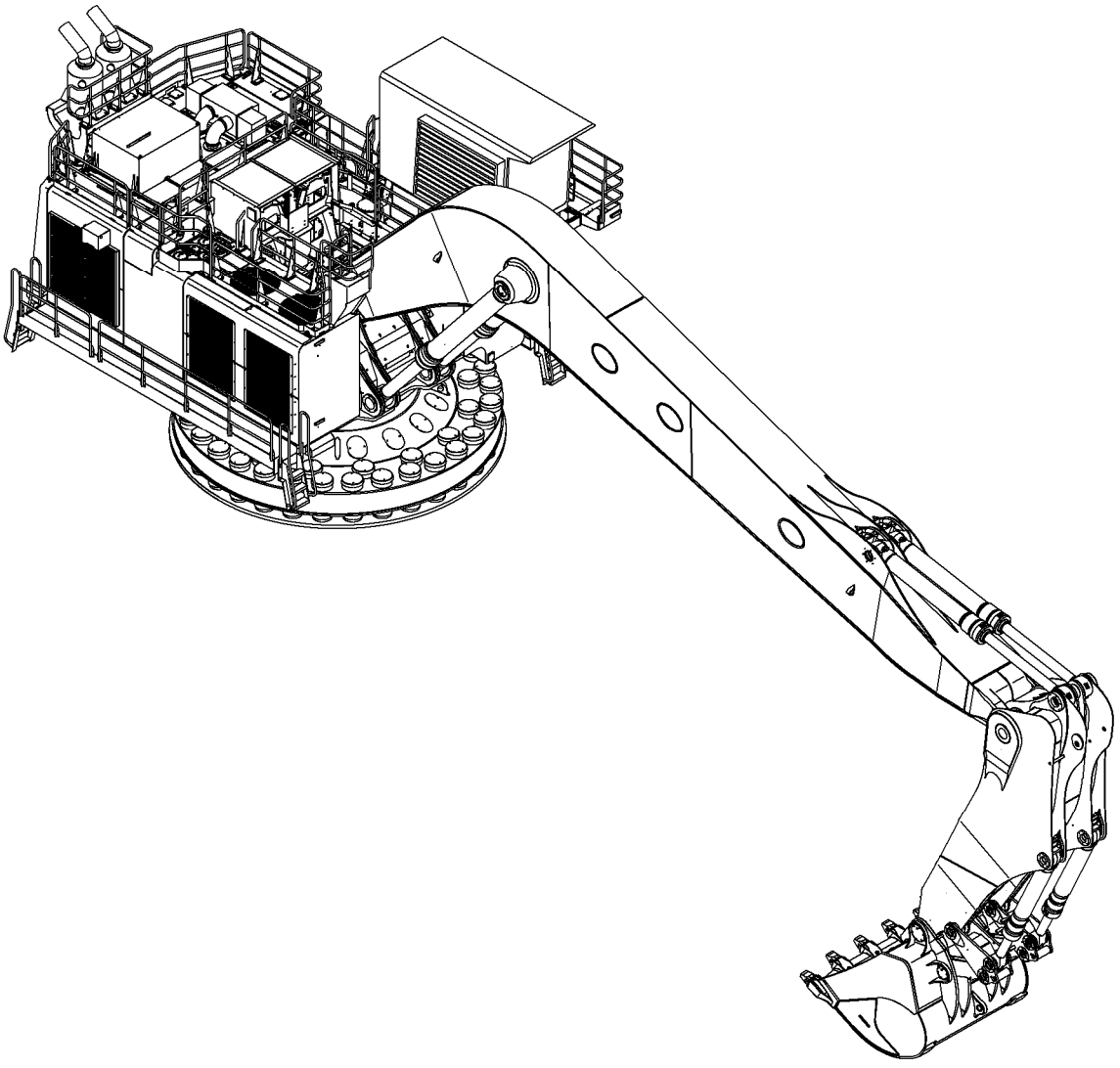
Operation and Maintenance Manual

P 994 B

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 P 994 B Litronic

ISSUE : ……. 06 / 05
ID. / NO : ……... 10069663

This Operation and Maintenance Manual is valid for P994 B excavators from the following serial numbers:

TYP	Valid from Serial Number
447	14754

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 2005
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 für 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 994 B
Litronic®

Operating Weight with Backhoe Attachment 296,80 t/654,330 lb
Operating Weight with Shovel Attachment 306,40 t/675,500 lb
Engine Output 1500 HP (1120 kW)
Bucket Capacity 15,30 – 18,00 m³/20.0 – 23.5 cuyd
Shovel capacity 15,30 – 18,00 m³/20.0 – 23.5 cuyd

LIEBHERR

Technical Data

Engine

1 Cummins diesel engine
- Rating per
- SAE J 1995 — 1500 HP (1120 kW) at 1800 RPM
- Model — QSK45
- Type — 12 cylinder turbocharged V-engine
  after-cooler
  two separate water cooling circuits
  direct injection system
- Displacement — 45 l/2745 cu.in
- Bore/Stroke — 159/190 mm/6.26/7.48 in

Engine cooling system — fans driven via hydraulic piston motor
Air cleaner — dry-type air cleaner with pre-cleaner, with automatic dust ejector, primary and safety elements
Fuel tank — 5350 l/1414 gal
Electrical system
- Voltage — 24 V
- Batteries — 6 x 170 Ah/12 V
- Alternator — 24 V/150 Amp

Engine idling — sensor controlled
Electronic engine control system — engine speed sensing over the entire engine RPM range. Provides integration of engine with other machine systems

Hydraulic System

Hydraulic pumps
- for attachment and travel drive — 4 variable flow axial piston pumps
- Max. flow — 4 x 754 l/min./4 x 199 gpm
- Max. hydr. pressure — 320 bar/4640 PSI

Hydraulic pump
- for swing drive — 2 reversible swash plate pumps, closed-loop circuit
- Max. flow — 2 x 390 l/min./2 x 103 gpm
- Max. hydr. pressure — 350 bar/5076 PSI

Pump regulation — electro-hydraulic
pressure compensation
flow compensation
automatic oil flow optimizer
Hydraulic tank capacity — 2200 l/581 gal
Hydraulic system capacity — 4200 l/1110 gal
Hydraulic oil filter — filtration of entire return flow, 1 high pressure filter for each main pump
Hydraulic oil cooler — 2 separate coolers, 2 temperature controlled fans driven via hydraulic piston motor

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

Swing Drive

Hydraulic motor — 2 Liebherr axial piston motors
Swing gear — 2 Liebherr planetary reduction gears
Swing ring — Liebherr, sealed triple roller swing ring, internal teeth
Swing speed — 0–3.7 RPM
Swing torque — 1120 kNm
Swing-Holding brake — hydraulically actuated, 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 left side with a hydraulically driven access ladder, catwalks in front of the pumps and in the counterweight, additional emergency ladder in front of the cab

Service Flap

Design — hydraulically actuated service flap, with lighting 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 teeth grease barrel refilling via grease filter
- attachment/swing ring bearing grease barrel refilling via grease filter
- windshield wash 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 right hand side windows, all other windows in tinted safety glass, high pressure windshield-washer system 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 with filter
Controls	joystick levers integrated into armrest of seat
Monitoring	via LCD-Display, data memory
Automatic engine shut off	engine self-controlled shut off
Destroking of main pumps	in case of low hydraulic oil level
Safety functions	aditional gauges with constant display for: engine speed, hourmeter, voltmeter, safety mode for engine speed control and pump regulation

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 planetery reduction gear
Travel speed	0–2,3–3,0 km/h/0–1.45–1.86 mph
Parking brake	spring engaged, hydraulically pressure released wet multi-disc brakes for each travel motor, maintenance-free
Track components	D 12, maintenance-free, forged double grouser pad
Track rollers/ Carrier rollers	9/2
Automatic track tensioner	pressurized hydraulic cylinder with accu-mulator
Transport	undercarriage side frames are removable

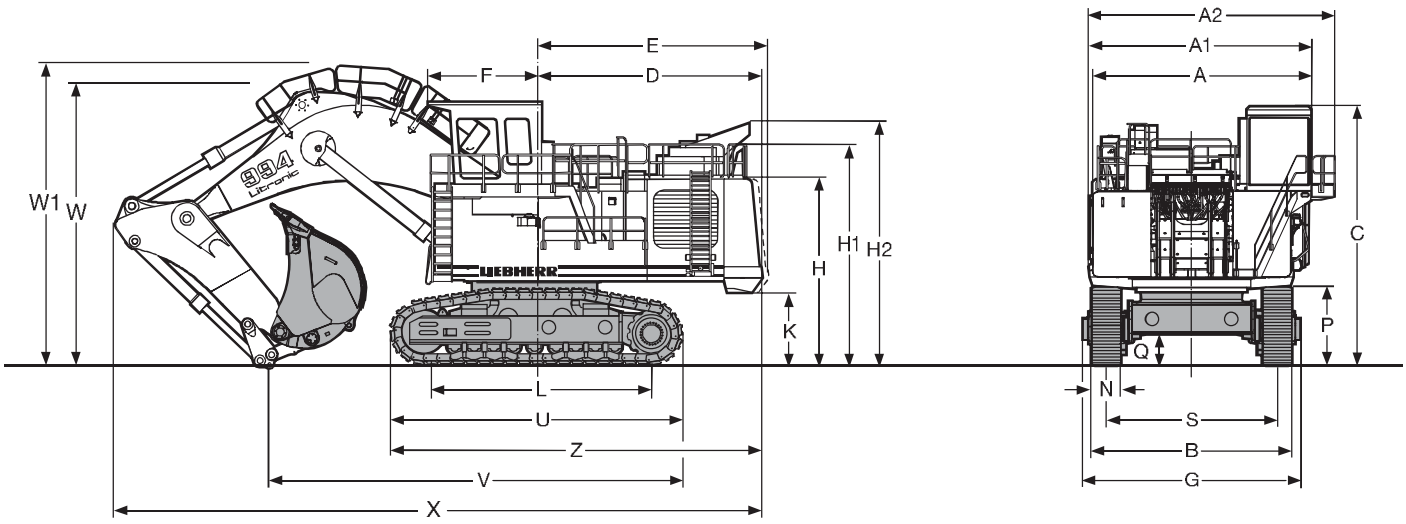
Central Lubrication System

Type	Lincoln Centromatic lubrication system, for the entire attachment and swing ring
Grease pumps	Lincoln Powermaster pump plus separate pump for swing ring teeth
Capacity	200 l/52.8 gal bulk container for attachment and swing ring, separated 80 l/21 gal bulk container for swing ring teeth
Refill	via the service flap for both containers, fill line with grease filters

Attachment

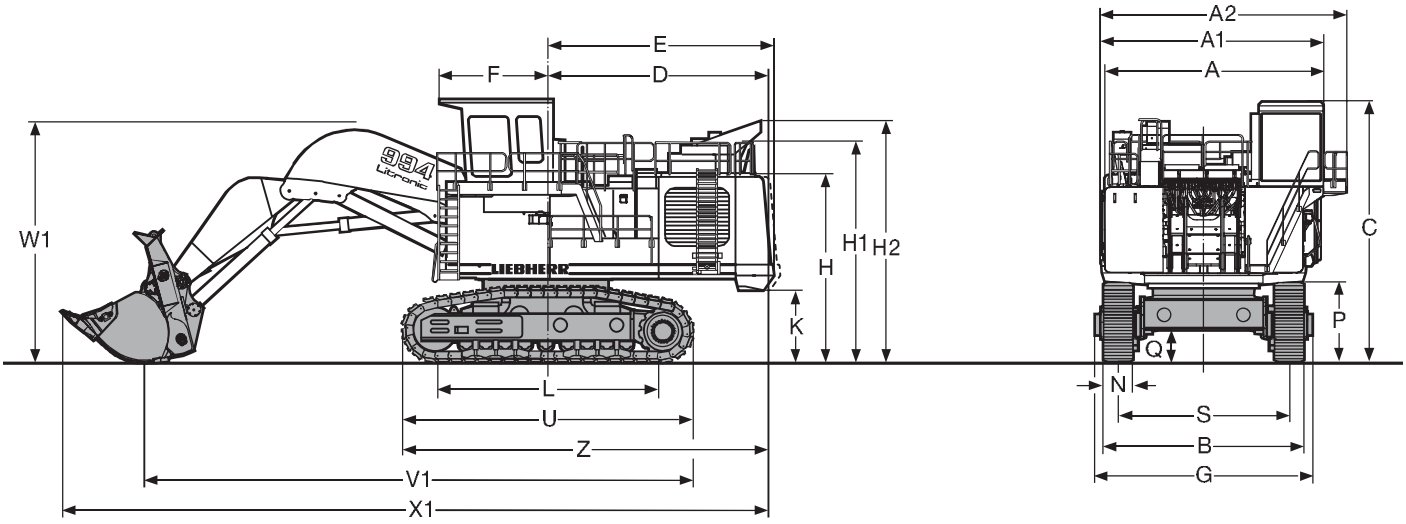
Design	box-type structure with large steel castings in all high-stress areas
Pivots	sealed with double side centering with 1 single floating pin per side, all bearings with wear resistant steel bushings, bolts hardened and chrominium-plated
Hydraulic cylinder	Liebherr design, all cylinders located in well protected areas
Hydraulic connections	pipes and hoses equipped with SAE split-flange connections
Kinematics	Liebherr parallel face shovel attachment geometry, backhoe bucket pivoting angle 160°

Dimensions



	mm/ft-in
A	6390/21’ 0”
A1	6490/21’ 4”
A2	7190/23’ 7”
C	7570/24’10”
D	6360/20’10”
E	6525/21’ 5”
F	3100/10’ 2”
H	5435/17’10”
H1	6455/21’ 2”
H2	6995/22’11”
K	2235/ 7’ 4”
L	6385/20’11”

	mm/ft-in
P	2300/ 7’ 7”
Q	942/ 3’ 1”
S	5000/16’ 5”
U	8250/27’ 1”
Z	10470/34’ 4”
N	850/ 2’ 9”
B	6080/19’11”
G	6340/20’10”
V	11800/38’ 9”
W	8100/26’ 7”
W1	8700/28’ 7”
X	18450/60’ 6”



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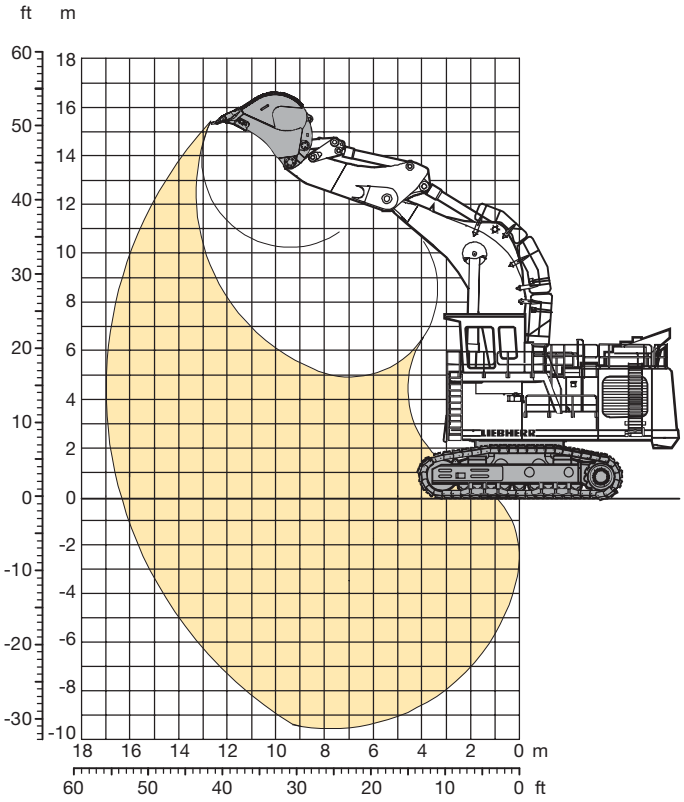
	mm/ft-in
P	2300/ 7’ 7”
Q	942/ 3’ 1”
S	5000/16’ 5”
U	8250/27’ 1”
Z	10470/34’ 4”
N	850/ 2’ 9”
B	6080/19’11”
G	6340/20’10”
V1	15800/51’10”
W1	7100/23’ 4”
X1	20300/66’ 7”

Backhoe Attachment



Digging Envelope

Max. reach at ground level	16,30 m/53'6"
Max. teeth height	15,40 m/50'6"
Max. dump height	10,20 m/33'6"
Max. digging depth	9,50 m/31'2"
Max. digging force	880 kN (89,7 t)/197,750 lb
Max. breakout force	1020 kN (104,0 t)/229,280 lb

Operating Weight and Ground Pressure

The operating weight includes the basic machine with gooseneck boom 9,30 m/30'6", stick 4,20 m/13'9" and bucket 18,00 m^3/ 23.5 cuyd.

Pad width	mm/in	850/34
Weight	kg/lb	296800/654,330
Ground pressure	kg/cm^2/PSI	2,48/35.27

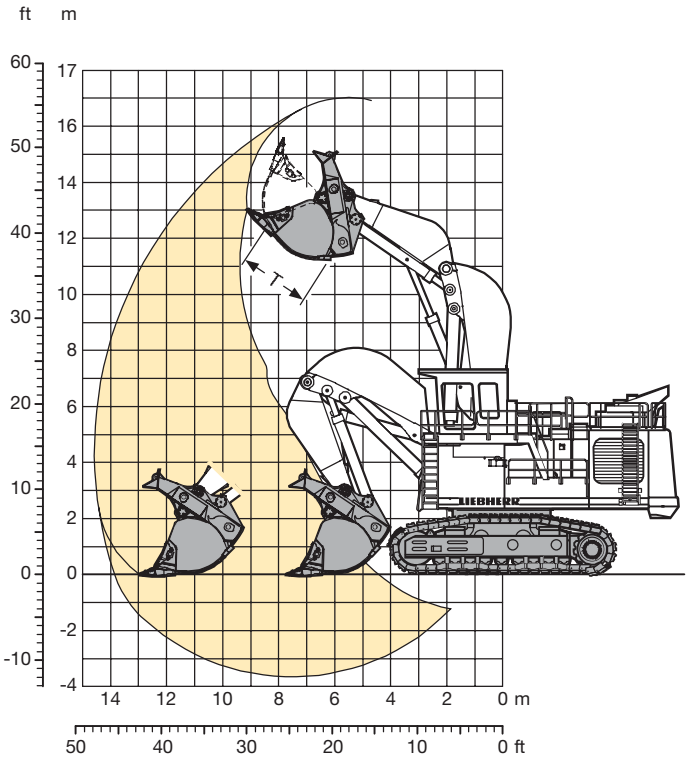
Bucket

Cutting width SAE	mm/in	3400/134[1)]	3400/134[1)]	3400/134[1)]
Capacity SAE heaped	m^3/cuyd	15,30/20	17,00/22.2	18,00/23.5
Weight	kg/lb	17000/37,480	17790/39,220	18155/40,020
Suitable for material up to a specific weight of	t/m^3/lb/cuyd	2,10/3,570	1,90/3,230	1,80/3,000
Wear kit level		II	II	II

[1)] Bucket with delta cutting edge and tooth system Posilok size S 95.
Wear kit level II: For heavy rock, not deteriorated or cracked. Has to be shot to be dug.

Additional buckets on request.

Shovel Attachment



Digging Envelope

Max. reach at ground level	13,75 m/45'1"
Max. dump height	11,20 m/36'9"
Max. crowd length	5,20 m/17'1"
Bucket opening width T	2500 mm/98"
Crowd force at ground level	1040 kN (106,0 t)/233,690 lb
Max. crowd force	1300 kN (132,5 t)/292,110 lb
Max. breakout force	1060 kN (108,0 t)/238,100 lb

Operating Weight and Ground Pressure

The operating weight includes the basic machine with shovel attachment and bucket 18,00 m^3/23.5 cuyd.

Pad width	mm/in	850/34
Weight	kg/lb	306400/675,500
Ground pressure	kg/cm^2/PSI	2,57/36.55

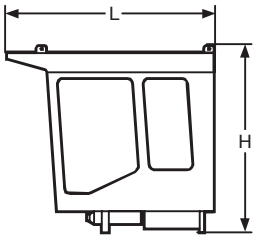
Bottom Dump Bucket

Cutting width SAE	mm/in	4100/161[1)]	4100/161[1)]	4100/161[1)]
Capacity SAE heaped	m^3/cuyd	15,30/20	17,00/22.2	18,00/23.5
Weight	kg/lb	30000/66,140	31000/68,340	31500/69,450
Suitable for material up to a specific weight of	t/m^3/lb/cuyd	2,10/3,570	1,90/3,230	1,80/3,000
Wear kit level		II	II	II

[1)] Bottom dump bucket with delta cutting edge and tooth system Posilok size S 95.
Wear kit level II: For heavy rock, not deteriorated or cracked. Has to be shot to be dug.

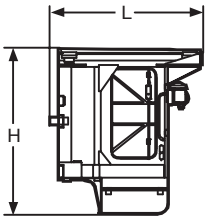
Additional bottom dump buckets on request.

Component Dimensions and Weights



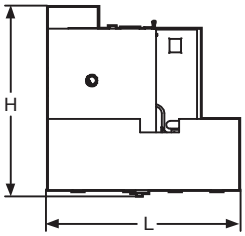
Cab

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	2800/6,170



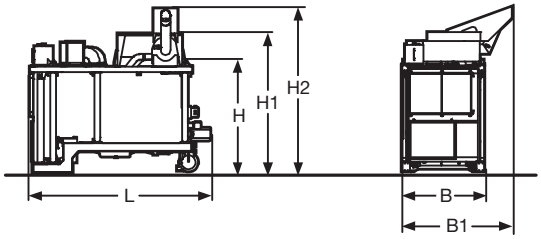
Cab Elevation

L	Length	mm/ft-in	2415/7’11”
H	Height	mm/ft-in	2550/8’ 4”
	Width	mm/ft-in	2500/8’ 2”
	Weigh	kg/lb	3300/7,280



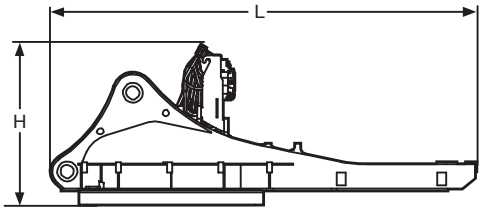
Fuel Tank

L	Length	mm/ft-in	2970/9’9”
H	Height	mm/ft-in	2930/9’7”
	Width	mm/ft-in	2130/7’0”
	Weight	kg/lb	3700/8,160



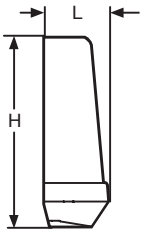
Powerplant

L	Length	mm/ft-in	4800/15’ 9”
H	Height	mm/ft-in	3000/ 9’10”
H1	Height	mm/ft-in	3700/12’ 2”
H2	Height	mm/ft-in	4400/14’ 5”
B	Width	mm/ft-in	2200/ 7’ 3”
B1	Width	mm/ft-in	2950/ 9’ 8”
	Weight	kg/lb	17500/38,580



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

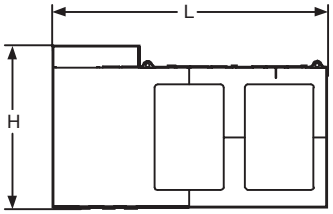
L	Length	mm/ft-in	8070/26’6”
H	Height	mm/ft-in	3882/12’8”
	Width	mm/ft-in	3700/12’2”
	Weight	kg/lb	42700/94,140



Counterweight

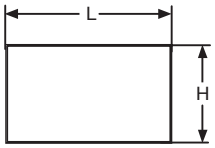
L	Length	mm/ft-in	1100/ 3’7”
H	Height	mm/ft-in	3250/10’8”
	Width	mm/ft-in	6000/19’8”
	Weight	kg/lb	25320/55,820

Component Dimensions and Weights



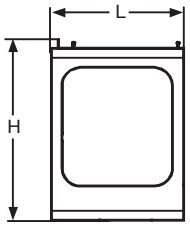
Hydraulic Tank

L	Length	mm/ft-in	4920/16’2”
H	Height	mm/ft-in	2900/ 9’6”
	Width	mm/ft-in	1820/ 6’0”
	Weight	kg/lb	7870/17,350
	Hydraulic oil		
	Weight	kg/lb	4450/9,810



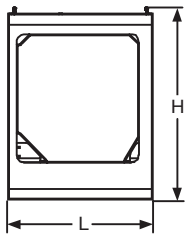
Small Pieces

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	4500/9,920



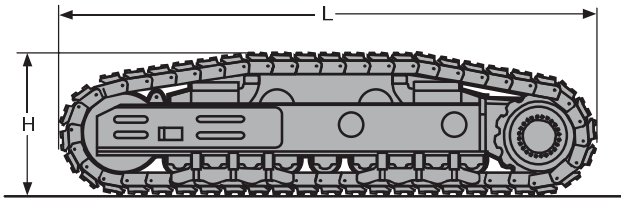
Catwalk Box Left

L	Length	mm/ft-in	2250/7’5”
H	Height	mm/ft-in	2970/9’9”
	Width	mm/ft-in	700/2’4”
	Weight	kg/lb	1900/4,190



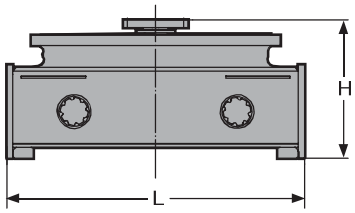
Catwalk Box Right

L	Length	mm/ft-in	2180/7’2”
H	Height	mm/ft-in	2960/9’9”
	Width	mm/ft-in	950/3’1”
	Weight	kg/lb	800/1,760



