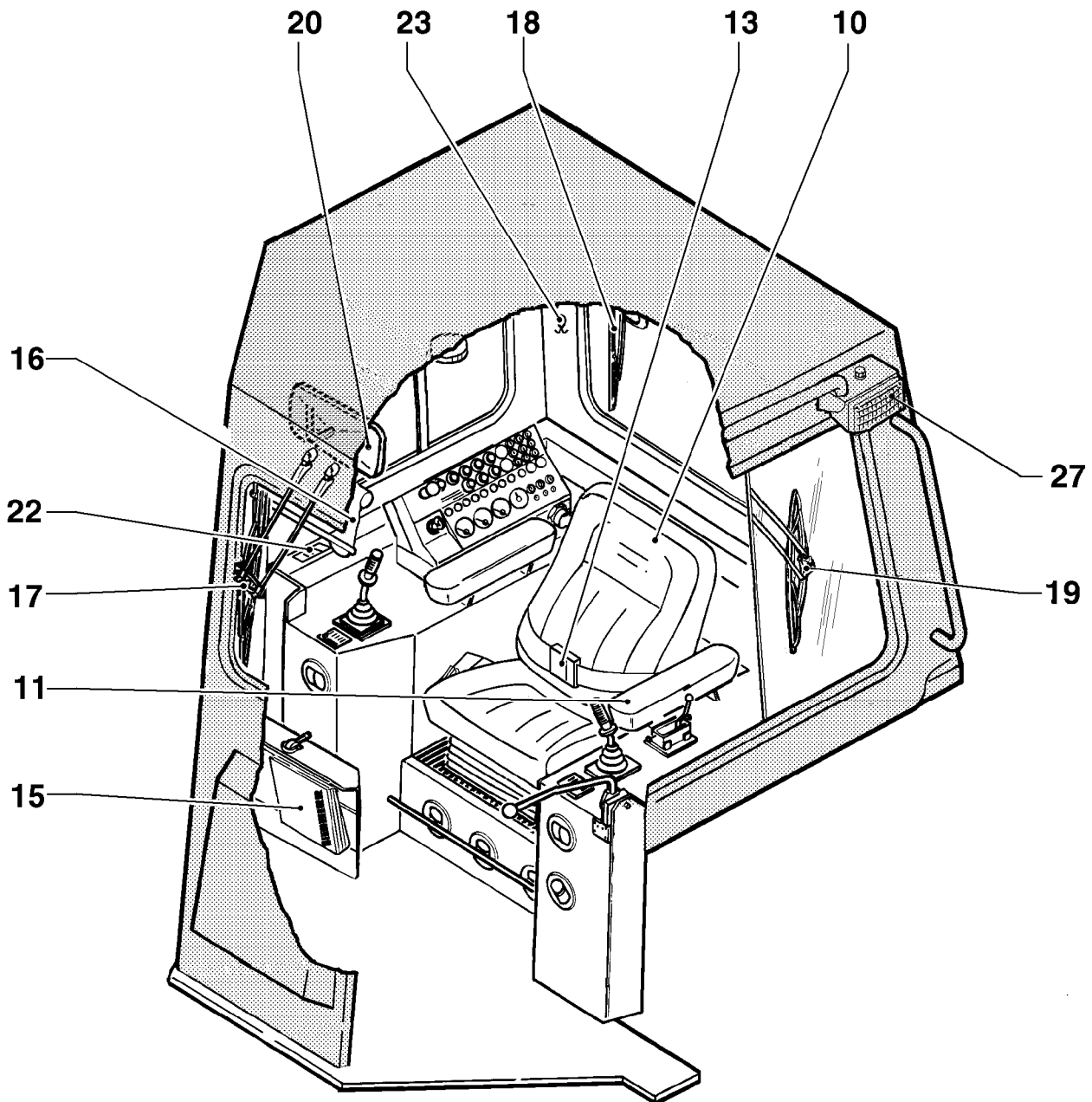
3. CONTROLS AND INSTRUMENTATION

3.1 OPERATOR'S CAB AND ROPS (ROLL OVER PROTECTIVE STRUCTURE)

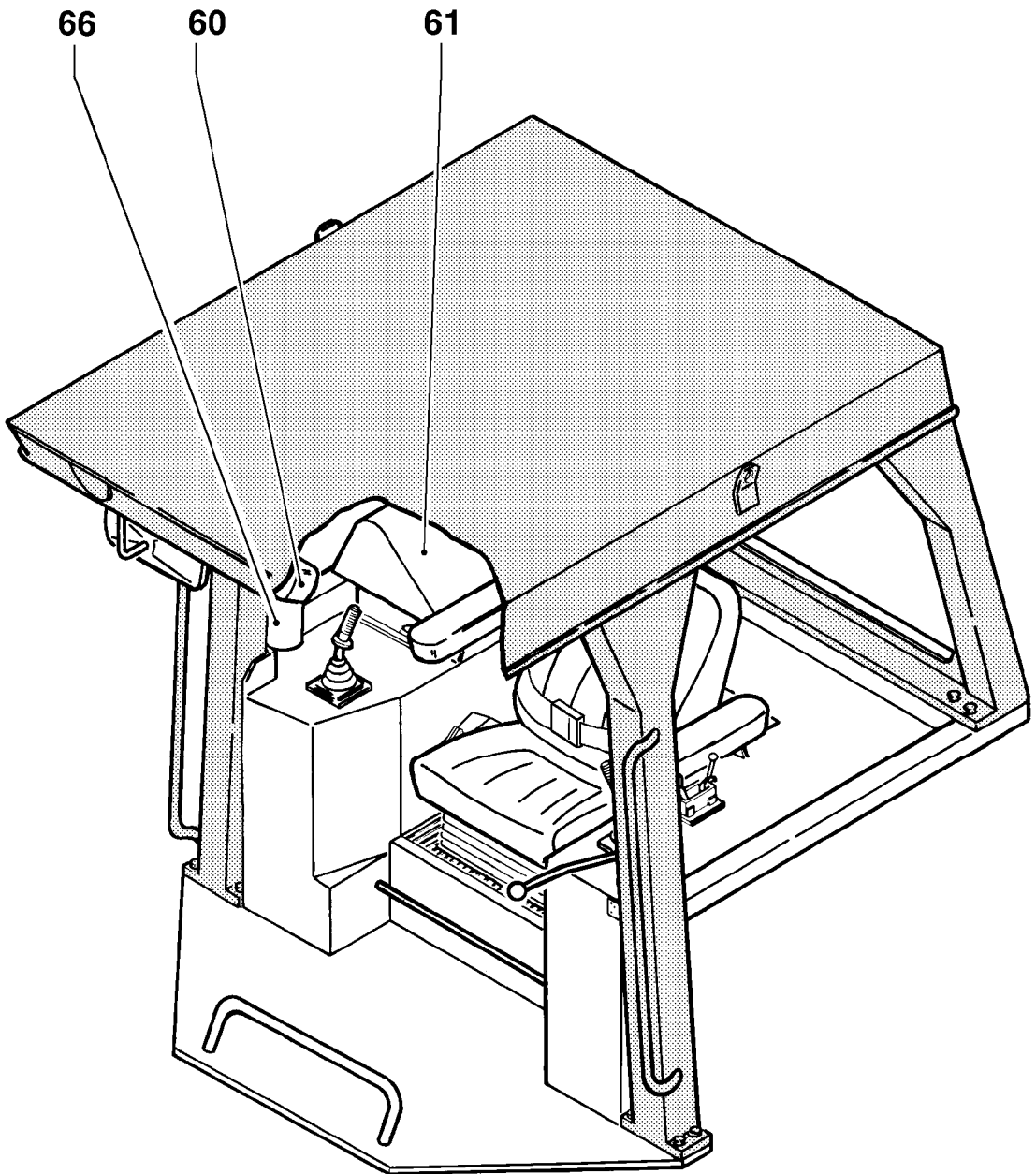


- | | | | |
|-----|----------------------------------|----|------------------|
| 1 | Travel lever | 7 | Throttle control |
| 1.1 | Push button - counter-rotation | 8 | Instrument panel |
| 2 | Boom - hoist winch control lever | 9 | Heater control |
| 2.1 | Push button - free fall device | 12 | Heater vents |
| 3 | Safety lever | 21 | Interior light |

ENGLISCH LWT - TD 19/4/99

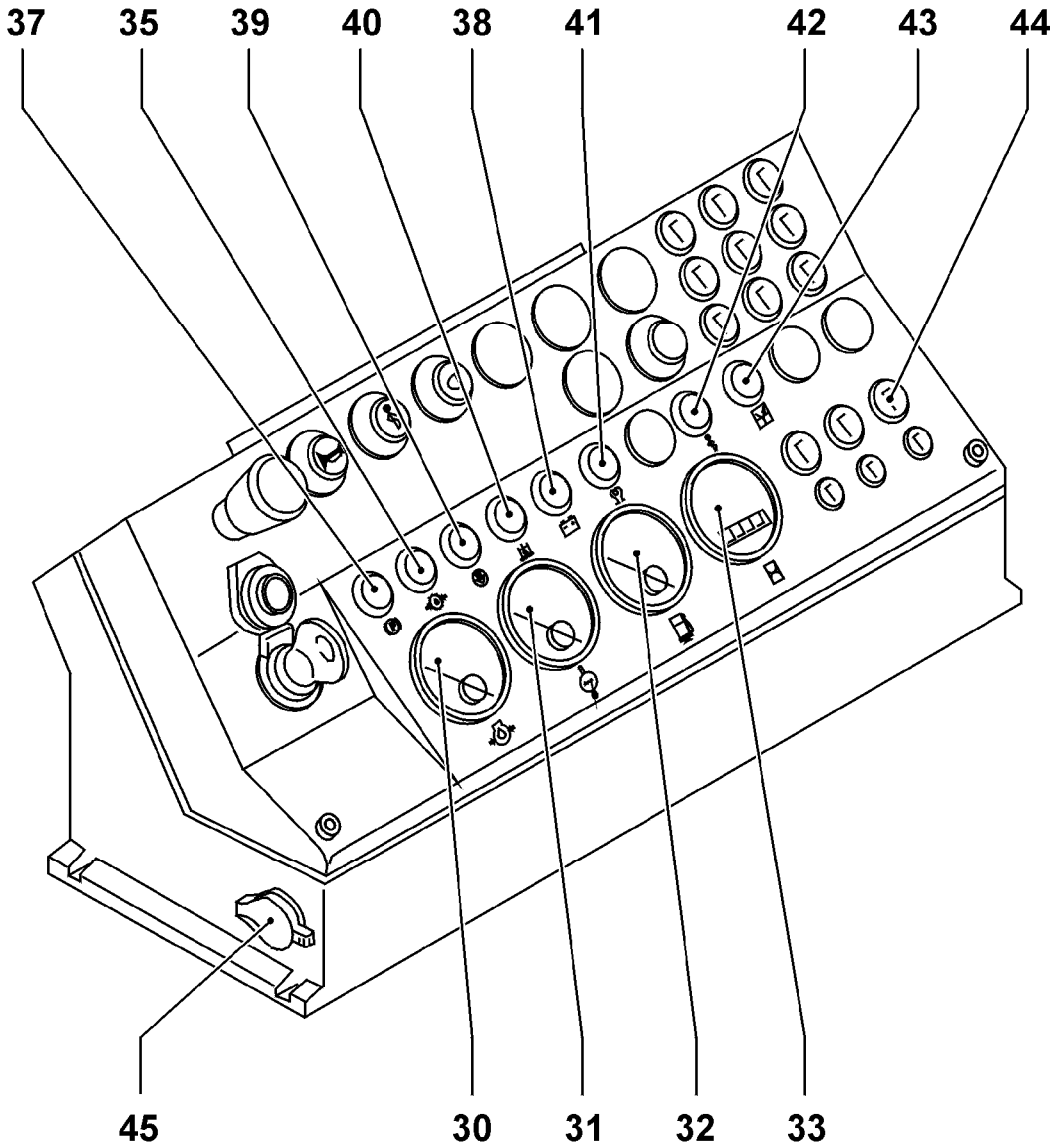


- | | | | |
|----|---------------------------------|----|--------------------------------|
| 10 | Driver's seat | 18 | Windshield wiper - rear window |
| 11 | Arm rests | 19 | Windshield wiper - side window |
| 13 | Seat belt | 20 | Interior mirror |
| 15 | Compartment - documentation | 22 | Ashtray |
| 16 | Sun shade | 23 | Coat hook |
| 17 | Windshield wiper - front window | 27 | Working floodlight |



- 60 Warning light - ROPS (Roll over protective structure)
- 61 Vandalism protection
- 66 Storage tube - Operating manual

3.2 INDICATOR LIGHTS AND GAUGES ON THE INSTRUMENT PANEL



30 ENGINE OIL PRESSURE

The engine oil pressure should not drop below the following values:

- At low idle 1 bar
- At full engine load 3.5 bar

If the engine oil pressure is below these values, turn the engine off, check for and fix the problem (possibly change the engine oil and filters)



31 COOLANT TEMPERATURE GAUGE

if the coolant temperature stays constantly above 100 °C, turn the engine off, check and correct the problem (for example, clean the cooler, add coolant, check for and repair leaks or check the water pump).



32 FUEL GAUGE

Shows the amount of fuel in the tank. To reduce condensation, maintain a high fuel level in the tank.

**33 HOUR METER**

The hour meter is the basis to schedule maintenance tasks, as outlined in the Maintenance and Inspection Schedule.

**35 INDICATOR LIGHT - REPLENISHING OIL PRESSURE (red)**

Turn the engine off immediately if the indicator light lights up. Check for and fix the problem.

**37 INDICATOR LIGHT - PARKING BRAKE (yellow)**

Light up when the safety lever is in the down position, if the parking brake is applied and if the replenishing pressure drops.

**38 CHARGE INDICATOR LIGHT (red)**

Must turn off as soon as the engine is started. If the indicator light comes on while the engine is running, stop the engine, check for and fix the problem.

**39 INDICATOR LIGHT - VACUUM INDICATOR (yellow)**

If the indicator light lights up, turn the engine off and clean or replace the main air filter element.

**40 INDICATOR LIGHT - RETURN FILTER (yellow)**

If the indicator lights up when the hydraulic oil is at operating temperature, then replace the return filter element.

**41 INDICATOR LIGHT - PREGLOW SYSTEM (yellow)**

With the ignition key in preglow position 50.2, the indicator light turns off after approx. 20 seconds. After the indicator light turns off, continue to turn the ignition key to start position 50.3 to start the engine.

**42 INDICATOR LIGHT - HI / LOW TRAVEL SPEED SELECTOR (yellow)**

Lights up when the low travel speed is selected, limiting the travel speed of the machine to 0 - 4.5 km/hr. (0 - 2.8 mph).

**43 INDICATOR LIGHT - ELECTRONIC (red)**

Lights up if there is a problem in the electronic system.

**44 FUSES**

Location as well as size of fuses are described later in this Operation and Maintenance Manual.

**45 ELECTRICAL OUTLET 24 V**

Can only be used with key in contact position 50.1.

3.3 CONTROLS ON THE INSTRUMENT PANEL

50 STARTER SWITCH



50.0 Zero position



50.1 Contact position



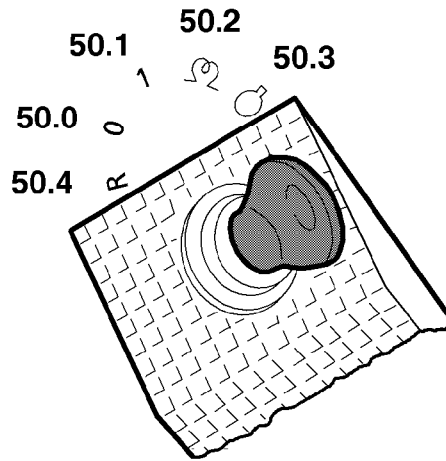
50.2 Preglow position



50.3 Starting position



50.4 Parking position



51 EMERGENCY OFF BUTTON

The machine stops immediately when this button is pushed in.



52 HORN

Push the button to sound the horn.



54 HI / LOW SPEED SELECTOR

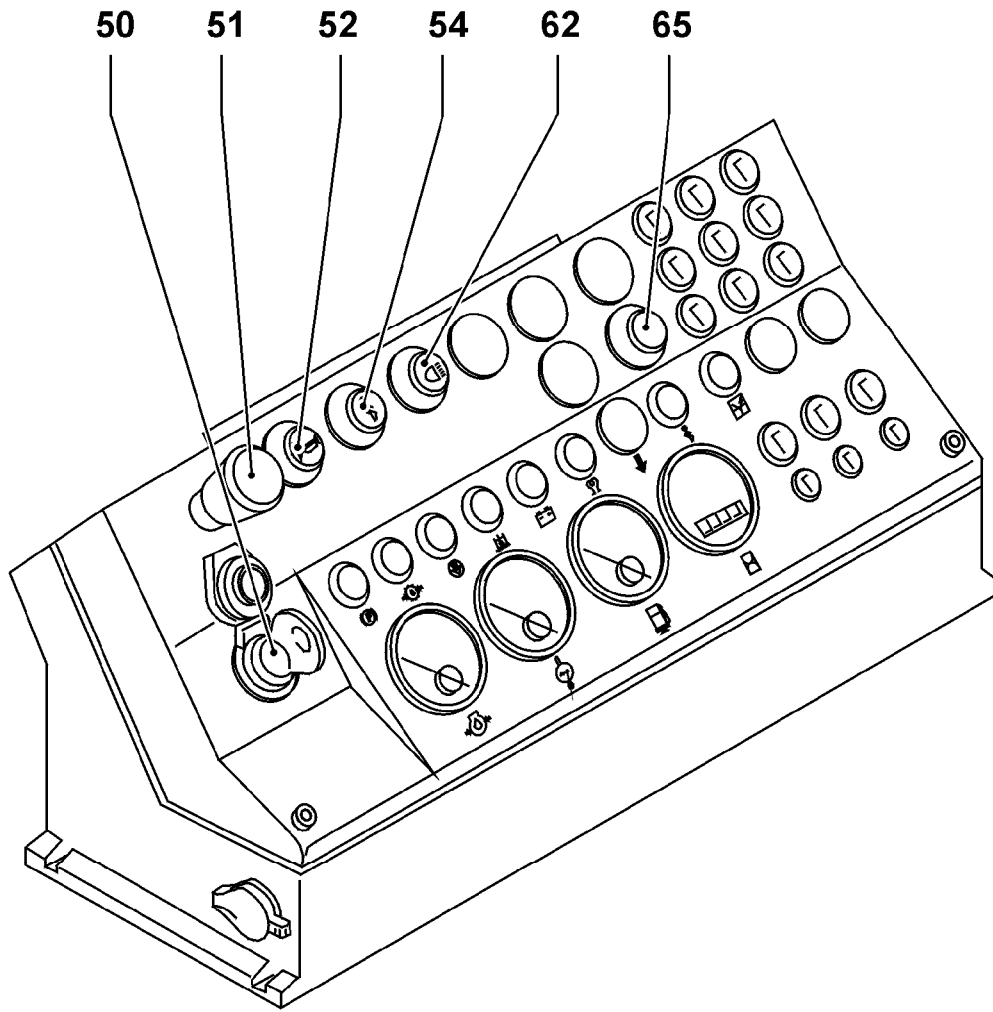
Push the button to reduce the speed range to 0 - 4.5 km/hr.

62 ADDED FLOODLIGHT

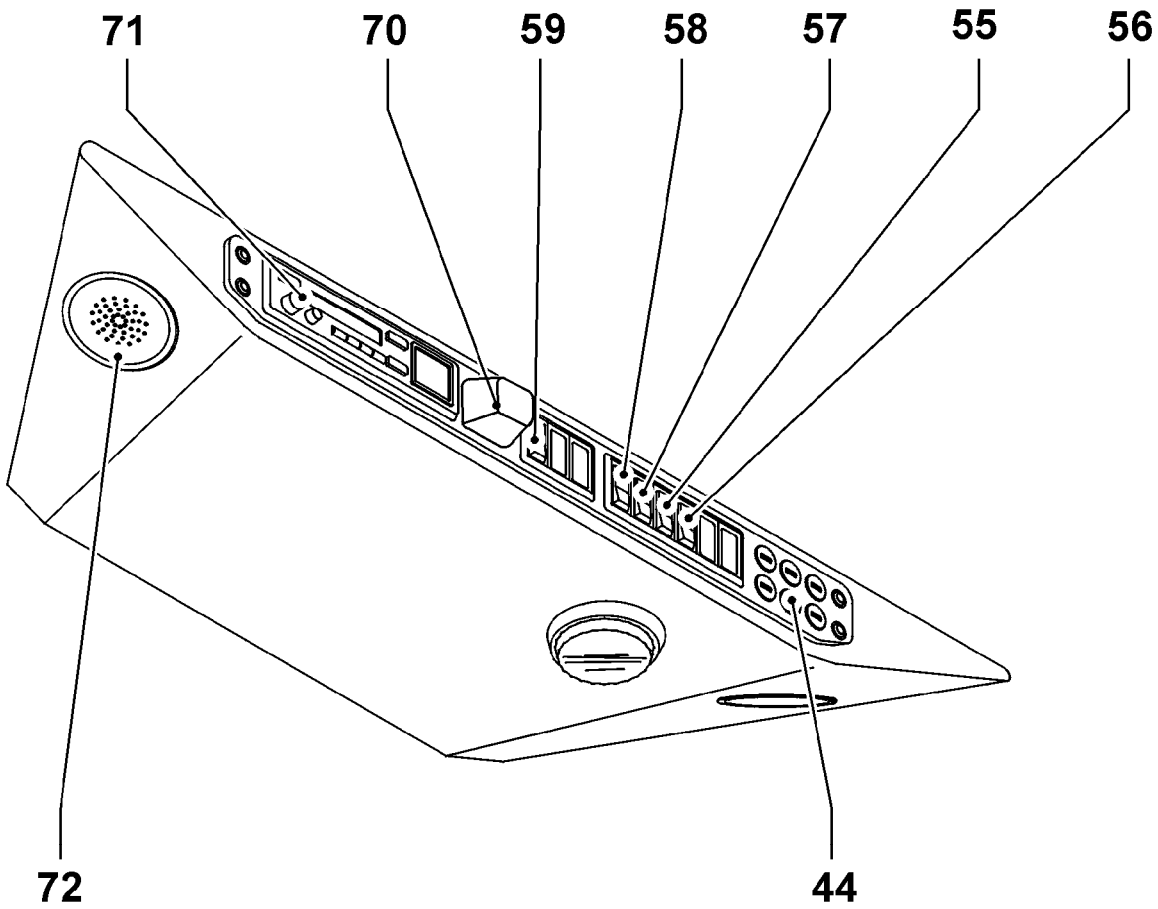
Push to turn on / off

65 BUTTON - HOIST LIMIT SWITCH

If the hook block is raised too far, the hoist movement will be turned off by the limit switch. Push the button to lower the hook block again.



3.4 INDICATORS AND CONTROLS IN THE OVERHEAD CONSOLE



70 WARNING LIGHT - OPERATOR'S CAB

Warning light lights up:

- at increased coolant temperature
- at low engine oil pressure
- at low replenishing pressure
- if ignition is turned on and the engine is not running.



NOTE

If the warning light lights up, turn the engine off and find and fix the problem.



55 WINDSHIELD WIPER FRONT

Stage 1: turn on / off

Stage 2: Button / windshield washer system



56 WINDSHIELD WIPER REAR

Stage 1: turn on / off

Stage 2: Button / windshield washer system



57 WINDSHIELD WIPER DOOR LEFT

Stage 1: turn on / off

Stage 2: Button / windshield washer system



58 SIDE WINDOW

Stage 1: turn on / off

Stage 2: Button / windshield washer system



59 WORKING FLOODLIGHT

Turn on / off

71 RADIO

72 SPEAKER

3.5 HEATER AND VENTILATION



NOTE

The cab can only be heated when the engine is at operating temperature and the shut off valves are open (Fig. 1).

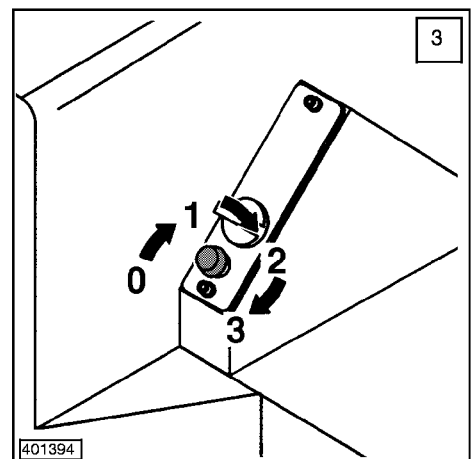
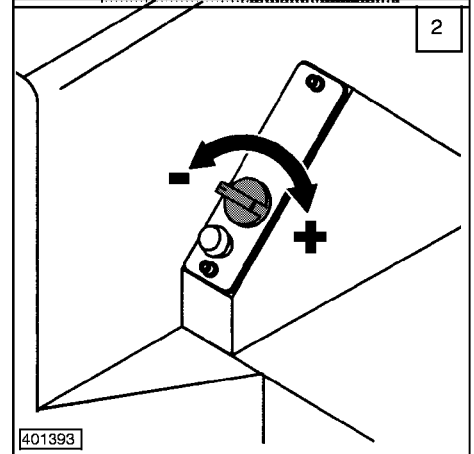
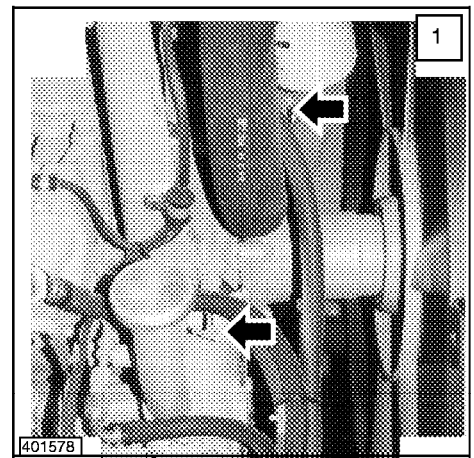
- Set the temperature (fig. 2)

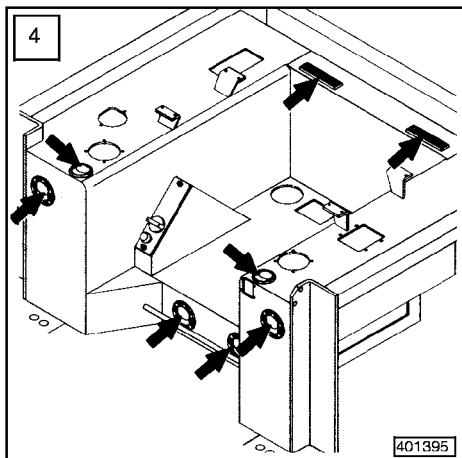
To increase the temperature: turn the knob in "+" direction.

To lower the temperature: turn the knob in " - " direction.

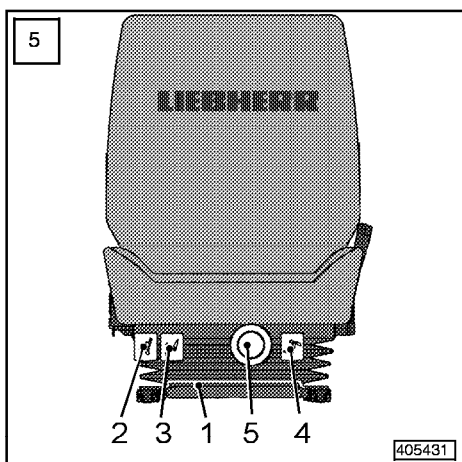
- Select the air flow (Fig. 3)

Fan switch settings range from 0-1-2-3 for more or less air flow.



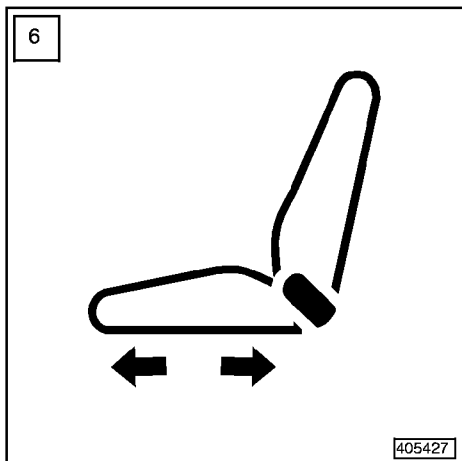


- Air vents (Fig. 4)
Set the optimum air circulation via adjustable air vents.



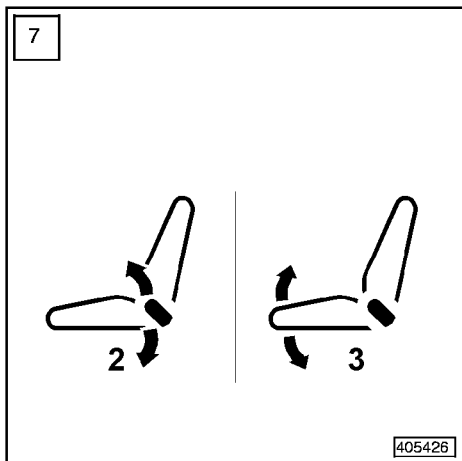
3.6 OPERATOR'S SEAT

A few minutes spent on seat adjustment will contribute greatly to operator comfort.



3.6.1 HORIZONTAL SEAT ADJUSTMENT

Lift the lever (1) and bring the seat into the desired position (fig. 6).



3.6.2 VERTICAL SEAT ADJUSTMENT

Pull the handles (2+3) at the same time and raise the seat to the desired height (fig. 7).

3.6.3 SEAT CUSHION ADJUSTMENT

To lower the seat in the rear

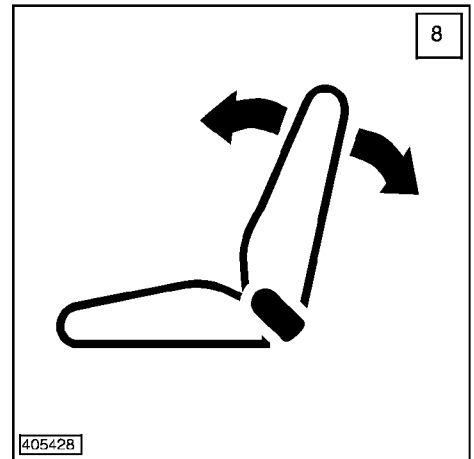
Raise the handle (2) and change the seat incline to the rear (fig. 7).

To lower the seat in the front

Raise the handle (3) and change the seat incline to the front (fig. 7).

3.6.4 BACK REST ADJUSTMENT

Raise the handle (4) and bring the backrest to the desired position (fig. 8).

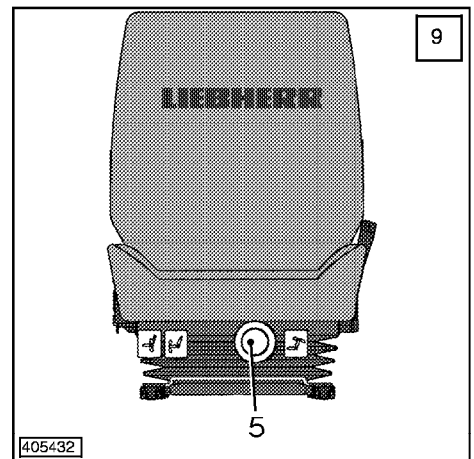


3.6.5 SEAT SUSPENSION ADJUSTMENT

Turn the knob (5) to adjust the seat suspension to the weight of the operator.

The knob (5) shows the adjusted weight in kg (fig. 9).

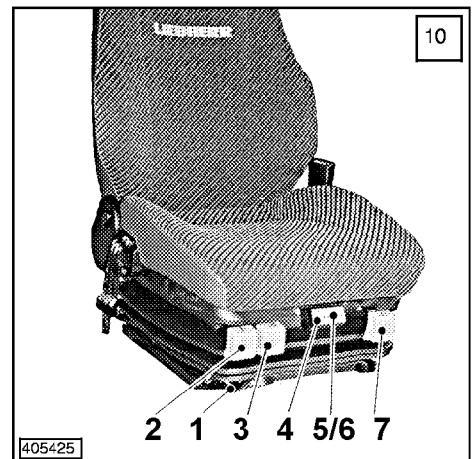
When this earthmoving machine is used in certain job applications and these operator's seats, which conform to ISO 7096, are used, it is assured that the measured vibration accelerations a_{zw} (measured according to ISO 2631 part 1), meet the requirements for total body protection from vibrations.



3.7 AIR CUSHIONED OPERATOR'S SEAT (Optional equipment)

3.7.1 HORIZONTAL SEAT ADJUSTMENT

- Raise the lever (1) on the front of the operator's seat and bring the seat to the desired position (fig. 10).



3.7.2 VERTICAL SEAT ADJUSTMENT

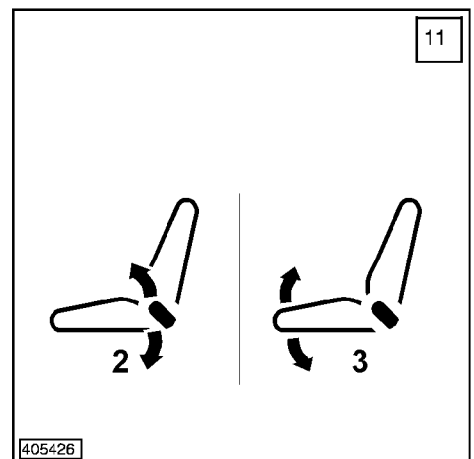
- Raise the levers (2+3) at the same time and bring the seat to the desired position (fig. 11).

3.7.3 SEAT CUSHION ADJUSTMENT

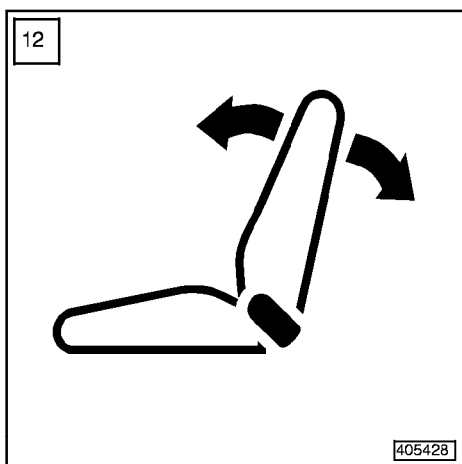
To lower the seat cushion in the rear

- Raise the handle (2) and change the seat incline to the rear (fig. 11).

To lower the seat cushion in the front

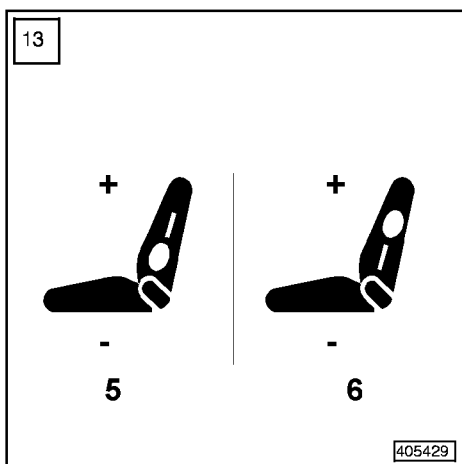


- Raise the handle (3) and change the seat incline to the front (fig. 11).



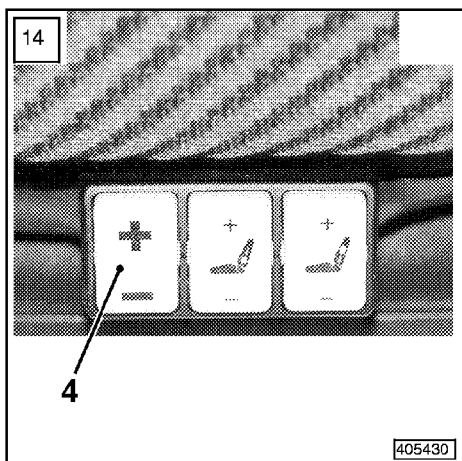
3.7.4 BACKREST ADJUSTMENT

- Raise the handle (7) and bring the backrest to the desired position (fig. 12).



3.7.5 BACK SUPPORT ADJUSTMENT

- Push the two buttons (5 + 6) to adjust the back support (fig. 13).



3.7.6 SEAT SUSPENSION ADJUSTMENT

- Press the button (4) on the '+' or '-' side until the seat is set to the most comfortable suspension (fig. 14).

When this earthmoving machine is used in certain job applications and these operator's seats, which conform to ISO 7096, are used, it is assured that the measured vibration accelerations a_{zw} (measured according to ISO 2631 part 1), meet the requirements for total body protection from vibrations.

3.8 ARM RESTS

The armrests are located in such a way that the operator can rest the forearms on the armrest during joystick operation (Fig. 15).

3.9 SEATBELT

CAUTION

The operator must always fasten the seatbelt before operating the machine.

To ensure safety, check condition, function and mounting of the belt frequently and replace worn, damaged or defective parts immediately.

Make sure that the seatbelt is not twisted when in use.

The seatbelt is adjusted automatically to the correct length.

3.9.1 TO APPLY THE SEATBELT

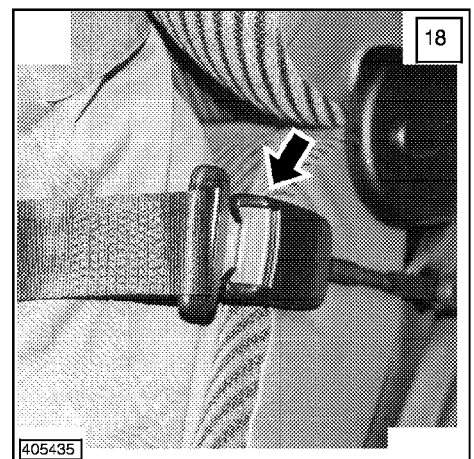
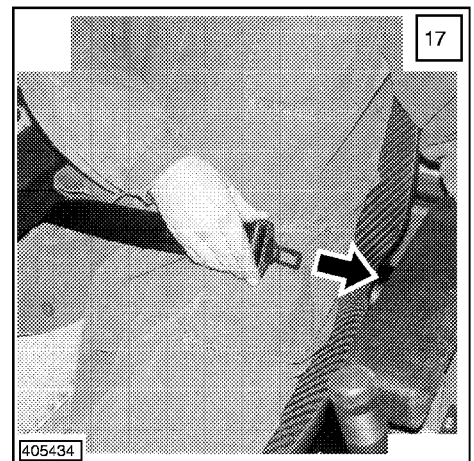
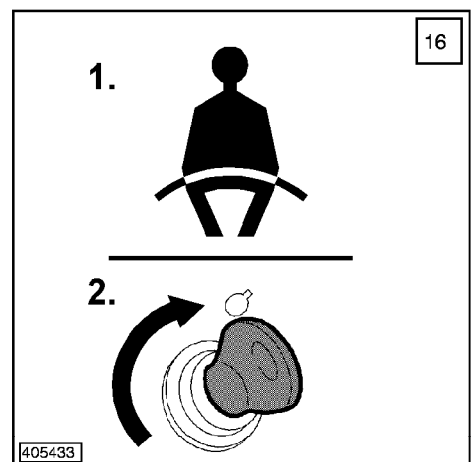
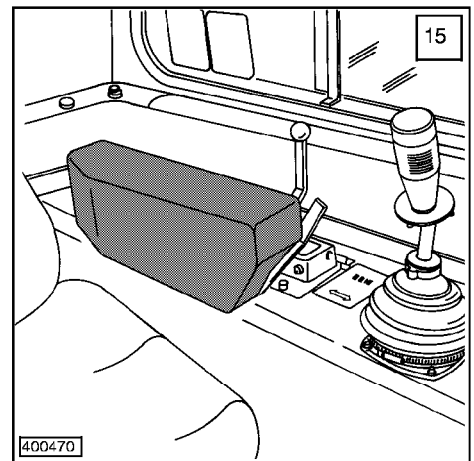
- Pull the seatbelt from the automatic housing on the right hand side of the seat (fig. 17).

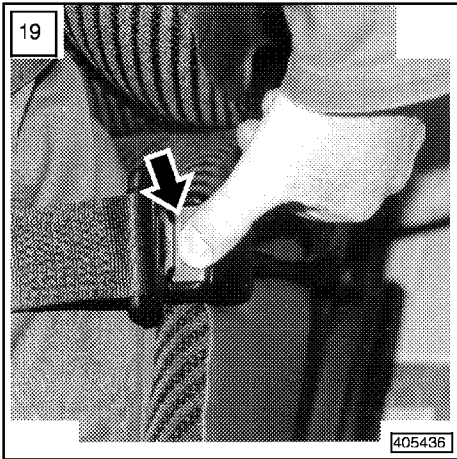
- Pull the seatbelt over your lap and engage it into the lock on the left hand side of the seat to fasten (fig. 18).
- Pull the belt to make sure it is locked.



NOTE

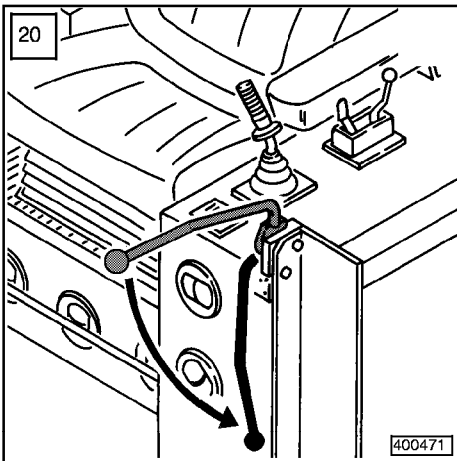
Pull the seatbelt slowly from the automatic housing, or the lock mechanism will be triggered.





