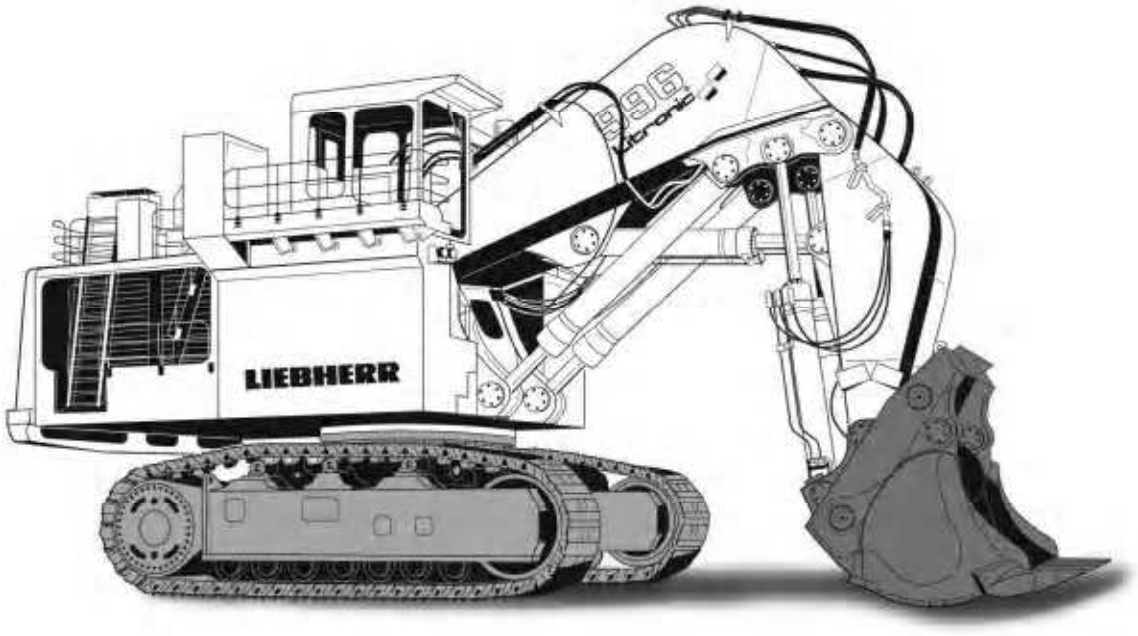
# Operation and Maintenance Manual

# R 996

## Litronic



# FOREWORD

This manual is primarily for the operator and the maintenance crew and contains information which is vital to the correct and secure operation and proper maintenance of the LIEBHERR excavator.

It includes:
- Accident Prevention Guidelines
- Operating Instructions
- Maintenance Instructions.

This Operation and Maintenance manual should be given to the OPERATOR and any other person, who might work on the machine. It is very important that should read the manual carefully before operating or working on the LIEBHERR excavator and at regular intervals thereafter, for example:

- Operation, including installing and removing the attachments, trouble,
- shooting during operation, removing production residue, care, disposing of operating and auxiliary fluids,
- Maintenance work (maintenance, inspection, repair),
- Transportation.

The manual will make it easier for the operator to get accustomed to the hydraulic excavator and to prevent any problems due to improper handling.

All maintenance personnel should follow the operating and maintenance instructions and your LIEBHERR excavator will give you constant and reliable service with excellent performance, reducing repair costs and downtime.

In addition to the operating and maintenance guidelines in this manual, additional local and national accident prevention guidelines and environmental regulations might be applicable and must be observed.

**The Operation and Maintenance Manual is part of the machine and should be left in the glove compartment of the operator's cab.**

Please take notice that we cannot honor any claims which could arise due to careless handling, improper operation, inadequate maintenance, use of unauthorized oils or lubricants, non-observance of the safety instructions, etc.

LIEBHERR reserves the right to cancel any warranty claims, service contracts etc. without prior notice if any other than Original LIEBHERR parts or parts sold by LIEBHERR are being used for maintenance and repairs.

This Operation and Maintenance manual contains all necessary information to operate and maintain your Litronic track type excavator. However, should you need additional information or explanations, please contact LIEBHERR's Technical Documentation, Service school or Customer Service Department.

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**INFORMATION ABOUT THE OPERATION AND MAINTENANCE MANUAL R 996 Litronic**

## ISSUE : …… 06 / 05
## ID. / NO : ……... 8503721

This Operation and Maintenance Manual is valid for R996 excavators from the following serial numbers:

| TYP | Valid from Serial Number |
|---|---|
| 173 | 115 |

We recommend that you fill in the following table as soon as you receive your excavator. This will also be helpfull when you order parts.

| | |
|---|---|
| **Product Id. No (PIN No.):** | . . . / . . . . |
| **Manufacturing Date :** | CE 2006 |
| **Delivery Date :** | . . / . . / . . |

This excavator meets EC Safety guidelines 89/392/EEC, 89/336/EEC and 91/368/EEC.
Noise emission data has been measured according to EC guidelines 86/662/EEC and 89/514/EEC.
Die Abgaben fьr Schall – Emission wurden nach EG Richtlinie 89/662/EWG gemessen.

**We reserve the right to make any technical changes compared to data and illustrations given in this manual.**

**Warranty and liability are subject to LIEBHERR's general business terms and conditions are not changed in any way by instructions in this manual.**



Manufacturer : LIEBHERR France S.A.S 2 Avenue Joseph Rey, F-68005 COLMAR, FRANCE

# Technical Description
# Hydraulic Excavator

# R 996
Litronic®

**Operating Weight with Backhoe Attachment 659 t/1,452,800 lb**
**Operating Weight with Shovel Attachment 672 t/1,482,827 lb**
**Engine Output 3000 hp (2240 kW)**
**Bucket Capacity 30,00 – 33,00 m³/39.2 – 43.1 yd³**
**Shovel Capacity 29,00 – 34,00 m³/37.9 – 44.4 yd³**


LIEBHERR

# Technical Data

## Engine

2 Cummins diesel engines
- Rating per
- SAE J 1995 — 3000 hp (2240 kW) at 1800 RPM
- Model — K 1800 E
- Type — 16 cylinder V-engine, water-cooled, direct injection, turbo-charged, after-cooler
- Displacement — 50,3 l/3069 cu in
- Bore/Stroke — 159/159 mm/6.26/6.26 in

Air cleaner — dry-type air cleaner with pre-cleaner, with automatic dust ejector, primary and safety elements
Fuel tank — 13 000 l/3440 gal
Electrical system
- Voltage — 24 V
- Batteries — 8 x 170 Ah/12 V
- Alternator — 2 x 24 V/150 Amp

Engine idling — sensor controlled

## Hydraulic System

Hydraulic pumps
- for attachment and travel drive — 8 variable flow axial piston pumps
- Max. flow — 8 x 840 l/min./8 x 222 gpm
- Max. hydr. pressure — 320 bar/4640 PSI

Hydraulic pumps
- for swing drive — 4 reversible swash plate pumps, closed-loop circuit
- Max. flow — 4 x 413 l/min./4 x 109 gpm
- Max. hydr. pressure — 350 bar/5076 PSI

Pump regulation — electro-hydraulic, pressure compensation, flow compensation, automatic oil flow optimizer
Hydraulic tank capacity — 4600 l/1215 gal
Hydraulic system capacity — 8200 l/2166 gal
Hydraulic oil filter — filtration of entire return flow, 1 high pressure filter for each main pump
Hydraulic oil cooler — 2 separate coolers, 4 temperature controlled fans driven via hydraulic piston motors
Electronic engine speed sensing — over the entire engine RPM range
Lubrication — central lubrication system

## Hydraulic Controls

Servo circuit — independant, electric over hydraulic proportional controls of each function
- Emergency control — via accumulator for all attachment functions with stopped engine

Power distribution — via monoblock control valves with integrated primary relief valves and flanged on secondary valves for travel
- Flow summation — to attachment and travel drive

Control functions
- Attachment and swing — proportional via joystick levers
- Travel — proportional via foot pedals or hand levers
- Bottom dump bucket — proportional via foot pedals

Operation with one engine possible

## Swing Drive

Hydraulic motor — 4 Liebherr axial piston motors
Swing gear — 4 Liebherr planetary reduction gears
Swing ring — Liebherr, sealed triple roller swing ring, internal teeth
Swing speed — 0–3.5 RPM
Swing-Holding brake — hydraulically released, maintenance-free, multi-disc brakes integrated in each swing gear

## Uppercarriage

Design — torque resistant designed upper frame in box type construction for superior strength and durability
Attachment mounting — parallel longitudinal main girders in box-section construction
Catwalks — on the right side with a hydraulically driven access ladder, additional emergency ladder in front of the cab

## Service Flap

Design — hydraulically actuated service flap, easily accessible from ground level to allow:
- – fuel fast refill
- – hydraulic oil refill
- – engine oil quick change
- – splitterbox oil quick change
- – swing gearbox oil quick change
- – swing ring gearing grease barrel refilling via grease filter
- – attachment/swing ring bearing grease barrel refilling via grease filter
- – windshield washer water refilling

Quick coupler upon request

# Technical Data

## Operator's Cab

| | |
|---|---|
| Design | resiliently mounted, sound insulated, large windows for all-around visibility, integrated falling object protection FOPS |
| Operator's seat | suspended, body-contoured with shock absorber, adjustable to operator's weight |
| Cabin windows | 20,5 mm/0.8 in tinted armored glass for front window and left hand side windows, all other windows in tinted safety glass, high pressure windshieldwasher-system with 75 l/20 gal watertank, sun louvers on all windows in heavy duty design |
| Heating system/ Air conditioning | heavy duty, high output air conditioner and heater unit |
| Cabin pressurization | ventilation unit with filters |
| Controls | joystick levers integrated into armrest of seat |
| Monitoring | via LCD-Display, data memory |
| Automatic engine shut off | in case of low engine oil pressure or low coolant level |
| Destroking of main pumps | in case of engine overheating or low hydraulic oil level |
| Safety functions | additional gauges with constant display for: engine speed, hourmeter, engine oil pressure, coolant temperature and hydraulic oil temperature |

## Undercarriage

| | |
|---|---|
| Design | 3-piece undercarriage, box type structures for center piece and side frames, stress relieved |
| Hydraulic motor | 2 axial piston motors per side frame |
| Travel gear | Liebherr reduction gear |
| Travel speed | 0–2,2 km/h/0–1.4 mph |
| Parking brake | spring engaged, hydraulically released wet multi-disc brakes for each travel motor, maintenance-free |
| Track components | maintenance-free combined pad-link, heavy duty track shoes |
| Track rollers/ Carrier rollers | 7/3 |
| Automatic track tensioner | pressurized hydraulic cylinder with accumulator, maintenance free |
| Transport | undercarriage side frames are removable |

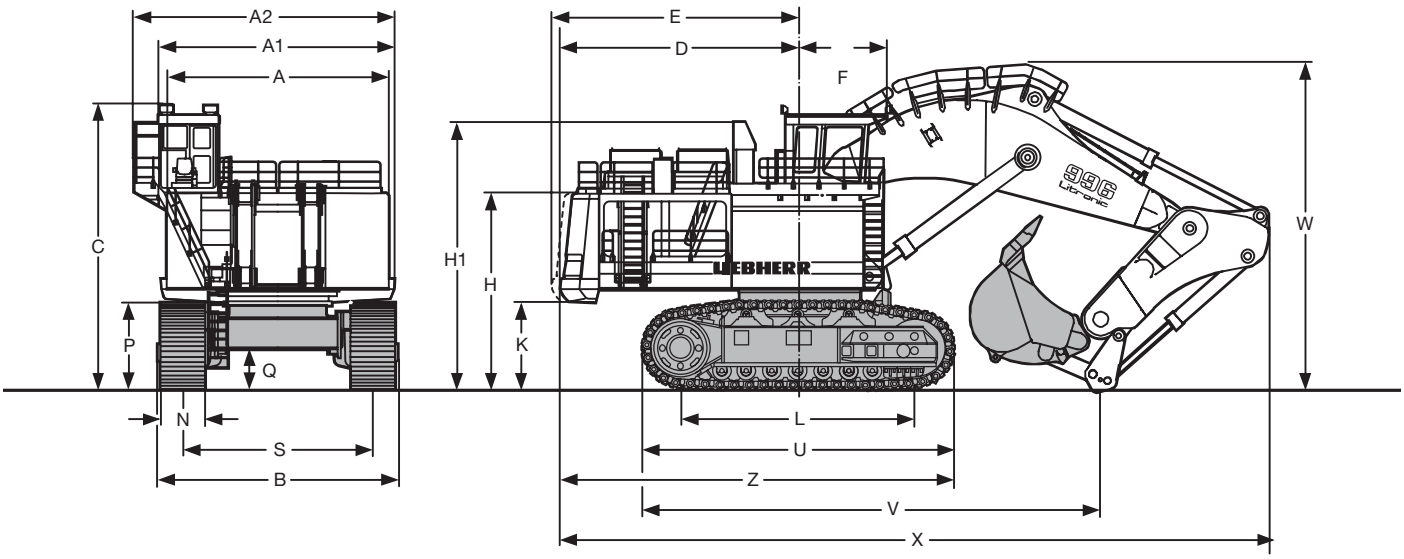
## Central Lubrication System

| | |
|---|---|
| Type | Lincoln Centromatic lubrication system for the entire attachment and swing ring |
| Grease pumps | 2 Lincoln Powermaster pumps with switch over function, plus 1 separate pump for swing ring teeth |
| Capacity | 1 x 600 l/158.5 gal bulk container for attachment and swing ring, separated 1 x 80 l/21 gal grease drum for swing ring teeth |

## Attachment

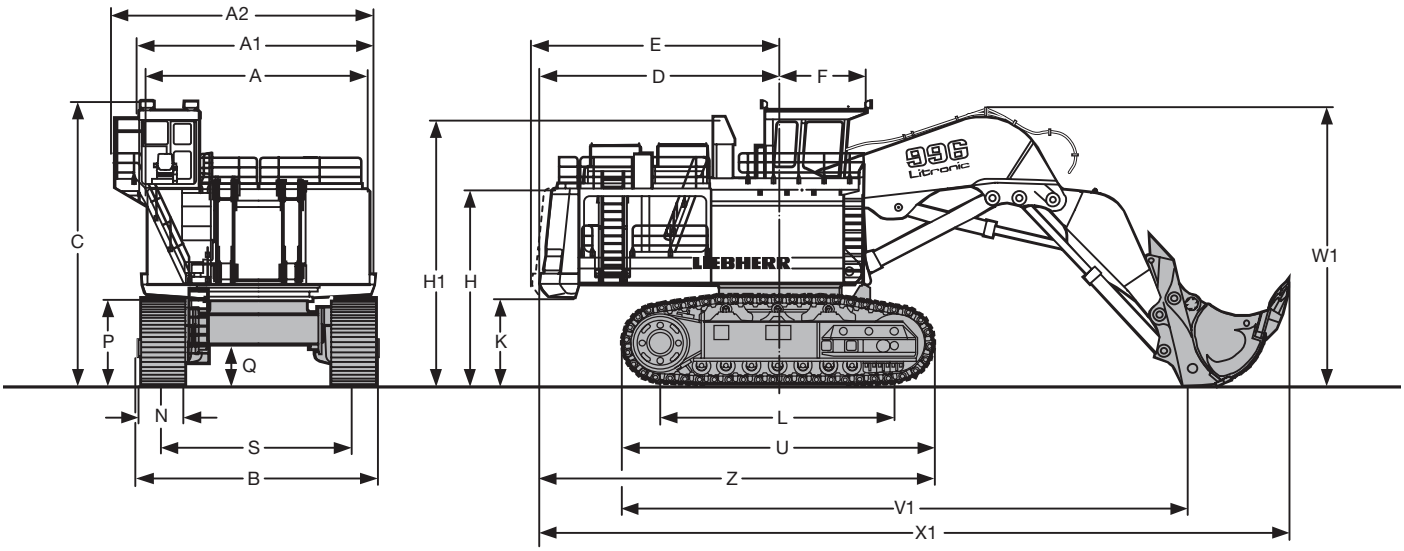
| | |
|---|---|
| Design | box type structure with large steel castings in all high-stress areas |
| Pivots | sealed with double side centering with 1 single floating pin per side, all bearings with wear resistant, steel bushings, bolts hardened and chromium-plated |
| Hydraulic cylinders | Liebherr design, all cylinders located in well protected areas |
| Hydraulic connections | pipes and hoses equipped with SAE split flange connections |
| Kinematics | Liebherr parallel face shovel attachment geometry |

# Dimensions




| | mm/ft in |
|---|---|
| A | 7000/22’11” |
| A1 | 7430/24’ 4” |
| A2 | 8250/27’ 1” |
| B | 7650/25’ 1” |
| C | 9070/29’ 9” |
| D | 7550/24’ 9” |
| E | 7795/25’ 7” |
| F | 2780/ 9’ 1” |
| H | 6275/20’ 7” |
| H1 | 8480/27’10” |
| K | 2845/ 9’ 4” |

| | mm/ft in |
|---|---|
| L | 7500/24’ 7” |
| U | 10000/32’ 9” |
| P | 2985/ 9’ 9” |
| Q | 1435/ 4’ 8” |
| S | 6000/19’ 8” |
| N | 1400/ 55” |
| W | 9750/32’ |
| V | 14350/47’ 1” |
| X | 22600/74’ 1” |
| Z | 12465/40’10” |

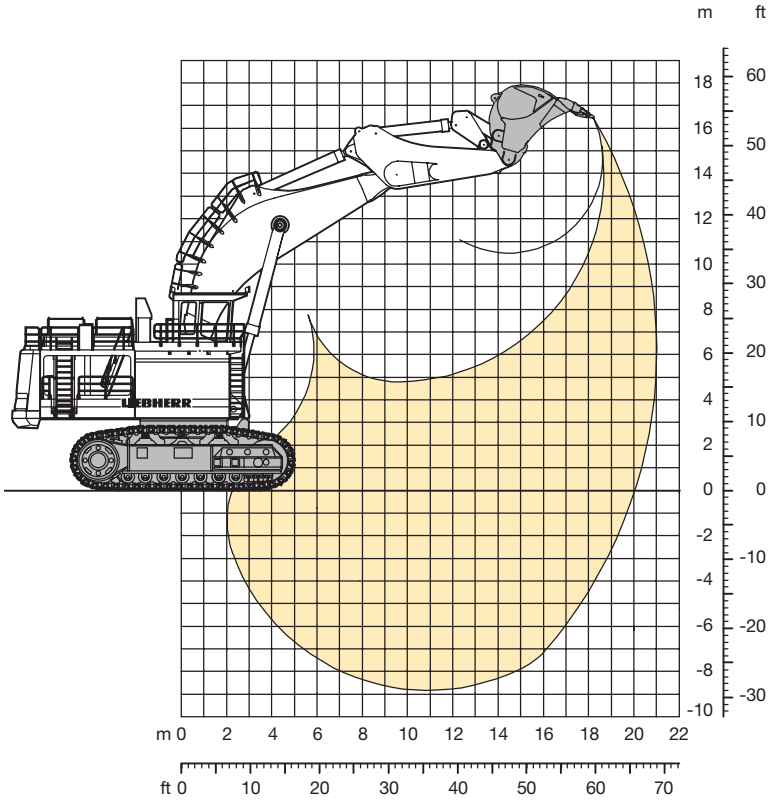



| | mm/ft in |
|---|---|
| A | 7000/22’11” |
| A1 | 7430/24’ 4” |
| A2 | 8250/27’ 1” |
| B | 7650/25’ 1” |
| C | 9070/29’ 9” |
| D | 7550/24’ 9” |
| E | 7795/25’ 7” |
| F | 2780/ 9’ 1” |
| H | 6275/20’ 7” |
| H1 | 8480/27’10” |
| K | 2845/ 9’ 4” |

| | mm/ft in |
|---|---|
| L | 7500/24’ 7” |
| U | 10000/32’ 9” |
| P | 2985/ 9’ 9” |
| Q | 1435/ 4’ 8” |
| S | 6000/19’ 8” |
| N | 1400/ 55” |
| W1 | 8500/27’10” |
| V1 | 17800/58’ 4” |
| X1 | 23450/76’11” |
| Z | 12465/40’10” |

# Backhoe Attachment

## with Gooseneck Boom 11,75 m/38’6”




## Digging Envelope

| | |
|---|---|
| Stick | 5,00 m/16’ 4” |
| Max. reach at ground level | 20,00 m/65’ 7” |
| Max. teeth height | 16,60 m/54’ 5” |
| Max. dump height | 10,50 m/34’ 5” |
| Max. digging depth | 8,80 m/28’10” |
| Max. digging force | 1500 kN (153,0 t)/337,100 lb |
| Max. breakout force | 1670 kN (170,2 t)/375,300 lb |

## Operating Weight and Ground Pressure

The operating weight includes the basic machine with backhoe attachment and bucket 33,00 m³/43.1 yd³.

| | | |
|---|---|---|
| Pad width | mm/in | 1400/55 |
| Weight | kg/lb | 659000/1,452,800 |
| Ground pressure | kg/cm²/PSI | 2,81/39.97 |

## Bucket

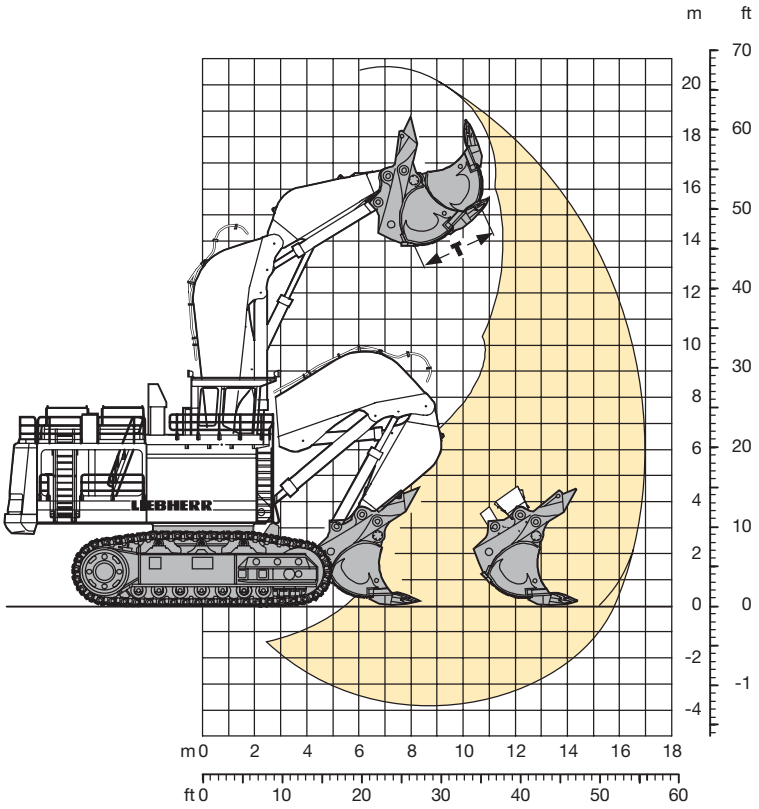
| | | | |
|---|---|---|---|
| Cutting width SAE | mm/in | 4800/189”[1)] | 4800/189”[1)] |
| Capacity SAE heaped | m³/yd³ | 30,00/39.2 | 33,00/43.1 |
| Weight | kg/lb | 39000/85,980 | 41200/90,760 |
| Suitable for material up to a specific weight of | t/m³/lb/yd³ | 2,20/3700 | 1,80/3000 |
| Wear kit level | | II | II |

[1)] Bucket with delta cutting edge and tooth system Posilok size S 145.
Level II: For rock which is not detoriorated or cracked.

Additional buckets on request.

# Shovel Attachment

## with Shovel Boom 8,00 m/26’3”




## Digging Envelope

| | |
|---|---|
| Shovel stick | 5,00 m/16’ 4” |
| Max. reach at ground level | 15,60 m/51’ 2” |
| Max. dump height | 14,30 m/46’11” |
| Max. crowd length | 6,40 m/21’ |
| Bucket opening width T | 2800 mm/110” |
| Crowd force at ground level | 1960 kN (199,8 t)/440,450 lb |
| Max. crowd force | 2340 kN (238,5 t)/525,850 lb |
| Max. breakout force | 1905 kN (194,2 t)/428,100 lb |

## Operating Weight and Ground Pressure

The operating weight includes the basic machine with shovel attachment and bottom dump bucket 34,00 m³/44.4 yd³.

| | | |
|---|---|---|
| Pad width | mm/in | 1400/55 |
| Weight | kg/lb | 672000/1,482,827 |
| Ground pressure | kg/cm²/PSI | 2,870/40.82 |

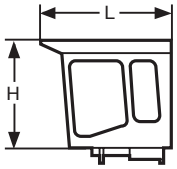
## Bottom Dump Bucket

| | | | |
|---|---|---|---|
| Cutting width SAE | mm/in | 4700/185”[1)] | 5500/217”[1)] |
| Capacity SAE heaped | m³/yd³ | 29,00/37.9 | 34,00/44.4 |
| Weight | kg/lb | 58900/129,850 | 64000/141,000 |
| Suitable for material up to a specific weight of | t/m³/lb/yd³ | 2,20/3700 | 1,80/3000 |
| Wear kit level | | II | II |

[1)] Bottom dump bucket with delta cutting edge and tooth system Posilok size S 145
Level II: For rock which is not deteriorated or cracked.

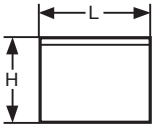
Additional bottom dump buckets on request.

# Component Dimensions and Weights



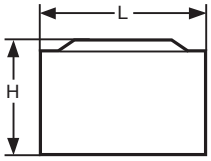

## Cab

| | | | |
|---|---|---|---|
| L | Length | mm/ft in | 3215/10’ 6” |
| H | Height | mm/ft in | 2885/ 9’ 6” |
| | Width | mm/ft in | 1900/ 6’ 3” |
| | Weight | kg/lb | 2800/6,200 |



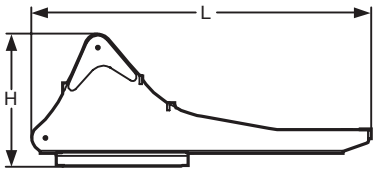

## Cab Elevation with Fuel Tank

| | | | |
|---|---|---|---|
| L | Length | mm/ft in | 4150/13’ 7” |
| H | Height | mm/ft in | 3100/10’ 2” |
| | Width | mm/ft in | 2700/ 8’10” |
| | Weight | kg/lb | 8000/17,650 |



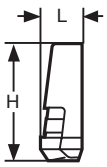

## Powerpack Modules (two)

| | | | |
|---|---|---|---|
| L | Length | mm/ft in | 5280/17’ 4” |
| H | Height | mm/ft in | 3640/11’11” |
| | Width | mm/ft in | 2070/ 6’ 9” |
| | Weight | kg/lb | 2 x 22000/2 x 48,500 |



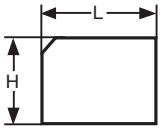

## Rotation Deck (with swing ring, swing gears and control valve bracket)

| | | | |
|---|---|---|---|
| L | Length | mm/ft in | 9750/32’ |
| H | Height | mm/ft in | 4250/13’11” |
| | Width | mm/ft in | 4270/14’ |
| | Weight | kg/lb | 83100/183,200 |



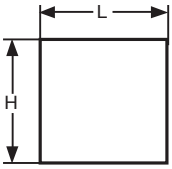

## Counterweight

| | | | |
|---|---|---|---|
| L | Length | mm/ft in | 1250/ 4’ 1” |
| H | Height | mm/ft in | 3430/11’ 3” |
| | Width | mm/ft in | 7360/24’ 2” |
| | Weight | kg/lb | 60000/132,300 |




## Hydraulic Oil Cooling
with hydraulic tank without hydraulic oil

| | | | |
|---|---|---|---|
| L | Length | mm/ft in | 4210/13’10” |
| H | Height | mm/ft in | 3100/10’ 2” |
| | Width | mm/ft in | 2100/ 6’11” |
| | Weight | kg/lb | 8000/17,650 |



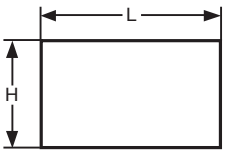

## Compartment Panel (two)

| | | | |
|---|---|---|---|
| L | Length | mm/ft in | 4145/13’ 7” |
| H | Height | mm/ft in | 3100/10’ 2” |
| | Width | mm/ft in | 950/ 3’ 1” |
| | Weight | kg/lb | 2 x 1500/2 x 3,300 |

## Hydraulic Oil

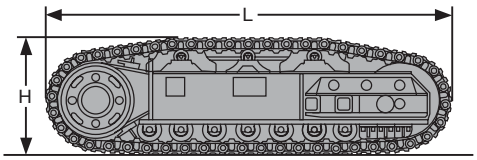
| | | | |
|---|---|---|---|
| | Weight | kg/lb | 8000/17,640 |

# Component Dimensions and Weights



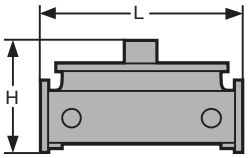

## Miscellaneous

| | | | |
|---|---|---|---|
| L | Length | mm/ft in | 4500/14’ 9” |
| H | Height | mm/ft in | 2600/ 8’ 6” |
| | Width | mm/ft in | 2000/ 6’ 7” |
| | Weight | kg/lb | 5000/11,100 |



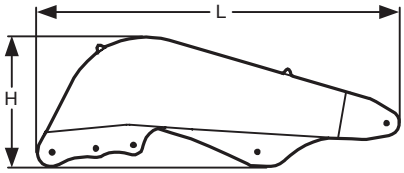

## Side Frame (two)

| | | | |
|---|---|---|---|
| L | Length | mm/ft in | 10000/32’ 9” |
| H | Height | mm/ft in | 2985/ 9’ 9” |
| | Width over travel drive | mm/ft in | 2700/ 8’11” |
| | Width without travel drive | mm/ft in | 2225/ 7’ 4” |
| | Weight | kg/lb | 2 x 117000/2 x 258,000 |




## Undercarriage Central Girder

| | | | |
|---|---|---|---|
| L | Length | mm/ft in | 4000/13’ 1” |
| H | Height | mm/ft in | 2690/ 8’10” |
| | Width | mm/ft in | 4600/15’ 1” |
| | Weight | kg/lb | 40000/88,200 |

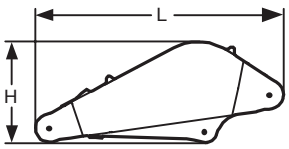



## Shovel Boom

| | | | |
|---|---|---|---|
| L | Length | mm/ft in | 8650/28’ 4” |
| H | Height | mm/ft in | 3300/10’10” |
| | Width | mm/ft in | 3350/11’ |
| | Weight | kg/lb | 59140/130,400 |

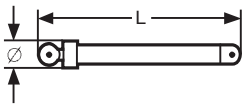

## Hoist Cylinder (two)

| | | | |
|---|---|---|---|
| L | Length | mm/ft in | 5430/17’10” |
| Ø | Diameter | mm/in | 600/ 24” |
| | Weight | kg/lb | 2 x 5910/2 x 13,050 |



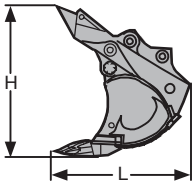

## Shovel Stick

| | | | |
|---|---|---|---|
| L | Length | mm/ft in | 5620/18’ 5” |
| H | Height | mm/ft in | 2300/ 7’ 6” |
| | Width | mm/ft in | 3350/11’ |
| | Weight | kg/lb | 27150/59,850 |




## Crowd Cylinder (two)

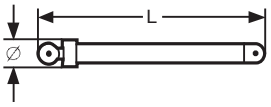
| | | | |
|---|---|---|---|
| L | Length | mm/ft in | 3880/12’ 9” |
| Ø | Diameter | mm/in | 490/ 19” |
| | Weight | kg/lb | 2 x 3430/2 x 7,560 |




## Bottom Dump Bucket (including clam cylinders)

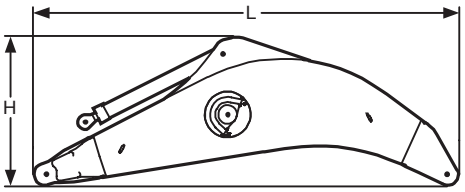
| | | | |
|---|---|---|---|
| Cutting width | mm/in | 4700/185” | 5500/217” |
| Capacity | $m^3/yd^3$ | 29,00/37.9 | 34,00/44.4 |
| L Length | mm/ft in | 4650/15’3” | 4650/15’3” |
| H Height | mm/ft in | 4500/14’9” | 4500/14’9” |
| Width | mm/ft in | 4700/15’5” | 5500/18’ |
| Weight | kg/lb | 58900/129,850 | 64000/141,000 |

# Component Dimensions and Weights



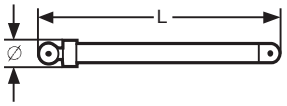

## Bucket Tilt Cylinder (two)

| | | | |
|---|---|---|---|
| L | Length | mm/ft in | 4690/15’ 5” |
| Ø | Diameter | mm/in | 490/ 19” |
| | Weight | kg/lb | 2 x 3670/2 x 8,090 |



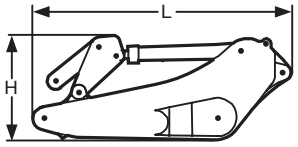

## Gooseneck Boom with Two Stick Cylinders

| | | | |
|---|---|---|---|
| L | Length | mm/ft in | 12500/41’ |
| H | Height | mm/ft in | 4500/14’ 9” |
| | Width | mm/ft in | 2800/ 9’ 2” |
| | Weight | kg/lb | 68950/152,000 |



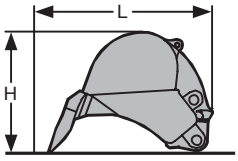

## Hoist Cylinders (two)

| | | | |
|---|---|---|---|
| L | Length | mm/ft in | 5430/17’10” |
| Ø | Diameter | mm/in | 600/ 24” |
| | Weight | kg/lb | 2 x 6060/2 x 13,360 |




## Stick with Two Bucket Cylinders

| | | | |
|---|---|---|---|
| L | Length | mm/ft in | 7500/24’ 7” |
| H | Height | mm/ft in | 3300/ 9’10” |
| | Width | mm/ft in | 2500/ 8’ 2” |
| | Weight | kg/lb | 42000/92,594 |




## Backhoe Buckets

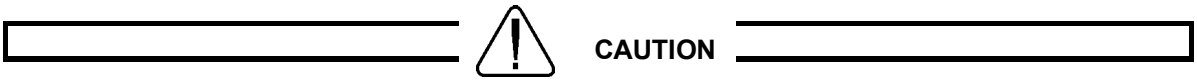
| | | | | |
|---|---|---|---|---|
| Cutting width | | mm/in | 4800/189” | 4800/189” |
| Capacity | | $m^3/yd^3$ | 30,00/39.2 | 33,00/43.1 |
| L | Length | mm/ft in | 4650/15’ 3” | 4650/15’ 3” |
| H | Height | mm/ft in | 3150/10’ 4” | 3300/10’10” |
| | Width | mm/ft in | 4850/15’11” | 4850/15’11” |
| | Weight | kg/lb | 39000/86,000 | 41200/90,760 |

# 2. SAFETY INFORMATION

Working with an excavator can be dangerous, it could result in injury or death if proper precautions are not taken! **WE URGE YOU TO READ THIS MANUAL CAREFULLY!** This safety information is provided to operators and maintenance mechanics to ensure the safe operation and maintenance of the excavator. It is essential that you read and familiarise yourself with this information, which explains safety requirements, precautions and specific hazards of which you should be aware. This also applies to any personnel, who might be working on the machine only occasionally, such as during set up or maintenance. It is essential that you read and familiarise yourself with this information, which explains safety requirements and precautions and specific hazards of which you should be aware. Careful adherence to these safety guidelines will permit safe operation and maintenance and potentially prevent personal injury to yourself and others, and possible damage to the excavator. Important safety notes such as **DANGER, CAUTION** or **NOTE** are used throughout this manual to emphasise important or critical instructions.

In this manual, **DANGER, CAUTION** or **NOTE** are defined as follows :


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




Denotes a reminder of safety practices or directs attention to unsafe practices if proper precautions are not taken.

**NOTE** describes operation and maintenance procedures, which should be followed to keep your excavator in operation and to insure long machine life and / or to facilitate certain procedures.

**In addition to these instructions you must follow the safety regulations applicable to your work environment and job site and any federal, state and local safety requirements (a model excavators must also follow local and federal highway regulations).**

For EC countries, guidelines 89 / 655 / EWG contain the minimum safety guidelines for users.

## DESTINED USE

The excavator with the standard backhoe, grapple or bucket attachment may only be used to loosen, pick up, move, load and dump soil, gravel, rock, or other material and to load trucks, barges, conveyor belts, or rock crushing systems.
Special guidelines are applicable for machines used for lifting applications and special safety devices must be installed.
Any other use above and beyond the applications described above, such as breaking out rock or demolishing buildings, pounding in posts etc. requires special attachments and safety devices.
If the machine is exposed to the risk of falling down objects during operation, the cab machine must be fitted with a safety device according to the FOPS prescriptions
Transporting personnel or loads etc. is not considered destined use and is therefore prohibited. The manufacturer / dealer is not responsible for any resulting damage. Any risk must be carried by the user himself.
Destined use is considered part of observing and adhering to all regulations and inspection and maintenance guidelines given in this Operation and Maintenance Manual.

**GENERAL SAFETY INFORMATION**

- Study the Operation and Maintenance Manual before operating or working on the excavator.
  Make sure that you have additional information for special attachments of your machine, read it and understand it!
- Allow only authorized personnel informed about the safety rules to operate, service or repair the excavator. Make sure to observe any minimum applicable age requirement.
- Allow only properly trained personnel to operate or work on the excavator, make sure to clearly specify the person who is responsible for set up, maintenance and repairs.
- Make sure the operator knows his responsibility regarding the observance of traffic regulations and permit him to refuse any unsafe instructions given by a third person.
- Any persons still in training should only operate or work on the machine under the supervision and guidance of an experienced person.
- Check and observe any person working or operating the excavator periodically and regularly, if they observe safety instructions and guidelines given in the Operation and Maintenance Manual.
- Wear proper work clothing when operating or working on the excavator. Rings, watches, bracelets and loose clothing such as ties, scarves, unbuttoned or unzipped shirts and jackets are dangerous and could cause injury!
  Wear proper safety equipment, such as safety glasses, safety shoes, hard hats, work gloves, reflector vests and ear protection.
- Consult your employer or supervisor for specific safety equipment requirements and safety regulations on the job site.
- Always tilt up the safety lever before leaving the operator's seat.
- Do not carry tools, replacement parts or other supplies while climbing on or off the excavator. Never use the steering column, control levers or joysticks as handholds.
- Never jump off the excavator, climb on and off the excavator using only the steps, rails and handles provided.

When climbing on or off the excavator, use both hands for support and face the machine.

- If needed, use the front window as an escape hatch.
- If no other guidelines are given, perform maintenance and repairs utilizing the following precautions :
  - Park excavator on firm and level ground. Rest the attachment on the ground.
  - Place all control in neutral position and raise the safety lever.
  - Turn the engine off and remove the ignition key.
- Before working on the hydraulic circuit, move all joysticks and pedals with the ignition key in contact position and the safety lever tilted down to relieve the servo pressure and the remaining pressures in the different main circuits. In addition, relieve the pressure in the hydraulic tank as described in the Operation and Maintenance Manual.
- Secure all loose parts on the excavator.
- Never operate the excavator without a complete walk around inspection. Check if all warning decals are on the machine and if they are all legible.
- Observe all danger and safety guidelines.
- For certain special applications, the excavator must be equipped with specific safety equipment. Use the excavator only, if they are installed and functioning properly.
- Never perform any changes, additions or modifications on the machine, which could influence the safety, without obtaining the written permission from the manufacturer. This also applies to the installation and adjustment of safety devices and safety valves as well as to any welding on load carrying parts.
  It is forbidden to repair the cab.
- Do not install any equipment or attachments made by other manufacturers or any which are not specifically authorized by LIEBHERR for installation without first obtaining the written permission from LIEBHERR.
  LIEBHERR will issue any required technical documentation for approved installations.
- Should the electrical circuit be modified or additional components be installed, so the modification must be performed according to the national standards and safety regulations (such as OSHA per the USA).
  The installation must be certificated by an approved organization and a copy of the certification has to be sent to the LIEBHERR company.

**CRUSHING AND BURN PREVENTION**

- Never work underneath the excavator unless it is safely resting on the ground and / or is properly blocked and supported.
- Never use damaged or insufficient wire ropes, slings or chains. Always wear gloves when handling wire ropes.
- Never reach into bores during attachment installation or removal. Never align bores with your fingers or hands. Use proper alignment tools when installing, changing or servicing attachments by qualified mechanics
- Keep objects away from the radiator fan. Rotating fans will swirl and throw out objects, which can become very dangerous and cause severe injury to yourself and others.
- Avoid contact with any components containing coolant.
  At or near operating temperature, the engine coolant is hot and under pressure and could cause severe burns.
- Check the 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. Keep sparks or open flames away!
- Never permit anyone to hand guide the bucket or grapple into position.
- When working in the engine area, make sure the top covers and side doors are properly secured or closed with the appropriate supports.
- Never work underneath or on the excavator unless it is properly blocked and supported.

**FIRE AND EXPLOSION PREVENTION**

- Always turn off the engine while refuelling the excavator.
- Never smoke or allow an open flame in refuelling areas or where batteries are being charged, or where batteries or flammable materials are stored.
- Never leave machine unattended while fuelling. During this operation, no one but the employee in charge of refuelling is allowed to stay on the excavator.
- Always start the engine as described in the Operation and Maintenance Manual.
- Check the electrical system regularly and frequently.
  All defects, such as loose connections, burnt out fuses and bulbs, burnt or damaged cables must be repaired immediately by a licensed electrician or specially trained personnel.
- Never store flammable fluids on the machine except in storage tanks intended for the excavator’s operation.
- Inspect all components, lines, tubes and hoses for oil and fuel leaks and / or damage.
  Replace or repair any damaged components immediately.
  Any oil, which escapes from leaks, can easily cause a fire.
- Be certain that all clamps, guards and heat shields are installed. These components prevent vibration, rubbing, chafing and heat build-up. Install tie wraps to fasten hoses and wires, as required.
- Cold start ether is extremely flammable. Do not use together with preheat. Use ether only in ventilated areas and as directed. Never use it near heat sources or open flames, do not permit anybody to smoke.
- Know the location of the excavator's fire extinguisher and be familiar with its operation. Make sure you know your local fire regulations and fire reporting procedures.
- A fire extinguisher can be attached inside the operator's cab, using the four threaded holes provided in the rear left support of the cab.

**MACHINE START UP SAFETY**

- Before excavator start up, perform a thorough walk around inspection.
- Visually inspect the excavator, look for loose bolts, cracks, wear, any leaks and any evidence of vandalism.
- Never start or operate an unsafe excavator.
- Report all defects to your foreman or supervisor and make sure they are corrected immediately.
- Make sure all covers and doors are closed and all warning decals are on the machine.
- Make sure all windows, as well as inside and outside mirrors are clean, and secure all doors and windows to prevent any unintentional movement.
- Be certain that the area surrounding the excavator is free of other personnel, and that no one is working on or under the excavator before starting the engine.
- Covers and boxes locks have to be unlocked, to facilitate the fight against fire in case of.
- Proceed with the same precaution while climbing up and down the cab, as for the ascension of the machine
- Keep ladders, footsteps, handles and handrail in clean condition and always free them from mud, oil, grease, ice, snow or any other obstacles.
- To guarantee an easy opening of the cab door in all weather conditions, coat the rubber seals around the door with silicon oil or talcum every two months and more often if necessary. Regularly grease the hinges and lock of the cab door as well the fixing device of the door in opened position.

  During maintenance works, always wear safety glasses and proper protective clothes..
- To climb up or down the cab, the excavator must be parked on firm, flat and level ground and the uppercarriage must be swung so to align ladders and steps on upper and undercarriage.
- Face the excavator when climbing up or down and always hold on to the machine at three points, i. e. keep the contact with the access components at the same time with two hands and one foot or with one hand and the two feet.
- As soon as you can reach the handle of the door with your free hand unlock it, and keeping yourself apart from the slewing range of the door, open the door before climbing up any more. Some external influences, and especially the wind, may make the opening of the door uneasy. For this reason, keep and guide the door all the way with your hand and lock it in its opened position, making sure it is securely fixed in this position, so it can not be slammed by the wind.
- If the weather conditions are bad, increase your attention to realise climbing or descent from the cab with a maximum of precautions, and do or let do the preliminaries operations of preparation which are necessary so you can move safely.
- With those conditions be especially vigilant.
- Go on climbing up, always holding yourself by three points, enter the cab and seat down to the seat
- If applying fasten the seat belt. Unlock the door using the unlocking lever and close the door holding it by the handle designed for this purpose. Only thereafter lower the safety lever and start the machine.
- It is essential to have your seat belt fastened if you want to operate the machine with the cab door opened.
  Should the belt be missing on your machine, so you must compulsorily get one installed before you start working with opened cab door.
- After entering the cab, adjust the operator's seat and controls, the inside and outside mirror, the armrests and fasten and adjust the seat belt. Be certain that all controls can be reached comfortably.
- All noise protection devices on the machine must be functional during operation.

**ENGINE START UP AND OPERATING SAFETY**

- Before start up, check if all indicator lights and instruments are functioning properly, place all controls in neutral position and tilt the safety lever up.
- Before starting the engine, alert any nearby personnel that the excavator is being started by sounding the horn.
- Start the machine only when seated in the operator's seat, and with the seat belt fastened (if installed).
- If you have no other instructions, start the engine as outlined in the Operation and Maintenance Manual.
- Tilt the safety lever down and check all indicators, gauges, warning devices and controls for their proper indication.
- Start and operate the engine only in a well ventilated area. If necessary, open doors and windows.
  Warm up the engine and hydraulic system to operating temperatures. Low engine and hydraulic oil temperatures can cause the excavator to be unresponsive.
- Check that all attachment functions are operating properly.
- Move the excavator slowly into an open area and check all travel functions for their proper operation, check travel and swing brakes, the steering function as well as the turn signals and lights.

**MACHINE OPERATING SAFETY**

- Familiarize yourself with job site rules. Be informed about traffic and hand signals and safety signs. Ask who is responsible for signalling.
  Check your surrounding for any obstacles in the working and movement range, check the load carrying capacity of the terrain, and secure the job site to shield it from any public highway traffic.
  Rope off the working area of the machine and install the necessary signs to forbid any non authorized person entering the area.
- Always keep a safe distance from overhangs, walls, drop offs, and unstable ground.
- Be alert of changing weather conditions, bad or insufficient visibility and of changing ground conditions.
- Be alert for utility lines, check the location of underground cables, gas and water lines, and work especially careful in that vicinity. If necessary and/ or if required, call local authorities to mark the location, and take precaution against contact with underground utilities.
- Keep sufficient distance to electrical lines. When working in the vicinity of high voltage electrical lines, keep proper distance to assure that the attachment does not come close to the lines. DANGER! You must inform yourself about safe distances.

  Preferably have the electrical lines de-energized (and lockout / tagged out according to the regulations applicable on the job-site) each time it is possible, and in any case if the closeness of the working area make it necessary.
- In case you do touch a high voltage line by accident, proceed as follows:
  - do not leave the machine,
  - move the machine, if possible, from the danger zone until you obtain sufficient distance,
  - warn any personnel in the vicinity not to come close to the excavator and not to touch it,
  - instruct or initiate that someone turns off the voltage.
  - Do not leave the machine until you are absolutely sure that voltage in the line, which had been touched or damaged, has been turned off!
- Before moving the machine, make sure that the attachments and equipment is secured properly to avoid accidents.
- When travelling on public roads, make sure to observe traffic regulations, and make sure that the machine meets federal and local public highway standards.
- Always turn on the lights if visibility is bad or if you are still working during dusk.
- Never allow other personnel on the excavator.
- Operate the excavator only while seated and with the seat belt fastened, if installed.
- Report any problems or needed repairs to your foreman or supervisor and make sure they are corrected immediately.
- Do not move the excavator until you are certain that no one is endangered by moving the excavator.
- On machines without negative brakes check the brake system before starting to work, as outlined in the Operation and Maintenance Manual.
- Never leave the operator's seat while the machine is still moving.
- Never leave the machine unattended (within view of machine), with the engine running.
- When moving the excavator, keep the uppercarriage in lengthwise direction and keep the load as close as possible to the ground.

- Prevent any working movements, which could tip the machine over. If the excavator begins to tip or slip on a grade, immediately lower the attachment and load to the ground and turn the excavator facing downhill.

  If possible, always operate the excavator with the attachment positioned uphill or downhill, never sideways.
- Always travel slowly on rough or slippery ground and on slopes, and on loose soils.
- Always travel downhill at permissible speed, so you don't loose control over the machine. The engine must run at nominal speed, use only the foot pedals to brake and slow down the machine.

  Never shift during down hill travel, always shift to a lower gear before travelling downhill.
- Load an occupied truck only if all safety requirements are fulfilled, notably in order to protect the truck operator.
- For demolition work, clearing, crane operation, etc. always use the appropriate protection device designed for this specific application.
- If operating in visually obstructed terrain or whenever necessary, have another person guide you. Always have only one person signal you.
- Allow only experienced persons to attach loads or to guide operators. The guide must be visible by the operator and / or must be in voice contact with him.
- Depending on the attachment combination, it is possible for the bucket teeth to hit the cab, the cab protection or the boom cylinders. Be very careful when the bucket teeth get in this range to prevent any damage.
- In case of a thunderstorm :
  - lower the attachment to the ground and if possible anchor the digging tool into the soil.
  - leave the cab and move away from the machine before the storm breaks out. Otherwise, you must stop the excavator, turn off the radio and keep inside the closed cab until the end of the storm.
- Auxiliary control units can have various functions. Always check their functions when starting up the machine.
- Stop the swinging motion of the uppercarriage when lowering the attachment into a ditch without striking the attachment on the ditch walls.
- Inspect the machine for damage if the attachment has been swung into a wall or any other obstacles.
- Applications in which the attachment is to be used to strike the material being extracted are not permitted, even when working in a longitudinal direction.
- Repeated strikes against an object leads to damage to the steel structures and machine components.
- Please refer to your LIEBHERR dealer if special teeth for heavy-duty or special applications are required.
- Do not attach too large bucket or bucket with side cutters or that are during operations with rocky material. This would prolong the work cycles and may lead to damage to the bucket as well as further machine components.
- With the 2x45° offset articulation, the offset position may only be employed if the working tool or the attachment does not touch the material.
- Operation of the offset articulation to drill into the material is not permitted.
- Do not lift the machine during operation. Should this happen, lower the machine slowly back to the ground.
- Do not let the machine fall heavily on the ground and do not hold it back with the hydraulics. This would damage the machine.
- During operation with the attachment it is forbidden to raise the machine with the dozing blade (e.g. carving at the ceiling when tunnelling).
- The hydraulic hammer must be selected with particular care. When using a hydraulic hammer not permitted by LIEBHERR, steel structures or the other machine components can become damaged.
- Before beginning breaking tasks, position the machine on firm and level ground.
- Use a hydraulic hammer designed exclusively for breaking stone, concrete and other breakable materials.
- Only operate the hydraulic hammer in the longitudinal direction of the machine and with the windshield closed or with a front protective grid.
- Ensure during hammer operation that no cylinder is entirely extended or retracted and that the stick is not in the vertical position.
- In order to avoid damages to the machine, try not to break stone or concrete while performing retraction and extension motions of the hydraulic hammer.
- Do not apply the hydraulic hammer uninterrupted for more than 15 secs. at a time to the same place. Change the breaking point. Too long uninterrupted operation of the hydraulic hammer leads to an unnecessary overheating of the hydraulic oil.
- Do not use the drop force of the hydraulic hammer to break stone or other materials. Do not move obstacles with the hydraulic hammer. Misuse of this nature would damage both the hammer and the machine.
- Do not use the hydraulic hammer to lift objects.