Side Frame (two)

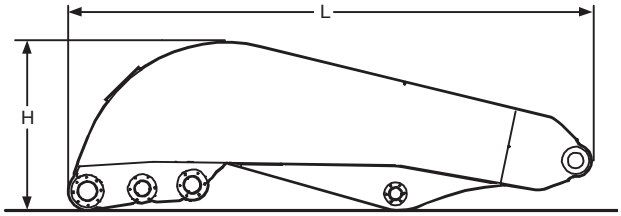
L	Length	mm/ft-in	8250/27’ 1”
H	Height	mm/ft-in	2300/ 7’ 7”
	Width over		
	travel drive	mm/ft-in	2055/ 6’ 9”
	Width without		
	travel drive	mm/ft-in	1485/ 4’10”
	Weight	kg/lb	2 x 41055/2 x 90,510



Undercarriage Central Girder

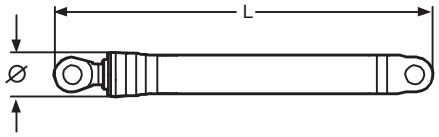
L	Length	mm/ft-in	3670/12’ 0”
H	Height	mm/ft-in	2265/ 7’ 5”
	Width	mm/ft-in	4860/15’11”
	Weight	kg/lb	26000/57,320

Component Dimensions and Weights



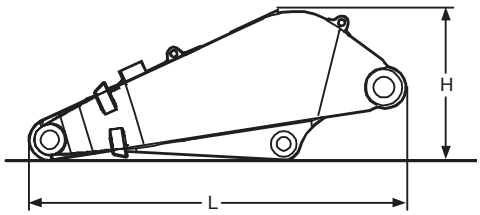
Shovel Boom

L	Length	mm/ft-in	7250/23’ 9”
H	Height	mm/ft-in	2350/ 7’ 9”
	Width	mm/ft-in	2400/ 7’10”
	Weight	kg/lb	25200/55,560



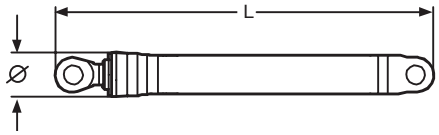
Hoist Cylinder (two) for Shovel Attachment

L	Length	mm/ft-in	4690/15’ 5”
Ø	Diameter	mm/in	550/ 22”
	Weight	kg/lb	2 x 3510/2 x 7,700



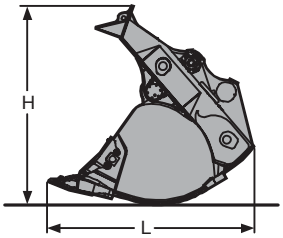
Shovel Stick

L	Length	mm/ft-in	4700/15’5”
H	Height	mm/ft-in	1900/ 6’3”
	Width	mm/ft-in	2250/ 7’5”
	Weight	kg/lb	12750/28,110



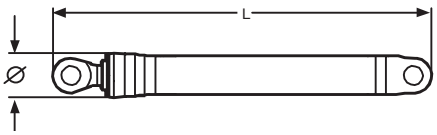
Crowd Cylinder (two)

L	Length	mm/ft-in	3350/11’ 0”
Ø	Diameter	mm/in	400/ 15”
	Weight	kg/lb	2 x 1470/2 x 3,240



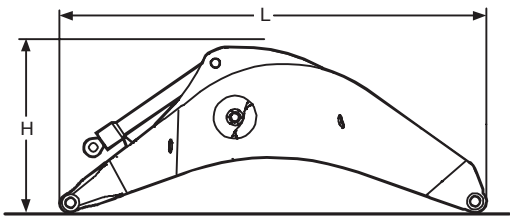
Bottom Dump Bucket

			15,30 m³/ 20.0 cuyd	17,00 m³/ 22.2 cuyd	18,00 m³/ 23.5 cuyd
L	Length	mm/ft-in	3700/12’2”	3900/12’10”	4200/13’9”
H	Height	mm/ft-in	3800/12’6”	3800/12’ 6”	3800/12’6”
	Width	mm/ft-in	4200/13’9”	4200/13’ 9”	4200/13’9”
	Weight	kg/lb	30000/66,000	31000/68,340	31500/69,450



Bucket Tilt Cylinder (two)

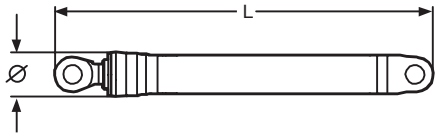
L	Length	mm/ft-in	3950/13’ 0”
Ø	Diameter	mm/in	450/ 18”
	Weight	kg/lb	2 x 2015/2 x 4,440



Gooseneck Boom with Stick Cylinders

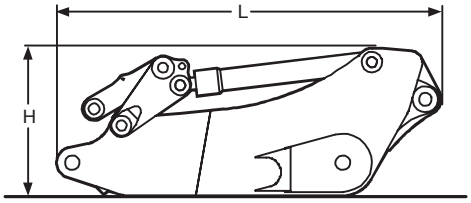
L	Length	mm/ft-in	9800/32’ 2”
H	Height	mm/ft-in	3900/12’10”
	Width	mm/ft-in	2200/ 7’ 3”
	Weight	kg/lb	29300/64,600

Component Dimensions and Weights



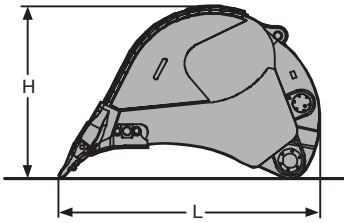
Hoist Cylinders (two) for Backhoe Attachment

L	Length	mm/ft-in	4680/15’ 4”
Ø	Diameter	mm/in	550/ 22”
	Weight	kg/lb	2 x 3700/2 x 8,160



Stick with Bucket Cylinders

L	Length	mm/ft-in	6000/19’ 8”
H	Height	mm/ft-in	2400/ 7’10”
	Width	mm/ft-in	1750/ 5’ 9”
	Weight	kg/lb	18940/41,670



Backhoe Bucket

			15,30 m³/ 20.0 cuyd	17,00 m³/ 22.2 cuyd	18,0 m³/ 23.5 cuyd
L	Length	mm/ft-in	4000/13’ 1”	4000/13’1”	4200/13’9”
H	Height	mm/ft-in	2700/ 8’10”	2800/ 9’2”	2800/ 9’2”
	Width	mm/ft-in	3500/11’ 6”	3500/11’6”	3500/11’6”
	Weight	kg/lb	17000/37,480	17790/39,220	18155/40,020

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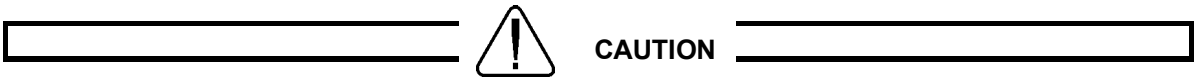
2. SAFETY INFORMATION

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.

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).

NOISE EMISSION

ISO 6396 LpA (inside cab) = 76 dB(A)

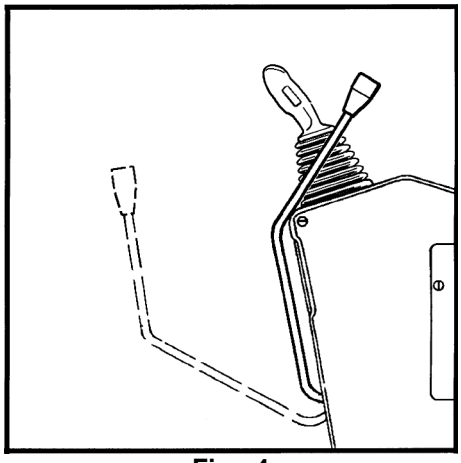


Fig. 4

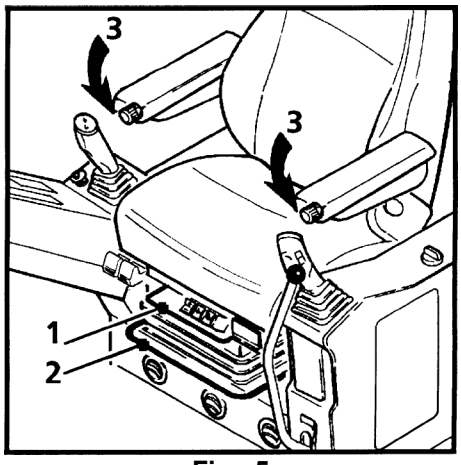


Fig. 5

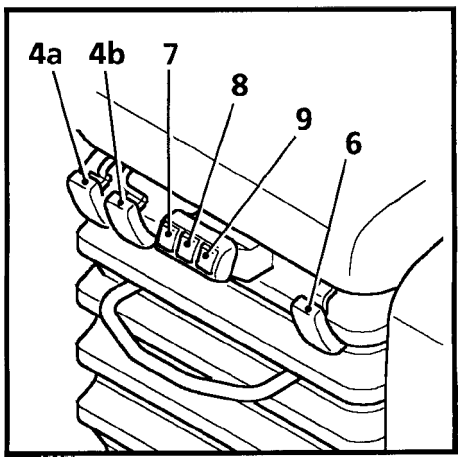
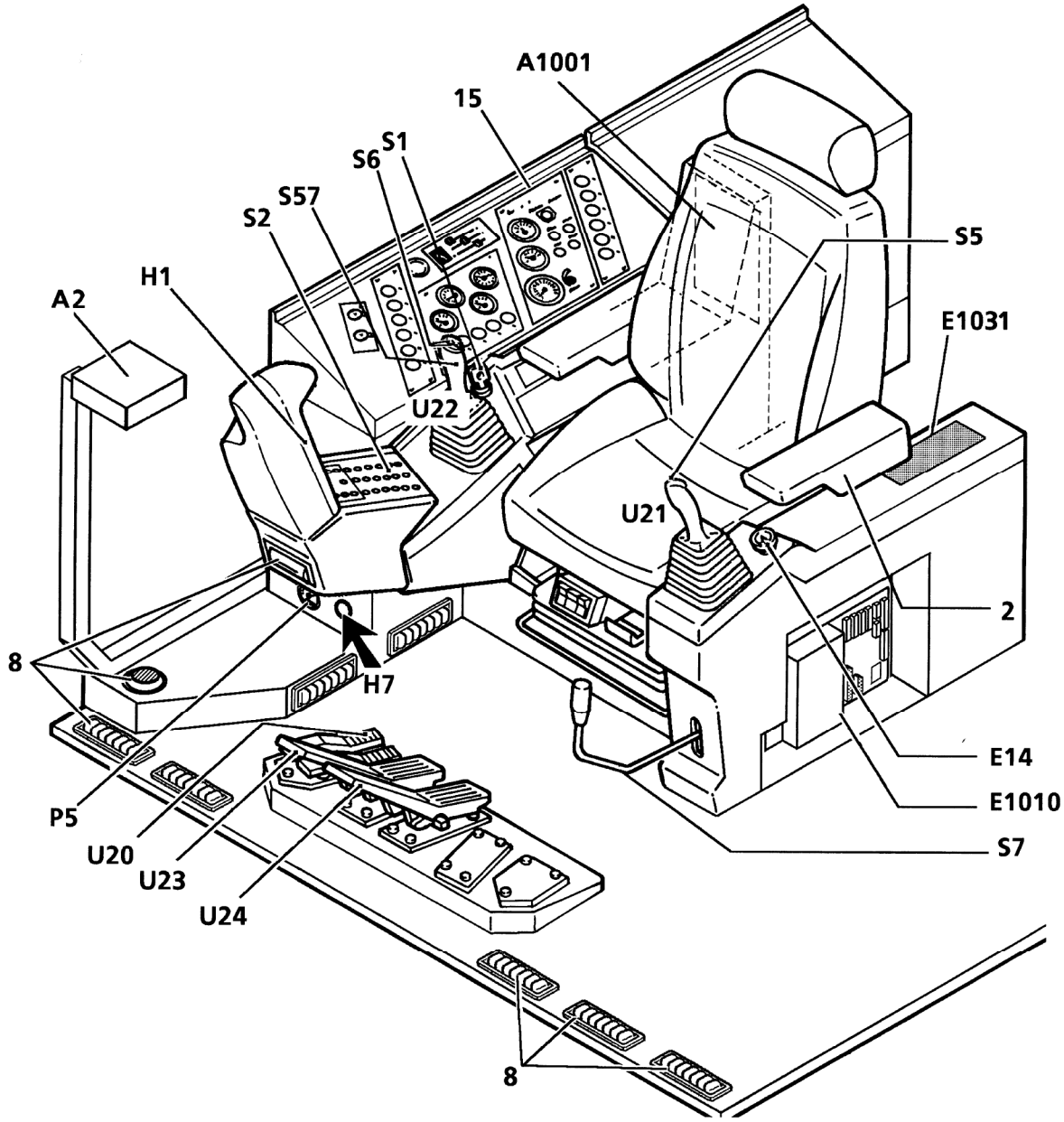


Fig. 6

CONTROLS AND INSTRUMENTATION IN THE CAB



2	Arm rests	S1	„Contact“ key
8	Heater vent	S2	Switching unit
15	Control board for safety operation of engine & hydraulics pumps, control of floodlights, …	S5	Switch / horn
		S6	Switch / float position attachment
		S7	Safety lever / servo control
A2	Radio	S57	Swing brake
A1001	Printplate ESP01	U20	Pedal for bottom dump shovel flap
E14	Cigarette lighter	U21	Left joystick
E1010	Switching box central lubrication	U22	Right joystick
E1031	Central lubrication control	U23	Pedal for right travel gear
H1	Monitoring display	U24	Pedal for left travel gear
H7	Horn		
P5	Hourmeter		

* Optional equipment

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).

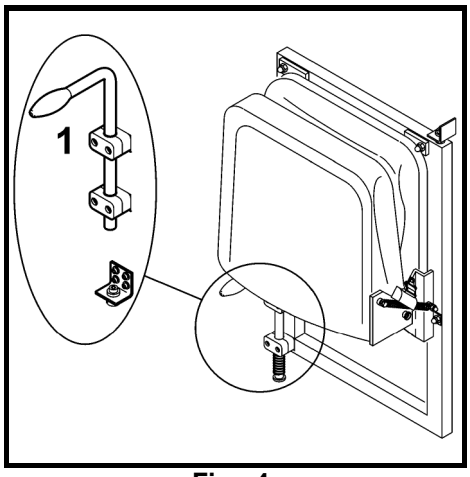


Fig. 4

ADJUSTING OF THE AUXILIARY SEAT

The lever (Fig. 4, 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. 4, 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.

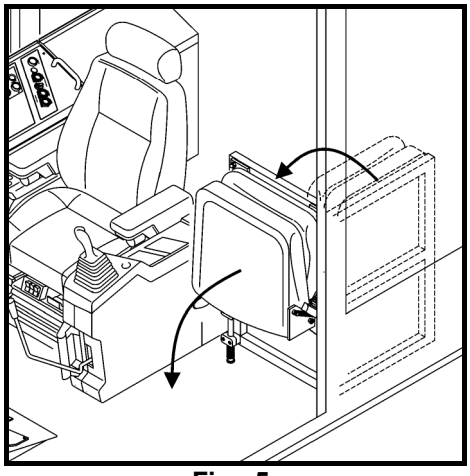


Fig. 5

CONTROL UNIT

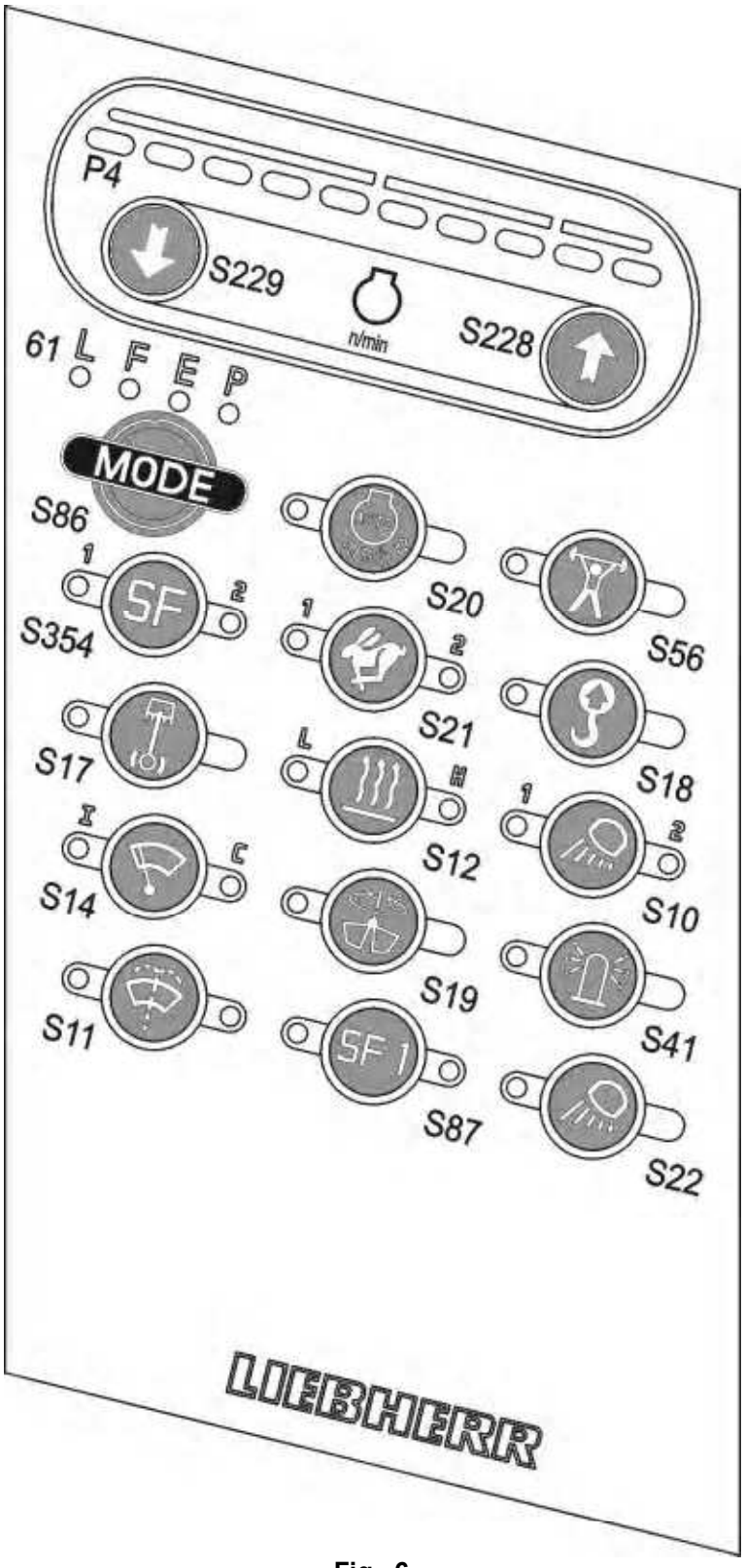


Fig. 6

S86	Operation mode selection
61	LED for mode selection indication

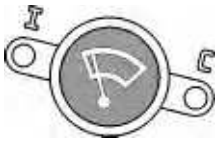
Controls for engine

P4	LED indicator for engine RPM
S10	Attachment floodlight
S11	Windshield washer
S12	Heater blower
S14	Windshield wiper
S17	Swing brake
S18	Not used
S19	Not used
S20	Not used
S21	Not used
S22	Not used
S36	Cold start system
S41	Dome light
S56	Not used
S87	Not used
S228	Engine RPM increase
S229	Engine RPM decrease
S354	Not used

S10 - Floodlights
Depressing the push button will successively:
- turn on the floodlights on the uppercarriage,
- turn on only the working floodlights on attachment,
- turn on all the above floodlights,
- switch off all the above floodlights.

S11 - Windshield washer

S12 - Heater
When depressing this push button, the heater fan will be successively switched to stage 1, switched to stage 2, turned off, ... etc.



S14 - Windshield wiper
Depressing the Push button S14 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 S14:
- Select the intermittent mode and keep the button S14 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.

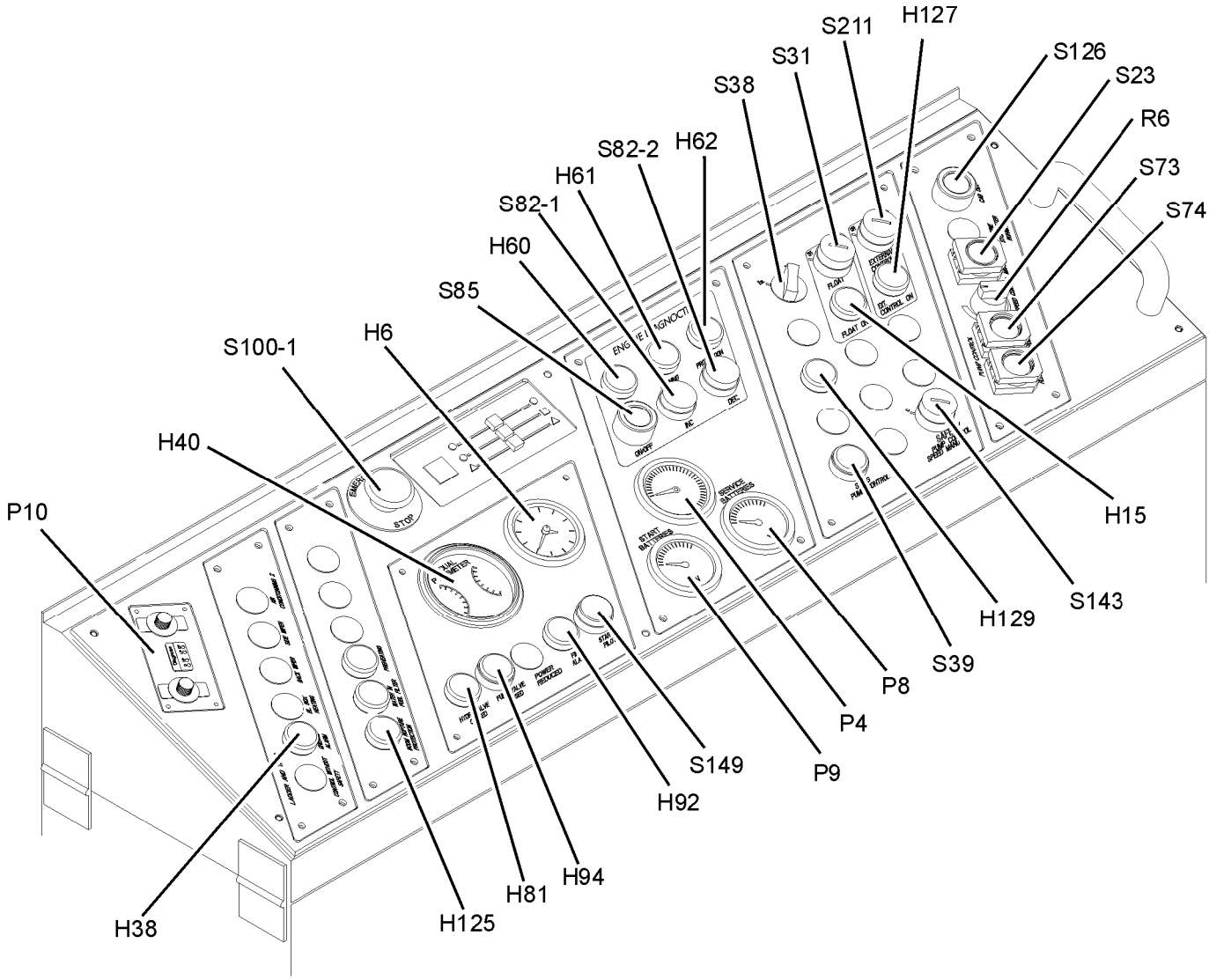
S17 - Swing brake
Pushing the button alternately applies and releases the brake. If the brake is applied, the red diode in the button is on.

S36 - Cold start system
Depressing this impulse switch will improve starting the engine at low temperatures.

S86- Engine speed adjustment with mode pre-selection (see page 4.4-4.5)
Depressing the button S86 causes to change from one mode into the next, in the order L, F, E, P, L, ... and so on.
L (Mode LIFT) = RPM stage 1
F (Mode FINE) -- RPM stage 10
E (Mode ECD) = RPM stage 8
P (Mode POWER) = RPM stage 10

LED indicator P4 for engine RPM
Via this indicator, the engine RPM is displayed. The complete RPM range is divided into 10 stages.

CONTROL BOARD



Indicator lights and gauges

H6	Clock
H15	Float position on
H38	Failure in central lubrication
H40	Pyrometer – Exhaust silencer
H60	Engine monitoring system / Red light stop
H61	Engine monitoring system / Yellow light warning
H62	Engine monitoring system / Red light protection
H81	Supervision hydraulic tank
H92	Fire alarm
H94	Fuel valve closed
H125	Boom rupture protection
H127	External control on
H129	Hydraulic oil level low
P4	Engine-RPM gauge
P8	System voltage / Service Batteries
P9	System voltage / Main Batteries
P10	Air conditioner control

Control switches

R6	RPM adjustment by safety operation
S23	Safety operation for diesel engine
S31	Float position ponton
S38	Servo control commut./excavator-ponton
S39	Inhibition of the uppercarriage swing limitation
S73	Safety operation for working pumps
S74	Flow reduction on working pumps
S82-1	Quantum diagnostic switch – DEC
S82-2	Quantum diagnostic switch – INC
S85	Quantum diagnostic switch – ON/OFF
S100-1	Emergency stop
S126	Floodlight on cab roof
S143	Safety control
S149	Start pilot (cold start)
S211	External control

Dial H6 : clock

Indicator H15 : Lights up if the float position is on

Indicator H38 : Lights up if a failure appears in central lubrication

Indicator H60 (Engine monitoring system / Red light stop) : Lights up when an important fault, which could cause serious engine damages, is detected (see page 3.10).