3.9.2 TO RELEASE THE SEATBELT

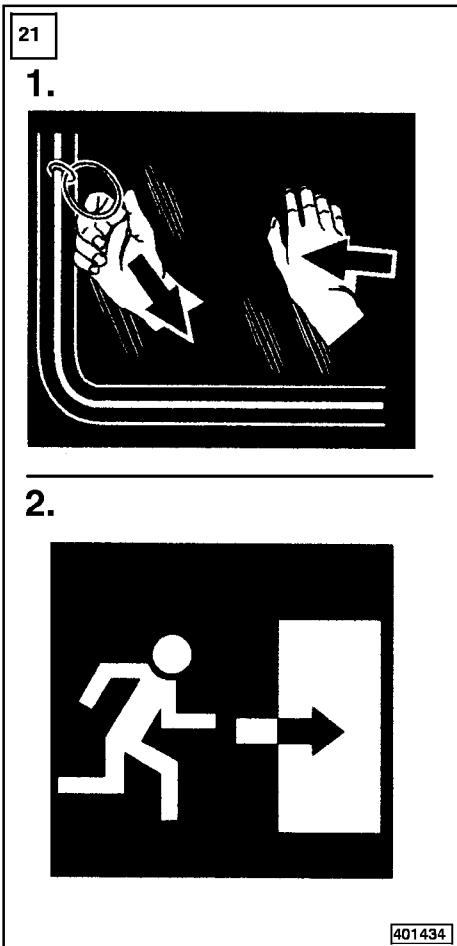
- To release the seatbelt, push the orange button on the lock downward (fig. 19).
 - Let the seatbelt retract slowly in its housing to prevent it from getting stuck or becoming dirty.



3.10 EMERGENCY EXIT

CAUTION

Always enter and leave the cab through the left side. Use the emergency exit only in true emergency situation. Before machine start up check if you can leave the cab through the right door without a problem. Before leaving the cab, make sure to place the safety lever in the full down position (fig. 20).



3.10.1 EMERGENCY EXIT

The rear window of the operator's cab is designed as an emergency exit.

To use:

- Pull the ring to remove the gasket (fig. 21).
- Push the window out.

3.10.2 EMERGENCY EXIT - ROLL OVER PROTECTION

If the roll over protection is installed, exit the machine to left in an emergency.

3.11 ENTERING AND LEAVING THE CAB

Always use the steps, rails and handles provided to enter and leave the cab.

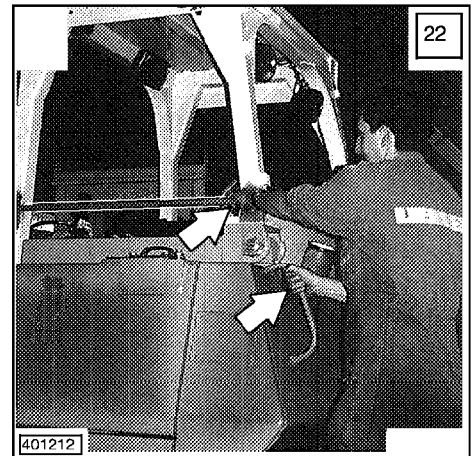
- Make sure to clean steps and chain before entering or leaving the cab.

CAUTION

Make sure the steps and chains are clean before stepping on them.

Always grasp the handles with both hands when stepping on or off the machine (fig. 22).

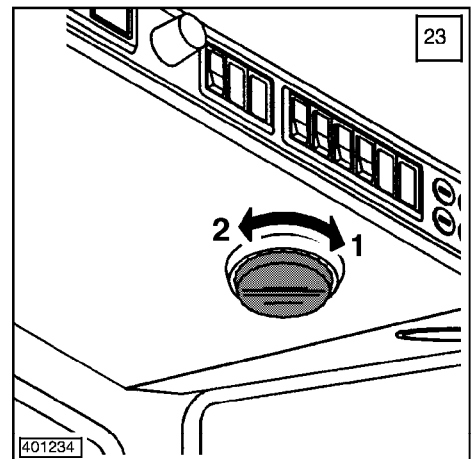
NEVER JUMP OFF THE MACHINE!



3.12 DOME LIGHT

To turn on dome light on, turn the dome light cover to the right. (Fig. 23, Pos. 1).

To turn the dome light off, turn the dome light cover to the left. (Fig. 23, Pos. 2).

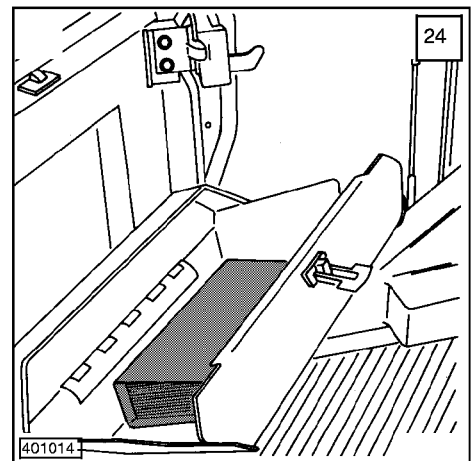


3.13 GLOVE COMPARTMENT - DOCUMENTATION

3.13.1 OPERATOR'S CAB

The glove compartment on the front of the cab can be opened with the quick release lock. Always keep a copy of the machine manuals in the glove compartment (fig. 24).

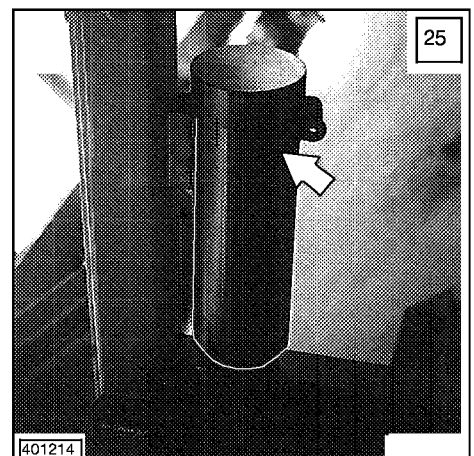
One set of manuals is part of the machine.

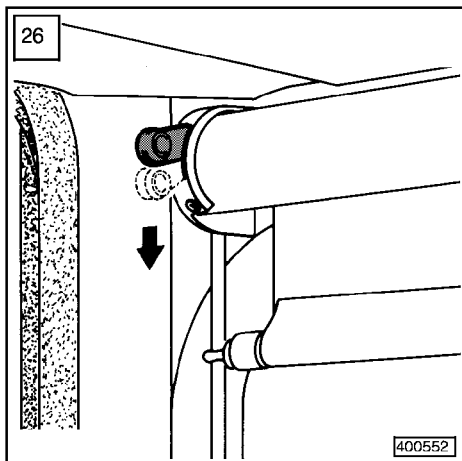


3.13.2 ROLL OVER PROTECTION

Always keep a copy of the machine manuals in the tube on the right hand side of the roll over protection (fig. 25).

One set of manuals is part of the machine.

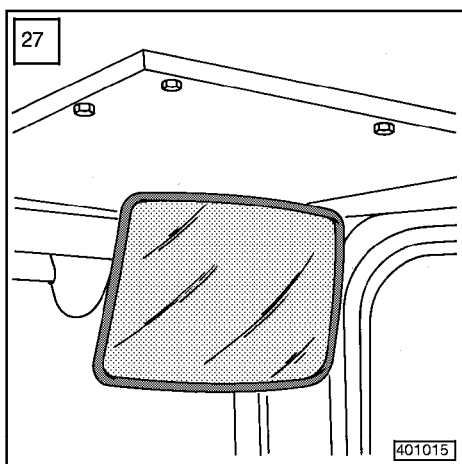




3.14 WINDOW SHADE

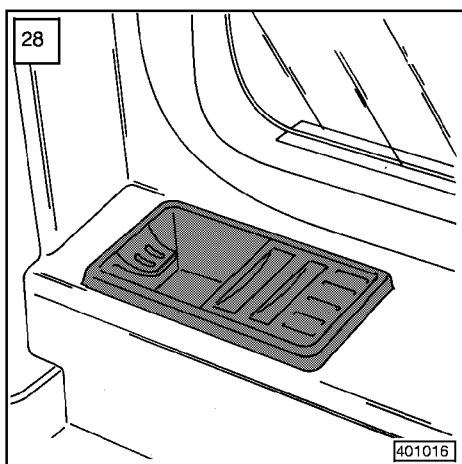
Every cab is equipped with a window shade, which can be adjusted to suit individual needs by pulling on the cross bar of the shade.

By pushing the lever on the left of the shade down, the window shade will automatically roll up (Fig. 26).



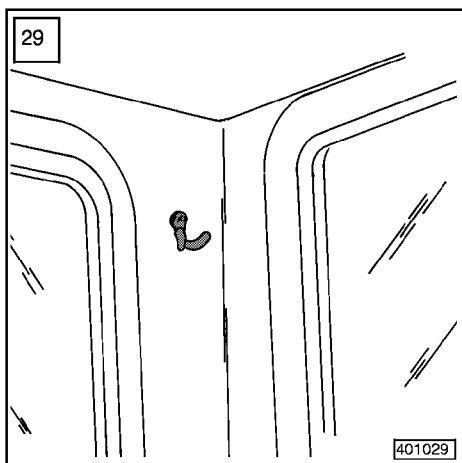
3.15 REAR VIEW MIRROR

A rear view mirror is standard equipment in every cab. Before start up, the mirror should be adjusted so the operator can see the complete rear area, while seated. (Fig. 27).



3.16 ASHTRAY

The ashtray can be removed for cleaning by holding it by the edge and pulling it upward (Fig. 28).

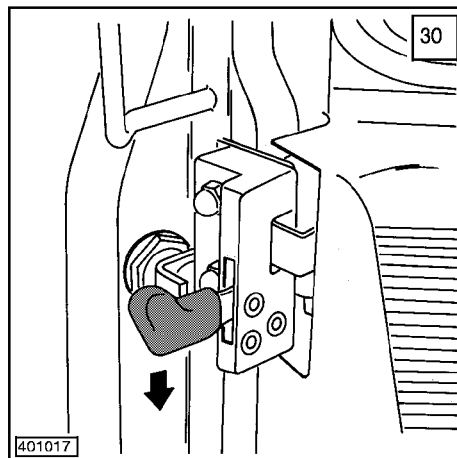


3.17 COAT HANGER

A coat hanger is located on the left rear wall of the cab (Fig. 29).

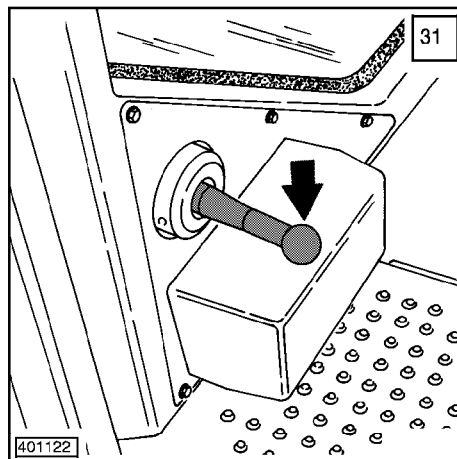
3.18 DOOR LOCK

The cab door lock holds the doors closed. Push the door lever down to open the door. (Fig. 30).



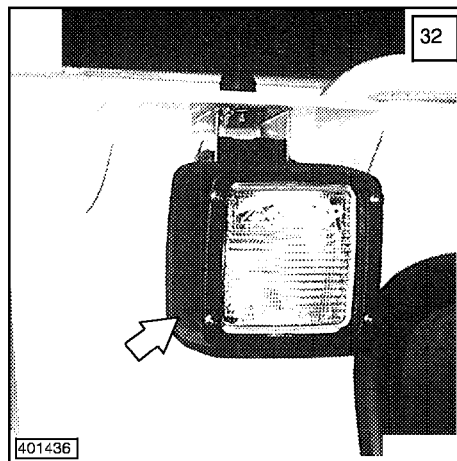
3.19 DOOR RETAINER

When the doors are fully opened, they can be retained in this position by the door retainer. To release the door, push down the lever on the door frame (Fig. 31).



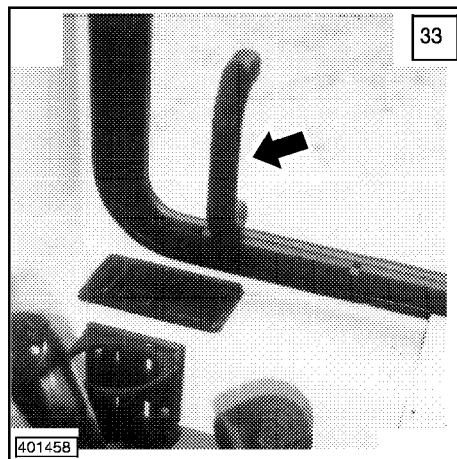
3.20 FLOODLIGHT

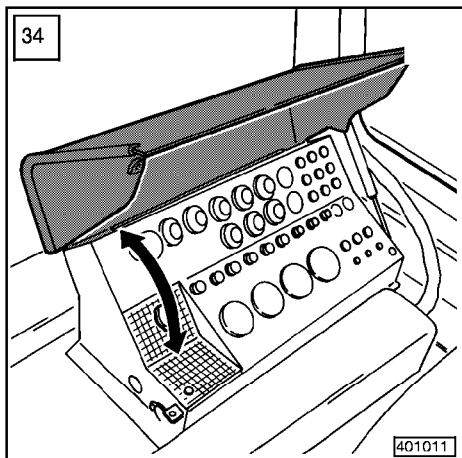
The floodlights should be adjusted in such a way that the working area in front and behind the machine are illuminated sufficiently (Fig. 32).



3.21 WINDOW LOCK

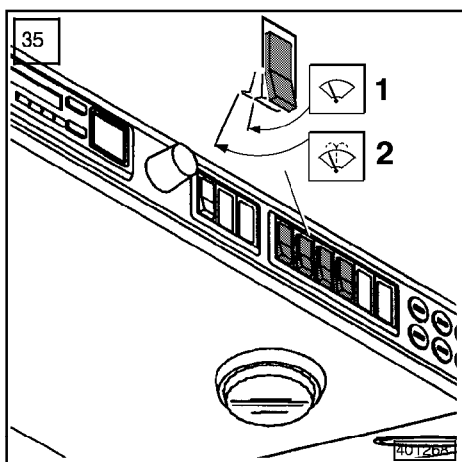
Push the lever on the handle and push the sliding window to the desired position (fig. 33). The window can be locked by engaging the lever in any of the recesses on the window frame.





3.22 VANDALISM PROTECTION

The vandalism protection hood can be locked to protect from unauthorized access or vandalism. Flip the hood upward to gain access to the instrument panel (fig. 34).

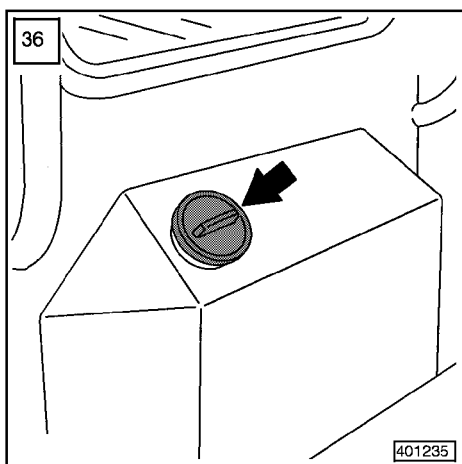


3.23 ELECTRIC WINDOW WASHER SYSTEM

To turn the window washer on

Push the button for the window to be cleaned and hold it down (fig. 35/pos. 2).

Windshield washer fluid is sprayed onto the windshield as long as the button is held down.



The fluid reservoir is located on the front side in the cab (fig. 36).

3.24 FIRE EXTINGUISHER (Optional equipment)

A mounting bracket for the fire extinguisher has been placed on the left hand side behind the operator's seat.

Contact your Liebherr dealer to obtain the fire extinguisher installation kit.

3.25 BEACON (Optional equipment)

Your machine has been prepared at the factory for the installation of a beacon.

For Id. No. and retrofit installation, contact your Liebherr dealer or service center.

4. OPERATION

4.1 WALK AROUND INSPECTION

 **CAUTION**

Observe all safety guidelines in chapter 2 of this Operation and Maintenance manual.



NOTE

Always keep the cab area, steps and handles free of grease and contaminants, clean with a rag if necessary before operating the machine.

- For maintenance tasks on the right side of the machine, the engine compartment door must be removed. Open the engine compartment door and unhook it with the installed handles. (fig. 1).
- Set down the engine compartment door between the back wall and the cab or roll over protective structure.

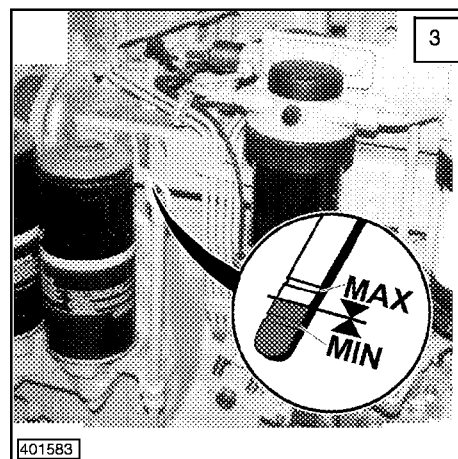
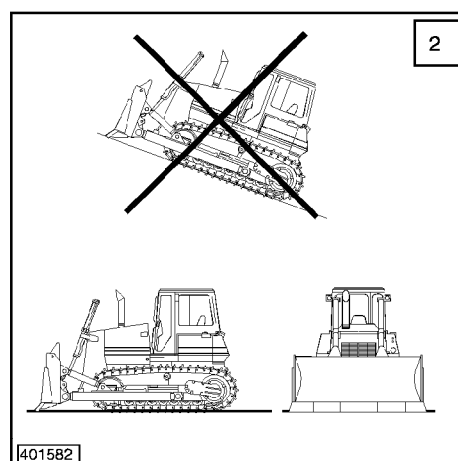
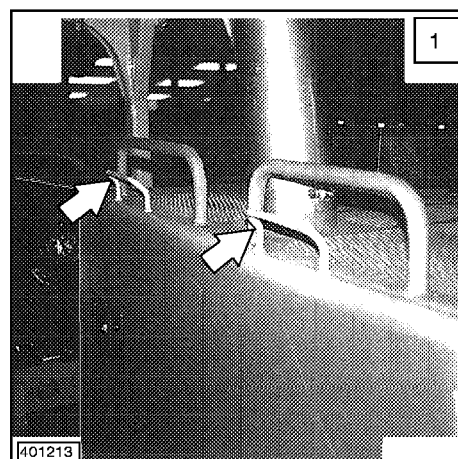
4.1.1 ENGINE OIL LEVEL

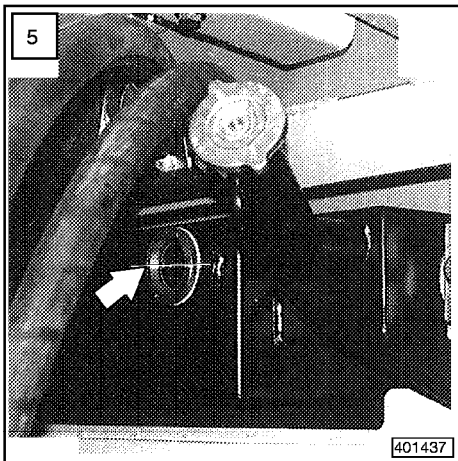
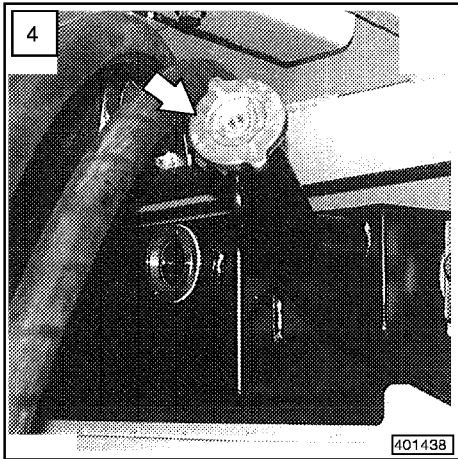
Check the oil level with the machine in horizontal position (fig. 2).

Turn the engine off, wait a few minutes for the oil to collect in the oil pan.

The oil level must be between the MIN. and MAX. mark on the dipstick (fig. 3).

Do not overfill the engine past the MAX. mark. The difference between MIN. and MAX. is 7 l.





4.1.2 COOLANT LEVEL

CAUTION

At or near operating temperature, the engine coolant system is hot and under pressure. Avoid contact with components containing coolant, since it could cause severe burns.

Open the cap on the expansion tank only if it is cool enough to touch.

Carefully turn the cap to relieve pressure.

- Continue to turn the cap and open (fig. 4)

The coolant level must be visible in the center of the sight gauge (fig. 5).

Check coolant, fan and engine for damage, clean as necessary.

After refilling the cooling system, let the engine run for a short time with the heater turned on. Recheck the coolant level.

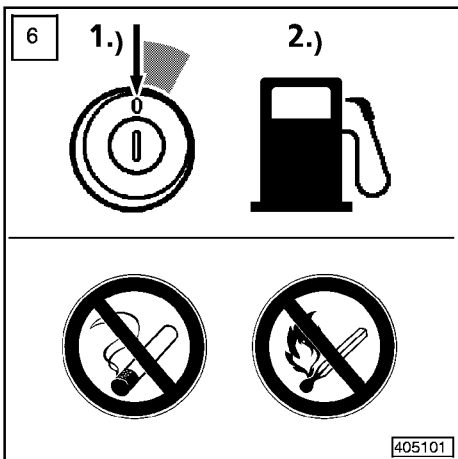


NOTE

When refilling the cooling system, always use a mixture of anti-corrosion and antifreeze fluid and DCA4.

The machine is filled at the factory with a coolant mixture of approx. 50 % antifreeze to protect the system to a temperature of -36°C.

For quantities and mixing ratio, refer to the lubrication chart.



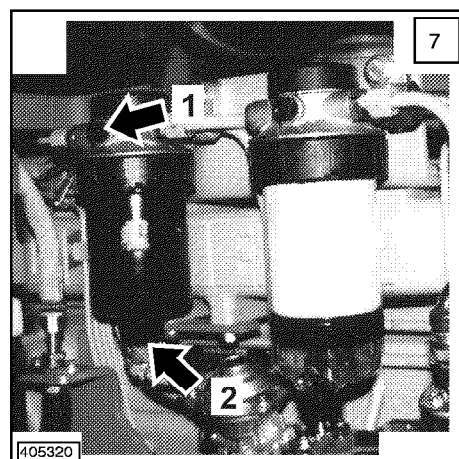
4.1.3 FUEL SYSTEM

CAUTION

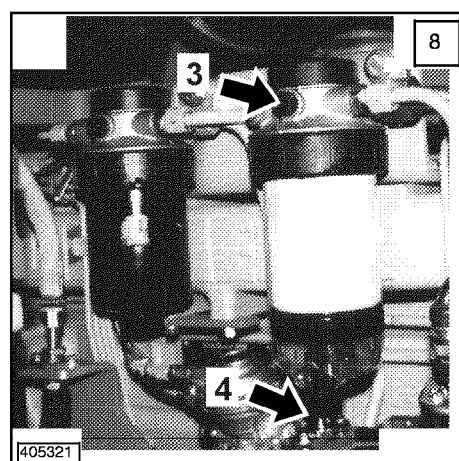
Do not store fuel on the machine or in glass containers. Do not add fuel in a closed area. Never smoke or allow an open flame in refueling areas.

Drain water and sediments from the fine filter and prefilter, daily if necessary.

- Place a suitable container under the drain valve.
- Open the bleeder screw, pos. 1 on the fuel filter. Open the drain plug until clean fuel emerges (fig. 7, pos. 2).



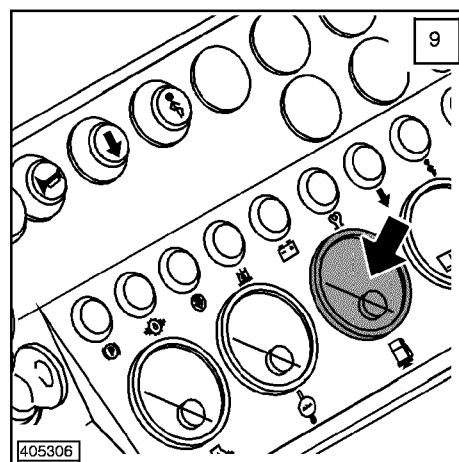
- Open the bleeder screw on top on the fuel prefilter (fig. 8, pos. 3).
- Open the drain valve on the fuel prefilter until clean fuel emerges (fig. 8, pos. 4)
- Close the bleeder screws and drain valves again.

**Note:**

The fuel gauge in the instrument panel shows the fuel reserves in the fuel tank (fig. 9)

**NOTE**

Maintain a high fuel level in the tank to reduce condensation and corrosion.



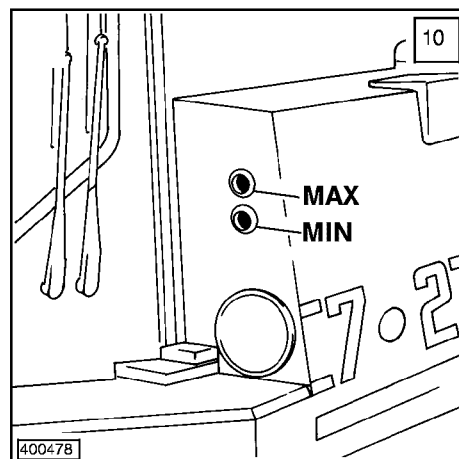
4.1.4 CHECK THE OIL LEVEL IN THE HYDRAULIC TANK

With the machine on level ground and the hydraulic cylinders retracted, the oil level may not exceed the center of the upper sight gauge (fig. 10, MAX.)

With the machine in the same position, and the hydraulic cylinders extended, the oil level may not drop below the center of the lower sight gauge (fig. 10, MIN.)

**NOTE**

Add hydraulic oil only through the return oil filter.



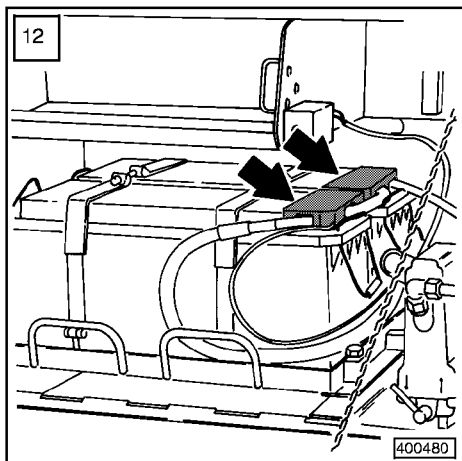
Refer to chapter 5 in this Operation and Maintenance manual for specifications.



4.1.5 CHECK OIL LEVEL IN THE SPLITTERBOX

Check the oil level in the splitterbox with dipstick (fig. 11). The oil level must be between the MAX. and the MIN. mark on the dipstick.

Refer to chapter 5 in this Operation and Maintenance manual for specifications.



4.1.6 ELECTRICAL SYSTEM

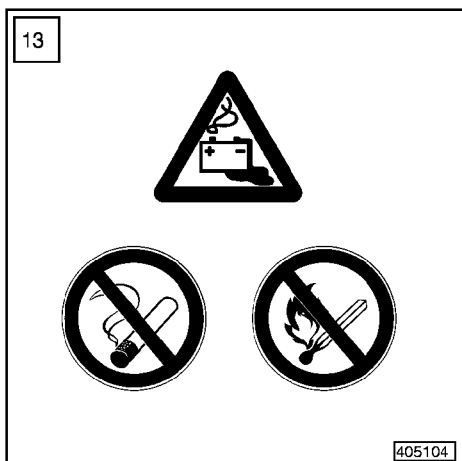
Check all switch functions, indicator lights, headlights, fuses, as well as battery acid level and mounting tightness (fig. 12).

CAUTION

When working on the battery, always wear gloves and safety glasses.

Battery acid can cause severe burns!

Do not smoke or keep and open flame near this area.



4.2 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 operation 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 machine and make sure that all of them are legible.
- Clean all windows and mirrors, secure doors and windows to prevent any inadvertent movement.
- Always enter and leave the cab through from the left over the chain. Always use the appropriate handles.
- 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 arms rests and the seat belt as well as set 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 when operating the machine.
- Never operate the machine without a cab or canopy.

4.3 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.

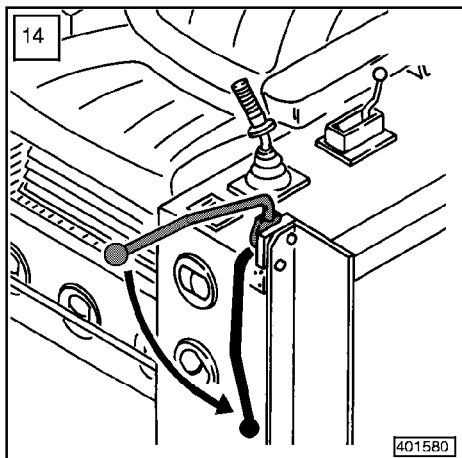
4.4 STARTING THE DIESEL ENGINE



NOTE

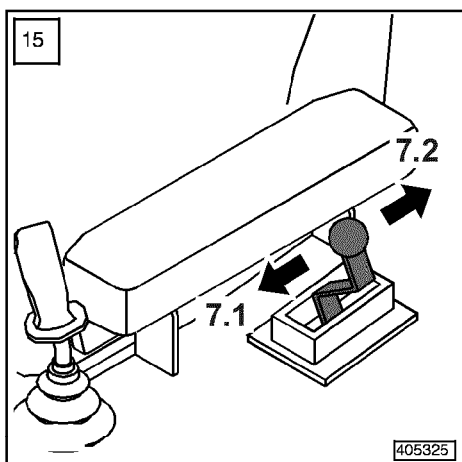
Do not operate the machine unless you have read and understood the instructions given in this Operation and Maintenance Manual.

Due to the hydrostatic drive, the engine cannot be started by pushing or by towing the machine.



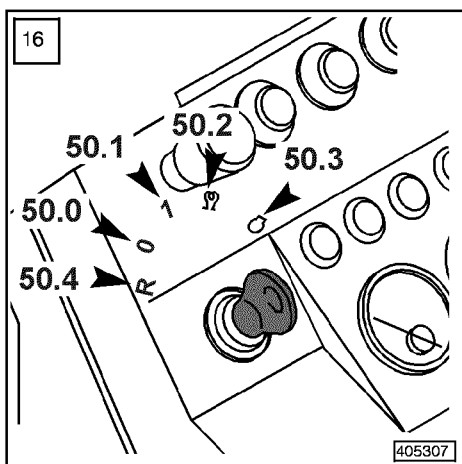
CAUTION

The engine can only be started with the safety lever in the full down position. (fig. 14) Should it be possible to start the engine with the safety lever in any other position, check and correct the defect.

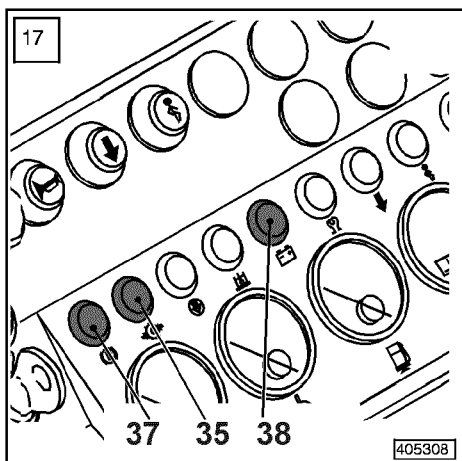


4.4.1 STARTING PROCEDURE AT AMBIENT TEMPERATURES TO -12°C (10° F)

- Check the position of the travel lever.
 - It must be in neutral position.
- Set the throttle control lever to 'high idle' position (fig. 15, pos. 7.1)



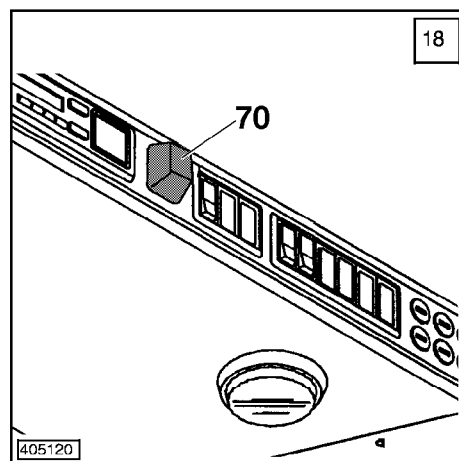
- Turn the ignition key to position 50.1 (fig. 16) to energize the electrical system.



The following indicators and warning devices must come on: (fig. 17/ 18)

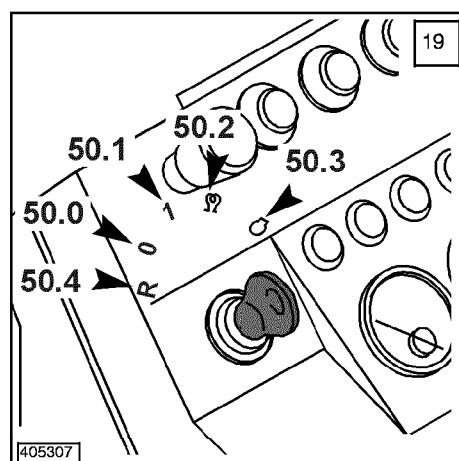
- Indicator light - travel brake (pos. 37)
- Indicator light - replenishing oil pressure (pos. 35)
- Charge indicator light (pos. 38)

- Warning light - operator's cab (pos. 70)



- Turn the ignition key, without preheating, to position 50.3 (fig. 19) and hold it in this position until the engine starts. As soon as the engine is running, release the ignition key - it returns automatically to operating position (50.1).

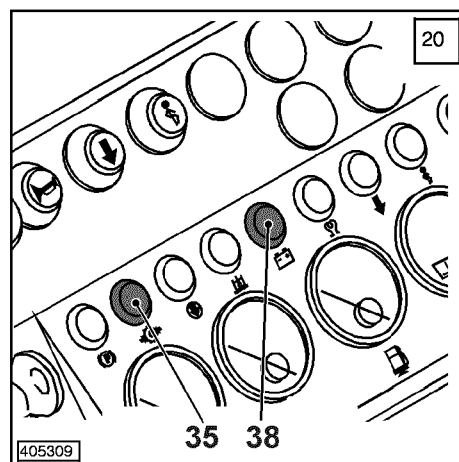
Note: Do not crank the starter for more than 10 seconds. If the engine does not start, repeat the starting procedure at 2 minute intervals.



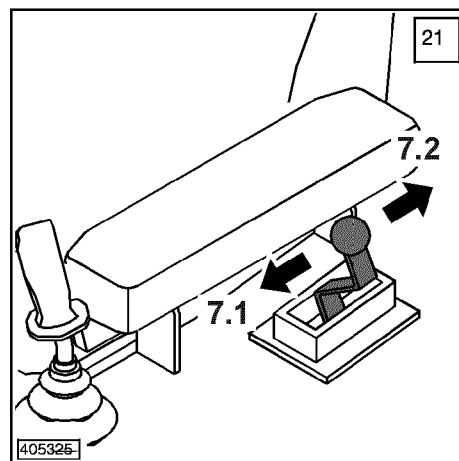
As soon as the engine starts, the following indicators and warning devices must turn off: (fig. 20)

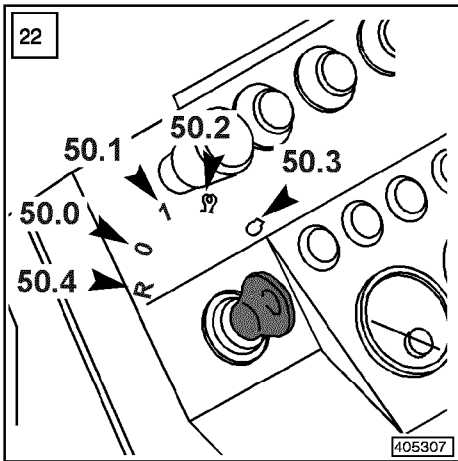
- Indicator light - replenishing oil pressure (fig. 35)
- Charge indicator light (pos. 38)
- Warning light - operator's cab (fig. 18, pos. 70)

If the indicators and warning devices do not turn off immediately, turn the engine off and correct the problem.



Move the throttle control lever to low idle position (fig. 21, pos. 7.2). Avoid full engine load until the system is at operating temperature.

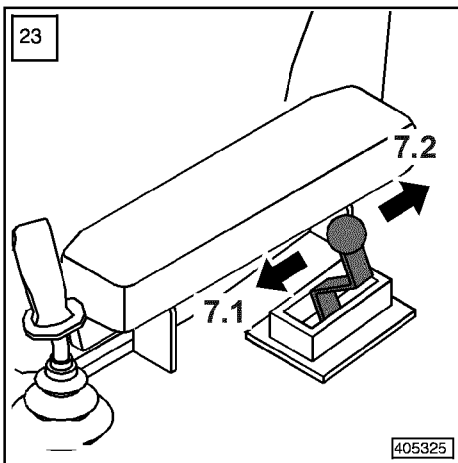




4.4.2 STARTING PROCEDURE AT AMBIENT TEMPERATURES BELOW -12°C (10°F)

At low ambient temperatures, the engine should be started with the glow plug (preheated) to improve the starting behavior.

- Bring the throttle control lever in operating position. Turn the ignition key to position 50.1 and check the electrical system.
- Bring the ignition key to preglow position (fig. 22, pos. 50.2) and hold it in this position. As soon as the indicator light turns off, continue to turn the key to position 50.3 to start the engine.
- If the engine does not start, release the ignition key, it will automatically return to operating position (50.1).



- Set the throttle control lever to low idle (fig. 23, pos. 7.2). Avoid full engine load until the system is at operating temperature.

Note: Do not crank the starter for longer than 10 seconds. If the engine does not start, repeat the starting procedure in two minute intervals to allow the starter to cool off.

CAUTION

Do not use the preheat system if the engine is at or near operating temperature. Do not use an ether starting aid when using preglow systems. (Danger of Explosion!)

4.5 MACHINE PARKING SAFETY

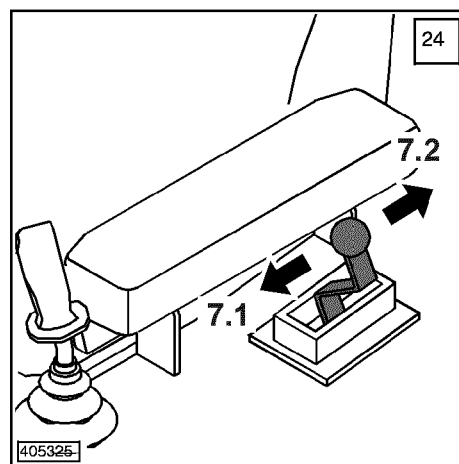
- Park the machine only on firm and level ground. If it becomes necessary to park the machine on a grade, it must be properly blocked with wedges to secure it and prevent any unintentional movement.
- Bring all operating levers and controls into neutral position, place the safety lever in full down position, 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.

4.6 MACHINE SHUT DOWN

4.6.1 TURN OFF THE ENGINE

Reduce the engine speed to low idle (fig. 24, pos. 7.2) and let the engine run for a short time to lower the temperatures and to give the turbocharger time to run out.

- Move the safety lever down, the indicator light - travel brake must light up.



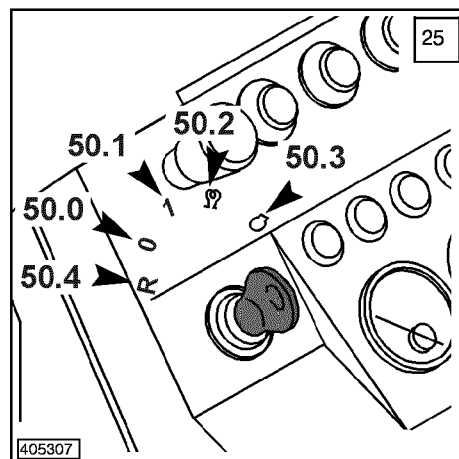
NOTE

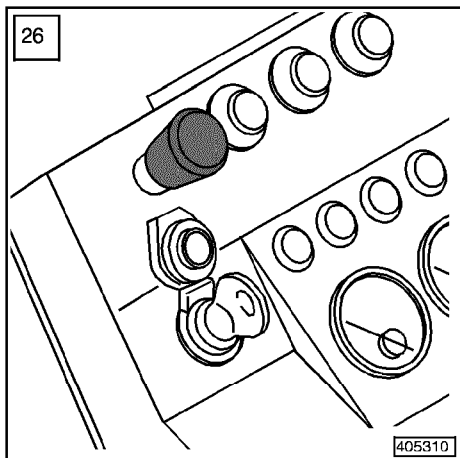
Turn off all electrical components before turning off the ignition switch.

- Turn the ignition key to position 50.0 (fig. 25) and pull it off.

All indicators and warning devices must be off.

The radio and the interior lights can be used by moving the ignition key to position 50.4 (fig. 25).





4.6.2 EMERGENCY OFF BUTTON

CAUTION

The machine stops suddenly.

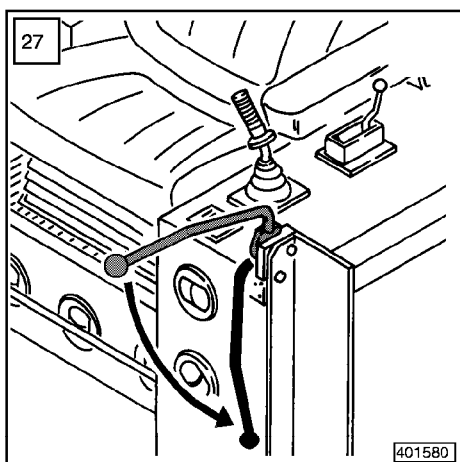
To stop travel

In dangerous situations or emergencies, the machine can be stopped by pushing the emergency off button. The engine continues to run, the attachment can still be operated (fig. 26).

To continue travel operation

Bring the travel joystick to neutral position. Move the safety lever to the full down position (fig. 27).

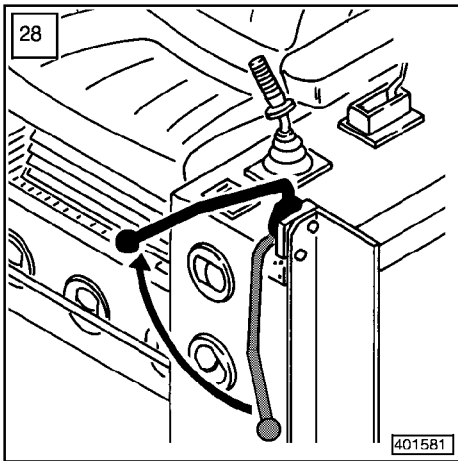
Lift the button until it engages, raise the safety lever, deflect the travel joystick to release the brake and continue travel operation.