**MACHINE PARKING SAFETY**

- Park the excavator only on firm and level ground.

  If it becomes necessary to park the machine on a grade, properly block and secure it with wedges.
- Lock the uppercarriage with the lock pin (if lock pin is installed).
- Lower the attachments to the ground and anchor the bucket lightly in the ground.
- Bring all operating levers in neutral position and engage the travel and swing brakes.
- Turn the engine off as outlined in the Operation and Maintenance Manual and raise the safety lever before you leave the operator's seat.
- Proceed with the same precaution while climbing up and down the cab, as for the ascension of the machine
- Before climbing down the cab, you must make sure the machine is parked on a flat, firm and level ground and the ladders and steps are aligned on upper and undercarriage.
- Then open the cab door and lock it in opened position and make sure it is securely fixed in this position.
  Be aware of difficult weather conditions and anticipate their possible consequences. The wind for example could slam the cab door. If necessary unfasten the seat belt.
- Carefully begin climbing down, facing the machine and always holding the contact at three points, keeping the contact with the access components at the same time with two hands and one foot or with one hand and the two feet, until you reach the height where you can close the cab door in the best conditions, keeping yourself apart from its slewing range. Unlock the door using the unlocking lever designed for this purpose and close the door guiding it by the handle.
  If you want so lock the door and take away the key.
- Slowly and carefully go down to the floor.
- Lock the cab, covers and boxes, remove all keys and secure the excavator against vandalism, unauthorized use, and any attractive nuisance.

**MACHINE TRANSPORTING SAFETY**

- Use only suitable transporting and lifting devices with sufficient capacity.
- Park the machine on firm and level ground and block the chains or wheels.
- If necessary, remove part of the attachments during transport.
- When loading the machine on a flatbed trailer or railroad car, be sure that the loading ramp incline is less than 30° and covered with wooden planks to prevent skidding.
- Remove all mud, snow or ice from track components before moving up the ramp.
- Before loading, secure the uppercarriage with the undercarriage with the lock pin (if lock pin is installed).
- Align the machine with the loading ramp.
- Attach the manual control levers to the foot pedals for sensitive control.
- Have another person guide and signal the operator.
- Have blocks or wedges ready to block the machine, if necessary, to prevent the machine from rolling backwards. Be careful to crushing risks when handling and applying these wedges. Keep clear of wheels and do not attempt to chock or block the machine before its complete standstill.
- Retract the attachment as far as possible and lower the attachment as close as possible to the loading surface and carefully drive up the ramp and onto the flat bed trailer.
- When the excavator is on the trailer, release the uppercarriage lock pin, turn the uppercarriage back and lower the attachment.

If the backhoe attachment is attached, tilt the stick and bucket in and relock the uppercarriage (if lock pin is installed).

- Carefully secure the uppercarriage and other parts with chains, wedges and blocks to prevent slipping.
- Release the hydraulic pressure, remove the ignition key, raise the safety lever, close and lock the cab and close and secure all other doors and leave the machine.
- Carefully check out the transport route. Make sure that width, height and weight allowances are within the permitted limits.
- Check that there is enough clearance underneath all bridges, underpasses, utility lines, and in tunnels.
- During the unloading procedure, proceed with the same care and caution as during the loading procedure. Remove all chains and wedges. Start the engine as outlined in the Operation and Maintenance Manual. Carefully drive off the loading platform. Keep the attachment as close as possible to the ground level. Have another person guide and signal you.

**MACHINE TOWING SAFETY**

- Observe the correct procedure: check the index in your Operation and Maintenance manual and refer to the appropriate section : ”Towing the Excavator“.
- Only tow the excavator if absolutely necessary, for example to remove it for repairs from a dangerous job site.
- Be sure all towing and pulling devices such as cables, hooks, and couplers are safe and adequate.
- Make sure that the cable or the towing rod are strong enough and are routed around the centre of the undercarriage or to the towing hook on the undercarriage, which is designated for this purpose. Be aware that any damage to the machine caused by towing is never covered by the manufacturer's warranty.
- Never allow anyone to stand near the cable when pulling or towing the excavator.
- Keep the cable tight and free of kinks.
- Engage travel slowly, and do not jerk. With a slack cable, the sudden impact of the load being towed could snap and break.
- Keep personnel out of area. If cable breaks while under stress, it could cause severe injury.
- During the towing procedure, keep within the required transport position, permissible speed and distance.
- After the towing procedure is completed, return the machine to its previous state.
- Proceed as outlined in the Operation and Maintenance Manual when putting the excavator back in service.

**MACHINE MAINTENANCE SAFETY**

- The machine may not be made unsafe when performing maintenance work. Never attempt maintenance procedures or repairs you do not understand.
- Check the Operator’s and Maintenance Manual for service and maintenance intervals. Make sure you use only appropriate tools for all maintenance work.
- Refer to your Operator’s and Maintenance Manual to see, who is authorized to perform certain repairs. The operator should only perform the daily / weekly maintenance procedures.

  The remaining work may only be performed by especially trained personnel.
- Use only replacement parts corresponding to the technical requirements specified by the manufacturer. This is assured by using only original Liebherr replacement parts.
- Always wear proper work clothing when maintaining the excavator. Certain work may only be performed with a hard hat, safety shoes, safety glasses and gloves.
- During maintenance, do not allow unauthorized personnel to enter the maintenance area.
- Secure the maintenance area, as necessary.
- Inform the operator before any special or maintenance work. Make sure he knows the person, who is in charge of the work.
- If not otherwise noted in the Operation and Maintenance Manual, always make sure the excavator is parked on firm an level ground and the engine is turned off.
- During maintenance and service work, make sure you always retighten any loosened screw connections!
- If it is necessary to disconnect or remove any safety devices during set up, maintenance or repair, make sure that after completion of repairs, the safety devices are reinstalled and checked for proper function.
- Before any maintenance work and especially when working under the machine, make sure a ”Do not operate’ tag is attached to the starter switch. Remove the ignition key.
  After end of maintenance works or repair, restart the machine according to the instructions "Machine start up", in this manual.
- Before any repairs or maintenance work, clean any oil, fuel and / or cleaning substances from any fittings and connections .
  Don’t use any harsh cleaners and use only lint free cloths.
- Use only non-flammable cleaning fluids to clean the machine.
- Any welding, torch or grinding work on the machine must be explicitly authorized. Written authorization is necessary for welding on carrying structures. Before any using a welder, torch or grinder, clean off any dust and dirt and remove any flammable materials from the surrounding area. Make sure the area is sufficiently ventilated. Danger of Fire and Explosion!
- Before cleaning the machine with water or steam (high pressure cleaning) or other cleaning fluids, make sure that all openings, which , for safety and/ or functioning reasons should not be exposed to water / steam/ cleaners, are covered and / or masked off. Especially sensitive are electrical motors, control boxes and plug connectors.

- Make sure that the temperature sensors of the fire alarm and extinguishers system do not come in contact with the hot cleaning fluids, which could trigger the fire extinguishing system.
  Remove all coverings and masking material after completing the cleaning procedure.
  Then check all fuel lines, engine oil lines and hydraulic oil lines for leaks, loose connections, chafing and / or damage.
  Fix any problems immediately.
- If you use a high pressure cleaner with steam or hot water to clean the machine, observe following recommendations :
  - the distance between the nozzle and the surface to be cleaned must be no lower than 20 inches
  - the water temperature should not exceed 60°c (140°F)
  - limit the water pressure to 80 bar maximum (11500 PSI)
  - if you employ cleaning fluid, only use neutral cleaning agents such as customary car shampoos diluted to 2 or 3 percent maximum
- Never employ high pressure cleaning apparatus during the two first months following machine delivery or repainting.
- Observe all product safety guidelines when handling oils, grease, and other chemical substances.
- Make sure service fluids and replacement parts are disposed of properly and in an environmentally sound manner.
- When using hot service fluids, be very careful. (They can cause severe burns and injury!).
- Operate combustion motors and fuel operated heaters only in well ventilated areas. Before operating these units, check ventilation. In addition, always follow applicable local regulations.
- Never try to lift heavy parts. Use appropriate lifting devices with sufficient load carrying capacity. When replacing or repairing parts or components, make sure they are mounted very carefully on lifting devices, to prevent any possible danger. Use only suitable and technically sound lifting devices, make sure that lifting tackle, wire cables, etc. has adequate load carrying capacity.
  Never position yourself, walk or work underneath suspended loads.
- Never use damaged lifting devices, or devices which are not sufficient to carry the load. Always wear gloves when handling wire cables.
- Ask only experienced personnel to attach loads and guide and signal the crane operator. The guide must be within the visibility range of the operator and / or must be in direct voice contact with the operator.
- When working overhead, use appropriate and safe ladders, scaffolding or other working platforms designated for that purpose. Never step on parts or components on the machine when maintaining or repairing items overhead. When working high above ground, make sure you are fitted with ropes and appropriate safety devices which will prevent a possible fall. Always keep handles, steps, railings, platforms and ladders free of dirt, snow and ice!
- When working on the attachments, for example when replacing the bucket teeth, makes sure the attachment is supported properly. Never use metal on metal support!
- For safety reasons, never open and remove a track chain unless having previously totally released the pretension of the chain tensioning unit.
- Never work underneath the machine if it is raised or propped up with the attachment. The undercarriage must be supported with wooden blocks and supports.
- Always support the raised machine in such a way that any shifting to the weight change will not influence the stability. Do not support the machine with metal on metal support.
- Only qualified, especially trained personnel may work on travel gear, brake and steering systems.
- If it becomes necessary that the machine must be repaired on a grade, block the chains with wedges and secure the uppercarriage to the undercarriage with the lock pin.
- Only qualified, especially trained personnel may work on the hydraulic system.
- Never check for leaks with your bare hands, always wear gloves. Fluid escaping from a small hole can have enough force to penetrate the skin.
- Never loosen or remove lines or fittings before the attachment has been lowered to the ground and the engine has been turned off. Then turn the ignition key to contact position with tilted down safety lever, move all servo controls (joysticks and foot pedals) in both direction to release pressures. Then release the tank pressure as outlined in this Operation and Maintenance Manual.
- Always disconnect the battery cable before working on the electrical system or before any arc welding on the machine. Always disconnect the negative (-) cable first and reconnect it last.

- Check the electrical system regularly. Make sure that any problems, such as loose connections, burnt out fuses and bulbs, scorched or chafed cables are fixed immediately by an electrician or qualified personnel.
- Use only Original fuses with the specified amperage. Never use a different size or stronger fuse than the original fuse.
- On machines with electrical medium or high voltage systems:
  - If there is any problem with the electrical energy supply, turn the machine off immediately.
  - Follow established lockout / tag out procedures where applicable.
  - Any work on the electrical system may only be performed by a qualified electrician or qualified personnel under the guidance and supervision of an electrician, according to electro - technical regulations.
- If any work is required on any parts which carry current, use a second person to turn off the main battery switch, if necessary. Rope the work area off with a safety rope or chain, and set up warning signs. Use only insulated tools.
- When working on medium and high voltage components, shut off the voltage and connect the supply cable to the ground and ground the components, such as the condenser, with a grounding rod.
- Check all disconnected parts if they are truly free of current, ground them and close them off quickly. Insulate any close-by, current carrying parts.

**HYDRAULIC LINES AND HOSES**

- Hydraulic lines and hoses may never be repaired!
- All hoses, lines and fittings must be checked daily, but at least every 2 weeks for leaks and any externally visible damage! Never check for leaks with your bare hands, use a sheet of paper or something else. 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. Concerning the hoses, you must follow the safety regulations applicable to your work environment and job site and any federal, state and local safety requirements.
- 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 (see guidelines ISO 8331):
  - Damage on the external layer into the inner layer (such as chaffing, 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, crushing or pliers.
  - 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;

  When replacing hoses or lines, always use Original replacement parts.
- Route or install the hoses and lines properly. Do not mix up the connections!
- Always take care to avoid torsional strain when installing a new hose. On high pressure hydraulic hoses, the mounting screws must be first mounted on both hose ends (full flange or half clamp) and tightened only thereafter.

  On high pressure hoses having one curved end, always tighten first the screws on the curved hose end and only then the screws on the straight hose end.

  Install and tighten the hose clips that may be mounted on the hose middle only when the both hose ends are already tightened.
- Always install hoses so to avoid any friction with other hoses and parts.

  We recommend to keep a distance between hose and other parts of at least one half of the hose outer diameter. Keep a minimum gap of 1/2 inch in any case.

  After mounting a hose connecting two parts that are movable to each other, check during the return to service that the hose is not rubbing in the whole moving range.

  Check daily that all flanges and covers are fixed correctly. It will prevent vibrations and damage during operation.

**PROTECTION AGAINST VIBRATION**

- Stress caused by vibration in mobile construction machinery is predominantly a result of the way in which it is operated. The following parameters have a particularly significant influence:
  - Terrain conditions: Unevenness and potholes;
  - Operational technique: Speed, steering, braking, control of the machine's operating elements during travel and during operation.
- The machine operators themselves are largely responsible for the actual stress caused by vibration as the operators determine speed, gear transmission, manner of handling and travel routes.

  Thus, a wide range of different forms of vibrational stress are resulted for the same machine type.

  Vibrational stress of the machine operator's body can be reduced by noting the following recommendations:

  Select the correct machine, equipment and accessories for each respective application.
  - Use a machine which features a suitable seat (thus, for earthmoving machines, e.g. hydraulic excavators, a seat which complies with EN ISO 7096).
  - Ensure that the seat remains in good condition and adjust the seat as follows:
    1. Adjustment of the seat, and thus the vibrations being produced from the seat, should be carried out in relation to the weight and size of the operator
    2. Check the vibration absorption and adjustment mechanisms of the seat regularly and ensure that condition of the seat always adheres to the specifications of the seat manufacturer.
- Check the maintenance condition of the machine, in particular: tyre pressure, brakes, steering, mechanical connections, etc.
- Do not carry out steering, braking, acceleration and switching, or move or load the machine's working attachment, in jerky movements.
- Adapt the machine speed to the travel path to reduce vibrational stress:
  - Reduce the speed when negotiating rough terrain;
  - Travel around obstacles and avoid very rough terrain whenever possible.
- Ensure that the terrain over which the machine is being driven or operated is well maintained:
  - Remove large stones and obstacles;
  - Fill in ditches and holes;
  - Ensure that machines are on-hand for the preparation and upkeep of practical terrain conditions and that sufficient time for this work is allowed for.
- Travel over longer distances (e.g. on public roads) with adequate (average) speed.
- For machines which are used primarily for travelling, use special auxiliary systems for the journeys (wherever available), allowing a vibration reduction for this application type.

  Should these auxiliary systems not be available, regulate the speed so that a "vibrational build-up" of the machine is avoided.

# 3. CONTROLS AND INSTRUMENTATION

## THE ACCESS LADDER

The access ladder to the uppercarriage is electrically driven and remote controlled.
Before operating the machine, the ladder must be fully raised to the uppercarriage and locked in place.

The ladder can be extended and retracted via a remote control (Fig. 3) and also from the uppercarriage via the rotary switch 2 on the control box 1, which is installed on the upper ladder section at the catwalk (Fig. 1).

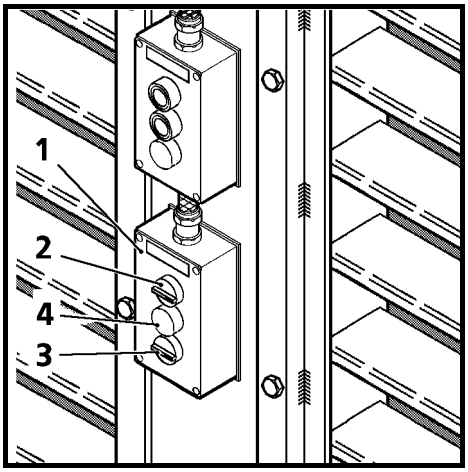


**Fig. 1**

**DANGER**

**Never actuate the ladder if you or a third person are on or in immediate proximity of the ladder!**

When the ladder has reached its top position, it can be mechanically locked via an electro-hydraulic actuated pin by turning the rotary switch (Fig. 1, pos.3) in clockwise direction. Hold the rotary switch until the red indicator light 4 goes out.

**CAUTION**

**For safety reason, the excavator can only be operated if the ladder is locked in its top position. Otherwise, the red indicator light 4 goes on. This means that the swing and travel movements remain locked.**

This safety measure can be momentarily by-passed by pushing and holding the button 61 on the right front of the control panel (see).

Correspondingly, the ladder can only be lowered from the upper position after the ladder has been unlocked, by turning the rotary switch 3 in counterclockwise direction.

The ladder must be raised after leaving the excavator to prevent unauthorized access.

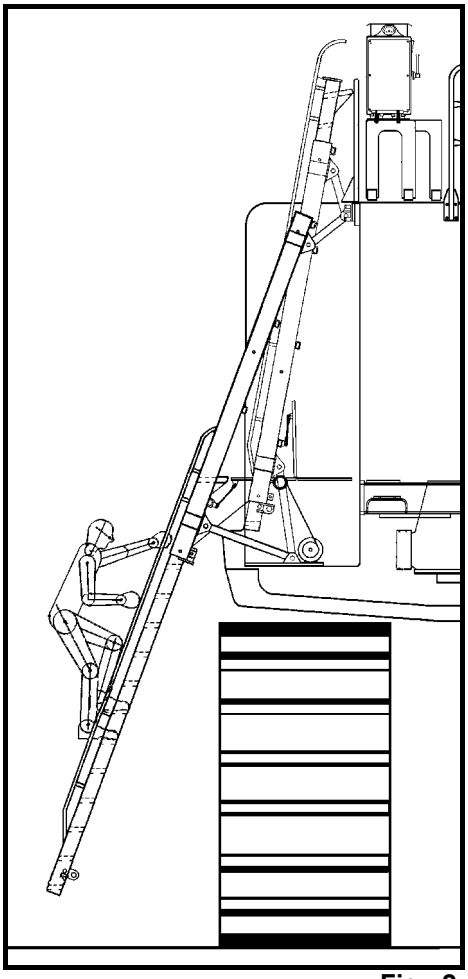
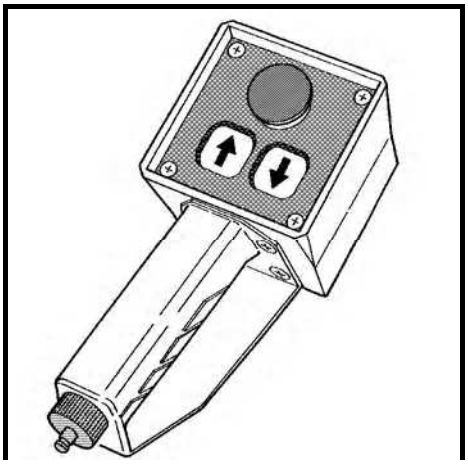


**Fig. 2**



## THE AIR CUSHIONED OPERATOR'S SEAT

**CAUTION**

**Before adjusting the operator's seat and the joysticks, make sure that the safety lever (fig. 9) is in the uppermost position to avoid any unexpected movements of the hydraulic excavator.**

### ADJUSTING THE OPERATOR'S SEAT

Adjusting the operator's seat horizontally with respect to the two control panels is possible after lifting lever 1 (Fig. 4).

Independent of this adjustment, the entire seat including the two control panels can be slid horizontally after lifting lever 2 (Fig. 4).

Adjusting the seating suspension to body weight is done via key 7 (Fig. 6).

Adjusting the seat cushion angle and the seat height is done via levers 4a and 4b (Fig. 6).

- By lifting lever 4a the seat cushion in back can be tilted up or down.
- By lifting lever 4b the seat cushion in front can be tilted up or down.

Adjusting the angle of the backrest is done via lever 6 ((Fig. 6).

- Lift lever 6
- Move the backrest to the desired angle
- Release lever 6

Adjusting the lower back support in the backrest occurs via keys 8 and 9 ((Fig. 6),

The angle of the right and left armrests can be adjusted. Turn the knurled screws 3 (Fig. 5) beneath the arm rests in the appropriate direction.

### VIBRATION DAMPING

The seat mounted in the excavator corresponds to ISO 7096 standards.

When used according to the excavator's specifications, the values of the vibration load transmitted by the operator's seat are less than or equal to the test vibrations of the corresponding machine type according to ISO 7096 standards. The resulting vibration acceleration values "$a_{zw}$", measured according to ISO 2631, part1, standards, meet the demands for vibration protection of the entire body according to EN 474-1 (acceleration " $a_{zw}$" between 0,5 and 2,5 m.s-2).

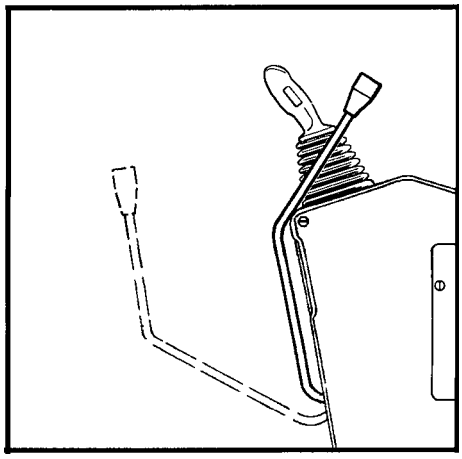


Fig. 4

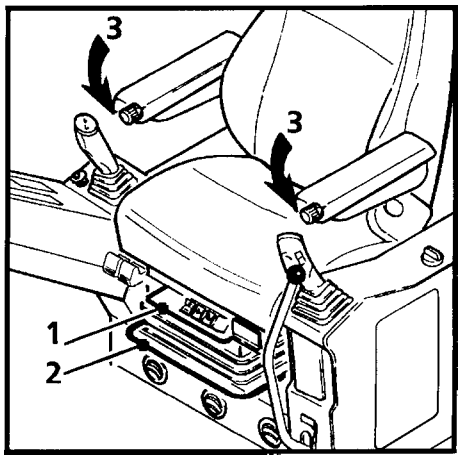



Fig. 5

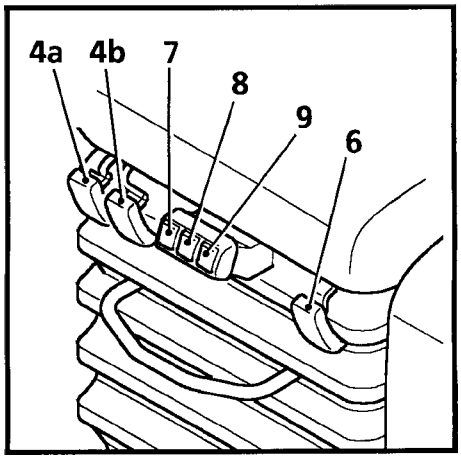
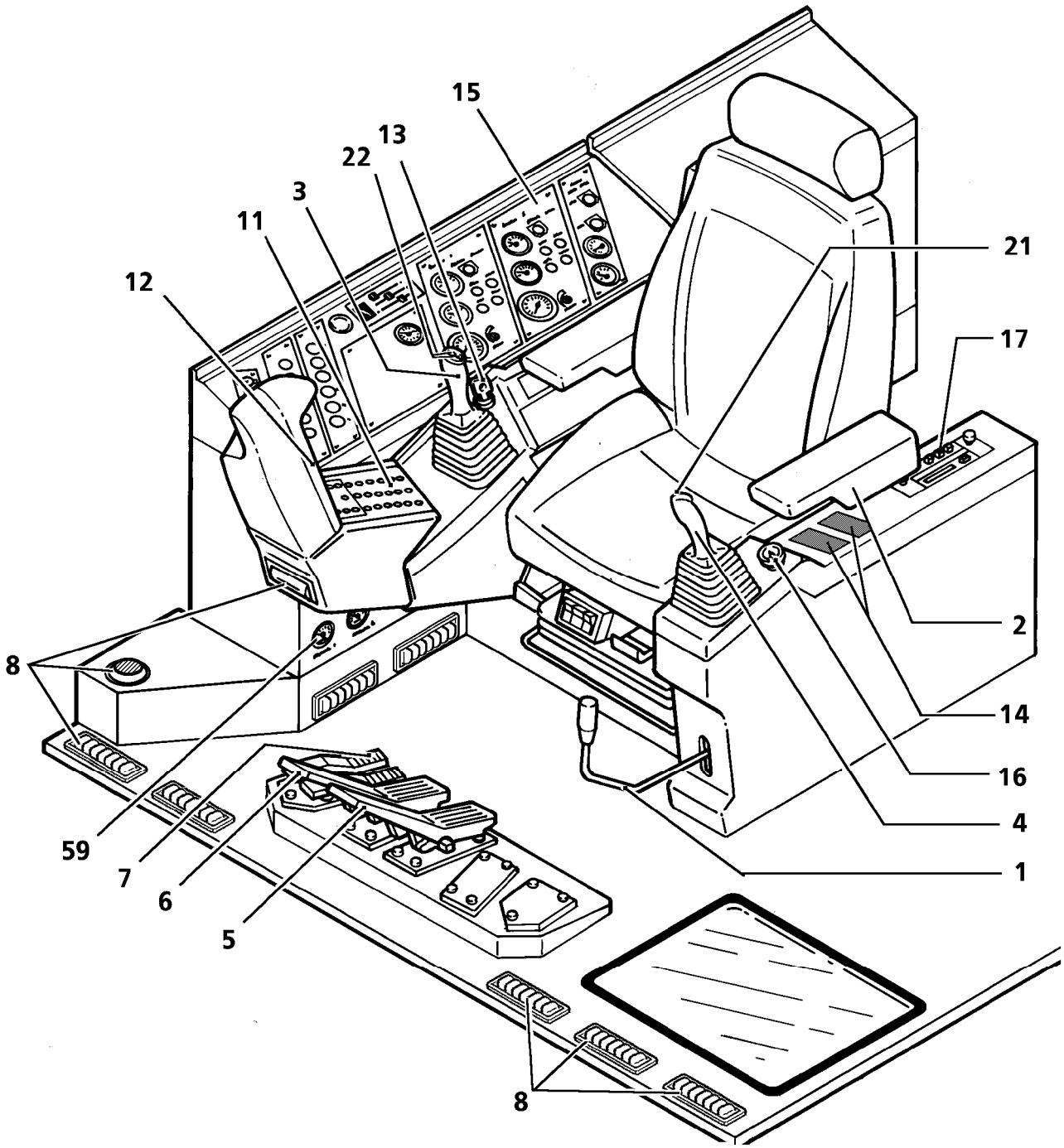



Fig. 6

## CONTROLS AND INSTRUMENTATION IN THE CAB




| | | | |
|---|---|---|---|
| 1 | Safety lever – Servo control | 14 | Central lubrication control |
| 2 | Arm rests | 15 | Control board for safety operation of engines & hydraulic pumps, control of floodlights |
| 3 | Right joystick | | |
| 4 | Left joystick | 16 | Cigarette lighter |
| 5 | Pedal for left travel gear | 17 | Radio |
| 6 | Pedal for right travel gear | 21 | Horn |
| 7 | Pedal for bottom dump shovel flap | 22 | Float position attachment |
| 8 | Heater vent | 59 | Hourmetter |
| 11 | Switching unit | | |
| 12 | Monitoring display | | * Optional equipment |
| 13 | “contact” key | | |

**SAFETY LEVER - SERVO CONTROL S7**

For safety reasons, a safety lever is installed on the left control console, and the operator must raise this lever before he leaves the operator's seat.

He must be safely seated before lowering the safety lever to start a new working cycle.

When the safety lever is raised, the servo pressure supply is interrupted, and no working movements can be carried out when the servo controls are actuated.
At the same time, the swing brake is applied. If the safety lever is raised, the swing brake cannot be released via the button S17 (see next page).
When changing the safety lever back to the lower position, the brake is returned to the same condition it was in before the lever was raised (released or applied).

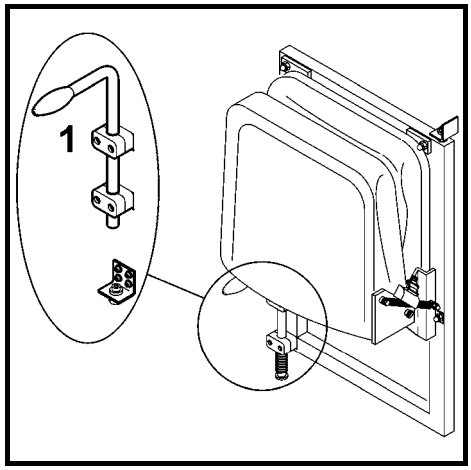



**Fig. 7**

**ADJUSTING OF THE AUXILIARY SEAT**

The lever (Fig. 7, pos. 1) serves to lock the auxiliary seat into position either beside the operator's seat or against the cab's wall.
To rotate the seat, pull the lever (Fig. 7, pos. 1).

To seat pull down the seating.
When there is no one on this auxiliary seat, the seating must be pulled up and the seat in position lock against the cab's wall.

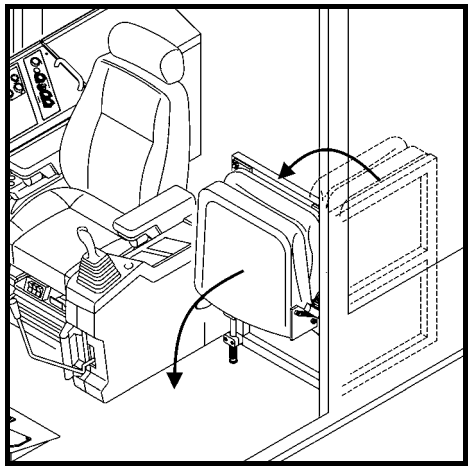


**Fig. 8**

## CONTROL UNIT

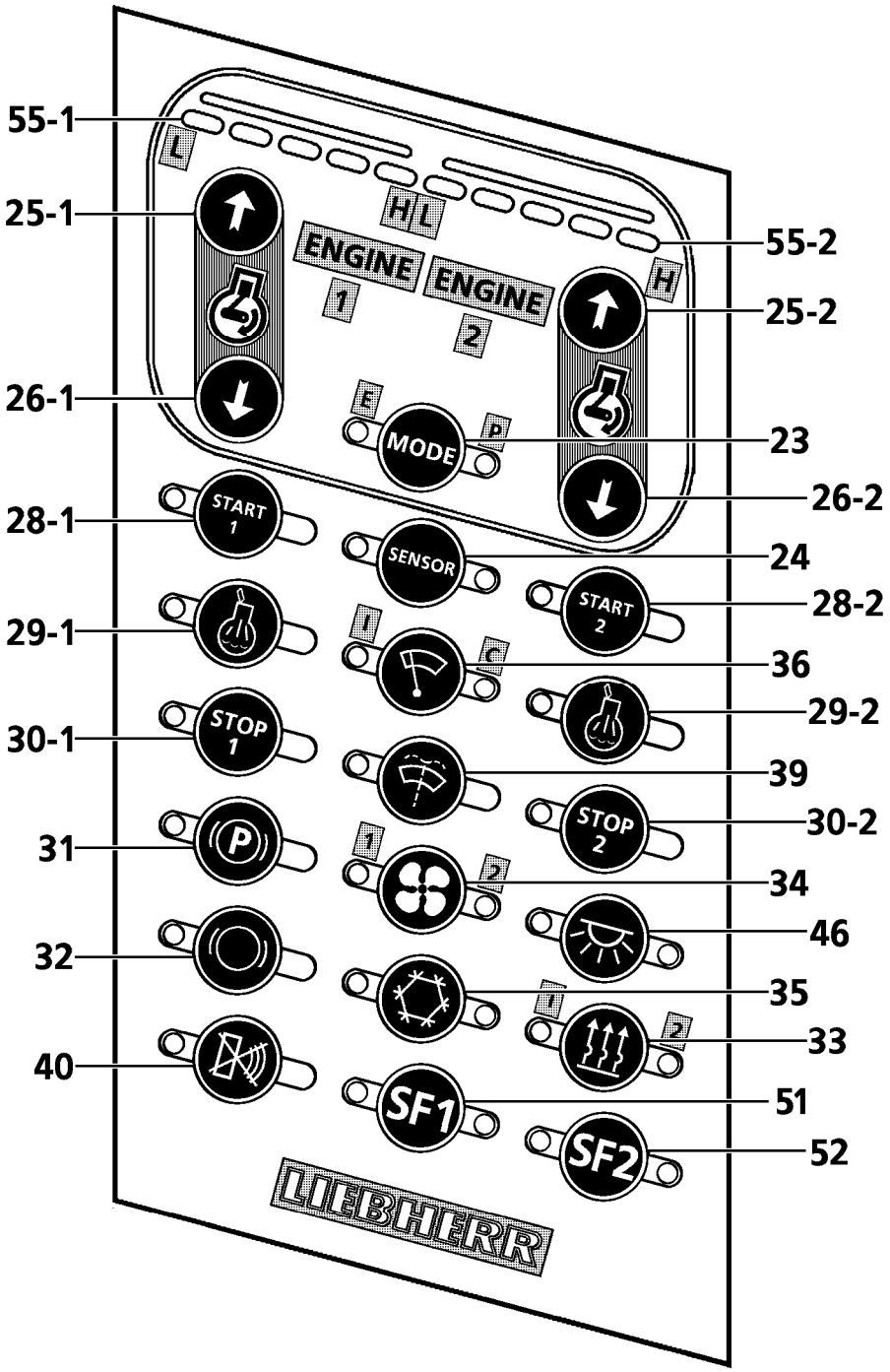



Fig. 9

| | |
|---|---|
| 23 | Engine RPM selection |
| 24 | Sensor control |
| | **Controls for engine 1** |
| 25-1 | Engine RPM increase |
| 26-1 | Engine RPM reduce |
| 28-1 | Start engine |
| 29-1 | Cold starting aid (startpilot) |
| 30-1 | Stop engine |
| 55-1 | LED for engine RPM indication |
| | **Controls for engine 2** |
| 25-2 | Engine RPM increase |
| 26-2 | Engine RPM reduce |
| 28-2 | Start engine |
| 29-2 | Cold starting aid (startpilot) |
| 30-2 | Stop engine |
| 55-2 | LED for engine RPM indication |
| 31 | Travel brakes |
| 32 | Swing brake |
| 33 | Heater fan |
| 34 | Air conditioner fan |
| 35 | Air conditioner on / off |
| 36 | Windshield wiper |
| 39 | Windshield washer |
| 40 | Buzzer off |
| 46 | Dome light in cab |
| 51 | Special equipment SF1* |
| 52 | Special equipment SF2* |
| * | For options |

**Push button 23 - Engine speed adjustment with mode pre-selection** (see page 4.4-4.5)
Depressing the button 23 causes to change from one mode into the other (E or P).
E (Mode ECD) = RPM stage 8
P (Mode POWER) = RPM stage 10

**Push button 24 – Low idle automatic**
Via this push button the function “low idle automatic” is turned on, resp. off (the light diode in the button is on, resp. off).
The push button 24 also serves to adjust the time lag between the return to neutral of all joysticks and pedals and the automatic reduction to low idle of the engine RPM. The adjustement is performed similar to the one described below for the windshield wiper pause time.

**Push button 28 – Start engine**
Depressing and holding this push button will activate the starting procedure.

**Push button 29 - Cold starting aid**
If the ambient temperature is below 0°C (32°F), push this button a few seconds to spray starter fluid into the intake manifold before starting.

**Push button 30 – Stop engine**
Depressing this button will stop the engine (see the complete procedure page 4.4).

**Push button 31 – Travel brake**
Via this button the travel brake can be switched from position “brake release” to “brake applied”.

**Push button 32 - Swing brake**
With this button the swing brake can be switched, either in position “brake applied” or in position “brake in semi automatic”.
Pushing this button shifts the brake from one operating mode into the other. With the brake applied, the red diode in the push button is on.

**Push button 33 – Heater**
When depressing this push button, the heater fan will be successively switched to stage 1, switched to stage 2, turned off, ... etc.

**Push button 34 – Air conditioner fan**
When depressing this push button, the air conditioner fan will be successively switched to stage 1, switched to stage 2, turned off, ... etc.

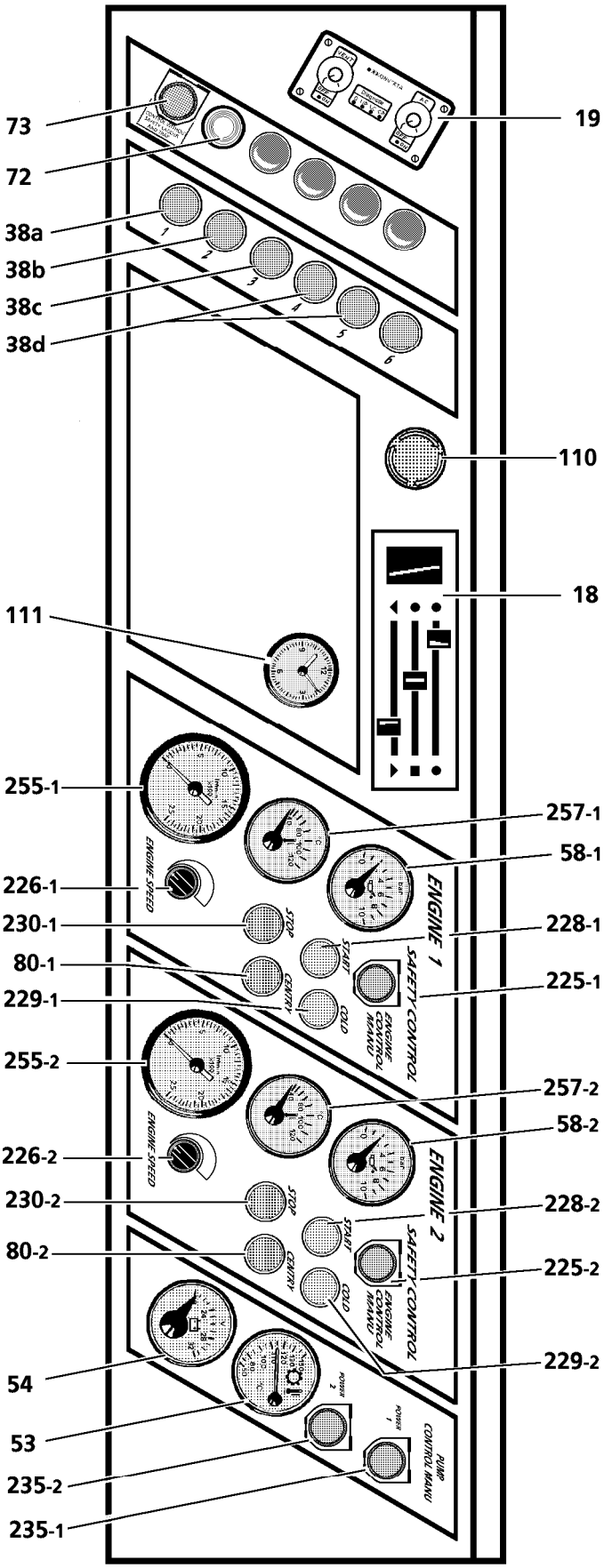
**Push button 35 – Air conditioner**
When depressing this push button, the air conditioner can be switched on or off (the light diode in the button is on, rep. off).

**Push button 36 - Windshield wiper**
Depressing the Push button 36 will successively:
- turn on the windshield wiper in intermittent mode (the light diode I is on),
- turn on the windshield wiper in continuous (the light diode C is on),
- switch off the windshield wiper (both light diodes are out).

In addition the pause time for the intermittent mode can be adjusted as follows using push button 36:
- Select the intermittent mode and keep the button 36 depressed; after a few seconds the light diode I will start blinking rapidly,
- Release the push button when the blinking duration has reached the desired pause time. Adjustment is possible between 2 and 9 seconds.

**LED indicator 55 for engine RPM**
Via this indicator, the engines RPM are displayed.
The complete RPM range for each engine is divided into 10 stages (5bars with 2 LED each).

## CONTROL BOARD




18 Heater control
19 Air conditioner control

38a Floodlights uppercarriage
38b Floodlights on counterweight
38c Floodlights on attachment
38d Additional floodlights

53 Hydraulic oil temperature
54 Electrical system voltage
58-1 Engine 1 – oil pressure
58-2 Engine 2 – oil pressure

72 Failure in central lubrication
73 Cancel of movement locking through ladder or service flap

80-1 Engine 1 – “centry” monitoring system
80-2 Engine 2 – “centry” monitoring system

110 Emergency stop
111 Clock

**SAFETY OPERATION ENGINE 1**

225-1 Engine 1 – safety operation on
226-1 RPM adjustment engine 1
228-1 Start engine 1
229-1 Cold starting aid engine 1
230-1 Stop engine 1
255-1 Engine 1 – RPM gauge
257-1 Engine 1 – coolant temperature

**SAFETY OPERATION ENGINE 2**

225-2 Engine 2 – safety operation on
226-2 RPM adjustment engine 2
228-2 Start engine 2
229-2 Cold starting aid engine 2
230-2 Stop engine 2
255-2 Engine 2 – RPM gauge
257-2 Engine 2 – coolant temperature

**SAFETY OPER. HYDRAULIC PUMPS**

235-1 Safety operation for hydraulic pumps on powerpack 1
235-2 Safety operation for hydraulic pumps on powerpack 2

**Control unit 18:** Heater control (see page 4.18)

**Control unit 19** : Control of the air conditioner unit (see page 4.19)

**Switch 38a:** floodlights on uppercarriage

**Switch 38b:** floodlights on counterweight

**Switch 38c**: floodlights on attachment

**Switch 38d**: Additional floodlights

**Dial 53:** Hydraulic oil temperature

Dial 54: Electrical system voltage

Dial 58: Engine oil pressure

Indicator 72: Light up if a failure appears in central lubrication

**Switch 73 (see page 3.1 and 5.12)** : For safety reasons, the swing and travel movements remain locked if the access ladder or the service trap are not locked in the uppermost position. This safety measure can be bypassed for as long as the button 73 is depressed.

**Switch 110 (emergency stop)** : Using the emergency switch will shut down the diesel engine and disconnect the electrical system (see page 4.6). Use this shut off method only in emergencies. There are 3 others emergency switches on the excavator: 2 near the engines, and near the access ladder under the uppercarriage.

**Dial 111** : clock

**Switch 225** : Use this button to switch the diesel engine operation in emergency control function (see page 4.7). When the emergency control is turned on, the indicator light in the button is on.

**Throttle control knob 226 (see page 4.7)** : In emergency operation of diesel engine, the knob 226 is used for the RPM adjustment.

**Switch 228 (start engine):** In safety operation, this switch will be use to start the diesel engine (see the complete procedure on page 4.7).

**Switch 229:** In safety operation and in case of starting difficulties, push this switch for a few seconds to spray starter fluid into the intake manifod before starting (see page 4.7).

**Switch 230:** in safety operation, depressing this switch will stop the engine (see page 4.7).

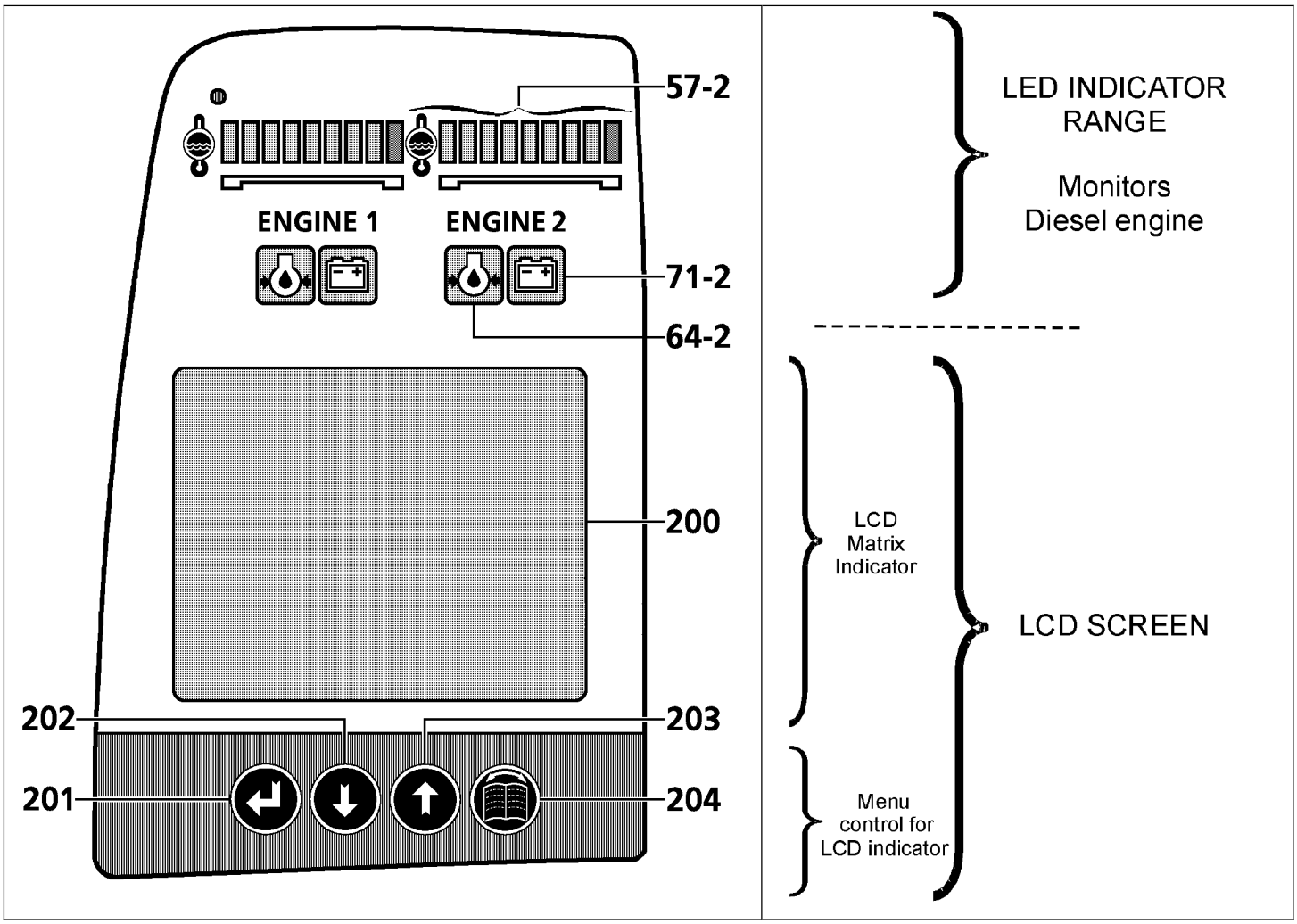
**Switch 235:** During normal operation of the excavator, the electronic horsepower control continuously adjusts the pump flow to the pressure level of the working circuits. If a trouble occurs in the circuit of the regulator, the pumps are swivelled back to minimal flow. However it remains possible in this case to carry on the working with the machine (with somewhat reduced power) by pushing the switch 235.

**Dial 255** : Engine RPM gauge

**Dial 257:** Engine coolant temperature.

**Test switch 80 (Centry monitoring system):** The control light in the switch 80 lights up for about 1 to 2 seconds after turning the key 13 to contact position and turns off thereafter if no error is detected. If the light goes on during operation, the test knob 80 will allow the engine maintenance mechanics to ask the system to indicate the registrated default by giving a coded message via the control light. For further information, see the attached “Centry” operation manual of CUMMINS.

## MONITORING DISPLAY

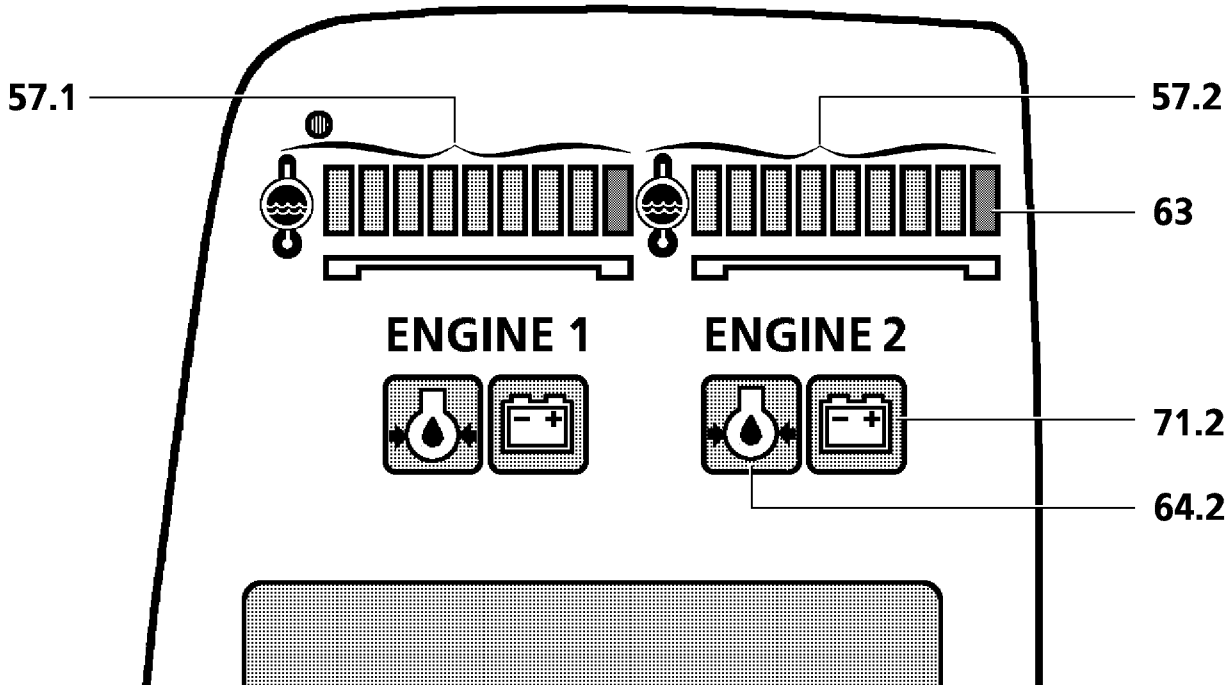



**LED INDICATOR RANGE**

**Indicator 57.1 and 57.2 for coolant temperature of the diesel engines**
During operation, the indication must remain in the green range. If the engine coolant overheats (coolant is above 98°C = 204°F), the red LED indicator lights 63 start to light up on the right end of the indicator and the buzzer sounds in the cab.
At the same time, the working pumps return to minimum flow.
In this case, continue to run the engine at high idle, shut the engine off if the red LED does not turn off after a few minutes, or if the temperature on the thermometer 257.1 or 257.2 (page 3.8) continues to increase.
If a coolant overheat is detected on powerpack 1 (resp. on PP2) the error code E 554 (resp. E 555) will be stored on the error statistics (see page 3.17 menu “I-errors”).