Indicator H61 (Engine monitoring system / Yellow light warning) : Lights up if another fault, which does not necessitate an immediate engine shutdown, is detected (see page 3.10).

Indicator H62 (Engine monitoring system / Red light protection) : Lights up if any parameter supervised by the system has come out of its normal operation range.

Indicator H81 : Lights up if the hydraulic tank valve is closed.

Indicator H92 : Lights up if a fire is detected.

Indicator H94 : Lights up if the fuel valve is closed

Indicator H125 : Turn off if there is a problem in the boom hose rupture protection.

Indicator H127 : Lights up if the external control is on (S211).

Indicator H129 : Lights up if the hydraulic oil level is low (super mini).

Dial P4 : Engine RPM gauge

Dial P8 : Electrical system voltage (safety circuit)

Dial P9 : Electrical system voltage (main circuit)

Control unit P10 : Control of the air conditioner unit (see page 4.19)

Throttle control knob R6 (see page 4.7) : In emergency operation of diesel engine, the knob R6 is used for the RPM adjustment.

Switch S23: 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.

Switch S31: Use this button to turned the float position on. The indicator H15 light up if the float position is on

Switch S38: Use this button to select the servo circuit to be pressurized (excavator or ponton operation)

Switch S39: For an excavator mounted to a pontoon, the swing angle to the left and to the right may be limited. Use this button for overpassing this maximum angle.

Switch S73: During normal operation of the excavator, the electronic horsepower control continuously adjusts the pumps 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 pump power) by pushing ths switch.

Switch S74 : During safety operation, the pre-set value for the flow of the hydraulic pumps is activated by pushing this button.

Switch S82-1 (Quantum diagnostic switch-INC) : Use this button to see the code of the next error detected by the Quantum system (see page 3.10).

Switch S82-2 (Quantum diagnostic switch-DEC) : Use this button to see the code of the previous error detected by the Quantum system (see page 3.10).

Switch S85 (Quantum diagnostic switch-MASTER): ON/OFF switch of the Quantum system.

Switch S100-1 (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 4 others emergency switches on the excavator: near the engine, near the hydraulic pumps, near the access ladder and on the uppercarriage.

Switch S126: Additional floodlights

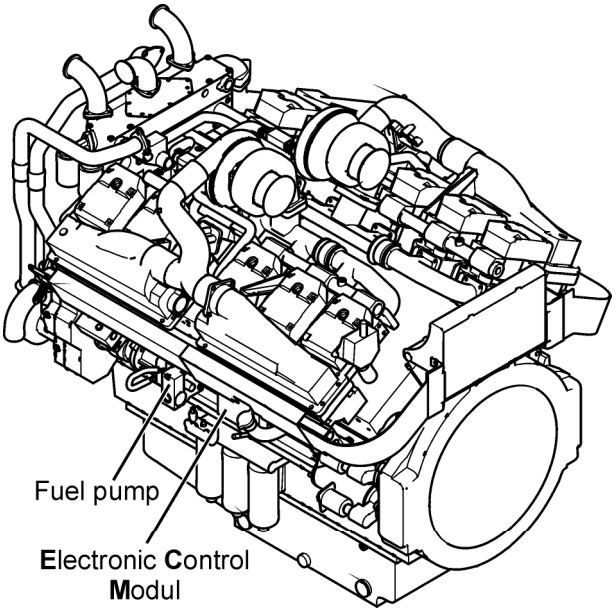
Switch S143: By turning the key, the 3 switches (S23, S73 and S74) are activated or disactivated

Switch S149: Start pilot

Switch S211: External control

MONITORING SYSTEM OF THE DIESEL ENGINE (QSK SYSTEM)

INDICATOR LIGHTS H60, H61 AND H62



All the troubles appearing on the Diesel engine or in its monitoring circuit are centrally indicated via the 3 indicator lights H60, H61 and H62.

These 3 control lights are connected to the ECM (Electronic Control Module) of the QSK system, which is mounted to the engine, next to the fuel pump.

Apart from its monitoring function, the QSK fuel system has been designed to control the engine speed and fuel pressure so to optimise the exhaust emissions.

The red indicator light STOP (H 60) lights up when an important fault which could cause serious engine damage is detected.
If the stoplight comes on while the engine is running, it may be automatically stopped by the monitoring system in case an important trouble is detected.
For the other faults, the monitoring system protects the engine while reducing its power or RPM.
Also in this case the engine has to be brought to low idle and stopped in a safe manner as soon as possible.
Afterwards recognise the detected error(s) using the diagnostic switches S85, S82-1 and 582-2.
Depending on the kind and severity of the recognised trouble, the system may cause automatic engine shutdown, power or speed derating.

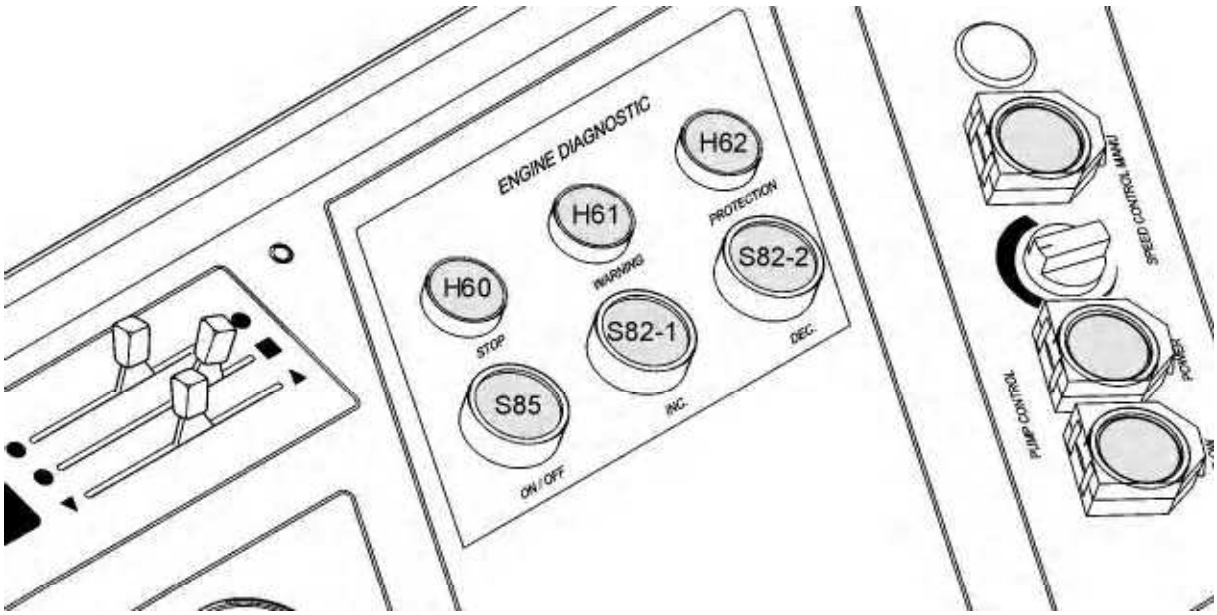
The yellow indicator light WARNING (H 61) indicates an engine error, which does not necessitate an immediate engine shutdown.
Recognise the detected error using the diagnostic switches, after stopping the engine
Get the cause of the problem remedied as soon as is convenient regarding the cause of the problem.
The detected error can result in a power loss.

The red indicator light PROTECTION (H 62) shows that any parameter supervised by the system has come out of its normal operation range.
The engine is automatically stopped by the monitoring system if one of the following troubles is detected:

- Low engine oil pressure
- High coolant temperature
- Low engine coolant pressure
- High intake air manifold temperature

For some other parameters the monitoring system achieves protection by derating the engine speed or the torque correspondingly.
The engine may be kept in operation temporarily, (eventually the engine power is reduced by the monitoring system), the problem must be diagnosed via the switches S85, S82-1 and S82-2.
Automatic torque derate will happen in case one of the following troubles is detected:

- High fuel temperature
- High blowby pressure (= pressure in crankcase housing)
- Low coolant pressure (first stage), also causes speed derate
- Low oil pressure (first stage)
- High coolant temperature (first stage)
- High intake air manifold temperature (first stage)



DIAGNOSTIC SWITCHES S82-1, S82-2 AND S85 FOR ENGINE MONITORING SYSTEM

These switches permit to recognise the faults, which are detected by the engine monitoring system (electronic control module). These faults are connected to the centralised warning lights H60, H61 and H62 of the control desk.

There are two types of fault codes:
- the engine electronic system fault codes which will light up the indicator lights H60 and H61.
- the engine protection system fault codes which will light up the indicator light H62.

All fault codes recorded will either be active (fault code is presently active on the engine) or inactive (fault code was active at some time, but is not presently active).

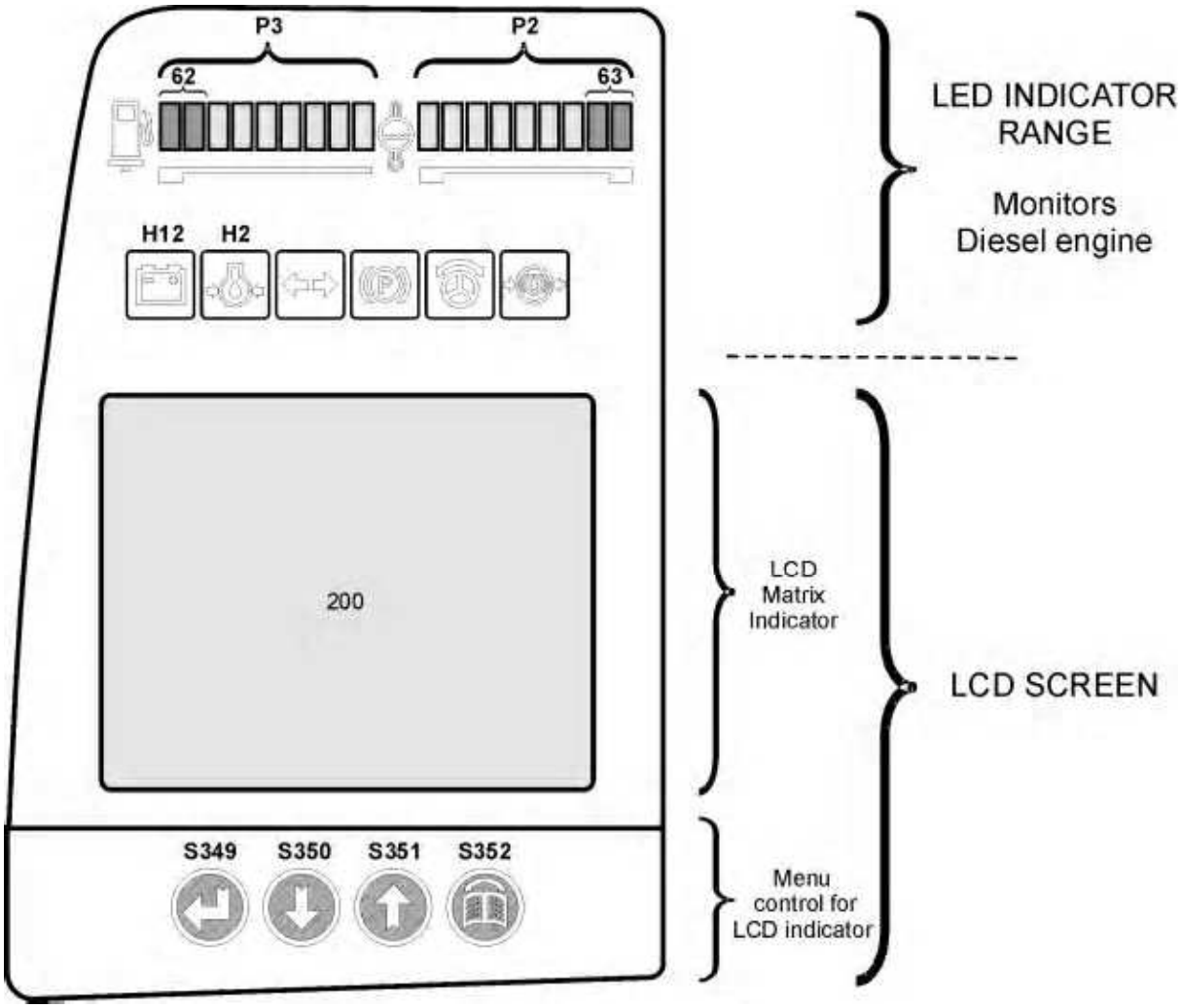
All active fault codes can be diagnosed as described below using both lamps H60 and H61.
Inactive fault codes can only be viewed with the optional equipment "Insite".

Diagnostic of the detected faults using the switches S82-1, S82-2 and S85

If an indicator light H60, H61 and H62 is lighting, proceed as follows to recognise the detected errors:
- turn the ignition key to "OFF" then to "contact" position
- depress the switch S85 to position "ON", the indicator lamp inside the switch lights up.
  If no active fault codes are recorded, all three lights will come on and stay on.
  If active fault codes are recorded, all three lights will come on momentarily and then...
- first the yellow lamp H61 will flash one time
- then the red indicator light H60 will blink, the sequence of blinking corresponds to the code of the error detected by the system. Between two consecutive blinking sequences for indication of the fault code, the yellow light H61 comes on.

Also see the section "Diagnostic fault codes" and the chart for diagnostic fault codes in the Cummins operation and maintenance manual.
- The sequence is repeated as long as the switch S85 remains on "ON" position, the yellow indicator light H61 goes briefly on between two consecutive flashing sequences.
- Remaining errors, which are still detected, can be recognised on the same way, using the switches S82-1and S82-2. Briefly depressing the switch S82-1 "INC" causes the blinking sequence of the error with the code directly above to be displayed on indicator light H60, depressing briefly S82-2 "DEC" will display the error with the code directly below.

MONITORING DISPLAY



LED INDICATOR RANGE

Fuel gauge P3
The LED indicator lights show the fuel level. When the both red LED 62 light up, about 10°/o to ZO°r6 fuel are left in the tank as reserves.

Engine coolant temperature gauge P2
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. Simultaneously, the red indicator protection H62 on the control board will light up (see page 3.10). The QUANTUM system will cause an engine shutdown (See "diagnostic fault codes in the Cummins Operation Maintenance Manual). Locate the reason for the trouble and get it repaired. If a coolant overheat is detected, the error code E503 will be stored on the error statistics (see on page 3.20, menu "i-errors").

Indicator light H2 - 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 H2 lights up and the buzzer will sound to alert the operator that the oil pressure is too low. At the same time, the red indicator protection H62 on the control board will light up (see page 3.10). The QUANTUM System will cause an engine shutdown (See "diagnostic fault codes in the Cummins Operation Maintenance Manual).
Locate the reason for the trouble and get it repaired.
If a low engine oil pressure is detected, the error code E501 will be stored on the error statistics (see on page 3.20, menu "i-errors").

Charge indicator light H12
Indicator light H12 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.

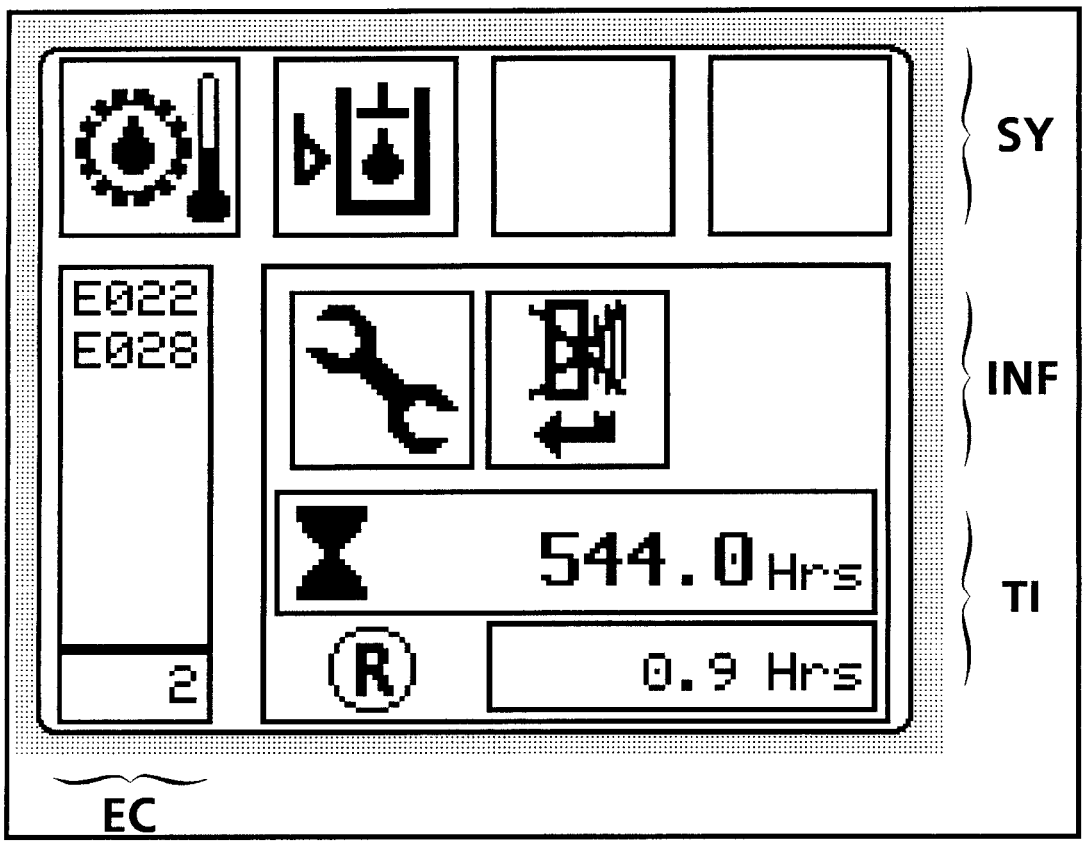
LCD SCREEN

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 S349 "RETURN", S350 "DOWN", S351 "UP” and S352 "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



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.

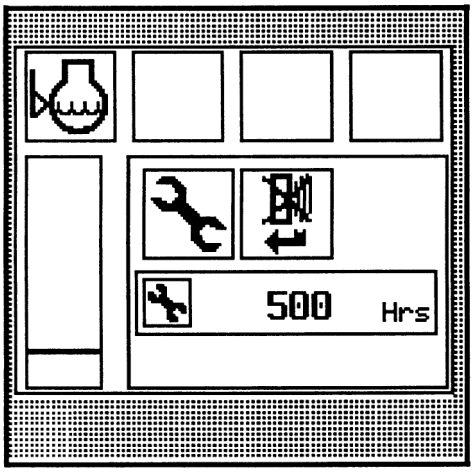
Main screen view (Fig. 45)

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.



INF field:

The INF field on the right hand side of the main screen displays temporary information, also in graphic form.

If more than 3 symbols must be shown, then every 10 seconds, the symbols move to the left by one symbol.

Displays are shown as graphics or text to show actuated flow reduction or emergency operation of Diesel engine or hydraulic pumps.

Fig. 7

TI field:
This field, at the bottom right of the screen displays the main hourmeter and the daily hourmeter of the machine.

The symbol Ⓡ is displayed when a flow limitation is activated for the pumps.

During the display start-up phase, the operator will be alerted about a possible upcoming service interval, by a graphic symbol displayed instead of the machine hourmeter (see example on fig. 48). The recalling of upcoming service interval lights up to about 8 seconds.
Control of the screen at error recognition
In case a new error, displayed in field SY, is recognised, the presentation will return to main screen, and the corresponding symbol is displayed. Depending on the default (urgency step), the buzzer will alert acoustically at the same time, either buzzing in continuous or emitting intermittent sounds.

The symbol  signals that the Buzzer of the control unit is activated.

Using the key ↵, it is possible to quit the defaults indicated by a continuous buzzing.
Symbols for operating errors displayed in field SY
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.


E 501

Low engine oil pressure
(see page 3.13)


E 502

Low coolant level
This symbol appears simultaneously with the red indicator protection H62 (see on pages 3,10 & 3.11) if the coolant level drops below the minimum level. Effect: see Cummins Operation Maintenance Manual. Find and repair the coolant loss. Add coolant until the level is correct (see page 5.14).


E 503

Engine coolant overheat
This symbol appears simultaneously with the lightning of the red LED 63 on the engine coolant temperature gauge P2, see on page 3.12.


E 540

Engine coolant pressure
This symbol appears simultaneously with the red indicator protection H62 (see on pages 3.10 & 3.11) if the coolant pressure is too low. Effect: see Cummins Operation Maintenance Manual. Locate the reason for the trouble and get it repaired.


E 597

Manifold overheat
This symbol appears simultaneously with the red indicator protection H62 (see on pages 3.10 & 3.11) if the manifold temperature is too high (above 104°C=220°F).Effect: see Cummins Operation Maintenance Manual. Locate the reason for the trouble and get it repaired.


E 506

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,...).

E 562

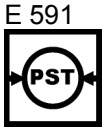
Low oil level in splitterbox
This symbol appears if the oil level drops below the minimum level. Turn the engine off, find and repair a possible leak. Add oil until the oil level is correct (see page 5.16).

E 564

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 591

Splitterbox oil pressure low
This symbol appears if the splitterbox oil pressure drops below 0.2 bar. Stop operation and turn the engine off. Find and correct the problem.



Low servo pressure
This indicator lights up if the servo pressure drops below 20 bar. In that case, the machine can not be controlled properly. Find and correct the problem.

E 504

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 the service flap or via one of the return filters (see page 5.23).

E 505

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 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 566-E568
E 567-E569

Main pumps are contaminated

This symbol appears if metallic particles have been deposited on the contamination switch of one of the main pumps (the pump number appears in the top left corner of the symbol). Stop operation, turn the engine off and notify the maintenance personnel.

E 572-E573

Swing pumps are contaminated

This symbol appears if metallic particles have been deposited on the contamination switch of one of the swing pumps (the pump number appears in the top left corner of the symbol). Stop operation, turn the engine off and notify the maintenance personnel.

E 578-E579
E 580-E581

Main pumps overheat

This symbol appears if the temperature on one of the main pumps increases above 105°C (221°F) (the pump number appears in the top left corner of the symbol).
Turn the engine off, find and correct the problem.

E 584-E585

Swing pumps overheat

This symbol appears if the temperature on one of the swing pumps increases above 105° C (221° F) (the pump number appears in the top left corner of the symbol).
Turn the engine off, find and correct the problem.

E 592

Low oil level in the Centinel System (optional)

This symbol appears if the oil level in the Centinel tank drops below the minimum level. Effect: see Cummins Operation Maintenance Manual. Full the Centinel tank as soon as possible (see page 5.13).

E 593

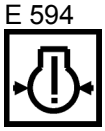
High fuel temperature

This symbol appears simultaneously with the red indicator protection H62 (see on pages 3.10 & 3.11) if the fuel temperature is too high (above 104°C=220°F).Effect: see Cummins Operation Maintenance Manual. Locate the reason for the trouble and get it repaired.

E 594

High fuel rail pressure

This symbol appears simultaneously with the red indicator protection H62 (see on pages 3.10 & 3.11) if the fuel rail pressure exceeds a normal limit. Effect: see Cummins Operation Maintenance Manual. Locate the reason for the trouble and get it repaired.



E 595

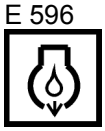
High blow-by pressure

This symbol appears simultaneously with the red indicator protection H62 (see on pages 3.10 & 3.11) if the blow-by pressure exceeds a normal limit. Effect: see Cummins Operation Maintenance Manual. Locate the reason for the trouble and get it repaired.

E 596

Low engine oil level

This symbol appears simultaneously with the red indicator protection H62 (see on pages 3.10 & 3.11) if the engine oil level drops below the minimum level. Effect: see Cummins Operation Maintenance Manual. Full the engine oil tank (see page 5.13).



E 598

Oil change required

This symbol appears simultaneously with the red indicator protection H62 (see on pages 3.10 & 3.11) if an engine oil change is required. Do it as soon as possible (see page 5.13).

ERROR CODES FOR ELECTRICAL ERRORS OF THE ELECTRONIC CONTROL SYSTEM

Detected errors			Error code
ERROR IN THE CIRCUIT OF THE SENSOR WHICH MONITORS	Coolant level B3	Accidental ground	E 004
		Accidental +	E 005
		Broken wire	E 006
	Coolant temperature B2	Accidental ground	E 007
		Accidental	E 008
		Broken wire	E 009
	Hydraulic oil level B14	Accidental ground	E 010
		Accidental +	E 011
		Broken wire	E 012
	Hydraulic oil temperature B67	Accidental ground	E 013
		Accidental +	E 014
		Broken wire	E 015
	Swing speed B53	Accidental ground	E 454
		Accidental +	E 455
		Broken wire	E 455
	Fuel level transmitter B1	Accidental ground	E 456
		Broken wire	E 458
ERROR IN THE REGULATING CIRCUIT FOR	Engine speed B12	Accidental ground	E 022
		Accidental +	E 023
		Broken wire	E 024
	Solenoid valve for flow control Y3.1 EV1	Cable defect	E 036
	Solenoid valve for flow control Y3.2 EV2	Cable defect	E 039
	Solenoid valve for flow control Y3.3 EV3	Cable defect	E 042
	Solenoid valve for power control Y4 LR1	Cable defect	E 027
	Output ventilator water Y10.1	Cable defect	E 033
	Output ventilator oil Y10.2	Cable defect	E 030
OTHERS ERRORS	Coding plug is missing in control unit		E 302
	No CAN 1 Connection between control unit S2 and circuit board BST. (Error detected also if BST is not operative : no power supply, ...)		E 303
	No CAN 2 Connection between control unit and circuit board ESPO1. (Error detected also if ESP01 is not operative)		E 305
	No CAN 2 connection between Control unit and Display or no function of the Control unit		E 308
	No CAN 1 connection on E1036		E 311
	No CAN 1 connection between Control unit and E1036 (connection box pump transmitters)		E 312
	No CAN 1 connection between Control unit and A1020 (FSG plate)		E 313
	BST coding not compatible with control unit coding		E 319
	No CAN 1 connection between E1036 (connection box pump transmitters) and translater J 1939		E 320
	Unknown excavator type from BBT		E 321
	Unknown hardware coding from BST		E 322
DIESEL ERRORS	Diesel engine Quantum error code : see electric scheme step 25A		D .....