4.7 MACHINE OPERATING SAFETY

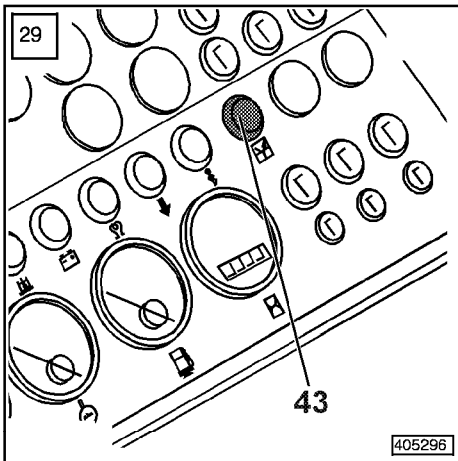
- Make sure you are aware of any special circumstances on the job site, make sure you are familiar with any special guidelines and warning signals. Familiarize yourself with the job site before starting to work, any special hindrances and obstacles influencing operation or movement, the ground conditions, 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 moving on public highways, roads or areas, make sure you observe all applicable rules and regulations for on road travel. If necessary, bring the machine to proper operating condition.
 - Always turn on the lights 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, 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 the 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 top 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 the travel speed to working conditions.
 - Never travel on slopes that exceed the maximum permissible gradeability of the machine.
 - Never travel downhill at maximum speed, always at low speed to prevent loss of control. The engine must be at nominal speed 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 into a slope and then change the speed.
 - 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 two way radios.
 - When using a two way radio or Citizens Band radio (CB), the safety lever must be in the full down position.



4.8 TRAVEL FUNCTIONS

- Raise the safety lever (fig. 28).

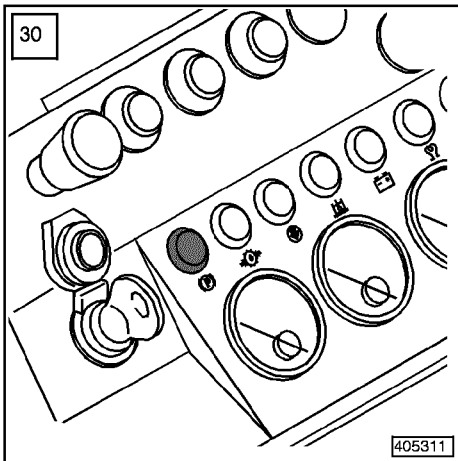


- After approx. 3 seconds, the indicator light - electronic lights up for a short time (fig. 29, pos. 43), indicating that the electrical system has passed a self test.



NOTE

Do not deflect the travel joystick until after the indicator light for the electronics lights up.



The machine is ready to travel, the parking brake is released by deflecting the travel joystick and the indicator light for the parking brake must turn off (fig. 30, pos. 37).



NOTE

Certain wave lengths may cause interference with the travel operation. Before operating a two way or CB radio, return the travel joystick to neutral position and place the safety lever in the full down position.



CAUTION

In case of an emergency or loss of machine control, immediately lower the attachment, then place the safety lever in the full down position.



NOTE

- Warm up the engine and the hydraulic system to operating temperature.
Actuate the attachment hydraulic cylinders all the way to bring the engine and the hydraulic system to operating temperature.

- As a basic rule, the machine should always be operated with the engine running at full engine RPM (fig. 31, pos. 7.1).

In certain cases, such as tight working areas, the machine may be operated at reduced engine speed.

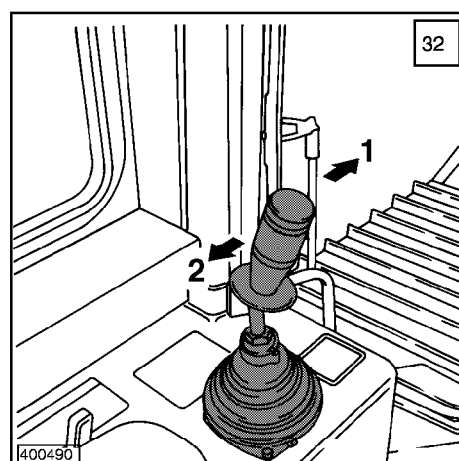
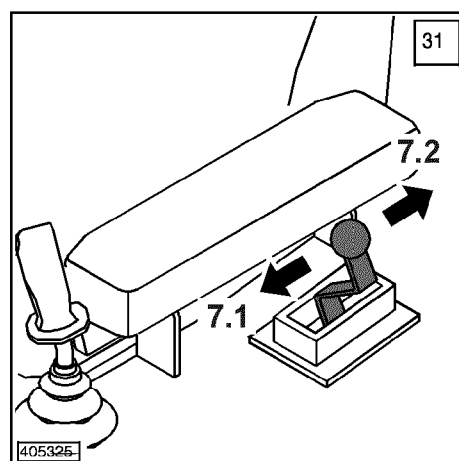
4.8.1 STRAIGHT TRAVEL

TRAVEL FORWARD

Slowly push the travel joystick forward. The more the joystick is pushed forward, the higher the travel speed will. (fig. 32, pos. 1)

TRAVEL REVERSE

Slowly pull the travel joystick backwards. The more the joystick is pulled backwards, the higher the travel speed will be. (fig. 32, pos. 2)



4.8.2 COUNTER ROTATION

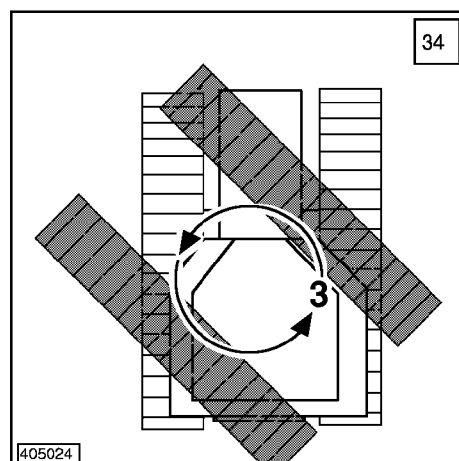
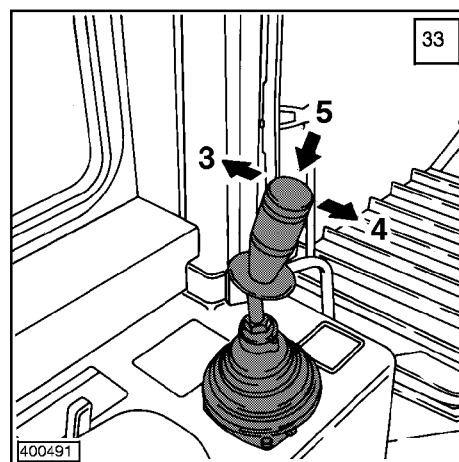


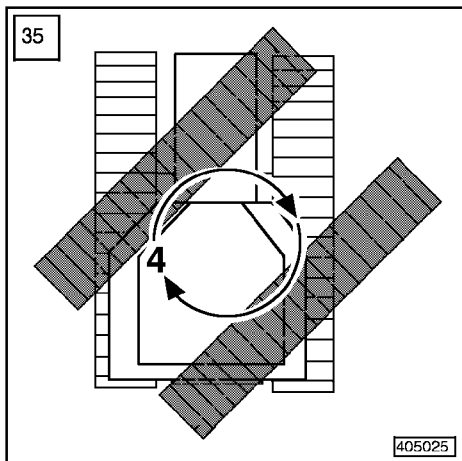
NOTE

During counter rotation, the two track chains turn in opposite directions. The counter rotation speed depends directly on the joystick deflection.

LEFT HAND TURN (COUNTERCLOCKWISE TURN)

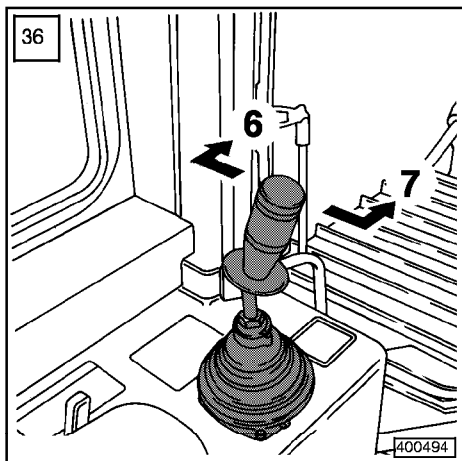
- Push the button on the travel joystick (fig. 33, pos. 5) and push the travel joystick to the left at the same time (fig. 33/34, pos. 3). The more the travel joystick is moved to the left, the faster the machine will counter rotate.





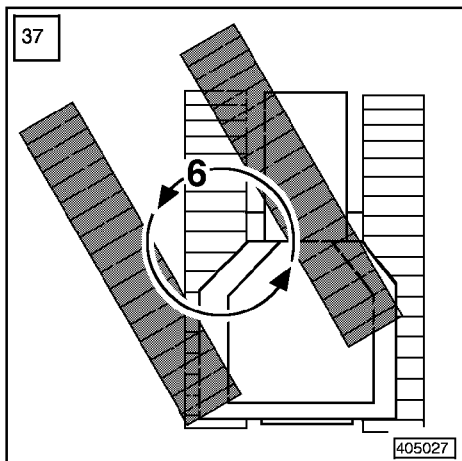
TURN TO THE RIGHT (CLOCKWISE TURN)

- Push the button on the travel joystick (fig. 33, pos. 5) and push the travel joystick to the right at the same time (fig. 33/35, pos. 4). The more the travel joystick is moved to the right, the faster the machine will counter rotate.



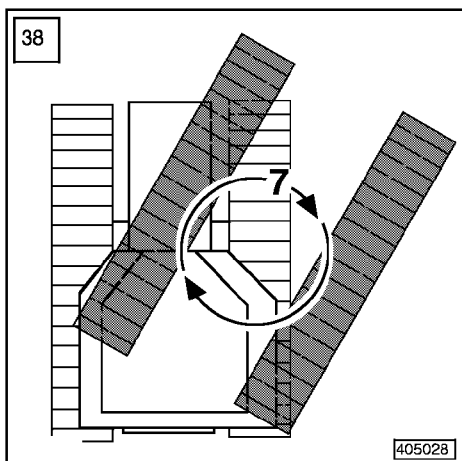
4.8.3 PIVOT TURN

In addition to forward, reverse, and counter rotation, the operator can make any type of turn in forward and reverse, at variable speeds. (fig. 36).



PIVOT TURN - LEFT FORWARD:

- Push the travel joystick all the way to the left and slowly forward (fig. 36/37, pos. 6).



PIVOT TURN - RIGHT FORWARD:

- Push the travel joystick all the way to the right and slowly forward (fig. 36/38, pos. 7).

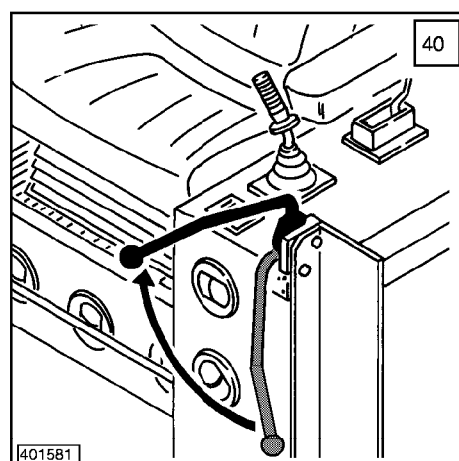
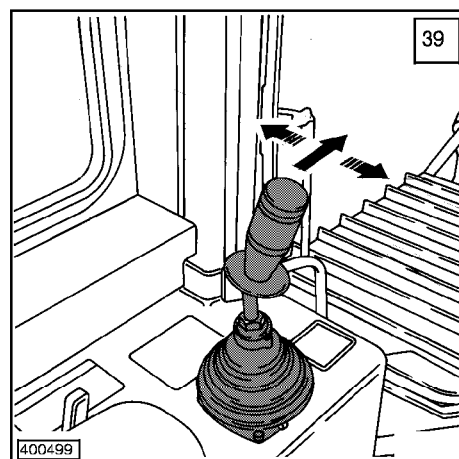
4.8.4 TURNING - POWER TURN

POWER TURN - LEFT FORWARD

- Move the travel joystick forward and slightly to the left. The machine will now travel forward with a slight left hand turn. Both tracks are turning. The further the joystick is deflected to the left, the sharper the turn will be. The same applies to power turns in left reverse (fig. 39).

POWER TURN - RIGHT FORWARD

- Move the travel joystick forward and slightly to the right. The machine will now travel forward with a slight right hand turn. Both tracks are turning. The further the joystick is deflected to the right, the sharper the turn will be. The same applies to power turns in right reverse (fig. 39).



4.8.5 BRAKE OPERATION

The hydrostatic travel drive is also an operating brake. As soon as the travel joystick is moved towards the neutral position, the machine slows down in the same ratio.

If the travel joystick remains in neutral position, the hydrostatic drive will automatically secure to the machine to prevent it from rolling off.

If the travel joystick remains in neutral position, the parking brake will automatically be applied after approx. 5 seconds.

The attachment functions remain operational.



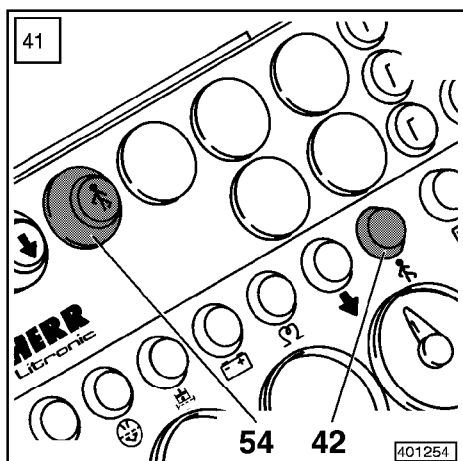
CAUTION

Moving the travel joystick into neutral position too fast will cause the machine to stop suddenly and abruptly.

The parking brake is applied:

- if the safety lever is placed in the full down position.
- if the travel joystick remains in neutral position for longer than 5 seconds.
- if the travel joystick is in neutral position and the chains turn 2 more cm.

The parking brake can be released by raising the safety lever when the engine is running and by deflecting the travel joystick (fig. 40).



CAUTION

The safety lever must always be in the full down position when the engine is not running. If the engine has been turned off inadvertently, move the travel joystick to neutral position and bring the safety lever to the full down position to apply the parking brake.

4.8.6 PRESELECTION OF LOWER TRAVEL SPEED RANGE (Hi / Low travel speed)

CAUTION

If the machine is used to constantly push heavy loads and when working on a slope, then the maximum travel speed must be reduced by pressing the switch.

The machine is equipped with a travel speed selector switch (fig. 41).

In neutral position, the travel speed can be varied between 0 and 11 km/hr. (0 and 6.8 mph) (forward and reverse).

- By pressing the switch, the travel speed can be varied between 0 and 5 km/hr. (0 and 3.1 mph) (forward and reverse). In low range, the indicator light lights up (fig. 41, pos. 42).
- Press the switch again to return to normal speed. The indicator light will turn off.

4.9 ATTACHMENT OPERATION

DANGER

Never work under the attachment if it is not properly supported or laying on the ground. Never allow anybody to remain under a suspended load! This is strictly prohibited!

Note: All attachment functions are servo controlled for easy, comfortable and precise operation.

The working attachment can only be operated with the safety lever in the raised position.

**NOTE**

When operating the machine with a rear winch, then the operator's area of the cab must be secured with a rear protection screen.

Contact your Liebherr dealer for installation details for the rear protection screen.

4.9.1 RAISE / LOWER BOOM

Move the boom control lever in crosswise direction to raise or lower the boom. The speed depends on the lever deflection.

Boom up:

Push the boom control lever to the right (fig. 42 / 43, pos. 1).

Boom down:

Push the boom control lever to the left (fig. 42 / 43, pos. 2).

Depending on the lever position, the boom can be returned quickly to the desired working position.

**NOTE**

When the boom control lever is released, it automatically returns to neutral position. The boom remains in the preselected working position.

The top position of the hook block is secured via a limit switch. When lowering the boom, the hook block is raised and the limit switch can be triggered.

The working cycle can be continued by lowering the hook block.

**DANGER**

When the boom is raised, make sure there is sufficient distance to overhead wires.

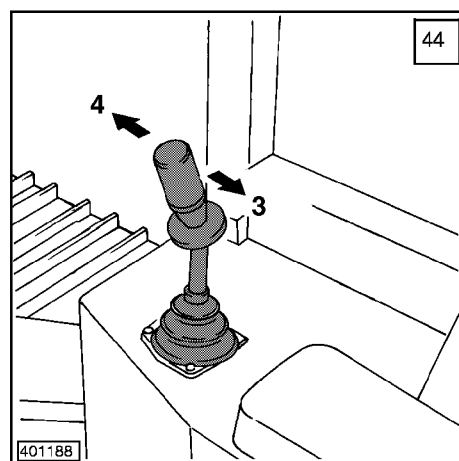
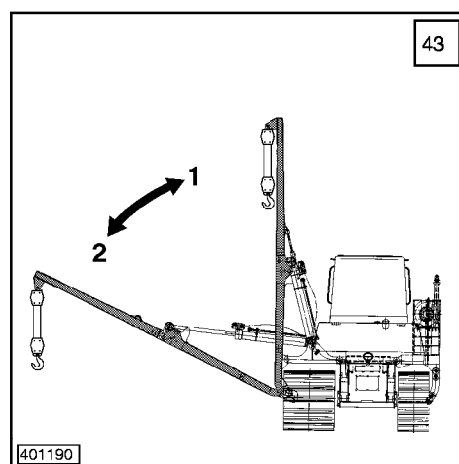
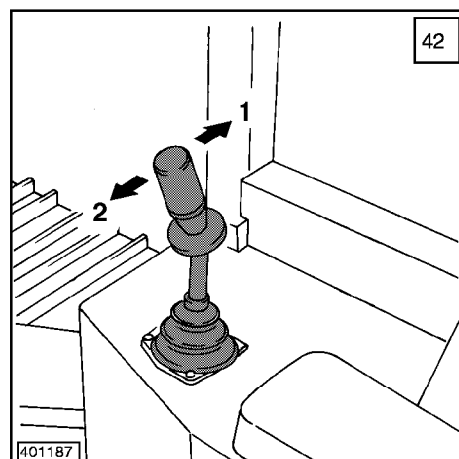
4.9.2 RAISE / LOWER THE HOOK BLOCK

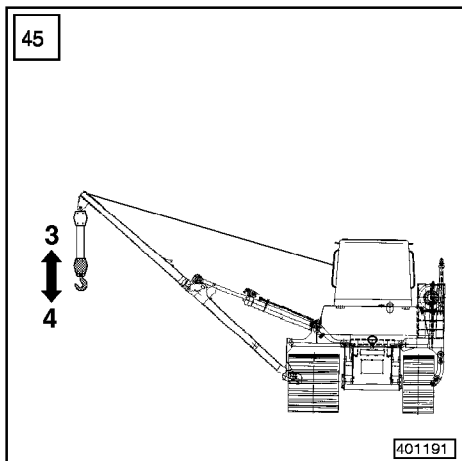
By moving the boom control lever to the front or to the rear, the hook block is raised or lowered, the speed depends on the lever deflection.

The top position of the hook block (hook block on top) is secured by a limit switch.

Raise the hook block

- Pull the boom control lever to the rear (fig. 44/ 45, pos. 3).



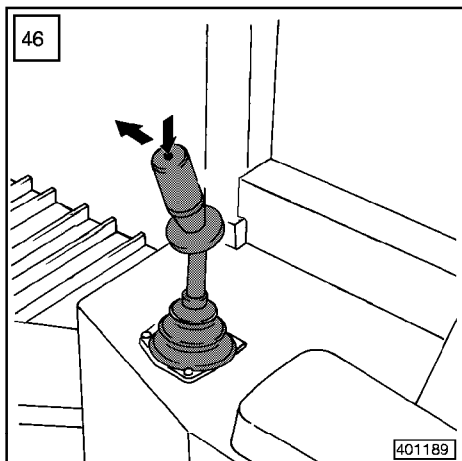


Lower the hook block

CAUTION

For safety reasons, the hook block may only be lowered to the point where at least five coils of cable remain on the cable drum.

- Push the boom control lever to the front to lower the hook block (fig. 44/ 45, pos. 4).

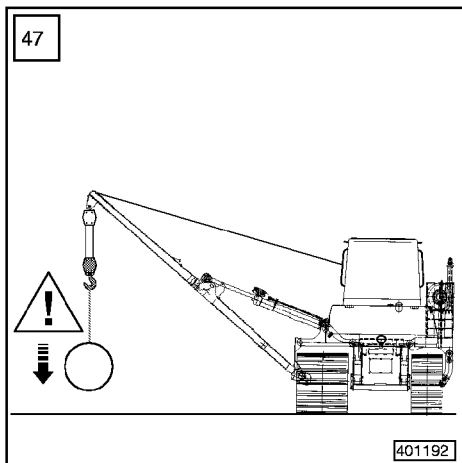


4.9.3 FREE FALL DEVICE

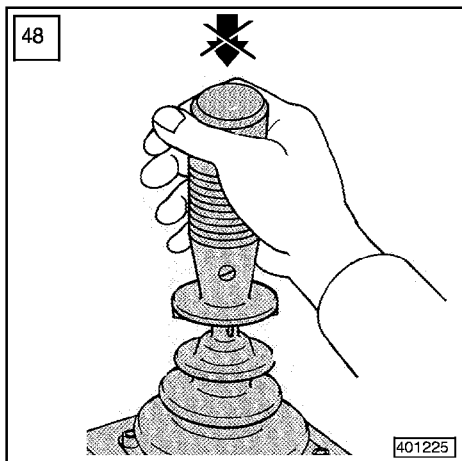
As a safety device to prevent the machine from tipping over, the hoist winch includes a free fall device.

CAUTION

The free fall device may only be used in an emergency, to be able to quickly lower a raised load.



- Press the button on the boom control lever and move the boom control lever all the way to the front in direction 'hook block down' (fig. 46/ 47). A raised load will drop freely to the ground.

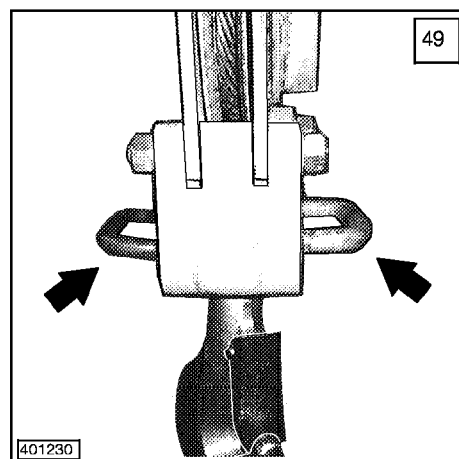


DANGER

To prevent inadvertent actuation of the free fall button, always keep your hand around the boom control lever when working (fig. 48).

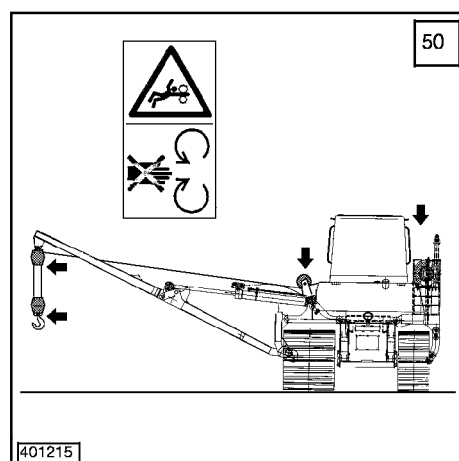
4.9.4 ATTACHING LOADS

Two handles are installed to guide the hook block when attaching loads. The hook block may only be brought into position with the two handles (fig. 49).



DANGER

When working, make sure not to get your fingers or loose close into the intake areas (fig. 50). This could result in serious injuries!

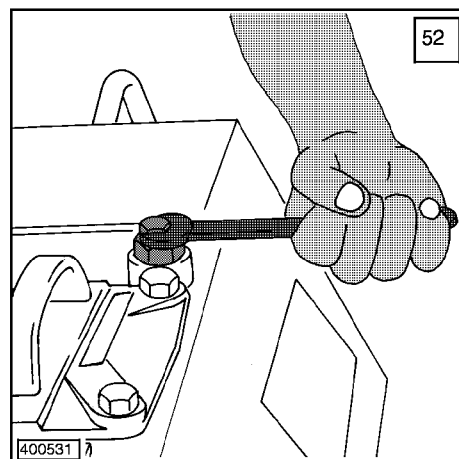
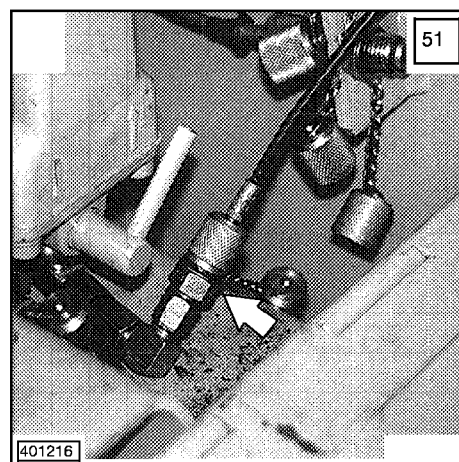


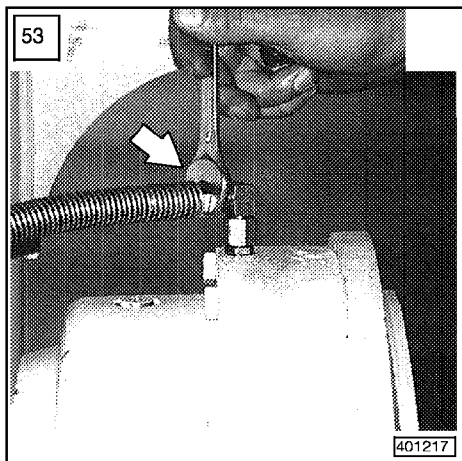
4.9.5 SET DOWN A LOAD IN AN EMERGENCY

In case of failure of the Diesel engine or a drop in replenishing pressure, a load suspended from the hook can be lowered with auxiliary tools supplied in your tool box.

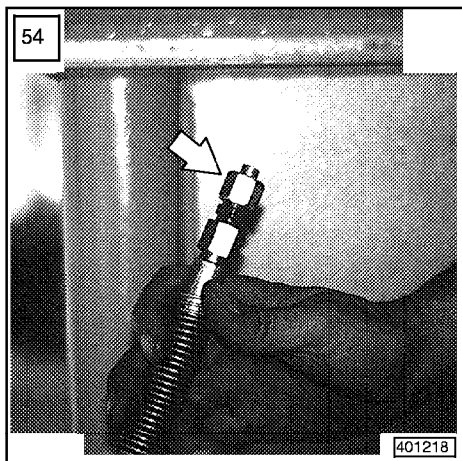
Procedure:

- Take the mini test line and fittings from the tool box.
- Open the battery box and connect the mini test line on the 'RAISE' connection on the hand pump (fig. 51).
- Relieve the pressure in the hydraulic tank by opening the bleeder valve by one turn (fig. 52).

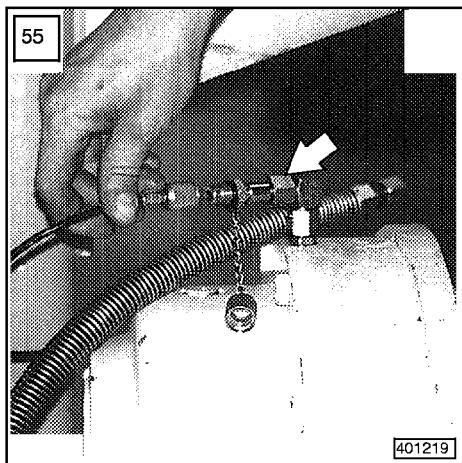




- Remove the hydraulic line for the free fall device on the cable winch (fig. 53).



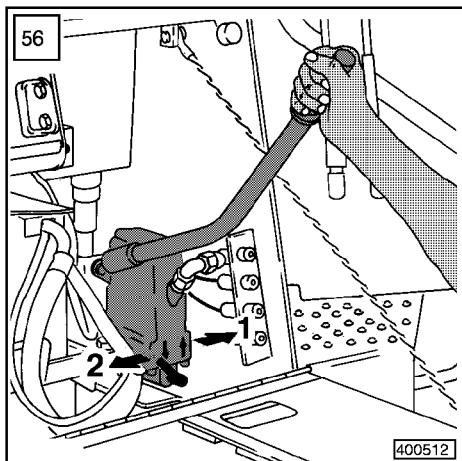
- With the screw plug fitting, close off the hydraulic line (fig. 54).



- Install the fitting on the connection, which is now free, and connect the mini test line (fig. 55).
- From the tool box, remove the extension pipe. Set the lever on the hand pump to 'RAISE' (fig. 56, pos. 1).

⚠ DANGER

DANGER OF ACCIDENTS! The load will suddenly drop!



- Actuate the hand pump until the load starts to drop.

⚠ CAUTION

Before putting the machine back into service, check if the installed parts for the lowering procedure have been removed again and the machine is again in series condition.

4.10 HYDRAULIC ADJUSTABLE BOOM

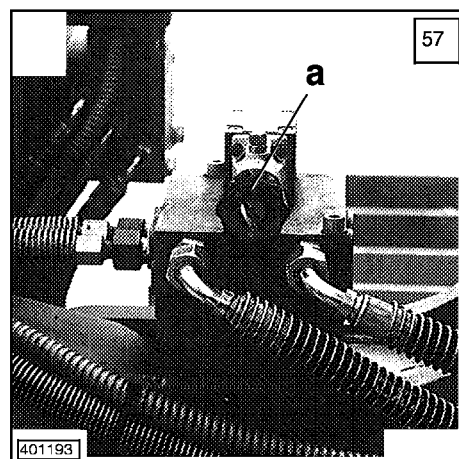


CAUTION

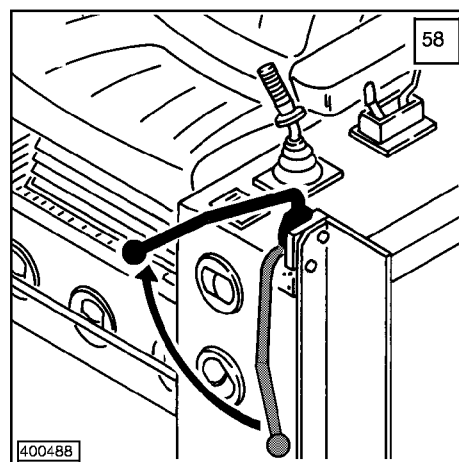
When folding the boom in or out, the doors on the cab must be closed.

4.10.1 BRING THE BOOM FROM TRANSPORT TO WORKING POSITION

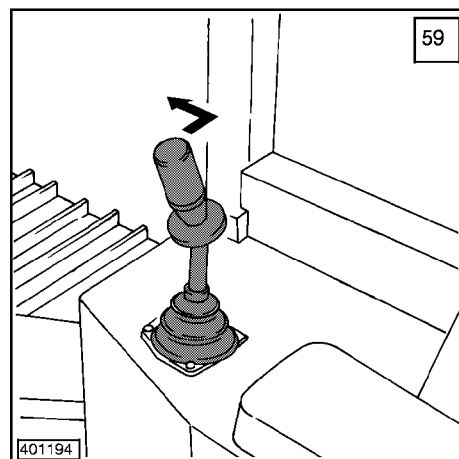
- Release the change over valve on the boom console and set it to position 'a' (black area on top) (fig. 57).
- Put the machine into operation as detailed in the Operation and Maintenance Manual.



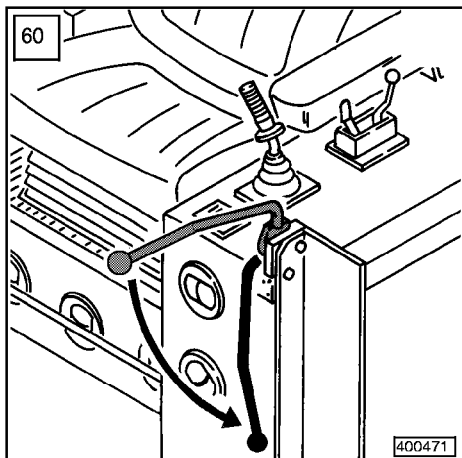
- Raise the safety lever (fig. 58).



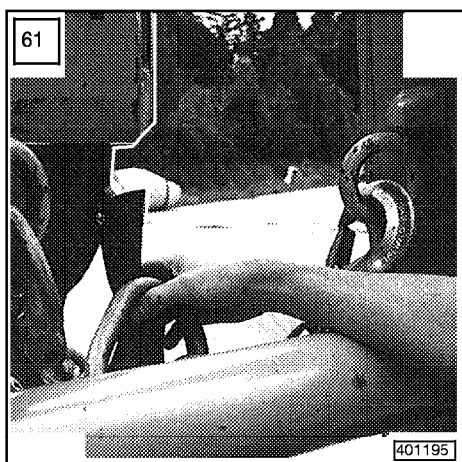
- Push the boom control lever to the right and slightly forward (fig. 59) until the upper section of the boom has reached the end position.
- Lower the hook block a little, so that the hook block can be removed from the rigging chain.



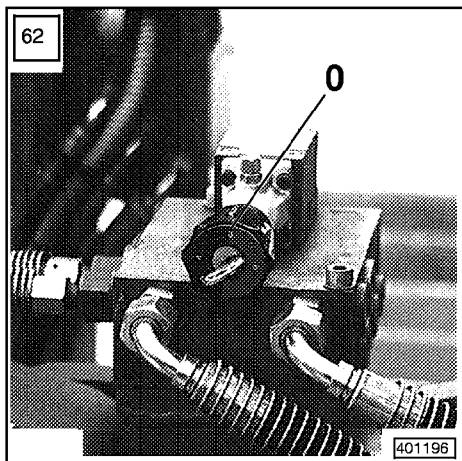
4. OPERATION



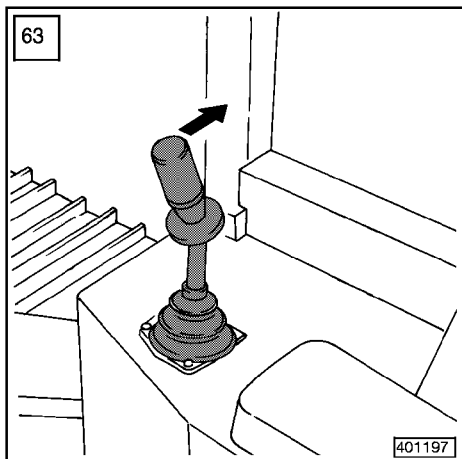
- Move the safety lever in the down position (fig. 60).



- Release the seat belt and step on the hydraulic tank step to remove the hook block from the rigging chain (fig. 61).



- Set the change over valve to position '0' (red area on the right). Shut off the change over valve and pull the key (fig. 62).
- Reenter the cab, attach the seat belt again and raise the safety lever.



- By deflecting the boom control lever to the right, the locking pins are extended and the upper section of the boom is locked (fig. 63). The attachment of the pipe layer is now operational and work can be started.

4.10.2 BRING BOOM FROM WORKING TO TRANSPORT POSITION

- Put the machine into service, as outlined in the Operation and Maintenance Manual.
- Raise the safety lever.
- Raise the boom **completely** (fig. 64).



NOTE

The boom must be completely raised to fold it in, otherwise it can cause the machine to be damaged.

- Raise or lower the hook block until it can be attached to the rigging chain.



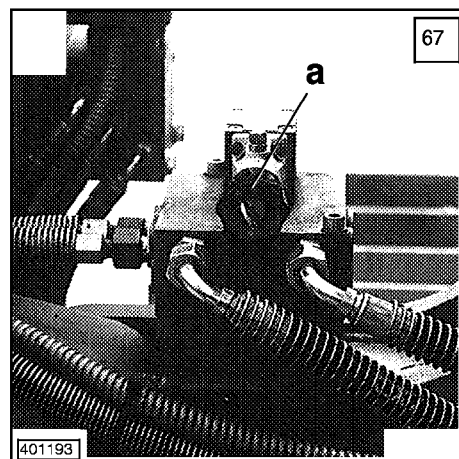
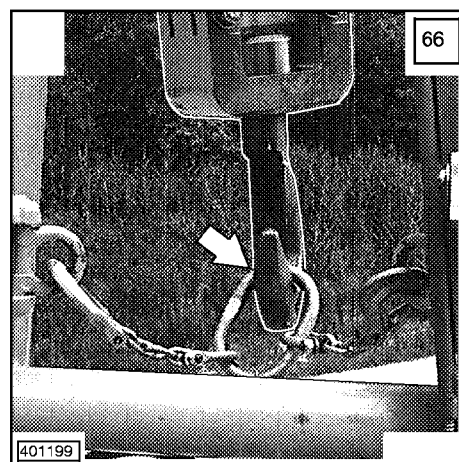
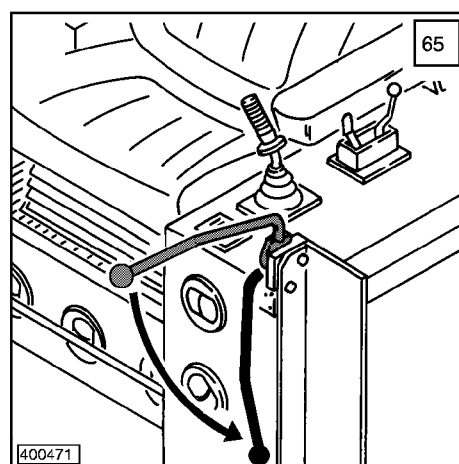
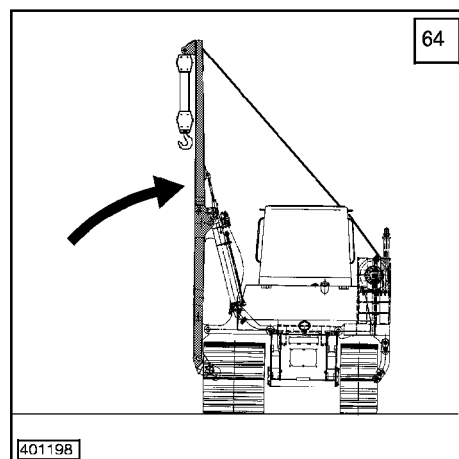
NOTE

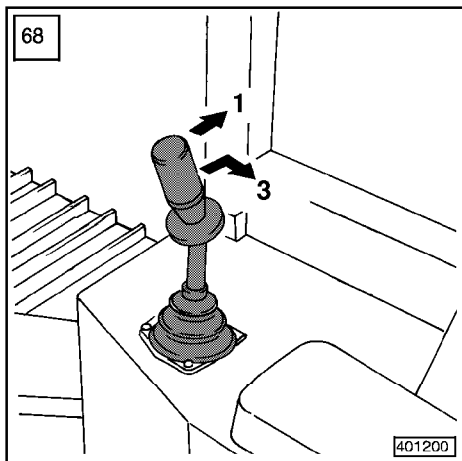
The upper section of the boom can only be folded in if the hook block is attached to the rigging chain.

- Move the safety lever down (fig. 65).

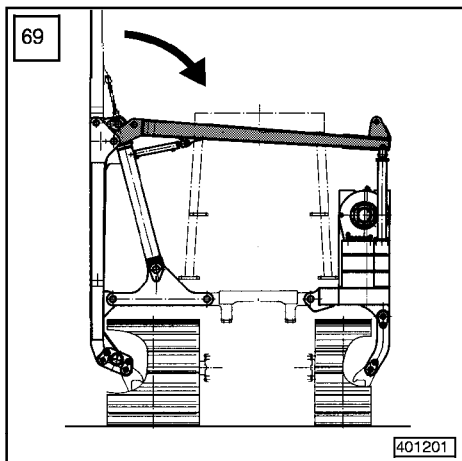
- Step on the step on the hydraulic tank and attach the hook block to the rigging chain (fig. 66).

- Use the key to unlock the change over valve and turn it to the right to position 'a' (black area on top). Lock the change over valve in this position and pull the key (fig. 67).
- Reenter the cab, attach the seat belt again and raise the safety lever.

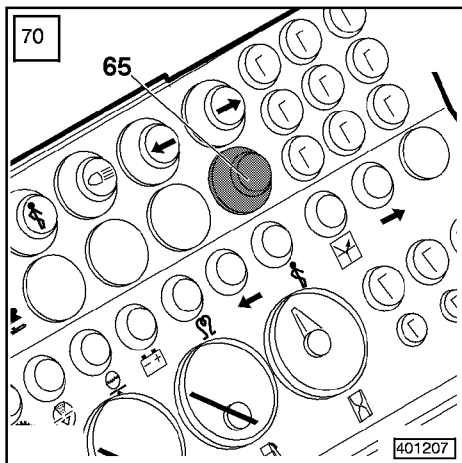




- Push the boom control lever to the right until the locking pins are retracted and the upper section of the boom is unlocked (fig. 68, pos. 1).



- Pull the boom control lever slightly to the rear to fold in the upper section of the boom (fig. 68/ 69, pos. 3).



NOTE

At the same time, when folding the boom in, push the blue button - transport position (fig. 70, pos. 65).

Never lower the boom when it is in transport position (boom control lever to the left). There is a danger of damage and injury!

4.11 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 or cables.
- 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 unless the machine is properly blocked and supported.

4.12 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.

4.13 MACHINE TOWING

In case of a problem with the hydrostat, we recommend to repair the machine on site and to tow the machine only in cases, when it must be removed from a danger zone.

⚠ DANGER

Improper towing of a disabled machine can be dangerous and could result in injury or death!
Always block and secure the machine to prevent it from moving before disconnecting or releasing the brakes!
When towing a machine, observe all safety rules and regulations and follow the below listed guidelines.