**Indicator lights 64.1 and 64.2 - low engine oil pressure**
If the engine oil pressure drops during operation below a pre-set value, which depends on the momentary engine RPM, the corresponding indicator light 64 lights up and the buzzer will sound to alert the operator that the oil pressure is too low.
Return the engine immediately to low idle. It will turn off automatically after a few seconds.
If a low engine oil pressure is detected on powerpack 1 (resp. on PP2), the error code E550 (resp. E551) will be stored on the error statistics (see on page 3.20, menu "i-errors").

**Charge indicator light 71.1 and 71.2**
Indicator light 71 lights up if the starter key is moved to contact position and turns off as soon as the engine start. During operation, this indicator light lights up if the alternator V-belt or the electrical charge system is defective.
Turn the engine off and correct the problem.




**LCD SCREEN**

Adjust the contrast on the LCD screen
The contrast on the LCD monitor can be changed by simultaneously pushing the ' MENU 'key and the "UP" or "DOWN" key. The new setting will be stored in the system.
To retrieve the original contrast setting, depress the both arrow keys "UP" and "DOWN" at the same time during system start (when all the light diodes are on).

Adjust the background lighting on the LCD screen
The background lighting on the LCD monitor can be changed by simultaneously pushing the “RETURN” key and the "UP" or "DOWN" key. The new setting will be stored in the system.
A light sensor on the upper left-hand side of the display controls the LCD lighting, depending on the ambient light conditions. The follow up control by the light sensor is performed around the basic setting adjusted via the keys.
If the ambient light conditions are low, the background lighting will be reduced accordingly.

LCD screen control keys
The display can be controlled via the four keys 201 "RETURN", 202 "DOWN", 203 "UP” and 204 "MENU" (see above illustration).
These keys are used to change from the main display to the menu selection and to scroll through various other menus.

MAIN SCREEN

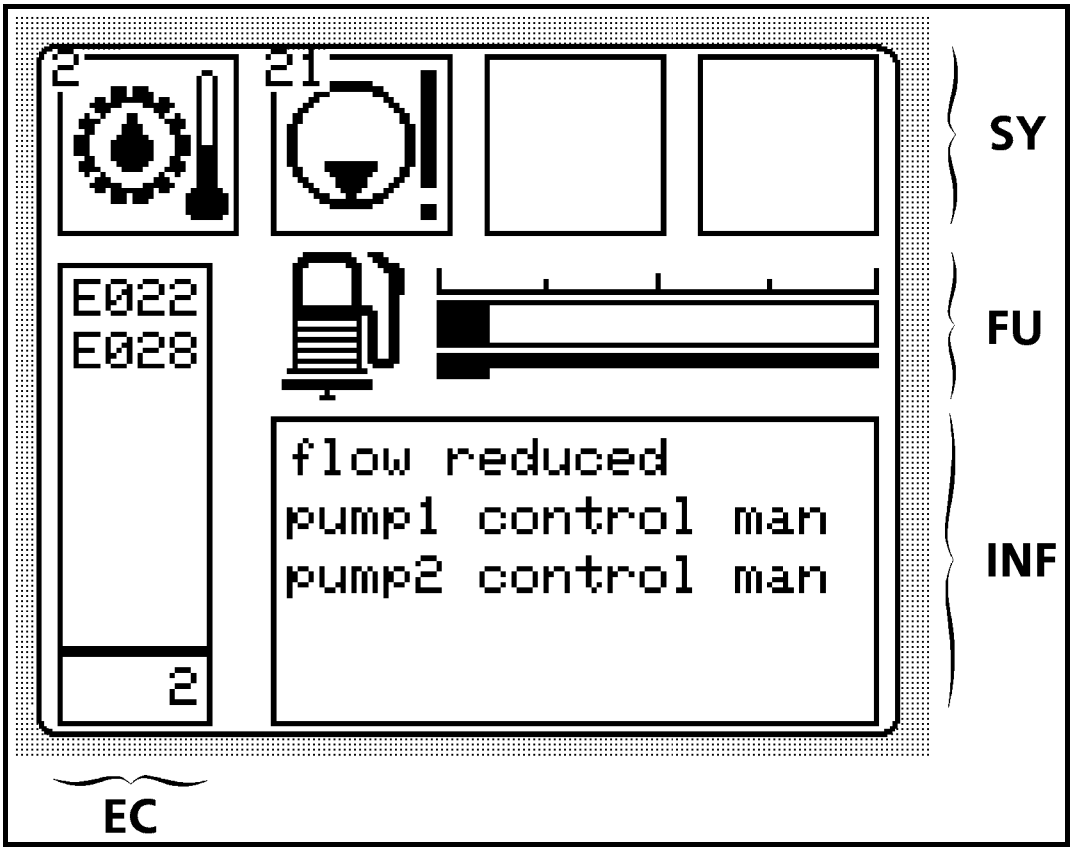



Fig. 10

The main screen appears after the unit is turned on and remains in place until the "MENU" key is pressed to change to the menu selection.

**Main screen view (Fig. )**

**SY field:** The upper field of the monitor shows warning and indicator symbols, up to maximum 4 symbols at the same time. If more than 4 symbols must be shown, then every 10 seconds, the symbols move to the left by one symbol.
The following list shows all symbols, which can appear in this field.

**EC field**: The EC window displays any applicable error codes far any electrical errors in the excavator electronics, (line errors, sensor errors,...). Max. 7 error codes can be displayed at the same time. If more than 7 errors occur, an arrow next to the error code window points to additional error codes on the list.
Press the arrow key to move the error code window in the selected direction on the error code list. For detailed error code list, refer to page no. 3.15.

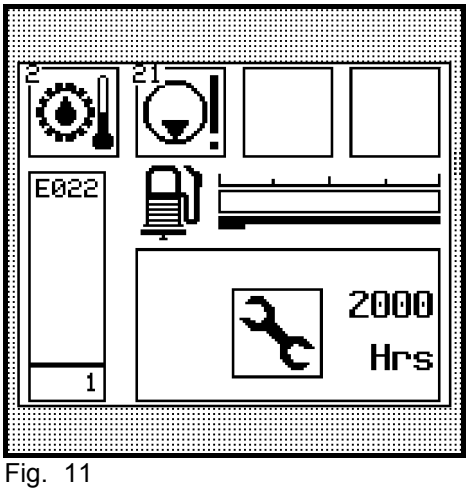



Fig. 11

**FU field:** This field (fuel gauge) shows the fuel level via a bar graph. If the bar is filled in over its total length, then the tank is 100% full. If the length of the bar equals the mark on the bar graph, then the symbol (refuelling pump) starts to blink.

**INF field:** The INF field on the right hand side of the main screen displays temporary information.
Displays are shown as graphics or text to show actuated flow reduction or emergency operation of Diesel engine or hydraulic pumps.
During the display start-up phase, the operator will be alerted about upcoming service intervals, as in this exemple (Fig. 11).

**Warning and indicator symbols**

Each one of the following symbols has one error code assigned to it, which is displayed as "E 5xx". As soon as an error appears, the control unit enters the corresponding error code in the stored error statistics.

If more than one error code applies to the same symbol, then the left side of the error codes always refers to the front powerpack 1, and the right side to the rear powerpack 2.

E 552 – E 553

Low coolant level

This symbol appears if the coolant level drops below the minimum level.

Bring the engine to low idle, it will turn off automatically after a few seconds. Find and repair the coolant loss. Add coolant until the level is correct (see page 5.14).


E 562 – E 563

Low oil level in splitterbox

This symbol appears if the oil level drops below the minimum level. Turn the engine off, find and repair a possible leak. Add oil until the oil level is correct (see page 5.16).


E 564 – E 565

High oil level in splitterbox

This symbol appears if the oil level in the splitterbox is above the maximum level. Turn the engine off, find and repair the problem. It is possible that too much oil has been added, or the oil level might have increased due to hydraulic oil entering via a defective pump shaft seal (see page 5.16).

E 558 – E 559

Oil in splitterbox is overheating

This symbol appears if the oil temperature in the splitterbox exceeds 85°C (185°F). Turn the engine off, find and correct the problem (splitterbox cooler dirty,...).


Low servo pressure

This indicator lights up if the servo pressure drops below 40 bar. In that case, the machine can not be controlled properly. Find and correct the problem.

E 556

Low hydraulic oil level

This symbol appears if the oil level in the hydraulic tank drops below the minimum level.

At the same time, the pumps are automatically returned to minimum flow.

Turn the engine off, find and repair the cause of the oil loss. Add hydraulic oil via one of the return filters (see page 5.23).

E 590

Low hydraulic tank pressure

This symbol appears if the hydraulic tank pressurisation drops below 0.15 bar.

Stop operation and turn the engine off. Find and correct the problem: check the air pressure system (see page 6.4).

E 557

### High hydraulic oil temperature

This symbol appears if the hydraulic oil temperature in the tank exceeds 98°C (208°F).

Stop Operation, continue to let the engine run in high idle and wait until the symbol disappears. If necessary, turn the engine off, find and correct the problem (oil cooler dirty, blower or thermostat defective,...).

E 566-E 572
E 567-E 573
E 568-E 574
E 569-E 575

### Main pumps are contaminated

This symbol appears if metallic particles have been deposited on the contamination switch of one of the main pumps. Stop operation, turn the engine off and notify the maintenance personnel.

E 570-E 576
E 571-E 577

### Swing pumps are contaminated

This symbol appears if metallic particles have been deposited on the contamination switch of one of the swing pumps. Stop operation, turn the engine off and notify the maintenance personnel.

E 578-E 584
E 579-E 585
E 580-E 586
E 581-E 587

### Main pumps overheat

This symbol appears if the temperature on one of the main pumps increases above 92°C (198°F).

Turn the engine off, find and correct the problem.

E 582-E 588
E 583-E 589

### Swing pumps overheat

This symbol appears if the temperature on one of the swing pumps increases above 92° C (198° F).

Turn the engine off, find and correct the problem.

ERROR CODES FOR ELECTRICAL ERRORS OF THE ELECTRONIC CONTROL SYSTEM

| | Detected errors | | Error code | | |
|---|---|---|---|---|---|
| | | | | Engine 1 | Engine 2 |
| ERROR IN THE CIRCUIT OF THE SENSOR WHICH MONITORS | Engine oil pressure B5 | Accidental ground | | E 001 | E 101 |
| | | Accidental + | | E 002 | E 102 |
| | | Broken wire | | E 003 | E 103 |
| | Engine coolant level B3 | Accidental ground | | E 004 | E 104 |
| | | Accidental + | | E 005 | E 105 |
| | | Broken wire | | E 006 | E 106 |
| | Coolant temperature B2 | Accidental ground | | E 007 | E 107 |
| | | Accidental + | | E 008 | E 108 |
| | | Broken wire | | E 009 | E 109 |
| | Hydraulic oil level B14 | Accidental ground | E 010 | | |
| | | Accidental + | E 011 | | |
| | | Broken wire | E 012 | | |
| | Hydraulic oil temperature B 67 | Accidental ground | E 013 | | |
| | | Accidental + | E 014 | | |
| | | Broken wire | E 015 | | |
| | Engine speed B12.2 | Accidental ground | | E 022 | E 122 |
| | | Accidental + | | E 023 | E 123 |
| | | Broken wire | | E 024 | E 124 |
| ERROR IN THE REGULATIN G CIRCUIT FOR | Flow limitation for hydraulic pump Y3.1 | Accidental ground | | E028 | E 128 |
| | | Accidental + | | E 029 | E 129 |
| | | Broken wire | | E 030 | E 130 |
| | Flow limitation for hydraulic pump Y3.2 | Accidental ground | | E 034 | E 134 |
| | | Accidental + | | E 035 | E 135 |
| | | Broken wire | | E 036 | E 136 |
| | Flow limitation for hydraulic pump Y3.3 | Accidental ground | | E 037 | E 137 |
| | | Accidental + | | E 038 | E 138 |
| | | Broken wire | | E 039 | E 139 |
| | Flow limitation for hydraulic pump Y3.4 | Accidental ground | | E 040 | E 140 |
| | | Accidental + | | E 041 | E 141 |
| | | Broken wire | | E 042 | E 142 |
| | Output ventilator oil Y10 | Accidental ground | | E 043 | E 143 |
| | | Accidental + | | E 044 | E 144 |
| | | Broken wire | | E 045 | E 145 |
| | Horsepower control RPM sensor B12.1 | Cable defect | | E 090 | E 190 |
| | Horsepower control power stage LR1 | Cable defect | | E 091 | E 191 |
| | Horsepower control power stage LR2 | Cable defect | | E 092 | E 192 |
| OTHERS ERRORS | Coding plug is missing | | E 302 | | |
| | No CAN 1 connection to circuit board BST1 | | E 303 | | |
| | No CAN 1 connection to circuit board BST2 | | E 304 | | |
| | No CAN 2 connection to circuit board ESP01 | | E 305 | | |
| | No CAN 2 connection to circuit board ESP02 | | E 306 | | |
| | No CAN 2 connection to circuit board ESP03 | | E 307 | | |
| | No CAN 2 connection to circuit board BBT | | E 308 | | |
| | Accidental ground / sensor for swing gear RPM | | E 453 | | |
| | Broken wire / sensor for swing gear RPM | | E 455 | | |
| | Short circuit to ground / fuel level transmitter | | E 456 | | |
| | Broken wire / fuel level transmitter | | E 458 | | |
| | Status error / circuit board ESP01 | | E 601 | | |
| | Status error / circuit board ESP02 | | E 602 | | |
| | Status error / circuit board ESP03 | | E 603 | | |

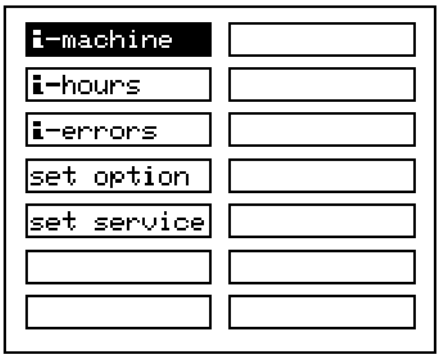



Fig. 12

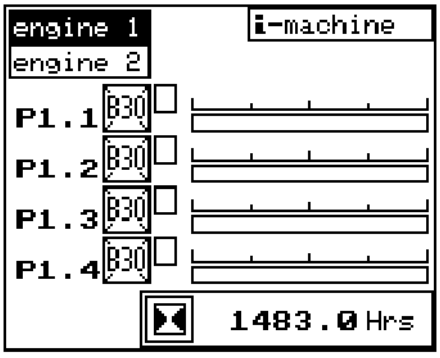



Fig. 13

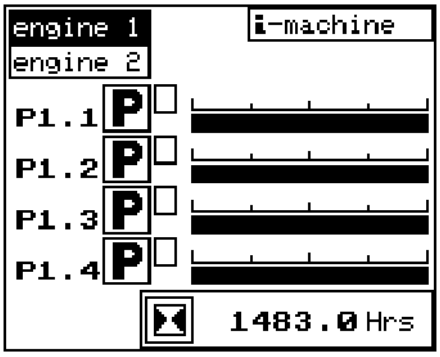



Fig. 14

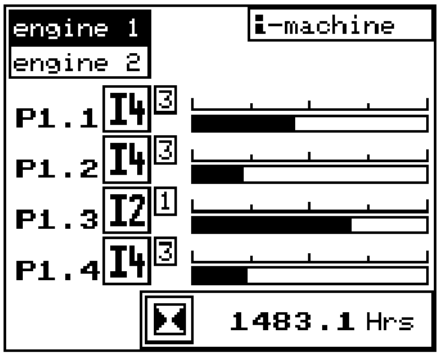



Fig. 15

## INFORMATION PROVIDED IN THE MENUS OF THE LCD SCREEN

### MENU SELECTION

Depressing the “MENU” key when the main screen is displayed shows the list of the accessible menus (see Fig. 12).

The current menu selection can be changed by pressing the “UP” and “DOWN” keys (the selected menu is inverse displayed, as an example in Fig. 12 the menu “I-machine” is selected).

When depressing the “MENU” key again, the inverse displayed function is branched out.

### MENU (“i-machine”)

This screen gives information about the operating position of the hydraulic pumps.

Use the arrow keys “UP” or “DOWN” to select the diesel engine which is to be displayed.

The menu gives following indications for each main working pump:

- If the pump receives a flow control signal (“~~B30~~” means no control signal, pump is at minimum swivel angle, Fig. 13.
- If the pump receives the maximum control signal (“P” means the maximum swivel angle for the pump is allowed, Fig. 14).
- If an external flow limitation is activated for the pump. The Fig. 15 shows an example with two external flow limitations (input I2 and I4) activated.
- The graphic bar indicates for each pump the amount of the maximum authorized flow control signal (= pump swivel angle reference), as an example the reference for pump P2 is 0% in Fig. 13, 100% in Fig. 14 and approx. 20% in Fig. 15.

**MENU "i-hours", INFORMATION ABOUT OPERATING HOURS FOR VARIOUS COMPONENTS AND MOVEMENTS**

This screen shows an overview about operating hours for various components, functional flows and operating modes.
As an example, the screen Fig. 16 indicates the operating hours for:

- Diesel engine 1
- Diesel engine 2
- Hydraulic circuit (control signal to pumps)
- Swing movements
- Travel movements
- Diesel engines in mode P
- Diesel engines in mode E
- Manual (safety) operation for pumps on engine 1
- Manual (safety) operation for pumps on engine 2
- Manual (safety) operation for diesel engine 1
- Manual (safety) operation for diesel engine 2

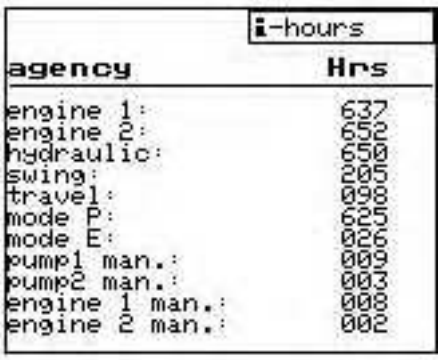



Fig. 16

**MENU "i-errors", INFORMATION ABOUT DETECTED ERRORS (OPERATING AND ELECTRICAL SYSTEM ERRORS)**

In this menu:

- Select "list sensor" to list all the operating errors detected by the switches and sensors for machine parameter monitoring (Fig. 18)
- Select "list elect.", to show a listing of all the electrical errors (system errors) detected during operation of the machine, see
- The "print error" selection prints both error listings on the serial port of the keyboard.

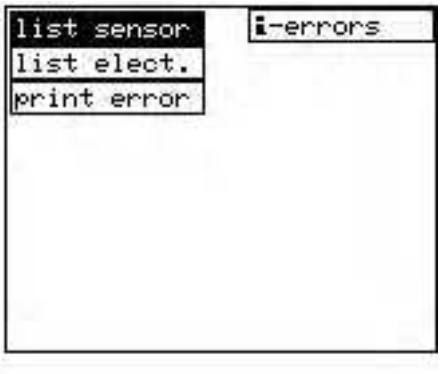



Fig. 17

"list sensor"
when selecting the operating errors "list sensor" all the errors according to the list on page 13and 14 are listed, with error code and number of occurrence (Fig. 18).
Move the arrow keys "UP" and "DOWN" to select the desired error.

By pressing the "MENU" key, the overview of the selected error appears (Fig. 19), with the indication of the operating hour and duration for the 10 first and the 10 last occurrences of the error.
Move the arrow keys "UP" and "DOWN" to page in this overview.

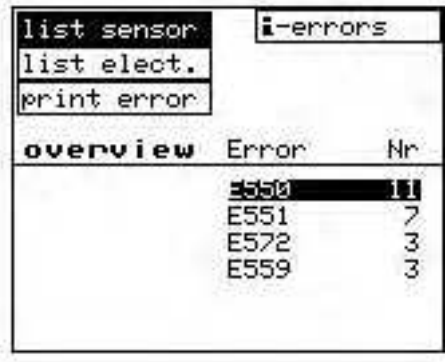



Fig. 18

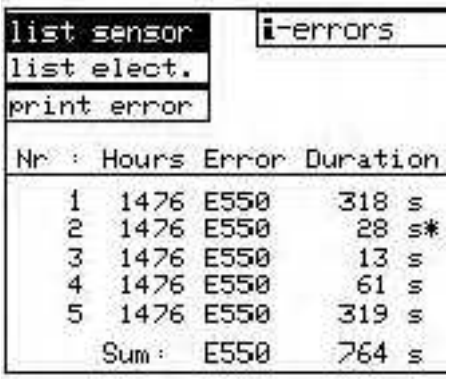



Fig. 19

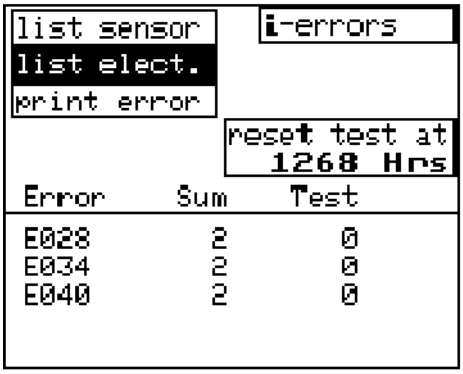



Fig. 20

**“list elec”**
When selecting the electrical errors “list elec” all the system errors according to the list on page 15 are listed, with error code and number of occurrence (Fig. 20).

The column “Sum” shows the number of all errors that were ever noted.

The column “Test” shows the number of errors occurred since the last deletion of this test error memory listing.

The operating hours above the test column show the operating hour when the last test memory was deleted (reset).

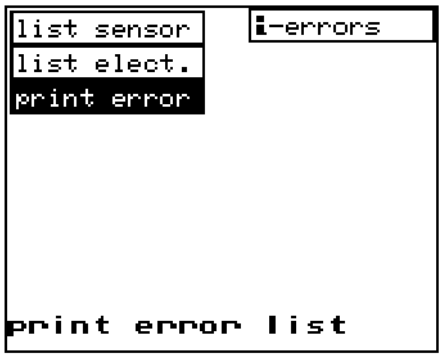



Fig. 21

**“print error”**
The “print error” selection prints both listings (operating errors and electrical errors) on a printer connected to the serial port of the keyboard (switching unit).
The information “print error list” appears for a moment at the bottom of the LCD screen.

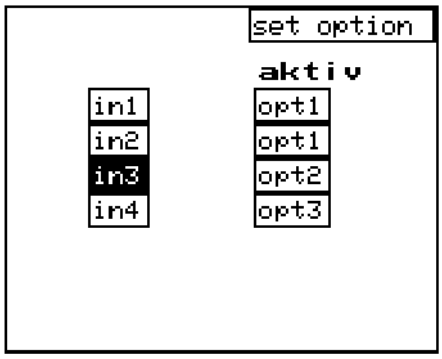



Fig. 22

**MENU “set option”**
**ALLOCATION OF FLOW LIMIT OPTIONS TO EXTERNAL INPUTS**

In this menu, pre-defined flow limitations (options) are allocated to a hardware input.

The screen (Fig. 22) shows the actual allocation between the four inputs and the options.

In this example, the option 2 is active for the input 3, this means, if the external hardware input 3 is activated, then the nominal pump values allocated in option 2 for the excavator control are given as maximum nominal values.

If another option must be allocated to input 3 (as an example due to a modification of the working attachment), so first select the input 3 via the arrow keys and then confirm the choice by pressing the “MENU” key.

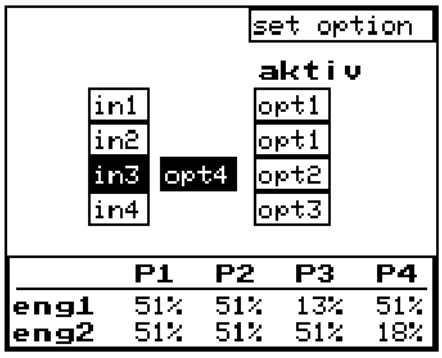



Fig. 23

Between the column with inputs and the column with actual allocation then appears at the level of the chosen input 3 a window for selection of allocation (Fig. 23). To define a new allocation for the input, press the arrow keys.

The lower part of the screen provides indication for the currently set pump values corresponding to the option shown in the selection window.

Confirm the selected option by pressing the “MENU” key, the new option must then appear in the “active” column.

**MENU “set service”,**
**INFORMATION AND CONFIRMATION OF SERVICE INTERVAL**

This screen is an information screen and can be used to confirm a completed service interval.
The screen shows the operating hour, when the last service interval was confirmed (in Fig. 24= “988 hrs”), the next service interval (“1500 hrs”) and the current operating hours (“1477 hrs”).


Fig. 24

An upcoming service interval can be confirmed within max. 50 operating hours before the next service interval.
When this time frame is reached, the screen will display a question regarding completion of the service works for this interval.
Select the answer “NO – YES” by pressing the arrows keys “UP” and “DOWN”, then confirm the selection by the “MENU” key.


Fig. 25

If the question is answered with “NO” then this menu will be discontinued.
If it is answered with “YES”, then the current operating hour will be stored as the last confirmed service interval and the data for the next service interval will be set at the same time (Fig. 26).


Fig. 26

# 4. OPERATING PROCEDURES

## PRE-STARTING INSPECTION

### CHECK AIR FILTERS FOR C0NTAMINATION

Check the, two dry air filters on top of the Diesel engines to determine degree of contamination.
When the maximum permissible vacuum has been reached, a red trip will appear in the inspection port of the maintenance indicator 16 (see Fig. 1) and the filters must be serviced, see page 6.16.

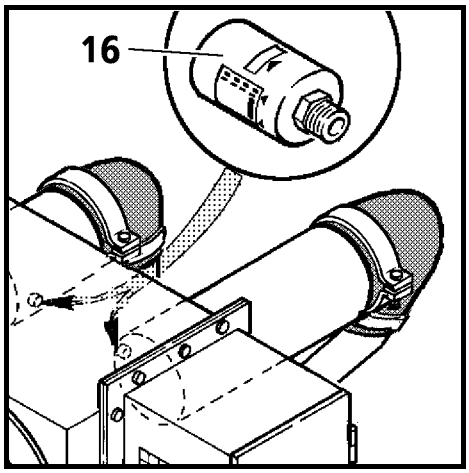


Fig. 1

### CHECK ENGINE OIL LEVEL

Check the engine Oil level with the machine parked on level ground. After engine has shut down, allow five minutes for the oil to drain into the oil pan. The oil level must be between the MIN. and MAX. mark on the dipstick 1 (see Fig. 2).

**CAUTION**

**The engine oil is very hot at or near operating temperature. Avoid contact with hot oil and components containing oil, since it could cause severe burns.**

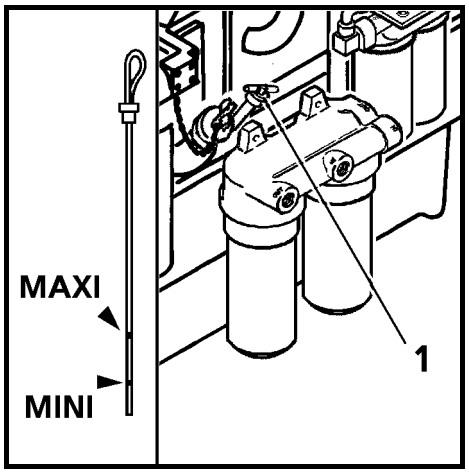


Fig. 2

### CHECK COOLANT LEVEL

**CAUTION**

**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 coolant level only after the cap 6 is cool enough to be touched.**
**To check the coolant level, first depress the red button in the cap 6 to relieve pressure.**

Check the coolant level when cold. It should reach the middle range of the indicator 7 (Fig. 3).

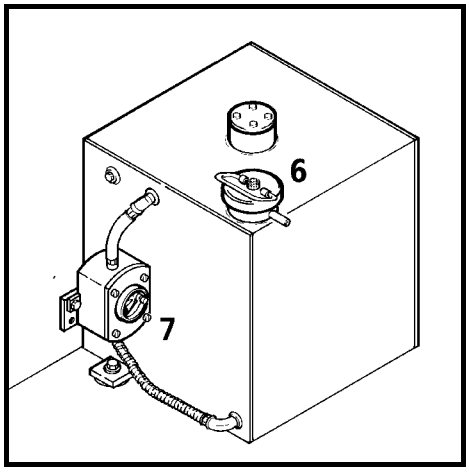


Fig. 3

The excavator is delivered from the factory with a cooling system protection to –35°C, which corresponds to a concentration of about 50% antifreeze. This proper antifreeze concentration must be maintained all year long.

The coolant filters installed on the engine contain a corrosion protector (Fig. 4). Regularly check its concentration in the coolant circuit, see Cummins Operation and Maintenance Manual.

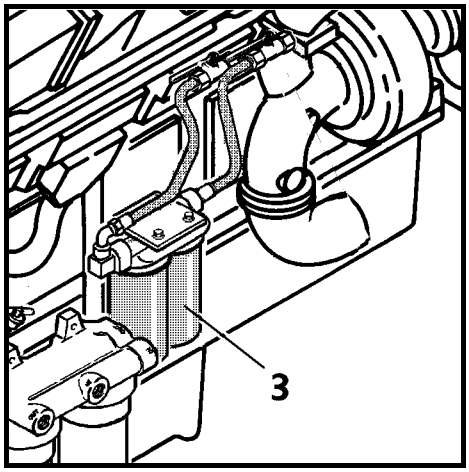


Fig. 4

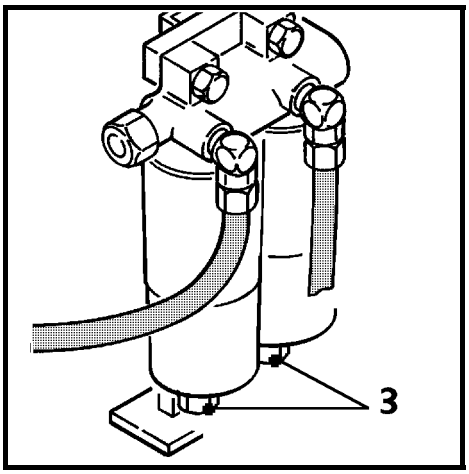



Fig. 5

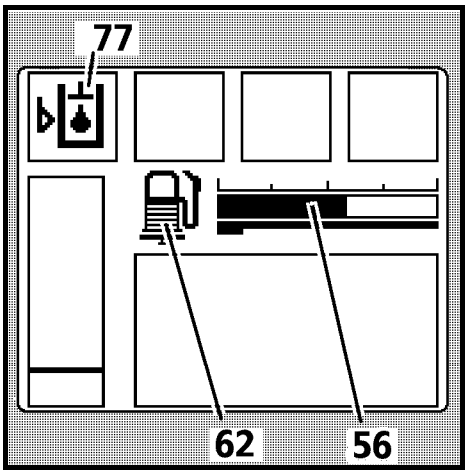



Fig. 6

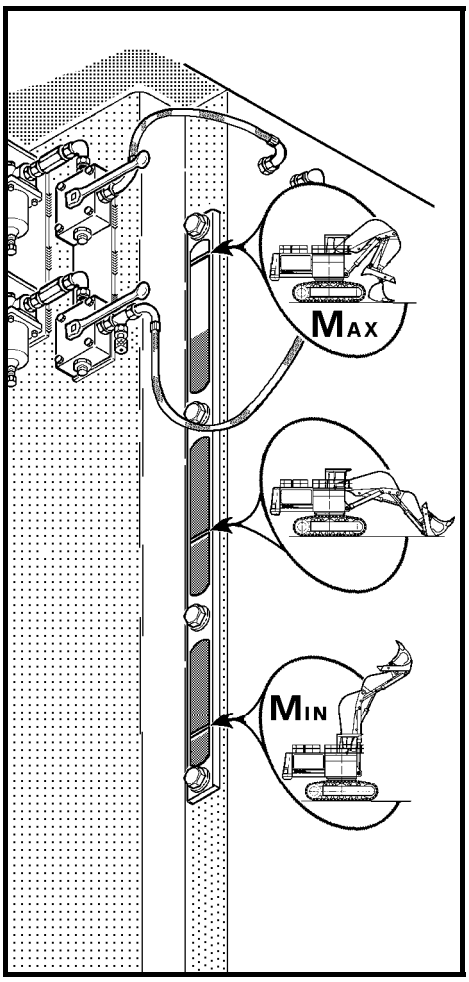



Fig. 7

**CHECK FUEL SYSTEM / FUEL LEVEL**

The condensation in the fuel system and fuel tank must be drained regularly (see page 6.4).

For interval, see maintenance schedule and Cummins Operation and Maintenance Manual.
Check the fuel gauge 56 (Fig. 6) on the LCD screen before starting to work.
If symbol 62 in the lower range of gauge 56 starts to blink, only a little reserve of fuel remains in the tank.
For remaining quantity, see page 3.12.
Refill the tank, if fuel level is low.

**Note : Maintain a high fuel level in tank to reduce condensation. Add fuel at the end of the day.**

**OIL IN THE HYDRAULIC SYSTEM**

When checking the oil level or when adding oil,
- park the machine on level ground,
- Rest the attachments on the ground, with stick and tilt cylinders fully extended and bucket closed
- Shut off both engines.

**Checking oil level in hydraulic tank :**
In this position, the oil level should not be below the centre of the sight gauge (Fig. 7, pos. 2). If the oil level is low, add oil via the return filter until the oil level reaches the centre mark.

See page 5.23 for description of procedure for adding oil.

The upper mark (MAX) shows the maximum oil level when all cylinders are fully retraced.

The lower mark (MIN) shows the minimum oil level when all cylinders are fully extended.

If the oil level drops below the lower mark (MIN), the corresponding symbol on the LCD screen will appear (Fig. 6). At the same time the pumps will return to minimum angle.

## MACHINE START UP SAFETY

- Before excavator start up, perform a thorough walk around inspection.
- Visually inspect the excavator, look for loose bolts, cracks, wear, any leaks and any evidence of vandalism.
- Never start or operate an unsafe excavator.
- Report all defects to your foreman or supervisor and make sure they are corrected immediately.
- Make sure all covers and doors are closed and locked and all warning decals are on the machine.
- Make sure all windows, as well as inside and outside mirrors are clean, and secure all doors and windows to prevent any unintentional movement
- Be certain that the area surrounding the excavator is free of other personnel, and that no one is working on or under the excavator before starting the engine.
- After entering the cab, adjust the operator's seat and controls, the inside and outside mirror, the armrests and fasten and adjust the seat belt. Be certain that all controls can be reached comfortably.
- All noise protection devices on the machine must be functional during operation.

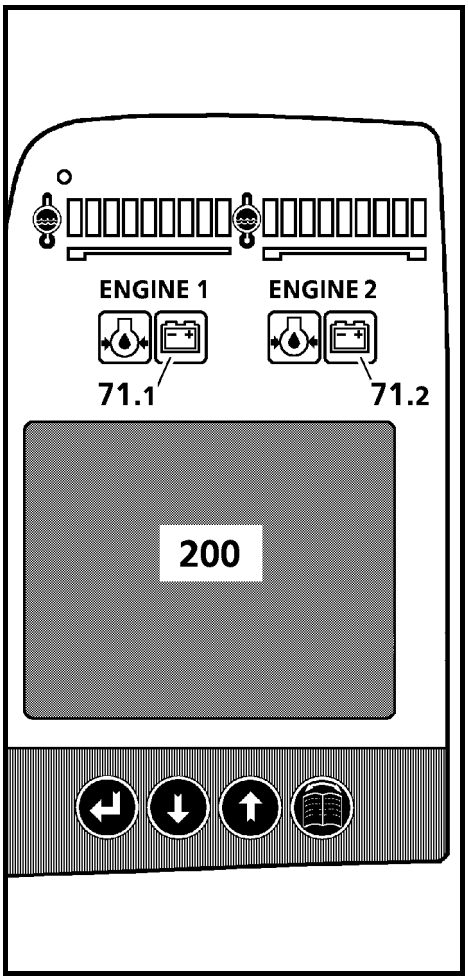



Fig. 8

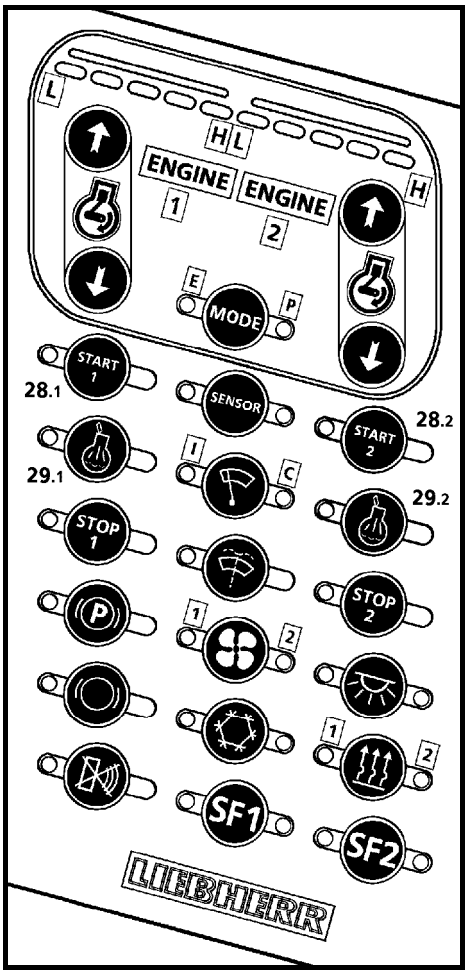



Fig. 9

## DIESEL ENGINE OPERATION

### TURN ON THE ELECTRICAL SYSTEM

Turn the key 13 to contact position –1-.
Immediately after turning the system on, the display and the control unit will run through a self test.
Make sure all indicators function properly after turning the electrical system on, i. e. the light emitting diodes (indicator lights and gauges) turn on for a short time then the complete field of the LCD indicator 200 turns momentarily black (the matrix indicator is energised completely for a short time).

### STARTING THE ENGINES

During the starting procedure of each engine, a starter first drives an engine oil pump to establish the correct lube oil pressure in the engine, before it is being started ( "PRELUBE" procedure).
Depending on engine oil temperature, a prelub time of up to 15 seconds might be necessary to obtain the correct pressure. Then the starter stops and after another 3 seconds, both starters start the Diesel engine.
Start diesel engine 1
Push button 28_1 “START 1” until the diesel engine starts.
During the complete prelube time, and until the engine starts, the indicator light in the button “START 1” will blink and at the same time, the charge indicator light 71.1 “Engine 1” on the display lights up (Fig. 8).
When the engine is running, the button “START 1” is locked, which means, no additional lubrication and starting procedures can be triggered.
Do not actuate the starter for more than 30 seconds without a stop.
Wait for two minutes before repeating the starting procedure.

Start diesel engine 2
The starting procedure for the second diesel engine is the same as for engine 1 and is carried out via button 28.2 “START 2”.
The two diesel engines may not be started at the same time, they must be started one after the other, in any sequence.
When the first engine is started, the sequence of the starting procedures can be heard from the operator’s seat (prelube, end of prelube, starting procedure).

### STARTING PROCEDURE AT AMBIENT TEMPERATURES BELOW 0° C (32° F)

A cold start system is standard equipment on each engine, which makes it easier to start at low temperatures.
The cold start system is actuated electrically via buttons 29.1 or 29.2.
If the engine will not start, or at the beginning of a starting procedure, push this button for a few seconds to spray starter fluid into the intake manifold. As soon as the engine turns over, release the button (once the engine is turning, the button is automatically locked).

**ENGINE SPEED ADJUSTMENT**

After the engine starts, the engine runs at low idle.
The engine speed can be changed either via the arrow keys 26.1/27.1 (engine 1) and 26.2/27.2 (engine 2) or via the mode key 23.
The engine speed for the two engines can be set differently via the arrow keys; however, when using the “Mode” key, both engines run at the same speed.

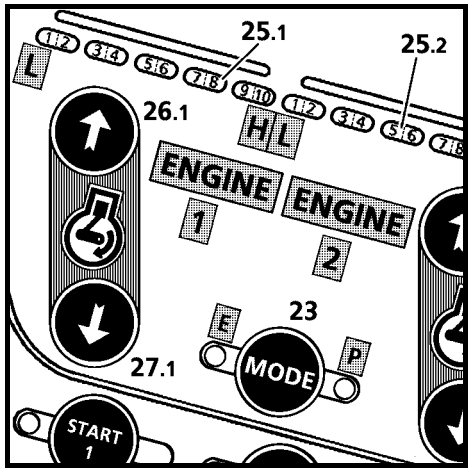


Fig. 10

With the arrow keys 

The complete RPM range for both engines are shown on the bar indicators 25.1 & 25.2, in 10 RPM stages each (5 bars with 2 LEDs each, Fig. 10).

Jump to the next higher or lower RPM stage by pressing on one arrow key.

With mode pre-selection 


Via the MODE key, two preset engine speeds can be preselected.

Immediatlely after the engine starts, the RPM preselection is on stage 1 (diesel engine at low idle).

One of the two light emitting diodes E or P blinks to show which mode (“ECO” or “POWER”) is preselected (the preselected mode which was in use before the machine was turned off remain stored).
E Mode ECO = RPM stage 8
P Mode POWER = RPM stage 10
RPM stage 8 corresponds to the most favourable specific fuel consumption, RPM stage 10 is full engine RPM.

By pushing the mode key 23, the initial condition is confirmed, the corresponding engine speed is transferred to the running Diesel engines, and the LED remains on.

By pushing the mode key again, the system changes from ECO to POWER or vice versa.

If the engine speed do not correspond to the pre-selected mode (either because the engine speed had been changed via the arrow keys or lowered via the low idle automatic), the LED blinks to indicate the mode selected before.

If the engine speeds for both engines are changed via the arrow keys to the engine speed for mode E or P, then it jumps automatically to the corresponding mode.

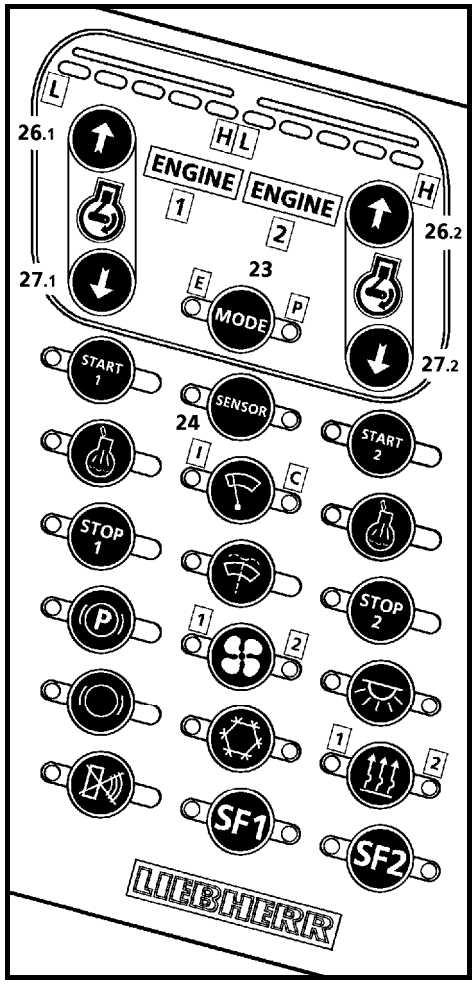


Fig. 11

Adjustment via low idle automatic
The low idle automatic is turned on or off via the “SENSOR” key 24 (left lighting emitting diode on the switch is on or off).
When the low idle automatic is turned on, the engine speed increases by itself to the preselected RPM stage as soon as any one of the pilot control units is actuated, and it is automatically reduced to low idle speed, if no pilot control unit is actuated within a given time frame.

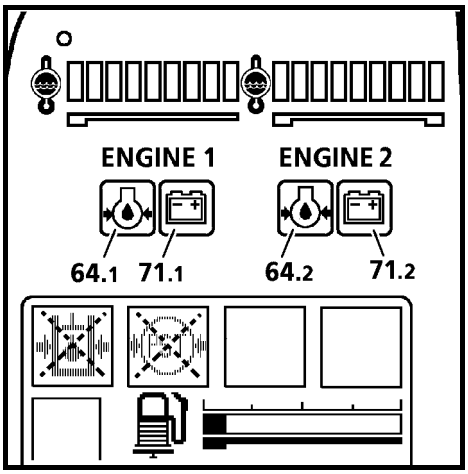



Fig. 12

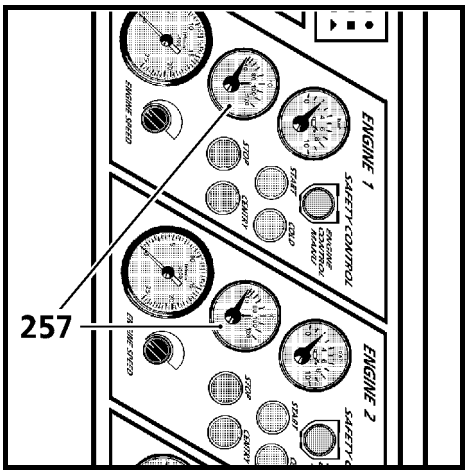



Fig. 13

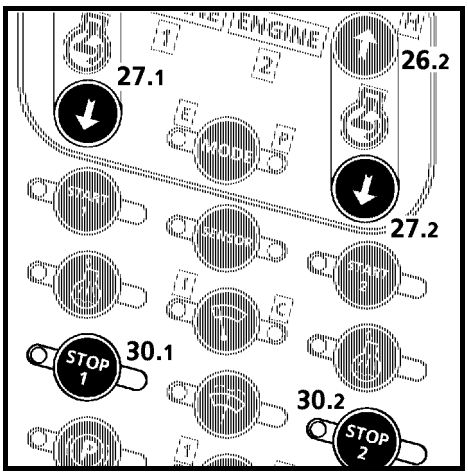



Fig. 14

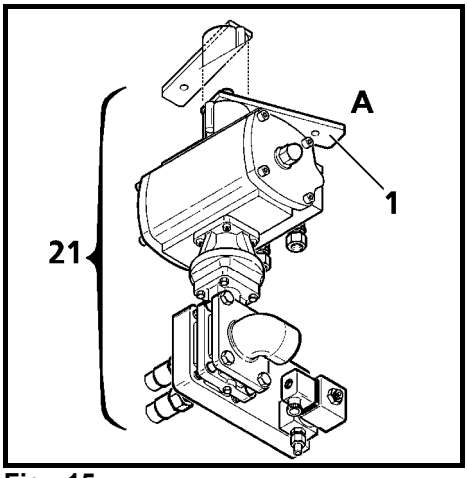



Fig. 15

**AFTER THE ENGINES ARE RUNNING**

After the engines are running, the indicator lights 64 (engine oil pressure) and 71 (charge indicator light) on the display must turn off (Fig. 12).
Let the engine idle at approx. 1000 RPM during the first 3 to 5 minutes, but at least until the warning symbols for low hydraulic tank pressurization and for low servo pressure turn off on the LCD screen. Slowly increase the engine load until the coolant temperature is 60° C on the thermometer 257 (Fig. 13).
Do not run the engine at low idle for extended periods (not more than 10 minutes), this can damage the engine! Turn the engine off if the machine is not used for a longer period of time.

**CAUTION**

- **Bring the engine and the hydraulic oil to operating temperature.**
- **Low oil temperatures causes the excavator to be sluggish and unresponsive.**
- **Move the machine carefully to an open area and check the function of the travel and swing brakes.**
- **Check if all attachment functions are operating properly.**

## ENGINE SHUT DOWN PROCEDURE

Do not suddenly turn the engine off when it is running at high idle. Reduce the engine RPM to low idle via the arrow key 27, and continue to run the engine run for 3-5 minutes to lower the temperature.
Then push the engine STOP button (Fig. 14, pos. 30) to turn the engine off and remove the key.

## EMERGENCY SHUT DOWN

Turn the starter key to the 0- position or push one of the emergency off switches ( see, pos. 110). This action will shut down both Diesel engines and disconnect the electrical system.

**CAUTION**

**Use this shut off method only in emergencies. After an emergency shut down, it is very important to let the engine run again for a short time at low idle after restarting.**

Using the emergency off switches 110 will cause the hydraulic tank to be depressurised quickly.

After a shut down via the switch 110, the lever 1 of the tank pressure release valve 21 must be returned by hand to the position “A” before attempting to restart.

Note: this must be done within ten minutes after an emergency shut down. Otherwise, you must first unlock the switch 110, depress it again, move the operating lever 1 to “A” and then unlock the emergency switch to restart.

## EMERGENCY OPERATION OF THE DIESEL ENGINE

If the Diesel engine can not be started, monitored or operated safely due to a functional problem in the control electronic of the excavator, the Diesel engine operation can be continued via the emergency control function.

To turn on the emergency control circuit for Diesel engine 1 (or 2), use button 225.1 (or 225.2). When the emergency control is turned on, the indicator light in the button is on.

### START DIESEL ENGINES 1 AND 2

Turn the throttle control knob 226.1 or 226.2) fully counterclockwise to low idle RPM.
Push the “START” button 228 until the diesel engine starts.
The starting procedure (prelube, waiting period, starting) is the same as during the normal starting procedure, see page 4.4.

In case of starting difficulties, push button 229 for a few seconds before or at the beginning of the starting procedure to spray starting fluid into the intake manifold.
Release the button as soon as the engine starts.

**Do not push the start button for more than 30 seconds.**
**If the engine does not start, wait 2 minutes before restarting.**

When the emergency control circuit is turned on, the engine control switches 23, 24, 26, 27, 28, 29 and 30 (Fig. 17) are not functioning.
All remaining switches on the control panel remain fully functional, if they are not affected by the existing problem.

**Monitoring the engine**
In emergency function, the indicator P4 (fig. 26) remains fully functional and must be monitored regularly and carefully, because all remaining indicators and warning symbols may no longer be reliable (depending on the problem) or fully functional.

### TURN THE DIESEL ENGINE OFF

Do not suddenly turn the engine off when it's running at high idle.
Reduce the engine RPM via the rotary switch 226 to low idle and continue to run the engine for 3-5 minutes to lower the temperature.
Then push the engine STOP button 230 to turn the engine off.