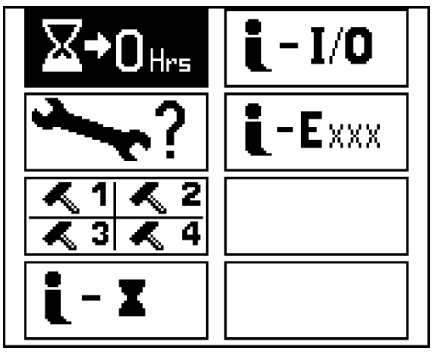
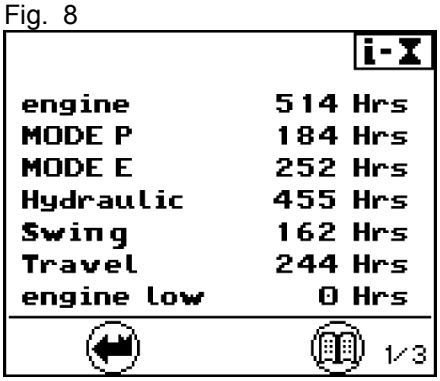


Fig. 8



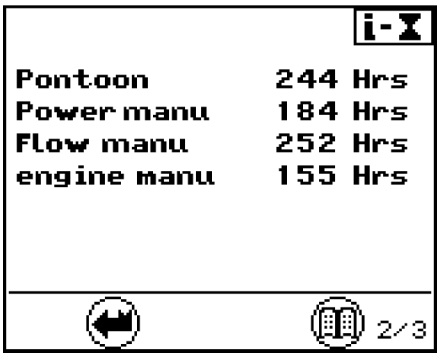


Fig. 9

Fig. 10

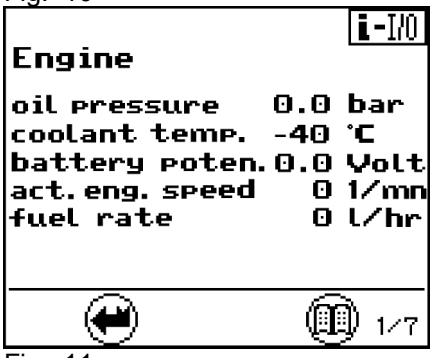


Fig. 11

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. 8).
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. 8 the menu “reset hours” is selected).
When depressing the “MENU” key again, the inverse displayed function is branched out.

MENU i - x (“i-hours”)

Information about operating hours for various components and movements.
The information screens 1 and 2 (see Fig. 9) shows an overview about operating hours for various components, functional flows and operating modes.
As an example, the screen (page 1/3) indicates the operating hours for:
- Diesel engine
- Diesel engine in mode P (RPM stage 10).
- Diesel engine in mode E (RPM stage 8).
- Hydraulic operation.
- Swing movements.
- Travel movements.
- Diesel engine at low idle.

The screen (page 2/3) indicates the operating hours for:
- Pontoon operation.
- Safety operation for pump power control.
- Safety operation for pump flow control.

Manual operation for diesel engine RPM control.

And the screen Fig. 10 gives information about the machine type and serial number and about software version actually mounted to the machine.

These both indications are determined by the position of a coding bridge on the print plate U16 (BST regulator).

The last line provides indication for the instantaneous operating voltage.

MENU i - I/O

a) Information about the engine, information screen Fig. 11.
This screen gives information from the Quantum system of the engine.

b) Information about the hydraulic pumps, information screen Fig. 12 and Fig. 13.
This screen gives information about the operating position of the hydraulic pumps.

The screen 2 (see Fig. 12) gives following indications for each working pump:

- If a flow limitation is activated for the pump. If it occurs, the symbol “R” is displayed in the field TI, see main screen.
  The Fig. 12 shows an example with the flow limitation M1 activated, which limits the pump P1 to 34% of the maximum flow. Should several flow limitations be actuated at the same time, so the one with the smallest flow value has priority.

- The graphic bar with electric current value indicates for the pump the amount of the momentary flow control signal.

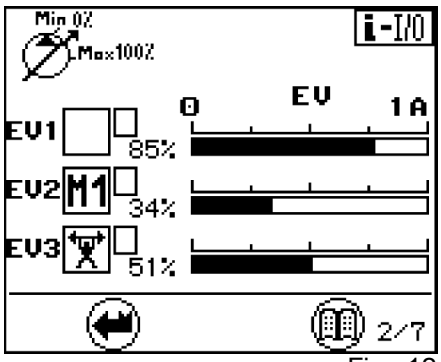


Fig. 12

The present LR solenoid current (current value for power control) is showed on screen 3 (see Fig. 13).

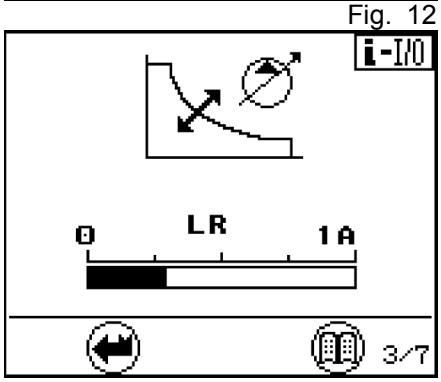


Fig. 13

c) Information about the fans

The screen 4 (see Fig. 14) indicates for the fan pumps the amount of the momentary flow control signal.

d) Information about the status of input terminals – information screens 5, 6 and 7
(see Fig. 15, Fig. 16 and Fig. 17)

This screen shows an overview about the status of different electrical inputs.

The sign “☐“ means “input not active”.
The sign “■“ means “input active”.

The indication “NC” under the terminal description means that the corresponding input is deactivated in the software.

The status of the inputs can be changed using the menu “set data” – “set E-code”.

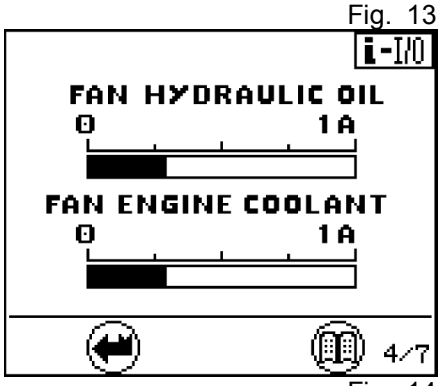


Fig. 14

The screen 5 (Fig. 15) indicates the status of the inputs for the different movements.

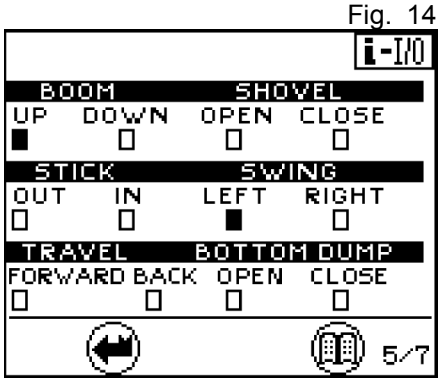


Fig. 15

The screen 6 (Fig. 16) indicates the status of the flow limitation. M1,M2,… correspond to machine specific (internal) oil flow limitations. I1, I2, … corresponds to predefined oil flow limitations (see also menu “set option”).

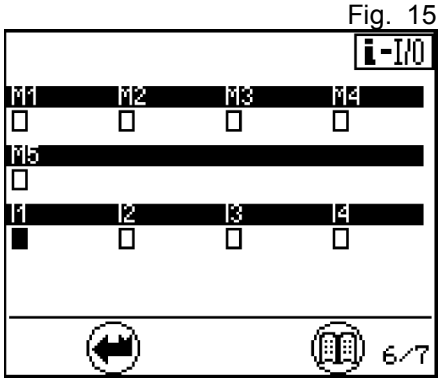


Fig. 16

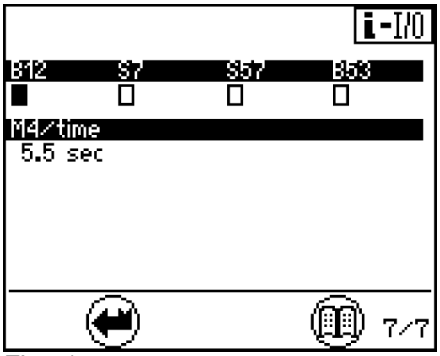


Fig. 17

Fig. 18

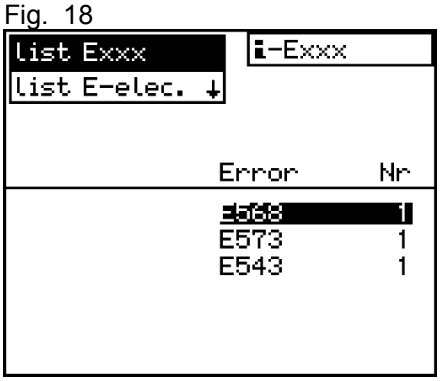


Fig. 19

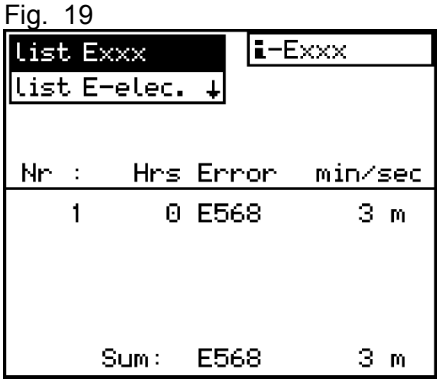


Fig. 20

Fig. 21

The screen 7 (Fig. 17) indicates the status others inputs. For the frequency inputs B53 and B12, the sign "■" means that a significant frequency is recognised by the system.

B12 : Engine RPM sensor B53 : Swing motor sensor
S7 : Safety lever servo control S57 : swing brake

The duration indicated on the last line M4 / time correspond to the time lags for the intermittent operation of the windshield wiper.

Menu i-Exxx ("i-errors"):

Information about detected errors (operating and electrical system errors)

In this menu (see Fig. 18):

- Select "list Exxx" to list all the operating errors detected by the switches and sensors for machine parameters monitoring (see Fig. 19).
- Select "list S-Exxx", to show a listing of the above mentioned errors which occurred during service operation.
- Select "list E-elec.", to show a listing of all the electrical errors (systems errors) detected during operation of the machine.

When selecting the operating errors "list Exxx" all the errors according to the list in chapter are listed, with error code and number of occurrence (see Fig. 19).

Move the arrow key "UP" and "DOWN" to select the desired error.

By pressing the "MENU" key, the overview of the selected error appears (see Fig. 20), with the indication of the operating hour and duration for the 10 first and the 10 lest occurrences of the error.

Move the arrow keys "UP" and "DOWN" to page in this overview.

When selecting the electrical errors "list E-elec." all the system errors according to the list on page 3.17 are listed, with error code and number of occurrence (see Fig. 21 and Fig. 22).

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).

Selecting “list S-Exxx” also shows the errors according to the list in pages 3.15 and 3.16, but this time only the errors that occurred during “service operation” (see Fig. 23 and Fig. 24).

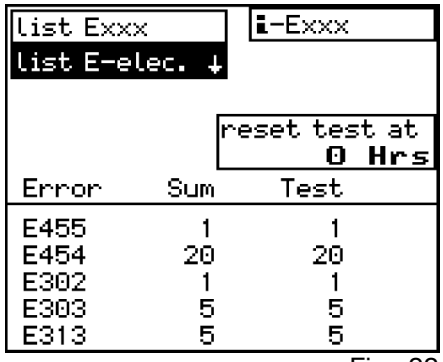


Fig. 22

For each error, an overview can be shown and paged in just like for the “list-Exxx” selection (see Fig. 25). The column “Sum” shows the number of all errors that were ever noted.

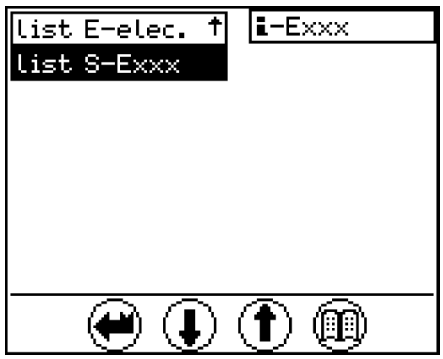


Fig. 23

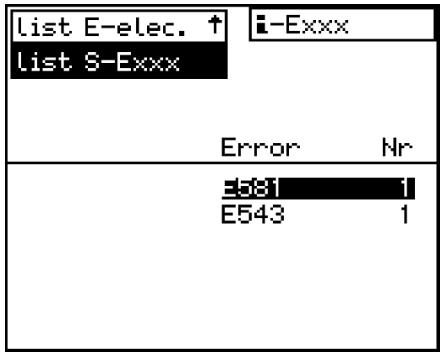


Fig. 24

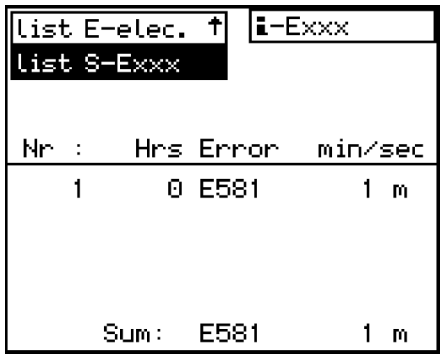


Fig. 25

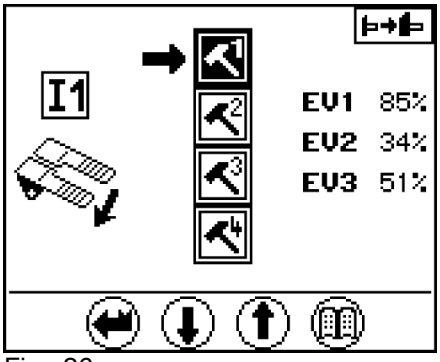


Fig. 26

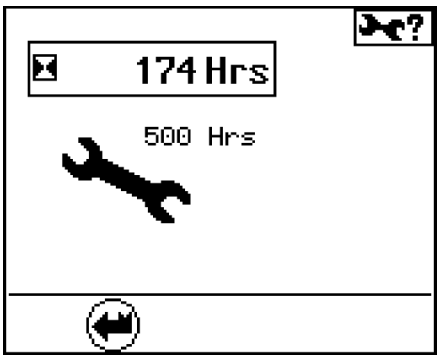


Fig. 27

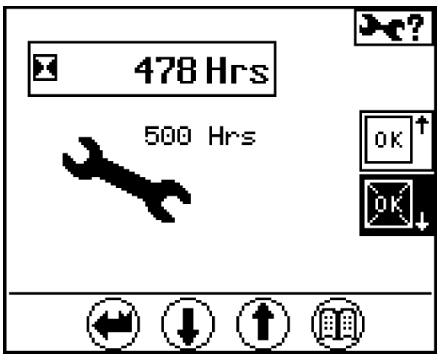


Fig. 28

Fig. 29

Menu 1 2 3 4 **(“set option”):**
Allocation of flow limit options to external inputs
(special attachment input; as an example when operating a hammer pedal).
In this menu, pre-defined flow limitations (options) are allocated to the hardware input I1.

The arrow near the symbol gives the actual allocation.

In example Fig. 26, the option 1 is active for the input I1, this means, if the external hardware input I1 is activated, then the nominal pump values allocated in option 1 for the excavator control are given as maximum nominal values.

If another option must be allocated to input I1 (as an example due to a modification of the working attachment), so first select another attachment in the vertical symbol range via the key “UP” or “DOWN”.

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

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

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 for the next service interval (in example Fig. 27 = “500 hrs”) and the current operating hours (“174 hrs”).

An upcoming service interval can be confirmed within max. 50 operating hours before the next service interval (see Fig. 28).

When this time frame is reached, the screen will display a question regarding completion of the service works for this interval.

If the question is answered with “~~OK~~” then this menu will be discontinued.

If it is answered with “OK”, then the current operating hour will be stored as the last confirmed service interval.

Menu 0 Hrs **(“set option”):**
Deletion of the daily hourmeter

This menu allows to reset the daily hourmeter (see Fig. 29).

To reset the daily hourmeter, first select “OK” via the key “UP” or “DOWN”, then confirm this choice by pressing the “MENU” key.

4. OPERATING PROCEDURES

PRE-STARTING INSPECTION

CHECK AIR FILTERS FOR CONTAMINATION

Check the, two dry air filters on top of the Diesel engine 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.

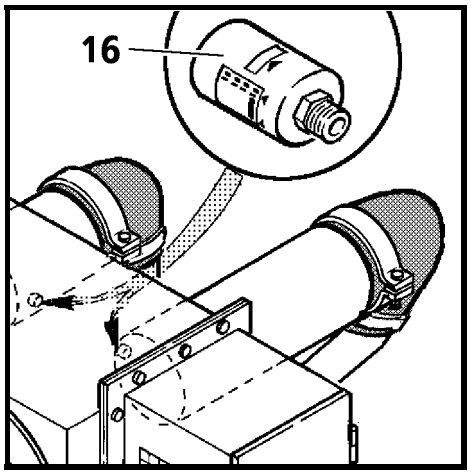


Fig. 1

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.

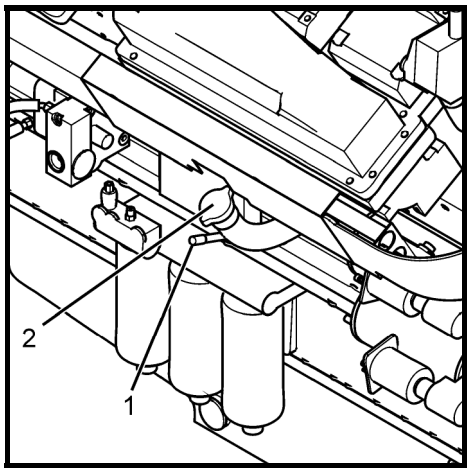


Fig. 2

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.

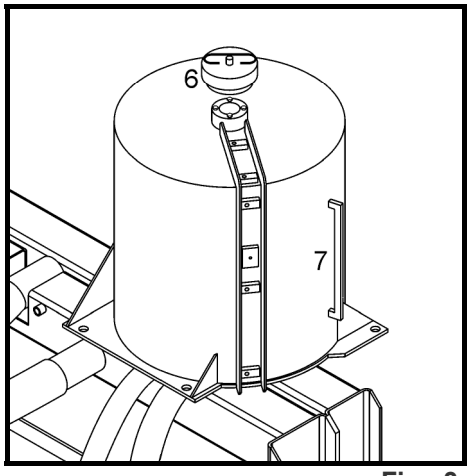


Fig. 3

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

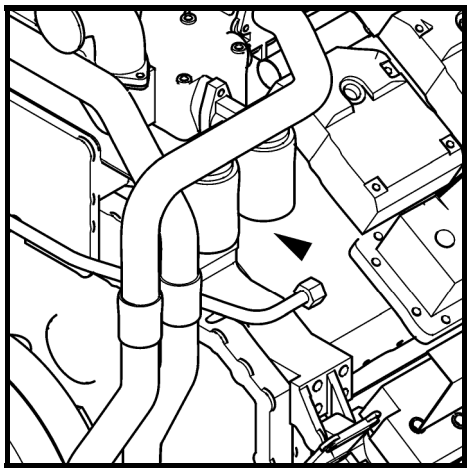


Fig. 4

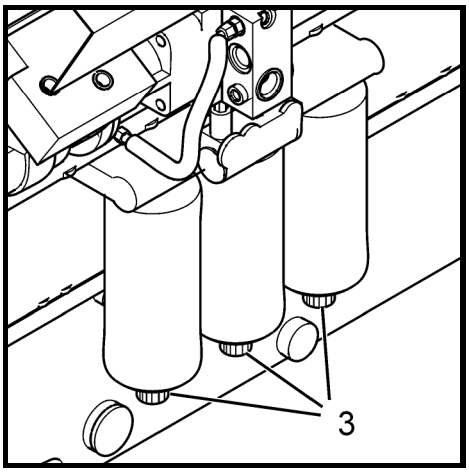


Fig. 5

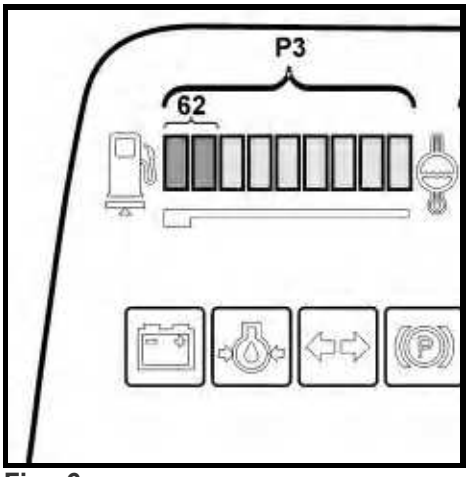


Fig. 6

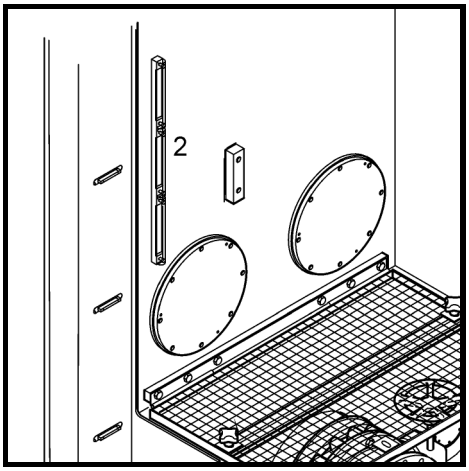


Fig. 7

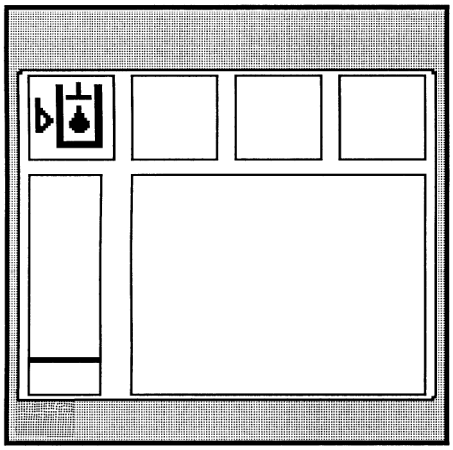


Fig. 8

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 P3 (Fig. 6) on the monitoring display before starting to work.
If the red diodes 62 on the left of the indicator P3 lights up, 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 the engine.

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. 8). 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.

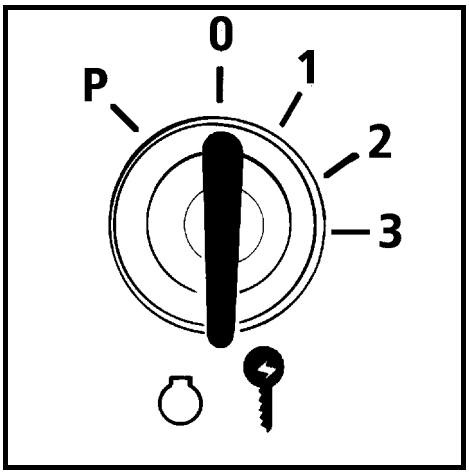


Fig. 9

DIESEL ENGINE OPERATION

IGNITION KEY POSITIONS **(FIG. 9)**

-0- Off
-1- Contact position
-2- Not used
-3- Start

TURN ON THE ELECTRICAL SYSTEM

Turn the key 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).
Only the diode in the button S22 (Fig. 10) turns not on at that time.

STARTING THE ENGINE

During the starting procedure of the engine, a starter first drives an engine oil pump to establish the correct lub 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, the principal starters start the Diesel engine.
To start the engine:
- Turn the ignition key to starting position 3.
- Maintain the key on this position during the prelub time.
- As soon as the engine is running, release the key.

The engine can not be cranked for more than 10 seconds!

If the engine does not start, repeat the starting procedure at 20 seconds intervals to allow the starter motor to cool off.

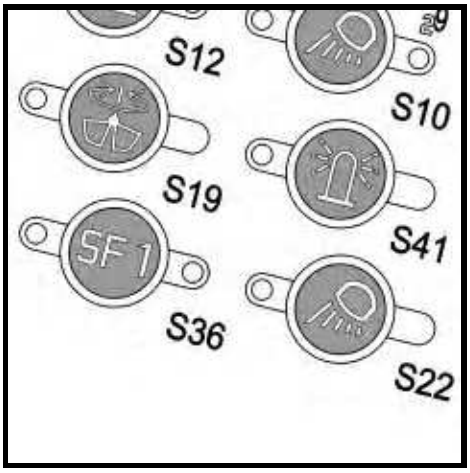


Fig. 10

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

A cold start system is standard equipment on the engine, which makes it easier to start at low temperatures.
The cold start system is actuated electrically via the button SF1 (S36, Fig. 10). 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

The LED indicator P4 (Fig. 11) displays the engine RPM. It divides the complete RPM range into 10 Stages.
The engine RPM can be set either using the arrow keys S228 and S229, or using the MODE key S86 (Fig. 11).