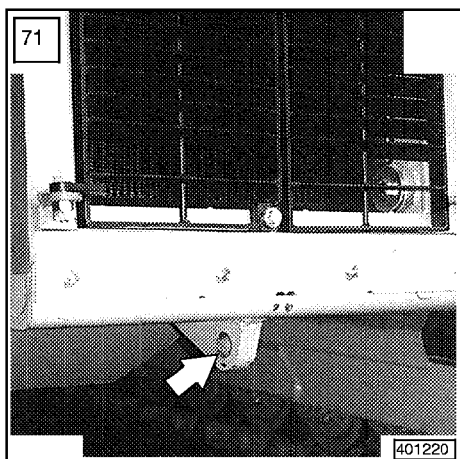
👉 NOTE

Towing the machine can be dangerous. The responsibility for safety rests with the person or persons performing the towing. Defects or accidents, which may occur when towing the machine, are not covered by the manufacturer's warranty.

The following towing instructions should only be used in case of emergencies in order to move a disabled machine to be repaired or hauled off. The machine should only be towed for a short distance at a maximum towing speed of no more than 1.2 mph (2 km/hr.)

Always haul the machine over long distances on a trailer!

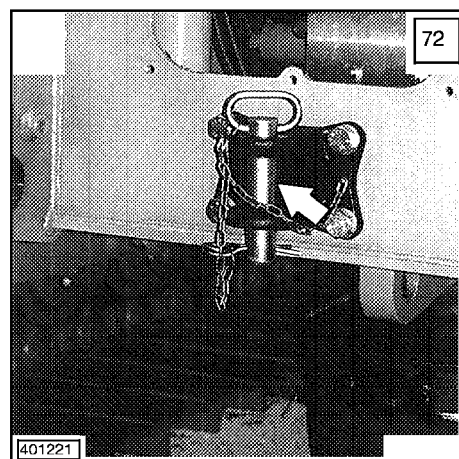
The machine is equipped with a parking brake, which is released by replenishing oil pressure. The hydrostatic drive is used as an operating brake. Should the machine become disabled and/or loss of replenishing oil pressure occur, then the parking brake is spring applied and cannot be moved.



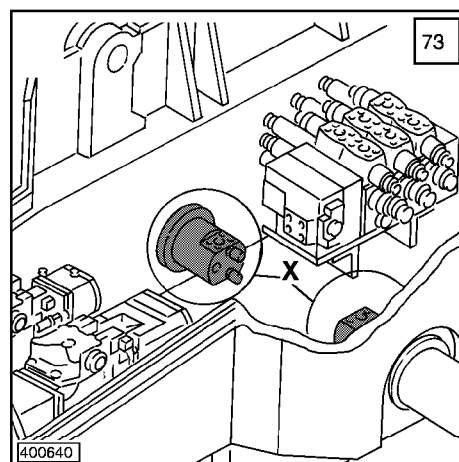
Before the machine is towed, observe the following safety rules:

- Never allow anyone to stand within the danger zone, near the machine or to stand or sit on the machine when it is towed.
- Do not use chains for towing. Chains may break and cause injury. Use only wire cables or a towing bar.
- Be certain that the operator of the towing vehicle is protected in case the cable snaps or the towing bar breaks.

- Be sure that all towing and pulling devices, such as hooks, cables and couplers have been inspected and are safe and adequate.
- Attach the towing cable on the intended hooks or towing devices (fig. 71 / 72).
Use a towing cable or rod with at least 1.5 times the capacity of the total weight of the machine to be towed. Keep the towing cable or bar as short as possible if the machine is stuck in mud or on an incline.
Keep the towing cable or bar as short as possible.
- Keep the angle of the towing cable to the machine at a minimum. The angle should never exceed 30° from the machine's longitudinal axle.



- Move the machine slowly and evenly, do not jerk. Jerky, uneven movements can stress the towing cable or the rod and a sudden impact could snap the cable or rod.
- When towing the machine on a hill, the towing machine must be at least as large as the machine being towed.
Power, weight and braking power must be adequate to keep both machines under control.
If necessary, add a machine of the same size to the rear for braking purposes.

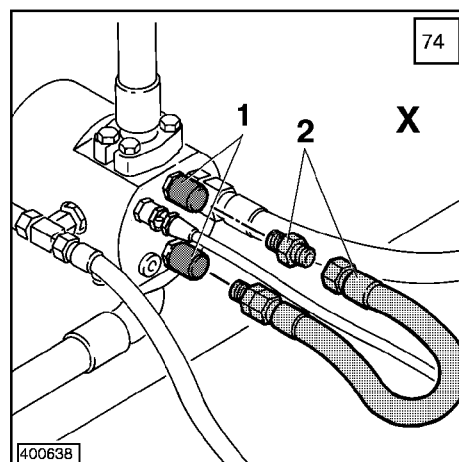


Prepare the machine for towing:

In order to tow the machine, short circuit the hydrostat and mechanically release the parking brakes.



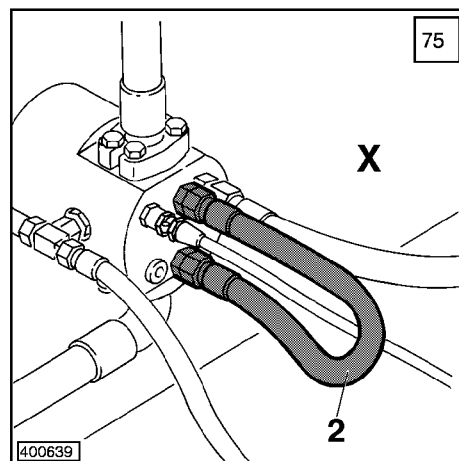
Always block and secure the machine against inadvertent movement before releasing the brakes.

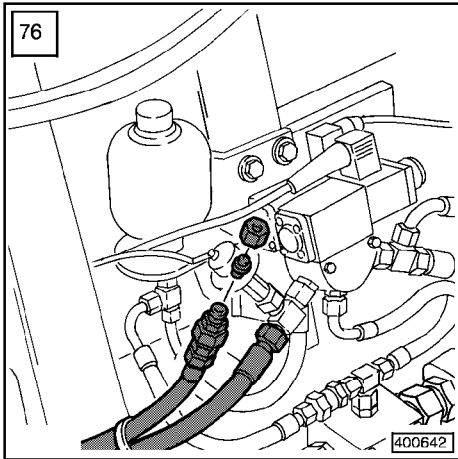


Raise the cab as outlined in section 6.2.1.

Remove the four test fittings on the left and right on the machine's axles (fig. 73 / 74, pos. 1).

Short circuit the connections with the hydraulic hoses supplied in the tool box (fig. 74 / 75, pos. 2).

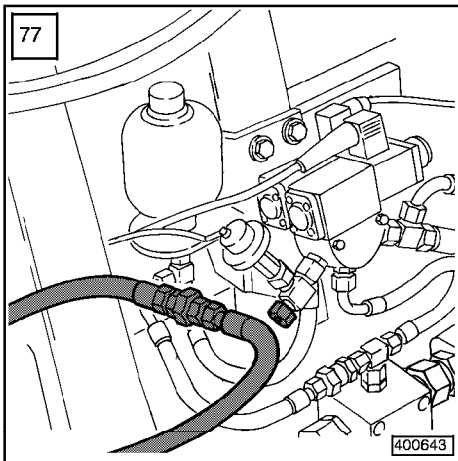




On the clear hydraulic hose (connection 'A') on the hand pump, which is connected to the brake hose, remove the union nut and fitting (fig 76) and connect it with the brake pressure hose on the brake valve (connection 'B').

Close off the released connection on the brake valve (connection 'B') with the fitting and union nut (fig. 77).

Lower the cab properly as described in section 6.2.2, but **do not** attach it on the carrier frame.



- Move the lever on the hand pump to 'up'. (fig. 78, pos. 1). Actuate the hand pump to release the parking brake.

Actuate the hand pump until you can feel an increase in pressure or until the cab starts to rise.

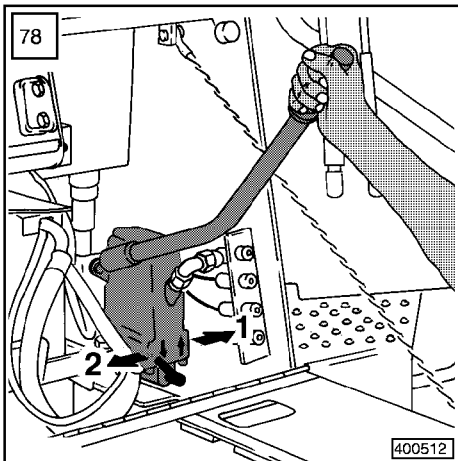
Be aware that the brakes are now not operational. Carry out the towing procedure by strictly observing all safety regulations.



NOTE

After the towing procedure, return the lever on the hand pump to 'down', the parking brake will be reapplied (fig. 78, pos. 2).

Secure the machine to prevent it from moving.



CAUTION

Before returning the machine into service, make sure and check that all times which were removed for the towing procedure have been reinstalled and that the machine is returned to its original condition.

4.14 MACHINE TRANSPORTING SAFETY

- The boom must be folded in for transport.
- Use only safe transportation and tackle 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 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 transport vehicle.
- Secure the machine and all remaining parts with chains and wedges to prevent 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 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 the machine from the trailer platform down the ramp. Use a guide to signal you.

4.15 TRANSPORTING THE MACHINE ON A LOW BOY OR TRAILER

4.15.1 LOADING THE MACHINE

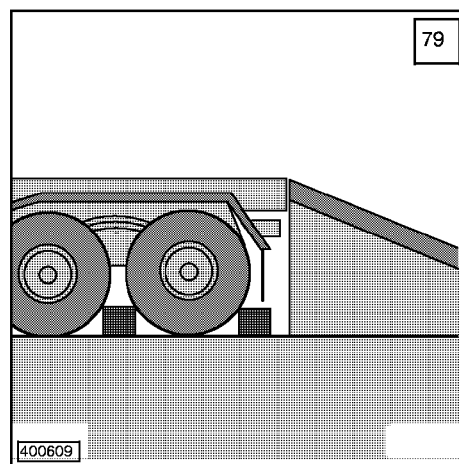
Park the transporting vehicle (trailer, lowboy, rail car, etc.) on firm and level ground and secure the wheels to prevent them from rolling (fig. 79).

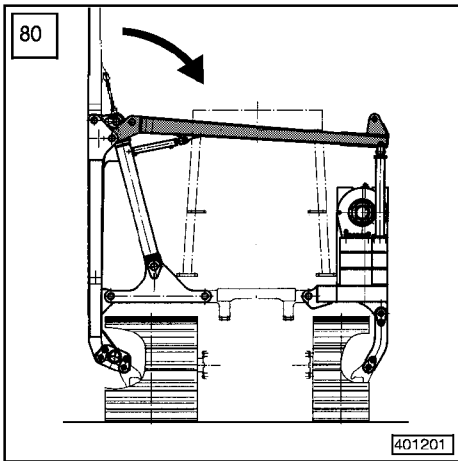
The loading ramp incline should not exceed 30° and should be covered with wooden planks to prevent the machine from sliding.



Be certain that the loading ramp is positioned on firm and level ground and is rated for the weight of the machine. Be certain that no one is being endangered in case the machine should slide or fall off the ramp.

DO NOT perform any turning or steering movements on the ramp.





- Fold boom in to transport position(fig. 80).
- Remove all mud, snow or ice from the track components.
- The machine may be loaded in forward or reverse. Always have another person guide and signal you.



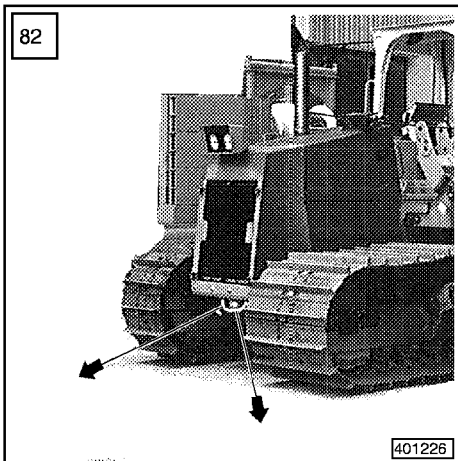
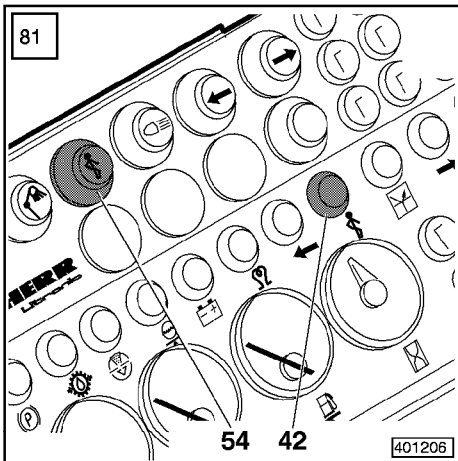
NOTE

Before driving onto the transport vehicle, shift to the low travel speed range (fig. 81).

Place the machine on the transport vehicle.
Close and lock all doors, covers, hoods and windows.

Cover the exhaust stack!

- Securely block and chain the machine on the intended tackle points and brackets on the transport vehicle by placing chains crosswise to prevent movement (fig 82/ 83). Place wedges in front and behind the travel gear to block the machine.



CAUTION

Be certain to properly block and secure the machine on the transport vehicle to prevent it from rolling, sliding or tipping.

4.15.2 TRANSPORTING

Check and observe all on road travel guidelines and regulations concerning weight, width and length of the machine to be transported.

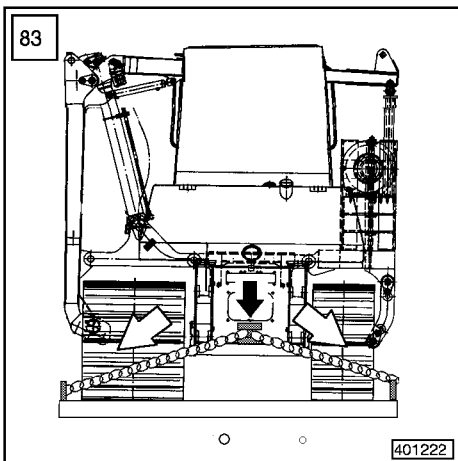
Carefully check out the transporting route beforehand. Check that there is enough clearance underneath bridges, underpasses, utility lines and tunnels. Be aware of width, height and weight restrictions.

If the height of the machine must be reduced, the smoke stack, the cab, canopy or boom might have to be removed.



NOTE

For dimensions and weights, refer to chapter 1.



4.16 SAFETY REGULATIONS FOR LOADING A MACHINE WITH A CRANE

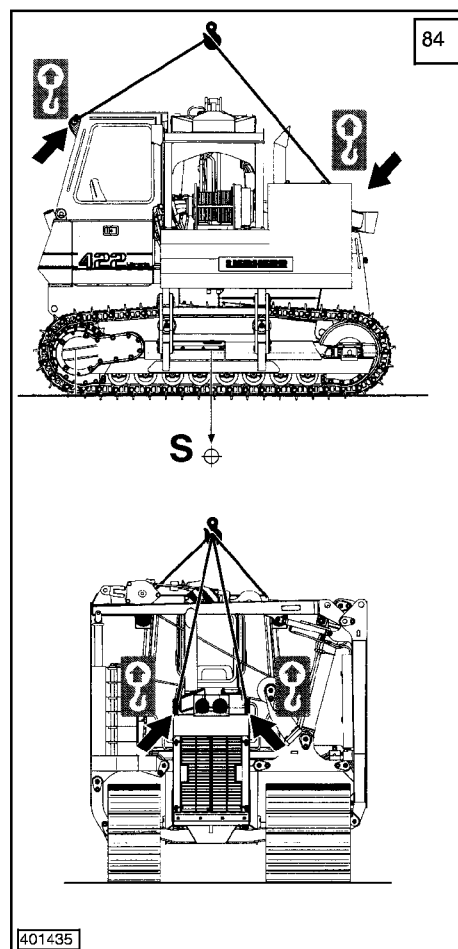
- Remove the boom or bring it to transport position.
- Bring all control levers into neutral position.
- Turn the engine off, according to the Operation and Maintenance Manual, and move the safety lever in the down position, before leaving the operator's seat.
- Close all doors, covers and hoods.
- Only experienced, specially trained personnel may attach loads and signal the operator. The guide must be within the visibility of the operator or be in direct voice contact via a two way radio.
- Attach the lifting devices only to the brackets / bores on the machine, which have been installed for this purpose.
- Make sure the lifting devices are long enough.
- Lift the machine carefully!
- **CAUTION! Make sure that nobody is underneath the raised machine. This is strictly prohibited!**
- When putting the machine back in service, proceed as described in the Operation and Maintenance Manual.

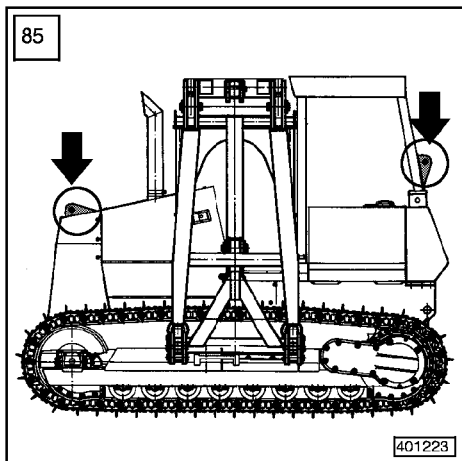
4.17 LOADING THE MACHINE WITH A CRANE

Be sure that the lifting device used to load the machine is of sufficient load carrying capacity.
Before lifting the machine, bring the boom into transport position.

To lift the machine, attach hoist cables onto the intended lifting eyes / hooks.

- Cab (fig. 84)





- Roll over protection (fig. 85)

! DANGER

Never step or stand underneath a suspended load.

Connect the cables only onto the eye hooks designed for lifting the machine.

The machine may only be lifted if the special equipment / eye hooks are installed.

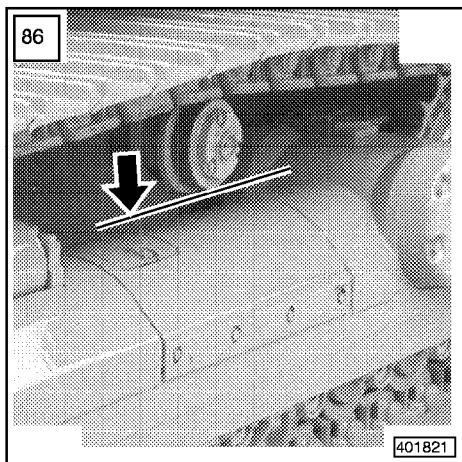
For retrofit installation, contact your Liebherr dealer or company for eye hooks and welding instructions.



NOTE

After the machine is loaded and secured, check and apply corrosion protection for the piston rods.

For specifications, refer to chapter 1.



4.18 NOTES FOR PASSING THROUGH AND WORKING IN WATER

When it is necessary to drive through water or to work in water, the maximum fording depth (lower edge of the carrier roller) may not be exceeded (fig. 86).

After working in water, make sure to lubricate / grease all lube points.

! CAUTION

- Be especially careful, danger of fan damage!
- If the maximum fording height is being exceeded, the fan will be destroyed.
- Never exceed the maximum fording depth (lower edge of the carrier roller).

4.19 MACHINE OPERATION IN VERY LOW AMBIENT TEMPERATURES

Your machine can be operated to an ambient temperature of -22°C without additional optional equipment.

If the ambient temperatures are always below -22°C, special optional equipment must be installed to ensure proper operation.

If you intend to operate the machine at temperatures below -22°C, contact your Liebherr Service Dept.

5. LUBRICANTS AND SERVICE FLUIDS

GENERAL INFORMATION

The conscientious adherence to the guidelines given for lubrication, fluid level check and changing of service fluids guarantees increased dependability and life expectancy of the machine .

It is particularly important that the various oil changes be performed regularly and within the recommended intervals and that the specified lubricants are used.

The quantities stated in this manual are theoretical. The dipstick or fluid level mark is always the deciding factor when adding service fluids.



When checking or changing service fluids, always observe the following guidelines:

Always perform the particular work only with the machine parked on firm and level ground and with the engine turned off, unless specified otherwise.

When working in the engine compartment, always secure the engine cover and the side doors to prevent them from accidentally moving or closing.

Always turn the engine off before refueling.

Never smoke or allow an open flame during refueling.


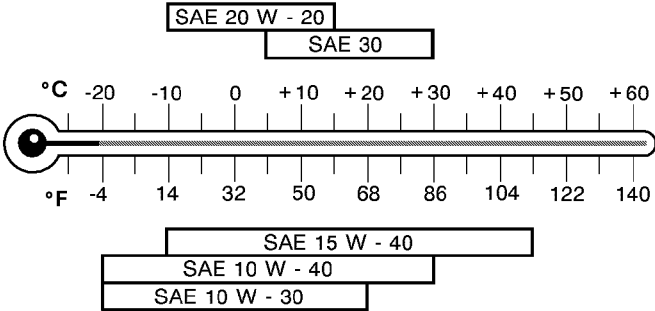
Cleanliness is of the utmost importance when changing the engine oil, gear or hydraulic oil. Before removing fittings, filler caps and covers, clean the parts and surrounding area carefully.



NOTE

Be certain to drain all oil into a suitable container and dispose of the oil and filter cartridges properly.

5.1 LUBRICANTS AND SERVICE FLUID CHART

QUANTITIES	SERVICE FLUIDS	SPECIFICATION	BI *																
DIESEL ENGINE (Turbo)																			
<p>18 l</p> 	<p>Lubricant</p> <p>Viscosity according to SAE</p>  <p>Various factors influence the maintenance intervals:</p> <table border="1" data-bbox="268 1111 971 1417"> <thead> <tr> <th colspan="2"></th> <th colspan="2">Intervals in operating hours for oil quality</th> </tr> <tr> <th>Ambient temperature</th> <th>Sulfur content in fuel</th> <th>CF-4, CF CE, D4</th> <th>SHPD D5</th> </tr> </thead> <tbody> <tr> <td>to -10°C</td> <td>to 0.5% above 0.5%</td> <td>250 hrs. 125 hrs.</td> <td>500 hrs. 250 hrs.</td> </tr> <tr> <td>below -10°C</td> <td>to 0.5% above 0.5%</td> <td>125 hrs. -</td> <td>250 hrs. 125 hrs.</td> </tr> </tbody> </table>			Intervals in operating hours for oil quality		Ambient temperature	Sulfur content in fuel	CF-4, CF CE, D4	SHPD D5	to -10°C	to 0.5% above 0.5%	250 hrs. 125 hrs.	500 hrs. 250 hrs.	below -10°C	to 0.5% above 0.5%	125 hrs. -	250 hrs. 125 hrs.	<p>API CC, CF-4, CF, CE ACEA D4, D5 SHPD</p> <p>MIL-L-2104 E = CF-4, CF, CE, D4</p>	<p>EO 20 EO 30</p> <p>EO 1540B EO 1040B</p>
		Intervals in operating hours for oil quality																	
Ambient temperature	Sulfur content in fuel	CF-4, CF CE, D4	SHPD D5																
to -10°C	to 0.5% above 0.5%	250 hrs. 125 hrs.	500 hrs. 250 hrs.																
below -10°C	to 0.5% above 0.5%	125 hrs. -	250 hrs. 125 hrs.																

Lube oil viscosity

The selection of the lube oil viscosity must be made according to SAE classification (Society of Automotive Engineers).

The ambient temperature is the deciding factor for the correct selection of the SAE classification.

The selection of the SAE classification provides no information regarding the quality of the lubricant.


If the viscosity is too high, it can cause starting problems, if the viscosity is too low, the lubrication efficiency can be endangered.

The temperature ranges shown in the chart are guidelines and can be exceeded or fallen below for a short time.

Oil change intervals

First oil and filter change at 30-60 operating hours. Additional filter changes every 500 operating hours and oil change depending on climate zone, sulfur content in fuel and oil quality according to chart.

If the stated operating hours are not reached, change the engine oil and filters once a year.

QUANTITIES	SERVICE FLUIDS	SPECIFICATION	BI *
FUEL SYSTEM			
310 I 	Fuel Use commercially available Diesel fuels with a sulfur content of less than 0.5 %. Higher sulfur content affects oil change intervals and engine service life.	DIN EN 590 NATO Codes F 54, F 75 BS 2869 : A1 and A2 ASTM D 975-88: 1 D and 2 D	

Diesel fuels in very low ambient temperatures

In ambient temperatures below 0°C, the flow properties in warm temperature Diesel fuel can become insufficient due to paraffin excretion. The same applies to cold temperature Diesel fuels in temperatures below -12°C.

In order to prevent operating problems in even lower temperatures, mix Diesel fuel with normal gasoline or petroleum.

Addition of normal gasoline is a makeshift measure and may not exceed **30 %** per volume.

Mixing fuel can diminish engine performance, for that reason, keep the added fuel as low as possible, depending on the ambient temperatures.

For safety reasons, mix fuel only in the fuel tank. When refueling, add the lighter additive before the Diesel fuel. Then let the engine run until the mixture has been distributed throughout the fuel system.

Diesel fuel mixing ratio (Vol. %)

Ambient temperature °C	Summer Diesel fuel %	Additive %	Winter Diesel fuel %	Additive %
0 to -10	70	30	100	--
-10 to -15	50	50	100	--
-15 to -20	--	--	70	30
-20 to -25	--	--	50 *	50

* If an addition of more than 50% is necessary, use only petroleum (no normal gasoline).

Additives to Diesel fuel (flow improvers)

F Commercially available flow improvers can also improve Diesel fuel properties in cold temperatures. Always read and observe manufacturer's user guidelines and quantities.

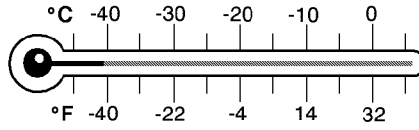
QUANTITIES	SERVICE FLUIDS	SPECIFICATION	BI *
COOLING SYSTEM			

52 l

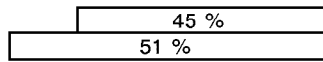


Antifreeze fluid / coolant

Antifreeze protection to



Percentage (%) of antifreeze fluid



Corrosion inhibitor / anti-freeze according to chart

SP-C

The cooling system must be filled with a mixture of at least 50 % anti-corrosion/ antifreeze fluids and 0.3 - 0.8 units of DCA4 (DCA4 = Diesel coolant Additives). Do not use more than 60 % anti-corrosion / antifreeze fluids, since a higher percentage would actually reduce the cooling effect and antifreeze protection.

When refilling the coolant, make sure not to fall below the minimum percentage.

Always check the mixing ratio of the coolant when performing maintenance.

The DCA4 concentration must be between 0.3 and 0.8 units per liter. To check the concentration, use the Fleetguard test kit CC2602 M.

Observe the stated change intervals of 2 years!

To fill the cooling system:

For initial filling of the cooling system, DCA4 must be added to the coolant in liquid form (see chart), in addition to the DCA4 concentration which is already in the filter. Premix the coolant in a suitable container.

Mixing ratio:

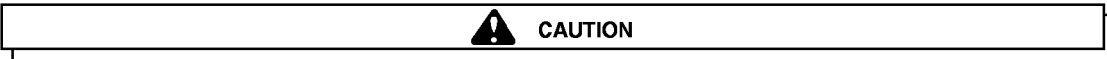
Machine type	Quantity	Part water	Part anticorrosion / antifreeze fluid	Part DCA liquid
RL 22B	approx. 52 l	25 l	25 l	2 l

Use of DCA4 without anticorrosion / antifreeze fluids:

In **exceptional cases** and where the ambient temperatures are always **above freezing**, for example in tropical regions, where **definitely no anticorrosion / antifreeze fluids are available**, water and DCA4 may be used as coolant.

To protect the cooling system from corrosion, use approximately twice as much DCA4 as compared to the mixing ration of anticorrosion / antifreeze fluid and DCA4, . DCA4 concentration must be between 0.6 and 1.06 units per liter.

The coolant must be changed **annually** .



When using water and DCA4, use no coolant refiners (anti-corrosion oils).

Fresh water guidelines:


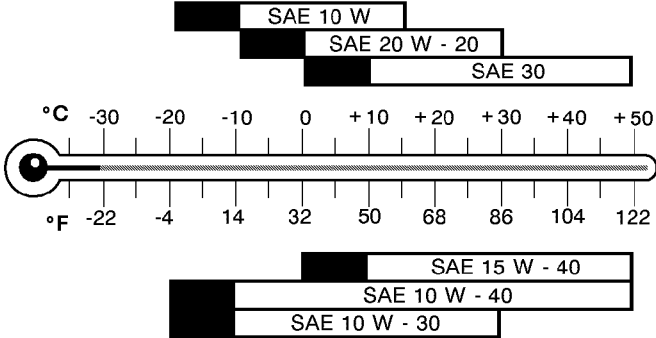


To mix coolant fluid, use clean water which is not too hard. Often, but not always, regular tap water may be used. Sea water, brackish water, brine or industrial waste water is not suitable.


Fresh water quality:

Sum of alkaline earths (water hardness):	0.9 to 2.7 mmol/l (5 to 15° d)
pH- value at 20 °C :	6.5 to 8.0
Chlorione content:	max. 80 mg/l
Sum of chlorides and sulfates:	max. 160 mg/l

Approved anticorrosion / antifreeze fluids:

Brand	Manufacturer
Agip Antifreeze Plus	Agip Deutschland AG, Munich, Germany
Agip Langzeit-Frostschutz	Autol-Werke GmbH, Würzburg, Germany
Antigel DB 486	Sotragal SA, St. Priest/France
Aral Kühlerfrostschutz A	Aral AG, Bochum, Germany
Avia - Antifreeze - APN	Deutsche Avia-Mineral-Öl Ges.mbH, Munich, Germany
BP anti-frost X 2270 A	Deutsche BP AG, Hamburg
BP Nappel C 2270/1	BP Chemicals Ltd., London/England
Caltex Engine Coolant DB	Caltex (UK) Ltd., London/England
Castrol Anti Freeze O	Deutsche Castrol Vertriebsges.mbH, Hamburg
Century F.L.Antifreeze	Century Oils, Hanley, Stoke-on-Trent/England
Deutz Kühlschutzmittel 0101 1490	Deutz Service International GmbH, Cologne, Germany
Esso Kühlerfrostschutz	Esso AG, Hamburg
Fricofin	Fuchs Mineralölwerke GmbH, Mannheim
Frostschutz Motorex (G 48-00)	Bucher + Cie AG, Langenthal/Switzerland
Frostschutz 500	Mobil Oil AG, Hamburg
Glacelf	Elf Mineralöl GmbH, Düsseldorf, Germany
Glycoshell AF 405	Shell
Glycoshell N	Shell
Glysantin (G 48-00)	Basf AG, Ludwigshafen, Germany
Igol Antigel Type DB	Igol France, Paris/France
Labo FP 100	Labo Industrie, Nanterre/France
Motul Anti Freeze	Motul SA, Aubervilliers Cedex/France
OEMV- Frostschutzmittel	OEMV-AG, Schwechat/Austria
OZO Frostschutz S	Total Deutschland GmbH, Düsseldorf, Germany
Total Antigel S-MB 486	Total Deutschland GmbH, Düsseldorf, Germany,
Total Frostfrei	Deutsche Total GmbH, Düsseldorf, Germany
Veedol Antifreeze O	Deutsche Veedol GmbH, Hamburg, Germany
Wintershall Kühlerschutz	Wintershall Mineralöl GmbH, Düsseldorf, Germany

QUANTITIES	SERVICE FLUIDS	SPECIFICATION	BI *
HYDRAULIC SYSTEM			
<p>178 l</p> 	<p>Hydraulic oil</p> <p>Viscosity according to SAE Use engine oil according to Mercedes-Benz service fluid recommendations.</p>  <p>WARMING UP THE HYDRAULIC SYSTEM</p> <ol style="list-style-type: none"> For temperatures to 10°C below the given limit: Run the engine at half speed after starting it. Warm up the hydraulic system by fully actuating the hydraulic cylinders and motors for short periods. Warm up time approx. 10 minutes. At even lower temperatures: Preheat the hydraulic oil in the tank before starting the engine. 	<p>Page No. 226.0 and 227.0 for single grade oils API CC/SF, CD/SF, CE/SF</p> <p>Page No. 227.1 and 228.1 for multi grade oils CD/SF, CE/SF, CD+ API CC/SF (MIL-L-46152 B) CD/SF, CE/SF (MIL-L-2104 D) CD/SF (MIL-L-2104 D) CE/SF, CD+ (MIL-L-46152 B)</p>	<p>HYD10 HYD20 HYD30</p> <p>HYD1040 HYD1030</p>
SPLITTERBOX			
<p>2.5 l</p> 	<p>Gear oil</p> <p>Viscosity according to SAE SAE 90 EP SAE 80 W - 90 EP SAE 85 W - 140 EP</p>	<p>API GL-5 and MIL-L-2105 B,C or D</p>	<p>GO 90 GO 140</p>
TRAVEL GEAR			
<p>2 x 13 l</p> 	<p>Gear oil</p> <p>Viscosity according to SAE SAE 85 W - 140 EP</p>	<p>API GL-5 and MIL-L-2105 B, C or D</p>	<p>GO 140</p>

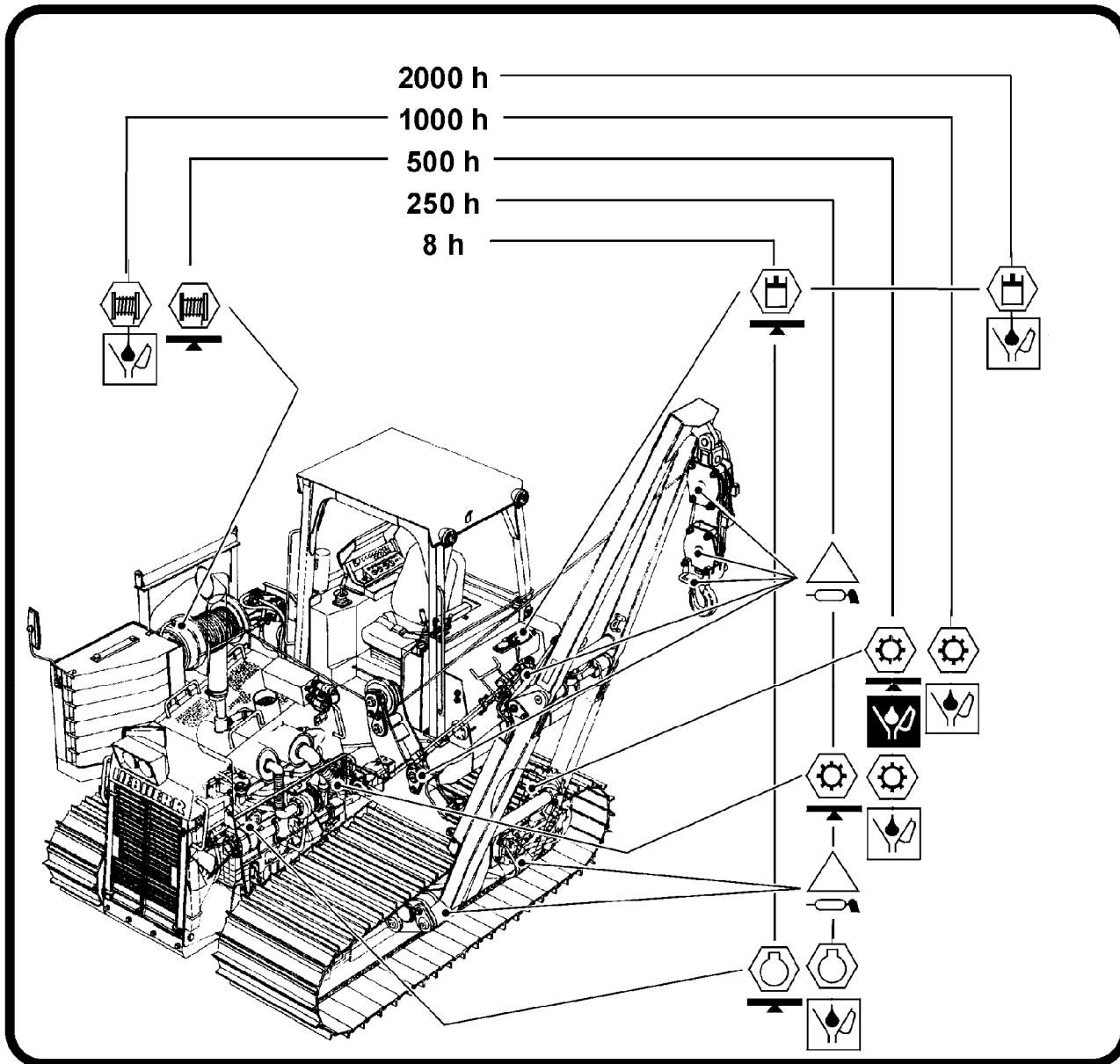
QUANTITIES	SERVICE FLUIDS	SPECIFICATION	BI *
CABLE WINCH			
7.6 l	Gear oil Viscosity according to SAE SAE 10 W	API CC, CF-4, CF, CE ACEA D4, D5 SHPD MIL-L-2104 B MIL-L-46152 B MIL-L-46152 D = CC MIL-L-2104 E = CF-4,CF, CE, D4	
HOIST CABLE			
	See chapter 7, Operating instructions for crane cables.		
LUBE POINTS - ATTACHMENT AND CHAIN TENSIONER			
	Grease Viscosity according to SAE Consistency 2 of NLGI classification The grease must be lithium based, with a VKA value of at least 2300 N according to DIN 51350 or ASTM D 2596.	High pressure grease KP2k, Consistency 2 of NLGI classification according to DIN 51818 and DIN 51825 or EP 2 according to NF- T-60 132 LIEBHERR Special grease CTK Id. No.: 861331301	MPG-A
HINGES - JOINTS			
	Engine oil Viscosity according to SAE		
RUBBER SEAL ON DOORS AND COVERS			
	Silicon spray or talcum powder		
WINDSHIELD WASHER SYSTEM			
8.5 l	Commercially available windshield cleaning fluid		
CORROSION INHIBITOR			
	Anti corrosion grease To protect exposed piston rods, cover them liberally with acid free corrosion grease.	For example LIEBHERR Anti corrosion grease CTK Id.No.861331301	




5. LUBRICANTS AND SERVICE FLUIDS




BI * 'STANDARD LUBRICANTS'





for construction machinery and vehicles covered by the "Hauptverbandes der Deutschen Bauindustrie e. V. (BI) (see brochure issued by the Bauverlag GmbH- Wiesbaden and Berlin)

5.2 LUBRICATION CHART



-  Diesel Engine
-  Splitter Box
-  Travel Gear

-  Hydraulic Tank
-  Cable Winch
-  Lubrication Point

- h** Intervals in Operating Hours
-  Check Oil Level
-  First Oil Change
-  Change Oil
-  Lubricate

6. MAINTENANCE

The listed maintenance and inspection intervals MAY NOT be extended, however, they may be shorted if required.

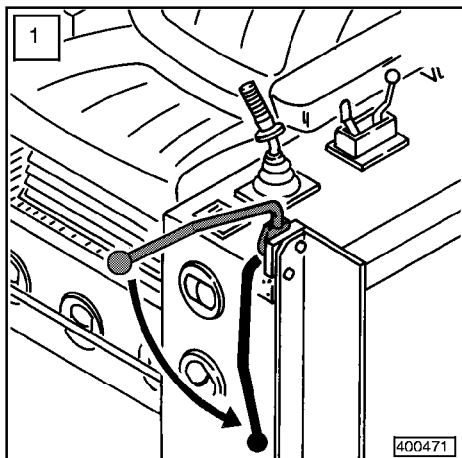
6.1 MACHINE MAINTENANCE SAFETY

- 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 Operation and Maintenance Manual. To perform any repairs, make sure you have the proper tools.
- Maintenance work should be performed according to the chart at the end of this 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 schedule. 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 / or gloves.
- Keep unauthorized personnel from the machine during maintenance and repair work.
- Secure the maintenance area, as necessary.
- Inform service personnel if any special task or maintenance work is required. Appoint a 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 be raised only if the machine is parked and the engine is turned off! Before raising the cab, make sure that 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 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 loosed, are retightened.
- If it becomes necessary to remove any safety devices during set up, 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 underneath the machine, attach an easily visible warning sign '**DO NOT OPERATE**' 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. Use only lintfree cloths.
- Never use flammable fluids to clean the machine.
- 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 systems), or other cleaning fluids, cover or tape all openings, make sure no water, steam or cleaning fluids enters these openings for safety and functional reasons. Electric motors, switch boxes, and battery compartments are especially vulnerable.
 - Make sure that during the 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.

6. MAINTENANCE

- After cleaning the machine, 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 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 careful when handling any hot service or operating fluids (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, 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 load carrying capacity.
 - **Do not allow anybody to work or remain underneath a suspended / raised load!**
- Do not use damaged or insufficiently strong ropes. Always wear gloves when handling wire ropes.
- Only experienced personnel may attach loads and signal the operator. The person used as guide must be visible by the operator or must 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 on the machine 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, walkways, catwalks, and ladders etc. are always free of dirt, snow and ice.
- When working on or changing any part of the attachment, make sure that the attachment is properly supported. Never use metal on metal supports.
- Never work underneath the machine unless it is properly supported with wooden supports.
- 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 with wedges to prevent any movement. The attachment must be brought into proper maintenance position.
- Only experienced, 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 and the engine has been turned off. Then, with the ignition key in contact position, acute all servo controls(joysticks and foot pedals) in both directions to release any servo pressure and to release all pressures in the working circuit. Release the tank pressure by slowly opening the bleeder valve.
- 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 starting any repairs, you also must make sure that all air pressures are relieved in any of the systems you need to gain access to: to be certain, refer to description of various components and groups and assemblies.
- Route and install all hydraulic and air pressure lines properly. Mark and check all connections to prevent any mix ups. All 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 spare 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 direct 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 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 or with 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 switch in case a problem should arise. Rope off the working area with a red and white safety chain and a warning sign. Use only insulated tools.
- 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.