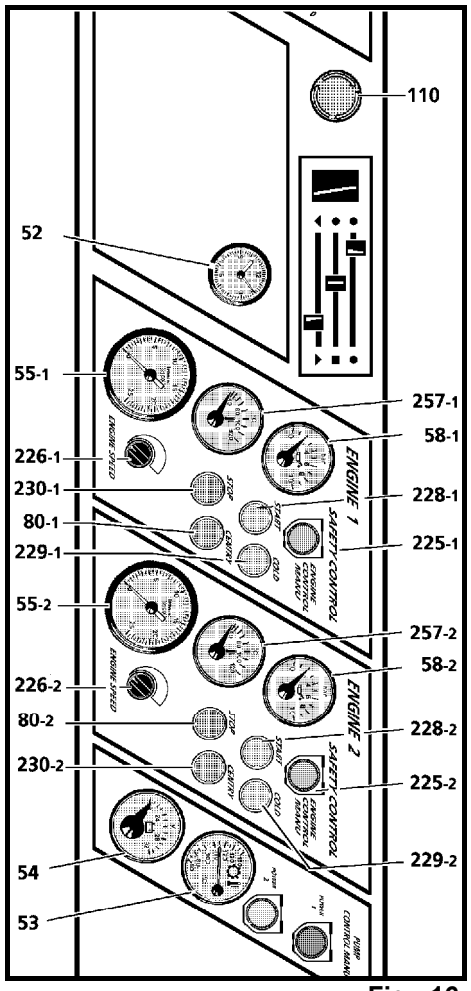


Fig. 16

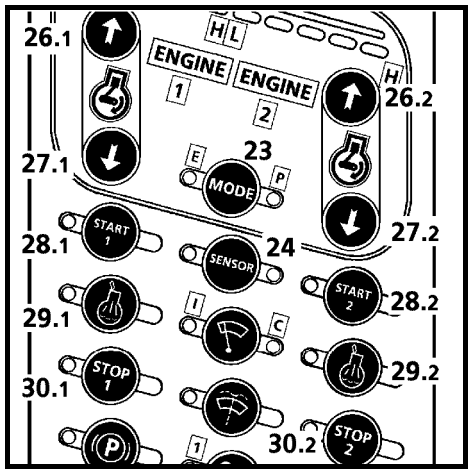


Fig. 17

## MACHINE OPERATING SAFETY

- Familiarise yourself with job site rules. Be informed about traffic and hand signals and safety signs. Ask who is responsible for signalling.
  Check your surrounding for any obstacles in the working and movement range, check the load carrying capacity of the terrain, and secure the job site to shield it from any public highway traffic.
- Always keep a safe distance from overhangs, walls, drop offs, and unstable ground.
- Be alert of changing weather conditions, bad or insufficient visibility and of changing ground conditions.
- Be alert for utility lines, check the location of underground cables, gas and water lines, and work especially careful in that vicinity. If necessary and/ or if required, call local authorities to mark the location.
- Keep sufficient distance to electrical lines. When working in the vicinity of high voltage electrical lines, keep proper distance to assure that the attachment does not come close to the lines.
  DANGER! You must inform yourself about safe distances.
- In case you do touch a high voltage line by accident, proceed as follows:
  - do not leave the machine,
  - move the machine, if possible, from the danger zone until you obtain sufficient distance,
  - warn any personnel in the vicinity not to come close to the excavator and not to touch it,
  - instruct or initiate that someone turns off the voltage.
  - Do not leave the machine until you are absolutely sure that voltage in the line, which had been touched or damaged, has been turned off!
- Before moving the machine, make sure that the attachments and equipment is secured properly to avoid accidents.
- When travelling on public roads or highways, make sure to observe traffic regulations, and make sure that the machine meets federal and local public highway standards.
- Always turn on the lights if visibility is bad or if you are still working during dusk.
- Never allow other personnel on the excavator.
- Operate the excavator only while seated and with the seat belt fastened, if installed.
- Report any problems or needed repairs to your foreman or supervisor and make sure they are corrected immediately.
- Do not move the excavator until you are certain that no one is endangered by moving the excavator.
- On machines without negative brakes check the brake system before starting to work, as outlined in the **Operation and Maintenance Manual.**
- Never leave the operator's seat while the machine is still moving.
- When moving the excavator, keep the upper-carriage in lengthwise direction and keep the load as close as possible to the ground.
- Prevent any working movements, which could tip the machine over. If the excavator beg ins to tip or slip on a grade, immediately lower the attachment and load to the ground and turn the excavator facing downhill. If possible, always operate the excavator with the attachment positioned uphill or downhill, never sideways.
- Always travel slowly on rough or slippery ground and on slopes.
- Always travel downhill at permissible speed, so you don't loose control over the machine. The engine must run at nominal speed, use only the foot pedals to brake and slow down the machine. Never shift during down hill travel, always shift to a lower gear before travelling downhill.
- Never load over an occupied truck. Request that the driver leave the cab, even if a rock protection is installed.
- For demolition work, clearing, crane operation, etc. always use the appropriate protection device designed for this specific application.
- If operating in visually obstructed terrain or whenever necessary, have another person guide you. Always have only one person signal you.
- Allow only experienced persons to attach loads or to guide operators. The guide must be visible by the operator and I or must be in voice contact with him.
- Depending on the attachment combination, it is possible for the bucket teeth to hit the cab, the cab protection or the boom cylinders. Be very careful when the bucket teeth get in this range to prevent any damage
- In case of a thunderstorm:
  - lower the attachment to the ground and if possible anchor the digging tool into the soil.
  - leave the cab and move away from the machine before the storm breaks out. Otherwise, you must stop the excavator, turn off the radio and keep inside the closed cab until the end of the storm.

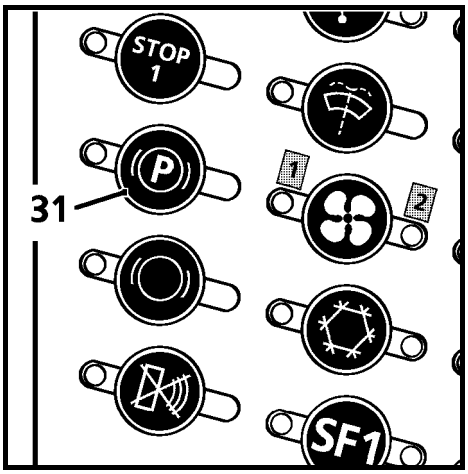


Fig. 18

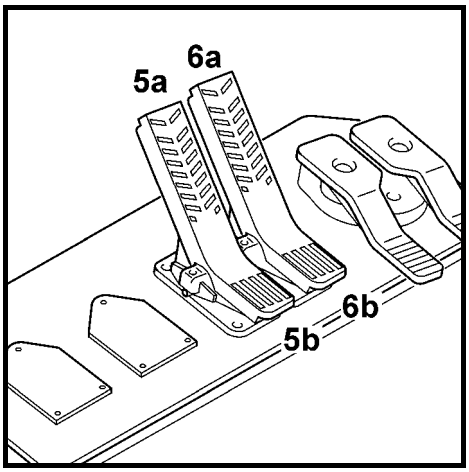


Fig. 19

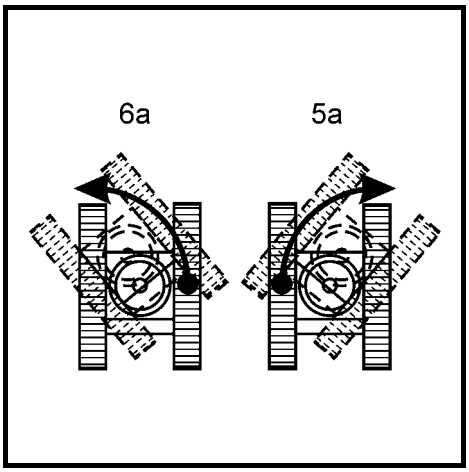


Fig. 20

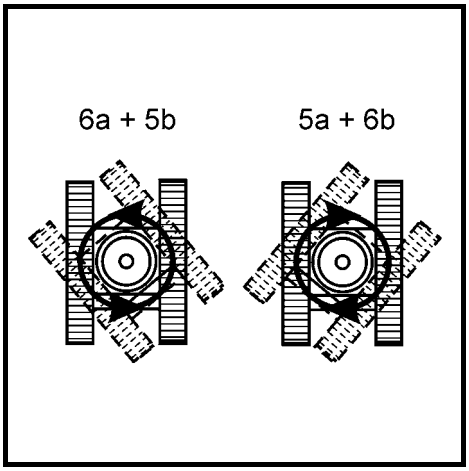


Fig. 21

## TRAVEL FUNCTIONS

**When traveling, align the uppercarriage up with the undercarriage (idlers in front, sprocket wheels in the rear). For travelling procedures, see page 7.1.**

### TO RELEASE THE TRAVEL BRAKES

The travel brakes are controlled by push button 31 (Fig. 18).
If the brakes are applied, the button lights up with a red light.

### STRAIGHT TRAVEL

- **Travel forward :**

Push both foot pedals equally forward with your toes (Fig. 19, pos. 5a and 6a).

- **Travel reverse :**

Push both foot pedals equally downward with your heels (Fig. 19, pos. 5b and 6b).

**DANGER**

**Before you travel in reverse make sure , it is clear and nobody is in your way!**

### TO TURN OVER ONE TRACK

- **To turn left forward (**Fig. 20**):**

Push the right foot pedal forward (pos. 6a).

- **To turn right forward (**Fig. 20**):**

Push the left foot pedal forward(pos. 5a).

**CAUTION**

**To protect the track components, reverse turns should be avoided.**

### COUNTER ROTATION

- **To turn left (**Fig. 21**):**

Push the right foot pedal forward (pos. 6a) and at the same time push the left pedal down with your heel (pos. 5b).

- **To turn right (**Fig. 21**):**

Push the right pedal down with your heel ( pos. 6b) and at the same time push the left pedal forward (pos. 5a).

**DANGER**

If the uppercarriage is turned by 180°, note that the direction of travel is reversed when you push the pedals!

## HAND LEVERS FOR TRAVEL

A more sensitive travel control can be achieved by using the two hand levers included in the tool kit (Fig. 22, pos. 1 and 2).

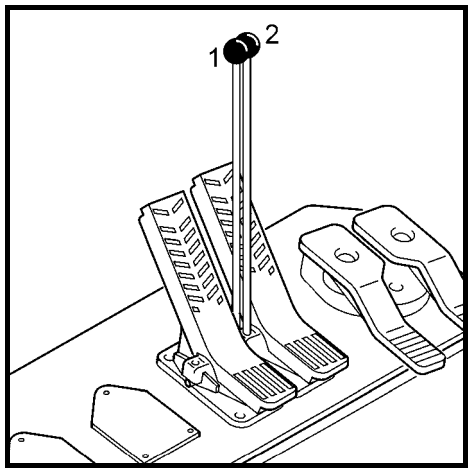



**Fig. 22**

## THE TRAVEL BRAKE

**Hydraulic brake:**

Releasing the foot pedals (Fig. 19, pos. 5 and 6) will automatically return them to neutral position, and a maximum hydraulic braking is achieved.
Run away of the machine traveling down a slope is prevented by the automatically acting brake valves integrated inside the control valve blocks.

The maximum travel speed can not be exceeded.

**DANGER**

**To obtain correct function of the automatic hydraulic brake valves in the travel circuits when travelling downhill, it is imperative that the diesel engine RPM is no lower than ECO speed. The travel speed must be reduced only by the foot pedals.**

**Mechanical brake:**

A negatively acting, hydraulic multi-disc brake is integrated in each travel gear are used to hold the machine on inclines or slopes.

To stop in difficult terrain push the button (Fig. 23, pos. 31) to “Brake locked” to apply the brakes.

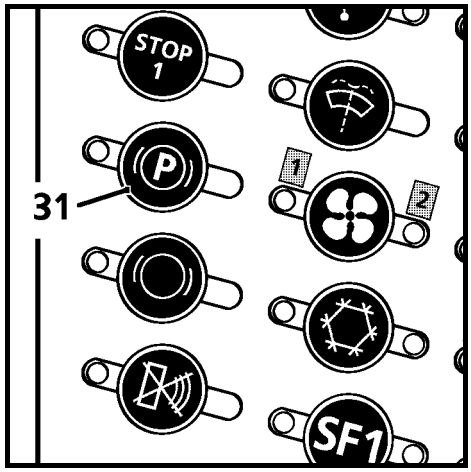



**Fig. 23**

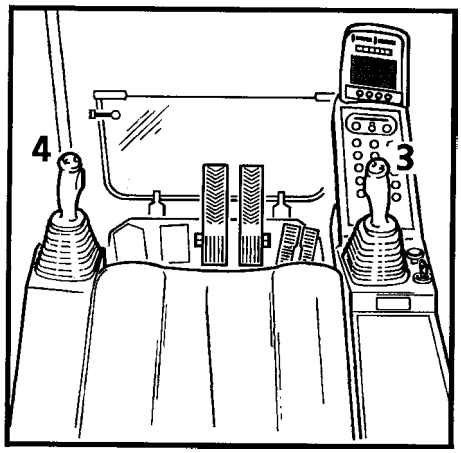


Fig. 24

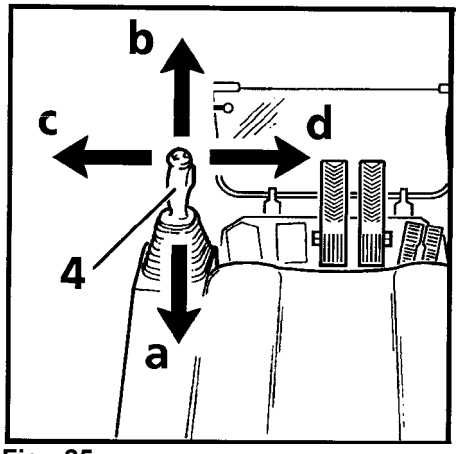


Fig. 25

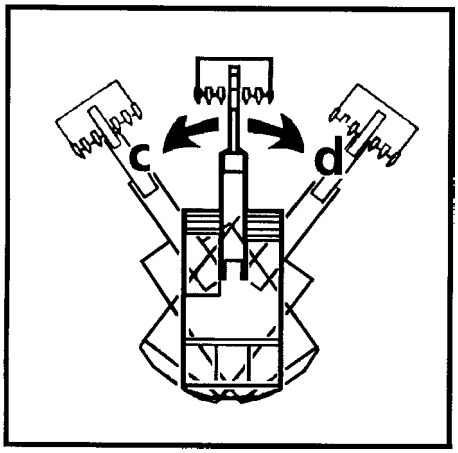


Fig. 26

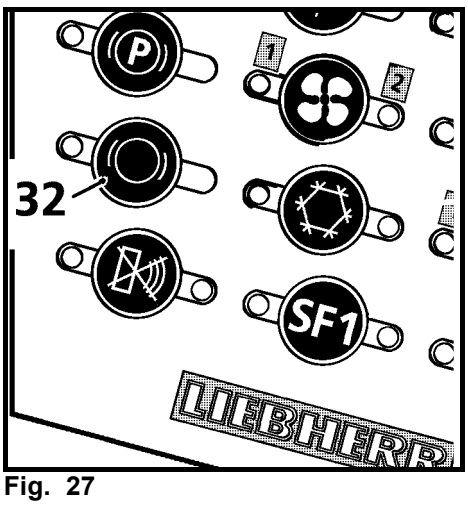


Fig. 27

## LOCATION OF THE TWO JOYSTICKS

The right lever (Fig. 24, pos. 3) controls the boom and the bucket movements.

The left lever (Fig. 24, pos. 4) controls the stick and the swing movements

## CONTROL OF THE SWING (LEFT JOYSTICK)

Moving the joystick (Fig.46, pos. 4) to the left (c) causes the uppercarriage to turn to the left (Fig.47).

Moving the joystick 4 to the right (d) causes the uppercarriage to turn to the right (Fig.47).

**SWING BRAKE**

**1) Hydraulic service brake**

A sufficient deceleration of the uppercarriage is achieved by moving the swing joystick to neutral position.

By moving the joystick to the opposite direction, maximum hydraulic braking action is achieved.

**2) Mechanical parking brake**

A multi disk swing brake, which is integrated in the swing gear, serves as an additional mechanical brake.

The brake is negatively acting, hydraulically actuated and serves as a holding or parking brake.
When working, the swing can be locked in any position with this brake.
When the push button indicator light is off, the brake is released.
The swing brake is actuated via the push button 32 (Fig. 27):

When the brake is applied, the red indicator light fights up.
When the push button indicator light is off, the brake is released.

**CAUTION**

**APPLY THE BRAKE ONLY WHEN THE UPPERCARRIAGE IS NOT MOVING!**

**In order to stop the uppercarriage when working on a slope, first stop its movement with joystick 4.**
**Then apply the brake via push button 32 and move joystick 4 to "O" position.**

**To check the swing brake**

Apply the swing brake via rocker 32 (Fig. 27). Then move the left joystick 4 (Fig. 28) to the right and then to the left to stop. The brake is working properly if the uppercarriage does not move.

**OPTIONAL EQUIPMENT: SWING BRAKE CONTROLLED IN SEMI AUTOMATIC.**

With this equipment, the function of the push button is not to apply and release the brake as described before, but to pre-select the operating mode of the mechanical swing brake, as follows:

- in one position the brake remains always applied.
- In the other position, the brake is in semi-automatic mode and is controlled via the rocker switch 81 (Fig. 29) mounted to the right joystick lever as follows:
  - with the rocker switch 81 tilted down, the brake is applied, respectively it applies as soon as the uppercarriage speed gets lower than a limit value.
  - with the switch tilted up, the brake remains released.

**Notice**: The red control light in the button 32 lights up each time the brake is applied.
If this light does not go out when the rocker switch 81 is tilted up, the button 32 must first be pushed to pre-select the semi-automatic mode.

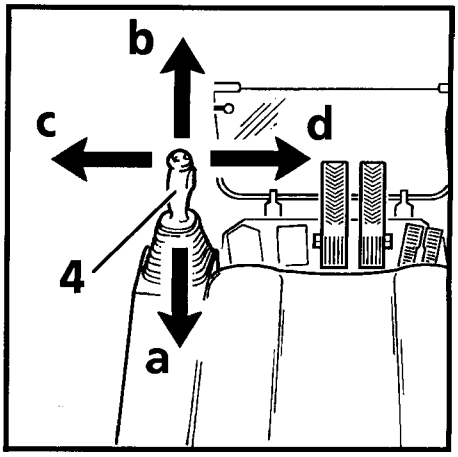



**Fig. 28**

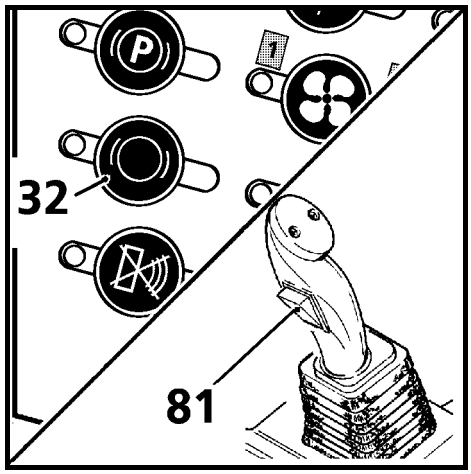



**Fig. 29**

**CAUTION**

**The brake only applies when the uppercarriage is near standstill and if no swing motion is actuated via the joystick!**
**In order to stop the uppercarriage when working on a slope, tilt the switch 81 down and reduce the uppercarriage speed by braking with joystick 4.**
**Move the joystick 4 back to "0"position only when the uppercarriage is quite immobile, the brake will apply.**

**Emergency stop of the uppercarriage swing motion:**

The swing brake can be applied independently of the uppercarriage RPM by switching the button 32 from position "semi-automatic" into position "applied".

**CAUTION**

**Perform this braking via button 32 only in emergency cases, since it causes fast abrasion of the brake discs.**

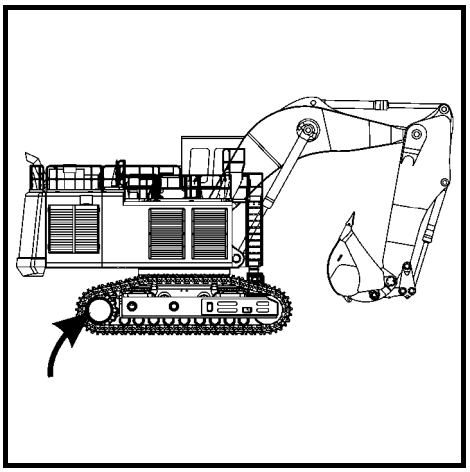


Fig. 30

## WORKING POSITION

When working in a straight line, the machine should work over the idlers (Fig. 30), the sprockets should be at the rear.

## ATTACHMENT CONTROL

**CONTROL OF THE STICK CYLINDER**
**(left joystick 4-Fig. 31)**

**For backhoe attachment (Fig. 32)**
Pull joystick 4 backwards (a) to move the stick in.
Push joystick 4 forward (b) to move the stick out.

**For shovel attachment (Fig. 33)**
Pull joystick 4 backwards (a) to move the crowd in.
Push joystick 4 forward (b) to move the crowd out.

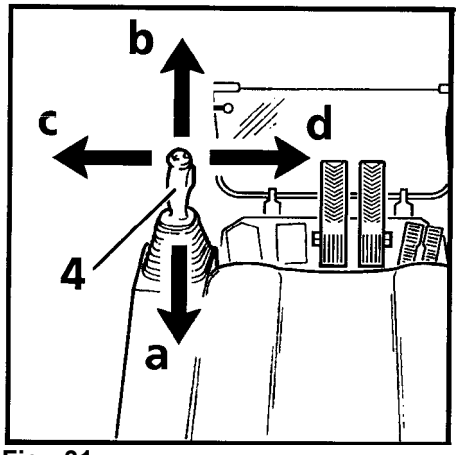



Fig. 31

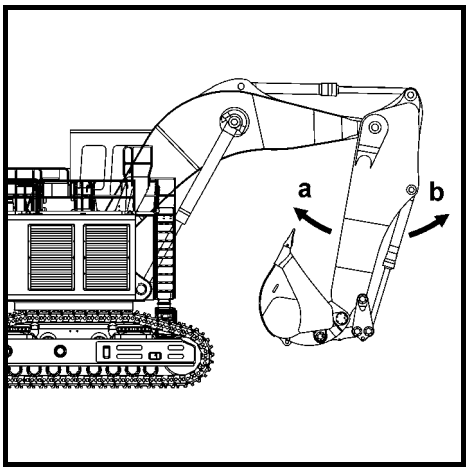



Fig. 32

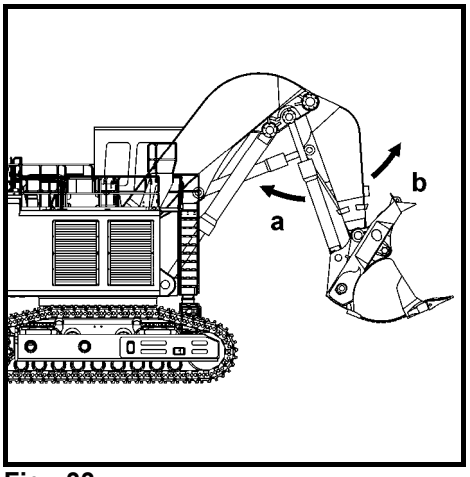



Fig. 33

**CONTROL OF THE BOOM CYLINDER**
**(right joystick 3 -Fig. 34)**

**1 For backhoe attachment (Fig. 35)**

Push joystick 3 forward (g) to lower the boom.
Pull joystick 3 forward (h) to lift the boom.

**2 For shovel attachment (Fig. 36)**

Push joystick 3 forward (g) to lower the boom.
Pull joystick 3 forward (h) to lift the boom.

**CONTROL OF THE BUCKET OR GRAPPLE CYLINDER**
**(right joystick 3 -Fig. 34)**

**3 For backhoe attachment (Fig. 35)**

Push joystick 3 to the left (e) to tilt the bucket in.
Push joystick 3 to the right (f) to tilt the bucket out.

**4 For shovel attachment (Fig. 36)**

Push joystick 3 to the left (e) to tilt the bucket in.
Push joystick 3 to the right (f) to tilt the bucket out.

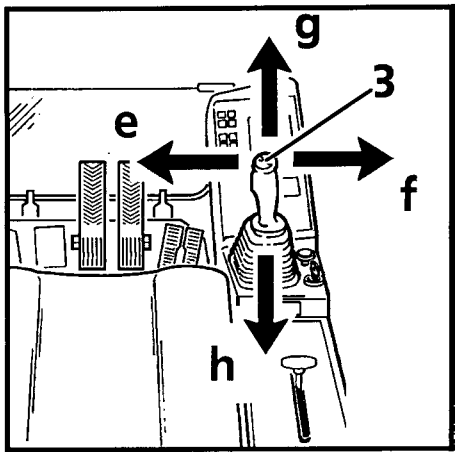


**Fig. 34**

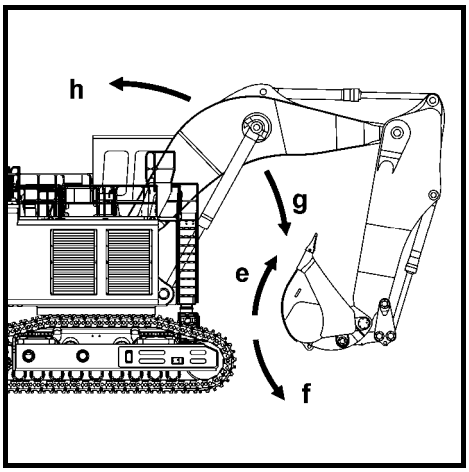


**Fig. 35**

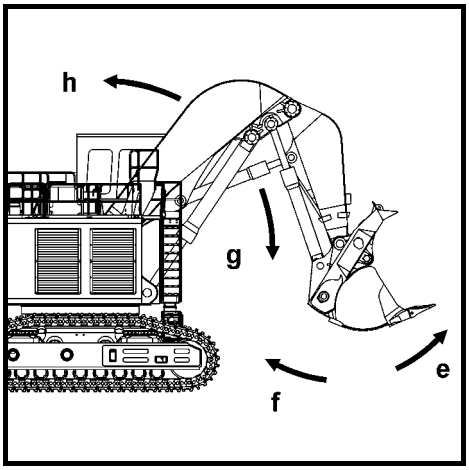


**Fig. 36**

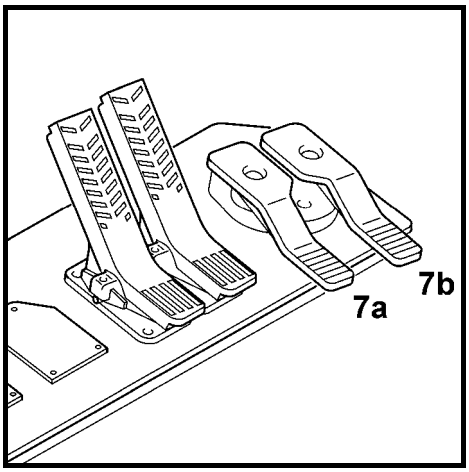



**Fig. 37**

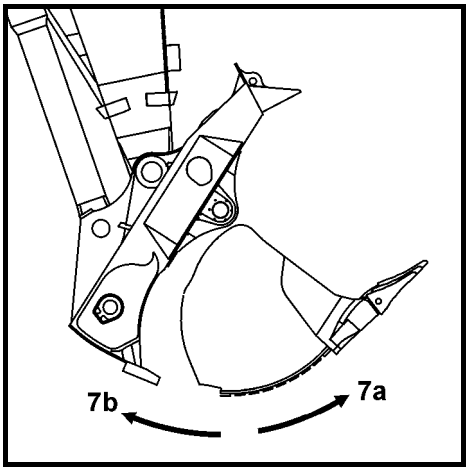



**Fig. 38**

**CONTROL OF THE BOTTOM DUMP SHOVEL BUCKET**
**(optional equipment)**

The bottom dump shovel bucket is moved via two pedals, 7a and 7b (Fig. 37).

- Push pedal 7a to open the shovel bucket (Fig. 38).
- Push pedal 7b to close the shovel bucket (Fig. 38).

**FLOAT POSITION OF BOOM CYLINDER FOR BUCKET OPERATION**

**(optional equipment)**

To turn on the float position for the lift cylinders, move the right joystick 3 forward (g) and push the button 22 on top of the handle at the same time (Fig. 39).

Now the bucket can be used for grading work while moving the joystick 4 forward to extend the crowd cylinders(Fig. 41).

The attachment can then move freely up or down depending on grade and the bucket will automatically follow the ground contour (Fig. 40).

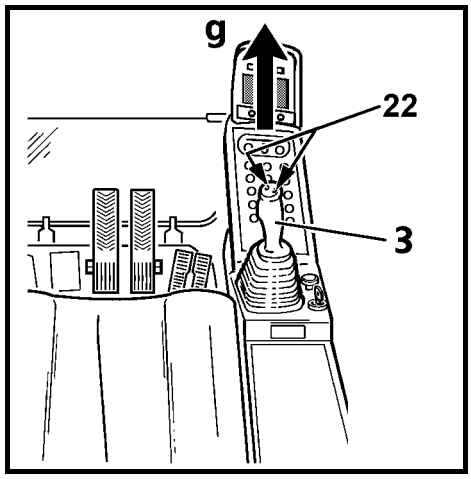



**Fig. 39**

**COMBINATION OF JOYSTICK MOVEMENTS**

**A diagonal movement of the joystick combines the movements of the attachment functions.**
**This makes is possible for all attachment movements to be controlled at the same time.**

The operator can do the following movements without any additional manipulations

When the swing movement is actuated, all working functions/ movements are possible without affecting the swing movement.

During travel, every attachment movement is possible, but the swing movement has priority. In this case, the travel movement is reduced.

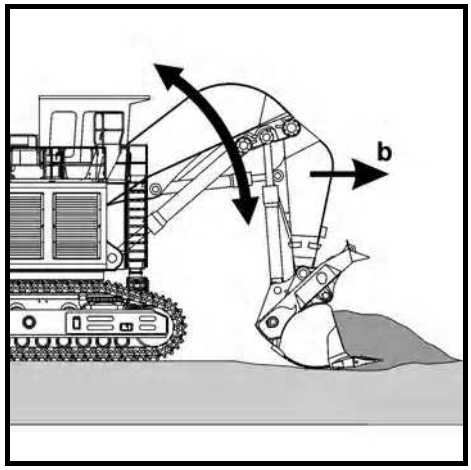



**Fig. 40**

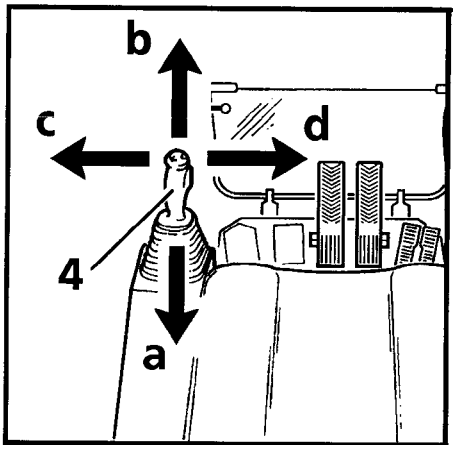



**Fig. 41**

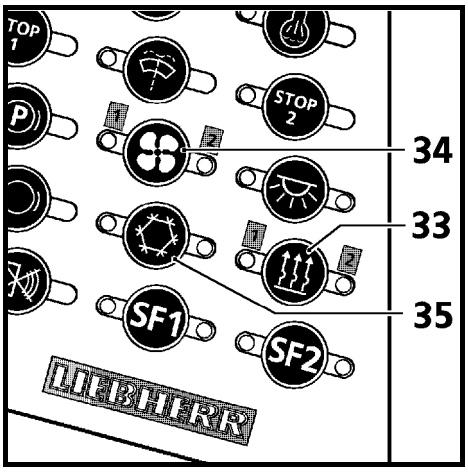


Fig. 42

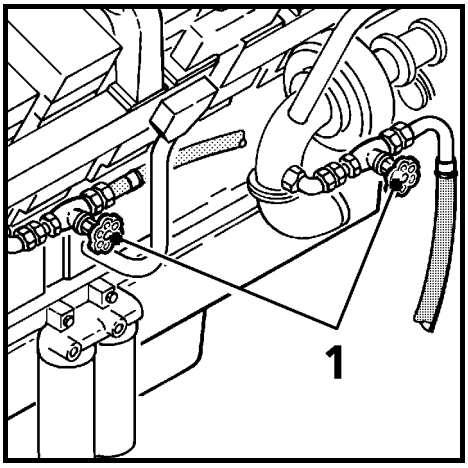


Fig. 43

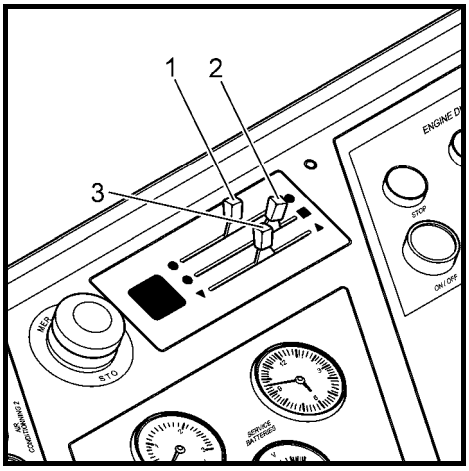


Fig. 44

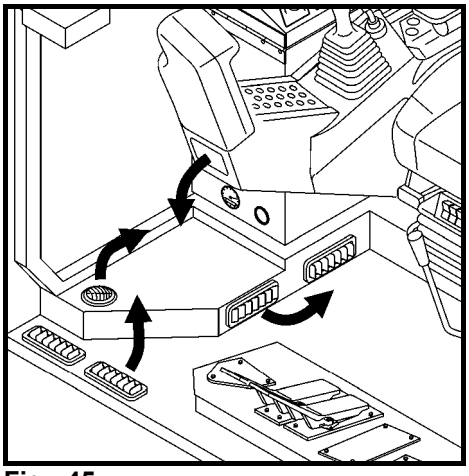


Fig. 45

## THE HEATER AND AIR CONDITIONER

A heater and an air conditioner are installed in the cab as standard equipment.

The heater is installed on the cab floor. The evaporator for the air conditioning system is integrated in the roof of the cab, and the condenser is installed on the engine cooling radiator.

### CAB VENTILATION

The heater as well as the air conditioner can both be used, at the same time and independently of each other to ventilate the cab.

**Ventilation via the heater**

For cab ventilation during the summer time, the two coolant shut off valves which join the Diesel engine to the cab (Fig. 43) should be closed.
Push the lever (Fig. 44, pos. 1) all the way forward to close off the water supply.

Push button 33 (Fig. 42) to select desired air flow.

The fresh air enters the cab via openings on the steps (Fig. 45) and via the vents on the left and right front (Fig. 45).

Move the lever 2 (Fig. 44,) to regulate the amount of fresh air / recirculated air coming into the cab.

If lever 2 is pushed forward, the fan recirculates the air in the cab.

**Ventilation via the air conditioner**

To ventilate the cab via the evaporator in the roof of the cab, turn the air conditioner off via button 35. Turn the blower fans on via button 34, and select the desired air flow via the rotary switch 19.1 (Fig. 46) and the vents of the evaporator.

### FOR HEATER OPERATION

Open the coolant shut off valves on the Diesel engine (Fig. 43).

The amount of water running through the heat exchanger can be regulated by moving the lever 1 (Fig. 44). If the regulator is pushed all the way to the rear, the maximum amount of coolant flows to the heater.

Set the desired air flow via button 33 .

Move the lever 2 to regulate the amount of fresh air recirculated air entering the cab.

The best heating effect can be reached when the air is recirculated, which means, the lever 2 should be pushed all the way to the front.
In this position, a small amount of outside air is mixed with the recirculating air in the cab.

To quickly defrost the windshield, direct the warm air flow via the vents to the front, and push the sliding regulator 3 all the way to the rear, so that the maximum air flow is blown via the vents in the step onto the windshield.

When the lever 3 is pushed all the way to the front, part of the warm air flow is blown against the left side window.

**AIR CONDITIONER OPERATION**

Adjust the air conditioner fan via button 34.
One of the Diesel engine must be running before the air conditioner blower is turned on.

Turn on the air conditioner compressor and the condenser fan via button 35 (Fig. 46).
The left LED on the button will light up if the air conditioner system is in operation.

The air conditioner can only be turned on if the evaporator fan unit is turned on via button 34.

Select the desired air flow via the rotary switch S1 .

Set the desired air temperature via the rotary switch S2.

The direction of the cold air flow can be adjusted via the vents on the evaporator unit (Fig. 47).

For air conditioner operation during the summer time, preferably close the coolant shut off valves on the Diesel engine, push the lever (Fig. 44, Pos. 1) all the way to the front and turn the heater blower off via button 33.

To dehumidify the air in the operator's cab

In case of very high humidity inside the cab during the colder season, the air conditioner can be operated for a short while simultaneously with the heater in order to eliminate the excess of humidity and the condensation.

For best efficiency, select a high evaporator air flow via the rotary switch S1 and operate the heater with recirculated air.

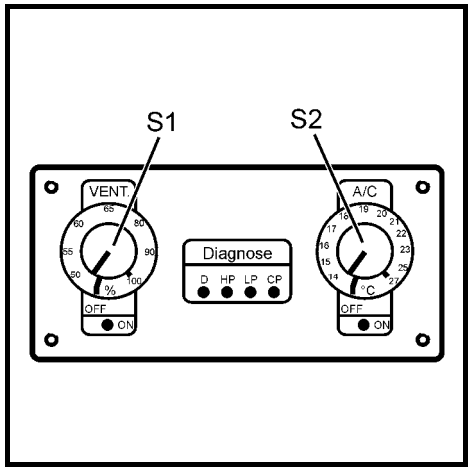



**Fig. 46**

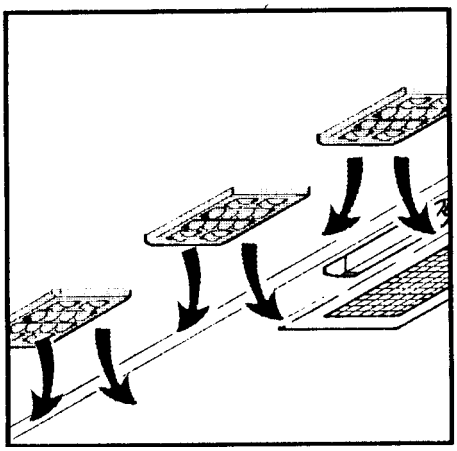


**Fig. 47**

# 5. LUBRICATION

## GENERAL SAFETY INFORMATION

It is very important that all guidelines describing lubrication, checking the oil level, replacing the oil are strictly adhered to!
This maintenance increases the life of the excavator and improves its dependability.

It is especially important to change the oil regularly and in the intervals noted on the maintenance schedule! Only use specified lubricants and oils!

**CAUTION**

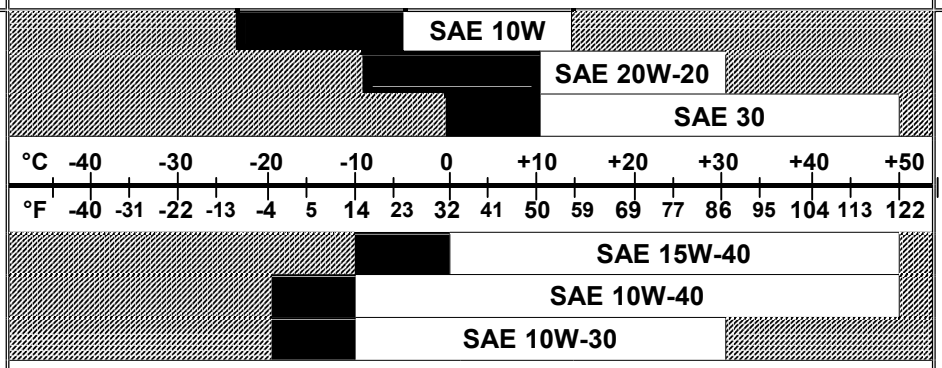
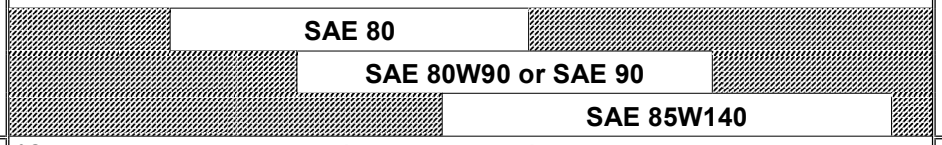
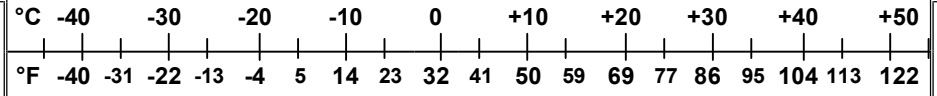
**When checking or replacing the oil, observe the following :**

- **Park the machine on level ground, if not otherwise stated, and turn the engine off.**
- **When working in the engine area, make sure the covers and side doors are secured.**
- **Only add fuel when the engine is turned off.**
- **Never smoke or allow an open flame in refuelling areas.**
- **Cleanliness is especially important when changing engine, gear or hydraulic oil. Before removing fittings or plugs, make sure the surrounding areas are cleaned. When changing the oil, clean the fill or drain plugs.**
- **The machine's zone of operation must always remain clear of lubricating materials to prevent the personnel working in the area from slipping. Be sure to clean excess oil or grease from the machine, especially where the various bearings are connected to the central lubrication devices.**

**IMPORTANT!**

Be sure to drain oil into a suitable container and dispose of oil and filter cartridges properly.

## LUBRICANTS AND FUEL CHART R 996 LITRONIC

| COMPONENTS | SYMBOL | VISCOSITY SAE DIN 51 512 — SPECIFICATION | QUANTITY |
|---|---|---|---|
| **DIESEL ENGINE** | | | |
| - Lubricant | | **See the Operation and Maintenance Manual for CUMMINS engine** | 2 × 170 l.<br>2×45 USgal. |
| - Fuel | | **See the Operation and Maintenance Manual for CUMMINS engine** | 13000 l.<br>3440 USgal. |
| - Coolant | | **See the Operation and Maintenance Manual for CUMMINS engine** | 2 × 170 l.<br>2×45 USgal. |
| **HYDRAULIC SYSTEM** | |  <br>**Warming up the hydraulic system**<br>**1. For temperatures 18°F (10°C) below the lower limits :**<br>Run engine at half speed. Warm up the hydraulic system by fully actuating hydraulic cylinders and motors for short periods. Continue to warm up during about 10 minutes or until operating temperature is reached.<br>**2. For temperatures below the limits listed under 1:**<br>Preheat hydraulic oil in the tank before starting the engine. | 6000 l.<br>1590 USgal.<br>In hydraulic tank<br><br>8700 l.<br>2298 USgal.<br>In whole circuit |
| **SWING GEAR** | 1 |  | 4×38 l.<br>4×10 USgal |
| **TRAVEL GEAR** | 2 |  | 2 × 200 l.<br>2×53 USgal |

## LUBRICANTS AND FUEL CHART R 996 LITRONIC

| COMPONENTS | SYMBOL | VISCOSITY SAE DIN 51 512 | SPECIFICATION | QUANTITY |
|---|---|---|---|---|
| SPLITTERBOX |  | SAE 90 or SAE 80W90 | API GL-5 AND MIL-L-2105 B, C or D | 2×100 l. in circuit 2×80 l. in splitterbox |
| COUPLING SPLITTERBOX / ENGINE |  | SAE 15W40 | MB 228.1 | 1,2 l. 0,32 US gal |
| SWING RING TEETH |  | Special grease | See lubricant specification | 80 l. (21 US gal.) |
| GENERAL LUBRICATIÓN POINTS<br><br>Swing ring, Attachment bearings, Track tensioner,… |  | Down to 0°C (32°F)<br>Down to -15°C (5°F)<br>Down to -40°C (40°F) | CONSISTENCY 2 NL GI N°2 Grade<br>NL GI Grade<br>SPECIAL GREASE As an example Mobilith SHC 460 o SHC PM | MULTUPURPOSE GREASE KP2k or EP2 (Extreme pressure N°2 Grade)<br>CONSISTENCY 1 | 600 l. 159 USgal. |
| Hinges, couplings, locks | | | Engine oil | |
| Rubber seal on doors and covers | | | Silicon Spray or talcum | |
| WINDSHIELD WASHER SYSTEM |  | | Commercial Windshield washer fluid or denatured alcohol | 75 l. (19,8 Usgal) |
| REFRIGERATING AGENT FOR AIR CONDITIONER | | | R 134a | 8,5 kg (18,5 lbs.) |
| REFRIGERATOR OIL IN AIR CONDITIONER COMPRESSOR | | | PAG SP 20 | 0,8 l. (28 oz.) |
| TRACK ROLLER | | Mix of oil and additive | Shell Tivela WB Tribostar 0,02 | 14×4,95 l. 14×1,65 l. |
| CARRIER ROLLER | | Mix of oil and additive | Shell Tivela WB Tribostar 0,02 | 6×0,55 l. 6×0,15 l. |

# LUBRICANTS AND FUEL SPECIFICATIONS

## INFORMATION TO THE LUBRICANTS AND LUBRICATION CHARTS

The capacities in the lubricants chart and on the lubrication inside the cab are only given for your guidance.

Always check the level of a component after replacing its oil or when topping it up.

### 1) LUBRICANT FOR DIESEL ENGINE

**See the Operation and Maintenance Manual for CUMMINS engine**

**4) HYDRAULIC OIL :**

**Hydraulic oil specifications**

**1. Mineral oils**

Recommended and approved are engine oils, which conform to the following specifications

For single viscosity oils : API - CD / CCMC- D4 / ACEA - E 1
Mercedes-Benz specifications -page No 226.0 and 227.0

For multi viscosity oil : API - CD +SF / CCMC - D5 / ACEA - E3
Mercedes-Benz specifications -page No 227.5, 228.1 and 228.3

**2. Environmentally friendly hydraulic fluids (also called "BIO oils" -biodegradable oils-)**

The "environmentally friendly hydraulic fluids" recommended by LIEBHERR are limited to synthetic ester based hydraulic fluids with a viscosity according to ISO VG 46.

Initial filling is performed ex works according to customer desires. The use of environmentally friendly hydraulic fluids must be arranged with the LIEBHERR Co beforehand.

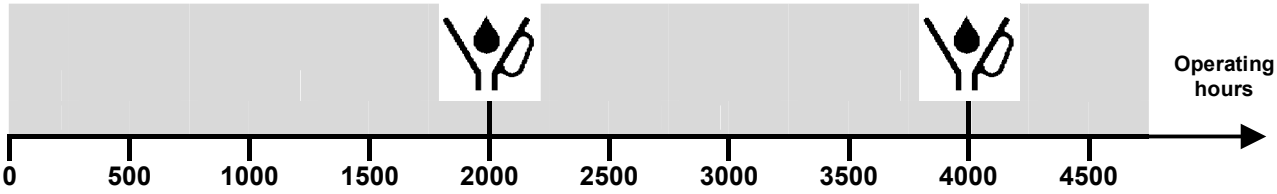
Organic oils should not be used due to their poor temperature consistency.

**Note: It is absolutely necessary never to mix different brands of environmentally friendly hydraulic fluids or to mix fluids with mineral oils.**
**For further information on operating while using environmentally friendly hydraulic fluids, see page 8.7.**

**Hydraulic oil change intervals**

**1. Oil changes in pre-set intervals**

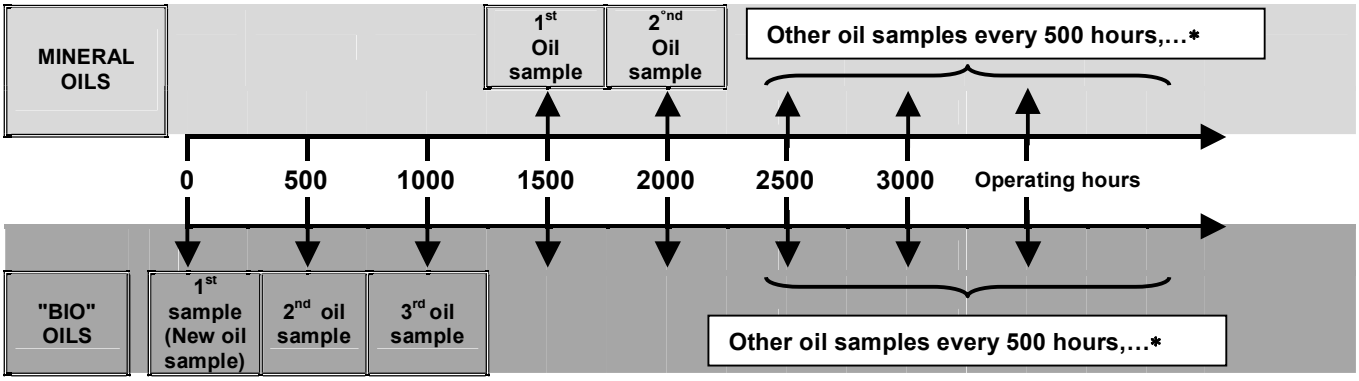
**Note: Oil changes in pre-set intervals are only permitted for mineral oils. When using environmentally friendly hydraulic fluids, oil sample analysis reports must be used to determine the time of the oil change, see §2**




**2. Optimised oil change intervals determined through oil sample analysis reports.**

Use this procedure to take oil samples in pre-set intervals. The intervals may be extended between two oil changes as long as the properties of the oil are still satisfactory. The time when the oil must be changed is determined by the lab report.

LIEBHERR recommends to submit the oil samples to "WEAR- CHECK" for oil analysis. A kit for 6 complete analysis at WEAR - CHECK is available : Id. No. 7018368 (The kit contains the sample containers, documentation, shipping container and oil sample hose). A hand pump is required to take the oil sample, and should be ordered separately (Id. No. 8145666).




***... time for oil change determined by lab report**

**5) SWING AND TRAVEL GEAR OILS**

Use gear oil meeting specifications API-GL-5 and MIL-L-2105 B, C or D.

**6) SPLITTERBOX OIL**

Use gear oil with viscosity classification SAE90 or SAE 80W90 and meeting specifications API -GL-5 and MIL-L-2105 B, C or D.

**7) LUBE OIL FOR ELASTIC COUPLING**

Use engine or gear oil with viscosity classification SAE 15W40 and meeting specification MB228.1.

**8) GREASE FOR SWING RING ROLLER BEARING RACES AND GENERAL LUBRICATION POINTS**


This grease must meet  specifications, consistency 2 of NL GI -classification per

DIN51818 and DIN 51825 or EP 2 per NF-T-60132.

The grease must be lithium-complex based, with a VKA value of at least 2300 N per DIN 51350 or ASTM D 2596.

**Between 0°C and –15°C (32°F and 5°F)** Use a grease with consistency classification 1 NL GI or EP1 grease.

**Between -15°C and -40°C (5°F and -40°F)** Only employ grease synthetic greases. We recommend the grease Mobilith SHC 460 or Mobilith SHC PM.

**9) GREASE FOR SWING RING TEETH**

This grease must comply with following recommendations:
- be of consistency classification 2 in NL-GI viscosity per DIN 51818,
- have a VKA value of at least 5500N per DIN 51350 or ASTM D 2596,
- show a water resistance of 1-90 per DIN 51807.