With the arrow keys 

Depressing an arrow key causes the RPM to jump in the next higher or lower RPM stage.

With mode pre-selection 

Via the MODE key, different pre-set RPM can be selected. Depressing the button S86 causes to change from a pre-selected mode into the next, in the following order L, E, P, L, … and so on (the mode F is not available).

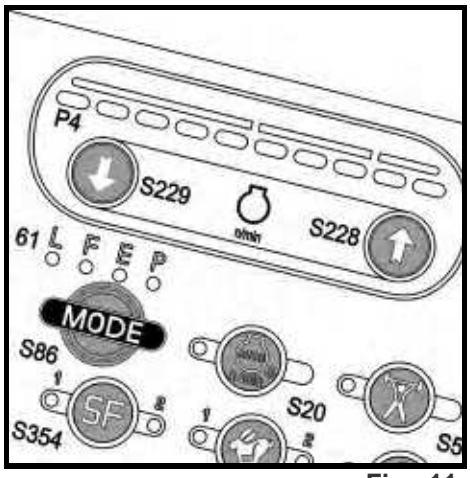


Fig. 11

Immediately after starting, the engine will run on RPM stage 1 (low idle).One of the four light emitting diodes (Fig. 11, pos. 61) blinks to show which mode L, E or P is pre-selected (the pre-selected mode, which was in use before the mac,hine was turned off remains stored).

L	Mode LIFT	=	RPM stage 1
F	Mode FINE	=	RPM stage 10 (not used)
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 S86, the initial condition is confirmed, the corresponding engine speed is transferred to the running Diesel engine, and the LED remains on.

If the engine speed is changed via the arrow keys to the engine speed for mode L, E or P, then it jumps automatically to the corresponding mode.

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.

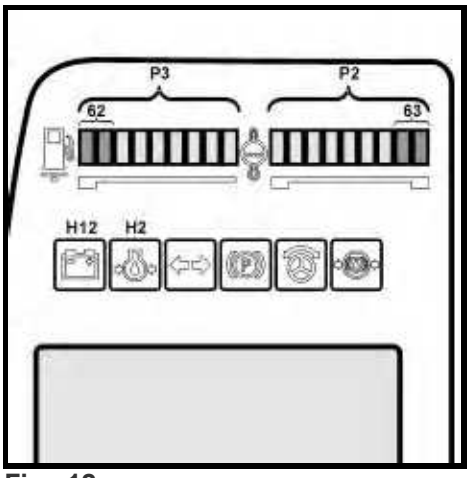


Fig. 12

AFTER THE ENGINE IS RUNNING

After the engine is running, the indicator lights H2 (engine oil pressure) and H12 (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 turnoff on the LCD screen.
Slowly increase the engine load until the coolant temperature is 40° C, in that case the second green lighting diode goes on, on the temperature gauge P2 (Fig. 12).
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

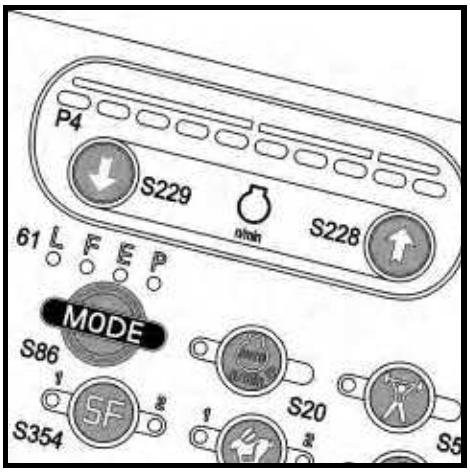


Fig. 13

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 570, and continue to run the engine run for 3-5 minutes to lower the temperature.
Then turn the ignition key to the "0" position 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 5100-1(see fig. 26), 5100-2, 5100-3, 5100-4 or 5100-5 (see location page 6.19) . This action will shut down the Diesel engine 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 one of the emergency off switches S100-1, S100-2, S100-3, S100-4 or S100-5 will cause the hydraulic tank to be depressurised quickly. After a shut down via an emergency off switch, you must unlock it before attempting to restart.

CAUTION

You must wait at least ten minutes after an emergency shut down before attempting 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, use button S23 (fig.25). When the emergency control is turned on, the indicator light in the button is on.

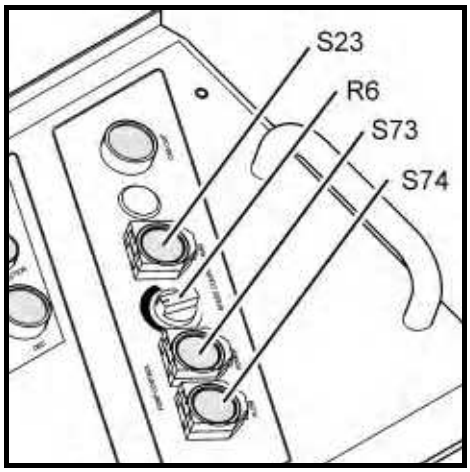


Fig. 14

START THE DIESEL ENGINE

Turn the throttle control knob R6 (fig.25) fully counterclockwise to low idle RPM.
The starting procedure is the same as during the normal starting procedure, see page 4.4.

Release the key as soon as the engine starts.

The engine can not be cranked for more than 10 seconds.
If the engine does not start, wait 20 seconds before restarting.

When the emergency control circuit is turned on, the engine control switches S20, S70 and S86 (fig. 18) are not functioning.
All remaining switches on the control panel remain fully functional, if they are not affected by the existing problem.

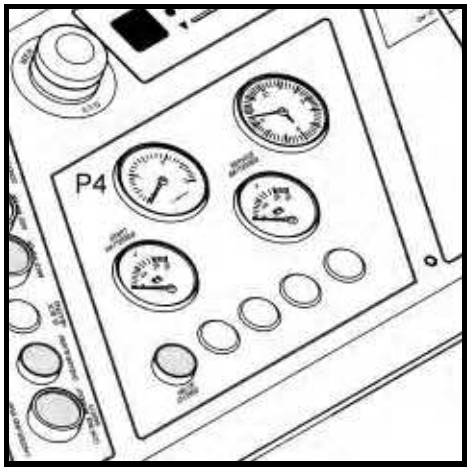


Fig. 15

1 <u>Monitoring the engine</u>
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 R6 to low idle and continue to run the engine for 3-5 minutes to lower the temperature.
Then turn the ignition key to the "0" position to turn the engine off and remove the key (fig. 27).

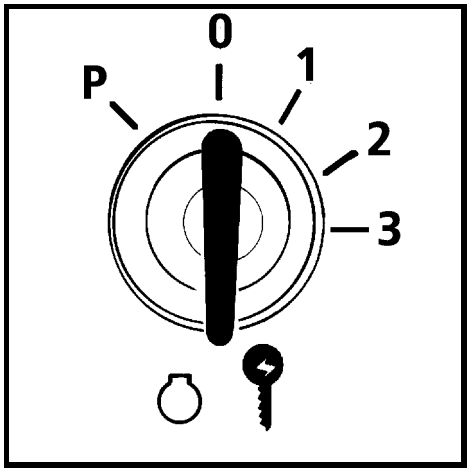


Fig. 16

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.

THE PONTOON OPERATION

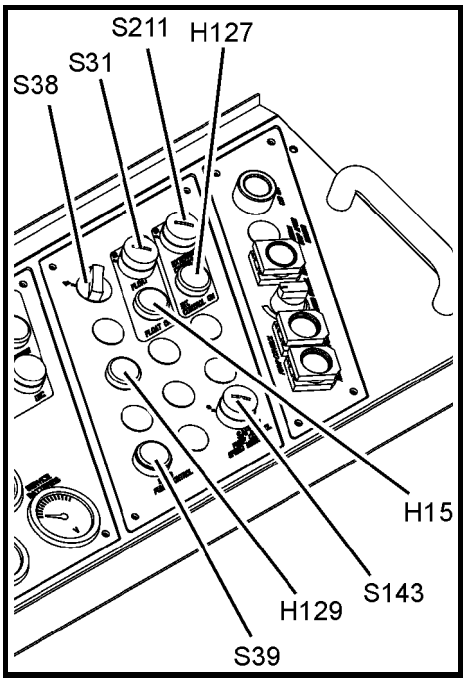


Fig. 17

CAUTION

It is forbidden to use the excavator and particularly the attachment to move the pontoon, barges and any other floating or immersed dead weight by actuating the rotation of the uppercarriage or the attachment functions.

COMMUTATION FOR SERVO CIRCUITS EXCAVATOR / PONTOON

To select the servo circuit to be pressurized, turn the key switch S38 either to “excavator” for excavator operation or to “pontoon” for pontoon operation.
In position “excavator”, the servo controls for excavator movements are alive, these for pontoon movements are switched off.
In the opposite, with the switch S38 in position “pontoon”, only the movements for pontoon can be fed with pressure oil, the excavation movements are not yet possible.

FLOAT POSITION OF THE ATTACHMENT FOR PONTOON OPERATION

The float position of the bottom cylinders allows the attachment to move up and down freely to compensate the differences in water level when the digging bucket is left (during tide or in locks,…) on an embankment or a wharf.
The float position is turned on and off via the key switch S31.
When the float position is on, the indicator light H15 lights up and the key can be taken away.

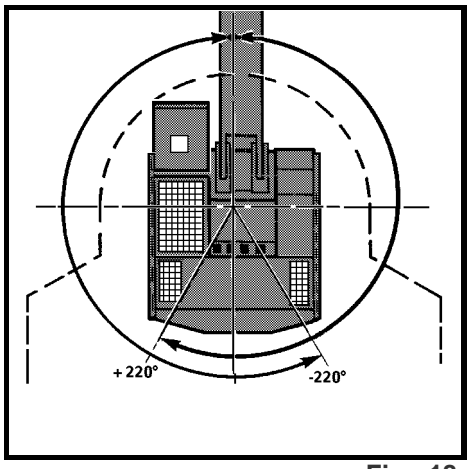


Fig. 18

CAUTION

Always switch on the float position before leaving the excavator.
First lower the attachment before switching on the float position, and then turn the engine off.
Take off the ignition key and the key S31 for float position when leaving the excavator.

UPPERCARRIAGE SWING LIMITATION FOR EXCAVATOR ON A PONTOON

For an excavator mounted to a pontoon, the swing angle of the excavator to the left and / or to the right may be limited to predetermined values by position switches.
On the example, the swing angles to the right and to the left are both limited to 220 degrees.
Overpassing this maximum angle automatically cuts off the swing movement, i.e. the swing brake applies and the swing pump is swivelled back to neutral position.
At the same time, the control light in the push button S39 lights up.
However it is still possible to turn the uppercarriage back in the opposite direction, while moving the left joystick and depressing at the same time the push button S39.
The control light in the button turns off as soon as the uppercarriage is swung back in the allowed sector.

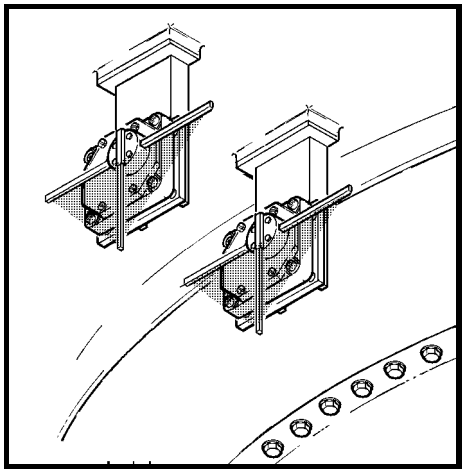


Fig. 19

CAUTION

The uppercarriage must always return to the authorized sector in the opposite direction it left this sector. As an example, if the sector was reached clockwise it must be reentered counterclockwise.

With the uppercarriage in the normal working area, the three arms of each position switch fixed to the upperstructure must shape an arrow showing down.

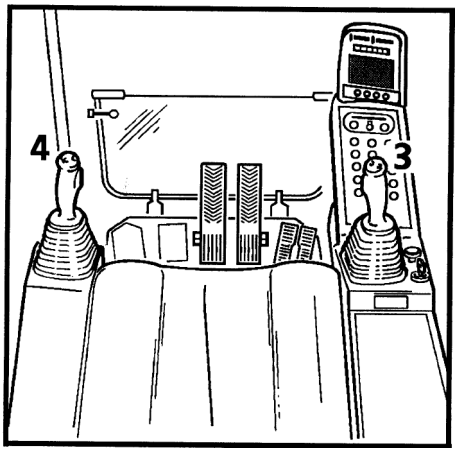


Fig. 20

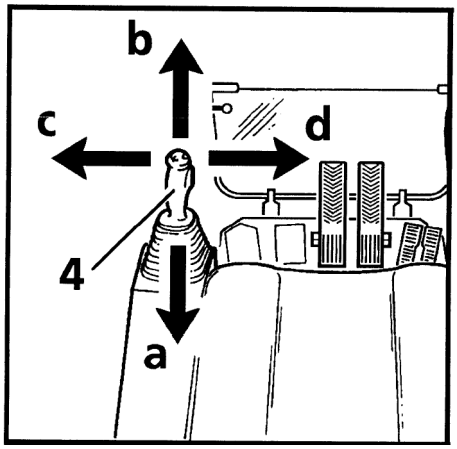


Fig. 21

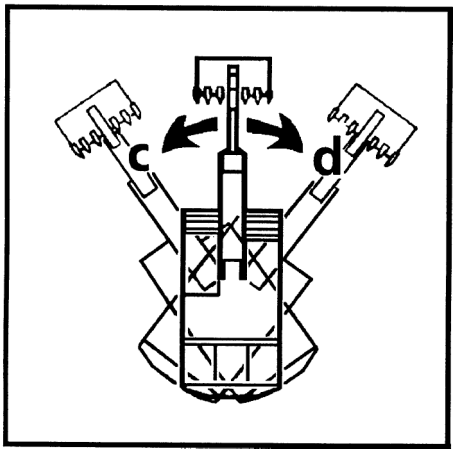


Fig. 22

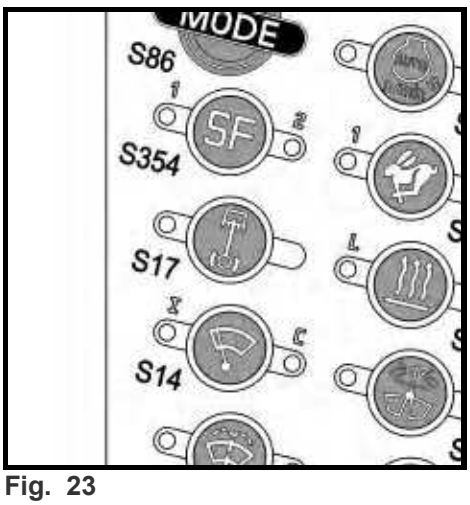


Fig. 23

LOCATION OF THE TWO JOYSTICKS

The right lever (Fig. 20, pos. 3) controls the boom and the bucket movements.

The left lever (Fig. 20, 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 S17 (Fig. 23):

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 517 and move joystick 4 to "O" position.

2 To check the swing brake

Apply the swing brake via rocker S17 (Fig. 23). Then move the left joystick 4 (Fig. 24) 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 S57 (Fig. 25) mounted to the right joystick lever as follows:
  - with the rocker switch S57 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 S17 lights up each time the brake is applied.
If this light does not go out when the rocker switch S57 is tilted up, the button S17 must first be pushed to pre-select the semi-automatic mode.

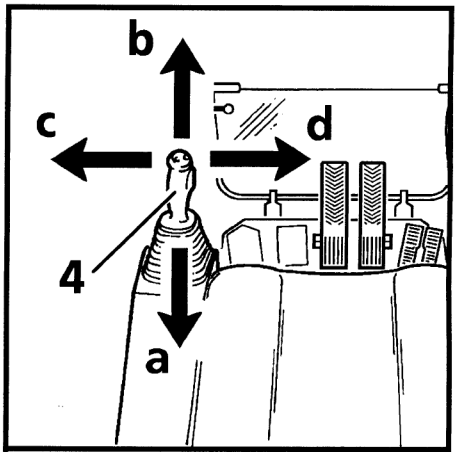


Fig. 24

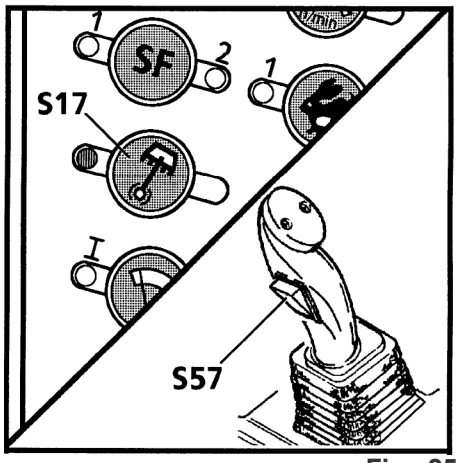


Fig. 25

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 S57 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.

3 Emergency stop of the uppercarriage swing motion:

The swing brake can be applied independently of the uppercarriage RPM by switching the button S17 from position "semi-automatic" into position "applied".

CAUTION

Perform this braking via button S17 only in emergency cases, since it causes fast abrasion of the brake discs.

ATTACHMENT CONTROL

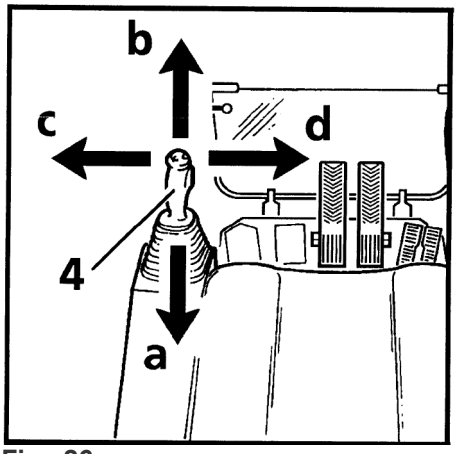


Fig. 26

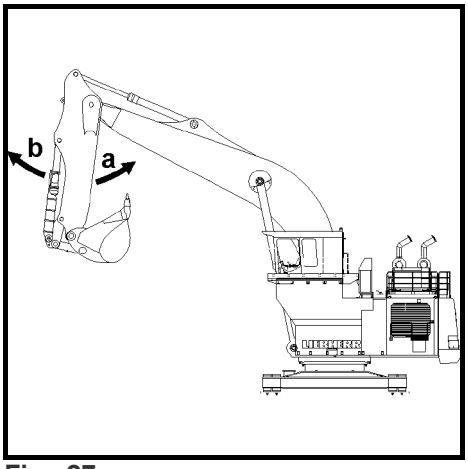


Fig. 27

CONTROL OF THE STICK CYLINDER
(left joystick 4-Fig. 26)

Pull joystick 4 backwards (a) to move the stick in.
Push joystick 4 forward (b) to move the stick out.

CONTROL OF THE BOOM CYLINDER
(right joystick 3 -Fig. 28)

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. 28)

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

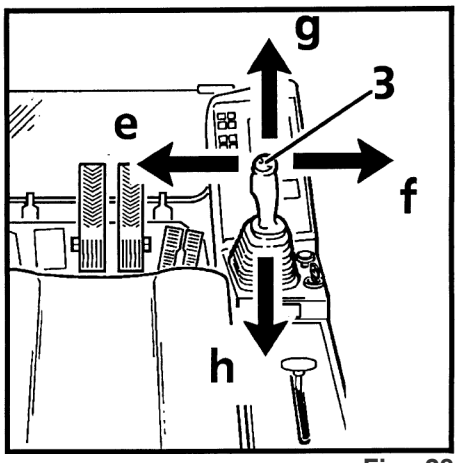


Fig. 28

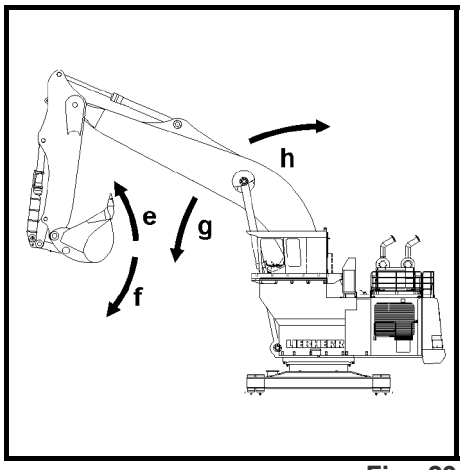


Fig. 29

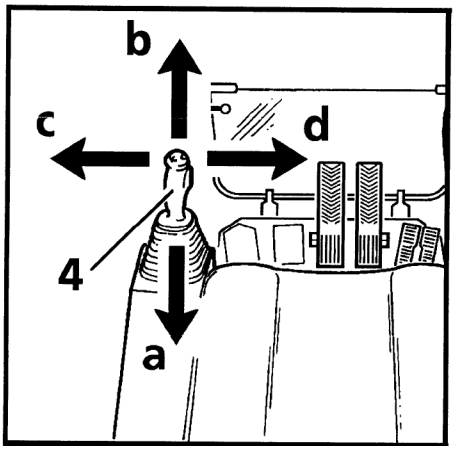


Fig. 30

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.

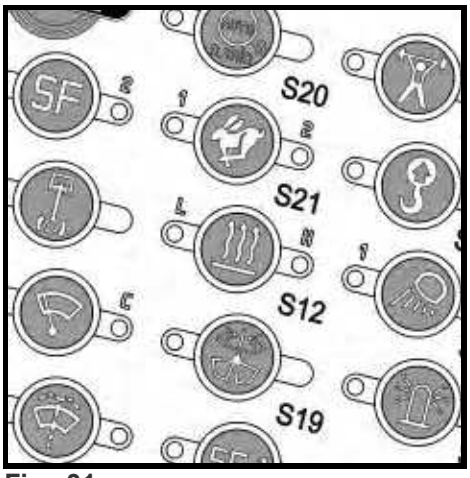


Fig. 31

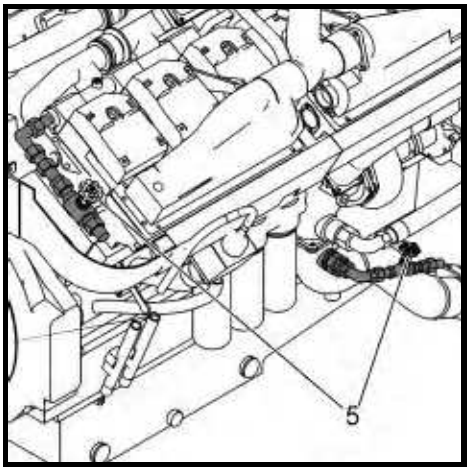


Fig. 32

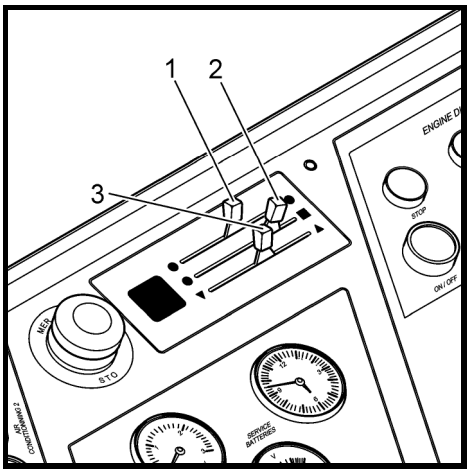


Fig. 33

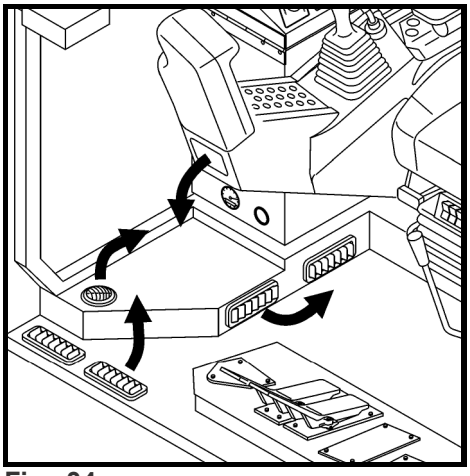


Fig. 34

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.

4 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. 32) should be closed.
Push the lever (Fig. 33, pos. 1) all the way forward to close off the water supply.

Push button S12 (Fig. 31) to select desired air flow.

The fresh air enters the cab via openings on the steps (Fig. 34) and via the vents on the left and right front (Fig. 34).

Move the lever 2 (Fig. 33,) 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.

5 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 19.2. Turn the blower fans on, and select the desired air flow via the rotary switch 19.1 (Fig. 35) and the vents of the evaporator.

FOR HEATER OPERATION

Open the coolant shut off valves on the Diesel engine (Fig. 32).

The amount of water running through the heat exchanger can be regulated by moving the lever 1 (Fig. 33). 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 S12 .

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 S1.
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 S2 (Fig. 35).

The air conditioner can only be turned on if the evaporator fan unit is turned on via button S1.

Select the desired air flow via the rotary switch S1 .

Set the desired air temperature via the rotary switch S2.

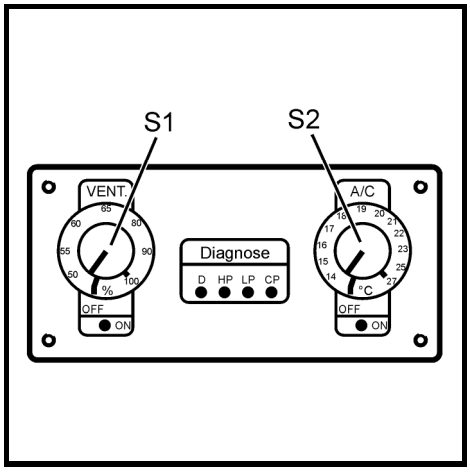


Fig. 35

The direction of the cold air flow can be adjusted via the vents on the evaporator unit (Fig. 36).