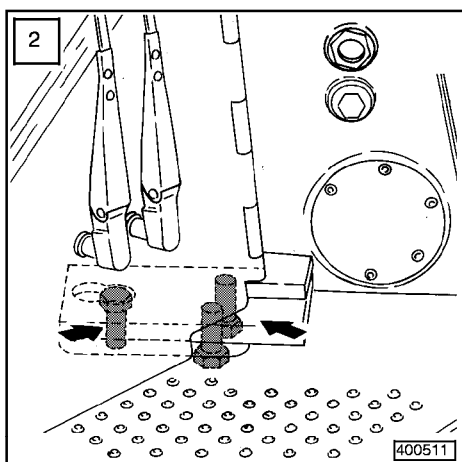


6.2 TILTING THE CAB

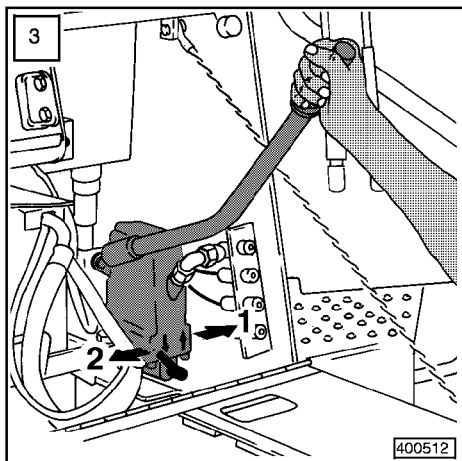
To simplify, service and repair on components within the main frame, the operator's platform with cab can be tilted hydraulically by actuating the manual pump.

6.2.1 RAISE (TILT) CAB

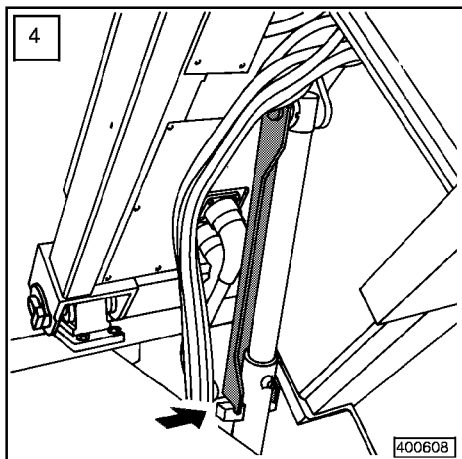
- Shut down engine.
- Place the safety lever in the full down position (fig. 1).



- Remove 3 hex head screws per side (fig. 2).
- Close both cab doors.



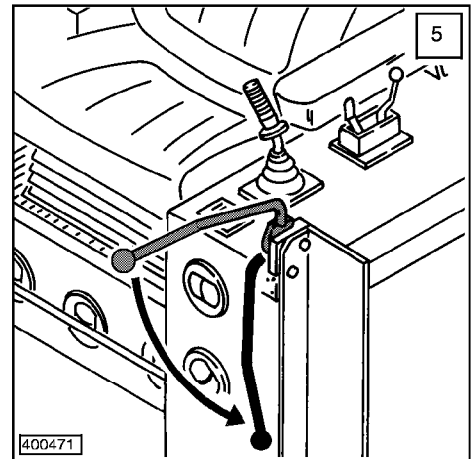
- Open battery compartment. Move the pump lever to 'raise' position 1 (fig. 3).
- Insert the pump handle, located in the tool box, into the hand pump.
- Operate the hand pump by moving the handle up and down until the piston bottoms out, hydraulic cylinder is fully extended. DO NOT leave the cab in an intermediate position.



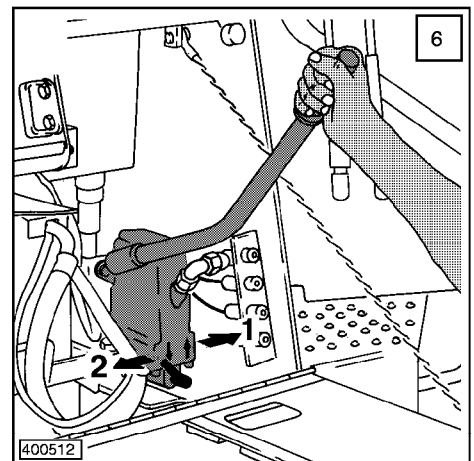
- Insert the safety bar at the hydraulic cylinder (fig. 4).
- Move the pump handle to the 'down' position 2 (fig. 3). Lower the cab by actuating the hand pump, until the cab is secured by the mechanical safety bar (fig. 4).

CAUTION

Never raise the cab or canopy with the engine running or when traveling. Stay clear of the cab or canopy until completely raised or lowered and secured with the safety bar. Do not work or allow work underneath or on the cab or canopy unless it is properly secured by the safety bar and the machine is parked. Never start the engine and operate the machine with a raised cab or canopy. The safety lever must remain in the full 'down' position, fig. 5.

**6.2.2 LOWER CAB**

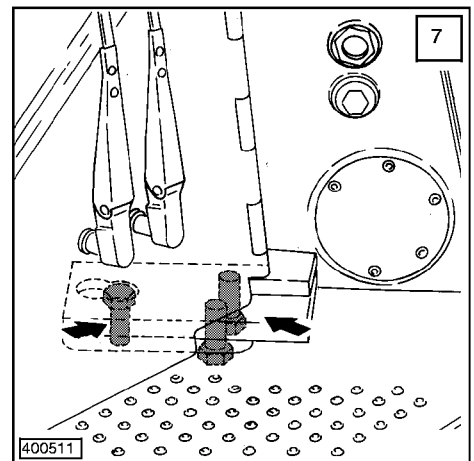
- Move the pump lever to 'raise' position 1 (fig. 6). Operate the hand pump by moving the handle up and down until the cab is high enough, so that the safety bar can be released.
- Move the pump lever to the 'down' position 2. Operate the hand pump by moving the handle up and down until the cab/canopy rests on the supports.



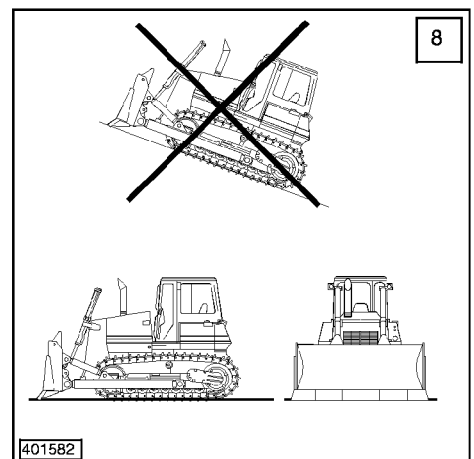
- Line up all the mounting holes and secure cab with 3 hex head screws per side (fig. 7).
- Check all safety features for proper operation. Be sure to reinstall all removed protective structures to make machine operational and safe.

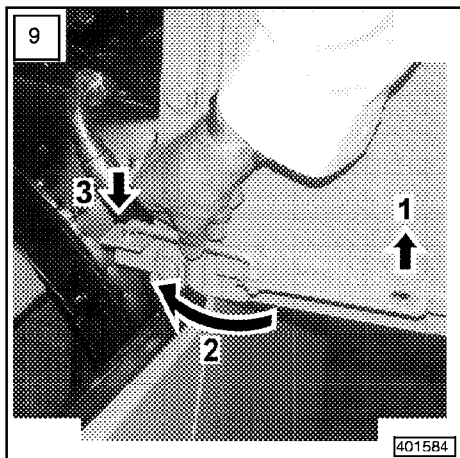
DANGER

DO NOT start the engine until the cab is lowered and secured.

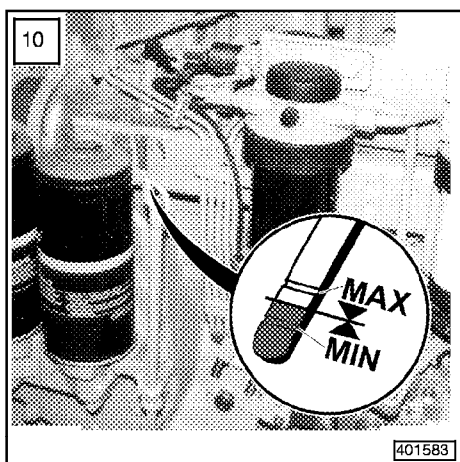
**6.3 DIESEL ENGINE****6.3.1 CHECK THE ENGINE OIL LEVEL**

- Check the engine oil level with the machine on level ground (fig. 8). After engine shut down, wait for a few minutes for the oil to collect in the pan.





- Open the engine compartment doors and secure the door with the door lock to prevent it from closing inadvertently (fig. 9).
- Pull the dipstick, wipe it with a clean cloth and reinsert it all the way. Pull the dipstick out again and check the oil level.



The oil level must be between the MIN. and the MAX. mark on the dipstick (fig. 10).



NOTE

Do not overfill the engine. The difference between the MIN. and MAX mark is 7 l.

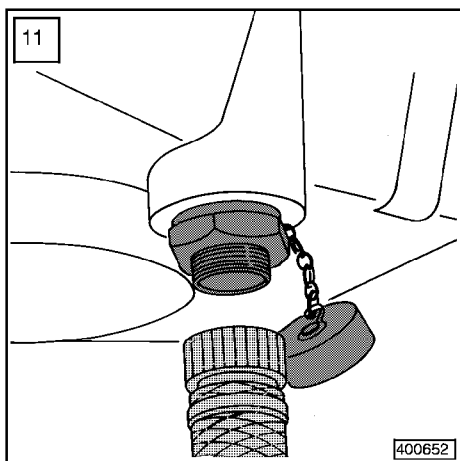
6.3.2 CHANGE ENGINE OIL

CAUTION

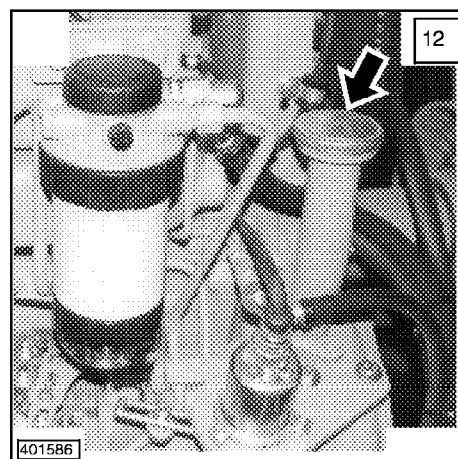
Hot engine oil can cause serious burns!

Change the oil with the engine at operating temperature.

- Remove the oil pan cover.
In case of contamination and heavy deposits in the oil pan, remove the oil pan and clean the pan.
- Remove the protective cap from the drain valve and connect the drain hose. Place a suitable container under the opening and drain the oil. Dispose of it properly (fig. 11).
- Remove the drain hose, reinstall the protective cap and cover.

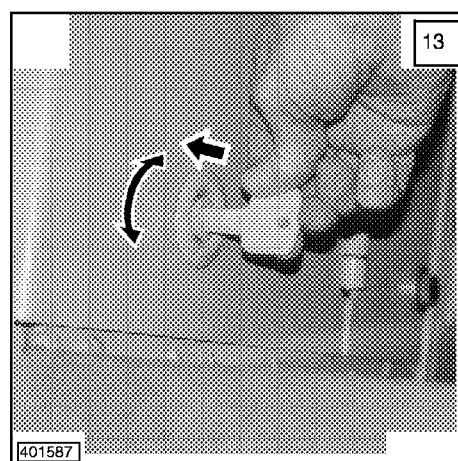


- Fill engine with oil through the filler neck (fig. 12). For quantity, quality and viscosity, refer to specifications given in this Operation and Maintenance Manual.

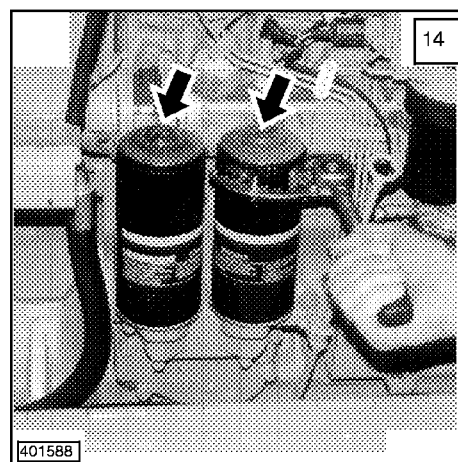


6.3.3 CHANGE THE ENGINE OIL FILTERS

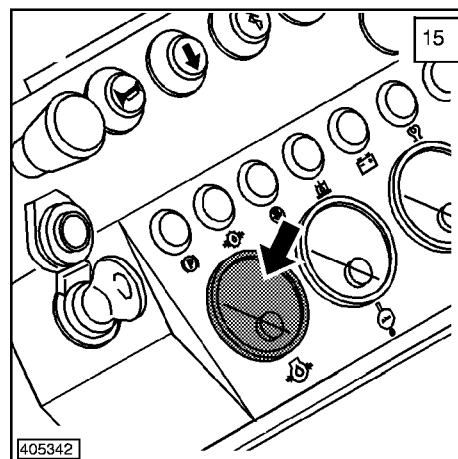
- Open the lower right cover with a socket wrench (fig. 13) and fold it down.
- Place a suitable container under the filters to catch any emerging oil.

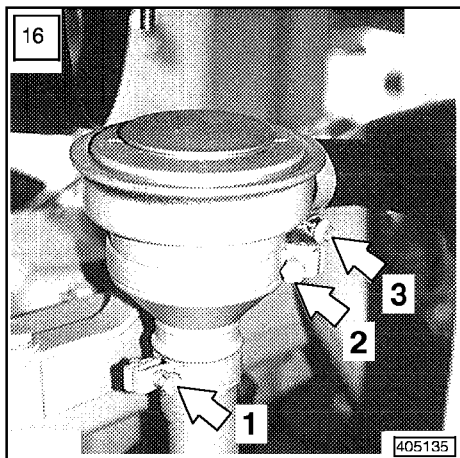


- Remove the filter and dispose of it properly (fig. 14). (There is still oil in the filter!)
- Clean the sealing surface on the filter base.
- Lubricate the seal ring of the new filter with clean oil.
- Reinstall the filter and tighten by hand.



- Start the engine and check the oil pressure gauge (fig. 15).
- If no oil pressure builds up, turn the Diesel engine off and fix the problem.
- Recheck the oil level, add oil as necessary.





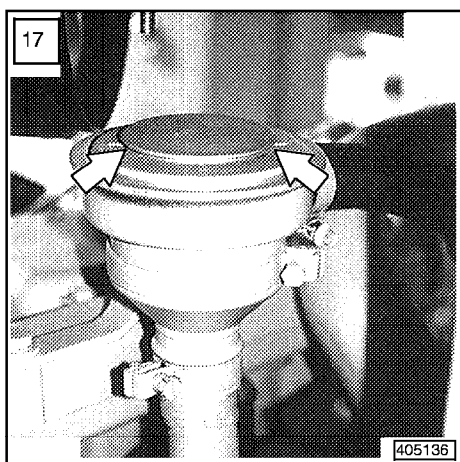
6.3.4 REMOVAL / INSTALLATION OF THE OIL SEPARATOR

REMOVAL

- Loosen the mounting clamp, pos. 1 and 2.
Loosen the hose clamp, pos. 3, push the hose back and remove the oil separator (fig. 16)

INSTALLATION

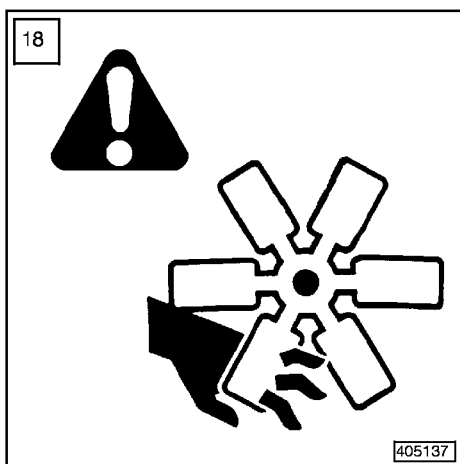
- Insert a new O - ring into the oil separator, add the oil separator and tighten the mounting clamp. Push on the hose and tighten the hose clamp.



NOTE

Replace the oil separator if oil vapors emerge from the bleeder bores (fig. 17), and as stated on the Maintenance and Inspection Schedule.

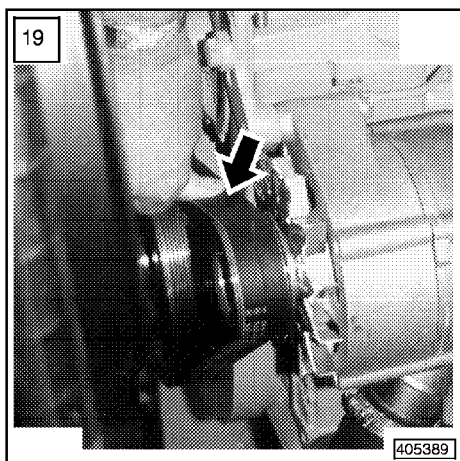
Make sure that no cleaning solutions (for example when cleaning the engine) get into the oil separator.



6.4 ALTERNATOR

CAUTION

NEVER touch the fan and V-belt when the engine is running (fig. 18).



6.4.1 CHECK V-BELT TENSION

Correctly tensioned V-belts can be deflected in the middle by approx. 10 mm (3/8"). (Fig. 19).

6.4.2 ADJUST V-BELT TENSION

- Loosen the 2 binding screws (Pos. 1-2) and the lock nut (Pos. 3).
- Turn the adjustment screw (Pos. 4) clockwise or counterclockwise until the correct tension is reached.
- Retighten the binding screw and lock nut (fig. 20).

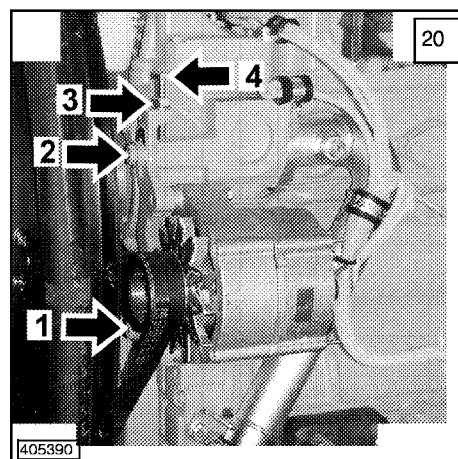


NOTE

Always replace worn, greasy or cracked V-belts.

6.4.3 REPLACE V-BELT

- Loosen the binding screws (fig. 1 - 2) and the lock nut (pos. 3), turn the adjustment screw (fig. 4) counterclockwise (fig. 20).
- Push the alternator down and remove the V-belt.
- Install the new V-belt and adjust the tension as outlined.



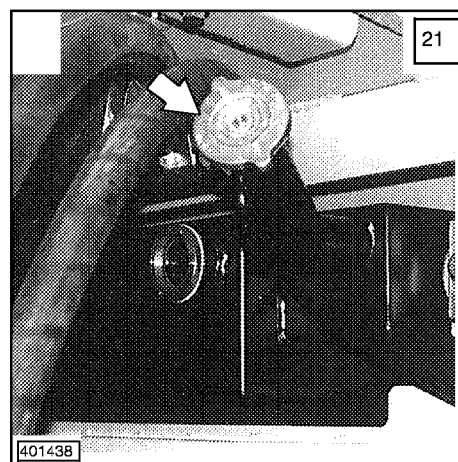
6.5 COOLING SYSTEM

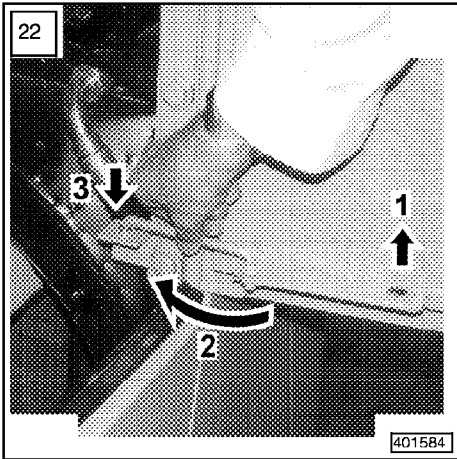
6.5.1 CHECK THE COOLANT LEVEL



At or near operating temperature, the engine coolant is hot and under pressure. Avoid contact with components containing coolant, since it could cause severe burns. .

Check the coolant level only after the radiator cap is cool enough to touch (fig. 21). Remove the radiator cap slowly to relieve pressure!





- Open the engine compartment door and secure it with the lock to prevent it from closing inadvertently (fig. 22).

- The coolant level must be visible in the center of the sight gauge on the (fig. 23).

Check the radiator, fan and engine for damage and contamination, clean if necessary.

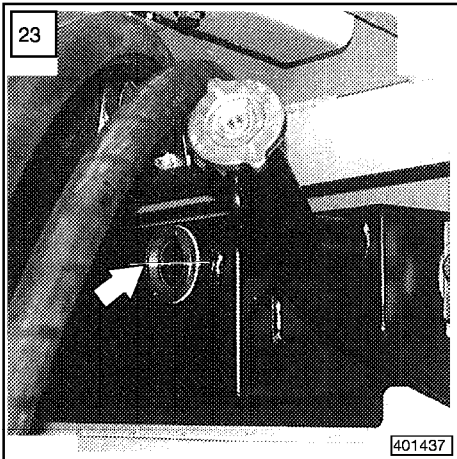
After refilling or adding to the cooling system, let the engine run for a short time with the heater turned on. Recheck the coolant level.



NOTE

The cooling system must always be filled with a mixture of anti corrosion / antifreeze fluid and DCA4 to provide year round protection.

The machine is filled at the factory with a coolant mixture of approx. 50% antifreeze / 50% water to protect the system to -36°C . For quantities and mixing ratio, refer to the lubrication chart.



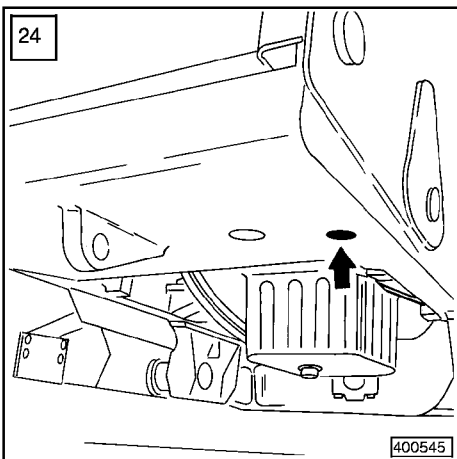
6.5.2 CHANGE THE COOLANT

Change the complete contents of the cooling system every two years.



NOTE

Change the coolant with the engine cold.



DRAIN THE COOLANT

Open the radiator cap slowly.

- Remove the drain plug on the underside of the radiator (fig. 24).
- Collect coolant in a suitable container and dispose of it properly.
On machines with cab, open the shut off valves for the cab heater on the engine.

Remove the drain screw on the oil cooler plate of the engine (fig. 25).

To completely drain the engine, you also must drain the coolant pump.

TO ADD COOLANT

CAUTION

Make sure that you don't get any cooling fluid on your skin.

Observe the manufacturer's safety guidelines!

When mixing coolant, wear rubber gloves and safety glasses. In case of splashes in eyes or on skin, use lots of water to flush off any coolant residue.

- Reinsert the drain plugs on the cooler and engine.
- Open the heater valves (fig. 26)

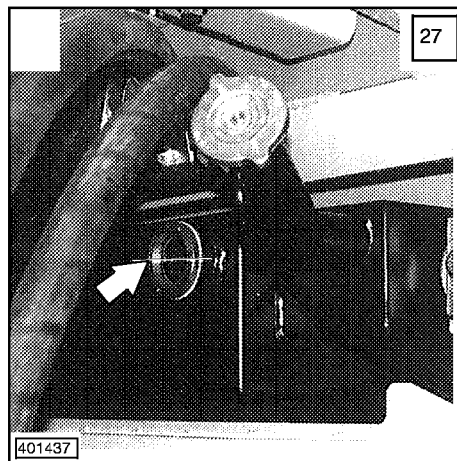
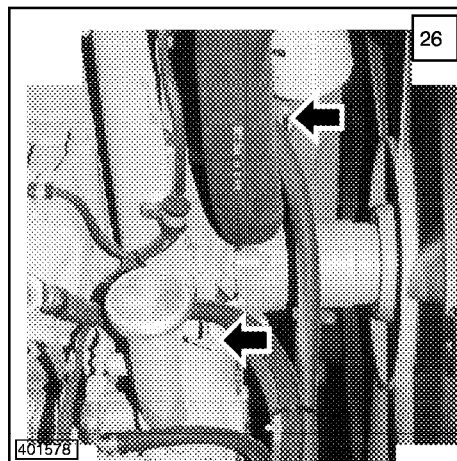
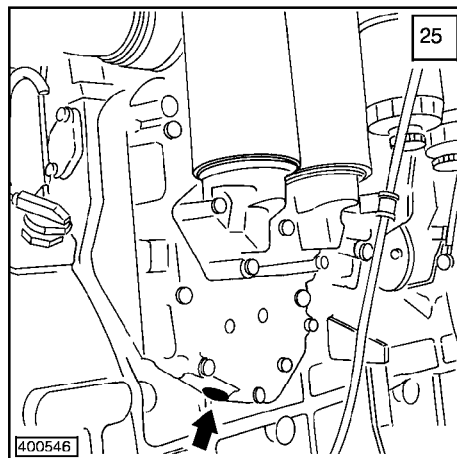
- Add coolant until it is visible at the center of the sight gauge (fig. 27).

Set the heater knob to 'warm', let the engine run, then check the coolant level again and add more coolant, if necessary.



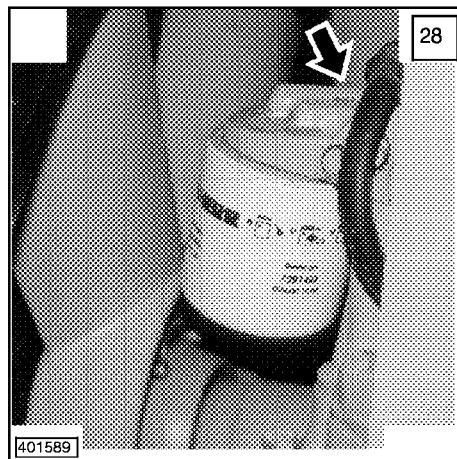
NOTE

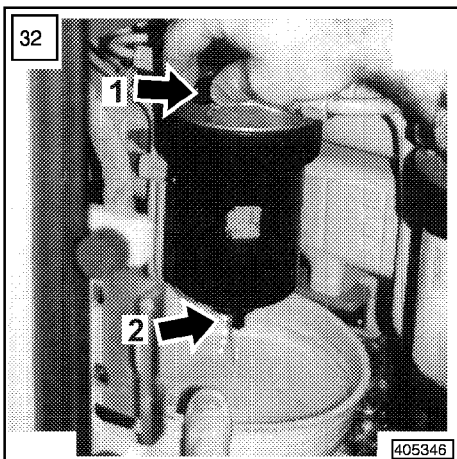
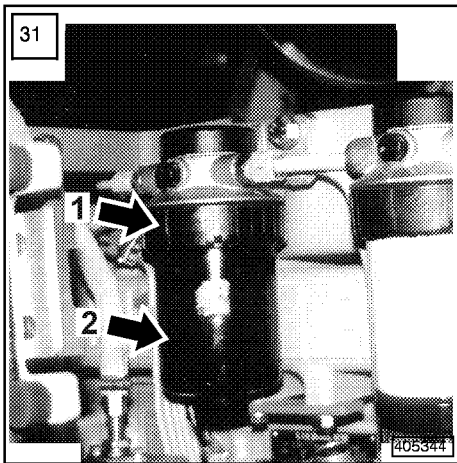
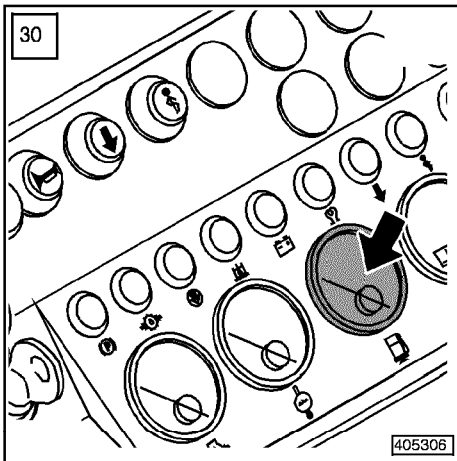
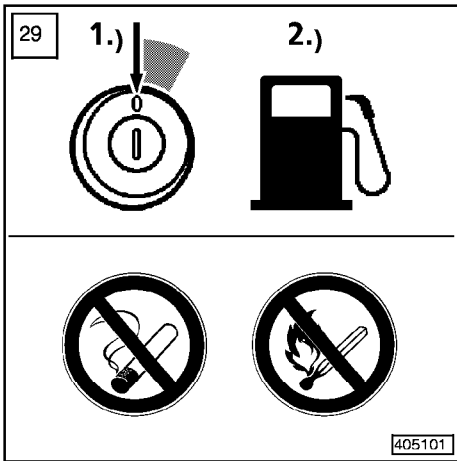
If the cooling system is contaminated, use a commercially available product to clean the complete cooling system.



6.5.3 CHANGE THE FILTER ELEMENT

- Close the shut off valves on the water filter.
- Unscrew the filter element and dispose of it properly (fig. 28).
- Lightly oil the rubber seal ring on the new filter element, screw on a new element and tighten by hand.
- Check the coolant level again and add more coolant, if necessary.





6.6 FUEL SYSTEM

CAUTION

Do not add fuel in closed areas. Never smoke or allow an open flame in refueling areas.

Always shut the engine off during refueling.

NEVER drain fuel onto the ground, always collect it in a suitable container.

- The fuel gauge in the instrument panel shows the fuel level in the fuel tank (fig. 30). Maintain a high fuel level in the tank to reduce condensation and corrosion.

6.6.1 REPLACE THE FUEL FILTER ELEMENTS

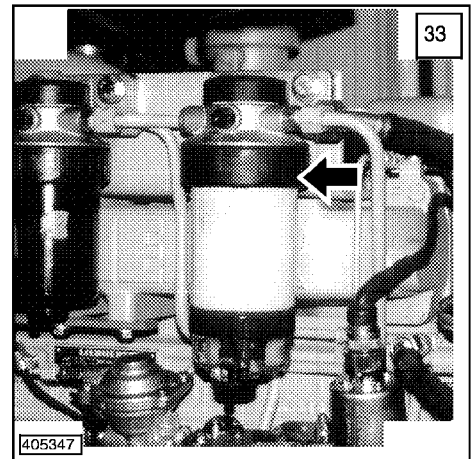
- Turn the end ring to the left to open (fig. 31, pos. 1).>)
- Remove the fuel filter element and dispose of it properly (fig. 31, pos. 2)..
- Install the supplied drain valve with seal on the new filter element.
- Clean the sealing surface on the filter base.
- Reinsert the filter element with end ring and install.

6.6.2 DRAIN THE WATER SEPARATOR ON THE FUEL FILTER

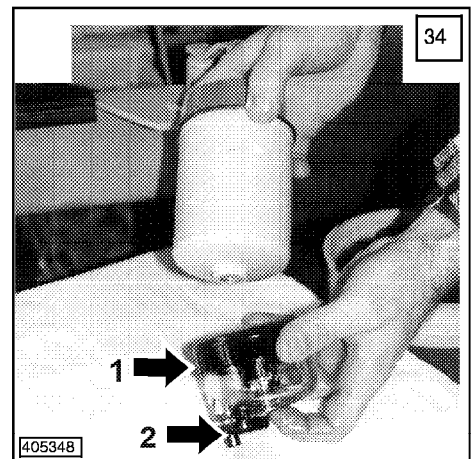
- Place a suitable container under the drain valve.
- Turn the bleeder screw on top of the fine filter a few times (fig. 32, pos. 1).
- Open the drain valve on the underside of the filter (fig. 32, pos. 2). Drain condensation until clean fuel emerges.
- Reinstall the drain valve.

6.6.3 REPLACE THE PREFILTER ELEMENT

- Turn the end ring to the left and remove the prefilter element with water separator (fig. 33).

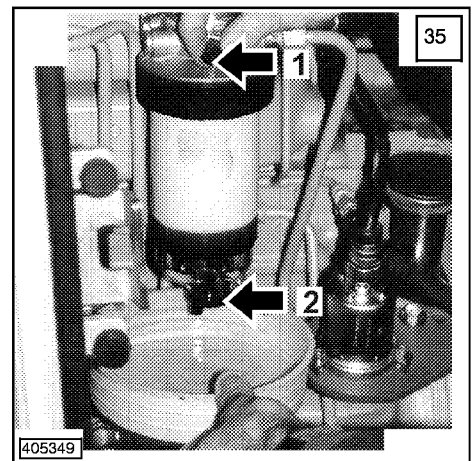


- Unscrew the water separator from the prefilter (fig. 34, pos. 1) and dispose of the filter element properly.
- Remove the drain screw with seal on the water separator and replace it with a new drain screw and seal (fig. 34, pos. 2).
- Clean the water separator glass, check the seals, replace them if necessary.
- Install the water separator on the new prefilter element.
- Push the prefilter element onto the filter base and attach with the end ring.



6.6.4 EMPTY THE WATER SEPARATOR ON THE PREFILTER

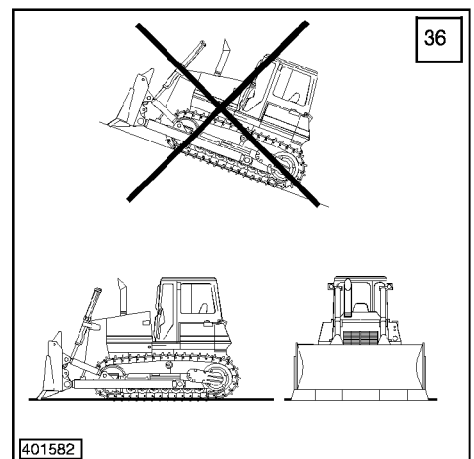
- Place a suitable container under the water separator.
- Open the bleeder screw on top of the prefilter a few turns (fig. 35, pos. 1).
- Open the drain screw (fig. 35, pos. 2) until clean fuel emerges, then close the drain and the bleeder screw again.

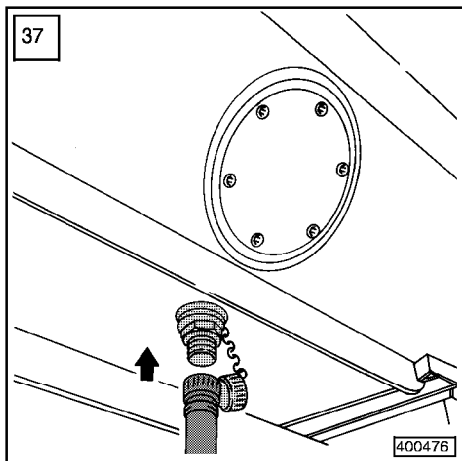


6.6.5 DRAIN THE FUEL TANK

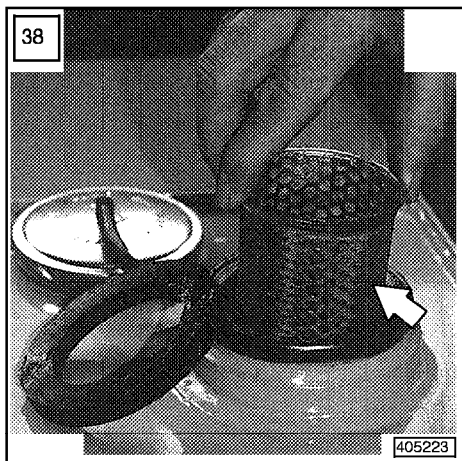
If the fuel filters have to be changed too often, it may be necessary to drain and clean the fuel tank.

- Lower the attachment into maintenance position (fig. 36).
- Close the shut off valve on the fuel tank.
- Place a suitable container under the drain plug.



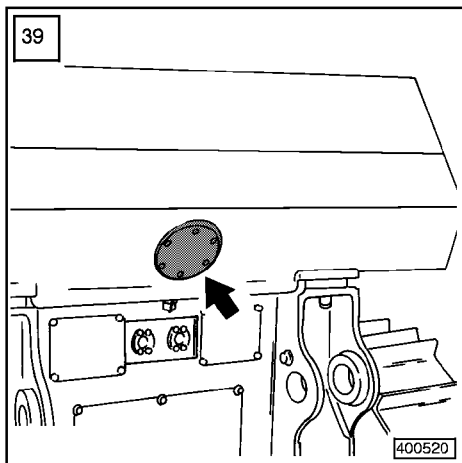


- Unscrew the tank cover and cap on the drain valve, connect a drain hose (fig. 37).

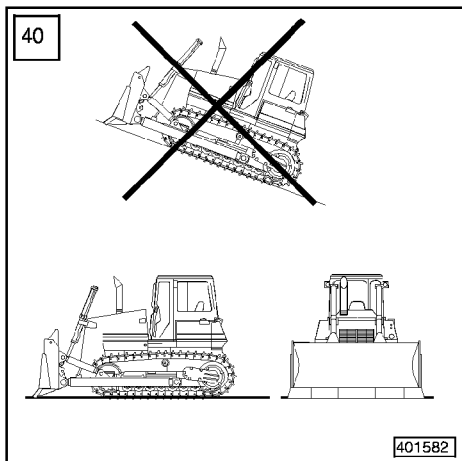


- Remove the rubber section.
- Remove the fill strainer, check it and replace it, if necessary (fig. 38).
- Check the fuel tank, clean it if necessary. If it does not require cleaning, remove the drain hose and reinstall the cap.

6.6.6 CLEAN THE FUEL TANK



- Lower the working attachment in to maintenance position.
- Empty the fuel tank completely.
- Remove the cover (fig. 39). Check the O-ring on the cover, replace it if necessary.
- Clean the fuel tank.
- Reinstall the cover with O-ring and attach the cover and refill the tank.



6.6.7 ADD FUEL TO THE FUEL TANK

⚠ DANGER

Lower the attachment into maintenance position (fig. 40) and turn the Diesel engine off!

Never work under a raised attachment!

- Open the fuel tank cap.
If it is necessary to add fuel with a canister, make sure you are positioned safely and you use a safe ladder or access.

**NOTE**

Add fuel only through the strainer.
To reduce condensation in the tank, add fuel in the evening or after every shift change.
Check the fuel quality regularly.

6.6.8 BLEED THE FUEL SYSTEM

- Loosen the bleeder screw on the fuel filter and turn it counterclockwise by 2-3 turns (fig. 41).

Always bleed the fuel system after the following service:

- Change of fuel filters.
- Cleaning of fuel tank.
- Repairs on fuel system.
- Draining the fuel tank or running out of fuel.

- Actuate the hand pump (fig. 42) until fuel free of air bubbles emerges on the bleeder screw.

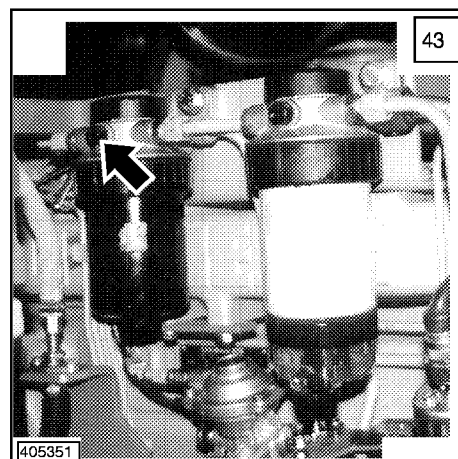
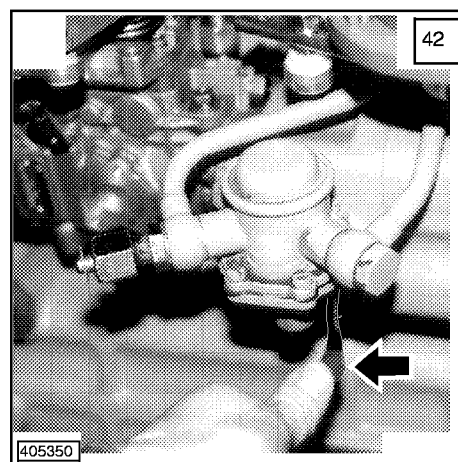
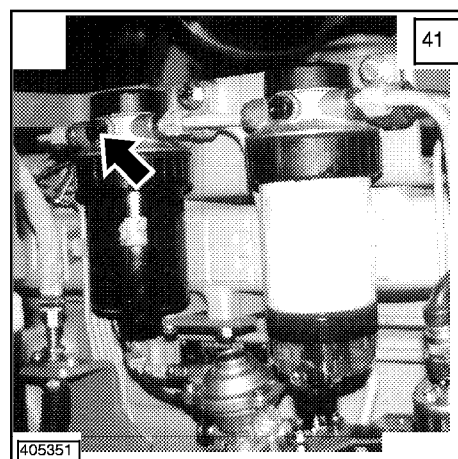
**NOTE**

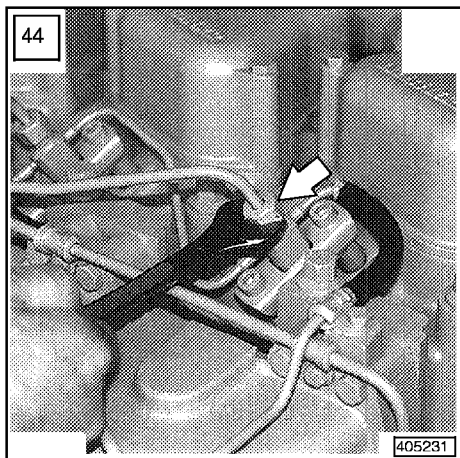
The hand pump is only functioning if a noticeable resistance of approx. 1 -1.5 cm can be felt on the pump lever. Otherwise, close the engine compartment doors and actuate the starter to obtain a different position of the cam.

**CAUTION**

Start the Diesel engine only if the engine compartment doors are closed.

- Close the bleeder screw again (fig. 43).



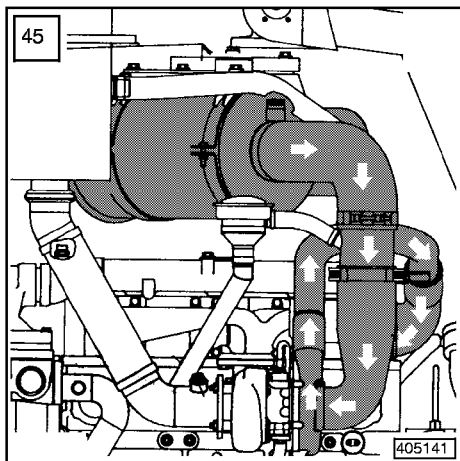


- Loosen the union nut on the injector valves actuate the starter until fuel free of air bubbles emerges. Reinstall the lines (fig. 44).
- Start the engine as described before. If the engine does not start, repeat the bleeding procedure.