LIEBHERR recommends the use of:
Grease BP Energol OGL 461 F Liebherr order n°: 8503629 for a 50 kg (110 lbs.) barrel

**10) REFRIGERATOR OIL IN AIR CONDITIONER COMPRESSOR**

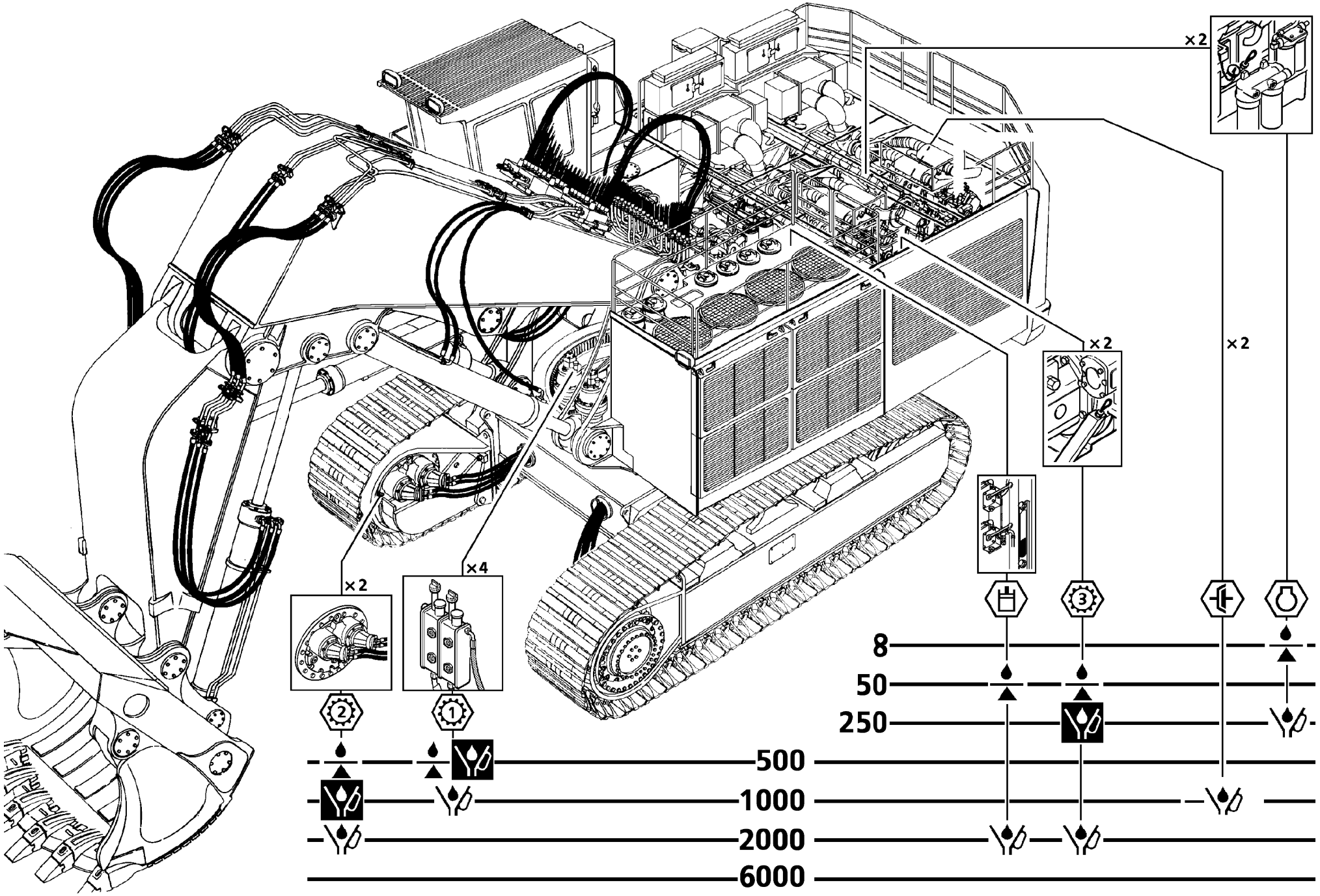
From the factory, the air conditioner compressors are filled with oil: PAG SP 20.

LIEBHERR part No: 8504414 / 0,25 liter (.066 Gal.) container of PLANETELF PAG SP20 oil.

PAG oils (Polyalcylen - Glycol oils) are the only oils presently authorized by the compressor.

**11) LUBRICANT OF TRACK AND CARRIER ROLLERS**

the lubricant is a mix of oil “Shell Tivela WB” and additive “Tribostar 0,02”
LIEBHERR part N°: 8503871 / 1 liter (0,26 Gal.) container of Shell Tivela WB oil
LIEBHERR part N°: 8503872 / 5 liters (1,32 Gal.) container of Tribostar 0,02 additive
No other lubricant is accepted


×2
×2
×2
×2
×4
8
50
250
500
1000
2000
6000

## THE LUBRICATION CHART

Components and maintenance work symbols, fluids quantities*

| | | | | | |
|---|---|---|---|---|---|
| Engine | 2 × 170 l<br>2 × 45 US gal | | Grease / swing ring teeth | 80 l<br>21 US gal |
| Engine coolant | 2 × 170 l<br>2 × 45 US gal | | Grease | 600 l<br>159 US gal |
| Hydraulic system | 5000 l<br>1321 US gal | | Windshield washer | 75 l<br>20 US gal |
| Swing gear | 4 x 38 l<br>4 x 10 US gal | | Check oil level | |
| Travel gear | 2 x 200 l<br>2 x 52,8 US gal | | Oil change | |
| Splitterbox | 2 × 80 l<br>2 × 21 US gal | | First oil change | |
| Fuel | 5100 l<br>1347 US gal | | Oil analysis | |
| Coupling | 1.275 l<br>0.34 US gal | | | |

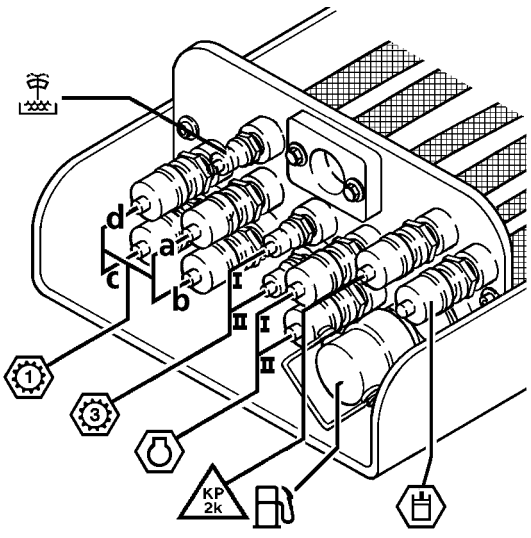
*the given quantities are only guidelines. Check fluid level after each change or refilling.

## THE SERVICE TRAP

To simplify the oil change and the refilling procedure, the drain of major components are centrally connected to a service trap.

- The two diesel engines
- The two splitterboxes
- The 4 swing gears
- The fuel tank
- The hydraulic oil tank
- The windshield washer fluid tank
- The grease tank for general lubrication
- The grease tank for swing ring teeth lubrication

| Component | Adapter WIGGINS | Flow max. |
|---|---|---|
| Swing gear | OSP 2 | 50 l/mn |
| Splitterbox | C-1807 | 50 l/mn |
| Engine oil | OSP 2 | 50 l/mn |
| Centinel oil | OSP 2 | 50 l/mn |
| Hydraulic oil | 6600 B12 | 100-200 l/mn |
| Fuel | ZZ 9A1 | 400 l/mn |
| Windshield washer | EC 280 B8 | 25 l/mn |
| Principal grease | OSP 2 | 15-30 l/mn<br>Pmini 100 bar |
| Teeth ring grease | 6000 B12 | |



For safety reasons and for ease of maintenance, oil for the connected components should only be drained and refilled via the quick-change couplings in the service trap.

However, these components are also equipped with oil drain valves, see description for oil change procedure of these components in this chapter.

**TO LOWER AND RAISE THE SERVICE TRAP**

When the service trap is lowered, the service plate is accessible from the ground level.
The service flap can be moved up and down via the two push buttons 1 and 2 on the control box (Fig. 1) on the upper section of the access ladder .
The service flap can also be actuated with the engine shut down.
It should only be moved out if the uppercarriage and the undercarriage are aligned.
When extending the service flap from its uppermost position, the flap is unlocked first and then moves downward.
In reverse, when retracting it, as soon as it has reached its uppermost position, it is automatically locked mechanically via an electro-hydraulically actuated pin. The button 1 must be pushed until the lock pin has reached its stop position, it eq. Until the red indicator light 3 goes out.

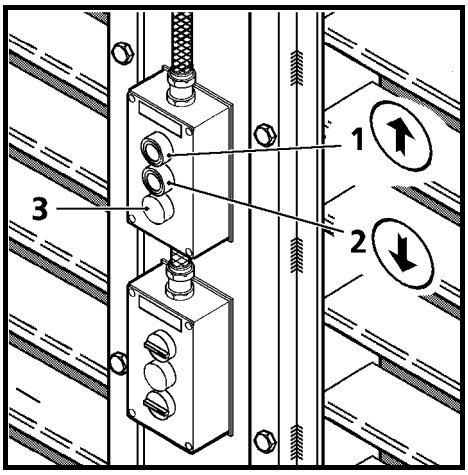



**Fig. 1**

**CAUTION**

**For safety reasons, the excavator can only be operated if the service flap is locked in its uppermost position. Otherwise the red indicator light 3 goes on.**
**This means that the swing and travel movements remain locked.**

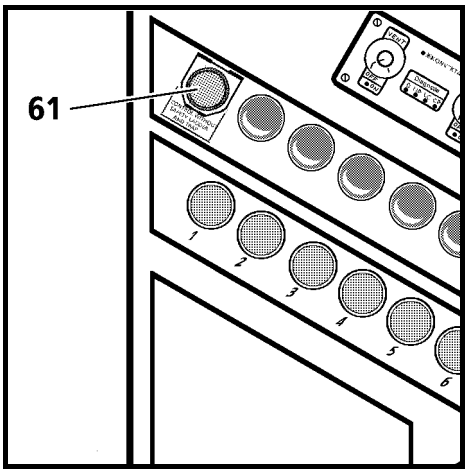



**Fig. 2**

However, this safety measure can be bypassed for as long as the button S122 on the right front instrument panel (Fig. 2) is depressed.

**LOCATION OF OIL SAMPLE POINTS**

To make the oil sampling easier, the following components of the excavator have been fitted either with an oil sample extraction valve (both diesels engine, both splitterboxes, the hydraulic circuit), or with a special drain valve allowing good accessibility and sampling conditions (both travel gears).

Remove the cap 5 and attach a sampling hose as a high-pressure hose for pressure gauge.
Turn the valve 6 to adjust and close off the oil flow.
The location of these sample valves is indicated in the description for oil change for the concerned components on next pages.

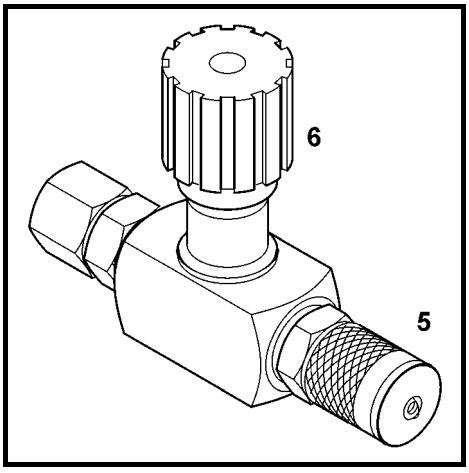



**Fig. 3**

## THE DIESEL ENGINE

### TO CHECK THE ENGINE OIL LEVEL

Park the machine on firm and level ground to check the engine oil level. Turn the engine off and wait for a few minutes for the oil to collect in the oil pan.
The oil must be between the min. and max. mark on the dipstick 1 (Fig. 4).

**CAUTION**

**The engine oil is very hot at or near operating temperatures. Avoid contact with hot oil and components containing oil, since it could cause severe burns.**

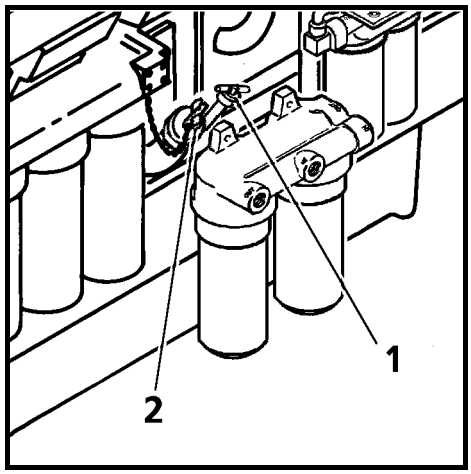



**Fig. 4**

### TO CHANGE THE ENGINE OIL

Drain the engine oil sump
Bring the engines to operating temperature, and drain the oil via the two quick change couplings in the service center (Fig. 5, pos. 5).
As a help way, the oil can also be drained via the drain valve on the oil pan of the Diesel engine.
To do so, remove the cap of the drain valve, attach the drain hose (supplied in the toolbox) to the drain valve and drain the oil into a suitable container.
Remove the hose, reinstall the cap on the drain valve and add oil via the filler neck 2 (Fig. 4).

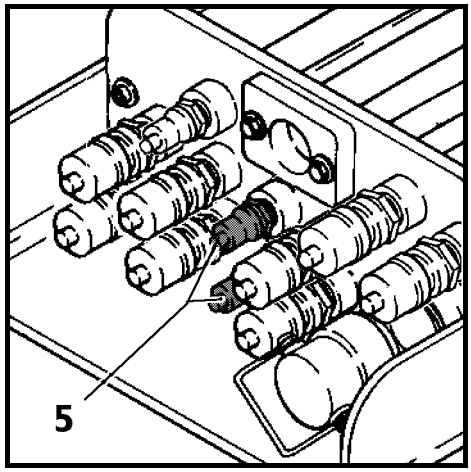



**Fig. 5**

**Replace the oil filter elements (Fig. 6)**

Unscrew and remove the main filter elements, pos.3 and the bypass filter elements 4. clean the sealing surfaces on the filter mounts.

**CAUTION**

**When removing the engine oil filters, be careful to avoid contact with hot oil, it could cause severe burns.**

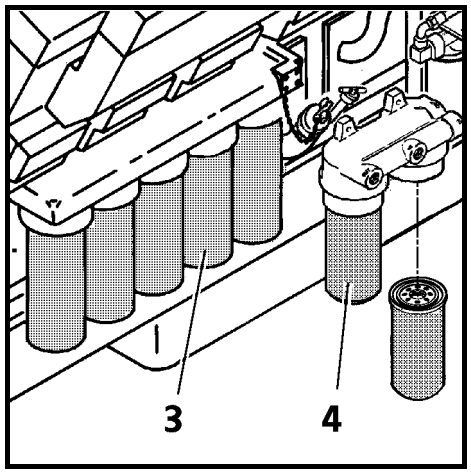



**Fig. 6**

Lightly lubricate the rubber seal on the new filters with oil, install and tighten the filters with both hands (see also enclosed CUMMINS engine operation and maintenance manual).
Check after every oil change or after adding oil to ensure that the oil level has reached the upper mark on dipstick 1.

### REFILL THE ENGINE OIL SUMP

Refill via the quick change coupling 5, until the max. mark is reached on dipstick 1. A small amount of oil can also be refilled via the filler neck 2 (Fig. 4). For oil quantities, oil specifications and oil change intervals, see lubrication and maintenance charts.

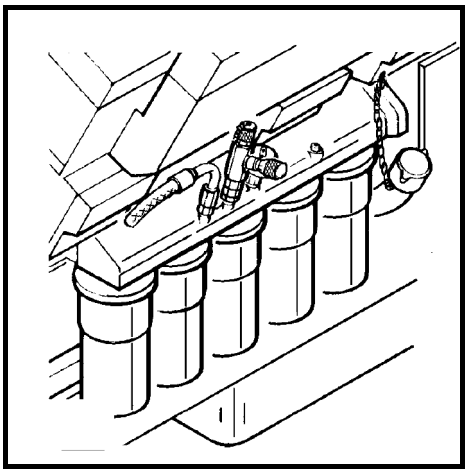


Fig. 7

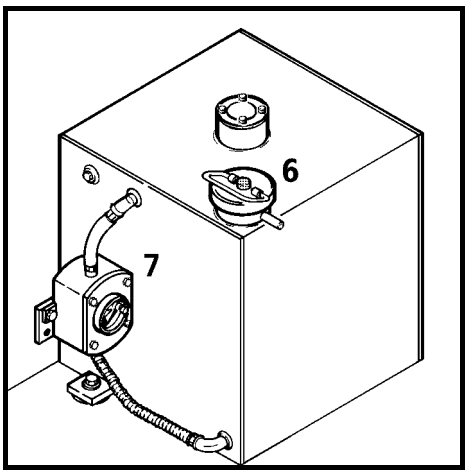



Fig. 8

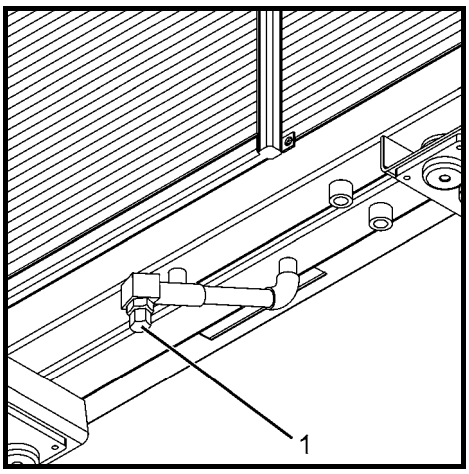



Fig. 9

**TO TAKE AN ENGINEOIL SAMPLE**

The valve for engine oil sampling is mounted to the filter head for main filter elements (Fig. 7).

**TO CHECK THE COOLANT LEVEL**

**CAUTION**

**At or near operating temperature, the engine coolant system is hot and under pressure.**
**Avoid contact with coolant and components containing coolant, since it could cause severe burns.**
**Check the coolant level only after the cap 6 is cool enough to touch. To check the coolant level, first depress the red button in the cap 6 to relieve pressure!**

Check the coolant level when cold. It should reach the middle range of the indicator 7 (Fig. 8).

**ANTIFREEZE AND CORROSION PROTECTION OF COOLANT**

The proper antifreeze and corrosion protection must be maintained all year long.

The excavator is delivered from the factory with a cooling system protection to -35°C (-31°F) (This corresponds to approx. 50 % antifreeze).

| | |
|---|---|
| System capacity of each cooling circuit : | 340 l (90 US gal.) |
| water ratio : | 170 l (45 US gal.) |
| antifreeze ratio : | 170 l (45 US gal.) |

In addition, the corrosion protection concentration in the cooling circuit must be constantly maintained.

Normally, changing the coolant filters (Fig. 10, pos. 10) regularly is sufficient to maintain the proper concentration.

However, check the concentration regularly, and, if necessary, corrosion protective additives must be added to the coolant, see the CUMMINS engine operation and maintenance manual for details.

**TO CHANGE THE COOLANT**

For coolant change interval, see CUMMINS Operation and Maintenance Manual.
**To drain the coolant**:
The drain plug is located under the radiator (Fig. 9, pos. 1).
For the procedure to drain and refill the engine cooling system refer to the CUMMINS engine operation and maintenance manual.

**Important !**

When refilling the system, make sure that the expansion tank is refilled to the middle range of the indicator 7 and until the water level will no longer drop.

**TO CHANGE THE COOLANT FILTER**

The filters contain a paste-like corrosion protection additive, which ensures the proper corrosion protection properties of the coolant.

The filters (Fig. 10) must be replaced at the intervals specified in the maintenance schedule:

- Close both shut off valves 11 on the filter inlet and return flow
- Unscrew and remove the filter elements
- lightly oil the seal rings on the new filter element,
- Screw on the new elements until the seal ring touches the filter housing, and then turn it by hand 1/2 – 3/4 turns (Do not use any tools to tighten the filters!),
- Reopen the shut off valves 11.

For detailed information, refer to the CUMMINS engine operation and maintenance manual.

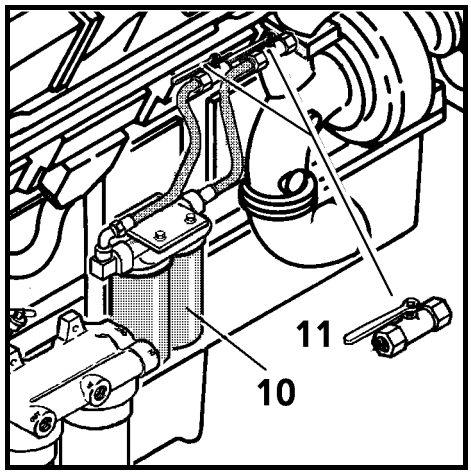



**Fig. 10**

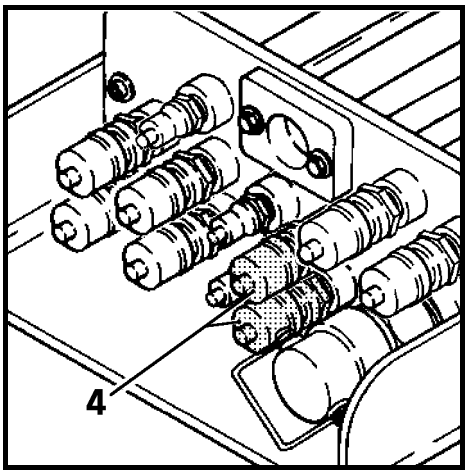



Fig. 11

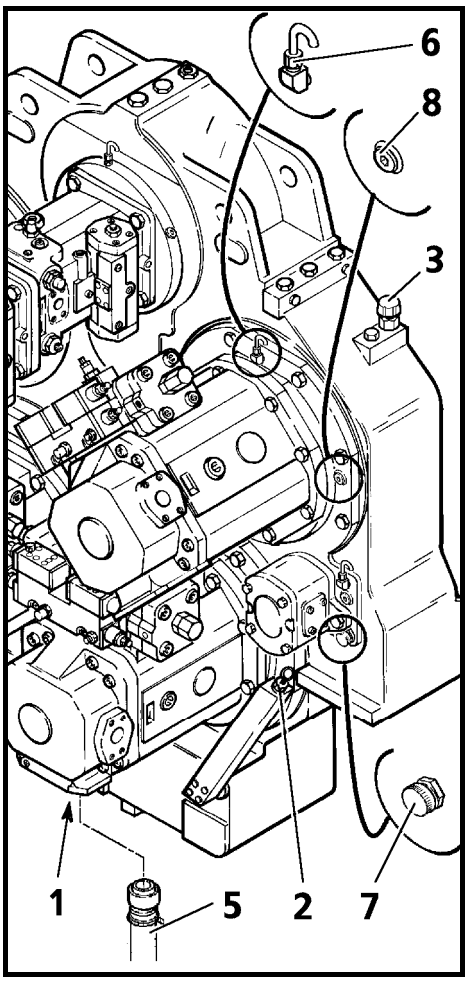



Fig. 12

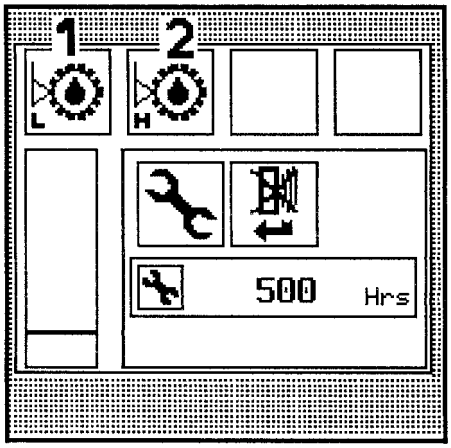



Fig. 13

## CHANGING THE OIL IN THE SPLITTERBOX

### TO CHANGE THE OIL IN THE SPLITTERBOX

**Check the splitterbox oil level**

To check the oil level, turn the engine off and wait 15 minutes for the oil to collect into the oil pan.

**Drain and refill the oil**

We recommend to drain and refill the oil in both splitterboxes via the two quick change couplings 4 on the service plate (Fig. 11), when the oil is at operating temperature.
Refill the splitterbox up to the mark on dipstick 2. Do not overfill.

**As a help way**, the oil can also be drained via the drain valve 1(Fig. 12) on the bottom of the box.
To drain the oil,

- remove the cap on the drain valve,
- screw on the drain hose, which is part of the toolbox,
- drain the oil into a suitable container.
- remove the hose and reinstall cap on drain valve 1.

To refill, add oil via the threaded bore hole of the removed breather cap 3 up to the mark on dipstick 2.
After each oil change, allow the engine to run for a few minutes, turn the engine off and wait a few minutes and recheck the oil level with dipstick 2.

For oil quality (specifications) and filling quantity, refer to the lubrication chart.
For oil change intervals, refer to the Maintenance Schedule.

### LOW OR HIGH OIL LEVEL IN THE SPLITTERBOX

The splitterbox oil is supervised by a level gauge triggering the indication on the display when the level is below the minimum (Fig. 13, pos.1) or above the maximum allowable level (Fig. 13, pos.2).
In case of low level indication:
Find out and remedy the leak on the splitterbox or splitterbox oil circuit as soon as possible, and top up to the dipstick mark.
If continuing to work in the meanwhile, correct oil level must be maintained.
In case of high level indication: Stop working immediately.
The problem is due to a defective shaft seal on a hydraulic pump causing some hydraulic oil to flow into the splitterbox.
In this case locate and repair the defective pump and change the oil in the splitterbox before restarting.

**TO TAKE A SPLITTERBOX OIL SAMPLE**

The valve for taking splitterbox oil sample is mounted to the exit of the splitterbox oil pump (Fig. 14).

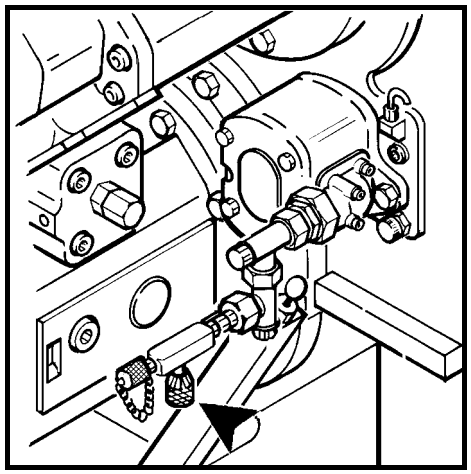


**Fig. 14**

## CHANGING THE OIL IN THE ELASTIC COUPLING

**TO REPLACE OIL**

The elastic coupling between Diesel engine and splitterbox is filled with oil.

**Note: The coupling may remain installed during an oil change. Execute an oil change in a warm service condition of the coupling and with a preheated new coupling oil (oil temperature min 40°C).**

Use the tool Id. 9943251 (see Fig. 17) to change the coupling oil.

- Turn the Diesel engine until the coupler plugs 907 (and 909) are accessible. The Diesel engine can be turned via the pin on the SAE- housing (see fig.36 and the CUMMINS operation and maintenance manual).
- Fill the oil container of the tool (on pump side) with 6 liters of flushing oil.
- Connect the filling hose 1 of the filling pump to the connection coupling 907 of the inner star 9.
- Connect the return line 2 of the tool to the connection coupling 909 of the flange 5.
- Switch on the pump and press an amount of flushing oil into the coupling (approx. 6 liter: 1,5 liter to fill the coupling and the holdover to rince the coupling).

**CAUTION**

**Do not suck in any air.**

- Switch off the oil pump and pull the filling hose 1 off the inner star 9.
- Leave the return hose connected until no more oil emerges, i.e. until the filling pressure has sunk to the ambient pressure again.
- Pull off the return hose 2.

For oil specification, see lubrication chart.

For oil change intervals, see maintenance schedule.

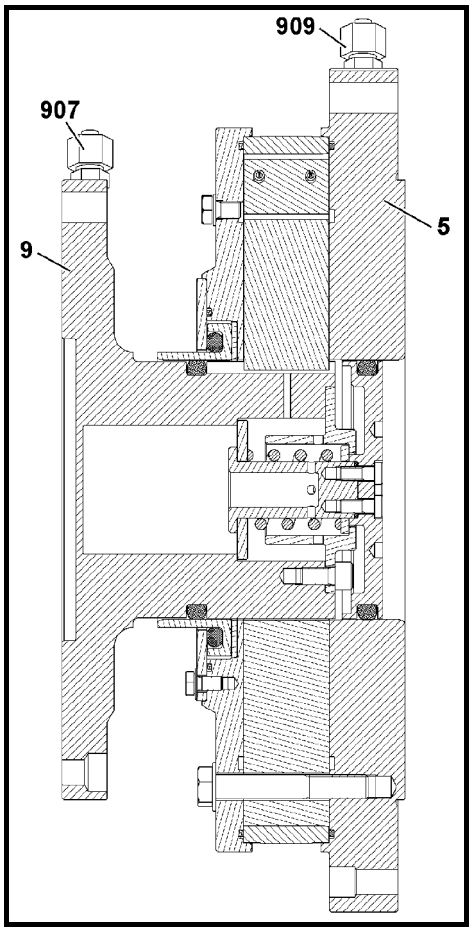



**Fig. 15**

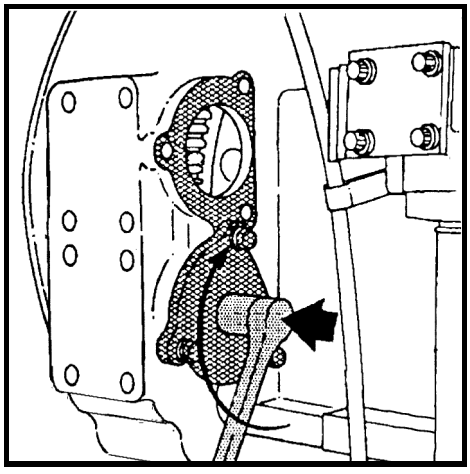


**Fig. 16**

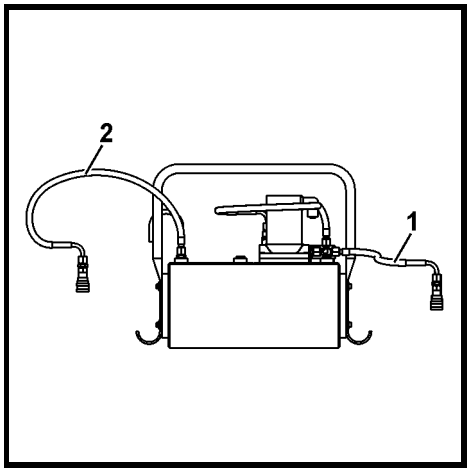



**Fig. 17**

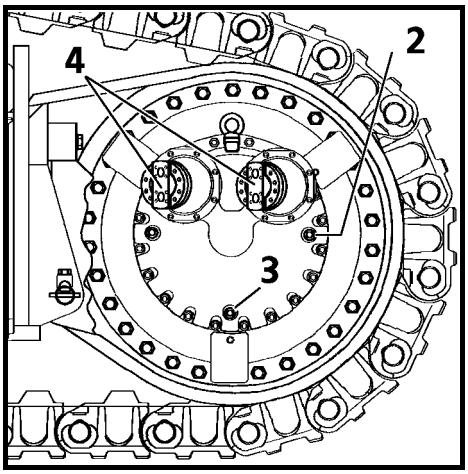



Fig. 18

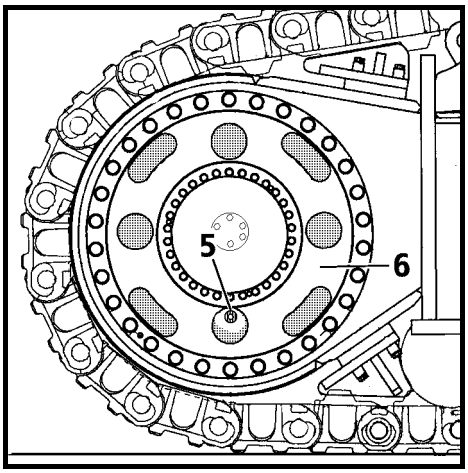



Fig. 19

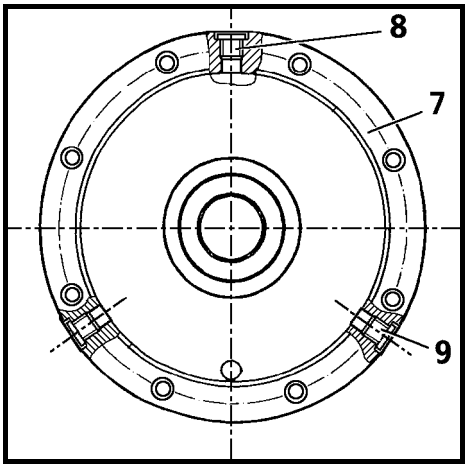



Fig. 20

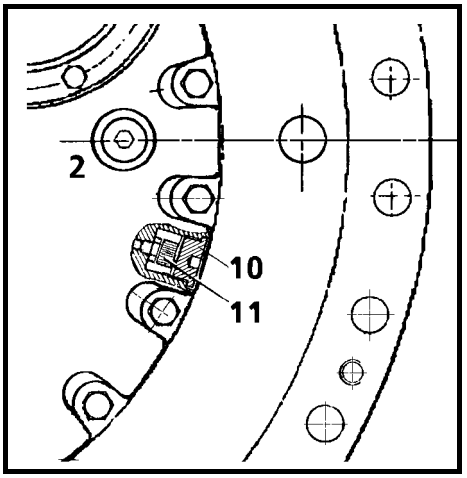



Fig. 21

## CHANGING THE OIL IN THE TRAVEL GEARS

**If possible, drain the oil when the oil is at operating temperature.**

Each travel gear is equipped with two plugs to check the oil level and to add oil (Fig. 18, pos.2) and with two oil drain plugs. One drain plug (Fig. 19, pos.3) is mounted to the lower inner section, the second drain plug (Fig. 18, pos.5) to outer ring which rotates with the sprocket.

### TO DRAIN THE OIL

Move the travel gear, until the plug 5 is straight below the centre axle of the gear. Observe the position of the plug through the openings in the centering ring 6 of the gear.
Remove one plug 2 and then both plugs 3 and 5 and drain the oil into a suitable container.

**DANGER**

**When the oil is hot, the travel gear may be under pressure. Before draining the oil, carefully loosen the oil filler plug 2 to allow the internal pressure to escape.**

### TO ADD OIL

With the drain plugs 3 and 5 installed, slowly add oil via bore 2 until oil runs out.
Reinstall plug 2.
For oil specification and oil quantity, refer to the lubrication chart. For oil change intervals, refer to the Maintenance Schedule.

### CHECKING THE OIL LEVEL IN THE TRAVEL BRAKE HOUSING

Each time the travel gear oil is changed, also check and if necessary adjust the oil level in the adapter flange 7 for the travel motors 4.

Remove one of the lower plugs 9, if necessary also remove the upper plugs 8 and add oil until it escapes through the bore of the plug 9.

Reinstall and tighten both plugs.

To refill, employ a mineral oil raccording to the specifications and viscosity prescribed for the hydraulic oil in this manual.

### TRAVEL GEAR OIL SAMPLES

Each travel gear is fitted with a drain valve 11 situated just below the filler plug 2 and destined for oil sampling.

To take an oil sample, first remove the protection plug 10, unscrew the cap of the drain valve 11 and screw the drain hose delivered with the machine onto the drain valve so to let the desired amount of gear oil flow out. Remove the drain hose and reinstall the cap of the drain valve and the protection plug 10.

## CHANGING THE OIL IN THE SWING GEARS

**The oil in the swing gears must be changed via the four quick-change couplings 6 in the service plate Fig. 22 and when the oil is at operating temperature.**

To drain and also to refill oil, remove the caps 4 on the expansion reservoirs 7, Fig. 23.
The oil level must reach the middle of the lower sight glass "L" of the expansion reservoir 7 when the oil is cold, and must not overpass the sight gauge "H" when the oil is hot.
If at operating temperature the oil level is lower than the sight glass "L", oil must be refilled.

For small quantities, the oil refilling may be done via the filler tubes 3.

Each expansion reservoir is connected to the upper section of a swing gear via two hoses 8 and 9.
The lower fitting for oil drain of each gear (Fig. 24, pos. 1) is directly connected to a coupling 6 of the service plate.
No oil drain is possible at the lower section of the gears.

For oil specification and oil quantity, refer to the lubrication chart. For oil change intervals, refer to the Maintenance Schedule.

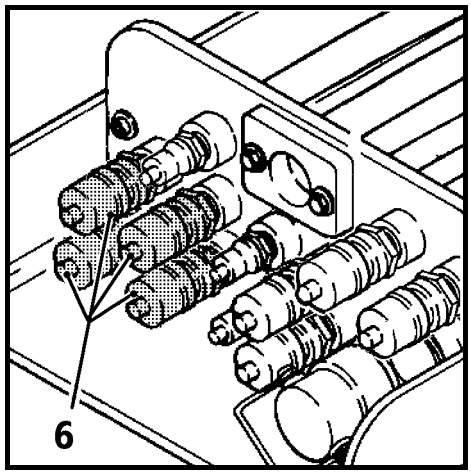



**Fig. 22**

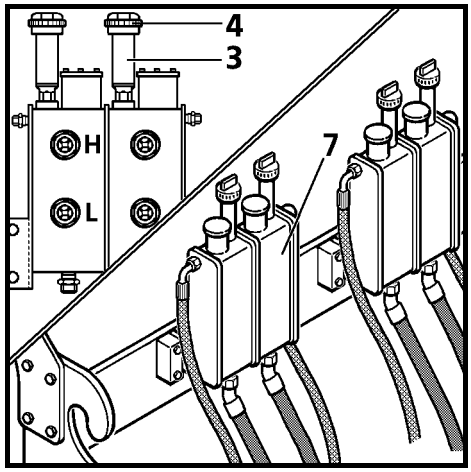



**Fig. 23**

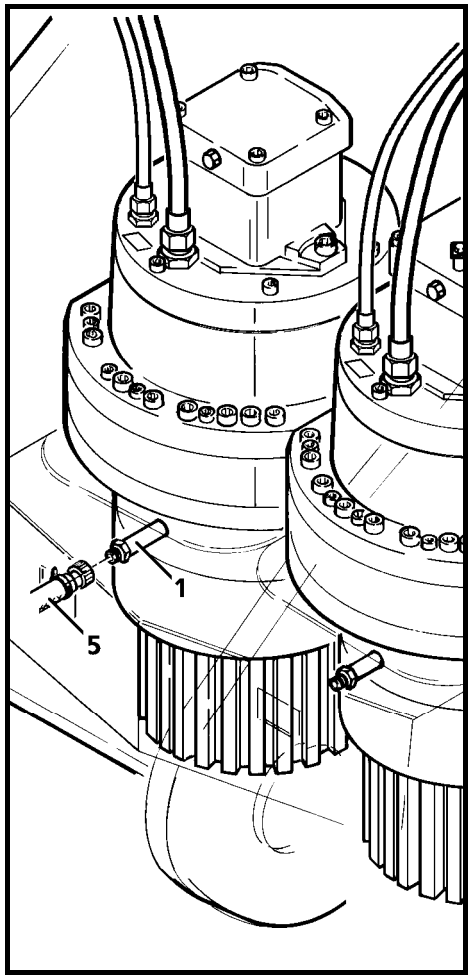



**Fig. 24**

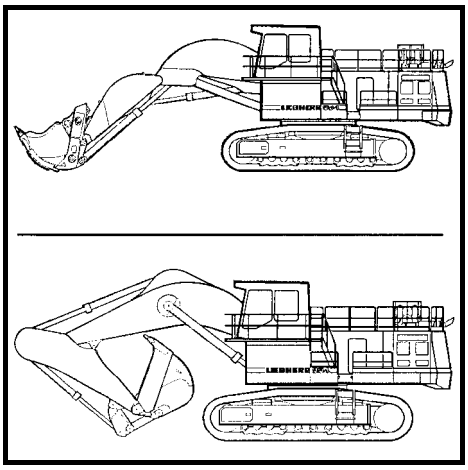


Fig. 25

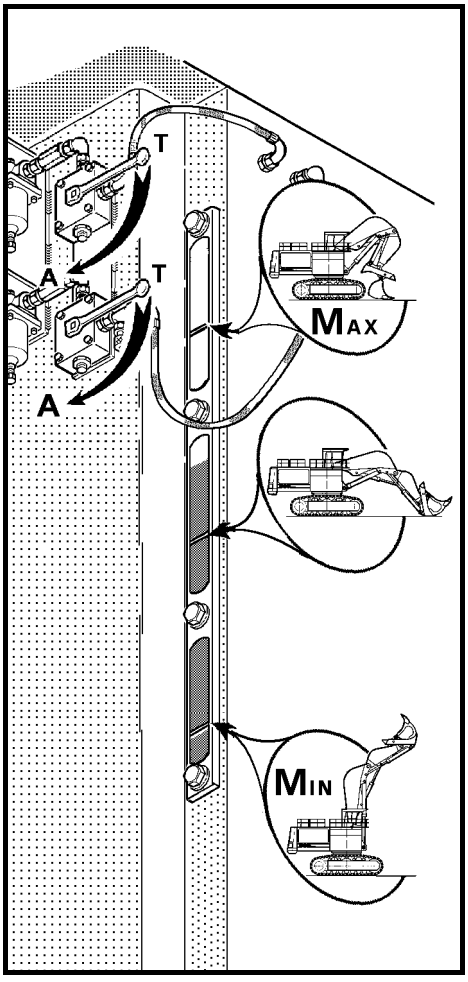



Fig. 26

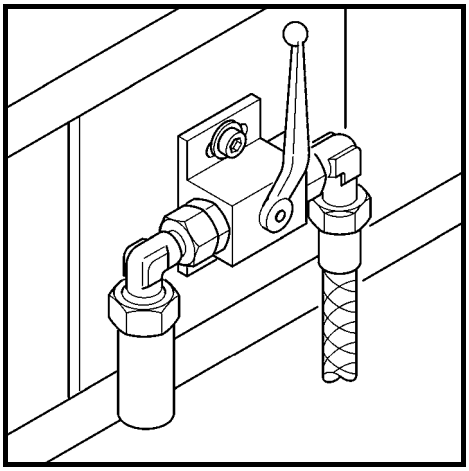


Fig. 27

## OIL IN THE HYDRAULIC SYSTEM

When checking the oil level or adding oil (Fig. 25):
- park the machine on level ground,
- rest the attachment on the ground, with stick and tilt cylinders fully extended, and bucket closed.
- turn the engine off.

### CHECK THE OIL LEVEL IN THE HYDRAULIC TANK

In this position, the oil level should not be below the center mark on the sight gauge (Fig. 26).
If the oil level is low, add oil via the service plate coupling or a return filter until the level reaches the center mark.

The upper mark (MAXI) shows the maximum oil level when all cylinders are fully retracted.

The lower mark (MINI) shows the minimum oil level when all cylinders are fully extended.

**TO ADD OIL TO THE HYDRAULIC TANK AND TO CHANGE HYDRAULIC OIL**

**CAUTION**

**Before draining the oil or before adding oil via the service plate coupling or a plug on a filter cover, always open the tank pressure release valve (Fig. 27) located at the back of the cabin.**

We recommend to add and to drain the hydraulic oil to the tank only via the coupling 8 in the service center.

As a help way, the hydraulic system can be drained using the hose supplied in the tool kit via the drain coupling and the shut-off valve 1 at the bottom of the tank (Fig. 29).

As a help way, or for small quantities oil can also be added via the cover of a return filter:

- remove the plug 3 (Fig. 30) on the return filters
- add oil via the return filter until the level is exactly at the center mark of the sight gauge.
- reinstall the plug 3
- After refilling, close the tank pressure release valve (Fig. 27) to repressurize the hydraulic tank.

**CAUTION**

**The hydraulic pumps must be bled after every oil change (see page 6.14).**

For oil specification and quantity, refer to the lubrication chart.

For oil change intervals, refer to the Maintenance Schedule.

**TO TAKE AN HYDRAULIC OIL SAMPLE**

The valve for taking hydraulic oil samples is mounted to the collector pipe, at the front right of the control valve assembly (Fig. 31).

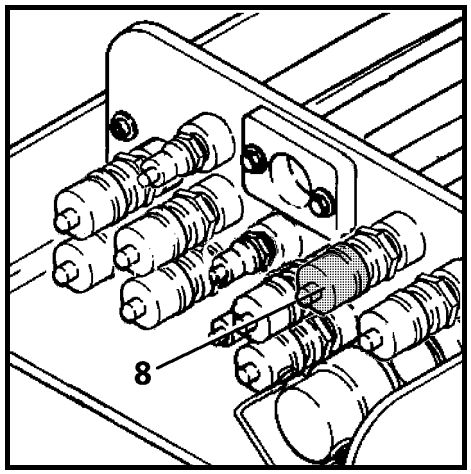



**Fig. 28**

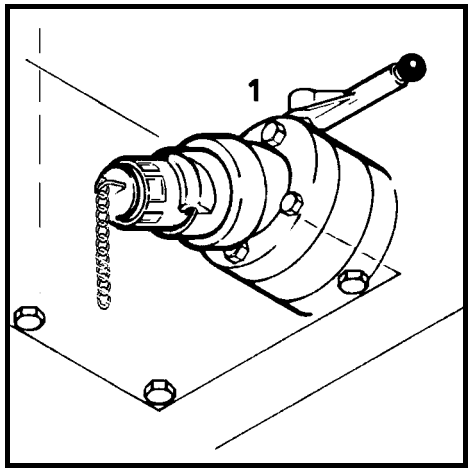



**Fig. 29**

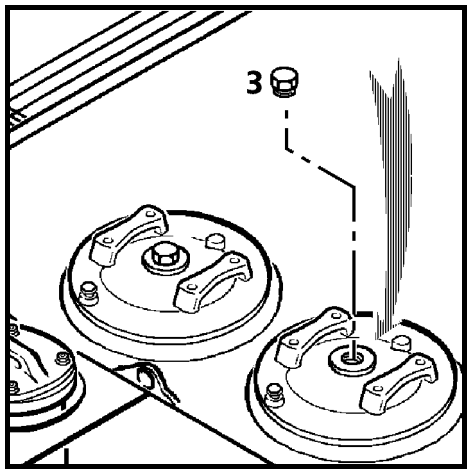



**Fig. 30**

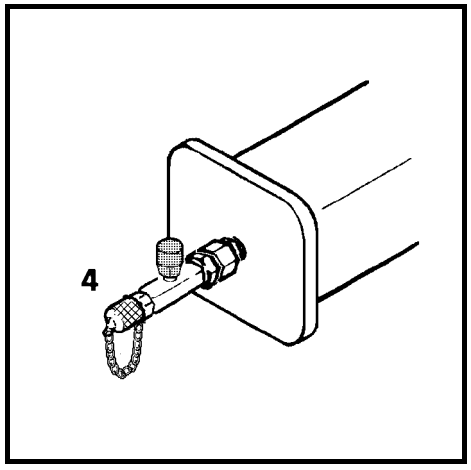



**Fig. 31**

# 1 Function of the lubrication system

### 1.1 Description of the entire system: see diagram under item 1.3

The lubrication points of the hydraulic excavator are supplied by three mutually independent centralized lubrication systems:

System 1 – Equipment lubrication

Single-line system

| | | | |
|---|---|---|---|
| Main components: | Hydraulic pump | "P1" | 609-28814-1 |
| | Injectors | SL 11 | |

System 2 – Slewing rim lubrication

| | | | |
|---|---|---|---|
| Main components: | Hydraulic pump | "P2" | 609-28814-1 |
| | Injectors | SL 11 | |
| | Progressive metering devices | SSV 8 | |

System 3 – Gear rim lubrication

| | | | |
|---|---|---|---|
| Main components: | Hydraulic pump | "P3" | 984960-21E |
| | Progressive metering devices | SSV 10 / SSV 8 | |

### 1.2 Sequence of a lubrication cycle

#### 1.2.1 Systems 1 and 2:

Upon expiration of the pause time the pump begins operating and supplies the lubricant to the injectors 9 (SL11) via the main line. The pistons in the injectors are actuated by the lubricant under pressure and discharge a pre-dosed quantity of lubricant to the connected lubrication points.
The pressure continues to rise in the main line until the value (280 bar) set at the pressure switches (B69 or B71) is reached. The control unit stops the pump and, at the same time, the main line is discharged via the solenoid valves (Y79 or Y81). The relieved lubricant reaches the pump reservoir via a bypass.
The pistons in the injectors 9 (SL 11) return to their initial position by spring force.
The pause time begins. The system is ready to carry out a new lubrication cycle.

The solenoid valves Y80, Y82 and Y83 allow – after they have been switched accordingly – the systems 1 and 2 to be both supplied together by pump 1 or pump 2 in the case that either pump fails to operate owing to a fault.

#### 1.2.2 System 3

After the pause time has elapsed, the pump supplies the lubricant to the connected progressive metering devices.
A progressive metering device 8.3 (SSV 10) is equipped with a proximity switch for the control and monitoring.
A lubrication cycle is completed after the SSV10 has supplied twice, and the pump is switched off again.