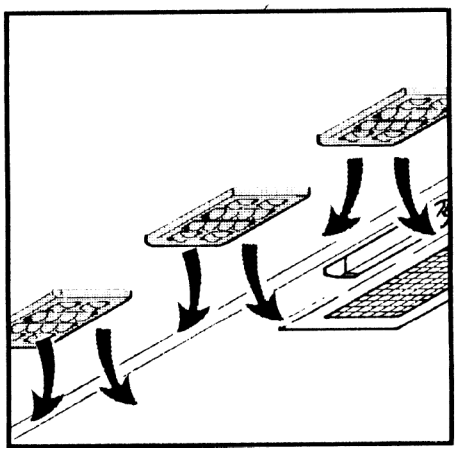


Fig. 36

For air conditioner operation during the summer time, preferably close the coolant shut off valves on the Diesel engine, push the lever (Fig. 33, Pos. 1) all the way to the front and turn the heater blower off via button S12.

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.

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

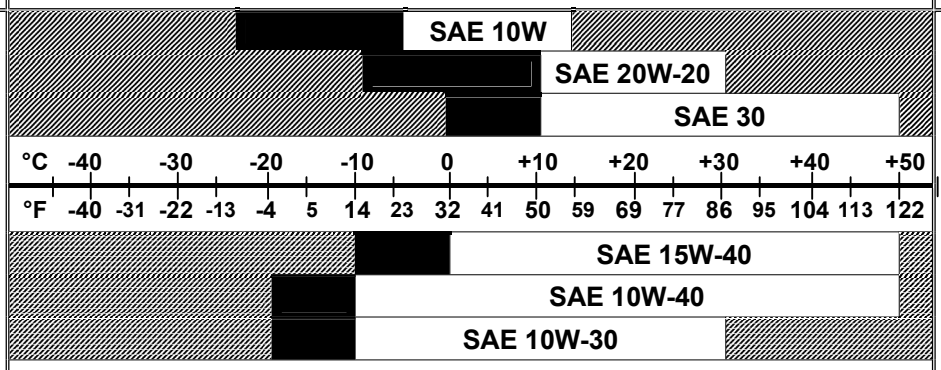
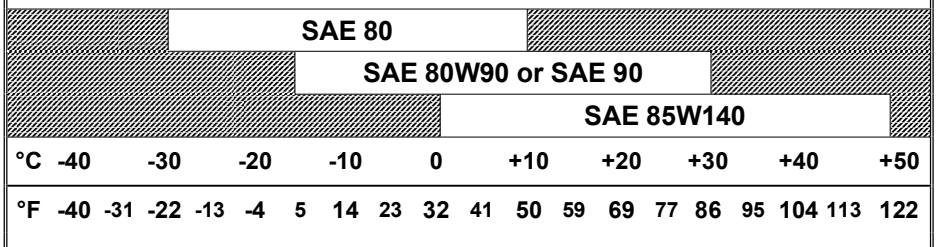
When checking or replacing the oil, observe the following :

- **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 P 994 B LITRONIC

COMPONENTS	SYMBOL	VISCOSITY SAE DIN 51 512 — SPECIFICATION	QUANTITY
DIESEL ENGINE			
- Lubricant	optional	**See the Operation and Maintenance Manual for CUMMINS engine**	In engine 280 l. 74 USgal. In Centinel Tank (optional) 300 l. 80 USgal.
- Fuel		**See the Operation and Maintenance Manual for CUMMINS engine**	5350 l. 1415 USgal.
- Coolant		**See the Operation and Maintenance Manual for CUMMINS engine**	320 l. 84,6 USgal.
HYDRAULIC SYSTEM		 **Warming up the hydraulic system** **1. For temperatures 18°F (10°C) below the lower limits :** 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. **2. For temperatures below the limits listed under 1:** Preheat hydraulic oil in the tank before starting the engine.	2500 l. 660 USgal. In hydraulic tank 4100 l. 1083 USgal. In whole circuit
SWING GEAR			2×37 l. 2×9,8 USgal

LUBRICANTS AND FUEL CHART P 994 B 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	75 l. (19,8 Usgal)
COUPLING SPLITTERBOX / ENGINE		SAE 15W40		MB 228.1	1,5 l. (0,4 US gal)
SWING RING TEETH		Special grease		See lubricant specification	80 l. (21 US gal.)
GENERAL LUBRICATIÓN POINTS Swing ring, Attachment bearings, Track tensioner,…		Down to 0°C (32°F)	CONSISTENCY 2 NL GI N°2 Grade	MULTUPURPOSE GREASE KP2k or EP2 (Extreme pressure N°2 Grade)	200 l. 53 USgal.
		Down to -15°C (5°F)	NL GI Grade	CONSISTENCY 1	
		Down to -40°C (40°F)		SPECIAL GREASE As an example Mobilith SHC 460 o SHC PM	
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	7 kg (15,5 lbs.)
REFRIGERATOR OIL IN AIR CONDITIONER COMPRESSOR				PAG SP 20	1 l. (34,8 oz.)

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

Standard or with the Centinel system

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-)

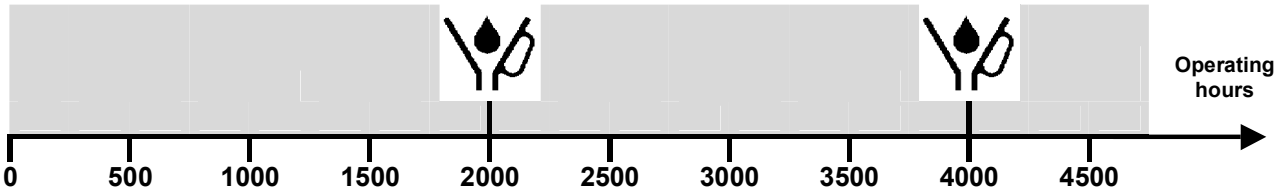
The "environmentally friendly hydraulic fluids" recommended by LIEBHERR are limited to synthetic ester based hydraulic fluids with a viscosity according to ISO VG 46.
Initial filling is performed ex works according to customer desires. The use of environmentally friendly hydraulic fluids must be arranged 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

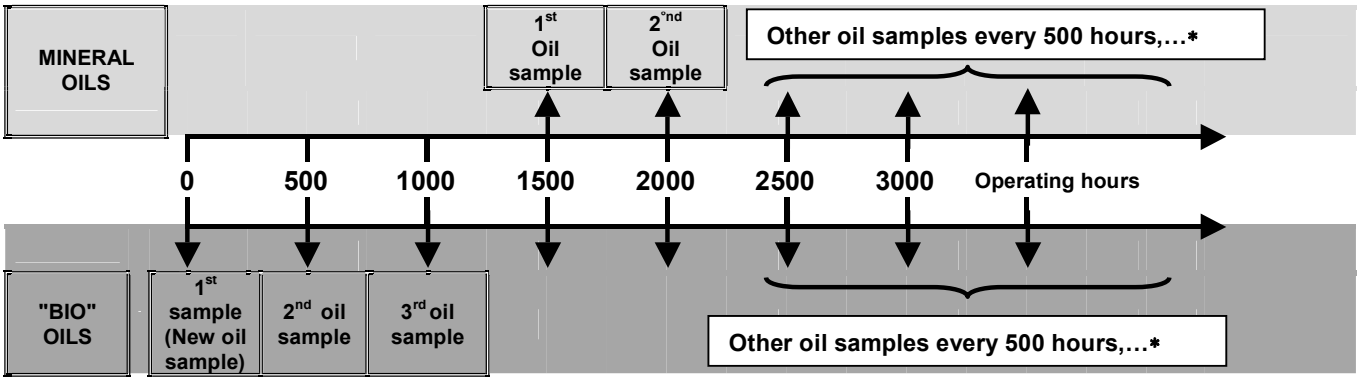
Note: Oil changes in pre-set intervals are only permitted for mineral oils. When using environmentally friendly hydraulic fluids, oil sample analysis reports must be used to determine the time of the oil change, see §2



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 KP 2k 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 UKA 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.

LIEBHERR part N°: 8502769 for a 50 kg (110 lbs) container
8503731 for a 180 kg (400 lbs) container

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.

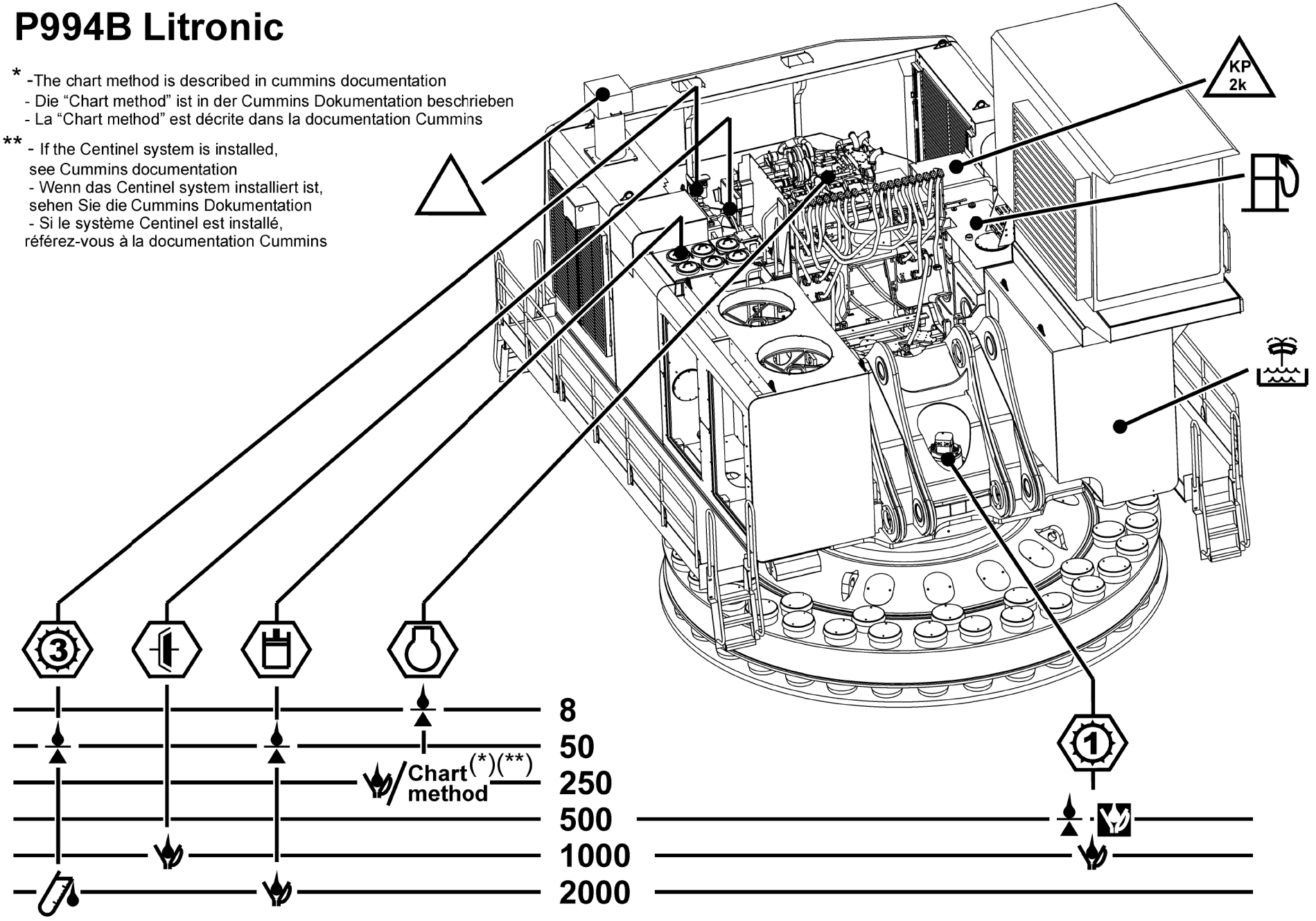
LIEBHERR part No: 850441410,25 liter (.066 Gal.) container of PLANETELF PAG SP20 oil.

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

P994B Litronic

* -The chart method is described in cummins documentation
- Die “Chart method” ist in der Cummins Dokumentation beschrieben
- La “Chart method” est décrite dans la documentation Cummins

** - If the Centinel system is installed,
see Cummins documentation
- Wenn das Centinel system installiert ist,
sehen Sie die Cummins Dokumentation
- Si le système Centinel est installé,
référez-vous à la documentation Cummins



THE LUBRICATION CHART

Components and maintenance work symbols, fluids quantities*

Engine	280 l 74 US gal		Grease / swing ring teeth	80 l 21 US gal
Centinel system	300 l 79 US gal		Grease	200 l 53 US gal
Engine coolant	350 l 92 US gal		Coupling	1.5 l 0.4 US gal
Hydraulic system	2500 l 660 US gal		Windshield washer	75 l 19.8 US gal
Swing gear	2 x 37 l 2 x 9.8 US gal		Check oil level	
			Oil change	
Splitterbox	80 l 21 US gal		First oil change	
Fuel	5100 l 1347 US gal		Oil analysis	

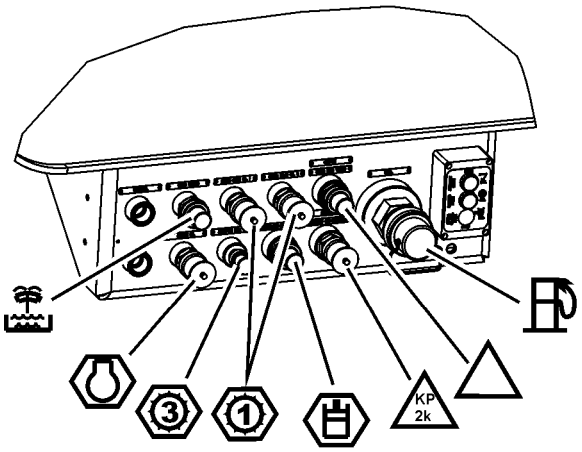
*the given quantities are only guidelines. Check fluid level after each change or refilling.

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 diesel engine system
- The replenishing tank for the Centinel system
- The splitterbox
- The two 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 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.

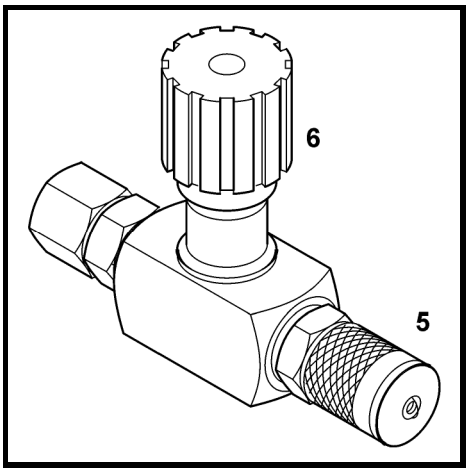


Fig. 1

The service trap is situated in front of the excavator, on the hydraulic tank side.

LOCATION OF OIL SAMPLE POINTS

To make the oil sampling easier, the following components of the excavator have been fitted with an oil sample extraction valve (Diesel engine, splitterbox, the hydraulic circuit).

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.

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. 2).

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.

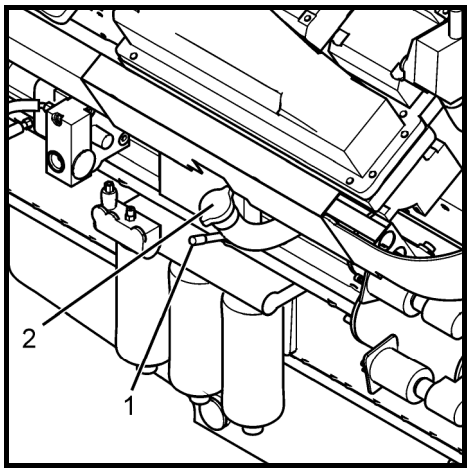


Fig. 2

TO CHANGE THE ENGINE OIL

Drain the engine oil sump
Bring the engine to operating temperature, and drain the oil via the quick change coupling in the service center (Fig. 3, 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. 2).

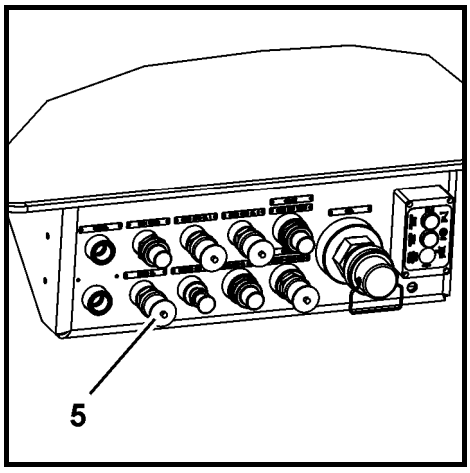


Fig. 3

Replace the oil filter elements (Fig. 4)

Unscrew and remove the 3 filter elements, pos.3.
Each filter element is a combination oil filter comprising a full flow element and a by-pass element.

CAUTION

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

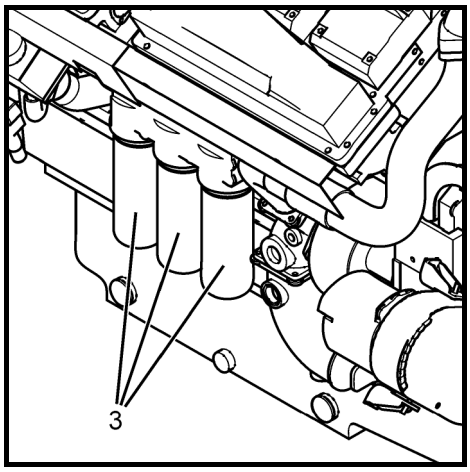


Fig. 4

Clean the sealing surfaces on the filter mounts.
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. 2) or via the Centinel valve if the excavator is equipped with Centinel system (see page 8.1).For oil quantities, oil specifications and oil change intervals, see lubrication and maintenance charts.

Note

To extend the oil change interval, it is advised to use the chart method of CUMMINS.

Fig. 5

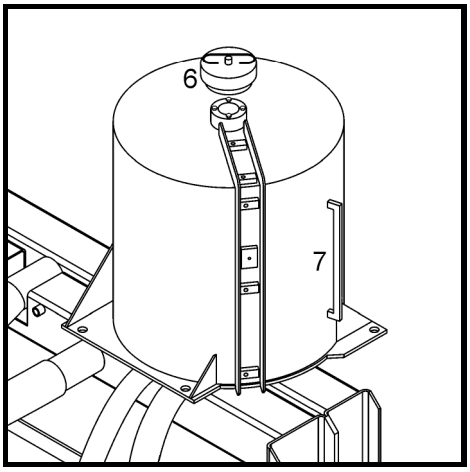


Fig. 6

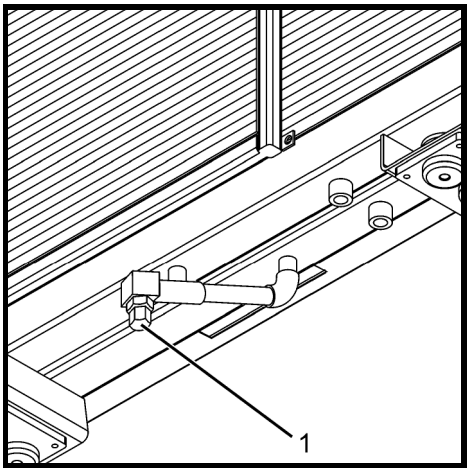


Fig. 7

TO TAKE AN ENGINEOIL SAMPLE

The valve for engine oil sampling is mounted to the front side of the engine (Fig. 5).

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. 6).

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 the cooling circuit :	320 l (84 US gal.)
water ratio :	160 l (42 US gal.)
antifreeze ratio :	160 l (42 US gal.)

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

Normally, changing the coolant filters (Fig. 8, 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. 7, 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.

Fig. 8

TO CHANGE THE COOLANT

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

The filters (Fig. 8) must be replaced every 250 operating hours:

- Turn the shut off valve on the filter head to the OFF position,
- 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 - 314 turns (Do not use any tools to tighten the filters!),
- Turn the shutoff valve to the ON position.

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

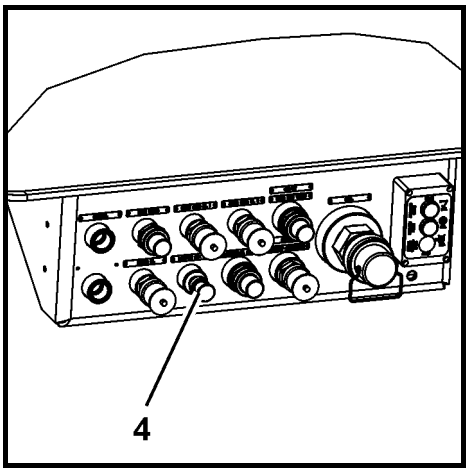


Fig. 9

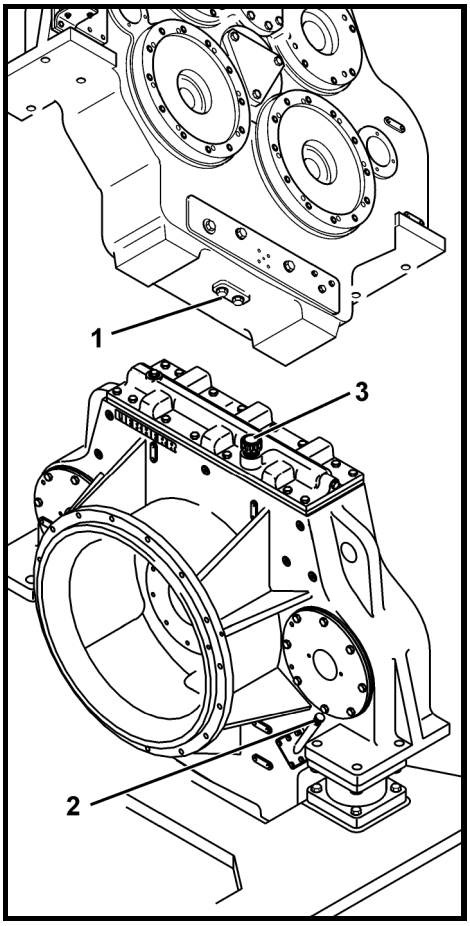


Fig. 10

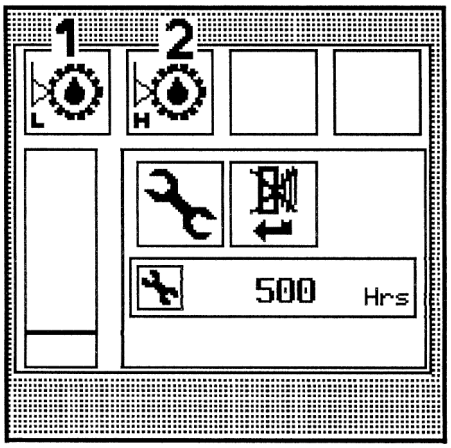


Fig. 11

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 the splitterbox via the quick change coupling 4 on the service plate (Fig. 9), 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. 10) 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. 11, pos.1) or above the maximum allowable level (Fig. 11, 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. 12).

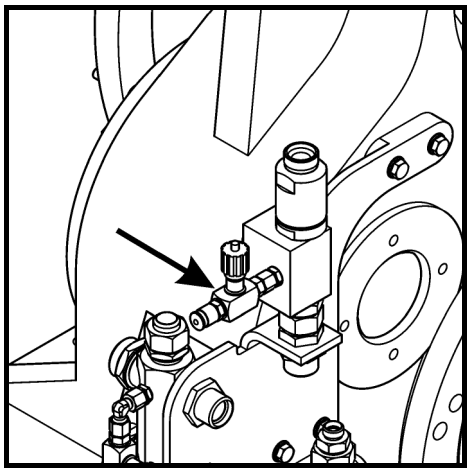


Fig. 12

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.

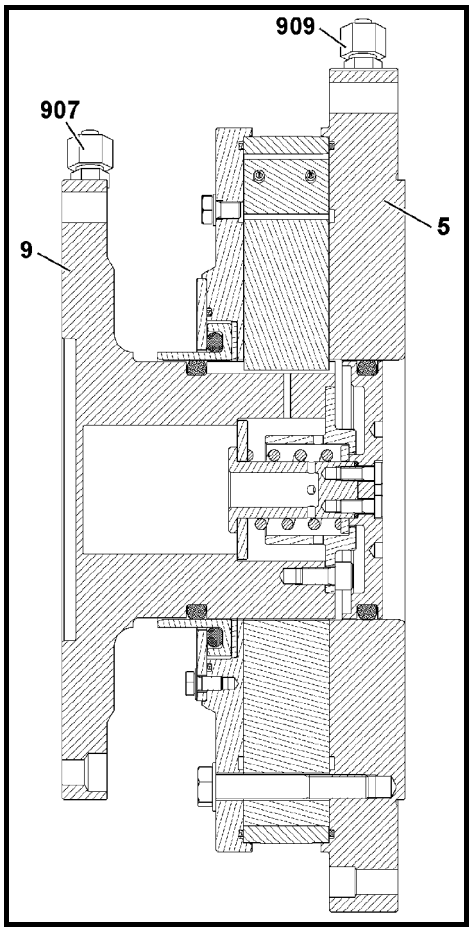


Fig. 15

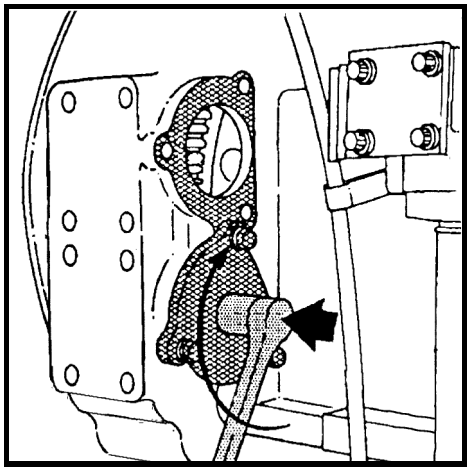


Fig. 16

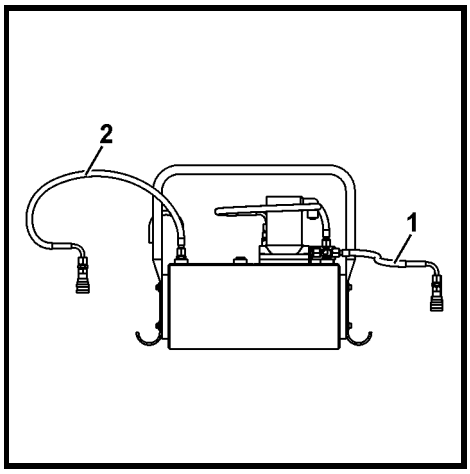


Fig. 17

CHANGING THE OIL IN THE SWING GEARS

The oil in the swing gears must be changed via the quick-change couplings 6 in the service plate Fig. 16 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. 17.
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. 18, 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.