6.7 ENGINE AIR INTAKE SYSTEM

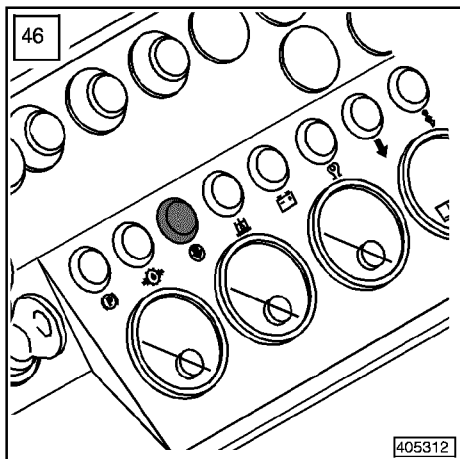
For maximum engine protection and service life, the air intake system must be checked and serviced at regular intervals.

Not only air filter elements should be cleaned and / or changed, all connections, pipes, hoses and clamps in the air intake system should be checked at regular intervals, according to the Maintenance and Inspection Schedule. Defects must be repaired immediately.



Air is drawn into the engine via the air intake pipe and through the air filter, which consists of the primary filter element and the safety element (45). Between the air intake pipe and the exhaust pipe, an automatic dust ejector is installed, which prevents dust from collecting in front of the filter.

After the filter, a vacuum gauge with electrical indicator is installed.



NOTE

When the maximum allowable restriction is reached, the vacuum indicator light in the cab will light up (fig. 46).

Turn the engine off and service the system.

NEVER run the engine without the air filter.

6.7.1 SERVICE THE PRIMARY FILTER ELEMENT

When the indicator light on the instrument panel (fig. 46) lights up, the filters should be cleaned or replaced.

The primary filter element should be replaced after it has been cleaned three times, or once a year.

The primary filter element can be wet or dry cleaned. Wet cleaning is only necessary when the element is oily or sooty.

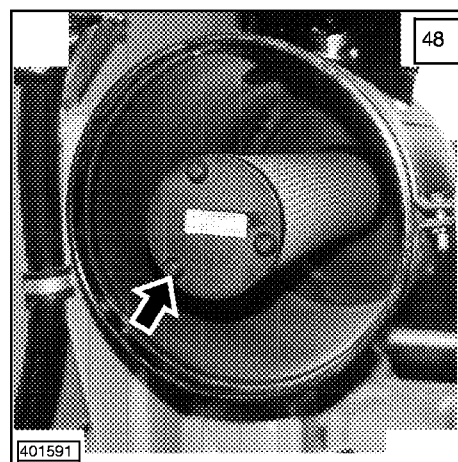


NOTE

Clean the primary filter element (fig. 47) only after the indicator light comes on.

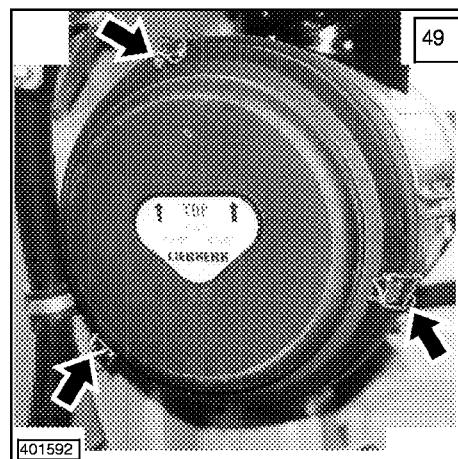


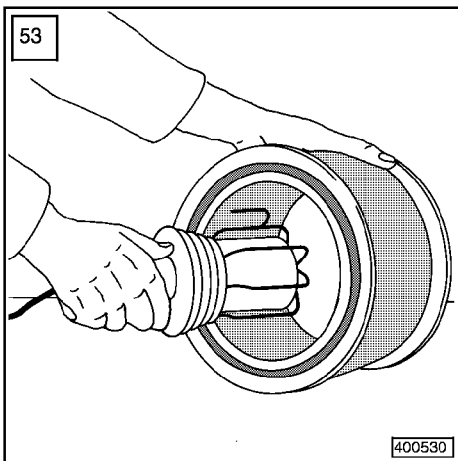
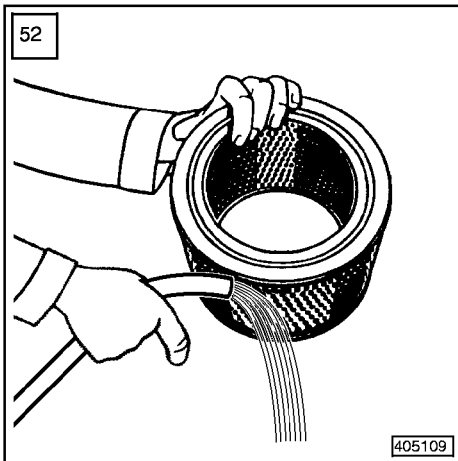
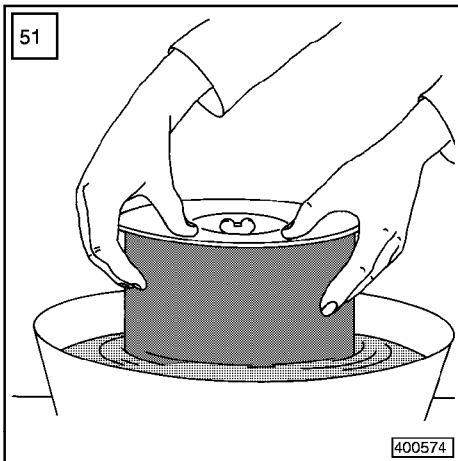
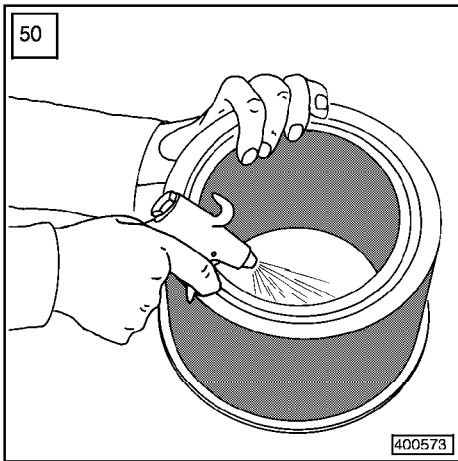
The safety element (fig. 48) should not be cleaned, it should be changed after the primary filter element has been cleaned three times and every time the primary filter element is replaced.



6.7.2 REMOVE THE PRIMARY FILTER ELEMENT

- Open the quick releases (fig. 49).
- Remove the cover.
- Remove the primary filter element from the filter housing.





6.7.3 CLEAN THE PRIMARY FILTER ELEMENT

DRY CLEANING

NOTE

Never try to clean the primary filter element by hitting it. This will not clean the filter, but could damage it.

Wet cleaning is necessary when the element is oily or sooty.

- Direct compressed air (maximum air pressure 100 PSI / 7 bar) through the primary element from the inside to the outside. Move the nozzle up and down while rotating the element. Keep at least 1" (2 cm) from the pleated paper. The cleaning is complete when no more dust escapes from the element (fig. 50).
- Check the primary filter element as outlined above.

WET CLEANING

- Dry clean the primary element, as outlined above.
- Soak the element for about 15 minutes or more in water and cleaning solution (fig. 51). Observe instructions given by the filter manufacturer.

- Rinse the primary filter element in clean water (fig. 52), use a water hose without a nozzle (max. 3 bar water pressure).
- Air dry the filter element or use warm air flow (max. 50°C / 125°F).

NOTE

Do not use heat from a light bulb to dry the filter element.

Never install wet filters.

6.7.4 INSPECT THE PRIMARY FILTER ELEMENT

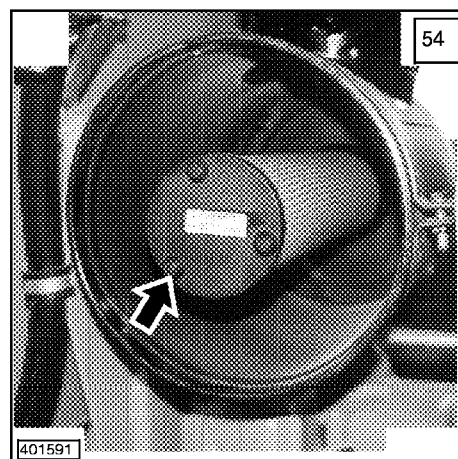
Place a bright light inside the cleaned and dried primary filter element and rotate it slowly. (fig. 53).

Check for cracks or holes. Even small hoses show up as a light spot. Inspect seals for wear and damage. Replace faulty or damaged filter elements.

6.7.5 REPLACE THE SAFETY ELEMENT

The safety element (fig. 54) **MAY NOT BE CLEANED**. Replace the safety element after the primary filter element has been cleaned three times, or at least once a year.

- Remove the primary filter element, as outlined.

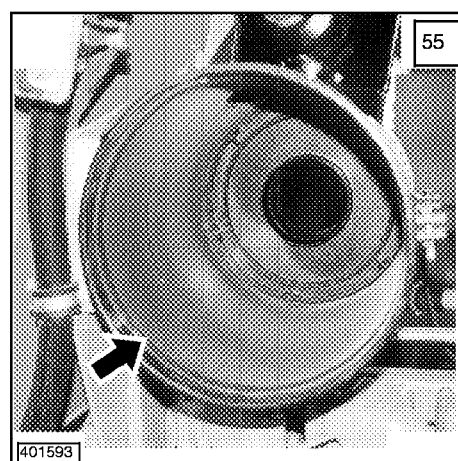


- Clean the filter housing with a damp cloth. Never use compressed air (fig. 55).
- Pull out the safety element. Insert a new element onto the receptacle and reassemble the air filter in reverse order.



NOTE

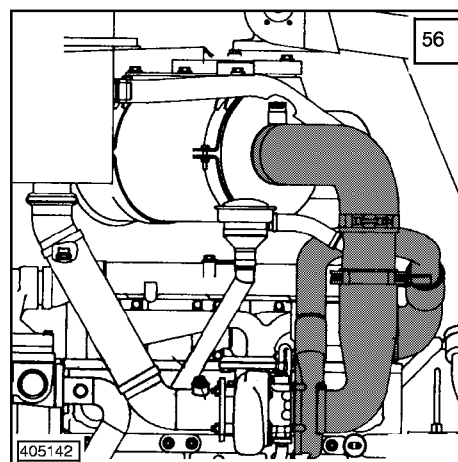
Make sure the area you work in is dust free, dust should not enter the air intake system.



6.7.6 INSPECTION OF AIR INTAKE SYSTEM

The connections and components of the air intake system as well as the dust ejector must be checked for wear, damage and leaks at regular intervals and every time the filter element is replaced (fig. 56). Retighten the clamps if necessary.

DO NOT operate the engine without air filters.



6.8 HYDRAULIC SYSTEM



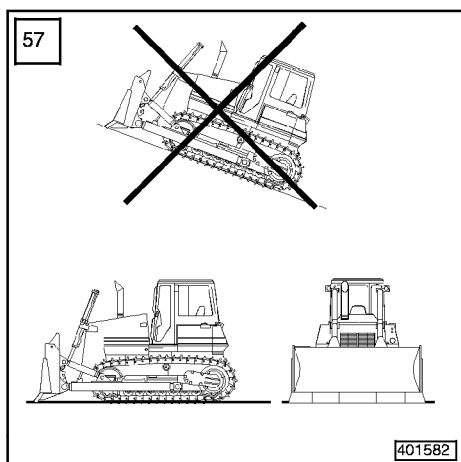
CAUTION

Before starting to perform any maintenance tasks, always lower the attachment to the ground. Turn the engine off and actuate all functions again to release pressure in all lines.

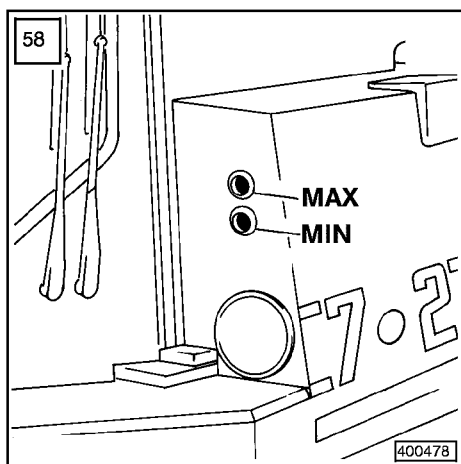
**NOTE**

Before removing filters, hoses, lines or fittings, clean all connections and surrounding area.

As soon as a component is disconnected, plug, tape or cap openings shut to prevent dirt from entering the hydraulic system.

**6.8.1 CHECK HYDRAULIC OIL LEVEL**

- Place the machine on level ground (fig. 57).
- Retract the hydraulic cylinders.

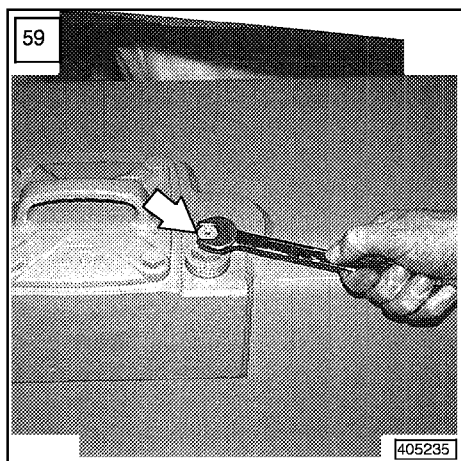


The oil level may not exceed the center of the sight gauge (fig. 58 MAX.).

- Extend the hydraulic cylinders.

The oil level may not drop below the center of the lower sight gauge (fig. 58, MIN)

Add hydraulic oil, if necessary.

**6.8.2 ADD HYDRAULIC OIL**

- Retract the hydraulic cylinders.
- Relieve the pressure in the hydraulic tank by turning the bleeder screw by one turn (fig. 59).

- Loosen the screws on the filter cover (fig. 60) and lift off the cover with the magnetic rod.
- Check and clean the magnetic rod, according to the data given in the Maintenance and Inspection Schedule..

**NOTE**

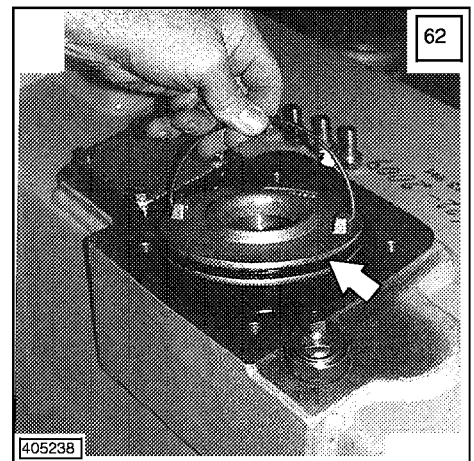
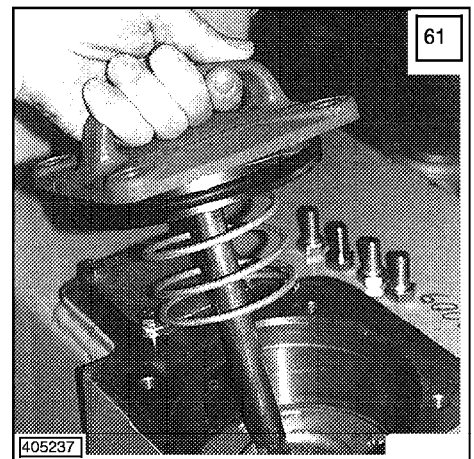
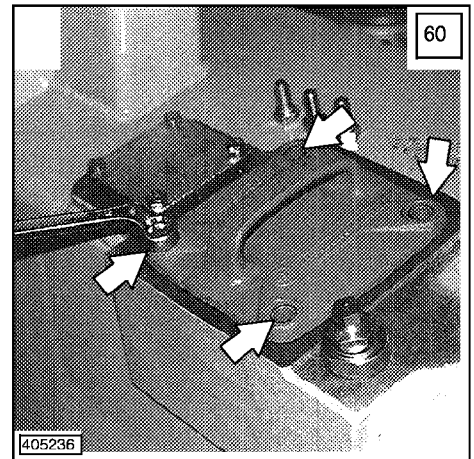
- Add hydraulic oil only through the return oil filter (fig. 60).
- Check the O-ring and replace it, if necessary. Reinstall the cover, tighten the screws and close the bleeder screw.

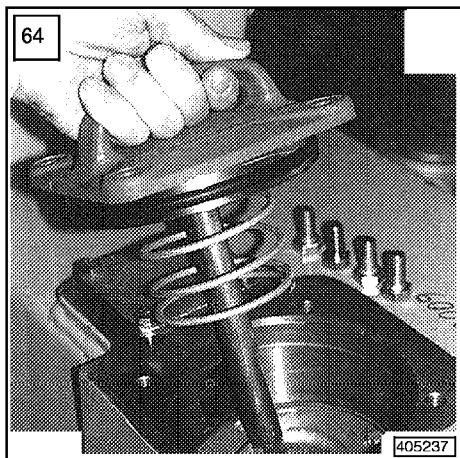
6.8.3 REPLACE THE HYDRAULIC TANK FILTER (RETURN FILTER)

- Remove the filter cover with magnetic rod (fig. 61)

- Remove the pressure plate (fig. 62).
- Remove the filter and dispose of it properly.

- Carefully insert the new filter element (fig. 63). Check the O-ring, replace it if necessary.



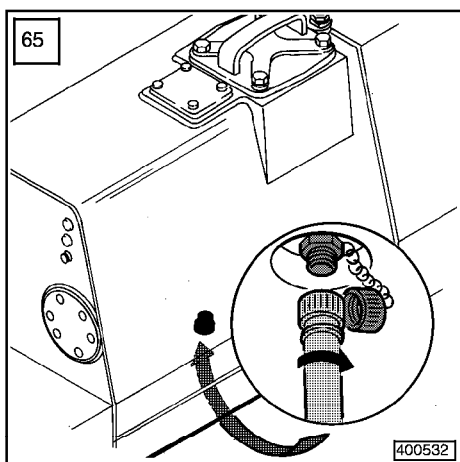


- Reinstall spring and pressure plate (fig. 64). Clean the magnetic rod and reinstall the cover.

**NOTE**

Do not clean or reuse old filters. Always replace the filters. Always keep spare O-rings on hand.

Use only Original Liebherr replacement filters.

**6.8.4 CHANGE HYDRAULIC OIL**

- Remove the hydraulic tank filter.
- Place a suitable container under the drain.
- Unscrew the cap at the bottom of the tank.
- Install a drain hose (fig. 65) and drain the oil into a suitable container, dispose of it properly.
- Remove the drain hose and reattach the cap.
- Insert new filter and fill the tank with oil through the return filter.

For oil specification, refer to data in this Operation and Maintenance Manual.

- Insert the magnetic rod. Reinstall the cover and close the bleeder screw again.

**6.8.5 REPLACE HYDRAULIC REPLENISHING OIL FILTER**

- Clean surrounding area. Place a suitable container under the filter.
- Remove the filter housing and dispose of the filter element properly (fig. 66).
- Clean the sealing surface on the filter base.
- Lightly lubricate the threads and sealing surfaces on the filter as well as the seal ring of the new filter element with clean oil.
- Reinstall the filter and tighten by hand.

Note: Observe the manufacturer's guidelines. When disposing of the filter, remember that it is filled with oil.

6.8.6 HYDRAULIC SYSTEM MAINTENANCE AND REPAIRS

Part of maintenance consists of checking the complete hydraulic system for leaks, loose connections, frayed, worn or damaged lines, tubes and hoses at regular intervals.

CAUTION

Never check for leaks with your bare hands. Fluid escaping from a small hole can have enough force to penetrate the skin (fig. 67).

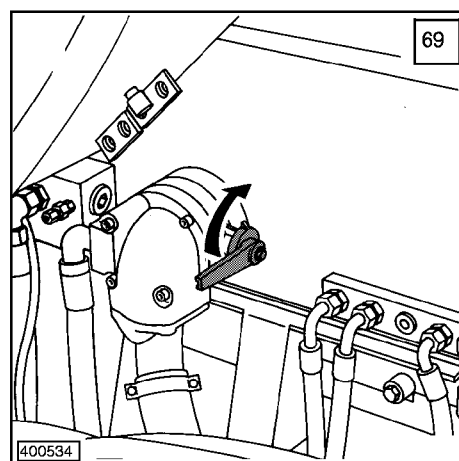
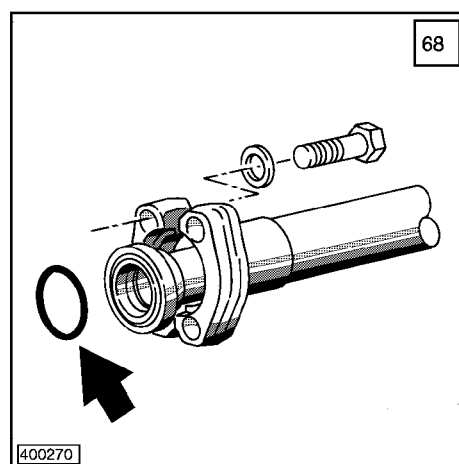
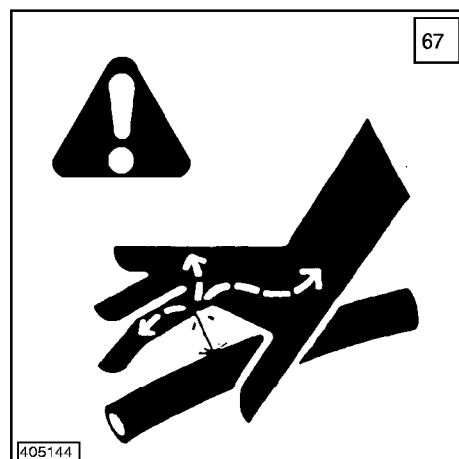
Do not disconnect lines or hoses or remove fittings or caps as long as the hydraulic system is still pressurized. Lower the attachment, turn the engine off and release system pressure.

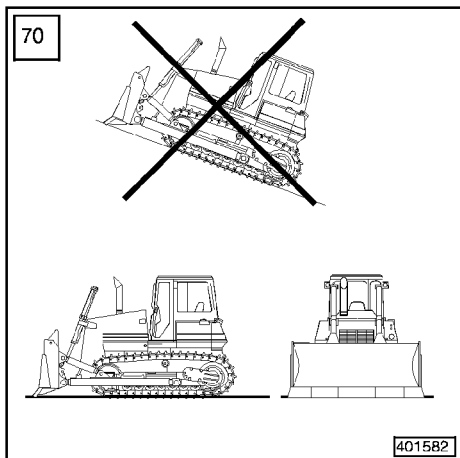
- Repair all defective hydraulic hoses immediately. Hose and tube assemblies must be installed free of distortion. Do not twist or kink hoses.
- In case of leakage on an SAE hose connection, replace the O-ring. Use only Original LIEBHERR O-rings (fig. 68).

- If the suction hose for the attachment pump has to be removed at the pump or hydraulic tank, close the shut off valves on the hydraulic tank first (fig. 69). Remove the hose at the pump and drain oil from the pump and the hose.
- Be certain to open the shut off valves on the hydraulic tank again after the repairs are completed.

6.8.7 HYDRAULIC CYLINDERS

Before attempting to repair, replace or research hydraulic cylinders and other components, contact your LIEBHERR dealer.

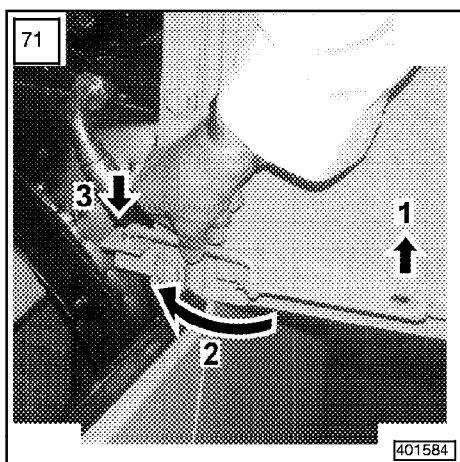




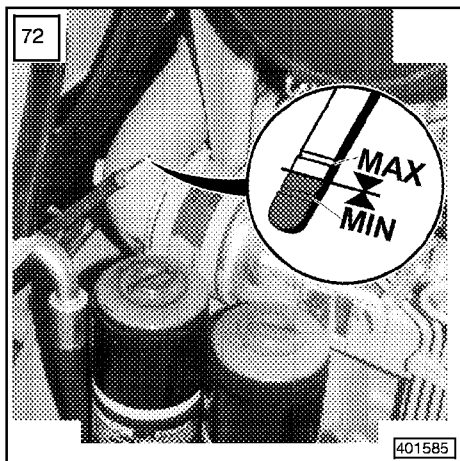
6.9 SPLITTERBOX

6.9.1 CHECK SPLITTERBOX OIL LEVEL

- Park the machine on firm and level ground (fig. 70).



- Open the engine compartment door and secure it to prevent it from closing inadvertently (fig. 71).

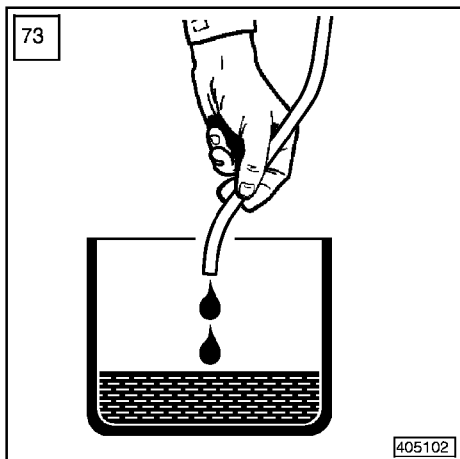


- Pull out the dipstick (fig. 72), wipe it off with a clean cloth and reinsert it all the way.
- Pull the dipstick out again and check the oil level. The oil level must be between the MIN. and MAX. mark on the dipstick (fig. 72).

6.9.2 CHANGE THE OIL

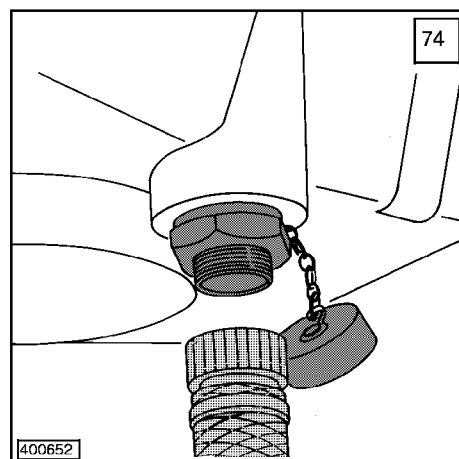
The oil in the splitterbox should be warm when changing the oil.

- Open the oil filler cover in the engine compartment.

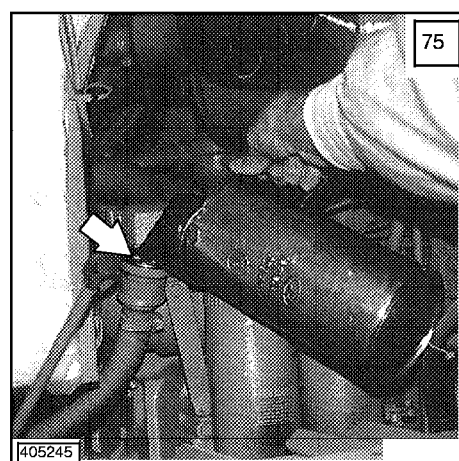


- Remove the access cover on the pan.
- Place a suitable container under the drain (fig. 73).

- Remove the cap from the drain valve (fig. 74).
- Connect the drain hose - oil begins to flow.
Check oil for contamination and dispose of it properly.
- Remove the drain hose, reinstall the cap and the cover.



- Fill the splitterbox with oil (fig. 75) - do not exceed the MAX. mark. For quantities, refer to the Lubrication Chart.
- Recheck the oil level with the dipstick.
- Close the oil filler cover and the engine compartment doors.



6.10 TRAVEL GEAR

6.10.1 CHECK TRAVEL GEAR OIL LEVEL

To check the oil level, park machine on level ground. Position the machine so that the drain plug 1 is on the bottom (fig. 76). Clean area around the filler plug 2. Slowly remove filler plug 2 (fig. 76), the oil level should be up to the filler plug opening. Add oil as necessary.

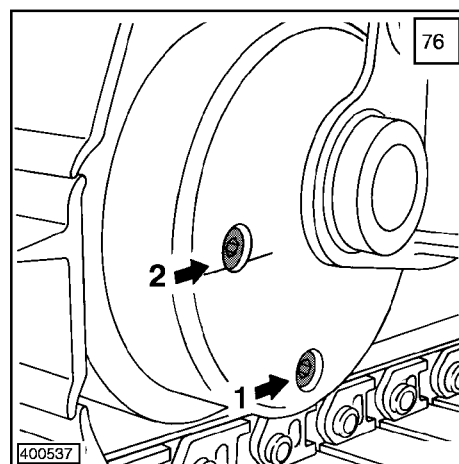
6.10.2 CHANGE TRAVEL GEAR OIL

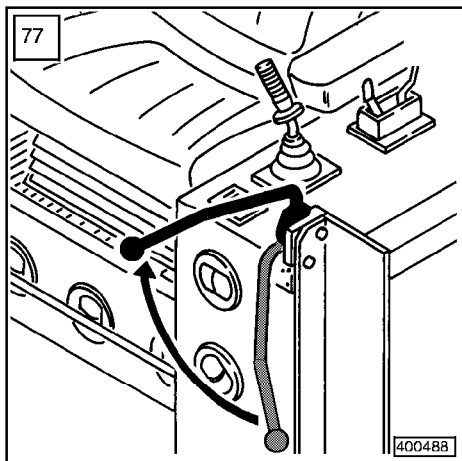
The oil of the travel gear should be warm when changing the oil.

To change the oil, park machine on level ground. Position the machine so that the drain plug 1 is on the bottom (fig. 76). Clean area around the filler and drain plug 1 and 2.

Place a suitable container under the drain plug. Slowly remove filler and drain plug. Check oil for contamination and then dispose of it properly.

Reinstall the drain plug and fill the gear with oil. Reinstall the filler plug and tighten to approx. 160 Nm.





6.10.3 TRAVEL BRAKE

OPERATING BRAKE

The hydrostatic travel drive is also an operating brake.

PARKING BRAKE

A wet disk brake integrated in the travel gear serves as the parking brake.

The parking brake is only released if the safety lever is raised and the travel lever is deflected, with the engine running (fig. 77).

The disk brake is used only as a parking brake, and is maintenance free.

6.10.4 CHECK CONDITION OF TRAVEL GEAR

Check the travel gear for leaks at regular intervals.

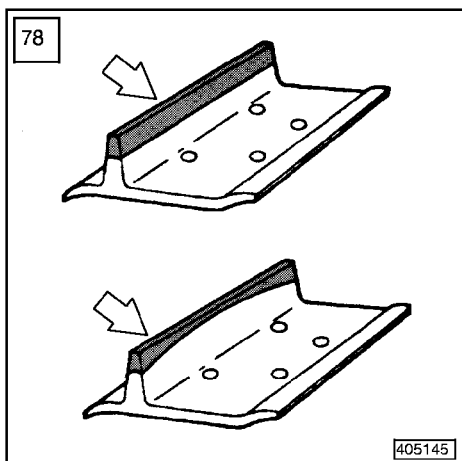
Check the travel gear housing for wear and damage. Cables, wires and ropes might wind around the gear and damage the seals.

6.11 TRACK COMPONENTS

With the exception of wear, track components are virtually maintenance free.

Improper operation will accelerate the wear and tear of track components.

Visual inspections of track components (measurements, if necessary) should be made at regular intervals to determine the condition and the degree of wear. Such inspections can help detect abnormal and premature wear. Some track components can be reconditioned, provided the wear limit is not exceeded.



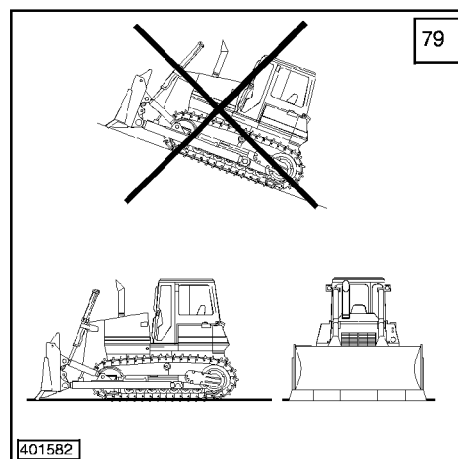
CHECK THE FOLLOWING PARTS:

- Check idlers, track and carrier rollers for leaks and wear.
- Check chain, track guides, track pads and sprockets for wear (fig. 78).

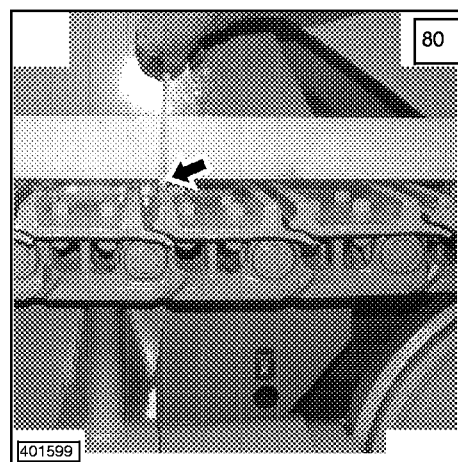
6.11.1 CHECK CHAIN TENSION

Due to wear of track components, it is necessary to check the track tension regularly and adjust the chain tension, as necessary.

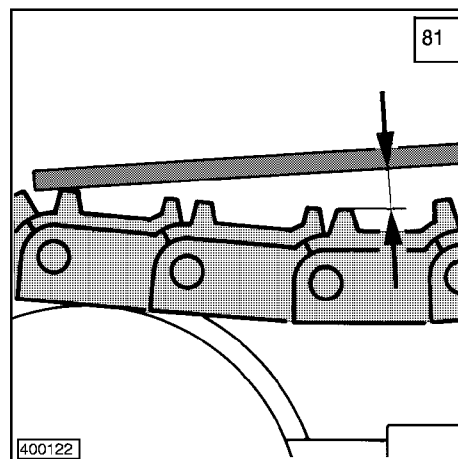
- Park the machine on level ground and lower the attachment (fig. 79).
Since material deposits on rocky ground are less than on muddy ground, the chain must be adjusted differently, i. e. the chain must be tensioned to conform to current working applications.
Do not remove any material which might have built up on the track before tensioning the track.
The conditions must be the same as the working conditions.

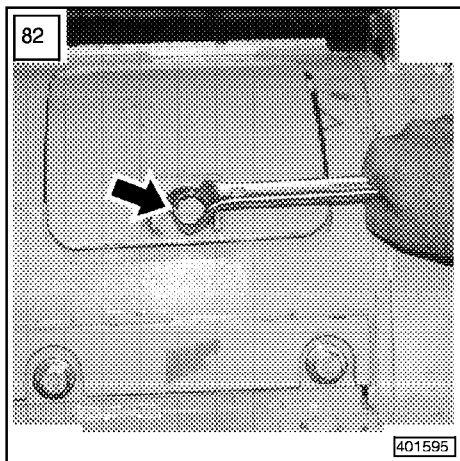


- Relieve the chain by moving forward and backward.
- Place a test board on the chain.
- Measure the distance between the lower edge of the board and the top of the chain (fig. 80).



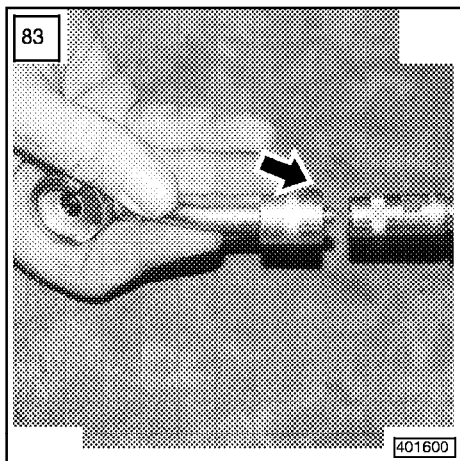
The chain is tensioned correctly if the slack between the carrier rollers and the idler is approx. 20-30 mm (3/4" to 1 1/4"), (fig. 81).



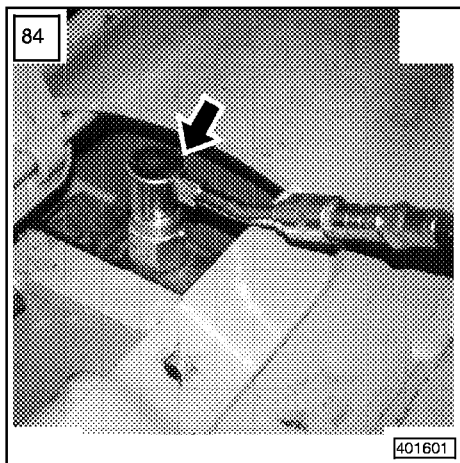


TO TIGHTEN TRACK TENSION

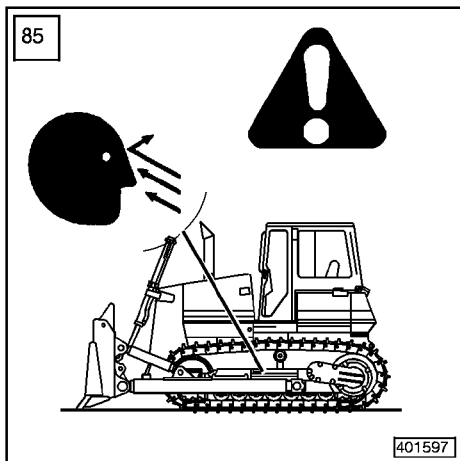
- Clean the surrounding area of the grease cylinder access cover.
- Remove the hex head screws and fold the cover to the back (fig. 82).



- Attach the manual grease gun and connect it to the fitting on the grease cylinder (fig. 83).



- Add the connector to the fitting of the grease cylinder (fig. 84).
- Pump grease into the cylinder until the track chain is properly tensioned (20 - 30 mm).



TO RELEASE TRACK TENSION

CAUTION

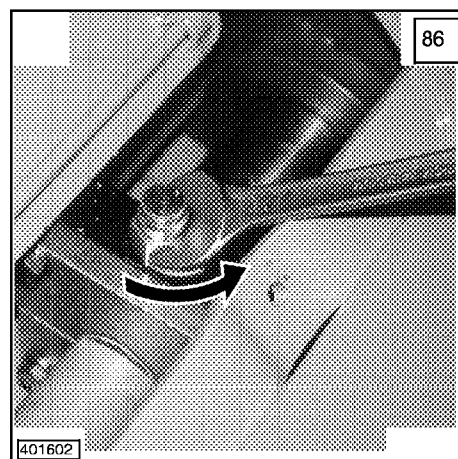
When adjusting the chain tension, keep your head clear of the access hole and track roller frame.

The grease cylinder is under high pressure and the chain will sag. Grease is under high pressure and might squirt out. (fig. 85).

- To release track tension, carefully release the pressure in the grease cylinder by loosening and turning the grease fitting counterclockwise until some grease emerges from the groove in the fitting (fig. 86).

⚠ DANGER

The chain tensioner may be replaced or repaired only by authorized expert personnel. The chain tensioner spring is pretensioned, even though the chain tension is released!



NOTE

After adjustment, move the machine forward and backward and then recheck the chain tension.

6.11.2 CLEANING THE TRACK COMPONENTS

At the end of a workday, the complete undercarriage should be checked and cleaned and repaired, if necessary (fig. 87).



NOTE

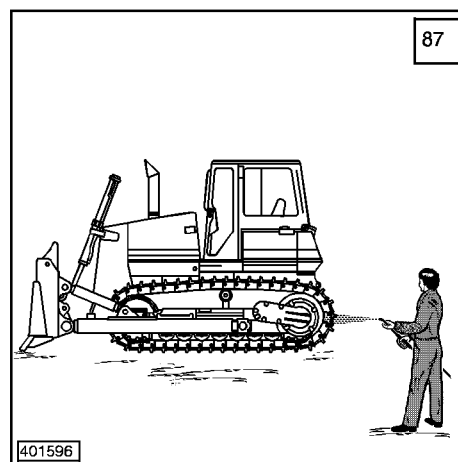
DO NOT operate the machine if large rocks or pieces of wood, steel, wires or cable are wedged into the track components.

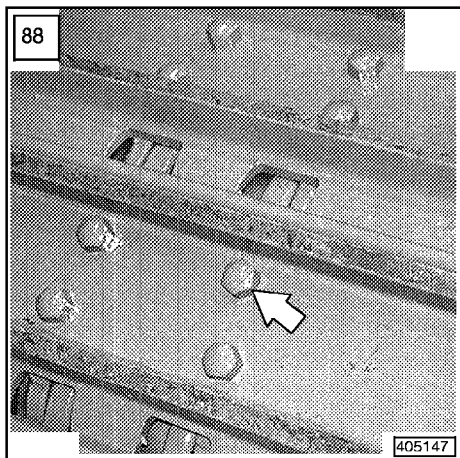
Dried or frozen mud, as well as rocks or pieces of wood or other debris in the track components could cause serious damage to the machine if operated, or if it attempted to break the machine loose under engine power.

In cold temperatures, always park the machine on wooden boards or on concrete to prevent the tracks from freezing to the ground.

Never rip a stuck machine loose by force, this can cause significant damage.

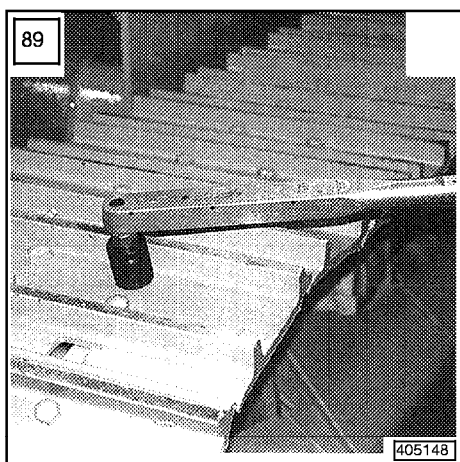
If frozen tracks are thawed with an open flame, the seal rings can be damaged due to overheating. Danger of causing a fire!