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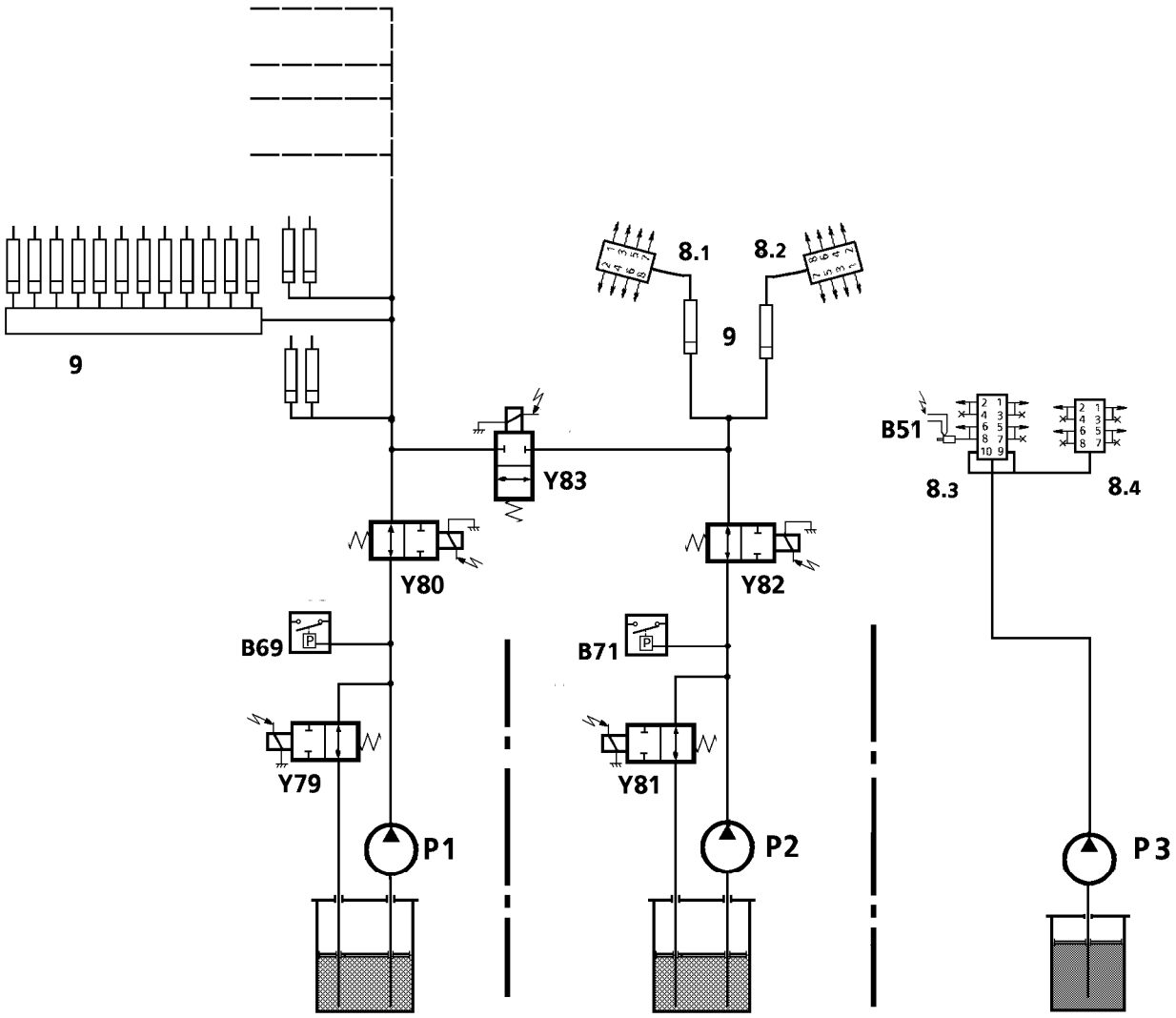
1.3




| | | | |
|---|---|---|---|
| P1 | Lubrication pump -attachment | Y83 | Solenoid valve / lube in parallel |
| P2 | Lubrication pump -swing ring race | B69 | Pressure switch / end of lube cycle for P1 |
| P3 | Lubrication pump -swing ring teeth | B71 | Pressure switch / end of lube cycle for P2 |
| Y79 | Solenoid valve / pressure release (attachment) | B51 | Limit switch on progressive distributor for P3 |
| Y81 | Solenoid valve / pressure release (swing ring race) | 8 | Progressive distributor SSV |
| Y80 | Solenoid valve / shut off P1 | 9 | Grease injector banks SL11 |
| Y82 | Solenoid valve / shut off P2 | | |



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## 2 Operation

CAUTION

- **Only allow operation by properly instructed personnel**
- **Do not exceed permissible system pressures**
- **Top up lubricant or change drum in good time**

When the machine is started all centralized lubrication systems are automatically pressurized.
Each pump triggers one lubrication cycle, stops only for the preadjusted pause time, ... etc.
When the excavator is delivered from the factory the time period between two lubrication cycles is eight minutes for pump P1 and P2 and four minutes for pump P3. This corresponds to a grease consumption of approx. 1200 g/h for P1, 10 g/h for P2 and 15 g/h for P3.

The time intervals for P1, (or P2 and P3 respectively) can be readjusted at the lubrication system monitor.



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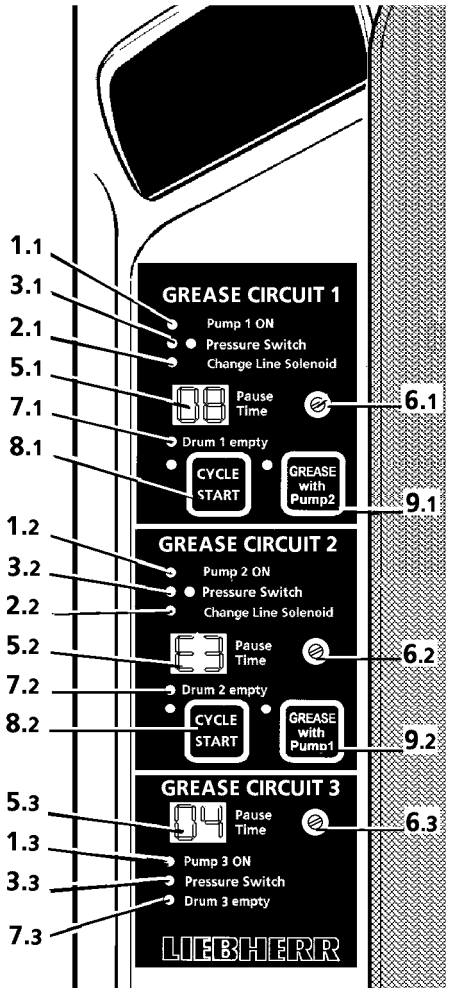


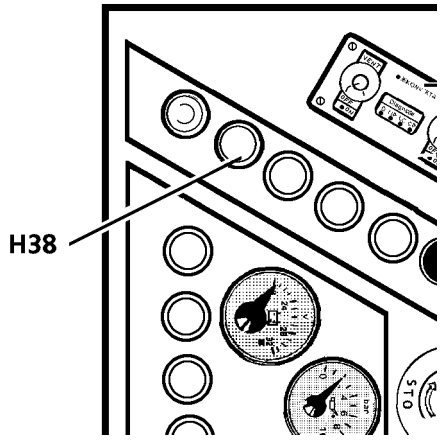


## 3 The Lubrication System Monitor

The green indicator lights 1.1, 1.2 resp. 1.3 light up as long as the corresponding pump is pressurized and thereby shows the frequency of the lubrication cycles.
The lighting up of the green lights 3.1 and 3.2 shows that the maximum pressure has been reached in the lubrication lines, this causing the pump to stop and the pressure in the lube line to be released.
The signal lamp 2.1 or 2.2 indicates that the feed line of the corresponding pump is relieved to the reservoir.
A new lubrication cycle can any time be started at once by depressing the push button 8.1 or 8.2.
If a red indicator light 7.1, 7.2 or 7.3 lights up, then the grease container for the corresponding lubrication pump is empty. In this case, the empty grease barrel must be replaced or the grease container must be filled up as soon as possible.
The red indicator light H38 "problem in the lubrication circuit" lights up if a lubrication cycle is not finished after 15 minutes.
The LCD-indicator of the defective lubrication circuit will display, alternately with the pump pause time an error code locating the trouble:

Possible error code in LCD-indicator:

| | |
|---|---|
| 5.1 | - E 1: Error in circuit of pump P 1 |
| 5.2 | - E 2: Error in circuit of pump P 2 |
| 5.3 | - E 3: Error in circuit of pump P 3 |

Possible causes are:

a) a defective switch or a defect in its supply cable
b) insufficient grease in the grease container (indicated via indicator light 7)
c) a problem in the electrical control circuit or in the hydraulic drive circuit of a lubrication pump
d) a leaking main supply line

**Safety lubrication of circuits P1, P2 and P3**
When an error code is displayed, the corresponding lube pump will automatically be operated so that the going on of the cycles is no longer controlled by the installed pressure switches, but the duration of the lubrication cycles is fixed to preadjusted values, that can be set on the printplate U 15 inside the control box of the left armrest.

CAUTION
When an error code is displayed, the corresponding circuit always must get repaired as soon as possible!
The automatic operating mode change in case an error is detected may only permit to release from a trouble in the circuit of a pressure switch (above mentioned error cause a). However it must be made sure that greasing is effective, i. e. that the grease injectors move during lubrication.

**Emergency lubrication of circuits P1 and P2**
The both lubrication systems P1 and P2 can be fed from only one lube pump by pressing button 9.1 or 9.2 (9.1 to lubricate with only P1 and 9.2 to lubricate with only P2). This permits to temporary remedy the error cause b) and in some cases also the error cause c9.
The two circuits are then parallel shifted via the solenoid valve Y83 (see paragraph 1.3) and at the same time the solenoid valve Y80 or Y82 closes the connection to the empty pump P1 or P2.



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## 4 Inspection and maintenance

- **Do not perform any repairs while system is pressurized.**
- **To relieve pressure open a threaded connection carefully**
- **Caution: Lubricant may escape while pressurized**

Regular inspection and maintenance are the prerequisites for proper operation of the centralized lubrication system over a prolonged period of time. The warranty on our product can only be valid if the prescribed maintenance intervals are adhered to. The regular inspections and maintenance procedures are described below:

1. System as a whole

Daily: Visual check of the lubrication points for escaping lubricant
Visual check of the hose connections for leaks or wearing

Weekly: Visual check of the screwed pipe connections for leakage
Determining the time for one operating cycle. If the time determined differs from the usual operating time, the individual components (pump station, injectors, pipes) must be checked.
Functional check of the pressure switch

2. Pump station

Weekly: Check that threaded connections and hoses are firm and tight.
Visual check of pump tube gland seal
Check function of the solenoid valve
Check electrical cable connections
Clean outside of pump station

1000 hours: Clean filter element of grease filter

7500 hours: Hydraulic pump: Change gland seal

3. Injectors

Daily: Check movement of control pins: During the work cycle the pins must be retracted depending on the metering quantity; in the resting phase all the pins must be extended.

Weekly: Visual check for leaks

4. Two-line Lubricant Metering Device

Weekly: Visual check for leaks

5. Progressive Plunger Metering Device

Weekly: Visual check for leaks



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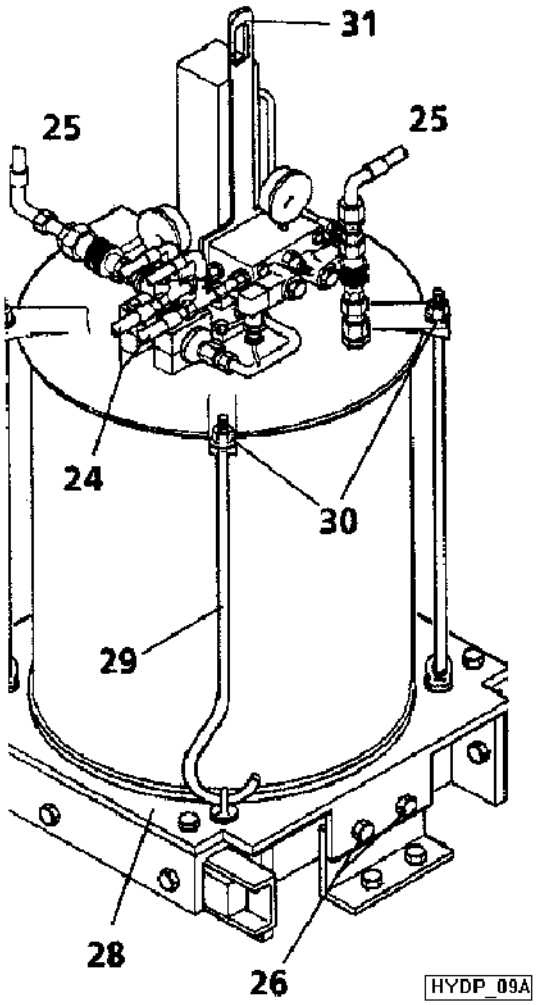
## 5 Exchanging / topping up grease reservoirs

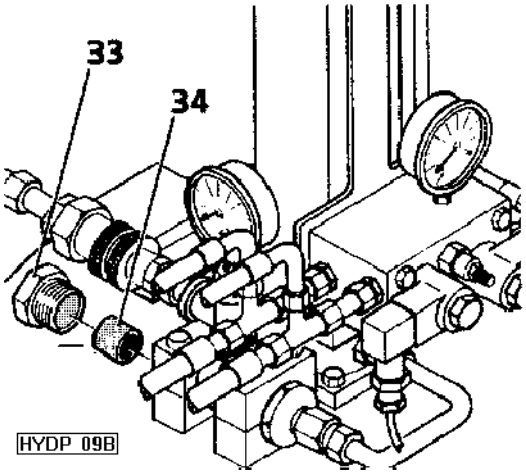
CAUTION

- **Lines are pressurized. Be careful when decoupling.**
- **Observe extreme cleanliness when exchanging or topping up the grease reservoirs.**
- **Contaminated lubricant causes malfunctions and premature wear of the grease pump and other components of the system.**
- **Clean surroundings before exchanging or topping up**
- **Switch off centralized lubrication system (turn off engine)**

### 5.1 P1 and P2: Replacing the grease container

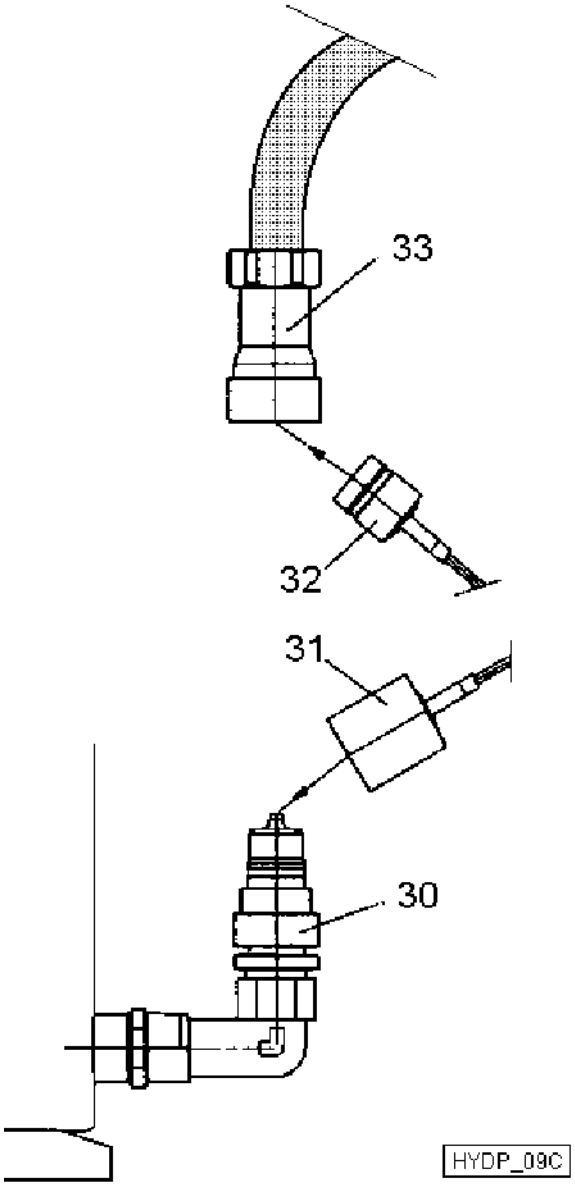



* Open cover of the lubrication box and lock in place
* Disconnect hydraulic hoses 24 and the grease hoses 25 on the quick change couplings
* Remove the two screws 26 and pull the transport carriage out
* Loosen the four nuts 30 on the grease container cover
* Attach the pump via the hook 31 to a suitable lifting device and remove ist complete with follower plate
* Remove the retainer rods 29, replace the empty container with a full one
* Place follower plate on top of the grease in the full container. Try not to trap any air under the follower plate
* Sink pump into the full container, reinstall the retainer rods and tighten the nuts 30
* Push the transport carriage into the lubrication box and secure the box with two screws 26
* Reinstall the hydraulic and the grease hoses




Clean grease filter after each grease container change:
Remove the plug 33
Take off the screen filter and clean or wash ist

## 5.2 P1 and P2: Filling of the container




* Remove dust protective cap 32 at the filling coupling and the dust protective cap at the filling nipple 30
* Couple the filling hose and switch on the filling pump
- The filling level is indicated visually by a plumb bob at the outside of the reservoir. When the reservoir is full, the ultrsonic sensor transmits an electric signal to the control unit. If the filling pressure is too high, grease will leak at the overpressure safety valve.
- the filling pump is switched off
* Disconnect the filling coupling and reinstall the dust protective caps



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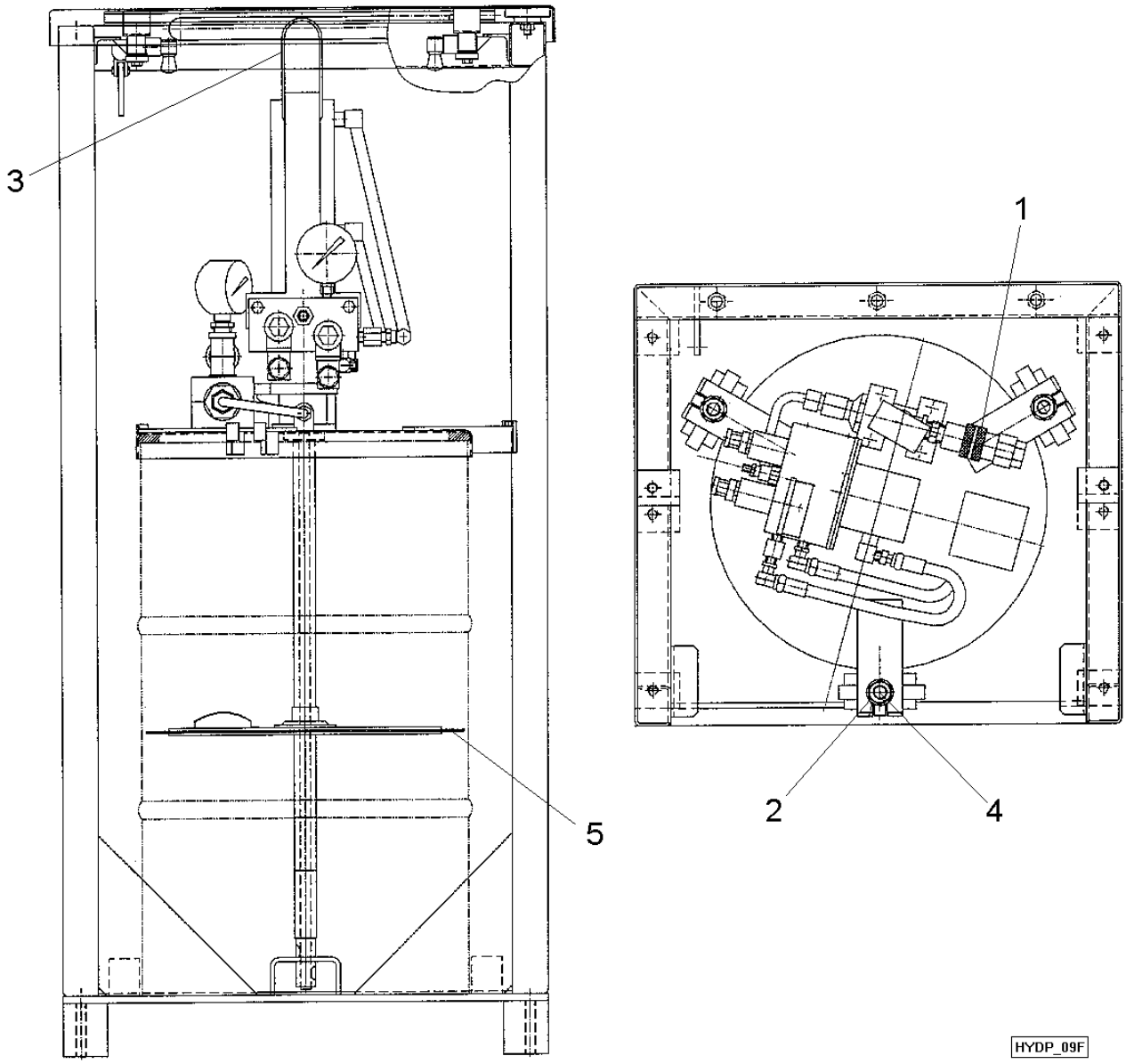
### 5.3 P3: Replacing the grease container




- Open cover of the lubrication box and lock in place
- Disconnect hydraulic hoses and the grease hoses on the quick change couplings
- Loosen the three nuts 2 on the grease container cover
- Lift the pump via the hook 3 by a suitable lifting device. Remove also the follower plate
- Remove the retainer rods 4, replace the empty container with a full one
- Place follower plate on top of the grease in the full container. Try not to trap any air under the follower plate
- Sink pump into the full container, reinstall the retainer rods 4 and tighten the nuts 3
- Reinstall the hydraulic and the grease hoses

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## 6 Malfunctions and their remedy

In the following, only malfunctions of the system as a whole are described. You will find detailed remedies for malfunctions of the individual units in the respective User's Information.

- **Malfunction: No pressure build-up in the system**

| **Cause:** | **Remedy:** |
|---|---|
| Malfunctions of the pump | See Troubleshooting: Pump |
| Leakage in the main line | Check main lines, eliminate leaks, tighten threaded connections, replace defective hoses |
| Air trapped in the main line | De-aerate the line |
| Two-line metering devices leaky or worn | Replace u-cup sealing at control pin if necessary Change complete metering device if pistons are worn |
| Injectors leaky or worn | See Troubleshooting: Injectors |

- **Malfunction: No pressure relief or too slow pressure relief in the main line**

| **Cause:** | **Remedy:** |
|---|---|
| Pressure control device faulty | Replace pressure control device, check electric cable |
| Solenoid valve faulty | Replace solenoid valve, check voltage supply |
| Grease too hard or not suitable for low temperatures | Change lubricant |



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# MAINTENANCE

## MACHINE MAINTENANCE SAFETY

- The machine may not be made unsafe when performing maintenance work. Never attempt maintenance procedures or repairs you do not understand.
- Check the Operators and Maintenance Manual for service and maintenance intervals. Make sure you use only appropriate tools for all maintenance work.
- Refer to your Operators and Maintenance Manual to see, who is authorised to perform certain repairs. The operator should only perform the daily / weekly maintenance procedures.
  The remaining work may only be performed by especially trained personnel.
- Use only replacement parts corresponding to the technical requirements specified by the manufacturer. This is assured by using only original Liebherr replacement parts.
- Always wear proper work clothing when maintening the excavator. Certain work may only be performed with a hard hat, safety shoes, safety glasses and gloves.
- During maintenance, do not allow unauthorised personnel to enter the maintenance area.
- Secure the maintenance area, as necessary.
- Inform the operator before any spezial or maintenance work. Make sure he knows the person, who is in charge of the work.
- If not otherwise noted in the Operation and Maintenance Manual, always make sure the excavator is parked on firm and level ground and the engine is turned off.
- During maintenance and service work, make sure you always retighten any loosened screw connections.
- If it is necessary to disconnect or remove any safety devices during set up, maintenance or repair, make sure that after completion of repairs, the safety devices are reinstalled and checked for proper function.
- Before any maintenance work and especially when working under the machine, make sure a „Do not operate“ tag is attached to the starter switch. Remove the ignition key. After end of maintenance works or repair, restart the machine according to the instructions „machine start up“ in this manual.
- Before any repairs or maintenance work, clean any oil, fuel and / or cleaning from any fittings and connections.
  Don’t use any harsh cleaners and use only lint free cloths.
- Use only non flammable cleaning fluids to clean the machine.
- Any welding, torch or grinding work on the machine must be explicitly authorised. Written authorisation is necessary for welding on carrying structures. Before any using a welder, torch or grinder, clean off any dust and dirt and remove any flammable materials from the surrounding area.
  Make sure the area is sufficiently ventilated.
  Danger of fire and explosion.
- Before cleaning the machine with water or steam (high pressure cleaning) or other cleaning fluids, make sure that all openings, which, for safety and / or functioning reasons should not be exposed to water / steam / cleaners, are covered and / or masked off. Especially sensitive are electrical motors, control boxes and plug connectors.
  Make sure that the temperature sensors of the fire alarm and extinguishers system do not come in contact with the hot cleaning fluids, which could trigger the fire extinguishing system.
  Remove all coverings and masking material after completing the cleaning procedure.
  Then check all fuel lines, engine oil lines and hydraulic oil lines for leaks, loose connections, chafing and / or damage. Fix any problems immediately.
- If you use a high pressure cleaner with steam or hot water to clean the machine, observe following recommendations:

  The distance between the nozzle and the surface to be cleaned must be no lowerthan 20 inches.
  The water temperature should not exceed 60°C (140°F).
  Limit the water pressure to 80 bar maximum (11500 PSI)
  If you employ cleaning fluid, only use neutral cleaning agents such as customary car shampoos diluted to 2 or 3 percent maximum.
- Never employ high pressure cleaning apparatus during the two first months following machine delivery or repainting.

- Observe all product safety guidelines when handling oils, grease, and other chemical substances.
- Make sure service fluids and replacement parts are disposed of properly and in an environmentally sound manner.
- When using hot service fluids, be very careful (they can cause severe burns and injury).
- Operate combustion motors and fuel operated heaters only in well ventilated areas. Before operating these units, check ventilation.
  In addition, always follow applicable local regulations.
- Never try to lift heavy parts. Use appropriate lifting devices with sufficient load carrying capacity. When replacing or repairing parts or components, make sure they are mounted very carefully on lifting devices, to prevent any possible danger. Use only suitable and technically sound lifting devices, make sure that lifting tackle, wire cables, etc. has adequate load carrying capacity.
  Never position yourself, walk or work underneath suspended loads.
- Never use damaged lifting devices, or devices which are not sufficient to carry the load.
  Always wear gloves when handling wire cables.
- Ask only experienced personnel to attach loads and guide and signal the crane operator. The guide must be within the visibility range of the operator and / or must be in direct voice contact with the operator.
- When working overhead, use appropriate and safe ladders, scaffolding or other working platforms designated for that purpose.
  Never Stepp on parts or components on the machine when maintening or repairing items overhead.
  When working high above ground, make sure you are fitted with ropes and appropriate safety devices which will prevent a possible fall.
  Always keep handles, Stepps, railings, platforms and ladders free of dirt, snow and ice.
- When working on the attachments, for example when replacing the bucket teeth, makes sure the attachment is supported properly. Never use metal on metal support.
- Never work underneath the machine if it is raised or propped up with the attachment. The undercarriage must be supported with wooden blocks and supports.
- Always support the raised machine in such a way that any shifting to the weight change will not influence the stability. Do not support the machine with metal on metal support.
- Only qualified, especially trained personnel may work on travel gear, brake and steering systems.
- If it becomes necessary that the machine must be repaired on a grade, block the chains with wedges and secure the uppercarriage to the undercarriage with the lock pin.
- Only qualified, especially trained personnel may work on the hydraulic system.
- Never check for leaks with your bare hands, always wear gloves. Fluid escaping from a small hole can have enough force to penetrate the skin.
- Never loosen or remove lines or fittings before the attachment has been lowered to the ground and the engine has been turned off. Then turn the ignition key to contact position with tilted down safety lever, move all servo control (joystick and foot pedals) in both direction to release pressures. Then release the tank pressure as outlined in this Operation and Maintenance Manual.
- Check all lines, hoses and screw connections regularly for leaks and externally visible damage. Fix any damage immediately. Oil escaping from fittings etc. can cause serious injury and fires.
- Before any repairs, always relieve pressures before opening up any system sections and pressure lines (hydraulic lines and air pressure lines).
- Always route and install hydraulic and air pressure lines properly. Do not interchange the connections. The length and quality of hoses must match specifications and requirements.
- Change all hydraulic hoses in specified or appropriate time intervals, even though no damage or defects are visible.
- Always disconnect the battery cable before working on the electrical system or before any arc welding on the machine. Always disconnect the negative (-) cable first and reconnect it last.
- Check the electrical system regularly.
  Make sure that any problems, such as loose connections, burnt out fuses and bulbs, scorched or chafed cables are fixed immediately by an electrician or qualified personnel.
- Use only original fuses with the specified amperage. Never use a different size or stronger fuse than the original fuse.
- On machines with electrical medium or high voltage systems:
  - If there is any problem with the electrical energy supply, turn the machine off immediately.

- Any work on the electrical system may only be performed by a qualified electrician or qualified personnel under the guidance and supervision of an electrician, according to electro – technical regulations.

- If any work is required on any parts which carry current, use a second person to turn off the main battery switch, if necessary. Rope the area off with a red and white safety rope or chain, and set up warning signs. Use only insulated tools.
- When working on medium and high voltage components, shut off the voltage and connect the supply cable to the ground and ground the components, such as the condensor, with a grounding rod.
- Check all disconnected parts if they are truly free of current, ground them and close-by, current carrying parts.

**Hydraulic lines and hoses – Maintenance safety**

- Hydraulic lines and hoses may never be repaired!
- All hoses, lines and fittings must be checked daily, but at least every 2 weeks 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 damge 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 two years (always check the manufacturer's date on the hoses).

  Using hoses ans 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 buble 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!
- Always take care to avoid torsional strain when installing a new hose. On high pressure hydraulic hoses, the mounting screws must be first mounted on both hose ends (full flange or half clamp) and tightened only thereafter.
  On high pressure hoses having one curved end, always tighten first the screws on the curved hose end and only then the screws on the straight hose end.
  Install and tighten the hose clips that may be mounted on the hose middle only when the both hose ends are already tightened.
- Always install hoses so to avoid any friction with other hoses and parts.
  We recommand to keep a distance between hose and other parts of at least one half of the hose outer diameter. Keep a minimum gap of ½ inch in any case.
  After mounting a hose connecting two parts that are movable to each other, check during the return to service that the hose is not rubbing in the whole moving range.

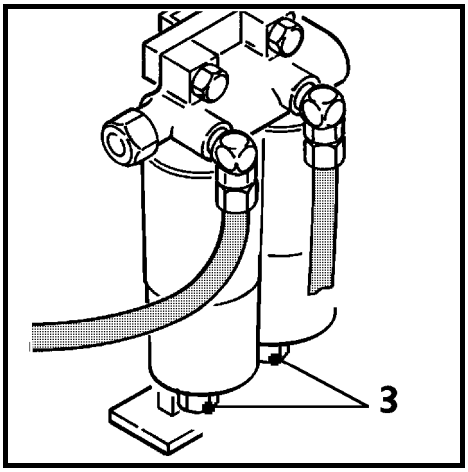



Fig. 1

# THE FUEL SYSTEM

**TO DRAIN AND CLEAN THE FUEL TANK**

A drain valve is installed on the bottom of the tank.

To drain condensation, turn the drain plug on the valve 2 turns counterclockwise until clean fuel appears, tighten the drain plug.

To empty the tanks, remove the tank cover, on the rear of the cab door and remove the drain valve on the bottom of the tank and drain the fuel into a suitable container.

The tank and the strainer in the tank filler neck should be checked regularly for contamination.

Change the strainer, and / or flush the tank, if necessary.

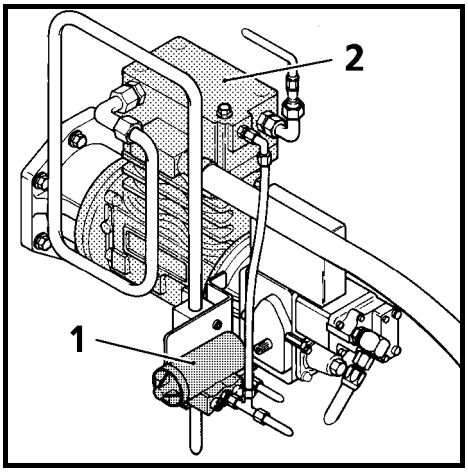



Fig. 2

**DRAIN THE WATER SEPARATOR ON THE FUEL FILTER**

Open the water separator drain valve (Fig. 1, pos 3) on the filter cartridge at the interval specified in the maintenance schedule.

Drain the contaminants until clean fuel emerges, retighten the valve.

For other maintenances on the fuel system, refer to the CUMMINS engine Operation and Maintenance Manual.

# THE AIR PRESSURE SYSTEM

During operation, the pressure on both pressure gauges () must be between 5 and 6 bar.

**PRESSURE REGULATOR AND COMPRESSOR (Fig. 2, pos. 1 and 2).**

Check if you can hear the pressure regulator 1 at regular intervals click the compressor 2 on and off.

To check, proceed as follows:

- Run the diesel engine at low idle,
- Slowly move the open the tank pressure release valve located at the back of the cabin and let out the air in the tank until the air pressure drops to approx. 5 bar.
- The pressure regulator 1 must now shift the compressor 2 into the working cycle.
- Continue to run the engine at low idle. When the pressure reaches 6 bar, the regulator shifts the compressor to the neutral cycle.

Adjust the pressure regulator if necessary until both pressures are correct.

For maintenance intervals, refer to the maintenance schedule and to the CUMMINS Operation and Maintenance Manual.

**THE AIR DRYER**

The air dryer in the air pressure circuit (Fig. 3, pos 3) dries and filters the pressurised air.

the air filter element must be replaced at intervals specified in the maintenance schedule.

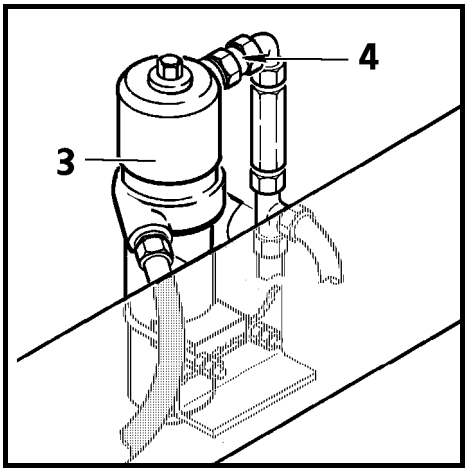


Fig. 3

**CAUTION**

**Open the air dryer only when the air pressure system is without pressure. If necessary, empty the air pressure tank.**

**To replace the air cleaner element**

Relieve the pressure in the air pressure system via the drain valves (Fig. 5).
Disconnect the air pressure line on the outlet to the air tank (Fig. 3, pos. 4).
Remove nuts 1 and cover 2 (Fig. 4).
Unscrew the threaded rod 5.
Remove the centering piece 6 and spring 7.
Slowly pull out the air cleaner cartridge 8; turn the cartridge back and forth if necessary.
Lubricate the o-rings 9 and 10 with oil.
Push in the new air filter cartridge, using a turning motion and make sure that the o-ring 9 on the upper end of the cartridge is inserted into the filter housing.
Reinstall spring 7, the centering piece 6, o-ring 10, cover 2 and tighten nuts 1.

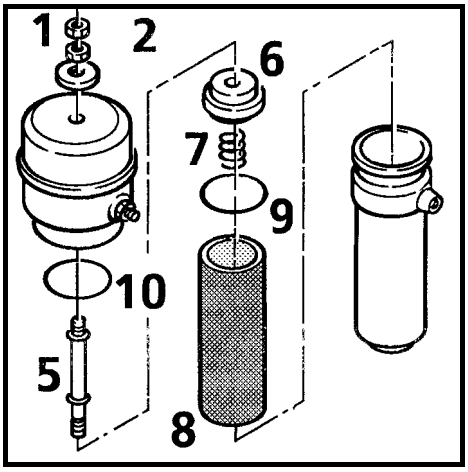


Fig. 4

**TO DRAIN THE AIR TANK**

Condensation in the air tank is automatically discharged via the drain valve when the pressure in the system drops.

However, we still recommend to drain condensation manually by pushing the pin on the bottom of the drain valve (Fig. 5), regularly as specified in maintenance schedule.

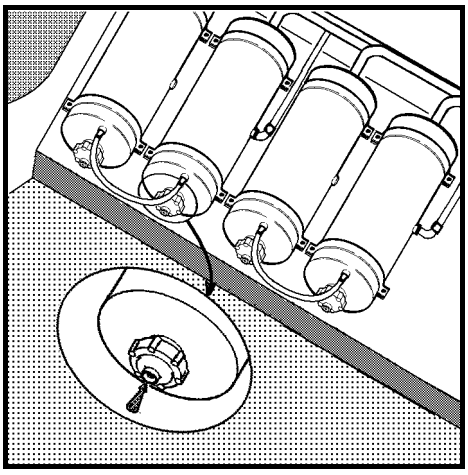


Fig. 5

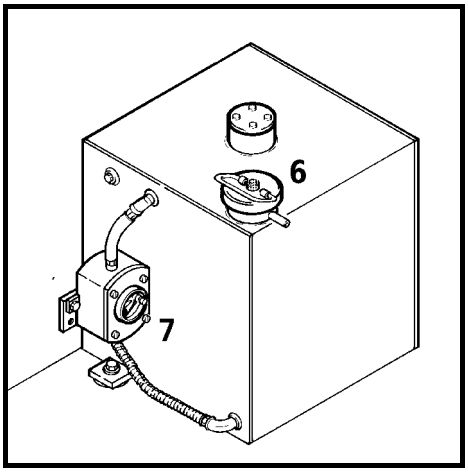



Fig. 6

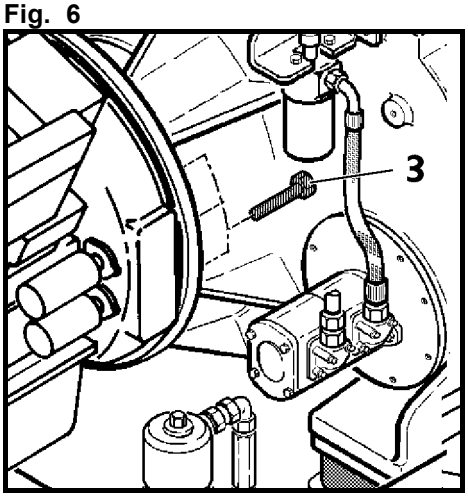



Fig. 7

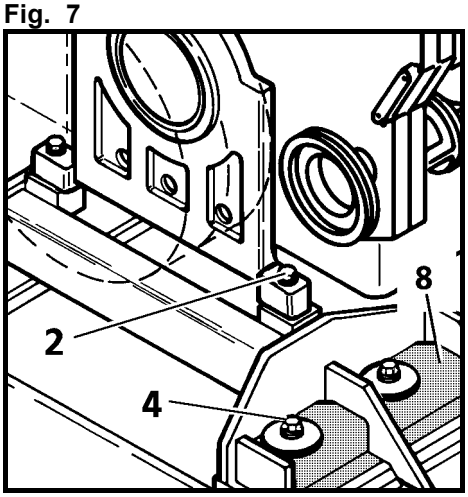



Fig. 8

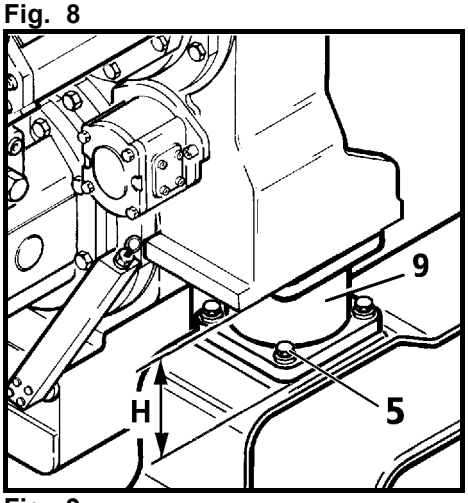



Fig. 9

# THE DIESEL ENGINE

Refer to the CUMMINS Operation and Maintenance Manual for detailed description of maintenance work to be performed.

In addition, accurately observe the following items and perform all maintenance work according to the intervals given in the maintenance schedule.

**COOLING CIRCUIT**

Clean the radiator with pressurised air or a steam cleaner, if necessary.

Change the pressure relief valve (in the radiator cap 6, Fig. 6) in case of leaks.

Regularly check the connector hoses between the radiator and the engine, as well as the heater hoses for condition and leaks. Check tightness of hose clamps.

**ENGINE AND SPLITTERBOX MOUNTING SCREWS**

Check the mounting screws 2 on the engine brackets (Fig. 8) and the engine or gear mounts (Fig. 8, pos.4 or Fig. 9, pos. 5) regularly for tightness, retorque if necessary.

Tightening torque for screws, pos. 2: 620 Nm (457 ft. lbs.).
Tightening torque for screws, pos. 4: 620 Nm (457 ft. lbs.).
Tightening torque for screws, pos. 5: 310 Nm (229 ft. lbs.).

**CAUTION**

**The screws 4 and 5 of the rubber mounts must never be tightened as long as the engine and the splitterbox are not firmly fixed together, or if the mounts are pretensioned by any force but the weight of the engine and splitterbox.**

Any improper fastening would greatly reduce the expected life of the rubber mounts.

**SPLITTERBOX MOUNTING SCREWS**

Check the tightness of mounting screws 3 (Fig. 7) from splitterbox to the diesel engine SAE housing regularly. Retorque if necessary.

Tightening torque for screws 3: 140 Nm (100 ft.lbs)

**ELASTIC BEDDING OF ENGINE AND SPLITTERBOX – REPLACEMENT OF RUBBER BUFFERS**

The four rubber cushions 8 at front face of engine (Fig. 8) and the two buffers 9 at the splitterbox side (Fig. 9) must be replaced at regular intervals.

For maintenance intervals, see maintenance schedule.

In addition, the height “H” of the rubber buffers 9 (total height, including steel plates) must be checked at the intervals specified in the maintenance schedule).

Should “H” be below the minimal acceptable height of 193 mm (7,6”), so the buffers 9 have to be replaced at once.

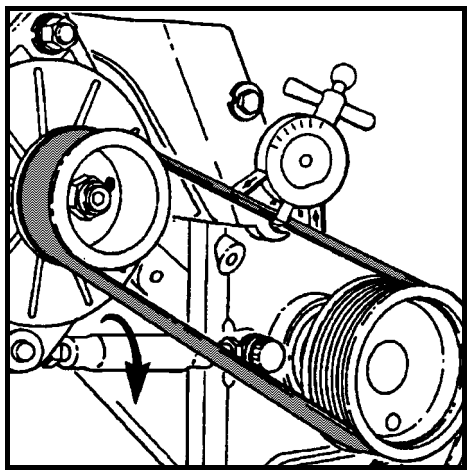


Fig. 10

**BELTS**

**Belt for the 24 V alternator of the diesel engine ().**

Please refers to the enclosed CUMMINS Operation and Maintenance Manual.

**Fan belt for radiator fan ()**

**Check the fan belt tension:**

Please refer to the enclosed CUMMINS Operation and Maintenance Manual.

**Adjust fan belt tension:**

Loosen lock nut 14 and screws 13, turn adjustment screw 15 until the correct fan belt tension is reached. Tighten screw 13 and nut 14.

Recheck the fan belt tension.

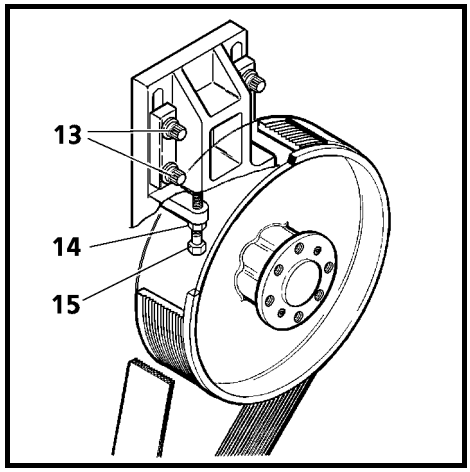



Fig. 11

**Belt for optional alternator ()**

**Check tension:**

The belt is tensioned properly if the belt can be pushed down approx. 10 mm (3/8”) with the thumb at the center, between the two V-belt pulleys.

**Adjust belt tension:**

Loosen lock nut 10, 12 and nuts 12, turn the adjustment screw 11 until the correct belt tension is reached. Tighten nuts 12 and lock nuts 10 and 12.

Recheck the fan belt tension.

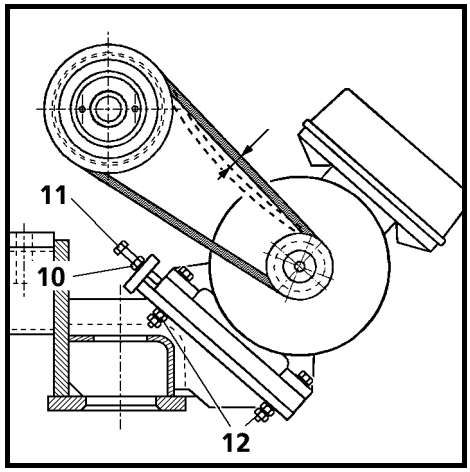


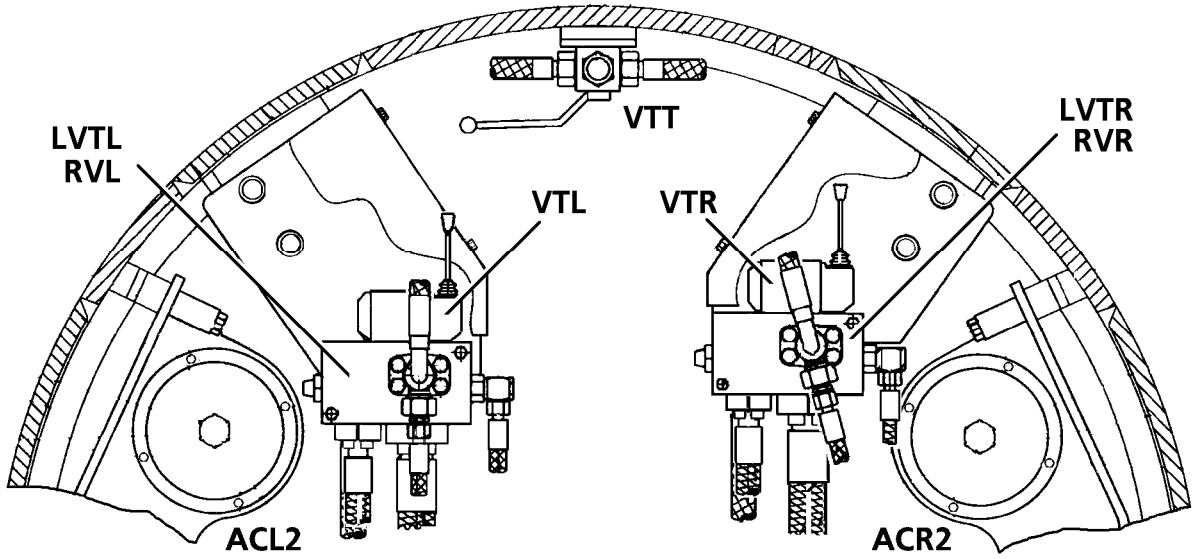

Fig. 12

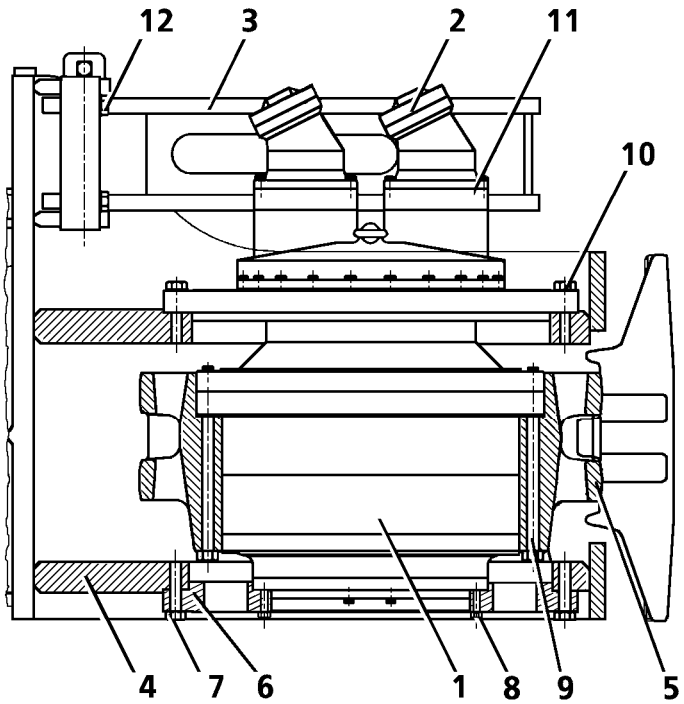
# THE TRACK COMPONENTS

The track chains are maintenance free, until the track does need to be reconditioned or have to be replaced.
Idlers are lifetime lubricated. The lifetime sealings prevent the bearing from dust, sand, mud, stones and earth contamination.
Track and carrier rollers oil must be changed at regular intervals (see maintenance schedule).
Sprocket is maintenance free.

**TRACK TENSIONING**

The track tension is hydraulically actuated and need no special maintenance.
To release the track tension: close the tap (VTT) in the swing ring turnet area in the center girder and move the lever (VTL or VTR) to release the track tension pressure for the side you are working on.
To tighten the track: open the track tension tap (VTT) and start the engine of the excavator. The chain will automatically be tightened.



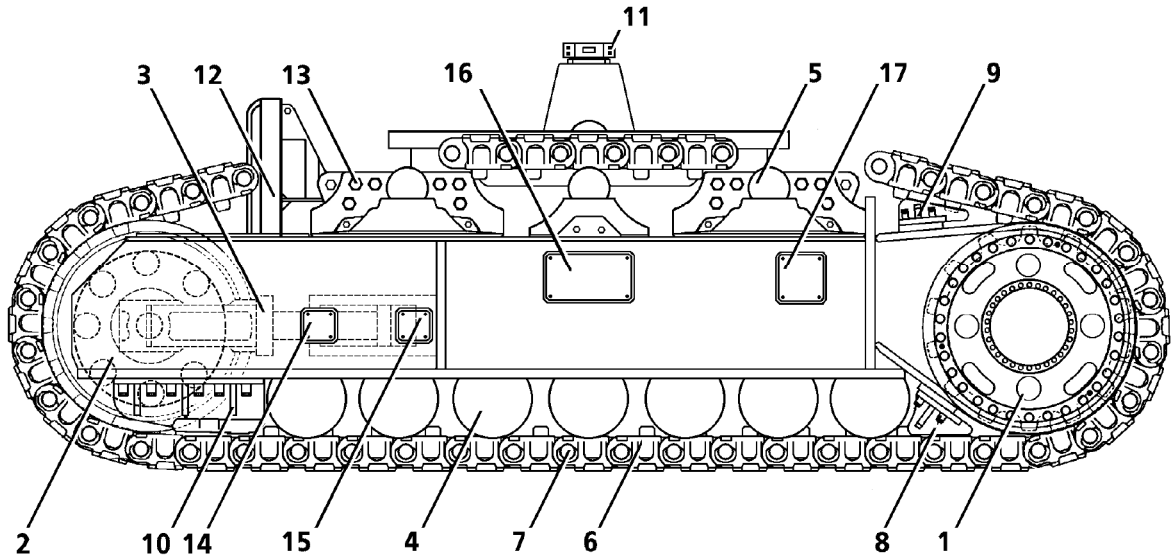




**MOUNTING SCREWS**

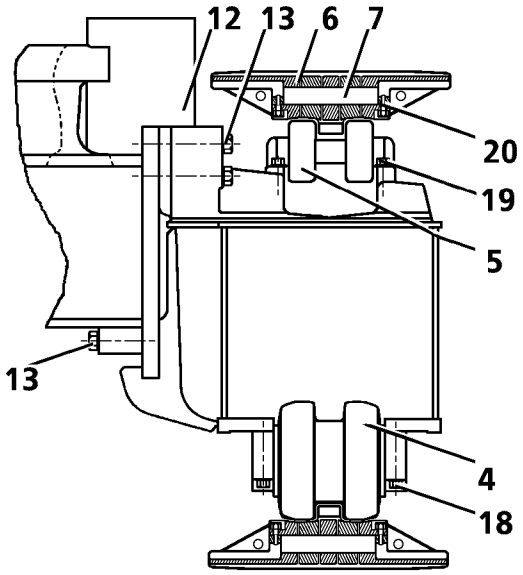
The tightening torque of the mounting screws must regularly be checked (see maintenance schedule)

**Tightening torque of the screws**

| | | |
|---|---|---|
| 1 | Travel gear | |
| 2 | Travel motor | |
| 3 | Travel motor protection | |
| 4 | Side frame | |
| 5 | Sprocket | |
| 6 | Center cover | |
| 7 | Screw M 45 | 6210 Nm |
| 8 | Screw M 24 | 1060 Nm |
| 9 | Screw M 45×3 | 6670 Nm |
| 10 | Screw M 45 | 6210 Nm |
| 11 | Screw M 20 | 620 Nm |
| 12 | Screw M 42 | 4975 Nm |




1 Track drive sprocket and final drive
2 Idler
3 Tension unit
4 Track roller
5 Carrier roller
6 Track pad
7 Pin
8 Chain guide down
9 Chain guide up
10 Chain guide front
11 Rotary connection
12 Ladder
13 Hex. Screw
14 Cover
15 Cover
16 Cover
17 Cover
18 Hex. Screw
19 Hex. Screw
20 Locking screw




**Tightening torque:**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 13 | Fixing side frame/Central part | M 64 | 17500 Nm | 20 | Locking screw/link pin | M36×2 | 4000 Nm |
| 18 | fixing track roller | M42 | 4975 Nm | | Chain guide down | M45 | 6210 Nm |
| 19 | fixing carrier roller | M24 | 1060 Nm | | Fixing ladder | M30 | 2100 Nm |
| | fixing sprocket/gear | M45×3 | 6670 Nm | | Chain guide front | M24 | 1060 Nm |
| | fixing gear/support | M45 | 6210 Nm | | | M42 | 4975 Nm |

**CLEANING THE TRACK COMPONENTS**

At the end of a workday, the complete undercarriage should be checked and cleaned.