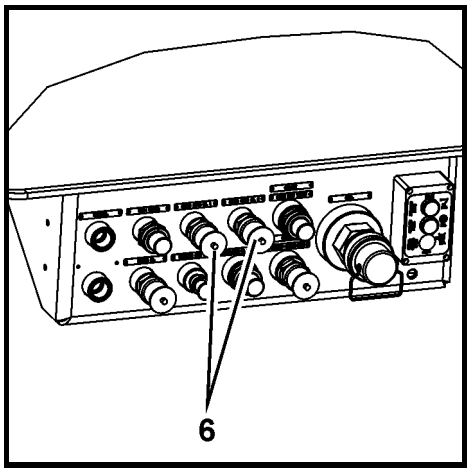


Fig. 16

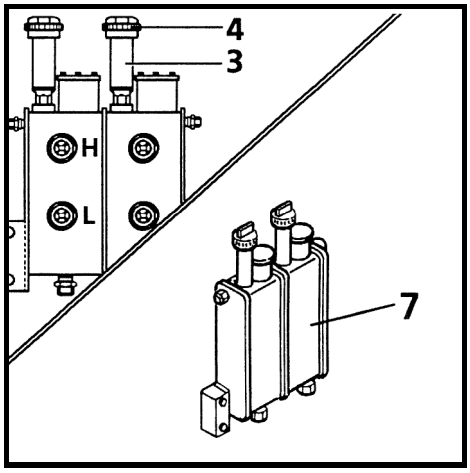


Fig. 17

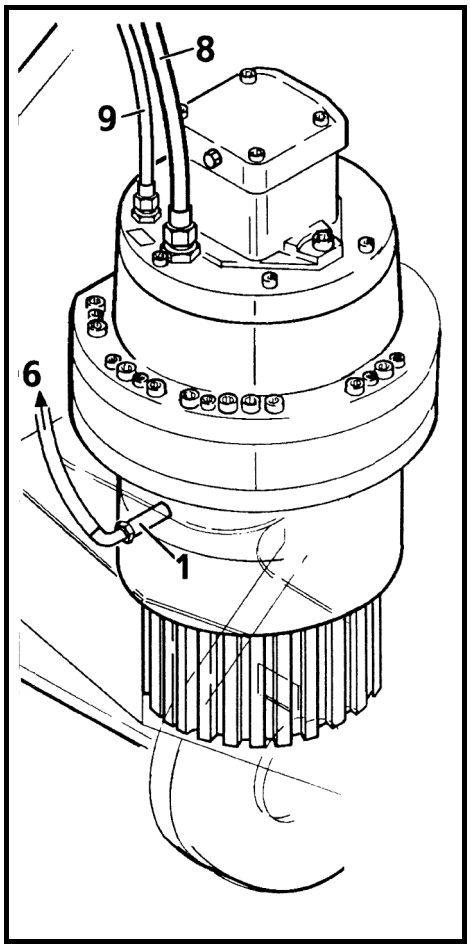


Fig. 18

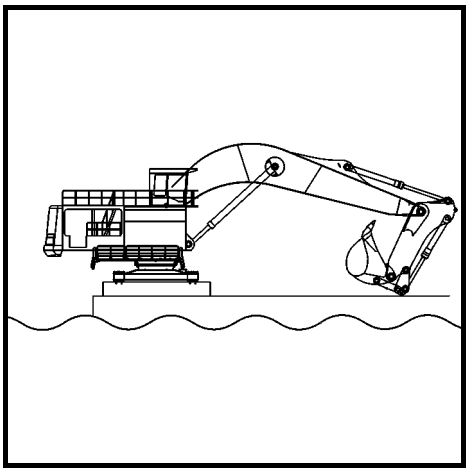


Fig. 19

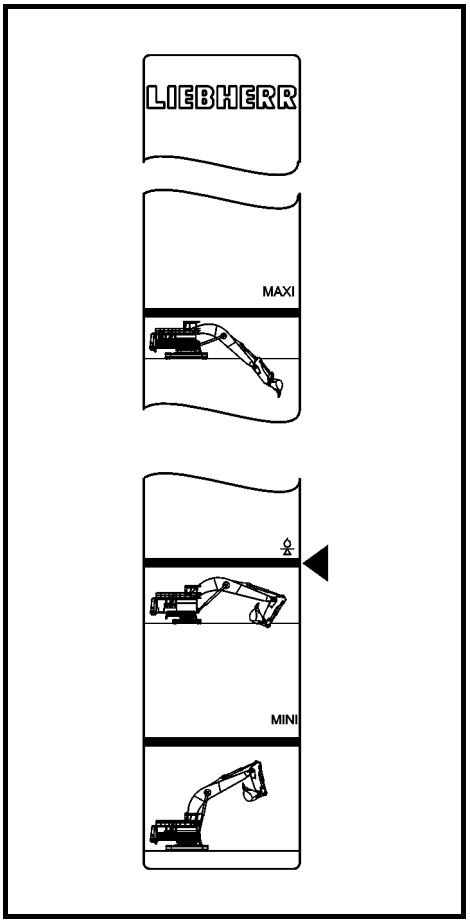


Fig. 20

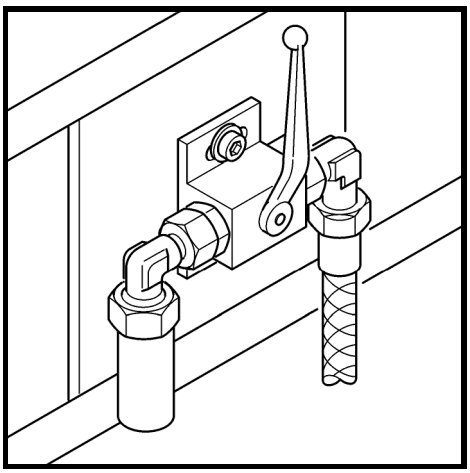


Fig. 21

OIL IN THE HYDRAULIC SYSTEM

When checking the oil level or adding oil (Fig. 19):
- rest the attachment on the pontoon deck, 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. 20).
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 TOTHE 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. 21) 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. 23).

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

- remove the cover 3 (Fig. 24) of on of the return filters
- add oil via the return filter until the level is exactly at the center mark of the sight gauge.
- reinstall the cover 3
- After refilling, close the tank pressure release valve (Fig. 21) to repressurize the hydraulic tank.

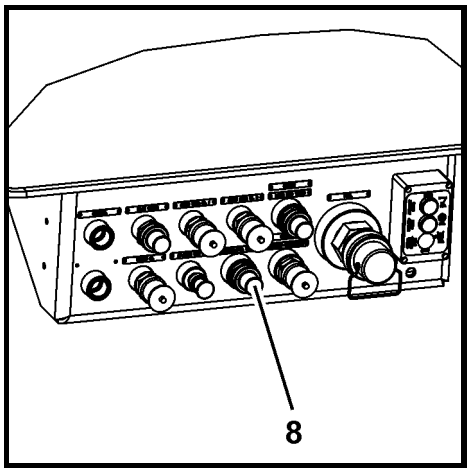


Fig. 22

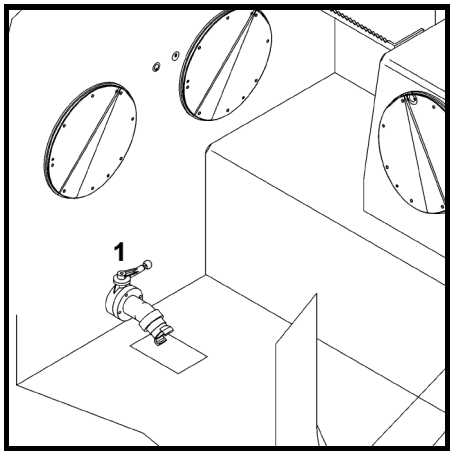


Fig. 23

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.

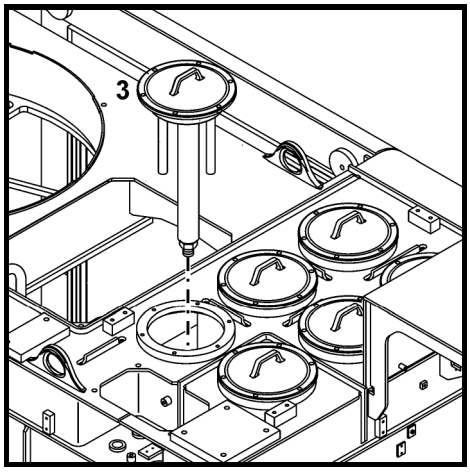


Fig. 24

TO TAKE AN HYDRAULIC OIL SAMPLE

The valve for taking hydraulic oil samples is mounted next to the rear bearing of the splitterbox housing (Fig. 25).

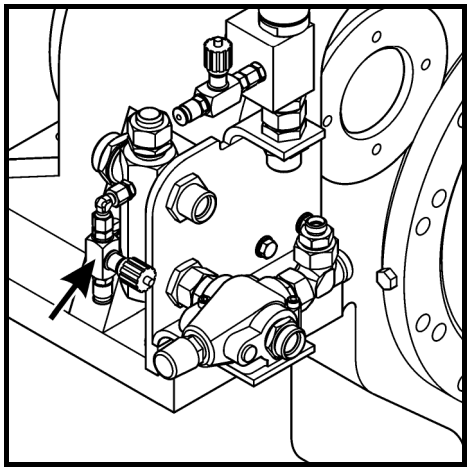


Fig. 25

THE CENTRALISED LUBRICATING SYSTEM

1 Function of the lubrication system

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

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

System 1 – Equipment lubrication- Slewing rim lubrication

Single-line system

Main components:	Hydraulic pump	"P1"	609-28942-1
	Injectors	SL 1	
	Progressive metering devices		SSV 6

System 2 – Gear rim lubrication

Main components:	Hydraulic pump	"P2"	609-28910-1
	Progressive metering devices		SSV 10

1.2 Sequence of a lubrication cycle

1.2.1 Systems 1

Upon expiration of the pause time the pump begins operating and supplies the lubricant to the injectors 9 (SL1) 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 switch (B69) is reached. The control unit stops the pump and, at the same time, the main line is discharged via the solenoid valve (Y79). The relieved lubricant reaches the pump reservoir via a bypass.
The pistons in the injectors 9 (SL 1) return to their initial position by spring force.
The pause time begins. The system is ready to carry out a new lubrication cycle.

1.2.2 System 2

After the pause time has elapsed, the pump supplies the lubricant to the connected progressive metering devices.
A progressive metering device 8 (SSV 10) is equipped with a proximity switch for control and monitoring.
A lubrication cycle is completed after the SSV 10 has supplied twice, and the pump is switched off again.

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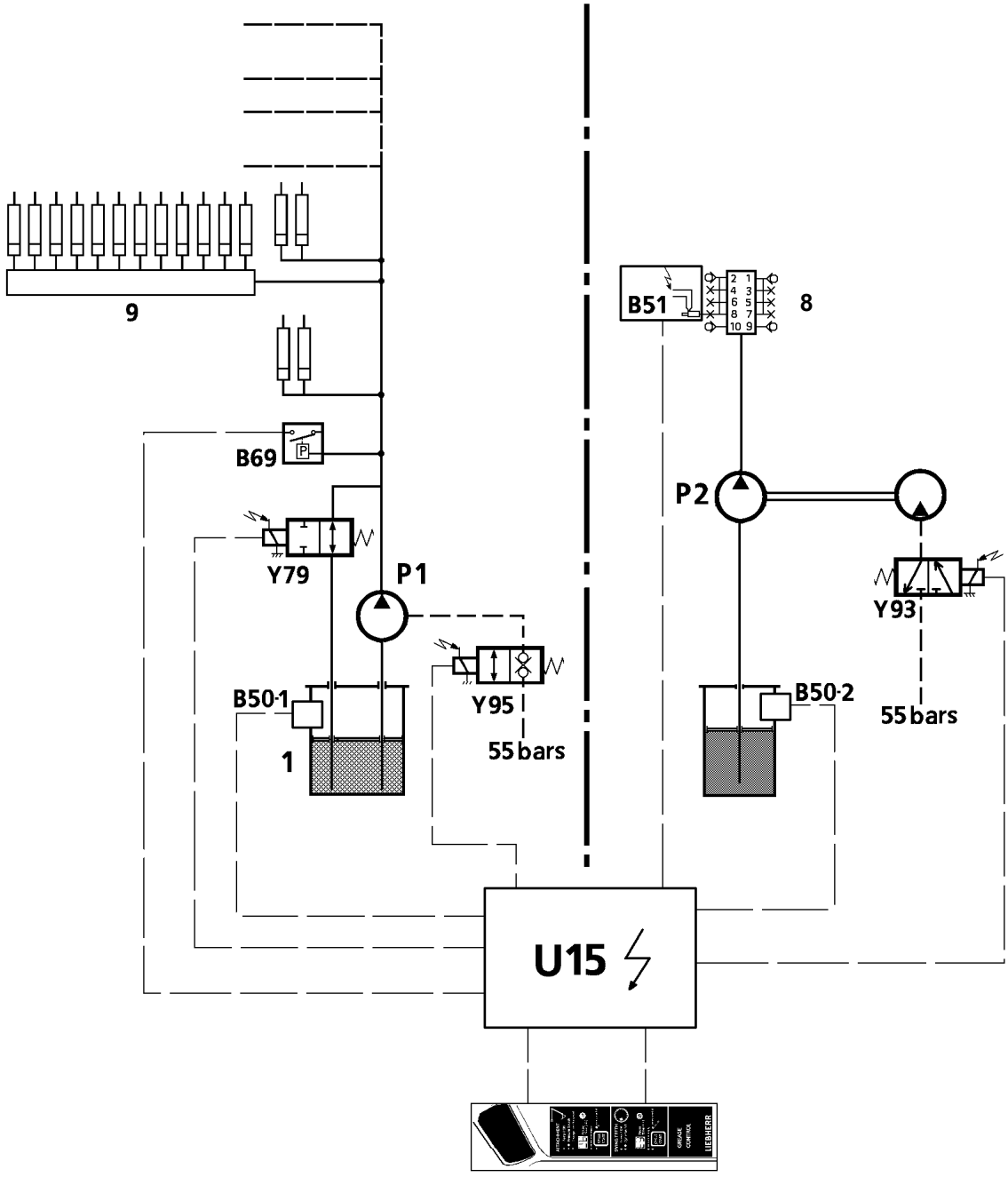

P1	Lubrication pump –attachment	**B69**	Pressure switch / end of lube cycle for P1
P2	Lubrication pump -swing ring teeth	**B51**	Limit switch on progressive distributor for P2
Y79	Solenoid valve / pressure release (attachment)	**8**	Progressive distributor SSV
Y95	Solenoid valve / hydraulic pressure drive for P1	**9**	Grease injector banks SL1
Y93	Solenoid valve / hydraulic pressure drive for P2	**B50-1**	“High level“ and “Low level“ sensor for P1
U15	Lubricating system monitor	**B50-2**	“High level“ and “Low level“ sensor for P2
1	Grease tank		

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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 pre-adjusted pause time, ... etc.
When the excavator is delivered from the factory the time period between two lubrication cycles is 6 minutes for pump P1 and 8 minutes for pump P2. This corresponds to a grease consumption of approx. 850 g/h for P1, 40 g/h for P2.

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

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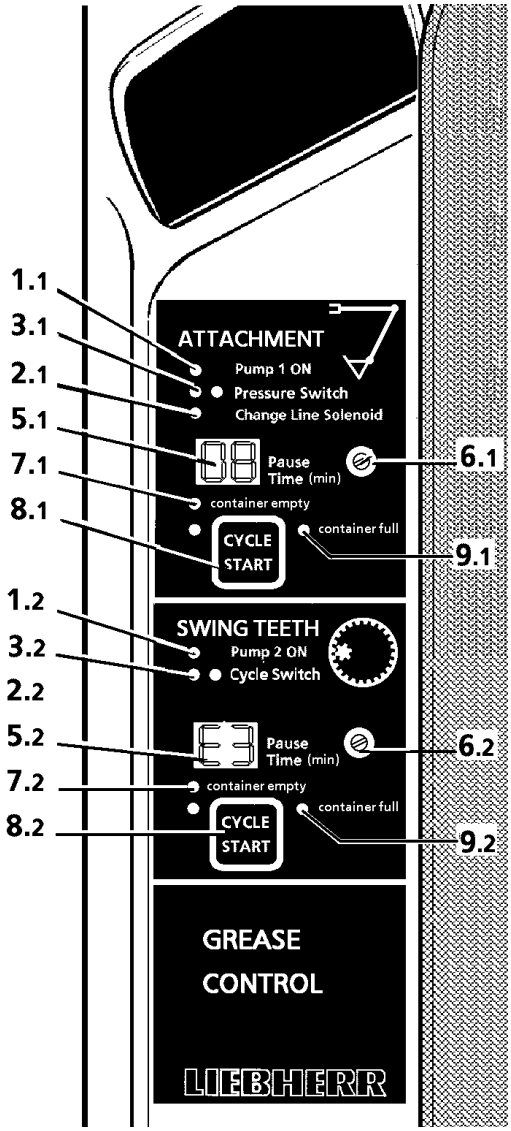

3 The Lubrication System Monitor

The green indicator lights 1.1 resp. 1.2 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 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 lights up, then the grease container for the corresponding lubrication pump is empty. In this case, the empty grease container must be filled up as soon as possible.
The signal lamp 9.1 resp. 9.2 indicates “container full”.
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

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 and P2
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.

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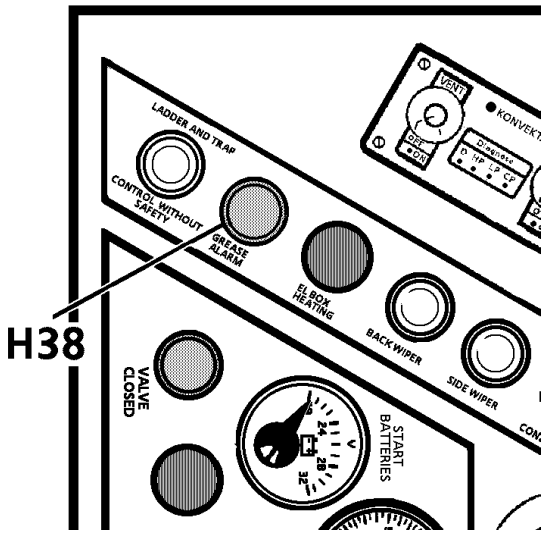

4 Inspection and maintenance

- **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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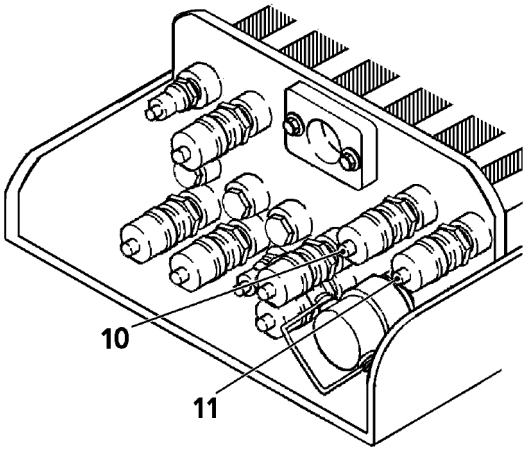
5 Exchanging / topping up grease reservoirs

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: Filling of the container



Filling of the container through service-plate

* Remove dust protective cap at the filling coupling and the dust protective cap at the filling nipple
* Couple the filling hose at item 10 (P1) resp. 11 (P2) and switch on the filling pump
- When the reservoir is full, the ultrasonic sensor transmits an electric signal to the control unit. Visual control is possible by screwing off a lid
- the filling pump is switched off
* Disconnect the filling coupling and reinstall the dust protective caps

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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.

THE FUEL SYSTEM

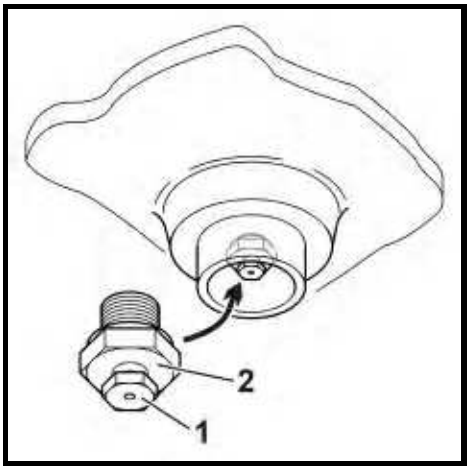


Fig. 1

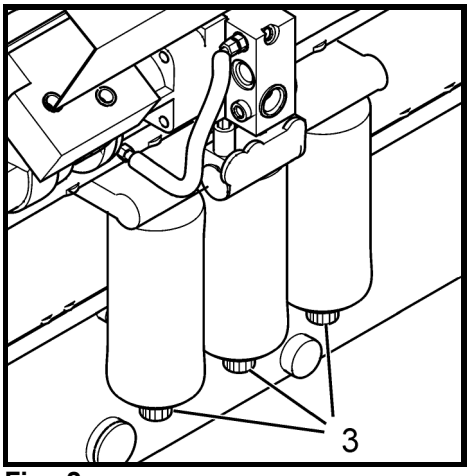


Fig. 2

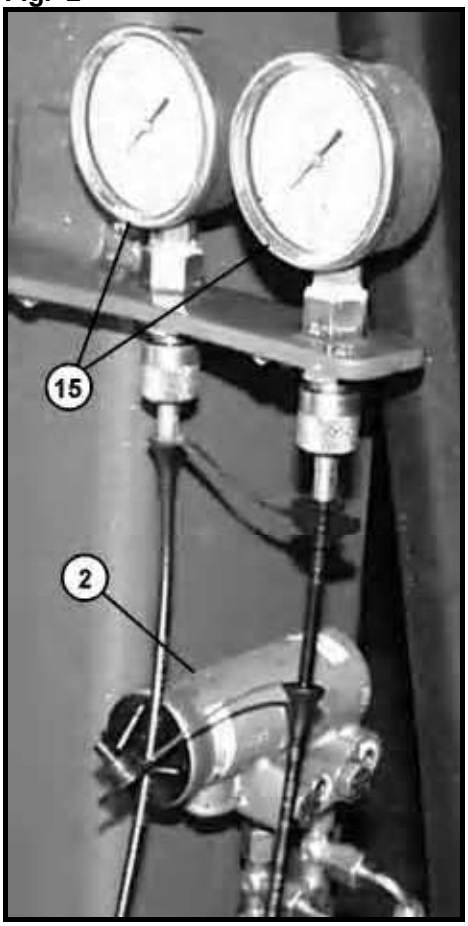


Fig. 3

TO DRAIN AND CLEAN THE FUEL TANK

A drain valve is installed on the bottom of the tank (Fig. 1).

To drain condensation, turn the drain plug 1 on the valve two 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.

DRAIN THE WATER SEPARATOR ON THE FUEL FILTER

Open the water separator drain valve (Fig. 2, 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 (15) must be between 6,2 and 7,25 bar.

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

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

To check, proceed as follows:

- Run the diesel engine at low idle,
- Slowly move 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. 6,2 bar.
- The pressure regulator 2 must now shift the compressor into the working cycle.
- Continue to run the engine at low idle. When the pressure reaches 7,25 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. 4, pos 4) dries and filters the pressurised air.

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

CAUTION

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

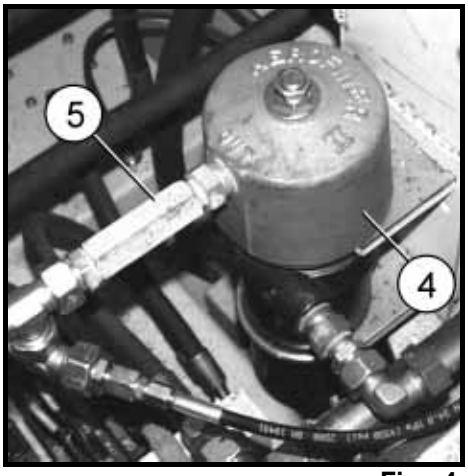


Fig. 4

To replace the air cleaner element

Relieve the pressure in the air pressure system via the drain valves (Fig. 7).
Disconnect the air pressure line on the outlet to the air tank (Fig. 4, pos. 5).
Remove nuts 1 and cover 2 (Fig. 5).
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 centring piece 6, o-ring 10, cover 2 and tighten nuts 1.