6.11.3 CHECK TIGHTNESS OF TRACK PADS AND SPROCKET SEGMENTS

- Visually check for loose track pad and sprocket segment mounting screws (fig. 88).



- Check tightening torques (fig. 89).

The tightening torque of track pad mounting screws 5/892 - 18 UNF is 350-390 Nm.

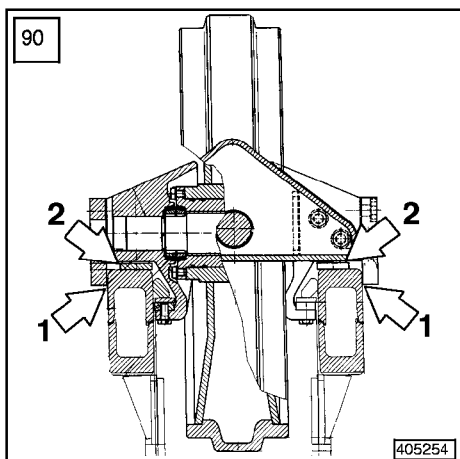
The tightening torque of sprocket segment mounting screws 5/892 - 18 UNF is 350-390 Nm.

6.11.4 CHECK AND ADJUST IDLER GUIDES

The normal play between the track roller frame and the side guides is 1 - 2 mm (0.06"), the height clearance of the rubber springs is approx. 3 mm (0.12").

The play is increased due to wear of the wear bars, guide rails and guide plates.

If the maximum permissible value is reached, the play must be readjusted or the worn guide sections must be replaced.



New / repair measurement

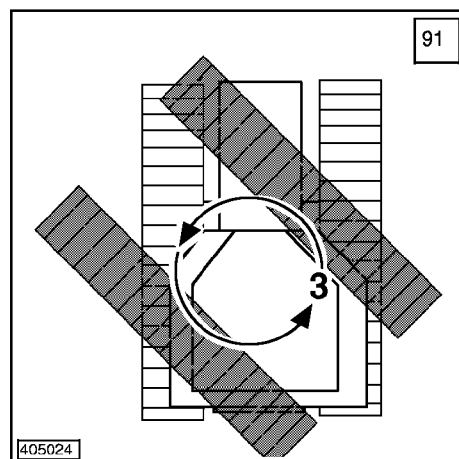
- Side clearance min. 1 - 2 mm (fig. 90, pos. 1)
- Height clearance min. 3 mm (fig. 90, pos. 2)

Maximum permissible

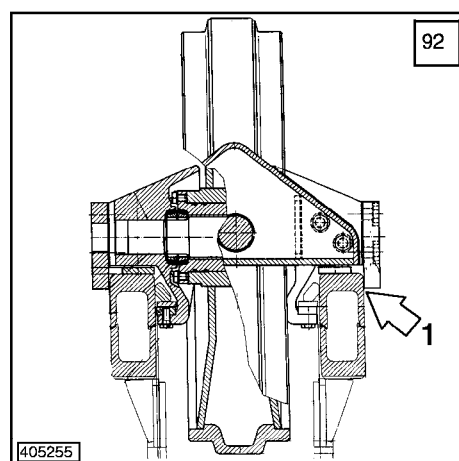
- Side clearance 5 mm
- Height clearance 6 mm

Check / adjust side clearance

- Touch the inner guide plate to the track roller frame (fig. 91) (for example by 'counter rotation').



- Check the existing play between the track roller frame and the outer guide plate (fig. 92).

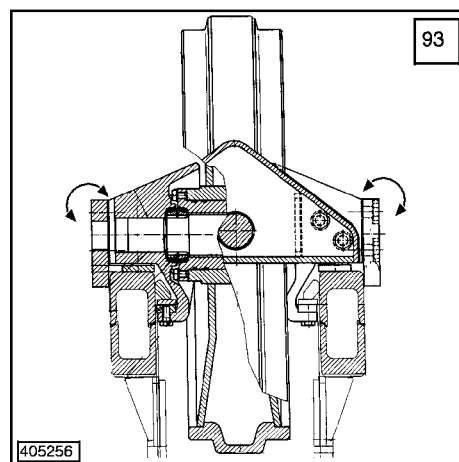


- If the maximum permissible play is exceeded, remove the existing shims on the inside and / or outside (fig. 93).

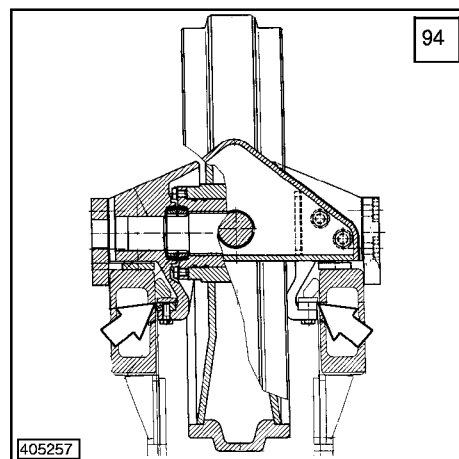
**NOTE**

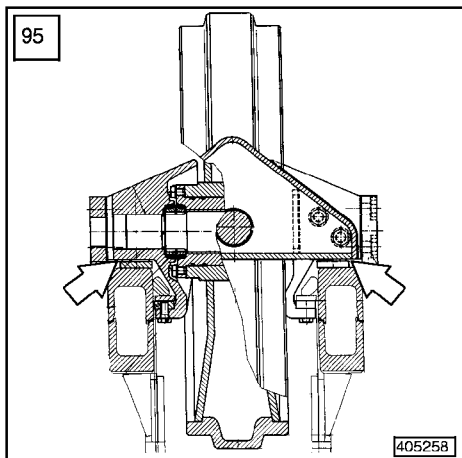
The difference between the inside and outside shims may not be more than one shim.

If no shims are available, then the guide plates must be replaced or reconditioned, maintain the new / repair measurement.

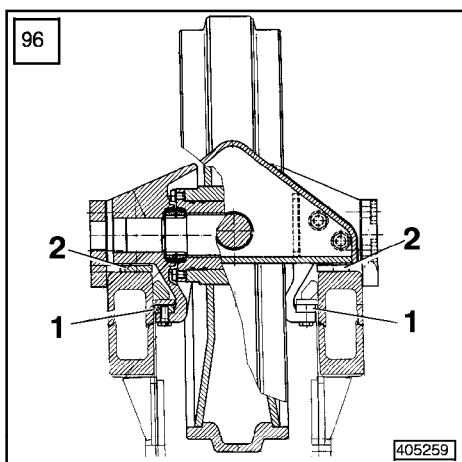
**Check and adjust the height clearance**

- Raise the idler, for example by moving onto a piece of wood until the claws touch the guide rails (fig. 94).

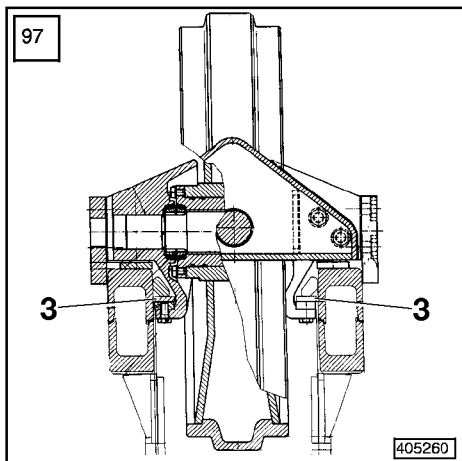




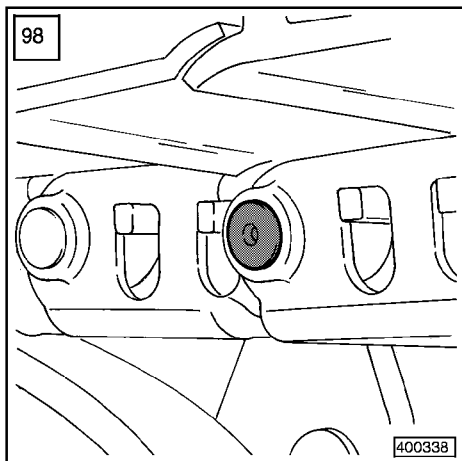
- Check the play between the wear strips and the bearing (fig. 95).



- If the permissible play is being exceeded, replace the worn wear strips (fig. 96, pos. 1 and 2) in equal numbers.



- When replacing the wear strips, check the welded-on guide rails and replace them, if they are worn (fig. 97, pos. 3)



6.12 REPLACING THE TRACK CHAIN

6.12.1 TO REMOVE A SEALED CHAIN

- Park the machine on firm and level ground in such a way that the master link pin is at one third height of the sprocket wheel.
- The master pin can be recognized by a large chamfered edge or a countersunk bore (fig. 98/99, pos. 1 and 2)
- Release the track tension carefully and push the idler assembly all the way in.

 **CAUTION**

Knocking the master pin in or out with a sledge hammer can be very dangerous due to material chipping off the pin, which could cause serious injuries. Always wear safety glasses and protective clothing. If possible, use a hydraulic press or proper pin removal tool to remove and install the pin.

- Remove the master pin with a hydraulic press or suitable tool (fig. 99, pos. 3).

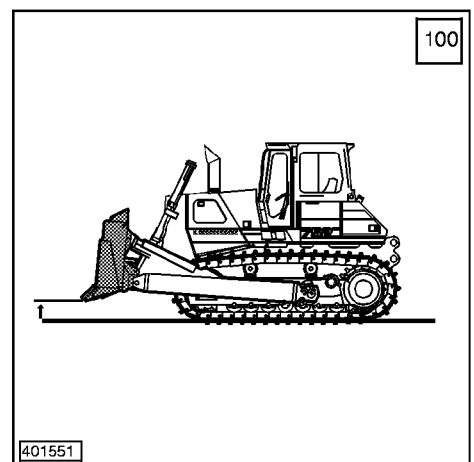
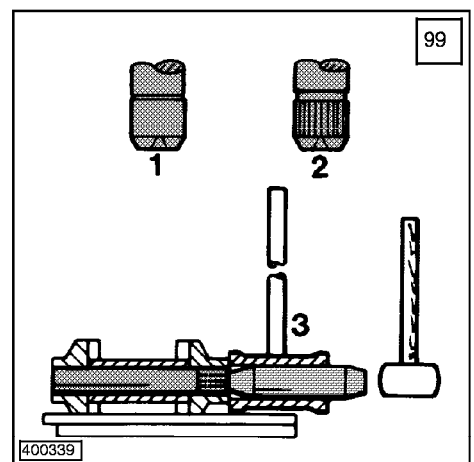
**NOTE**

The knurled master pins must be pressed in from the outside to the inside and pressed out from the inside to the outside. Knurled edge on the outside!

Master pins without knurled edge can be pressed in or out from the inside to the outside.

When knocking out the master pin, support the chain link on the other side.

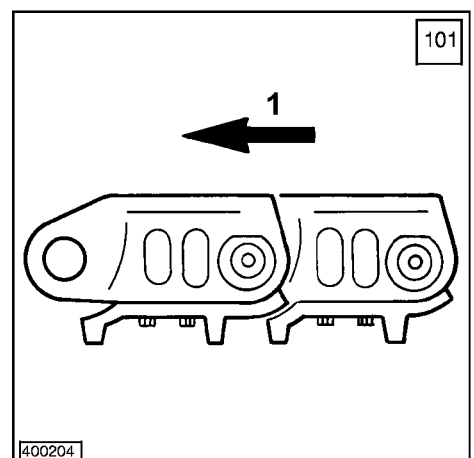
- Raise the attachment (fig. 100).
- Carefully drive the machine forward until the complete chain rests on the ground.

**6.12.2 TO INSTALL A SEALED TRACK CHAIN**

- Drive backward on the old chain.
- Place the new chain in proper direction on the ground and connect it to the old track chain with the master link pin.
- Insert the master link pin from the inside to the outside.

**NOTE**

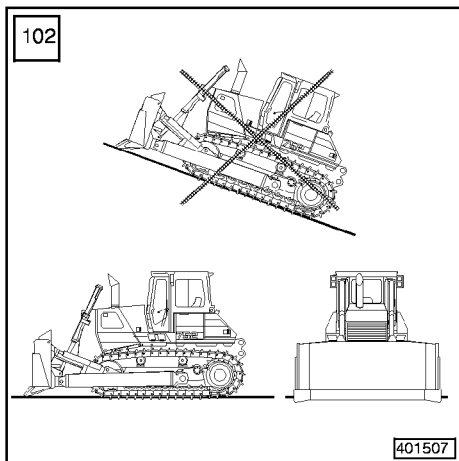
Make sure the new chain is installed in the correct direction (fig. 101) 1= travel direction.



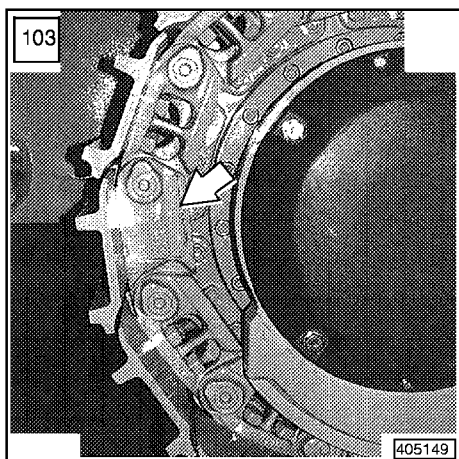
- Align the chain to the track frame and move the machine carefully onto the new chain until you get to the end of the new chain.
- Release the new chain from the old chain and attach the end of the new chain with a wire to the sprocket wheel.
- Carefully drive the machine forward until the chain is on the sprocket on top.
- Release the wire from the chain and the sprocket wheel and continue to drive forward to bring the chain over the carrier roller and the idler. Stop the machine when the idler wheel approaches the last two track pads.
- Raise the last track pads, reinsert the spacer rings and press in or knock in the master pin from the outside to the inside.

**NOTE**

When installing or removing the pin with a punch, support the chain link on the opposite side to create sufficient counter pressure.

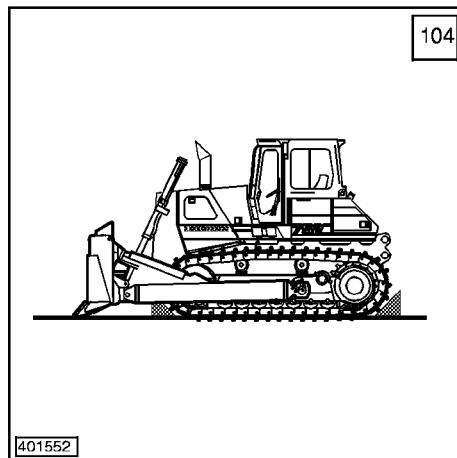
**6.12.3 REMOVE A CHAIN WITH A SPLIT MASTER LINK**

- Park the machine on firm and level ground (fig. 102).
- Release track tension.

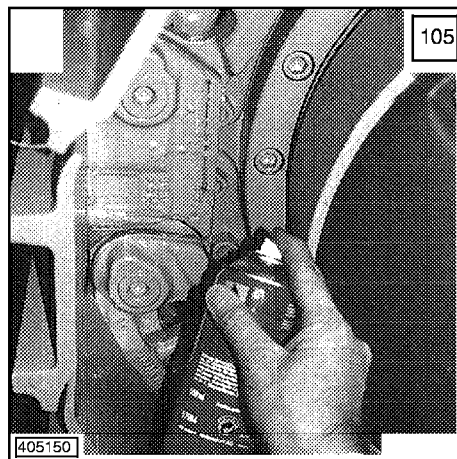


- Slowly travel with the idler against a wooden block until the idler is pushed in all the way. Remove the block, travel with the machine until the master link and the center of the sprocket are at one height (fig. 103).

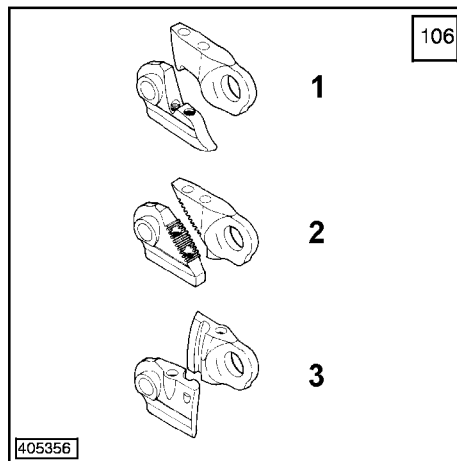
- Secure the chain in front of the idler and behind the sprocket with a wooden block to prevent it from moving (fig. 104).



- Spray the teeth or mating surfaces of the master link with penetrating oil, help the oil to penetrate by hitting the master link lightly with a hammer (fig. 105).

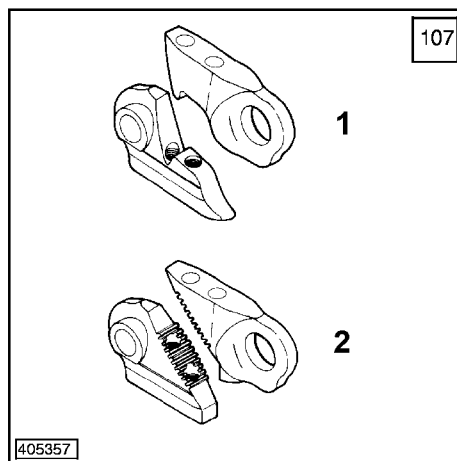


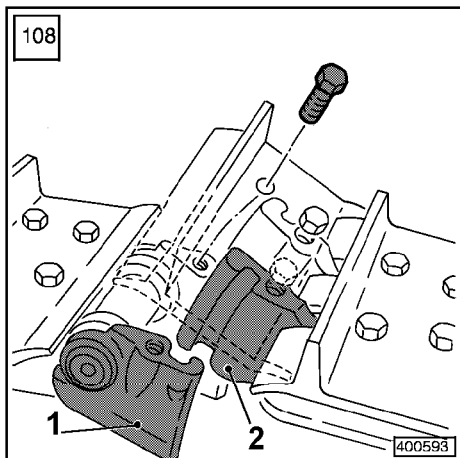
Various chains with split master links are used in Liebherr machines (fig. 106, pos. 1-3).



Model 1 + 2 (fig. 107)

- Remove the track pad screws, remove the track pad and hit the master link slightly with a hammer to loosen and separate the links. If necessary, apply more penetrating oil.



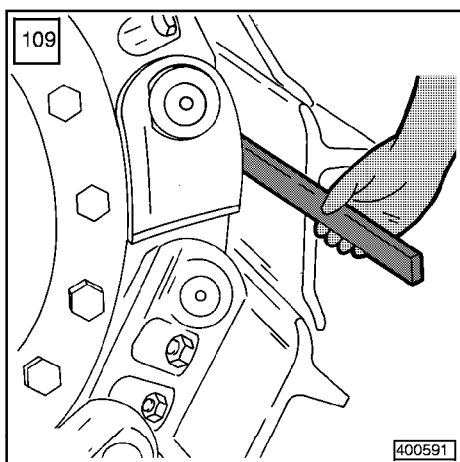
**Model 3**

This model can be recognized as follows:

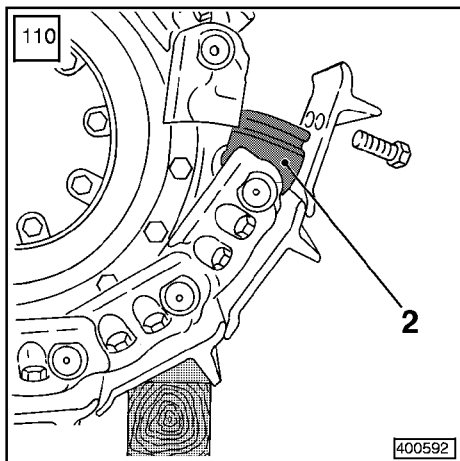
The pin section (fig. 108, pos. 1) is pressed to the pin, marked with the manufacturer's name and the track pad screws are spaced further apart.

The bushing section (fig. 108, pos. 2) is pressed to the bushing, appears shorter from the outside and the track pad screws are spaced closer together.

- Remove only the track pad screws from the pin section (fig. 108, pos. 1).



- Use a steel wedge between the track pad and the pin section to drive out the bushing section (fig. 109). Support the drive action of the wedge by hitting the track pads lightly with a hammer.
- Remove the track pad.



- Only the bushing section (fig. 110, pos. 2) can be turned to the outside.
- Remove the track pad by carefully moving forward until the complete track chain is on the ground.

6.12.4 INSTALL A CHAIN WITH A SPLIT MASTER LINK

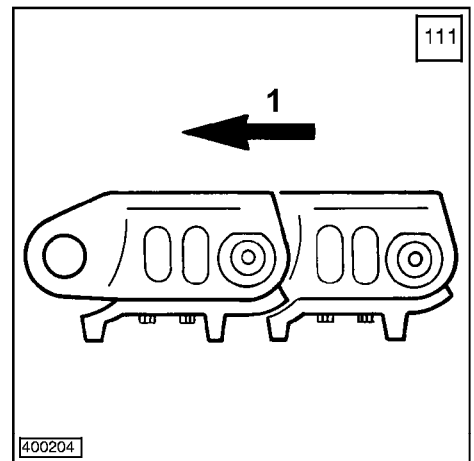
Track chains with master links can be easily installed on sprocket or idlers.

- Drive the machine back on the placed down chain.
- Care should be taken that the threads, teeth and mating surfaces of the new chain are clean, free of dirt, paint and burrs. coat the mating surfaces lightly with grease.

- Clean the bore holes, apply Never - Seize or grease to track pad screws (the threads should be clean enough so that the screws can be turned in by hand).

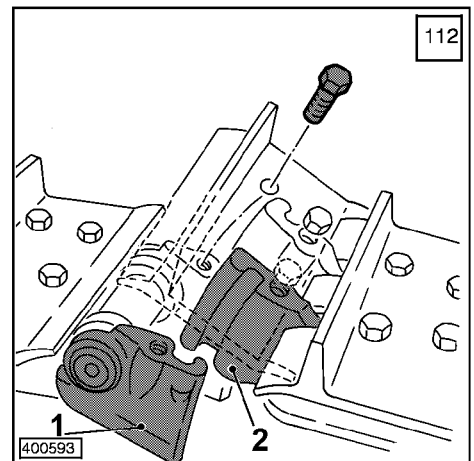
**NOTE**

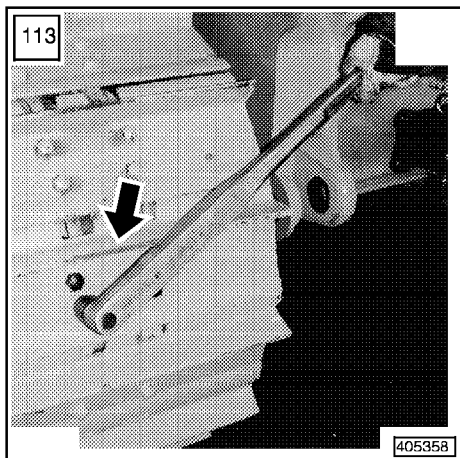
Make certain that the track chain is installed correctly (1= travel direction) (fig. 111).



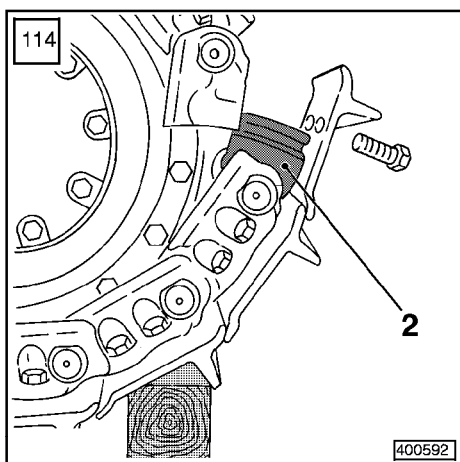
In case of model 3, the chain bracket with pin section must point to the sprocket, when the new chain is laid out behind the sprocket (fig. 112, pos. 1).

- Place the new chain on the ground and use a wire to connect it to the old chain.
- Align the track chain to the roller frame and carefully move the machine forward to the end of the new chain.
- Loosen the new chain from the old one and attach the new chain with the wire to the sprocket.
- Carefully drive the machine forward until the chain is on top of the sprocket.
- Loosen the wire from the chain and the sprocket, continue to drive forward to bring the chain over the carrier rollers and the idler. Stop the machine when the master link is at the same height as the center of the idler.
- Secure the chain in front of the idler and behind the sprocket with a wooden block.





- Connect the chain links.
Add the track pad, insert the screws and tighten to the correct tightening torque (5/8" - 18 UNF = 350 - 390 Nm) (fig. 113).

**NOTE**

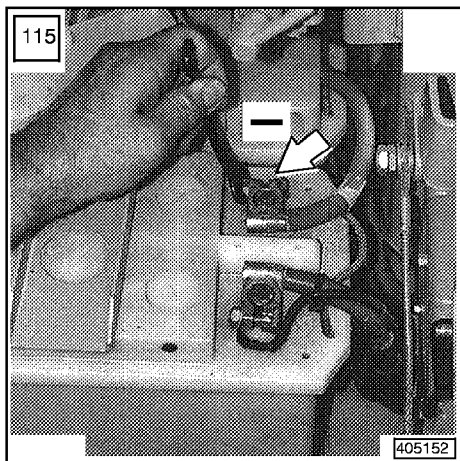
For chain version 3, the track pads must be installed with the bushing section before the master link is connected (fig. 114).

- Push the pin section towards the center of the idler. Insert the bushing end and slide both parts together until the track pad makes contact. Only the bushing section can be inserted (fig. 114).

**NOTE**

DO NOT hit the mating surfaces with a hammer.

- Adjust track chain tension as outlined.



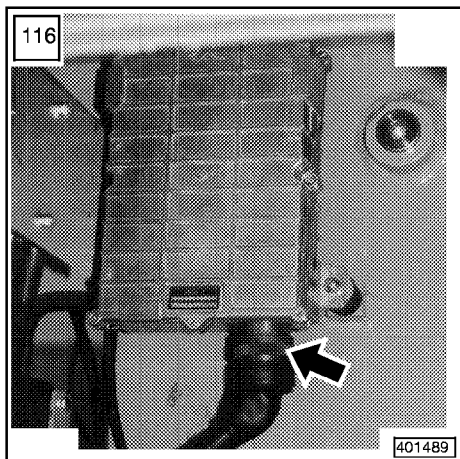
6.13 THE ELECTRICAL SYSTEM

To ensure trouble-free operation of your machine, the electrical system must always be in good condition.

The gauges and indicators and all components of the electrical system must be checked daily for proper function.

**NOTE**

Before working on the electrical system and before any welding, always disconnect the battery. Disconnect the negative (-) terminal first, and reconnect it last (fig. 115).

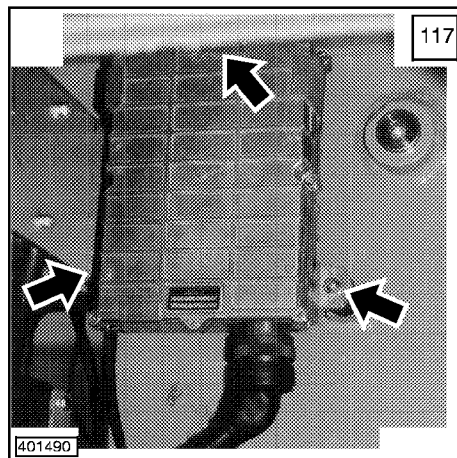


Before any arc welding, disconnect the battery and remove the electronic box (fig. 116).

To remove the electronic box

Unscrew the cable fitting on the bottom of the electronic box (fig. 116).

- Remove the mounting nuts (fig. 117) and remove the electronic box.
Install in reverse order.



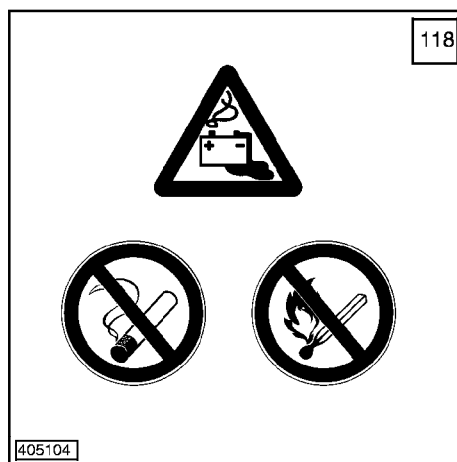
6.13.1 BATTERY

CAUTION

When working on the batteries, always wear protective gloves and safety glasses.

Battery acid can cause severe burns!

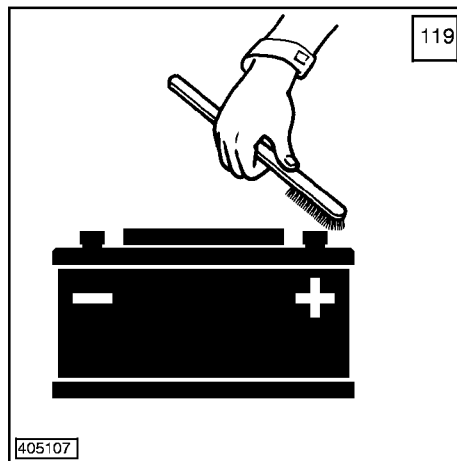
Keep sparks and open flames away from the battery (fig. 118).



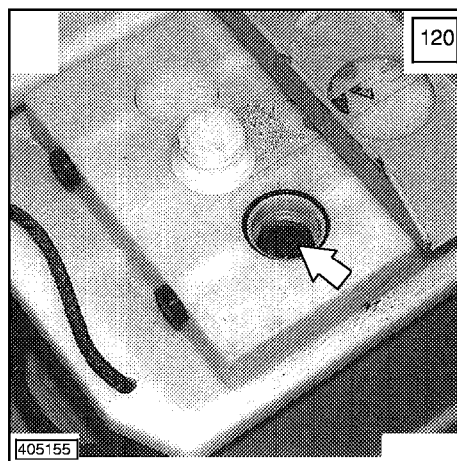
- In order for the battery to function properly, it is important to keep it clean at all times. The battery terminals and cable clamps should be cleaned regularly.

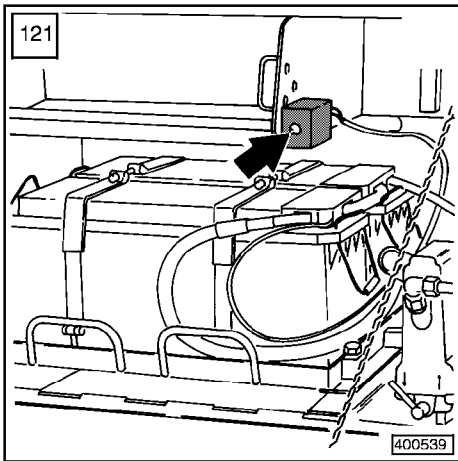
CAUTION

Do not use metal brushes to clean the battery!
Danger of spark formation - explosion!



- Coat the battery terminals and cable clamps with acid resistant grease.
- Unscrew the battery cell plug (fig. 120). The fluid level should be at least 15 mm above the upper edge of the plates.
If the fluid level is too low, add distilled water.





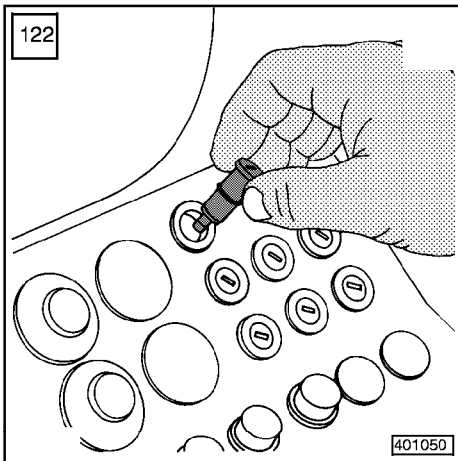
6.13.2 FUSES

MAIN FUSE

The automatic circuit breaker in the battery compartment serves as the main fuse for the complete electrical system of the machine (fig. 121).

If the (35 A) circuit breaker blows, then it is important to find the reason for the overload and to fix the problem.

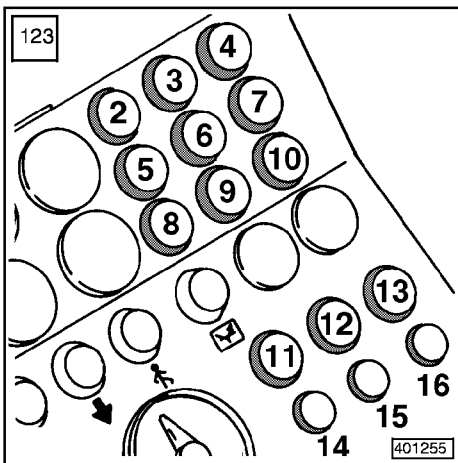
- Push the button on the automatic circuit breaker to reestablish the power supply for the machine.



ADDITIONAL FUSES

The remaining fuses are located in the instrument panel on the right hand side of the operator's seat and in the roof console.

- Unscrew and remove the covers to check and remove the individual fuses (fig. 122).



6.13.3 LOCATION OF FUSES (Fig. 123/124)

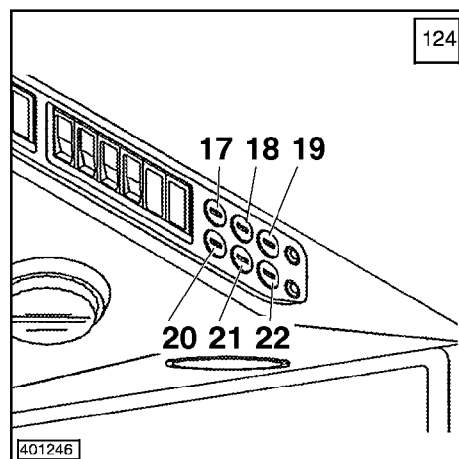
2	16A	Preglow system
3	5A	Charge indicator, cab illumination, radio, backup alarm
4	8A	Electronic supply
5	10A	Electrical socket
6	5A	Gauges, indicator lights
7	8A	Added floodlights (Optional equipment)
8	20A	Power supply - roof console
9		For optional equipment
10	5A	Hydraulic valves
11	10A	Heater fan, air conditioner, air cushioned operator's seat
12	16A	Condenser blower - air conditioner
13	20A	Refueling pump
14	3A	Free fall device
15	2A	Shut off valve
16	3A	Hoist limit switch

17	8A	Windshield wiper and washer system, doors and side windows
18		For optional equipment
19	8A	Headlight, cab - left front and right rear, instrument illumination in operator's cab
20	8A	Headlight, cab - right front and left rear
21	2A	Warning light - operator's cab
22		For optional equipment

CAUTION

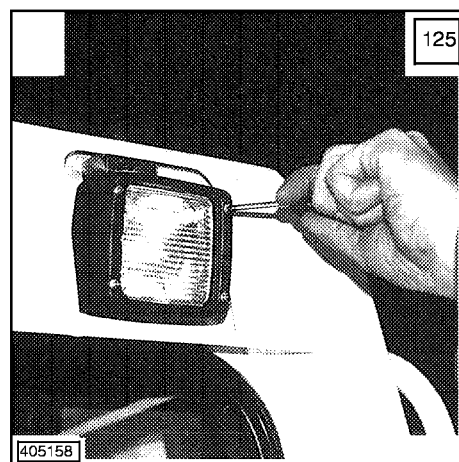
NEVER repair or short circuit fuses!

Never use a different size fuse than the original fuse. This could cause a fire!

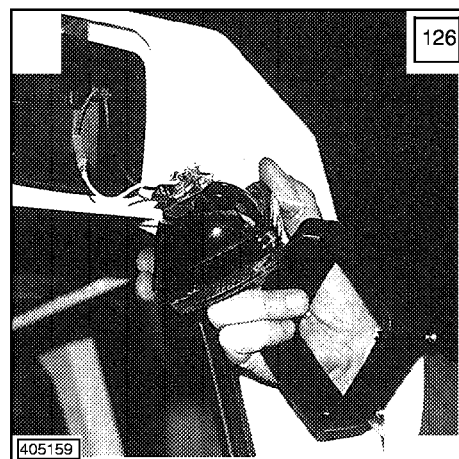


6.13.4 TO CHANGE THE BULBS IN HALOGEN LIGHTS

- Unscrew the four screws on the headlight frame (fig. 125).

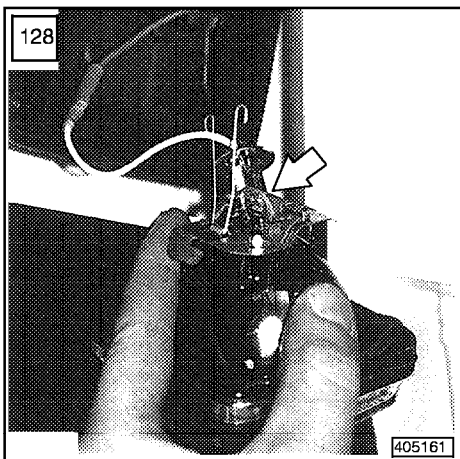


- Remove the frame with the glass (fig. 126).





- Loosen the spring bar and pull the lamp base out (fig. 127).



- Remove the halogen bulb from the base and replace it with a new one (fig. 128).



NOTE

Do not touch the halogen bulb with bare fingers, use a cloth to hold the bulb.

Install in reverse order.

6.13.5 TO CHANGE THE BULB FOR THE INTERIOR LIGHT OF THE CAB

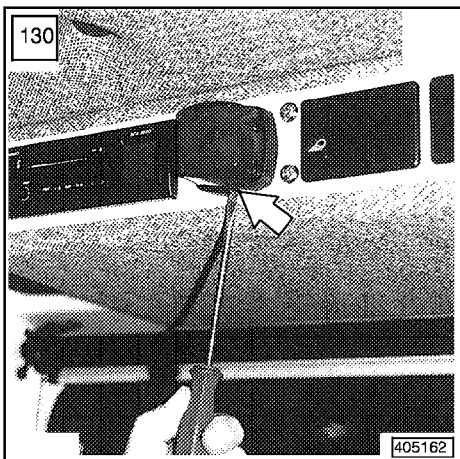
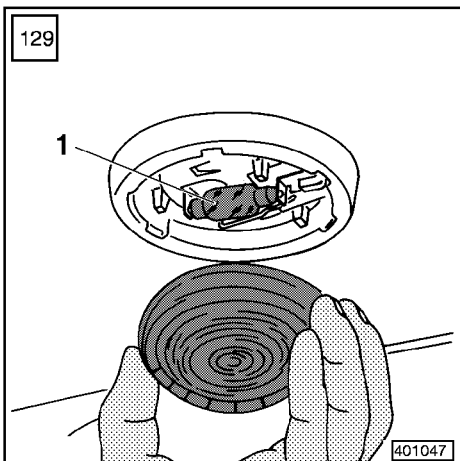
- Turn the diffuser all the way to the left, push it up slightly and remove it (fig. 129).
- Remove the bulb from the contact brackets and replace it with a new one (fig. 129, pos. 1).



NOTE

Do not touch the bulb with bare fingers, use a cloth to hold the bulb.

- Insert the bulb.
- Insert the diffuser, push it up and turn it to the right to lock.



6.13.6 TO CHANGE THE BULB IN THE WARNING LIGHT IN THE OPERATOR'S CAB

- Insert a screw driver into the recess on the light cover and push up (fig. 130) and remove the glass cover.
- Turn the bulb to the left and remove it from the socket and change it.



NOTE

Do not touch the bulb with bare fingers, use a cloth to hold the bulb.

6.13.7 TO CHANGE THE BULBS IN THE INDICATOR LIGHTS

- Unscrew the cap on the affected indicator light and remove it.
- Turn the bulb to the left and remove it from the socket and change it.

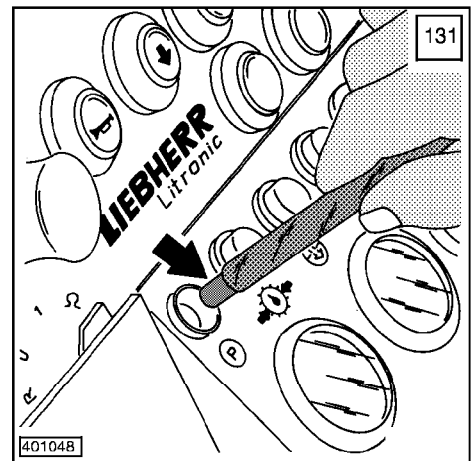


NOTE

If necessary, use a short piece of hose with a 6-8 mm inside diameter (fig. 131) to remove the bulb.

Do not touch the bulb with bare fingers, use a cloth to hold the bulb.

Install in reverse order.



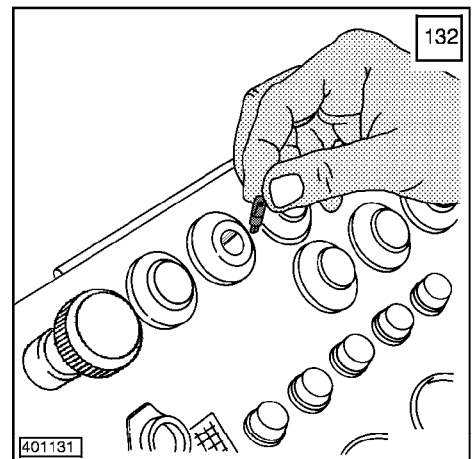
6.13.8 TO CHANGE THE BULBS IN THE SWITCHES

- Remove the symbol on the push button switch by turning it to the left.
- Pull the bulb from the switch (fig. 132).
- Insert a new bulb into the switch and turn in the cap.



NOTE

Do not touch the bulb with bare fingers, use a cloth to hold the bulb.