**CAUTION**

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

**Do not allow mud, rocks, etc. to collect on track components.**

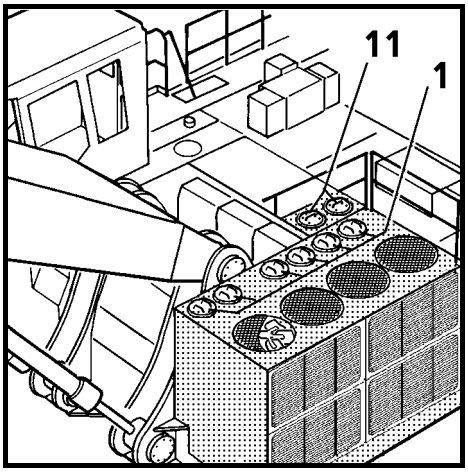


Fig. 13

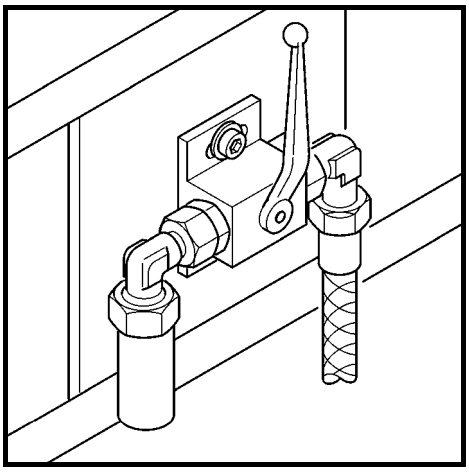


Fig. 14

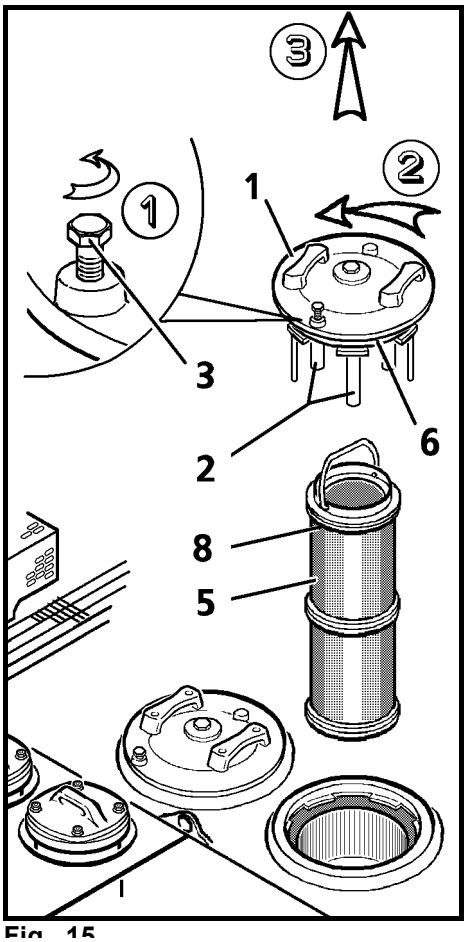


Fig. 15

# THE HYDRAULIC SYSTEM

Maintenance of the hydraulic system is generally limited to the hydraulic tank.

All other components in the system require no special maintenance.

However, hydraulic lines and hoses and fittings must be checked for leaks at regular intervals.

Cleanliness in the hydraulic lines and hoses and fittings must be checked for leaks at regular intervals.

for this reason, the given maintenance intervals to replace the return oil filters (Fig. 13, pos. 1) and leak oil filters (pos. 11), to clean the hydraulic oil cooler and to change the hydraulic oil must be strictly observed.

**DANGER**
**N**

**At or near operating temperature, the hydraulic oil is very hot and can be under pressure. Do not allow your skin to come into contact with hot oil or components containing hot oil!**

Always relieve the pressure in the hydraulic system before working on the hydraulic system.

Lower the attachment to the ground, actuate all servo control valves to relieve servo pressure (with ignition key in contact position) and open the tank pressure release valve located at the back of the cabin. In that way, the air pressure in the hydraulic tank will be relieved.

**OIL COOLING SYSTEM**

Clean hydraulic oil coolers are necessary to achieve optimum hydraulic oil cooling.

Clean the hydraulic oil coolers with compressed air or a steam cleaner at the intervals specified in the maintenance schedule, and more often, if working conditions make it necessary.

**TANK RETURN FILTER (Fig. 15)**

**The magnetic rods in the return filter of the hydraulic tank (pos. 2)** should be cleaned at the intervals specified in the maintenance schedule.

**Change the filter insert 5** at the intervals specified in the maintenance schedule and after every failure in the hydraulic system, which could have contaminated the hydraulic system.

**To check and clean the magnetic rods to replace a filter element:**

Loosen screws 3 (Fig. 16) and turn the filter cover approx. 45°counterclockwise, lift off the cover 1 with the magnetic rod 2.
Carefully remove any dirt adhering to the magnetic rods.
remove the old filter element 5 and replace it with the new element.

**CAUTION**

**Make sure that the lower section of the element touches the bottom of the canister.**

When inserting the element 5, make sure that the o-ring 8 is not damaged.
Install the cover 1, making sure that the o-ring 6 is seated correctly.
Reinstall and tighten screw 3 evenly.

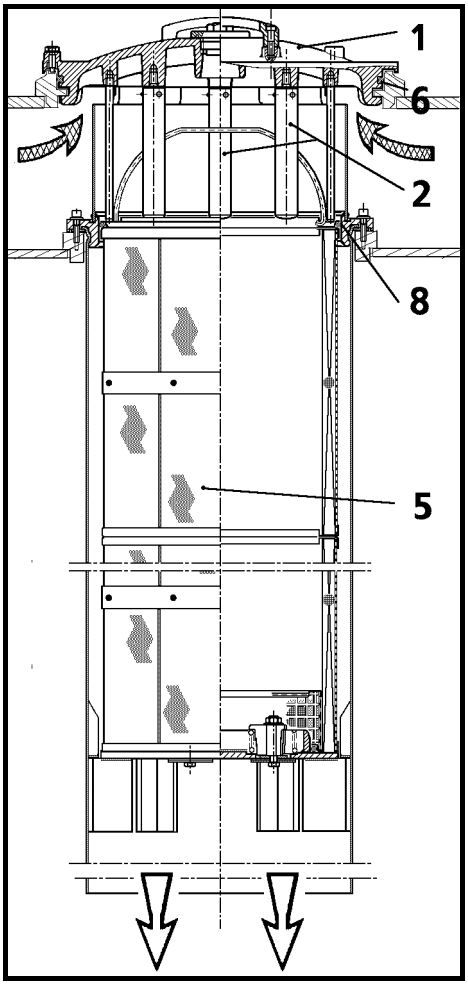


Fig. 16

**LEAK OIL FILTER (Fig. 17)**

**Clean the magnetic rod of the leak oil filters** (pos. 12) at the intervals specified in the maintenance schedule.

**Change the filter insert 15 for the first time** at the intervals specified in the maintenance schedule.

**To clean the magnetic rod and to replace the filter element:**

Loosen the nuts (pos. 13) on the filter cover and remove the cover 11 with magnetic rod 12.

Carefully remove any dirt adhering to the magnetic rod. Remove the old filter element 15 and insert the new element.

**CAUTION**

**Make sure that the lower section of the element touches the bottom of the canister.**

When inserting the element 15, make sure that the o-ring 18 is not damaged.

Install the cover 11, making sure that the o-ring 16 is seated correctly.

Reinstall and tighten nuts 13 evenly.

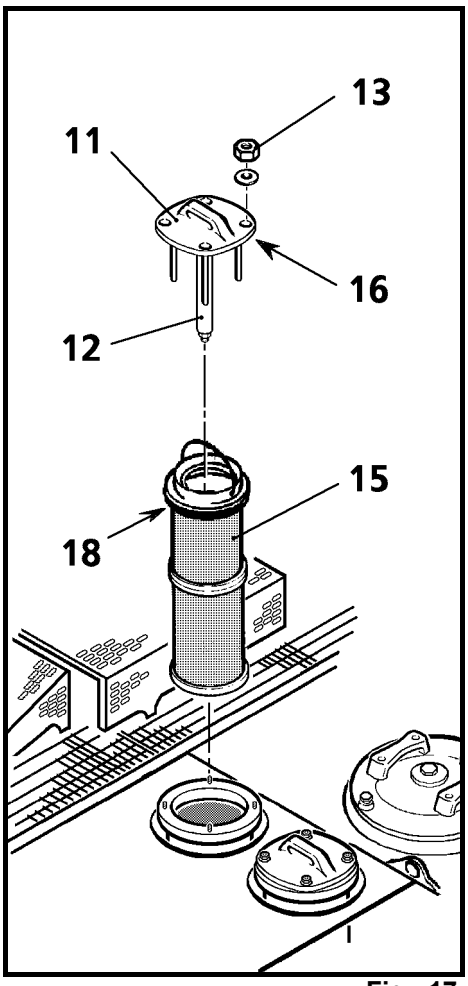


Fig. 17

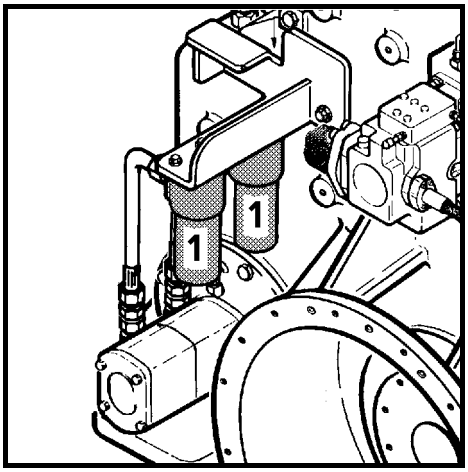


Fig. 18

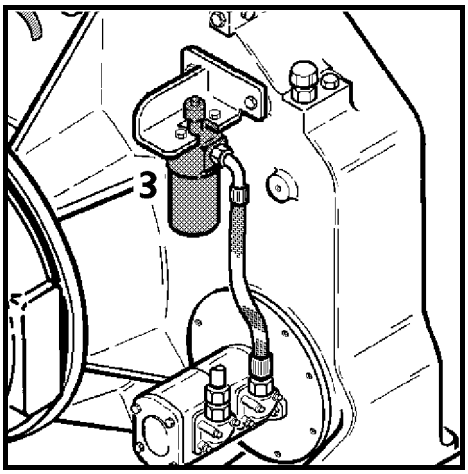


Fig. 19

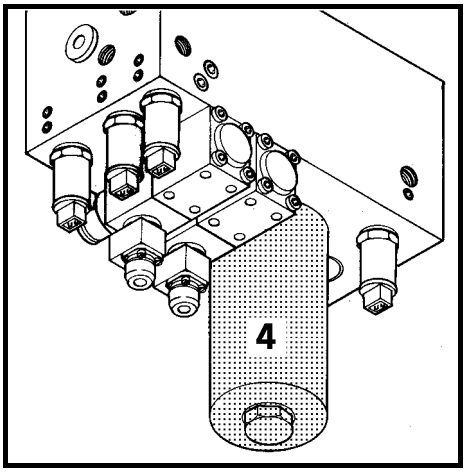


Fig. 20

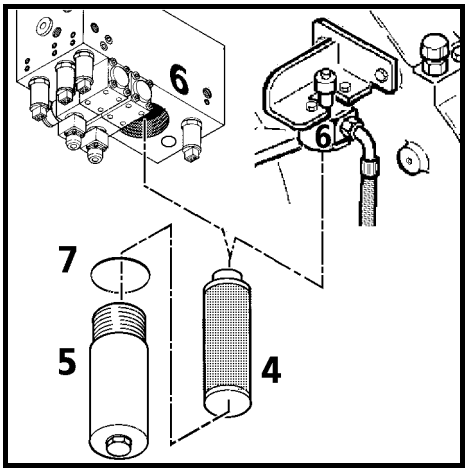


Fig. 21

**REPLENISHING OIL, BEARING FLUSH OIL AND SERVO OIL FILTER**

Four in-line hydraulic filters on each pump unit ensure filtration of the auxiliary circuits.

The two replenishing oil filters 1 for the closed swing circuit (Fig. 18) and the filter 3 for the pump flushing circuit (Fig. 19) are located opposite the diesel engine on the splitterbox.

The servo oil filter 4 (Fig. 20) is installed on the frame above the hydraulic pumps.

For the filter change intervals, see the maintenance schedule.

**To replace a filter element (**Fig. 21**)**

Before cleaning the filter, relieve the air pressure in the hydraulic tank ().

Remove the filter housing 5, take out the filter element 4, clean the filter head 6 and the filter housing 5.

Insert a new filter element 4, lightly lubricate the threads of the housing, reinstall the filter housing, making sure the o-ring 7 is positioned correctly, tighten the filter housing by hand.

Pressurise the hydraulic tank.

## HIGH PRESSURE FILTERS IN WORKING CIRCUITS

These filters Diese Filter (Fig. 22) are installed on the inlet port of the control valves.

The filters are maintenance free.

The elements should be checked, cleaned or replaced after replacing or repairing a working pump.

**To clean the filter element:**

- Relieve hydraulic tank pressure(),
- Remove the filter housing 1 (Fig. 23),
- Remove the filter element 2 and clean it with non flammable cleaning fluid, or replace it with a new element,
- Clean the filter housing 1 and the filter head 3 and reinstall, making sure the o-rings 4 and 5 are seated properly,
- Pressurise the hydraulic tank.

**Important:** Any time the filter element is cleaned or replaced, check for leaks.
To check for leaks, start the engine, operate the machine for a short period, and check for leaks between the filter housing 1 and the filter head 3.

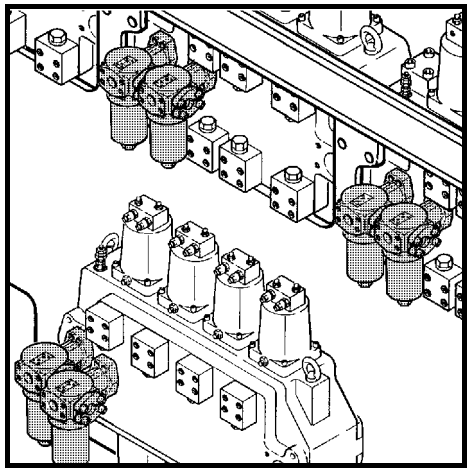


Fig. 22

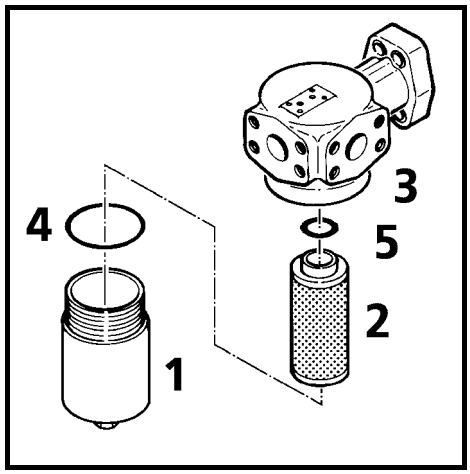



Fig. 23

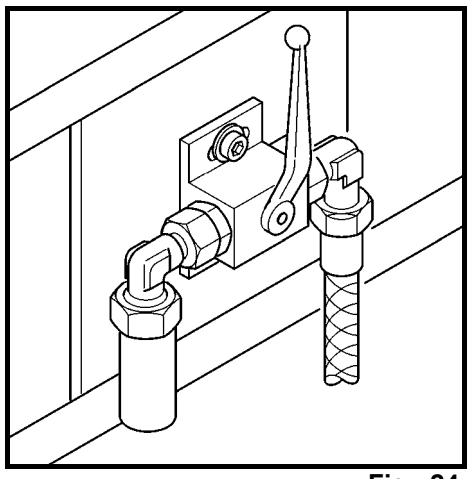


Fig. 24

## THE SUCTION PIPE TO THE MAIN PUMPS

The mounting bolts of the expansion joints (Fig. 25, pos.2 or 3) must be coated with loctite (Id. 8503598).

The mounting bolts 6 of the expansion joints (pos.2) on the main collector must be torqued to $150^{+75}$ Nm. The mounting bolts 7 of the expansion joints (pos.3) on an hydraulic pump must be torqued to $26^{+13}$ Nm.

If an expansion joint on an hydraulic pump or on the main collector must be exchanged, close the shut off valve 1 on the hydraulic tank and release the tank pressure ().

In addition, remove the cover of both leak oil filters, so to prevent the oil return via these filters and hydraulic pumps.

After repair, reinstall the leak oil filter covers, pressurise the hydraulic tank and return the shut off valve 1 in open position.

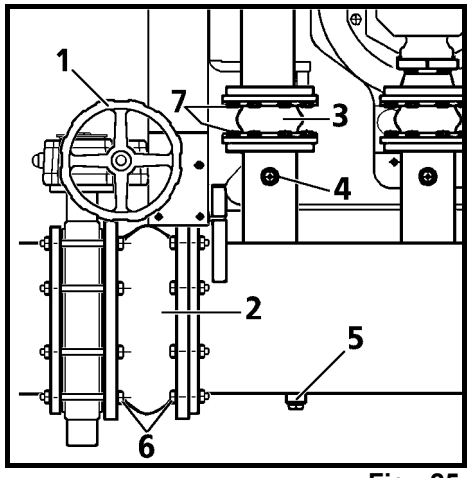



Fig. 25

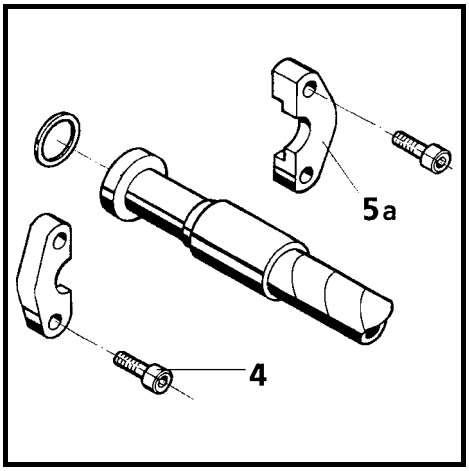



Fig. 26

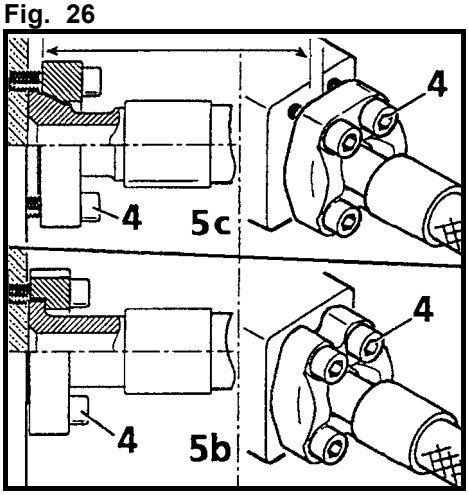



Fig. 27

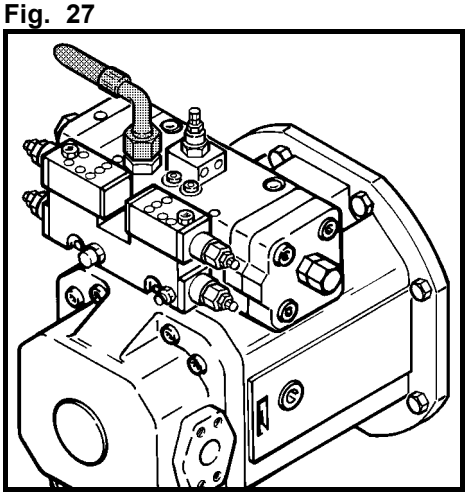


Fig. 28

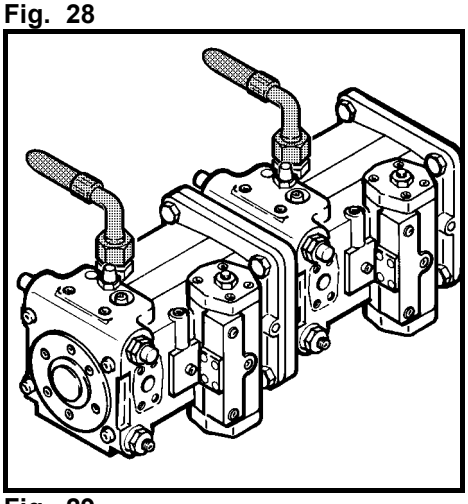


Fig. 29

**REPAIR ON THE HYDRAULIC SYSTEM**

The hydraulic system must be checked regularly for leaks.

**DANGER**

**Never check for leaks with your bare hands.**
**Fluid escaping from a small hole can have enough force to penetrate the skin.**
**Never loosen or remove lines or fittings before the attachment is lowered to the ground, the engine is turned off, both joysticks are moved, with the ignition key in contact position, and the air pressure in the hydraulic tank is relieved.**

NW 20, NW 25, NW 32, NW 40 and NW 60 high pressure hoses with SAE fittings are installed on this machine (Fig. 26and Fig. 27).

**DANGER**

**Any time a high pressure hose is defective (bubles, moisture, damage on the surface, etc.) it must be replaced. When installing replacement hoses, avoid any stress and strain on the hose. Do not turn or twist the hose during installation.**

The following o-rings are needed for hydraulic hoses:

| | | | |
|---|---|---|---|
| NW 20 – 25 | ×3,5 | Id. No. | 7367610 |
| NW 25 – 32,9 | ×3,5 | Id. No. | 7367611 |
| NW 32 – 37,7 | ×3,5 | Id. No. | 7367612 |
| NW 40 – 47,2 | ×3,5 | Id. No. | 7367613 |
| NW 60 – 69,5 | ×3,5 | Id. No. | 7360656 |

The mounting screws on the SAE fittings must be tightened to the following torque value:

| Screw 4 Size | Torque value in Nm (ft. lbs) – Quality 10.9 | | |
|---|---|---|---|
| | Half flange 5a | Flat flange 5b | Conical flange 5C |
| M8 | 31 (23) | / | / |
| M10 | 62 (45) | 45 (33) | 65 (48) |
| M12 | 108 (80) | 70 (51) | 110 (81) |
| M14 | 172 (127) | 120 (88) | 180 (133) |
| M16 | 264 (195) | 170 (125) | 250 (184) |
| M20 | 350 (258) | 250 (184) | 450 (332) |

**Note:** Tighten evenly and crosswise

**TO BLEED THE HYDRAULIC PUMPS**

Bleed the hydraulic pumps after every repair on the pumps and / or after every hydraulic oil change.
To bleed a pump, loosen the hose on top of the leak oil connection on the pump housing (do not remove) and allow air to escape. As soon as hydraulic oil without air bubbles emerges, tighten the leak oil hose (see Fig. 28 for working pump or Fig. 29 for swing pump). Before initial pump start up, after pump repair or replacement, fill the pump housings via the same connections with hydraulic oil.

**THE SERVO CIRCUIT**

check the complete servo circuit, tubes, connections, hoses as well as all component connections (accumulator, pressure relief valve, filters, etc.) regularly for leaks.

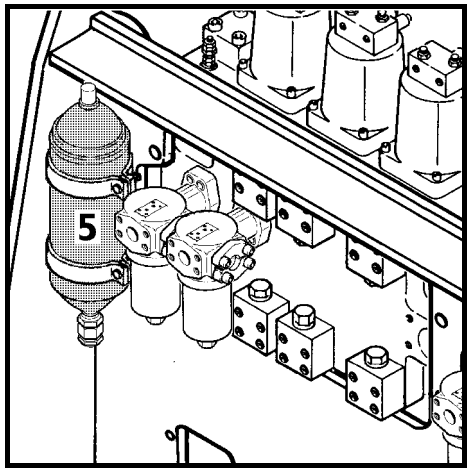



Fig. 30

**DANGER**

**Due to two accumulators (**Fig. 30**), the servo circuit remains under pressure to actuate several attachment functions (boom down) even after the engine is turned off.**
**Before any repair in the servo circuit, the pressure must be relieve as follows:**
**Lower the attachment to the ground, turn the engine off (turn starter key switch to the on position), and actuate both joysticks several times.**

**HYDRAULIC CYLINDERS**

Before attempting to repair, replace or reseal a hydraulic cylinde (Fig. 31), contact your LIEBHERR dealer. Leaks at the cylinder rod bearing should always be repaired by the LIEBHERR dealer.

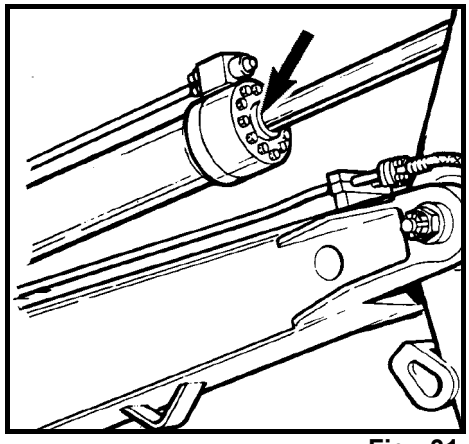


Fig. 31

**Piston rod preservation:**

If the machine is not used for more than 4 weeks or before transporting the machine by ship, the following preservation guidelines should be carried out:

**Park and / or transport the machine in such a way that the piston rods are fully retracted in the cylinders.**

Apply anti-corrosive grease (for example: LIEBHERR CTK grease, Id. 861331301) to all exposed sections of the piston rods (for ex.: Fig. 32).

If the machine is transported by ship (salt water), or in the winter (road salt), recheck the preservation of the piston rods after the machine has been loaded, since the anti-corrosive grease may have been removed by the wiper ring.

In addition, apply anti-corrosive grease if the machine is used in certain applications with short cylinder strokes, where the piston rods are not regularly lubricated with hydraulic oil (example: cylinder on basic boom, when working above ground level).

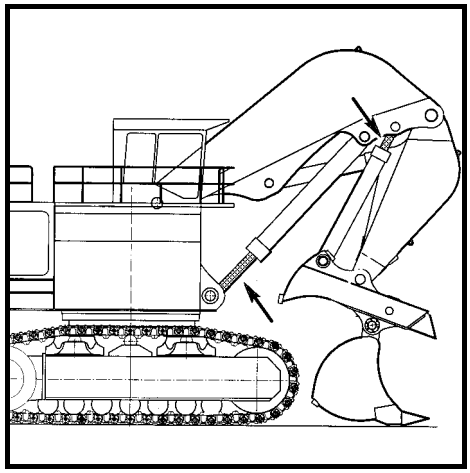


Fig. 32

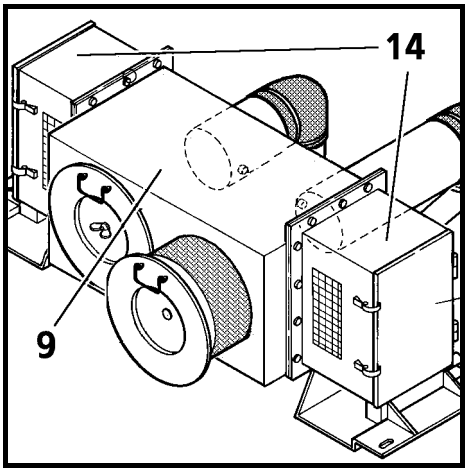


Fig. 33

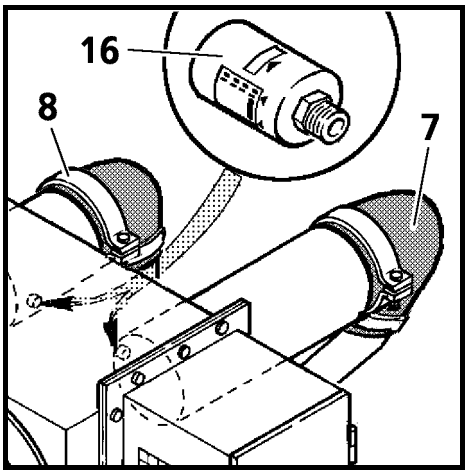


Fig. 34

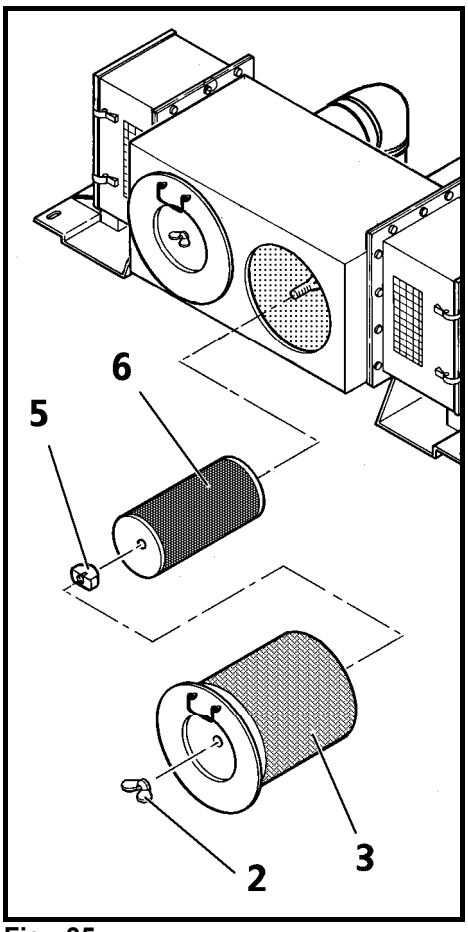


Fig. 35

# THE AIR FILTERS

Maximum engine protection against premature wear due to dust is only possible if the air intake system and filters are checked and serviced at regular intervals (Fig. 33).

The air cleaner with multi cyclone precleaner 14 and fine filter 9 with primary and safety element are designed to give maximum protection at long maintenance intervals.

**Maintenance also includes replacing the filter elements.**

For safety reasons, we do not recommend to clean the filter elements.

The vaccum indicator (Fig. 34, Fig. 36,pos. 16) stores the maximum recorded vaccum pressure on the filter outlet, during the diesel engine operation.

When the red stripe (Fig. 36, pos. 17) appears in the window 18, the maximum permissible vaccum of 50 mbar has been reached.

At that time, the corresponding primary filter element must be replaced.

To reset the vaccum indicator, press the „Reset“ button 19.

**We recommend to change the primary filter elements 3 only, when the maximum vaccum pressure has been reached, or at intervals specified in maintenance schedule.**

If the elements 3 are removed and installed too often, the seals between the filter elements and the filter housing may be damaged.

The safety elements 6 should be replaced after the primary elements have been changed three times, or at intervals specified in maintenance schedule.

Before installing a new element, carefully clean the seal and the sealing surface of the filter housing.

The dust in the cyclone precleaner 14 is constantly drawn in by the exhaust system and discharged.

**TO CHANGE THE PRIMARY FILTER ELEMENT**

Turn the engine off, remove nuts 2 and remove the dirty primary filter elements 3 (Fig. 35).

Clean the inside of the air filter housing 9 and wipe off the sealing surface in the filter housing with a damp rag.

Do not blow out the housing with pressurised air.

Insert the new primary filter elements, make sure they are seated correctly, tighten nuts 2.

**TO REPLACE THE SAFETY ELEMENTS**

The safety elements 6 are installed with a spezial wing nut with built in maintenance indicator (Fig. 37, pos.5).

Check the wing nut for tightness.

However, if a visual inspection shows that the green dot 5a on the wing nut has turned red, the safety elements should be replaced immediately.

**We recommend that the safety elements are replaced by a qualified maintenance or LIEBHERR service technician.**

To remove the safety elements, proceed as follows:

Remove the primary elements 3 as outlined before. Remove the special wing nut and take out the safety element 6.

Carefully clean the inside of the air filter housing 9 with a damp rag.

Clean the sealing surfaces in the housing and check for damage.

Carefully insert the new safety elements and secure with the spezial wing nuts.

Install the primary filter element 3, as outlined before.

**TO CLEAN THE AIR CHANNELS FOR THE PRECLEANER (Fig. 38)**

Check the condition of the air channels in the precleaner 14 at the intervals specified in the maintenance schedule.

Open the filter cover 1 and check the channels. If the channels are plugged with dust, use compressed air to blow the channels out from the inside of the filter towards the outside.

**CAUTION**

**Do not use steam.**
**The safety elements 6 must remain in place.**
**Do not direct the air flow towards the filter elements**

**CHECK THE AIR INTAKE SYSTEM, HOSES, ELBOWS, CLAMPS**

The rubber hoses and elbows between filter housing end engine (Fig. 34, pos. 7) must be checked for damage, wear, tightness and leaks whenever the filter elements are replaced.

If necessary, retighten the screws on the clamps 8.

The connection to the air intake side of the air compressor must also be checked for leaks (Fig. 39). If necessary, include the visual inspection of the air intake system in the daily maintenance.

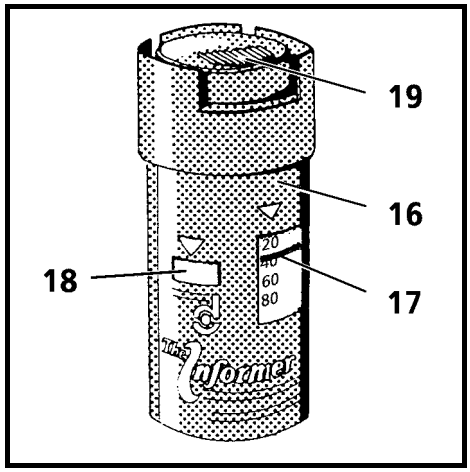



Fig. 36

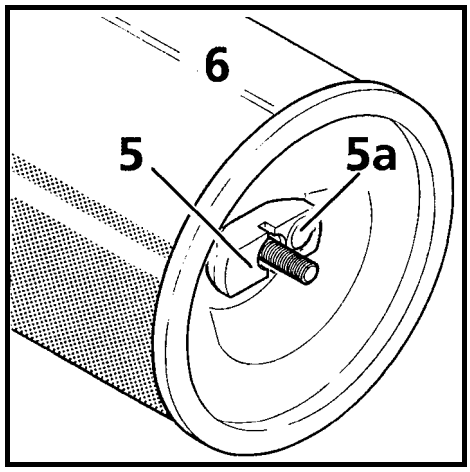



Fig. 37

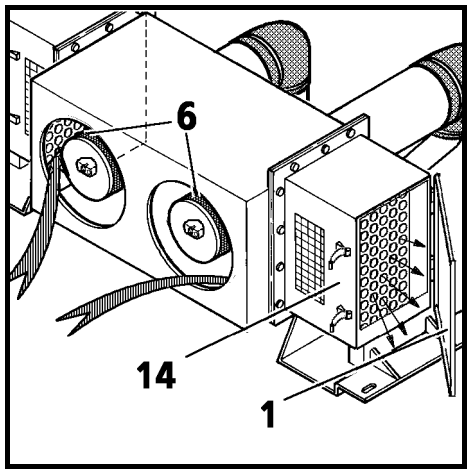



Fig. 38

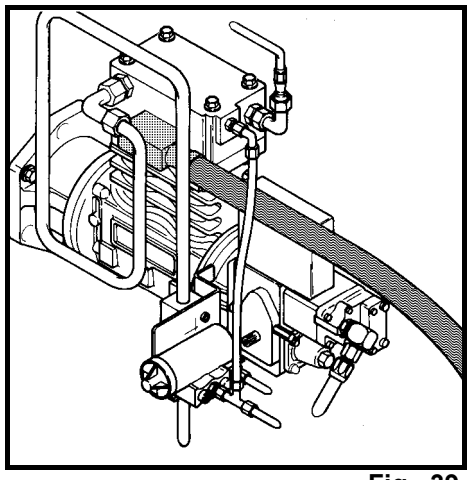


Fig. 39

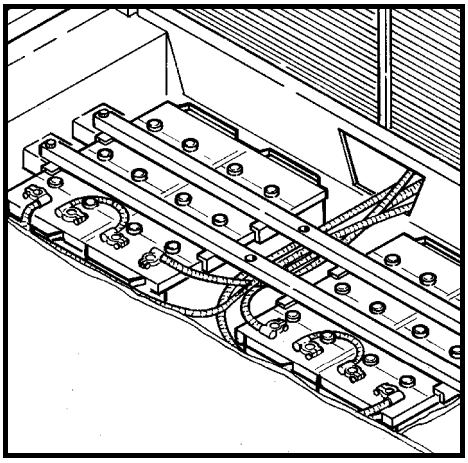


Fig. 40

# THE ELECTRICAL SYSTEM

To insure troublefree operation of your excavator, the electrical system must be in good condition. The gauges, indicators and components of the electrical system should be checked regularly for proper function (see maintenance schedule).

Always replace burnt out fuses and bulbs. **Do not repair** fuses.

Check for bare and damaged wires, which could cause damage to the electrical system or a fire. Check for loose, dirty or corroded connections.

**IMPORTANT**

**Before repairs on the electrical system, or before using an arc welder on the machine, the negative battery terminal should be disconnected first and reconnected last.**

**Cover the electrical components (especially the alternator) when washing the excavator to protect it from water.**

**BATTERY MAINTENANCE**

In order for the batteries to function properly, it is important to keep them clean at all times.

The battery poles and cable clamps in particular should be cleaned regularly and then coated with acid resistant grease (Fig. 40).

To check the electrolyte level open battery compartment door, lift up rubber cover and remove caps.

The electrolyte level should be ½“ (10 – 15 mm) above the plates.

If the electrolyte level is low, add distilled water.

Regularly check the specific gravity with a hydrometer. A fully charged battery should have a value of 1,28 kg/l (31,5°).

Batteries with a lower value should be recharged. Reinstall caps, check if battery is mounted securely and close the battery compartment door.

**DANGER**

**Wear protective gloves and safety glasses when handling batteries!**
**Keep sparks and open flame away from battery. Battery fumes are highly flammable and explosive.**
**Batteries contain acid which should not be touched. In case of contact, flush with water and get medical attention.**

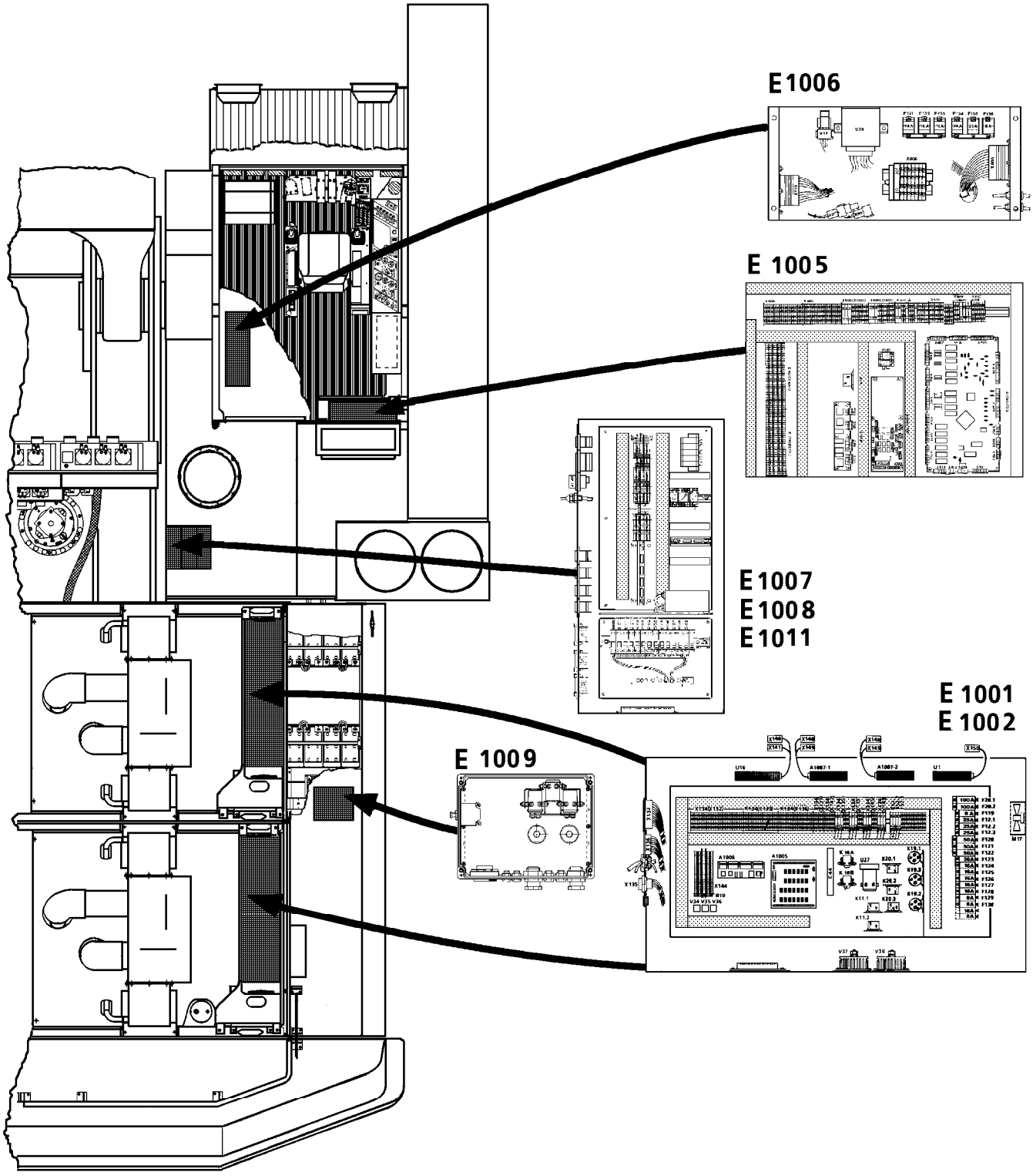


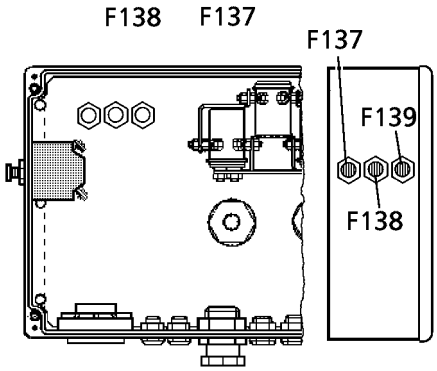

**Fig. 41**

E1001 Switching box powerpack 1
E1002 Switching box powerpack 2
E1005 Switching box driver's cab
E1006 Switching box air conditioner
E1007 Switching box access ladder and service center
E1008 Connection box ground switches
E1009 Switching box auxiliary batteries
E1011 Connection box for solenoid valves on control spools

## LOCATION OF SAFETY SWITCHES AND FUSES

Safety switches in control box E1001 / E1002 above the diesel engines 1/2 (…)

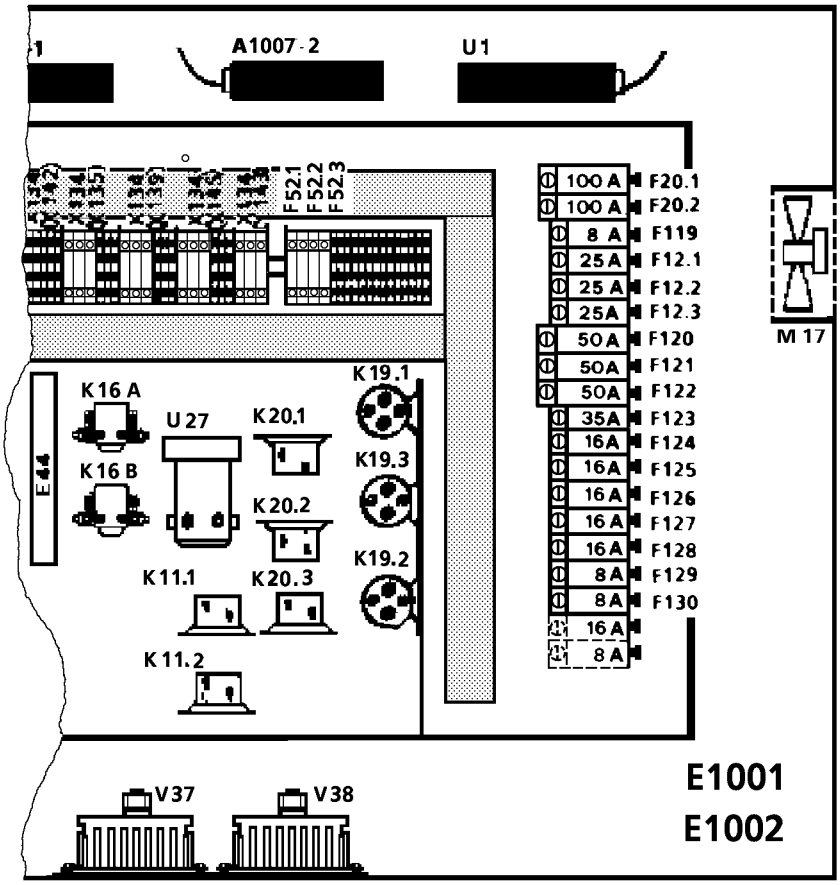
| | In (A) | Control box E1001 | Control box E1002 | Fused circuits and components |
|---|---|---|---|---|
| **F12.1** | **25** | × | × | Head light on hydraulic tank |
| **F12.2** | **25** | × | × | Head light on attachment |
| **F12.3** | **25** | × | × | Head light on counterweight |
| **F120.1** | **100** | × | | Primary safety switch – diesel engine 1 |
| | **100** | | × | Primary safety switch – diesel engine 2 |
| **F120.2** | **100** | × | | Starter circuit diesel engine 1, illumination |
| | **100** | | × | Starter circuit diesel engine 2, illumination |
| **F119** | **8** | × | | Cut on circuit starter key, starter relay, prelube control systems for powerpack 1 |
| | **8** | | × | Cut on circuit starter key, starter relay, prelube control systems for powerpack 2 |
| **F120** | **50** | × | | Not used |
| | **50** | | × | Evaporator unit – air conditioner |
| **F121** | **50** | × | | Not used |
| | **50** | | × | Condensor unit – air conditioner |
| **F122** | **50** | × | | Not used |
| | **50** | | × | Charge current – service batteries |
| **F123** | **25** | × | | Not used |
| | **25** | | × | Servo controls, shift logic |
| **F124** | **16** | × | | Cold start device, horsepower control for working pumps for powerpack 1 |
| | **16** | | × | Cold start device, horsepower control for working pumps for powerpack 2 |
| **F125** | **16** | × | | Electronic box excavator control BST, monitoring switch for pumps (powerpack 1) |
| | **16** | | × | Electronic box excavator control BST, monitoring switch for pumps (powerpack 2) |
| **F126** | **16** | × | | Centry monitoring system for powerpack 1 |
| | **16** | | × | Centry monitoring system for powerpack 2 |
| **F127** | **16** | × | | Control circuit – central lubrication, circuit board A1001 (winshield washer system, brakes, control circuit – air conditioner, safety lever,…) |
| | **16** | | × | Winshield wiper motor, air compressor – operator's seat |
| **F128** | **16** | × | | Not used |
| | **16** | | × | Heater fan |
| **F129** | **8** | × | | Emergency control circuit for powerpack 1 |
| | **8** | | × | Emergency control circuit for powerpack 2 |
| **F130** | **8** | × | | Shifting unit, indicator unit |
| | **8** | | × | Horn, dome light |




Safety switches in control box E 1009 for auxiliary batteries :

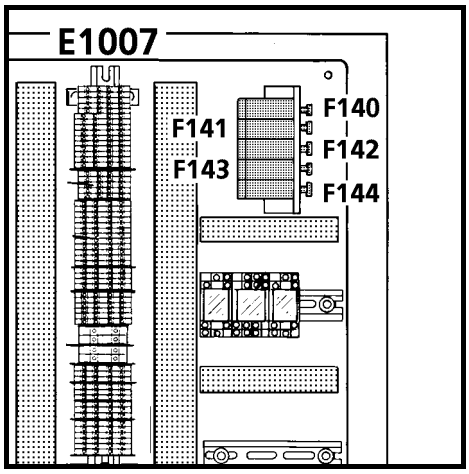
| | | |
|---|---|---|
| F137 | 100A | Starter circuit for diesel engine for auxiliary crane * |
| F138 | 80A | Primary safety switch – auxiliary batteries |
| F139 | 80A | Motor to actuate the access ladder |

* optional equipment



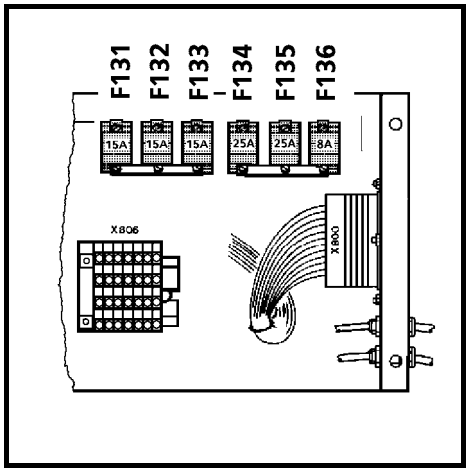

In control box E 1007 are safety switches for :

| | | |
|---|---|---|
| F140 | 16A | Radio, on board clock |
| F141 | 16A | Cigarette lighter |
| F142 | 15A | Electrical outlets 24 V |
| F143 | 15A | Service lights |
| F144 | 16A | Control circuit for access ladder and service station |




The safety switches for the air conditioner are in control box E 1006 under the cab

| | | |
|---|---|---|
| F131 | 15A | Evaporator blower |
| F132 | 15A | Evaporator blower |
| F133 | 15A | Evaporator blower |
| F134 | 25A | Condensor blower |
| F135 | 25A | Condensor blower |
| F136 | 8A | Magnetic coupling - compressor |



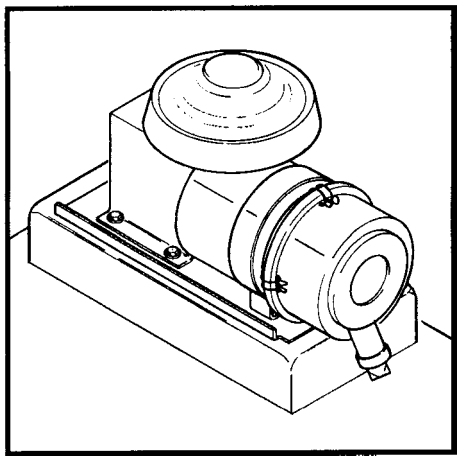


**Fig. 1**

The air filters for electrical box and cab pressurization.

# THE HEATER AND AIR CONDITIONER

## HEATING SYSTEM

The following maintenance should be performed at the intervals specified in the maintenance schedule:

- Check the heater water circuit for leaks, check and retighten all connections, hose clamps and the seals on the water valves.
- If dirty, the heat exchanger has to be cleaned immediately (Fig. 43, pos. 2).
- Remove and clean the fresh air filter of the heater (Fig. 43, pos. 3).

The heater should only be used with an antifreeze and anticorrosive mixture.
When changing the engine coolant, close the heater valves on the engine (Fig. 42). Otherwise the heater core must be vented correctly after refilling.

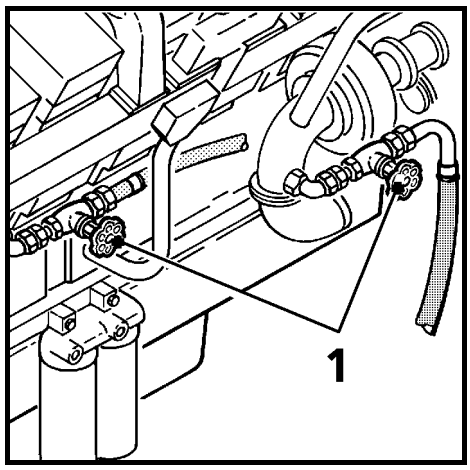



**Fig. 42**

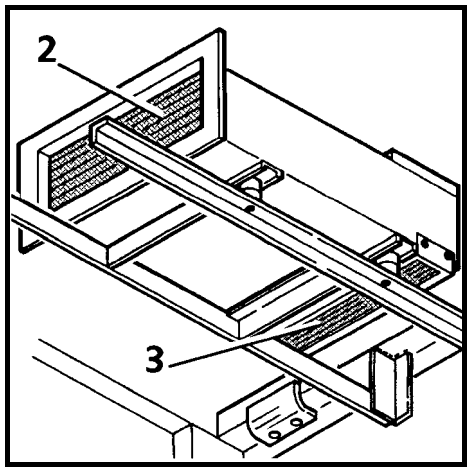



**Fig. 43**

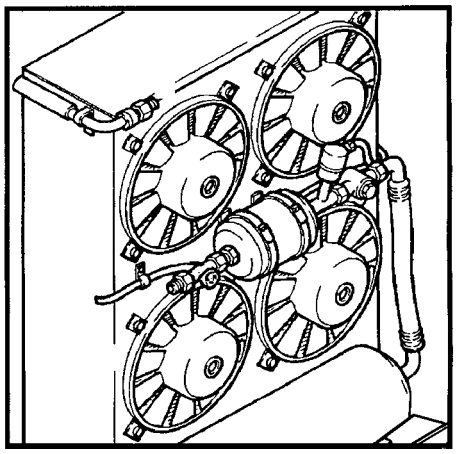


**Fig. 44**

## AIR CONDITIONER

Operate the air conditioner every second week for about 10 minutes regardless of the season.

**During the warm season, perform following checks or maintenance works:**

- Check the heat exchanger of the condenser and if necessary blow it out with pressurised air or steam, from the inner (fan side) to outside (Fig. 44).
- Clean the recirculating air filter on the evaporator in the cab (Fig. 45).

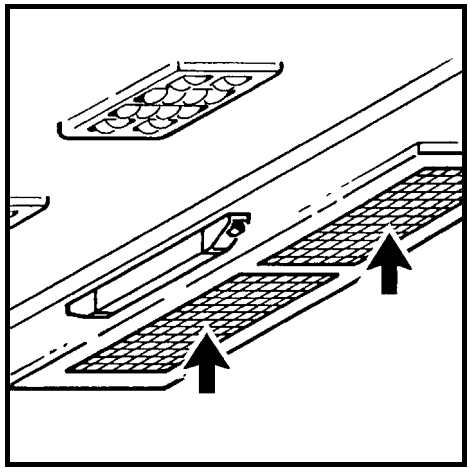


**Fig. 45**

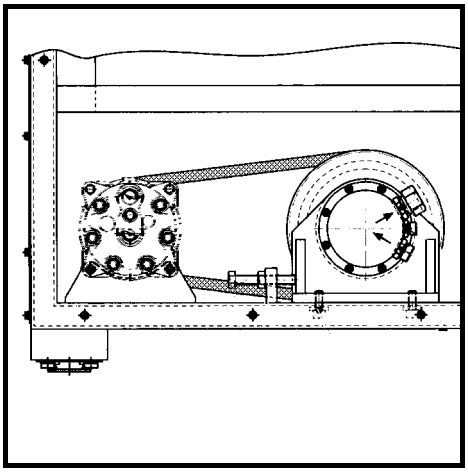


**Fig. 46**

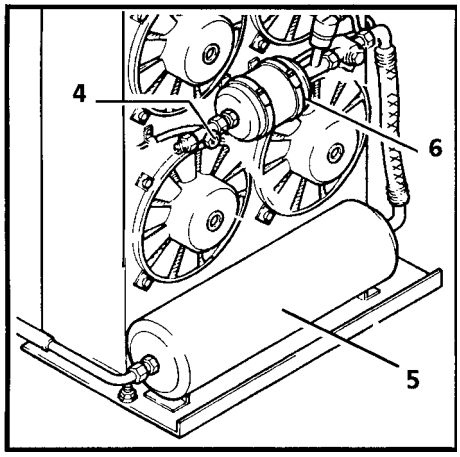



**Fig. 47**

- Check the V-belts of the compressor (Fig. 46) for correct tension and good condition.

In addition, the refrigerant charge of the system must be checked at regular intervals (see maintenance schedule), by observing the sight glass of the receiver drier while the air conditioner is operated.

Bubbles or foam in the sight glass indicate an insufficient refrigerant charge.

In this case, the system should be checked and refilled by a trained specialist.

The condition of the refrigerant receiver 5 must be checked visually for corrosion and mechanical damage. Should rust formation be observed on the receiver (on mounting consoles, connecting parts,…), so it must be replaced immediately.

The filter / drier 6 must be exchanged at regular intervals, since it may be obturated due to excessive absorption of humidity.

If the indicator becomes yellow, it means that there is too much humidity in the circuit. The filter / drier 6 must be exchanged immediatly by a trained specialist.

For maintenance intervals, see maintenance schedule.

# CHECK MOUNTING BOLTS FOR TIGHTNESS

The mounting bolts listed below must regularly be checked and retighten if necessary. See maintenance schedule for check intervals.

**Notice: When installing bolts of size bigger then M40 the thread of the screw must be slightly coated with a MoS2 based grease. Also grease the bolt head supporting surface, unless hereafter otherwise specified.**

**DANGER**

**Due to their size, most of the below listed mounting bolts require, to be tensioned to the prescribed torque, the use of a special, hydraulic or electric actuated tensioning device.**
**These high torque tensioning devices are power tools, which must be operated by trained mechanics, knowing the safety precautions edicted by the tool manufacturer and that must be observed to avoid accidents or personal injury.**
**In particular, pay attention to chose a solid and secure reaction point for the tool and position the reaction arm during operation. Keep clear of the reaction arm during operation; if it must be held or steadied during operation, use alternative means of securing the tool during operation.**

### MOUNTING BOLTS OF THE COUNTERWEIGHT

The mounting bolts M64 Fig. 48, pos. 1) must be torqued to 17500 Nm (12900 ft.lbs).

### MOUNTING BOLTS OF THE SWING RING

The stud bolts M48 (Fig. 49, pos. 4) for the mounting of the swing ring 10 to the uppercarriage 11 must be tensioned to 1070 kN, which corresponds to an elongation of 1,25 mm of the bolts 4. the stud bolts M48 (pos. 3) for the mounting of the swing ring 10 to the undercarriage 12 must be tensioned to 1060 kN, which corresponds to an elongation of 0,9 mm of the bolts 3. tighten the protection nuts 5 on the bolts 3 and 4 between 500 and 1000 Nm.
the use of spezial tensioning procedure and tool is necessary to obtain the correct bolt tension (LIEBHERR recommends the employ of the spezial bolt tensioning cylinder ident. Nb. 5612981, at the required hydraulic pressure of 1410 bar).

**DANGER**

**The special tool may only be operated by qualified personnel, especially trained for the use of this high pressure tensioning device and aware of the operating instructions as well of the recommendations for accident and damage prevention concerning this tool.**
**Use appropriate working platforms and lifting devices to install and hold in position the special tool while tensioning the bolts.**

### MOUNTING BOLTS OF TANKS AND POWERPACK

The mounting bolts M48 of the hydraulic tank, the fuel tank and the both powerpacks (Fig. 50, pos. 6) must be torqued to 8000 Nm (5900 ft.lbs).

### MOUNTING BOLTS OF THE SWING GEAR AND MOTOR

The mounting bolts M30 of the swing gear (Fig. 51, pos. 7) must be torqued to 2100 Nm (1550 ft.lbs).
The mounting bolts M24 of the swing motor (pos. 8) must be torqued to 1060 Nm (780 ft.lbs).

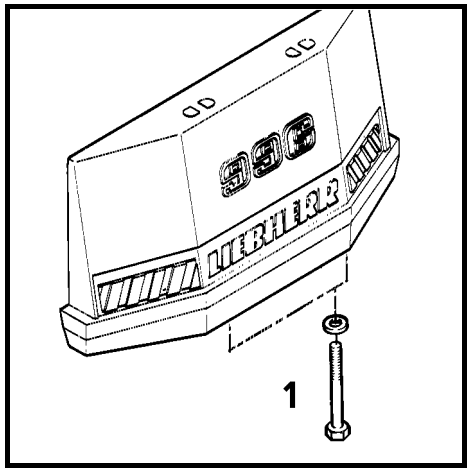


Fig. 48

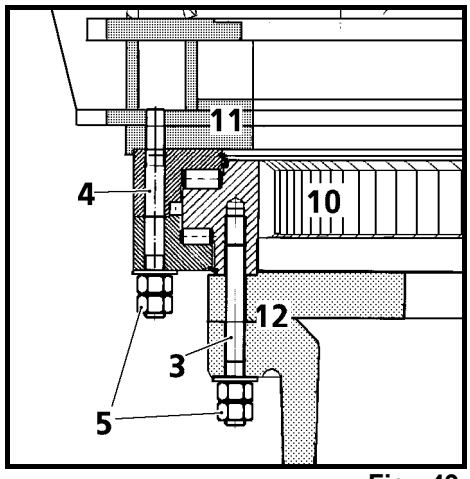


Fig. 49

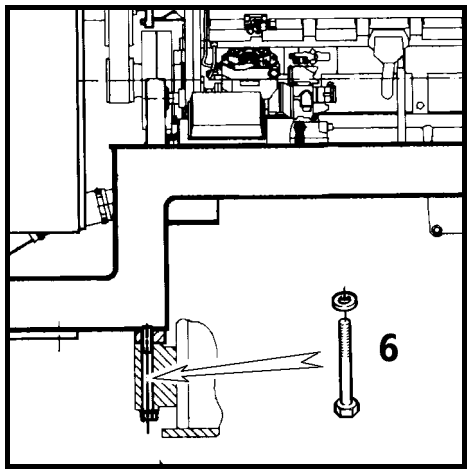


Fig. 50

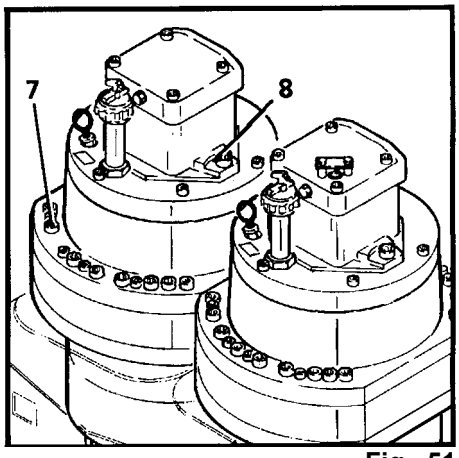


Fig. 51

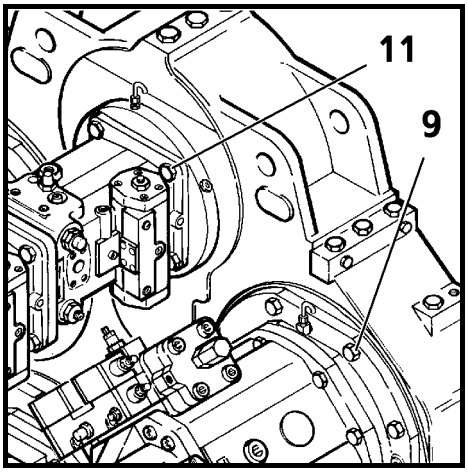


Fig. 52

**MOUNTING BOLTS OF HYDRAULIC PUMPS**

The mounting bolts of the main working pumps (Fig. 52, pos. 9) must be torqued to 620 Nm (460 ft.lbs).

The mounting bolts of the swing pumps (Fig. 52, pos. 11) must be torqued to 620 Nm (460 ft.lbs).Nm.

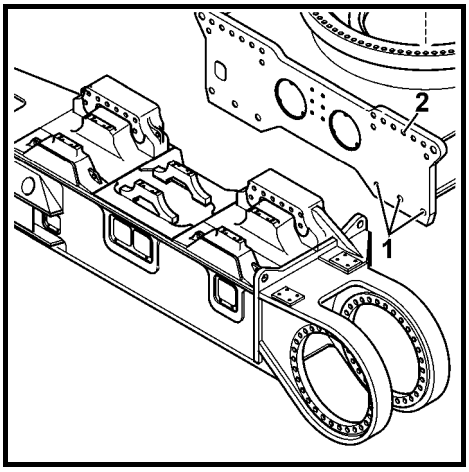


Fig. 53

**CONNECTION OF CENTRAL PIECE AND SIDE FRAMES**

These bolts must be checked regularly, and if necessary retightened.

The lower bolts M64 (Fig. 53, pos. 1) must be torqued to 17500 Nm (12900 ft.lbs).

The upper bolts M64 (Fig. 53, pos. 2) must be torqued to 17500 Nm (12900 ft.lbs).

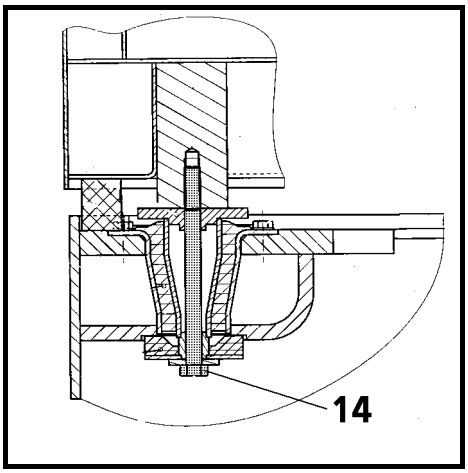


Fig. 54

**MOUNTING BOLTS OF THE DRIVER'S CAB**

These bolts must be checked regularly, and if necessary retightened.

This screw (Fig. 54, pos. 14) are of size M16 and must be torqued to 310 Nm (230 ft.lbs).

## REPLACING WEAR AND TEAR ITEMS

The regular maintenance described in this manual may be performed by the operator or maintenance personnel.

All other repairs should only be done by trained LIEBHERR service Personnel.

Always consult your LIEBHERR dealer, especially when removing counterweight.

## WELDING

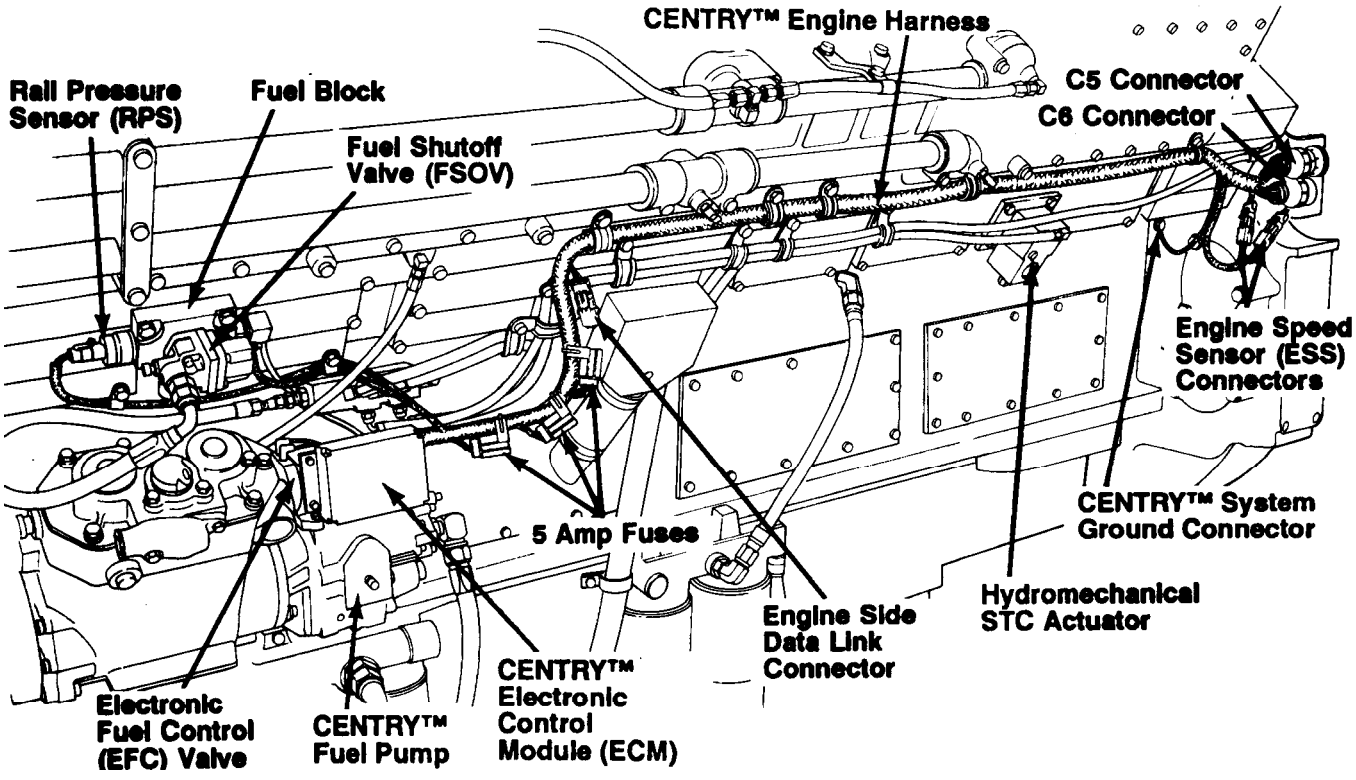
Any welding on structural parts may only be done by LIEBHERR service personnel. If this rule is neglected, the warranty is voided.

Before welding repairs on other parts, always disconnect the battery. Always remove the negative terminal first and reconnect it last.

Nevertheless if welding repair should be done on components which may contain inflammable gases (welded counterweight, hydraulic tank, fuel tank,…), these components must be previously and sufficiently ventilated with pressurized air to avoid all fire or explosion hazard.

**CAUTION**

**Before welding, connect the ground cable as close as possible to the welding point, so the welding current will not run through the swing ring, joints, gears, bushings, rubber parts and seals.**
**In addition the Centry System for the diesel engine must be disconnected before the beginning of the welding operation (disconnect both connectors C5 and C6 on the engine, also refer to the Operation and Maintenance Manual "Centry System" from the CUMMINS Company.**



# DAILY / WEEKLY MAINTENANCE SCHEDULE R 996

| Daily | Weekly | | WORK TO BE PERFORMED<br>O repeat interval<br>☐ first and only interval | Adjustment, Values, Quantities | For description refer to: **OM:** Operation and |
|---|---|---|---|---|---|
| | | | **DIESEL ENGINE & SPLITTERBOX** | | |
| O | O | | Check oil level | | OM 5.13 |
| O | O | | Check coolant level | | OM 5.14 |
| O | O | | Check speed on Rpm gauge | | OM 3.8 |
| O | O | | Check running noises | | |
| O | O | | Check exhaust gas colour | | |
| O | O | | Check engine and external pipework for leaks | | |
| O | O | | Check exhaust connections for leaks. Check oil supply / return pipework for leaks | | |
| O | O | | Empty water separator at fuel filter | | OM 6.4 |
| O | O | | Check for air filters clogging at the restriction indicators | | OM 6.16 |
| O | O | | Check oil pressure and coolant temperature during operation | | OM 3.8 |
| O | O | | Check coupling for leaks | | OM 5.19 |
| | O | | Check oil level in splitterbox | | OM 5.16 |
| | O | | Check condition of the cyclone tubes of the precleaner, clean if necessary | | OM 6.17 |
| | O | | Check air intake hose for condition and leaks | | OM 6.17 |
| | O | | Check and clean radiator core and fan | | OM 6.6 |
| | O | | Check radiator cap for leaks, replace if necessary | | OM 6.6 |
| | O | | Drain fuel tank | | OM 6.4 |
| O | O | | **Daily:** perform a complete “Daily” Maintenance Echelon, as stated in CUMMINS Operating and Maintenance Manual | | |
| | O | | **Weekly:** perform a complete “Weekly” Maintenance Echelon, as stated in CUMMINS Operating and Maintenance Manual | | |
| | | | **HYDRAULIC SYSTEM** | | |
| O | O | | Check oil level in hydraulic tank | | OM 5.22 |
| O | O | | Check hydraulic system for leaks | | OM 6.14 |
| O | O | | Inspect the fastening and the good condition of pipes and hoses for damage and leakage | | OM 6.14 |
| ☐ | O | | Clean magnetic rods in one of the return filters (each week another one) (daily during the first 300 hrs.) | | OM 6.11 |
| ☐ | O | | Clean magnetic rods in leak oil filters (daily during the first 300 hrs.) | | OM 6.11 |
| O | O | | Check hydraulic cylinder rods for leaks and good condition | | OM 6.15 |
| | O | | Inspect, and if necessary clean oil coolers | | OM 6.10 |
| | | | **ELECTRICAL SYSTEM** | | |
| O | O | | Clean and check LCD screen of the display for proper function when starting | | OM 4.4 |
| O | O | | Check indicator lights and gauges on control panel when starting | | OM 4.4 |
| O | O | | Press to open dust discharge valve on air cleaner for cab and electrical boxes | | OM 6.22 |
| | O | | Check head and floodlights, clean if necessary | | OM 3.8 |
| | O | | Visual inspection of wiring system damage | | |
| | | | **AIR SYSTEM** | | |
| O | O | | Check cut in and cut out pressure of air pressure regulator | 6,2 – 7,2 bar | OM 6.4 |
| O | O | | Check hydraulic tank pressurisation | 0,2 – 0,4 bar | |
| | O | | Drain air tanks | | OM 6.5 |

# DAILY / WEEKLY MAINTENANCE SCHEDULE R 996

| Daily | Weekly | | WORK TO BE PERFORMED<br>O repeat interval<br>☐ first and only interval | Adjustment, Values, Quantities | For description refer to: **OM:** Operation and |
|---|---|---|---|---|---|
| | | | **SWING RING** | | |
| O | O | | Check function of swing ring bearing lubrication system during operation | | OM 5.24 |
| O | O | | Check function of swing ring teeth lubrication system during operation | | OM 5.24 |
| O | O | | Check visually the grease delivery (outlet of new grease around the swing ring) | | |
| | | | | | |
| | | | **SWING GEAR** | | |
| O | O | | Check function and operation of swing brake | | OM 4.13 |
| O | O | | Visually check mounting bolts of gear and oil motor | | OM 6.25 |
| O | O | | Check for leaks on swing gears, check oil level in expansion tanks | | OM 5.21 |
| | | | | | |
| | | | **TRAVEL GEARS** | | |
| O | O | | Check for leaks, if gear is leaking, check oil level | | OM 5.20 |
| | O | | Check function and operation of travel brakes | | |
| | | | | | |
| | | | **TRACKS** | | |
| O | O | | Clean track chain (after working) | | OM 6.9 |
| O | O | | Visually check and tighten if necessary mounting screws of side frames | | OM 6.26 |
| O | O | | Check tensioning cylinders, idler, carrier and track rollers for leaks | | OM 6.8 |
| O | O | | Visually check and if necessary tighten screws of sprocket, rollers and chain guides | | OM 6.8 |
| O | O | | Check track chain tension visually | | OM 6.8 |
| | | | | | |
| | | | **CAB, HEATER AND AIR CONDITIONER** | | |
| | O | | Operate air conditioner every week for 10 minutes (during winter) | | OM 6.23 |
| | O | | Visual check condenser unit and evaporator filter | | OM 6.23 |
| | O | | Check refrigerant level, if necessary refill circuit | | OM 6.24 |
| | O | | Check tension of V-belt for air conditioner (behind the cab) | | |
| | | | **UNDER / UPPERCARRIAGE, & ATTACHMENTS** | | |
| O | O | | Check function of working attachment lubrication system during operation | | OM 5.24 |
| O | O | | Check visually the grease delivery at each lube point | | OM 5.24 |
| O | O | | Check bucket teeth visually for wear | | |
| O | O | | The daily maintenance work must include the check of the proper function of hydraulic, electric, pneumatic and brakes systems before starting operation. | | |
| | O | | Visually check and if necessary tighten mounting screws of counterweight, tanks, powerpack, control valve console, cab, catwalks, grease box, ladder | | OM 6.25 |
| | O | | Check fastening of pin covers | | |
| | O | | Check fastening of hoses and pipe clips | | |
| | O | | Check level in reservoir for windshield washer, refill if necessary | 75 l. (19,8 Gal.) | |
| | | | **CENTRALIZED LUBRICATION SYSTEM** | | |
| O | O | | **Daily:** perform a complete daily maintenance as stated on page 996_118a.4a | | OM 5.24 |
| | O | | **Weekly:** perform a complete weekly maintenance as stated on page 996_118a.4a | | OM 5.24 |

# MAINTENANCE SCHEDULE R 996

| At delivery | At 250, 750 hrs | At 500, 1500 hrs | At 1000, 3000 hrs | At 2000, 4000 hrs | At 7500, 15000 hrs | WORK TO BE PERFORMED<br>○ repeat interval<br>☐ first and only interval | Adjustment, Values, Quantities in liters (US Gal.) | For description refer to: **OM:** |
|---|---|---|---|---|---|---|---|---|
| ○ | ○ | ○ | ○ | ○ | ○ | Perform all checks and works in the daily / weekly maintenance schedule | | |
| | | | | | | **DIESEL ENGINE & SPLITTERBOX** | | |
| | | | ○ | ○ | | Check the tightness of all screws and bolts on splitterbox | | OM 5.16 |
| | ☐ | | | ○ | | Replace oil in splitterbox | 2×80 (2×21) | OM 5.16 |
| | | | | ○ | | Check mounting screws of engine and splitterbox for tightness | | OM 6.6 |
| | | | ☐ | ○ | | Check the engine rubber buffers (replace if necessary and at least every 10000 hours) | | OM 6.7 |
| | | | ○ | ○ | | Replace oil in elastic coupling | | OM 5.19 |
| | | | | | | Replace primary element of air cleaner (if necessary or once a year) | | OM 6.17 |
| | | | | | | Replace safety element of air cleaner (if necessary or once a year) | | OM 6.17 |
| | | | | | | | | |
| | | | | | | **Every 250 hours or 6 months**, perform a complete “250 hrs” Maintenance Echelon, as stated in CUMMINS Operation and Maintenance Manual | | |
| | | | | | | **Every 1500 hours or yearly**, perform a complete “1500 hrs” Maintenance Echelon, as stated in CUMMINS Operation and Maintenance Manual | | |
| | | | | | | **Every 6000 hours or 2 years**, perform a complete “6000 hrs” Maintenance Echelon, as stated in CUMMINS Operation and Maintenance Manual | | |
| | | | | | | **Every 20000 hours**, perform a complete “20000 hrs” Maintenance Echelon, as stated in Geislinger (coupling manufacturer) Manual | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | **HYDRAULIC SYSTEM** | | |
| | | ☐ | ○ | ○ | | Change elements of pump bearings lubrication filter (first after 500 hrs) | | OM 6.12 |
| | | ☐ | ○ | ○ | | Change servo filter elements (first after 500 hrs) | | OM 6.12 |
| | | ☐ | ○ | ○ | | Change swing pumps replenishing oil filter elements (first after 500 hrs) | | OM 6.12 |
| | | ☐ | ○ | ○ | | Change filter element of leakage oil filters (first after 500 hrs) | | OM 6.11 |
| | | ☐ | ○ | ○ | | Change filter element of return filters (first after 500 hrs) | | OM 6.11 |
| | | ☐ | ○ | ○ | | Check mounting of components (pumps, motors, clamps,…) | | OM 6.24 |
| ○ | | | ○ | ○ | | Check and adjust primary and secondary pressure relief valves | | |
| | | | | ○ | | Replace hydraulic oil | 6000 (1590) | OM 5.23 |
| | | | | ○ | | Visually check the cooling fan blades, replace if necessary | | |
| | | | | | | Bleed servo system and hydraulic pumps (as necessary) | | OM 6.14 |
| | | | | | | Clean high pressure filters (as necessary) | | OM 6.13 |
| | | | | | | | | |
| | | | | | | **CENTRALIZED LUBRICATION SYSTEM** | | |
| | | | ○ | ○ | | **Every 1000 hours**, perform a complete 1000 hrs Maintenance Echelon as stated on page 996_118a.4a | | OM 6.24 |
| | | | | | ○ | **Every 7500 hours**, perform a complete 7500 hrs Maintenance Echelon as stated on page 996_118a.4a | | OM 6.24 |
| | | | | | | | | |
| | | | | | | | | |

# MAINTENANCE SCHEDULE R 996

| At delivery | At 250, 750 hrs | At 500, 1500 hrs | At 1000, 3000 hrs | At 2000, 4000 hrs | At 7500, 15000 ... hrs | WORK TO BE PERFORMED<br>○ repeat interval<br>□ first and only interval | Adjustment, Values, Quantities in liters (US Gal.) | For description refer to: **OM:** |
|---|---|---|---|---|---|---|---|---|
| | | | | | | **ELECTRICAL SYSTEM** | | |
| | | ○ | ○ | ○ | | Check level and specific gravity of the electrolyte in the batteries | | |
| | | | ○ | ○ | | Check and clean battery terminals | | OM 6.18 |
| | | | | | | **AIR SYSTEM** | | |
| | | | | ○ | | Replace filter cartridge of air dryers | | OM 6.5 |
| | | | | | | | | |
| | | | | | | **SWING RING** | | |
| | | | □ | ○ | | Check and if necessary tighten mounting screws | | OM 6.25 |
| | | | □ | ○ | | Check pinion gear mesh | | |
| | | | □ | ○ | | Check axial play of swing ring | | |
| | | | | | | **SWING GEAR** | | |
| | | □ | ○ | ○ | | Replace gear oil (first at 500 hrs) | 4×38 (10) | OM 5.21 |
| | | | | ○ | | Check mounting screws of gear and oil motor | | OM 6.25 |
| | | | | | | **TRAVEL GEARS** | | |
| | | | □ | ○ | | Check mounting screws of gears, sprocket wheels and oil motors | | OM 6.9 |
| | | | □ | ○ | | Replace gear oil (first at 1000 hrs) | 2×200 (53) | OM 5.20 |
| | | | | | | **TRACKS** | | |
| | | | □ | ○ | | Check tightening torque of screws of rollers, pin locking screws and chain guides | | OM 6.8 |
| | | | □ | ○ | | Check tightening torque of side frames screws | | OM 6.26 |
| | | | | | | **Every 5000 hours,** change the oil in the track and carrier rollers | | |
| | | | | | | **CAB, HEATER AND AIR CONDITIONER** | | |
| | | | ○ | ○ | | Check locks and hinges on doors and windows (lubricate if necessary) | | |
| | | | | ○ | | Check heater for leaks, heat exchanger and heater filter | | |
| | | | | | ○ | Replace the filter / drier (at least every two years) | | |
| | | | | | | Yearly check condition of the refrigerant receiver, if necessary replace it | | |
| | | | | | | Replace main element on air cleaners (at least once a year) | | OM 6.22 |
| | | | | | | Replace safety element on air cleaners after 3 services of main element | | OM 6.22 |
| | | | | | | Lubricate all door seals with silicone or talc (before cold season) | | |
| | | | | | | | | |
| | | | | | | **UNDER / UPPERCARRIAGE, & ATTACHMENTS** | | |
| | ○ | ○ | ○ | ○ | | Check all parts for cracks | | |
| | | | ○ | ○ | | Check and lubricate cover hinges and locks | | |
| | | | | ○ | | Check tightening of mounting screws for counterweight, tanks, powerpack, control valve console, cab, catwalks, grease box, ladder | | OM 6.25 |
| ○ | | | | | | Explain proper use and maintenance to the operator | | |
| | | | | | | | | |
| | | | | | | | | |

# 7. TRAVELLING PROCEDURES FOR MINING MACHINE

The life expectancy of undercarriage components is based on standard working conditions with a maximum travel ratio of 5% per service meter unit. Working and l or travelling on uneven ground and l or abrasive material will influence the lifetime of the components and attract additional cost for the undercarriage components.

In general travel action has to be kept to the lowest level that is possible. Minimise travelling with turning through a narrow turning circle and long distance travel.

To minimise the travel ratio, professional mine planning with long front winning sections is preferred. If digging operations at various spots are necessary, a proper short term and long term plan of winning operations has to be employed to guarantee long term use of the excavator at one place before moving to another location.

However, if frequent machine movement is necessary, the following set of procedures defined by LIEBHERR to minimise possible machine damage, downtime and wear have to be taken into consideration.

**General**

In order to move the machine forwards: with the excavator in standard forward position, depress travel pedals all the way forward with the toes. Direction of travel is in the direction of idlers.
In order to move the machine backwards: with the excavator in standard forward position, depress travel pedals all the way down with the heels. Direction of travel is in the direction of the drive sprockets.

**Moving the machine during loading operations**

Moving the machine during loading operations means adjustment of excavator digging and l or truck loading position of some meters.

Important procedures:
- Before moving the machine, empty the bucket and close up the attachment to a position as close as possible to the excavator undercarriage.
- The practice of placing the attachment on the ground and lifting the machine, then counter turning the undercarriage, is not allowed, because it could cause premature structural damage to the machine
- If there is a build up of material around the tracks where the machine will not turn, you must move the machine several meters forwards and l or backwards and attempt to turn again.
- If mine safety regulations allow, the operator can use the swing function to assist in turning the tracks, i.e. if turning to the right, swing upper deck to the left and vice versa.

**Walking the machine over distance**

Walking the machine distances means any movement of the machine of more than 100m or for a time period longer than 3 minutes, whatever comes first.
In addition to above mentioned guidelines, when moving the machine during loading operations, the following procedures apply:

- It is required to have somebody standby with a heat gun, to monitor the temperature of the drive components, including the track and carrier rollers.
- If temperature of any moving part is growing up about 20°C above ambient temperature, interrupt travel and only commence again after parts have sufficiently cooled.
- To prevent overheating during travelling or to speed up cooling procedure it is advisable to have a water truck standby, to hose the heating components during travelling or cooling break.
- Move with idler and attachment forwards. Whenever possible, and not to contravene with mine safety regulations, swing whilst travelling to equally load track rollers. However, always ensure that clear forward vision is maintained.

**Travelling the machine down grades or upgrades**

In addition to above mentioned guidelines, when moving the machine during loading operations or when walking the machine distances, the following procedures apply

- When travelling down grades greater than ten percent, it would be better to walk the machine down with the track motors first, i. e. the machine is moved backwards.
- When travelling up an incline, the final drives must be at the rear of the excavator.
- When walking down from a bench, firstly prepare a ramp, making it no more than a 30° slope (machine must be able to walk up unaided). When moving down the ramp never allow the machine to fall down on the attachment. When walking up the ramp never use attachment to assist the movement by pushing with the hydraulic power of the bucket, stick or boom.

**Travelling the machine first time**

The slide bearing (friction bearing) of the track rollers needs some time for running-in. If the bearing becomes hot at an early stage of machine life, this may cause lubrication problems during further life.

Therefore when travelling the machine the first time aside from all above mentioned guidelines it is strongly recommended to move carefully and at reduced speed.

Note: Warranty may become void if failure to recognise and comply with the recommended travel operating procedures, as outlined in this document, is noted.

# 8. OPTIONAL ATTACHMENTS

## USE OF ENVIRONMENTALLY FRIENDLY HYDRAULIC FLUIDS

**General**

If specific applications require that even in the case of accidents or leakage there may be no damage caused to the environment, hydraulic excavators using environmentally friendly hydraulic fluids can be operated.

These lubricants are free of mineral oils, they are water-soluble in every proportion and meet the requirements for biodegradability.

**Never mix them together or with lubricants based on mineral oils.**

The following recommendations state how to proceed when using these biodegradable hydraulic fluids in LIEBHERR earthmoving machines.

**Prescriptions for biodegradable hydraulic fluids**

**When using environmentally friendly hydraulic fluids, we exclusively recommend synthetic ester oils with a viscosity according to ISO VG46.**

**Note**

Due to their limited high temperature stability, vegetable oils cannot be used.

Polyglycols decompose various machine paints and should only be used in special cases. In this instance, the material compatibility in regard to seals, paints, etc .... has to be observed.

Due to the lack of experience with the various products, a "Warranty Declaration" has to be inquired from the Oil Supplier if LIEBHERR earthmoving machines are to be operated with environmentally friendly hydraulic fluids based on synthetic ester upon "customer's demand". The declaration applies for hydraulic components in the case of damage caused by the hydraulic fluid. This "warranty declaration" together with the completely filled out confirmation has to be sent to LIEBHERR.

Fundamentally, the supplier is responsible to maintain the standard of quality, standards and specifications of his product when environmentally friendly products are being used.

In order to avoid misunderstandings, a distinct reference must be made on the hydraulic tank, stating the fluid which the machine is operating with.

**Attention**

Mixing various "environmentally friendly hydraulic fluids" together is prohibited.

The name "synthetic ester" for example does not mean, that all products carrying this name have the same contents. The lack of experience with biodegradable products does not allow a general statement.

**Oil change intervals**

The oil changes in pre-set intervals are not allowed for environmentally friendly hydraulic fluids.

The time for oil change must be determined by oil sample analysis and according to the laboratory reports. See page 5.8.

To take the oil samples, LIEBHERR offers its customers a complete Analysis-Set for Wear Check **Lubrication-Analysis** (Id. No. 7018368), which consists of 6 coded sample containers, 6 sample cover letters, 6 envelopes as well as a 3 mtr. silicon hose. Oil analysis and laboratory report are already included in the price for the set! Furthermore, only with the first command, a hand pump (Id.No. 8145666) or, as an alternative, an extraction valve (Id.No. 7019068) and a high pressure hose for pressure test-point (Id.No. 7002437), will be necessary only once.

Further oil analysis or oil change intervals have to be carried out according to the sample analysis in the laboratory report from Wear Check. The evaluation result has to be sent to LIEBHERR and the customer.

**Oil filters change intervals**
The filters change intervals as stated by LIEBHERR must be adhered to.
Use only Original LIEBHERR Filters. We recommend the use of special "bio oil filters" to reduce the percentage of zinc in the system (see also chart of return filters).

**Water Condensation**
Water Condensation must be drained from the hydraulic tank in regular intervals (drain plug on the tank). It is recommended to do this after the machine was stopped for a longer period of time, for exp. Monday morning.
The percentage of condense water is not allowed to exceed 0,1 wgt.%.

**Changing to environmentally friendly hydraulic fluid**
If machines, which used to operate with mineral oils or other hydraulic fluids, are modified to operate with environmentally friendly hydraulic fluids, it is imperative to observe all LIEBHERR guidelines for modifications. Flushing the system is absolutely necessary to ensure trouble-free operation.

Never install attachments from other machines without strictly adhering to all guidelines for modifications with regards to the interior coating of components (e.g. the hydraulic tank), and the procedure for flushing with flusher oil (to drain the mineral oil, ...).

The percentage of mineral oil, resulting from changing or mixing with other mineral oil based fluids, remaining within the system is not allowed to exceed 2 wgt.%.
**If the changing guidelines stated by LIEBHERR are not adhered to, warranty will be refused in case of damage. In case of a doubt, first obtain these guidelines from your LIEBHERR representative.**
Having changed to environmentally friendly hydraulic fluid or when initially filling the system a reference fresh oil sample must be taken after initial warm-up and sent to the laboratory for analysis. The sample must be taken while the machine is running using pressure test-point valve (Id.No. 7019068) or right after stopping the engine via the breather valve using the vacuum pump.

**Particular precautions**
- When disposing of these fluids make sure that this medium is not treated as a mineral oil, i.e. there are special regulations for the disposal of these fluids in individual countries.
In case you have any questions please contact your representative waste oil recycler.
- When handling the medium simply use gloves and, in case there is a risk of spraying, use safety goggles as well.
Wash your hands before taking a break and at the end of your shift. In case the fluids come into contact with skin, rinse with lots of water; in case of eye contact, rinse with water for 10 to 15 minutes.
- After any fluid is spilled or runs out, wash away any smaller amounts with lots of water; larger amounts must be properly collected and disposed of.
- In case of fire, the usual fire extinguishers may be used (like water vapor, CO2, foam, dry ice extinguishers, ...).
Never aim a stream of water directly at hot, burning material (risk of splattering). Thermal decomposition generates CO and/or CO2.

## PREHEATING OF THE HYDRAULIC EXCAVATOR

The hydraulic excavator can be preheated with an external electric power supply (40kW, 400V, 50Hz).

The preheating must be activated every time the excavator is still standing with external temperature between -30°C and 0°C (week end or service and reparation day).
The excavator must be preheated minimum 2 hours before the start and the utilization of the engine.

The electric power supply must be connected to the excavator through a connector situated in the left catwalk at the top of the rotating ladder (see Fig. 1). At this time and if the switch S176 in the cab elevation is activated, all preheating unit are starting:

Engine cooling water equipment (2×4kW per engine 230V)
Engine oil resistor (2×500W per engine 230V)
Hydraulic oil resistor (2×500W per suction pipe and 4×500W in hydraulic tank 230V)
Splitterbox resistor (2×500W per splitterbox 230V)
Battery heat blanket (10×100W 230V)
Cab preheating unit (2,5kW – 400V)
Electrical box preheater,

The function of the preheaters is monitored and a red light H104 in the cab will light up if a default is detected.
An other light H103 on the control unit alert the operator that the preheating is activated and that the excavator can not be started.

After the preheating, before starting the excavator, cut off the switch S176 in the cab elevation and disconnect the electric power supply.

**Fig. 1**


**Fig. 2**

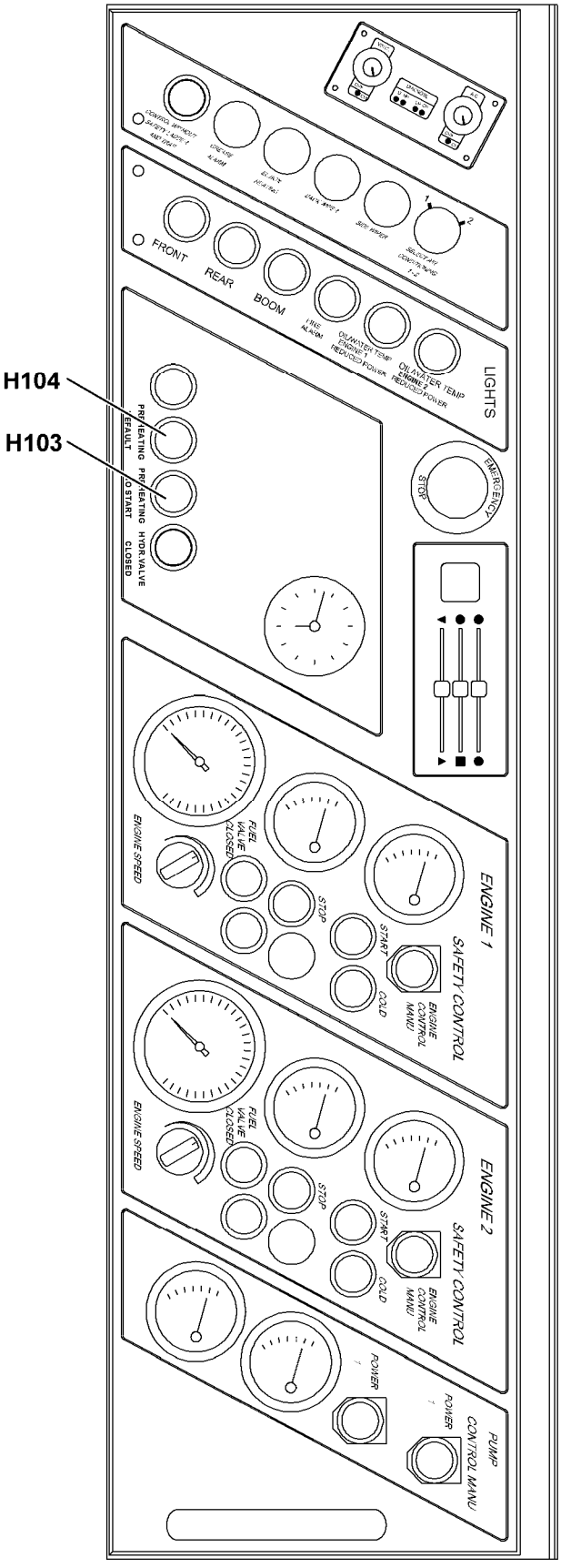

H104
H103
FRONT
REAR
BOOM
LIGHTS
OIL/WATER TEMP
ENGINE 1 REDUCED POWER
EMERGENCY STOP
PRE-HEATING DEFAULT
PRE-HEATING O START
HYDR.VALVE CLOSED
ENGINE 1
SAFETY CONTROL
ENGINE SPEED
FUEL VALVE CLOSED
STOP
START
COLD
ENGINE CONTROL MANU
ENGINE 2
SAFETY CONTROL
ENGINE SPEED
FUEL VALVE CLOSED
STOP
START
COLD
ENGINE CONTROL MANU
POWER
POWER
PUMP CONTROL MANU

Fig. 3

## WINTER POSITION OF AIR FILTER

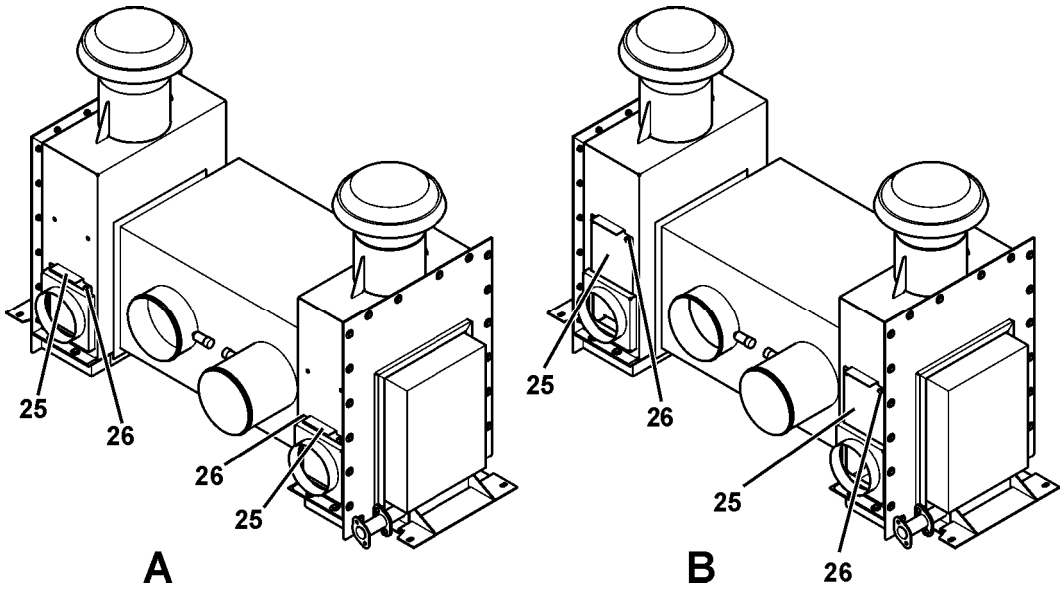
Before starting the engine at ambient temperature below 0°C, the air inlet of the engine air filter must be switched in winter position B.

**Summer position A:**

The cover 25 is on bottom position, fresh air comes exclusively from outside.

**Winter position B:**

Unscrew the screws pos 26.
Move up cover 25 and install the screws 26 on top position.
The air is a mixture between outside air and powerpack compartment air (warmed up).



# LUBRICANTS SPECIFICATIONS FOR –40°C

**Engine oil**
See Cummins Operation and Maintenance Manual.

First filling: BP Vanellus Ultima 5W30, Ident-Nr. 10287072 (20L), Ident-Nr. 10287073 (60L) from -40°C until +30°C (with preheating for -50° C excavator able).

**Hydraulic oil Avia Synthofluid PE-B 30 from -50°C until +40°C**

Ident-Nr. 10115282 drum 210 Liter.

**Gear oil: SAE 75W90 API GL5 : Purpoint < -54°C**

Like BP gear oil SHXM 75W90

- Ident-Nr. 8503299, drum 60 Liter
- Ident-Nr. 10033025, drum 208 Liter

from -50 °C until +40°C

Like AVIA Gear oil Synthogear FE 75W90 EP from -50°C until +40°C

**Grease: general lubepoint**

- Grease BP Energrease SY-HT2 from -40°c until +60 °C
  - Ident-Nr. 10013544 container 45 Kg
  - Ident-Nr. 10013547 drum 165 Kg

- Grease BP Energrease SY PM Drum 165 Kg from -30°C until +30°C, Ident-Nr. 850373l
- Grease BP Energrease SY PM Drum 45 Kg from -30°C until +30°C, Ident-Nr. 10279983
- Grease Avia Avilub Synthogrease PE-T1 from -50°C until +20°C
- Grease Avia Avilub Synthogrease PE-T2 from -40 °C until +60 °C, Ident-Nr. 10286656, Drum 180 Kg
- Grease Liebherr Spezialfett 1026 LS, Ident-Nr. 10113698, Drum 180 Kg from -30°C until +60°C.

- Grease Petro-Canada Multiflex Moly EP1 from -50°C until +20°C

- Fuchs Urethym HGO from -55°C until 0°C

**Grease for swing ring teeth**

Grease Avia : AVILUB PE-FK 50 VKA 5500N :

- Ident-Nr. 10113703 container 50 Kg
- Ident-Nr. 10113706 Drum 180 Kg

from -50°C until +20 °C

Grease Petro-Canada Vulcan Synthetic Arctic from -55°C until -20°C

## FIRE SUPPRESSION SYSTEM

The maintenance of the fire suppression system must only be done by the system supplier or the system dealer.
The maintenance intervals must be strictly observed.