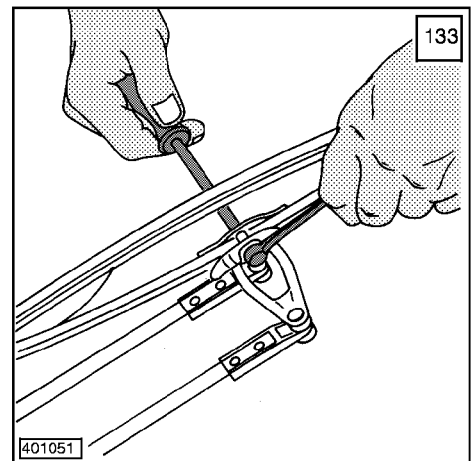


6.13.9 CHANGE THE WINDSHIELD WIPER BLADE

Front windshield wiper

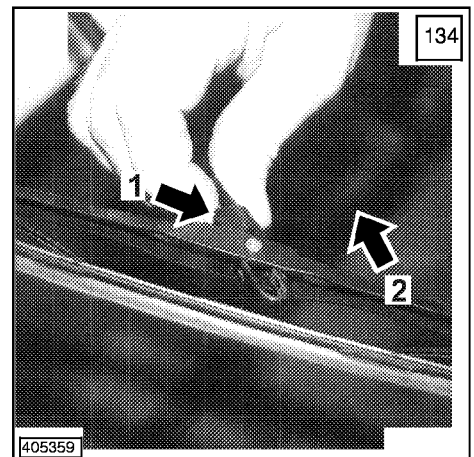
- Fold up the wiper arm.
- Unscrew the nut on the mounting screw (fig. 133).
- Remove the spring ring and washer and pull out the mounting screw.
- Remove the wiper blade and replace it with a new one.

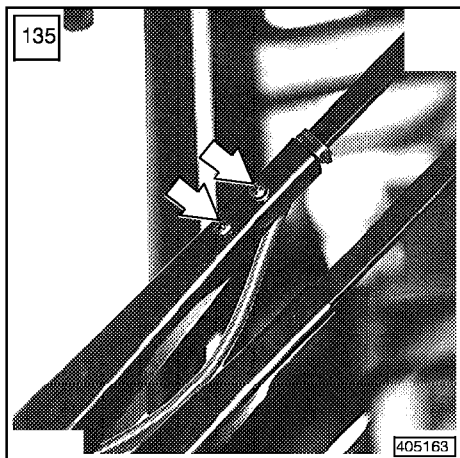
Install in reverse order.



Rear windshield wiper

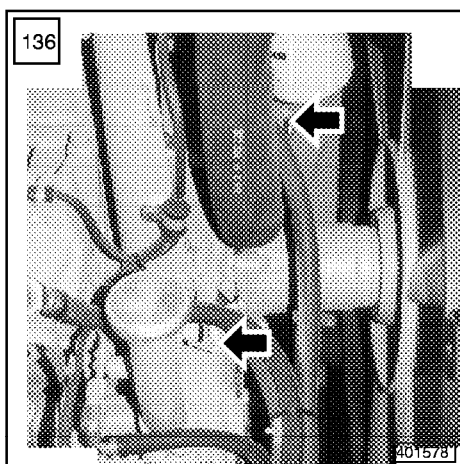
- Fold out the windshield wiper.
- Push the retainer on the windshield wiper, pull the blade to the rear and remove it (fig. 134)





Correct the windshield wiper position

- Loosen the binding screw on the windshield wiper arm (fig. 135) and set the blade vertically by changing the length of the guide arm.



6.14 HEATING AND FRESH AIR SYSTEM

Check the heater and ventilation functions. The following checks must be made regularly, but at least once a year, before the start of the cold season..

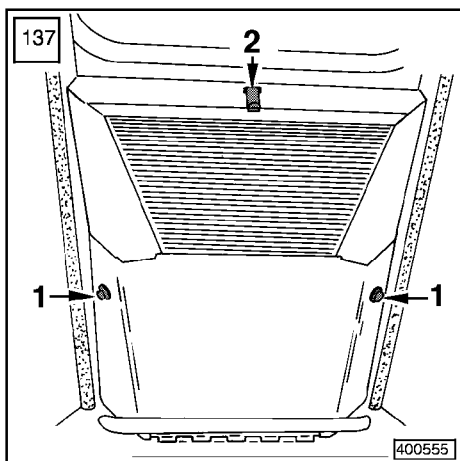
- Check the heater function.
- Check all connections of the hot water circuit for leaks.
- Check all clamps and tighten them, if necessary. Replace worn or damaged hoses.
- Check and clean the fan motor and the heat exchanger motor.
- Run the heater to insure it works properly and check if the coolant contains sufficient antifreeze fluid. For coolant specification, refer to chapter 5.



NOTE

During the summer months, when the heater is not used or during maintenance and repairs, close off the warm water flow to the heat exchanger by closing off the shut off valves on the engine (fig. 136, pos. 1 and 2).

Flush out the heat exchanger to remove any lime deposits and run water through until the water runs clear.



Fresh air filter - operator's cab

Replace the air filters in the cab, if necessary. Remove the hex head screws (fig. 137, pos. 1) on the left and right hand side of the panel.

Open the lock (fig. 137, pos. 2) and fold the cover down.

Replace the filter (fig. 138, pos. 3).
Install in reverse order.

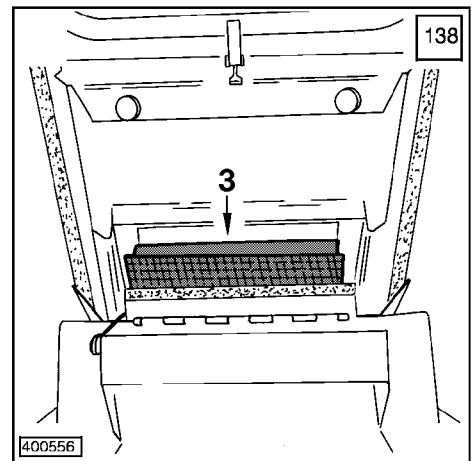
6.15 WORKING ATTACHMENTS

 CAUTION

Before the attachments are serviced, be sure to lower the attachments to the ground. Shut off the engine and actuate all functions again to relieve pressure.

Place the safety lever in the 'down' position.

Do not work or allow work underneath or on the attachment unless it is properly supported.



6.15.1 CHECK THE ATTACHMENT

Check the condition of the boom attachment regularly. Check the hook block, cable pulleys, hoist cable and boom framework for damage and wear.

Check the mounting screws to make sure they are tight.

6.15.2 TO LUBRICATE THE BOOM

- Lower the boom all the way (fig. 139, pos. 2).
- clean the tapered grease fitting and lubricate as specified on the lubrication chart.

6.15.3 CABLE WINCH

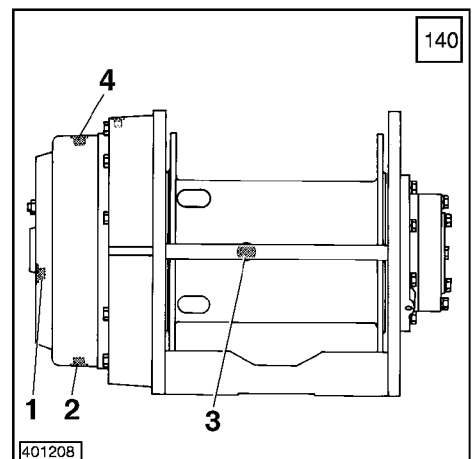
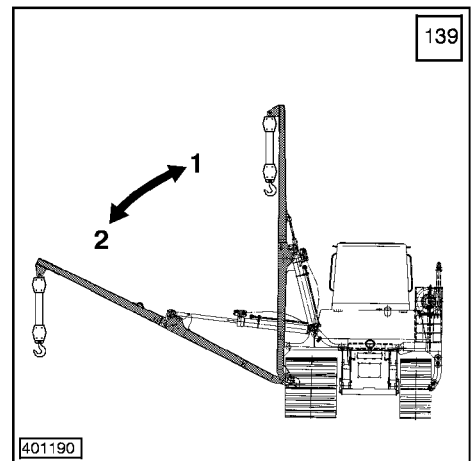
To ensure reliable winch operation, the cable winch must be serviced regularly.

- The following points must be observed to ensure problem-free operation.
 - Change the oil regularly, according to the Maintenance and Inspection schedule.
 - Use the correct gear oil.
 - Remove and inspect all wear parts annually, according to ANSI Specification B30.5c1987 and API RP 20, paragraph 3.

CHECK THE OIL LEVEL

Check the oil level, with the machine parked on level ground.

- Unscrew the oil level plug (fig. 140, pos. 1), the oil must be visible at the lower edge of the oil level port. Add oil, if necessary.



CHANGE THE OIL



NOTE

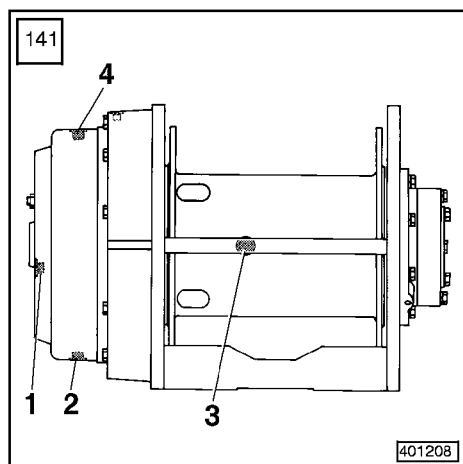
Change the gear oil to remove contaminating particles, which could influence reliable and safe operation of the brake coupling, and affect bearing, gears and seals. If the oil is not being changed regularly, it could affect the safe operation of the brake system, which could cause property damage and personal injury, even death. Change the oil when the cable winch is at operating temperature. In low ambient temperatures, flush the winch gear with preheated new oil.

- Unscrew the oil filler plug (fig. 140, pos. 4).
- Remove the drain plug (fig. 140, pos. 2) and catch the oil in a suitable container.
- Spool out the winch cable until the drain plug can be removed on the winch drum (fig. 140, pos. 3).

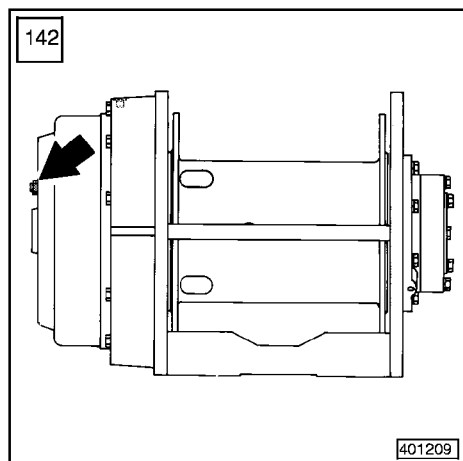


CAUTION

When spooling out the cable, make sure that it is not being damaged.



- Reinsert the oil drain plugs.
- Remove the oil level plug and add oil to the winch via the filler port (fig. 141, pos. 4) until the oil level reaches the oil level screw. Then wait for about 15 minutes until the oil is distributed in the gear area of the drum.
- Recheck the oil level and reinstall the oil level and oil filler screw.



BLEEDER SCREW - WINCH

The bleeder screw must always be clean and accessible. Remove the screw when changing the oil, clean it with detergent and reinstall.

6.15.4 WINCH CABLE

The winch cable must be checked and serviced regularly, according to the cable manufacturer's operating instructions (see chapter 7).

6.15.5 REPLACEMENT OF WEAR AND TEAR ITEMS

In addition to the normal maintenance tasks, which are carried out in stated intervals, the following repairs may be performed by the machine operator:

Replacement or repairs of track pads, track rollers and support rollers, idler unit.

(After these tasks, the track chain must be retensioned, as described in this operating manual).

Replacement of high pressure hoses, hydraulic lines, Ermeto fittings, SAE fittings or O-rings for these items.

We explicitly note that only Original spare parts may be used.

This applies especially to hoses and hydraulic lines, which are preassembled at the factory.

Should you have any questions regarding the information in this manual, or any repairs, contact your LIEBHERR service technician or dealer.

6.16 PISTON ROD PRESERVATION

If the machine is not being used or must be stored for a longer period of time, proceed as follows to prevent corrosion and damage to the piston rods.

- Park the machine in a way that the piston rods are retracted as much as possible.
- If the machine is not being used for an indefinite period, restart and operate it according to the Operation and Maintenance Manual at least once every two weeks.

Operate the engine and the hydraulic system until the recommended operating temperatures are reached. Activate all travel and hydraulic functions alternately.

The piston rods must be fully extended and retracted several times. Check oil level, lubrication points and electrical system.

- If the machine is to be stored for longer than 4 weeks, clean the machine thoroughly on the inside and outside.

Lubricate all bearings, ball joints, hinges, exposed parts, and exposed cylinder rods with anti-corrosive acid free grease. Fill the fuel tank to reduce condensation.

Note:

If the machine is to be transported by ship, check the piston rods again after the machine has been loaded, since the anti corrosive grease may have been removed by the wiper ring.



IMPORTANT

If the machine is put in storage for a longer period of time, contact your LIEBHERR Service Dept. for more information.

6.17 MAINTENANCE AND INSPECTION SCHEDULE

Maintenance / inspection at operating hours

WORK TO BE CARRIED OUT

							<input type="checkbox"/> by maintenance personnel <input type="checkbox"/> First and only interval <input type="checkbox"/> Maintenance interval	<input type="checkbox"/> by authorized trained technicians OM - Operation / Maintenance Manual	Referen.
at delivery	every 8 - 10	ever 50	every 250	every 500	every 1000	every 2000			
DIESEL ENGINE									
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Check oil level and oil pressure		OM
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Check coolant level		OM
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Check / clean engine, cooler assembly and oil pan for contamination		OM
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Check fuel water separator / empty as necessary		OM
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Drain condensation and contaminants from fuel tank - mind. 1x weekly		OM
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Change engine oil ¹⁾ (<input type="checkbox"/> = already permitted from 30 hrs. on) - mind. 1x annually		OM
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Change lube oil filter ¹⁾ (<input type="checkbox"/> = already permitted from 30 hrs. on) - mind. 1x annually		OM
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Check radiator cap, fan		OM
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Replace coolant filter, check antifreeze and DCA4 ratio in coolant		OM
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Check V-belt condition and tension		OM
<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Check hydraulic oil, cooling and fuel system for leaks and condition		OM
<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Check intake and exhaust system for mounting tightness and leaks		OM
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Check mounting tightness of oil pan and engine mounts		OM
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Check / adjust engine RPM		
				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Check / adjust valve play - with cold engine		
				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Check and service mechanical linkage for injection pump and potentiometer		OM
				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	RL 22B - Change fuel prefilter and fine filter element - Stage 1 and 2 -		OM
				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	RL 42 B - Check fuel prefilter strainer / clean as necessary		OM
				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	RL 42 B - Change fuel filter cartridge		OM
				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Grease flywheel teeth		
				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Check flame glow system - Before start of cold season		
							Replace air filter inserts - as necessary / annually		OM
							Replace oil separator - every 2 years		
							Replace coolant with antifreeze and DCA4 - every 2 years		OM
							Check / adjust fuel injectors - as necessary / every 3000 hrs.		
HYDRAULIC SYSTEM									
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Check oil level in hydraulic tank		OM
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Clean magnetic rod - up to 250 hrs. daily		OM
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Replace main return filter insert, check all flushing circuit return filter inserts (only by authorized personnel)		OM
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Replace filter (insert) - replenishing circuit		OM
<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Check working and travel hydraulic system for function and leaks, check hose routing for chafings.		OM
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Hydraulic tank - drain condensation and contaminants - at least every 6 month		OM
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Check / clean oil cooler for contamination - PR 752 check fan		OM
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Check / adjust all hydraulic pressures according to adjustment protocol		
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Check mountings and screw fittings for tight seating		OM
				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Replace oil in hydraulic system (fill via filter) ¹⁾ - at least every 4 years - when using 'environmentally safe hydraulic fluids' request / observe special guidelines		OM

WORK TO BE CARRIED OUT

Maintenance / inspection at operating hours

at delivery	every 8 - 10	every 50	every 250	every 500	every 1000	every 2000		Referen.
SPLITTERBOX								
<input type="radio"/>			<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Check oil level	OM
				<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Replace gear oil ¹⁾ - at least every two years	OM
ELECTRICAL SYSTEM								
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Check function of system incl. indicators and gauges	OM
<input type="radio"/>				<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Check electrolyte level in battery	OM
				<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Clean / check / grease battery terminals	OM
				<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Check cable routing and connections	OM
				<input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>	Check / adjust control system	
				<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Check battery charge - before start of cold season	
HEATER / VENTILATION								
<input type="radio"/>				<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Check system for function and leaks	OM
							Replace fresh air filter - as necessary	OM
TRAVEL GEAR								
<input type="radio"/>				<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Check oil level, clean magnetic plugs / spark plugs	OM
				<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Check screw fittings for tight seating	OM
				<input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>	Replace gear oil ¹⁾ - Clean magnetic plugs / spark plugs - at least every 4 years	OM
TRACK COMPONENTS								
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Check screws and nuts for tight seating	OM
	<input type="checkbox"/>		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Check carrier rollers, idlers, for leaks	OM
			<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Check / adjust idler guides	OM
							Adjust chain tension to suit application - as necessary	OM
							Clean track components - as necessary	OM
							Check track wear - as necessary	

by maintenance personnel
 First and only interval
 Repeat intervals

by authorized trained technicians
 OM - Operation / Maintenance Manual

Maintenance / inspection at operating hours

WORK TO BE CARRIED OUT

Maintenance / inspection at operating hours							WORK TO BE CARRIED OUT		Referen.	
at delivery	every 8 - 10	every 50	every 250	every 500	every 1000	every 2000	<input type="checkbox"/> by maintenance personnel <input type="checkbox"/> First and only interval <input type="checkbox"/> Repeat interval	<input type="checkbox"/> by authorized trained technicians OM - Operation / Maintenance Manual		
WORKING ATTACHMENT - HOIST GEAR										
<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			Lubricate all grease points	OM
		<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			Check screws, nuts and pin retainers for tight seating	OM
				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			Check the complete length of the winch cable for damage - grease if necessary See Operating manual issued by the cable manufacturer	OM
				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			Check attachment for intentional damage	OM
				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			Check all bearing points play / wear	OM
<input type="checkbox"/>				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			Check cable winch oil level (RL 42B - 2 sep. oil chambers) (at least every 3 months)	OM
		<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			Change cable winch oil - clean vent plug (at least every 6 month)	OM
				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			Cable winch - removal and basic inspection of all wear parts according to guidelines per ANSI - specification B30.5c and API RP2D, paragraph 3 (at least every 12 months)	OM
GENERAL										
				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			Check complete machine for correct maintenance and proper condition	OM
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			Maintenance and inspections for special attachments must be checked and carried out according to separately issued manufacturer's OM by the manufacturer	Special OM
<input type="checkbox"/>									Explain machine literature, special operation manual / safety guidelines to operator and maintenance personnel	OM
1) For oil quality and viscosity, refer to chapter 5 'Service fluids'										

6.18 TIGHTENING TORQUES

According to WN 4037B

Installation preload forces F_M and tightening torques M_A according to DIN 13 section 13, wrench sizes for hex head screws according to ISO 4014, for socket head screws according to DIN 912. Beginning with grade 10.9, using lock washers no longer provides safety.

For special screws, such as Durlock or Tensilock, the tightening torques given by the manufacturer should be observed.

When using impact wrenches, make sure that the torque values are not exceeded. (Check torque with torque wrench!).

The torque values shown in the following charts can only be achieved with the use of a torque wrench.

If tightening torques are shown in drawings or in descriptions, then these values must be observed.

6.18.1 TIGHTENING TORQUES FOR SCREWS WITH STANDARD METRIC THREAD

Screw type: "black" or "5 μm white galvanized A2E"

Metric Standard Thread	Preload values F_M based on grades in N			Tightening torques M_A based on grades in Nm			Wrench size for			
	8.8	10.9	12.9	8.8	10.9	12.9	Hex head screws		Socket head screws	
							mm	Inch	mm	Inch
M 4 x 0,7	3 900	5 700	6 700	3,1	4,5	5,3	7	9/32	3	---
M 5 x 0,8	6 400	9 300	10 900	6,1	8,9	10,4	8	---	4	5/32
M 6 x 1	9 000	13 200	15 400	10,4	15,5	18	10	---	5	---
M 7 x 1	13 100	19 300	22 600	17	25	30	11	---	---	---
M 8 x 1,25	16 500	24 200	28 500	25	37	43	13	1/2	6	---
M 10 x 1,5	26 000	38 500	45 000	51	75	87	(17)16	(11/16)	8	---
M 12 x 1,75	38 500	56 000	66 000	87	130	150	(19) 18	(3/4)	10	---
M 14 x 2	53 000	77 000	90 000	140	205	240	(22) 21	(7/8)	12	---
M 16 x 2	72 000	106 000	124 000	215	310	370	24	61/64	14	9/16
M 18 x 2,5	91 000	129 000	151 000	300	430	510	27	1 - 1/16	14	9/16
M 20 x 2,5	117 000	166 000	194 000	430	620	720	30	1 - 3/16	17	43/64
M 22 x 2,5	146 000	208 000	243 000	580	970	830	(32) 34	1 - 9/32	17	43/64
M 24 x 3	168 000	239 000	280 000	740	1 060	1 240	36	1 - 7/16	19	3/4
M 27 x 3	221 000	315 000	370 000	1 100	1 550	1 850	41	1 - 5/8	19	3/4
M 30 x 3,5	270 000	385 000	450 000	1 500	2 100	2 500	46	1 - 13/16	22	7/8
M 33 x 3,5	335 000	480 000	560 000	2 000	2 800	3 400	50	2	24	61/64
M 36 x 4	395 000	560 000	660 000	2 600	3 700	4 300	55	2 - 3/16	27	1 - 1/16
M 39 x 4	475 000	670 000	790 000	3 400	4 800	5 600	60	2 - 3/8	27	1 - 1/16



NOTE:

Preload forces and tightening torques are based on lightly lubricated screws and nuts (corresponds to medium friction $\mu_G=0.14$).

Wrench size (x) = wrench size according to DIN 931

6.18.2 TIGHTENING TORQUES FOR SCREWS WITH FINE METRIC THREADS

Fine metric threads	Preload values F_M based on grades in N			Tightening torques M_A based on grades in Nm			Wrench size for			
	8.8	10.9	12.9	8.8	10.9	12.9	Hex head screws		Socket head screws	
							mm	Inch	mm	Inch
M 8 x 1	18 100	26 500	31 000	27	40	47	13	1/2	6	---
M 9 x 1	23 800	35 000	41 000	40	58	68	---	---	---	---
M 10 x 1	30 500	44 500	52 000	57	84	98	17	11/16	8	---
M 10 x 1,25	28 500	41 500	48 500	54	79	93	17	11/16	8	---
M 12 x 1,25	43 000	64 000	74 000	96	140	165	19	3/4	10	---
M 12 x 1,5	40 500	60 000	70 000	92	135	155	19	3/4	10	---
M 14 x 1,5	58 000	86 000	100 000	150	220	260	22	7/8	12	---
M 16 x 1,5	79 000	116 000	136 000	230	340	390	24	61/64	14	9/16
M 18 x 1,5	106 000	152 000	177 000	350	490	580	27	1 - 1/16	14	9/16
M 18 x 2	98 000	140 000	164 000	330	460	540	27	1 - 1/16	14	9/16
M 20 x 1,5	134 000	191 000	224 000	480	690	800	30	1 - 3/16	17	43/63
M 22 x 1,5	166 000	236 000	275 000	640	920	1 070	32	1 - 9/92	17	43/64
M 24 x 1,5	200 000	285 000	333 000	830	1 180	1 380	36	1 - 7/16	19	3/4
M 24 x 2	189 000	270 000	315 000	810	1 160	1 350	36	1 - 7/16	19	3/4
M 27 x 1,5	258 000	367 000	430 000	1 200	1 710	2 000	41	1 - 5/8	19	3/4
M 27 x 2	245 000	350 000	410 000	1 190	1 700	2 000	41	1 - 5/8	19	3/4
M 30 x 1,5	323 000	460 000	538 000	1 670	2 370	2 780	46	1 - 13/16	22	7/8
M 30 x 2	309 000	440 000	515 000	1 610	2 300	2 690	46	1 - 13/16	22	7/8
M 33 x 1,5	396 000	563 000	659 000	2 220	3 170	3 710	50	2	24	61/64
M 33 x 2	380 000	540 000	630 000	2 250	3 200	3 700	50	2	24	61/64
M 36 x 1,5	475 000	677 000	792 000	2 910	4 140	4 850	55	2 - 3/16	27	1 - 1/16
M 36 x 3	425 000	610 000	710 000	2 800	3 900	4 600	55	2 - 3/16	27	1 - 1/16
M 39 x 1,5	562 000	801 000	937 000	3 720	5 300	6 200	60	2 - 3/8	27	1 - 1/16
M 39 x 3	510 000	720 000	850 000	3 600	5 100	5 900	60	2 - 3/8	27	1 - 1/16

**NOTE:**

Preload forces and tightening torques are based on lightly lubricated screws and nuts (corresponds to medium friction $\mu_G=0.14$).

Expanded standard WN 4037B according to Roloff Matek

6.18.3 TIGHTENING TORQUES FOR SCREWS WITH STANDARD METRIC THREADS

Screw type: "8 µm galvanized, yellow chromated A3C"

Standard metric thread	Preload values F_M based on grades in N			Tightening torques M_A based on grades in Nm			Wrench size for			
	8.8	10.9	12.9	8.8	10.9	12.9	Hex head screws		Socket head screws	
							mm	Inch	mm	Inch
M 4 x 0,7							7	9/32	3	---
M 5 x 0,8	6 900	9 700		4,9	7,0		8	---	4	5/32
M 6 x 1	9 750	13 700		8,0	12,0		10	---	5	---
M 7 x 1							11	---	---	---
M 8 x 1,25	17 900	25 100		20	28		13	1/2	6	---
M 10 x 1,5	28 400	40 000		40	56		(17)16	(11/16)	8	---
M 12 x 1,75	41 500	58 500		69	98		(19) 18	(3/4)	10	---
M 14 x 2	56 500	80 000		110	155		(22) 21	(7/8)	12	---
M 16 x 2	78 500	110 000		170	240		24	---	14	9/16
M 18 x 2,5							27	1 - 1/16	14	9/16
M 20 x 2,5	122 000	172 000		330	465		30	1-3/16	17	43/64
M 22 x 2,5							(32) 34	1 - 9/92	17	43/64
M 24 x 3	176 000	248 000		570	800		36	1-7/16	19	3/4
M 27 x 3							41	1 - 5/8	19	3/4
M 30 x 3,5	282 000	397 000		1 150	1 600		46	1-13/16	22	7/8
M 33 x 3,5							50	2	24	---
M 36 x 4							55	2-3/16	27	1-1/16
M 39 x 4							60	2-3/8	27	1-1/16

**NOTE:**

Preload forces and tightening torques are based on lightly lubricated screws and nuts (corresponds to medium friction $\mu_G=0.10$).

Wrench size (x) = wrench size according to DIN 931

7. SPECIAL ATTACHMENTS / OPTIONS

The components or functions outlined in section 7 are special attachments or options which deviate from the machines standard equipment.

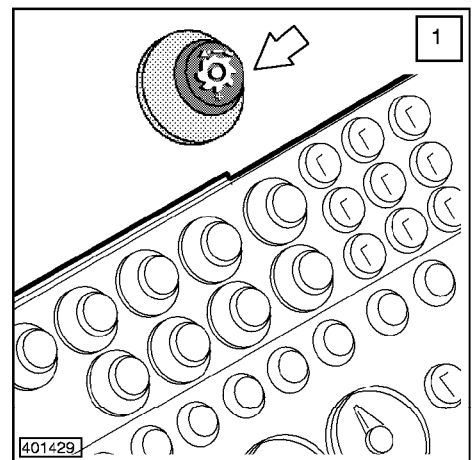
It is therefore possible that one or more of the functions outlined in section 3 or 4 are replaced by functions as outlined in group 7.

No matter which factory option is installed in the machine, the Operation and Maintenance Guidelines in section 1 through 6 remain valid.

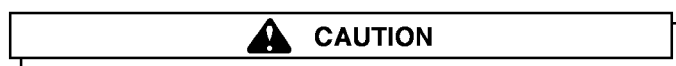
7.1 PIPE FACING ATTACHMENT

By pushing the switch (fig. 1), the hydraulic pressure can be diverted to the connections for the pipe facing machine.

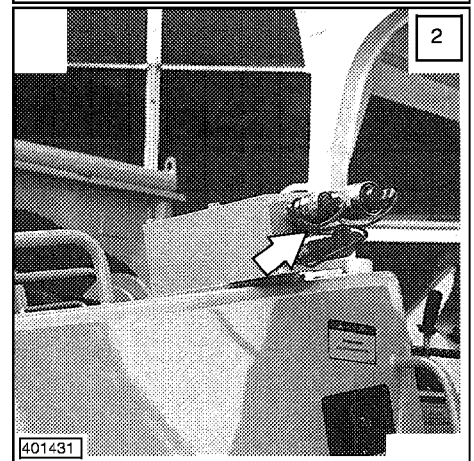
The indicator light lights up in the instrument panel as long as the switch is pushed.



The hydraulic connections are installed on the engine cover (fig. 2).



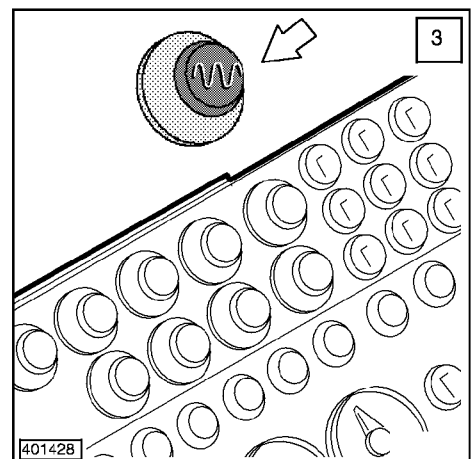
The hydraulic lines may only be connected or disconnected when the system is turned off.

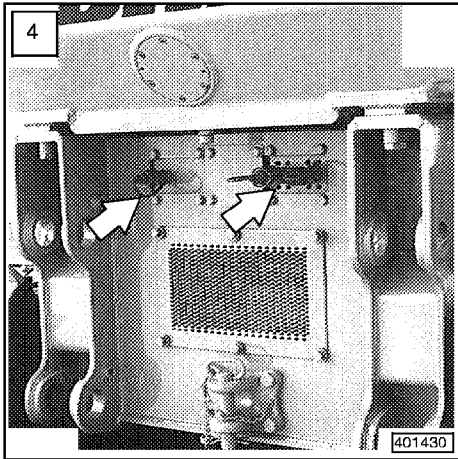


7.2 INSTALLATION OF WELDING GENERATOR

By pushing the switch (fig. 3), the hydraulic connections on the rear of the machine are pressurized.

The indicator light in the instrument panel lights up as long as the switch is pushed.





The hydraulic connections are installed on the rear of the machine (fig. 4).

CAUTION

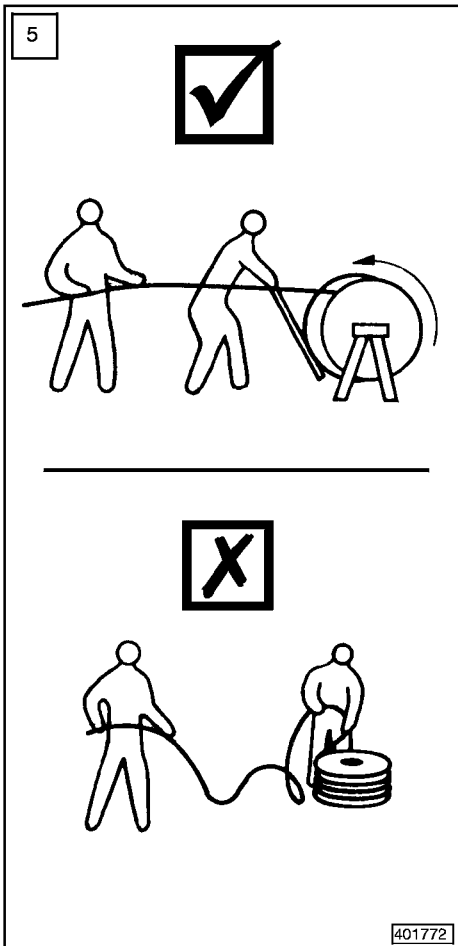
The hydraulic lines may only be connected or disconnected when the system is turned off.

7.3 CRANE CABLES

7.3.1 CABLE SELECTION

When changing the cables, make sure to use wire cables of the same type and strength as the original wire cable was when it was new. If you want to install another type of wire cable, you must first obtain the approval of the machine manufacturer.

Place a right-handed cable on a left-handed drum and reverse. Even lay cables experience less wear in multi-layer coiling than cross lay cables.



7.3.2 TO PLACE A CABLE

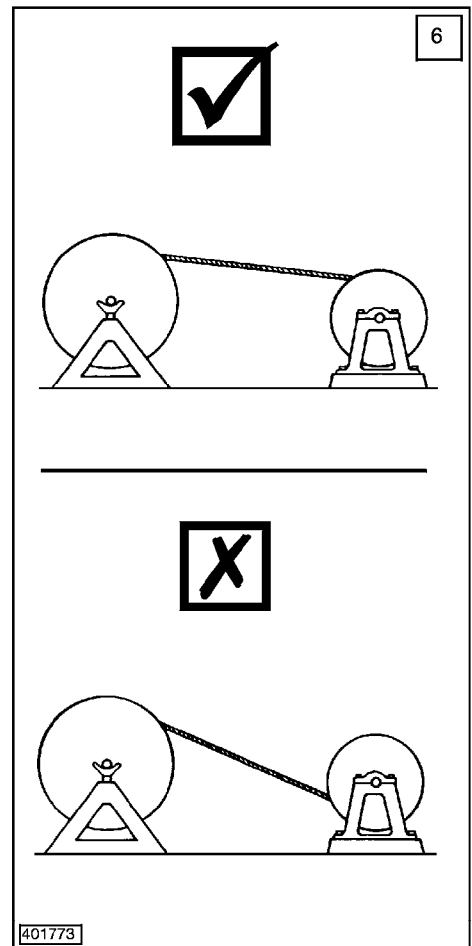
Wire cables are very vulnerable to external damage. They must be transported and unloaded very carefully. Spare wire cables should always be stored in a clean, cool and dry area. Do not lay them directly on the ground.

Hoist cables can only work properly only if they are placed without being twisted and damaged externally. The cables must be pulled off the reel or ring in the coiling direction (fig. 5). Pulling them sideways creates a twist in the cable, up to destruction due loop formation.

The best way to spool the cable onto the drum is from a raised reel (fig. 6). Winding the cable in the same bending direction prevents additional tension in the cable and provides the best coiling contact on the drum. Cables may not be pulled over the ground and soiled.

In multi layer coiling, the lower layers must also be coiled tightly at a pretension of 1 - 2 % of the minimum break force of the cable. This pretension can be obtained by slowing down the cable reel rotation.

After placing the cable, run it in at first with several hoisting movements at low partial loads and then change to loaded and unloaded hook block. As a result, the cable will adapt more flexibly to the bending direction and the bending radii of pulleys and drums.



7.3.3 MAINTENANCE AND CARE

Regular cable care ensures the safety of crane operation and increases the service life of the cable significantly.

Wire cables must be lubricated in regular intervals, depending on the operating conditions, especially in the area of the bending zones on drums and pulleys. Tests have shown that well lubricated cables have 4 times as much bending fatigue strength as un-lubricated cables, under the same test conditions.

The subsequent lubricants must be compatible with the original cable lubricants.

We recommend the following lubricants:

- Generally commercially available lubricants, as recommended by the crane manufacturer for open gears.
- Special cable lubricants, such as
Texaco Novatex Grease EP2
Aral Aralub LFZ 1
- In especially severe utilization via multi layer coiling, use graphite based lubricants, such as
Reiner Ceplattyn KG 19
Texaco Novatex FK10

Dirty wire cables should be cleaned regularly, by brushing. If the lower cable layers on the drum are rarely or not at all used, then they should be uncoiled from time to time and replaced under pretension. A cable works the most economical if it is always utilized in its entire length. For that reason, we recommend to always use the proper cable length for extended crane hoisting tasks. If some sections of the cable are stressed differently, then the cable should be turned after a certain operating time. If the previously free end of the cable is now attached on the drum, then the previously unstressed cable sections will now be in less stressed zones, which in turn can significantly extend the service life of the cable.

7.3.4 MONITORING

Crane cables are designed to still provide sufficient safety to place the new cable when the first wire breaks occur.

The cables must be inspected regularly, especially during the initial time of placement; in addition to unusual strain, in case of suspected, non-visible damage or when the first signs of cable damage appear.

The operational safety of the cables can be evaluated according to the following criteria:

- Type and number of broken wires (see chart)
- Position and timing of broken wires
- Reduction of cable diameter during operating time
- Corrosion, abrasion, cable distortions
- Heat effects
- Total time of utilization

Beginning changes in cable behavior must be monitored especially careful.



CAUTION

As soon as the cable strands above the hook block collapse, there is the danger of serious cable damage. The cause is always additional torsional stress in the torsion-free hoist cable, which can be caused by a variety of influences and problems, but also due to special extension stress of the hoist cable in severe applications. The compensation of such additional torsional stress requires great care and expertise.

Turn out the hook block for non-rotating cable fixed point:

- Set down the hook block.
- Determine the turn-in direction.
- Loosen the cable on the fixed point.
- Carefully turn the free cable end by 180 - 360 degrees in such a way to compensate for the turn-in of the hook block. The correct turning direction can possibly be determined by simulating it with a string.
- Reattach the cable on the fixed point.
- Carefully raise the hook block and run it without a load with the hook block and possibly with an available trolley.
- Repeat the procedure, if necessary.

Make sure that the twist is made in a free, especially long cable section. By running it without a load, the twist should be distributed to the entire cable length. Under no circumstances turn the cable by force over a short cable length, this could permanently destroy the cable structure.

The cable end connections and the cable suspensions must be checked for proper condition. The individual elements of cable drive, cable drum and pulleys must be able to turn easily in their bearings, and may not show a depression of the cable profile in the base groove. The groove radius on drums and pulleys should be at least 0.53 x nominal cable diameter.

7.3.5 DISCARD TIME OF WIRE CABLES DUE TO BROKEN WIRES

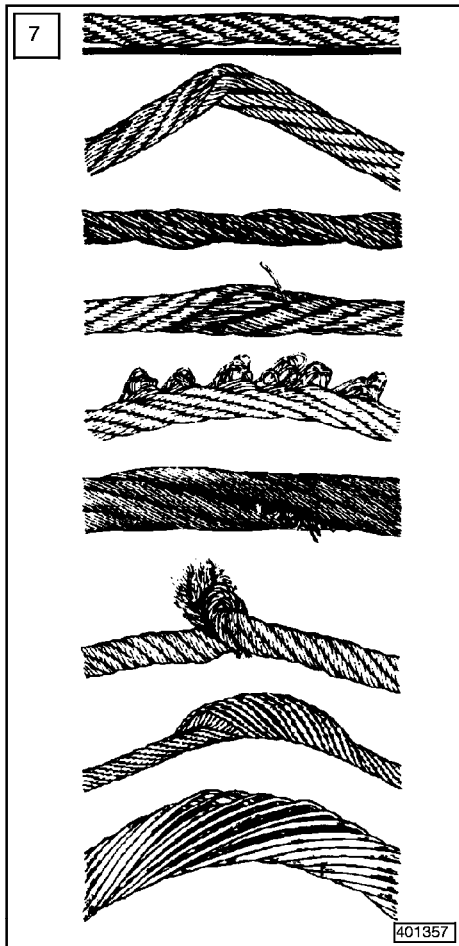
Number of carrying wires in outer strands of wire cable ³⁾ n	Number of visible broken wires at wear limit							
	Driving mechanism groups 1E _m , 1D _m , 1C _m , 1B _m , 1A _m				Driving mechanism groups 2 _m , 3 _m , 4 _m , 5 _m			
	Cross lay		Even lay		Cross lay		Even lay	
	At a length of		At a length of		At a length of		At a length of	
6 d	30 d	6 d	30 d	6 d	30 d	6 d	30 d	
to 50	2	4	1	2	4	8	2	4
51 to 75	3	6	2	3	6	12	3	6
76 to 100	4	8	2	4	8	16	4	8
101 to 120	5	10	2	5	10	19	5	10
121 to 140	6	11	3	6	11	22	6	11
141 to 160	6	13	3	6	13	26	6	13
161 to 180	7	14	4	7	14	29	7	14
181 to 200	8	16	4	8	16	32	8	16
201 to 220	9	18	4	9	18	35	9	18
221 to 240	10	19	5	10	19	38	10	19
241 to 260	10	21	5	10	21	42	10	21
261 to 280	11	22	6	11	22	45	11	22
281 to 300	12	24	6	12	24	48	12	24
above 300 ⁴⁾	0,04 . n	0,08 . n	0,02 . n	0,04 . n	0,08 . n	0,16 . n	0,04 . n	0,08 . n

For cables with especially thick wires in the outer layers of the outer strands, such as round stranded cables 6x19 Seale according to DIN 3058 or round stranded cables 8x19 Seale according to DIN 3062, the number of visible broken wires at wear limit is 2 lines less than stated on the chart values.
Driving mechanism groups according to DIN 15 020, page 1

d Wire cable diameter
Filler wires are not considered as load carrying.

3) For wire cables with several layers, only the strands in the outermost layer are considered „outer strands“. For wire cables with steel insert, the insert should be viewed as an inner strand.

4) The calculated numbers must be rounded up.



7.3.6 DISCARD TIME

! DANGER

For safety reasons, crane cables must be discarded in time if one of the following criteria is present (fig. 7)

- Broken strand
- Formation of broken wire clusters
- When the number of broken wires, as shown on the chart, is reached
- Corkscrew type distortion by more than 1/3 of the cable diameter
- Basket formation
- Hair pin shaped protrusion of wires or wire strands from the cable
- Reduction of cable diameter by more than 15 % of the nominal diameter or by 10 % with simultaneous corrosion and / or abrasion
- Loosening of the cable structure
- Constriction
- Sharp bends and compressions
- Kinked sections or permanent distortions

If any of the above damages are discovered, find the cause and take care of it before placing a new cable. Damages and cable marks on the construction components can be useful in determining the reasons for these damages.

If there is any doubt about the operational safety of a crane cable, then it should be removed or an expert should be called in for further evaluation.