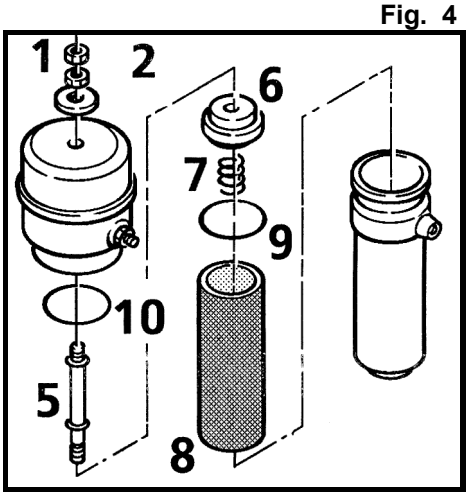


Fig. 5

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. 7), regularly as specified in maintenance schedule.

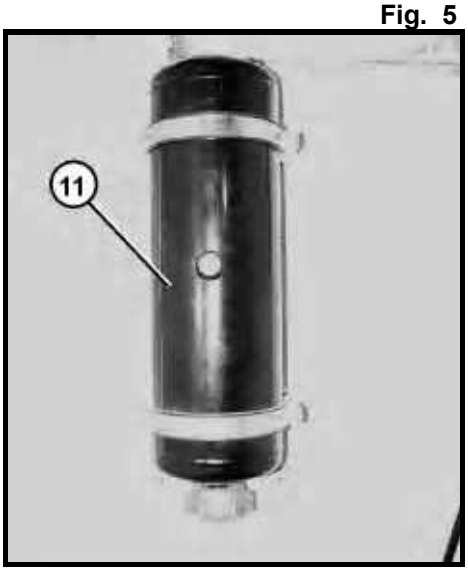


Fig. 6

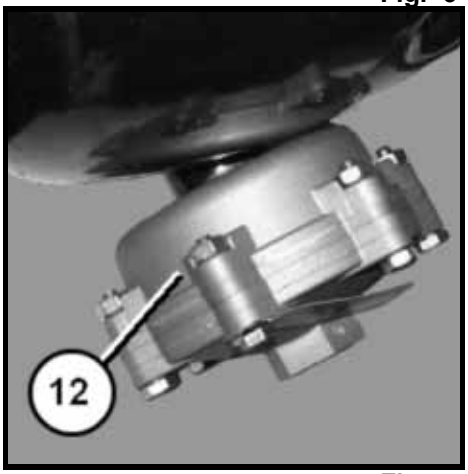


Fig. 7

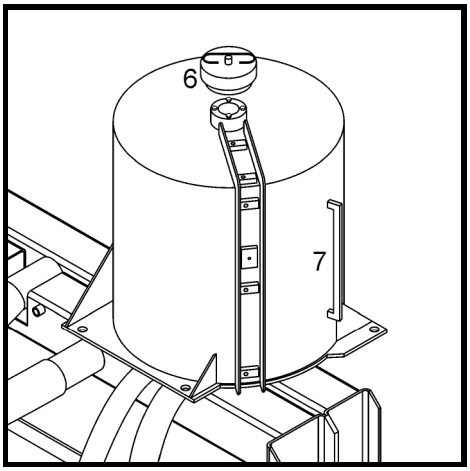


Fig. 8

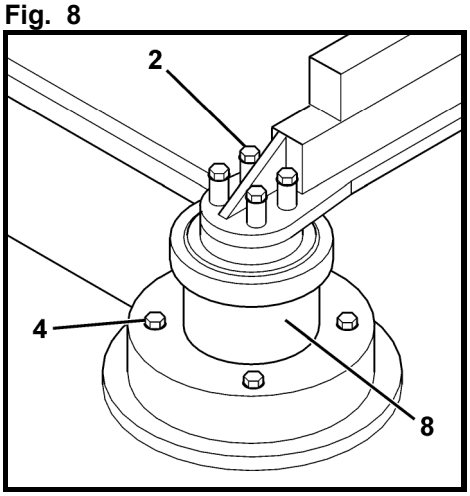


Fig. 9

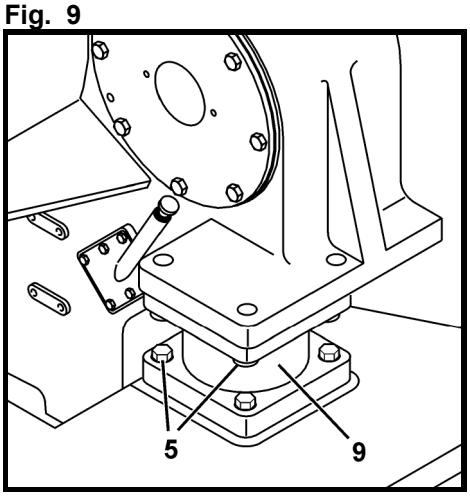


Fig. 10

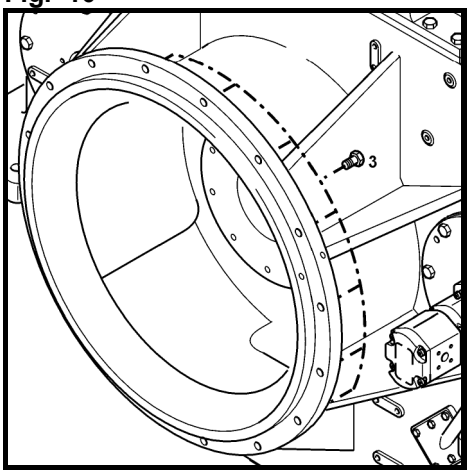


Fig. 11

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. 8) 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. 9) and the engine or gear mounts (Fig. 9, pos.4 orFig. 10, pos. 5) regularly for tightness, retorque if necessary.

Tightening torque for screws, pos. 2: 280 Nm (207 ft. lbs.).
Tightening torque for screws, pos. 4: 280 Nm (207 ft. lbs.).
Tightening torque for screws, pos. 5: 560 Nm (413 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. 11) from splitterbox to the diesel engine SAE housing regularly. Retorque if necessary.

Tightening torque for screws 3: 117 Nm (87 ft.lbs)

ELASTIC BEDDING OF ENGINE AND SPLITTERBOX – REPLACEMENT OF RUBBER BUFFERS

The four rubber cushions 8 at front face of engine (Fig. 9) and the two buffers 9 at the splitterbox side (Fig. 10) must be checked and replaced at regular intervals.

For maintenance intervals, see maintenance schedule.

BELTS

Belt for the 24 V alternator of the diesel engine (Fig. 12**).**

Please refers to the enclosed CUMMINS Operation and Maintenance Manual.

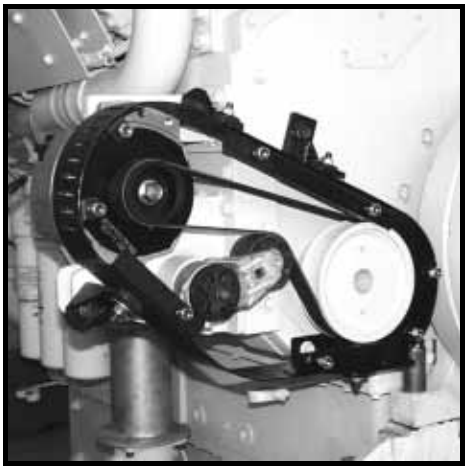


Fig. 12

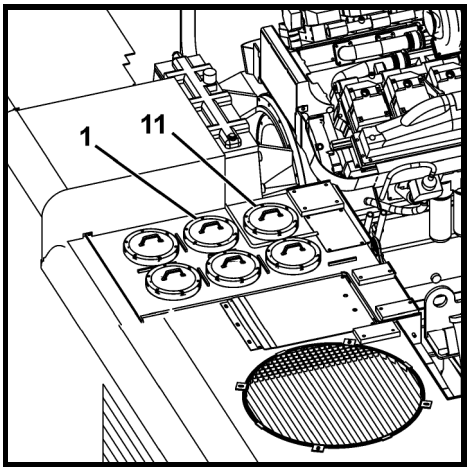


Fig. 13

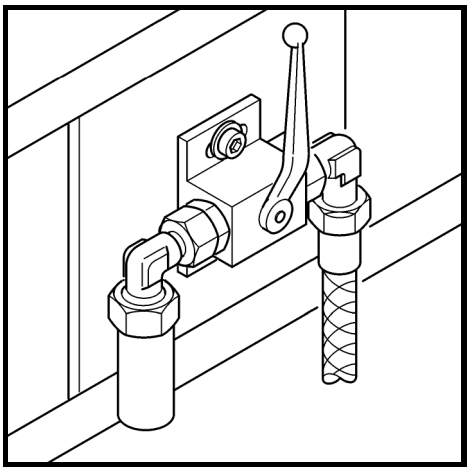


Fig. 14

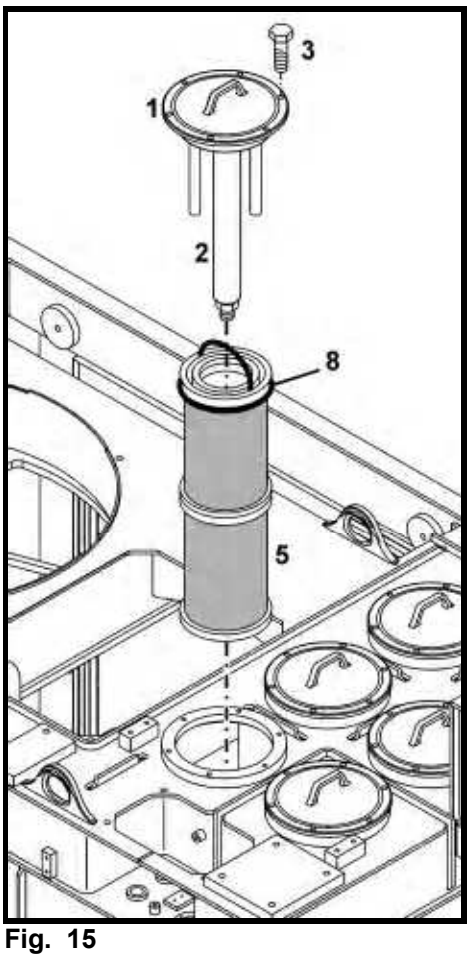


Fig. 15

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

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 (Fig. 14) 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:

Remove screws 3 (Fig. 15) and pull off the cover 1 with the magnetic rod 2.
Carefully clean the magnetic rod 2.
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.

LEAK OIL FILTER (Fig. 16)

Clean the magnetic rod of the leak oil filter (pos. 2) at the intervals specified in the maintenance schedule.

Change the filter insert 5 at the intervals specified in the maintenance schedule.

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

Remove screws 3 on the filter cover and remove the cover 1 with magnetic rod 2. carefully remove any dirt adhering to the magnetic rod. Remove the old filter element 5 and insert the new element.

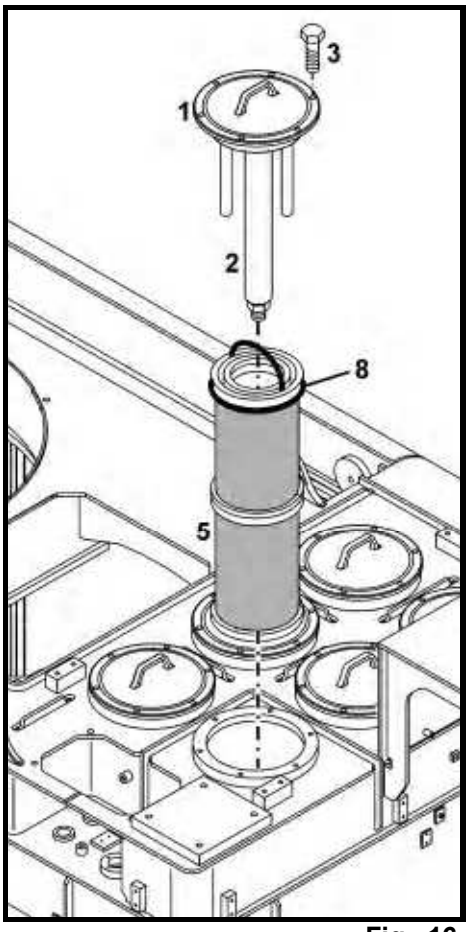


Fig. 16

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, reinstall and tighten nuts 3 evenly.

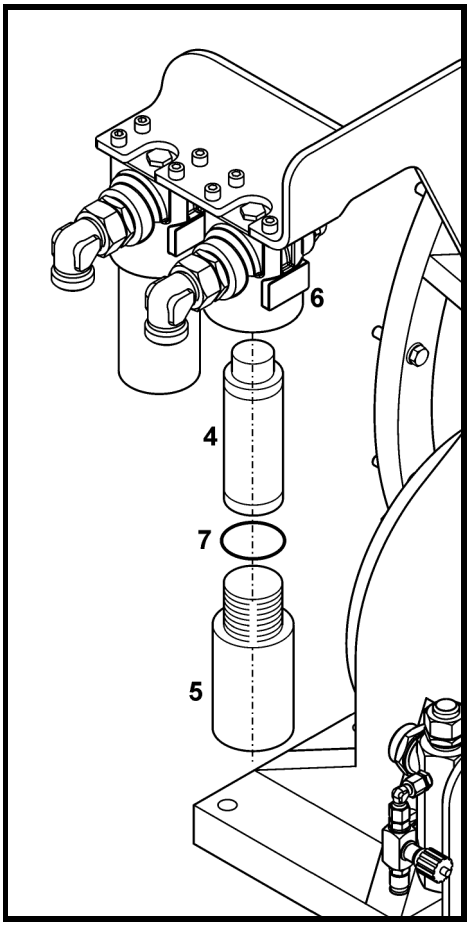


Fig. 17

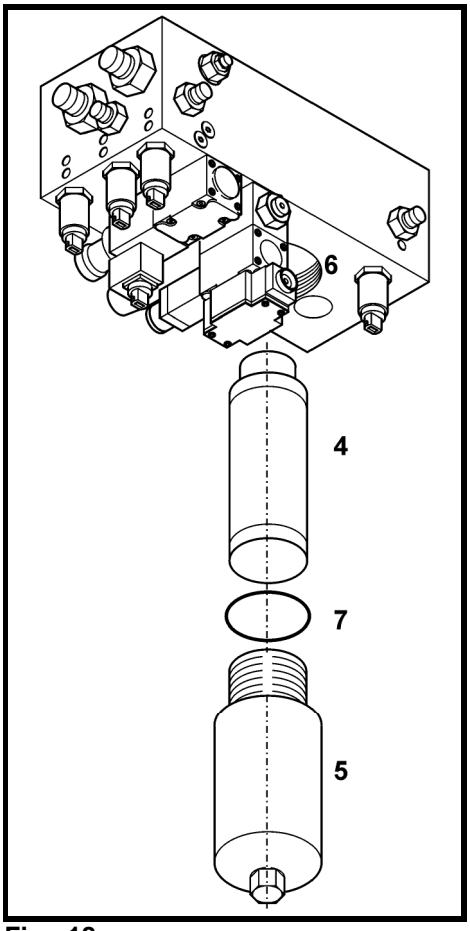


Fig. 18

REPLENISHING OIL AND SERVO OIL FILTER

Three hydraulic filters ensure filtration of the auxiliary circuits:

Two replenishing oil filters

One servo oil filter

The two replenishing oil filters for the closed swing circuit (Fig. 17) are located on the splitterbox.

The servo oil filter (Fig. 18) is installed on the frame above the hydraulic pumps.

For the filter change interval, see the maintenance schedule.

To replace a filter element

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 (Fig. 19) 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. 20),
- 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.

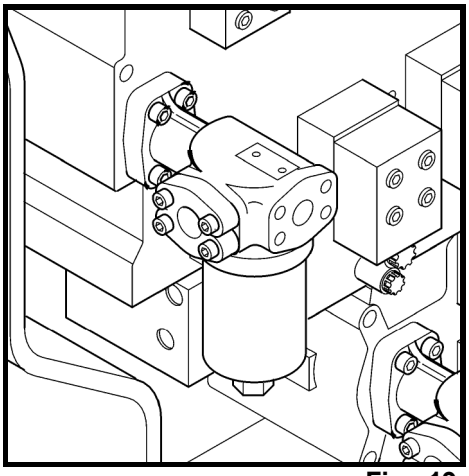


Fig. 19

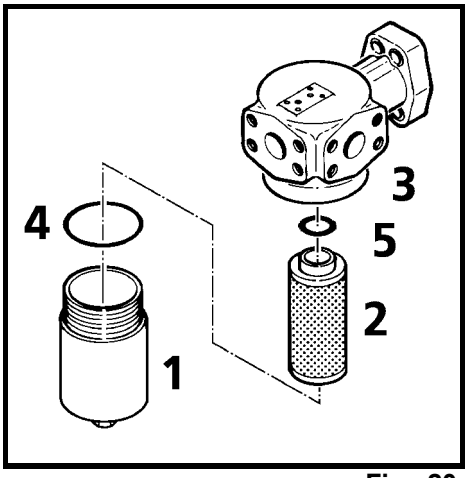


Fig. 20

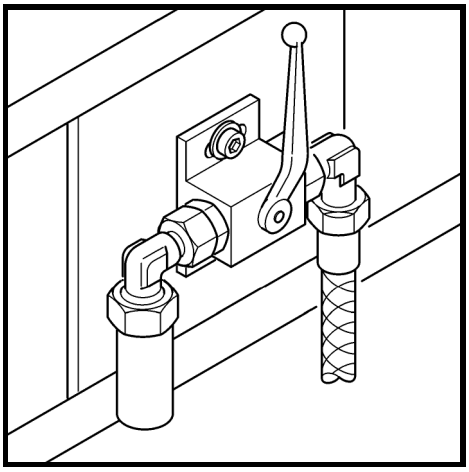


Fig. 21

THE SUCTION PIPE TO THE MAIN PUMPS

If an expansion joint on an hydraulic pump or on the main collector must be exchanged, close the shut off valve located under the grid (Fig. 22) and release the tank pressure (Fig. 21).

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

After repair, reinstall the leak oil filter cover, pressurise the hydraulic tank and return the shut off valve in opened position.

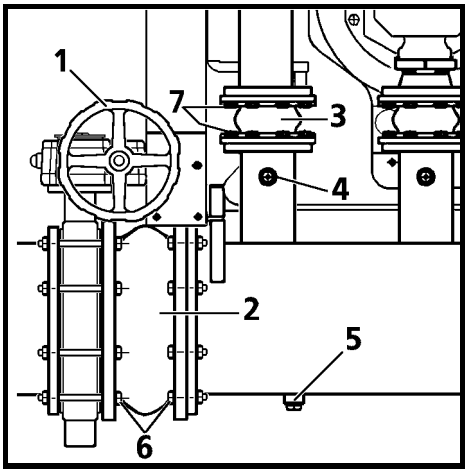


Fig. 22

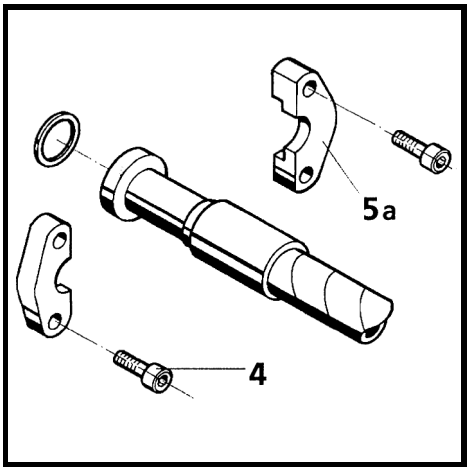


Fig. 23

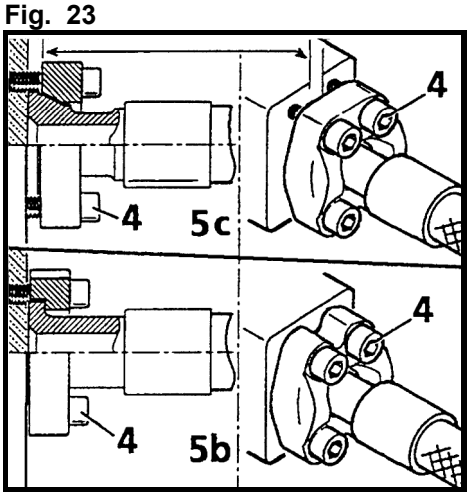


Fig. 24

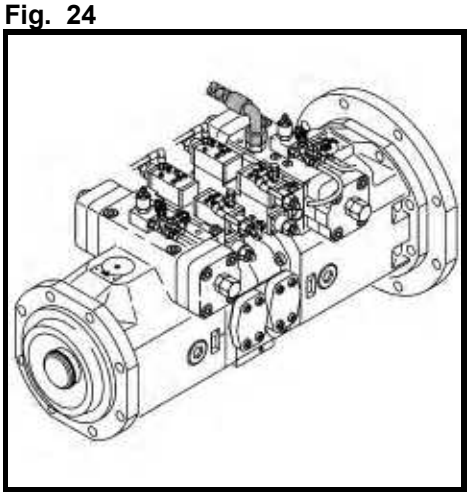


Fig. 25

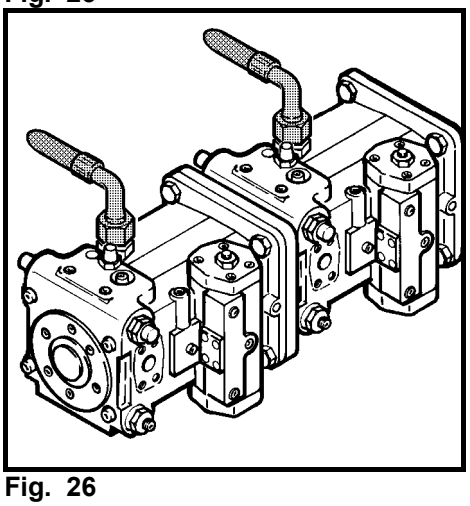


Fig. 26

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. 23and Fig. 24).

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. 25 for working pump or Fig. 26 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.

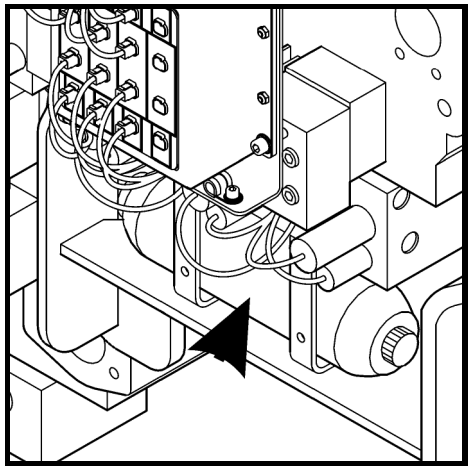


Fig. 27

DANGER

Due to an accumulator (Fig. 27**), 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 cylinder (Fig. 28), contact your LIEBHERR dealer. Leaks at the cylinder rod bearing should always be repaired by the LIEBHERR dealer.

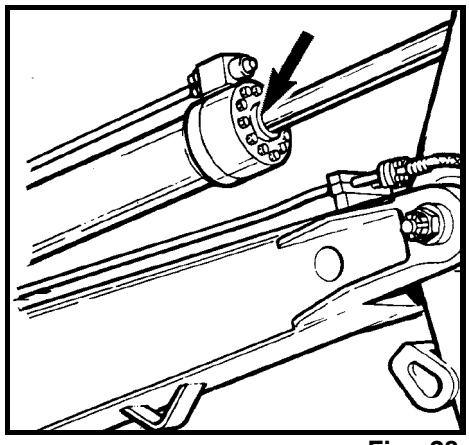


Fig. 28

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. 29).

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).

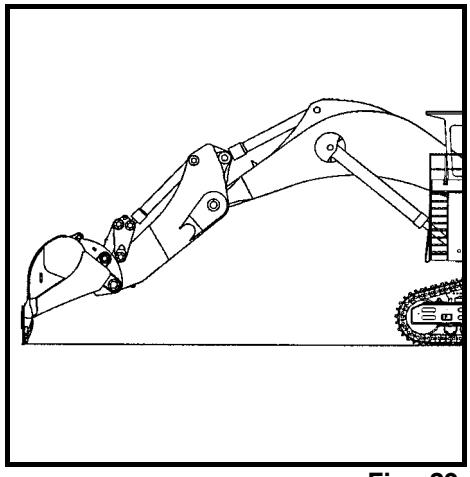


Fig. 29

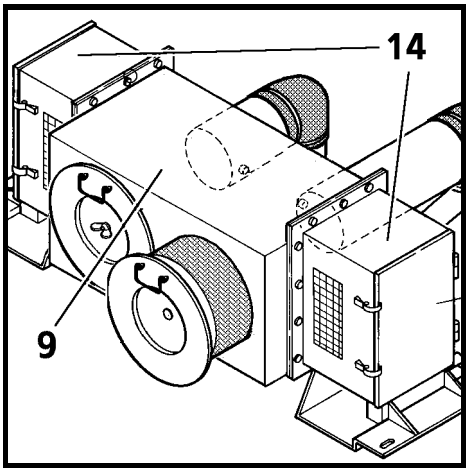


Fig. 30

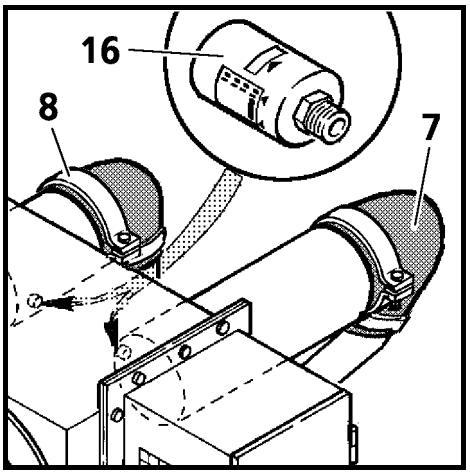


Fig. 31

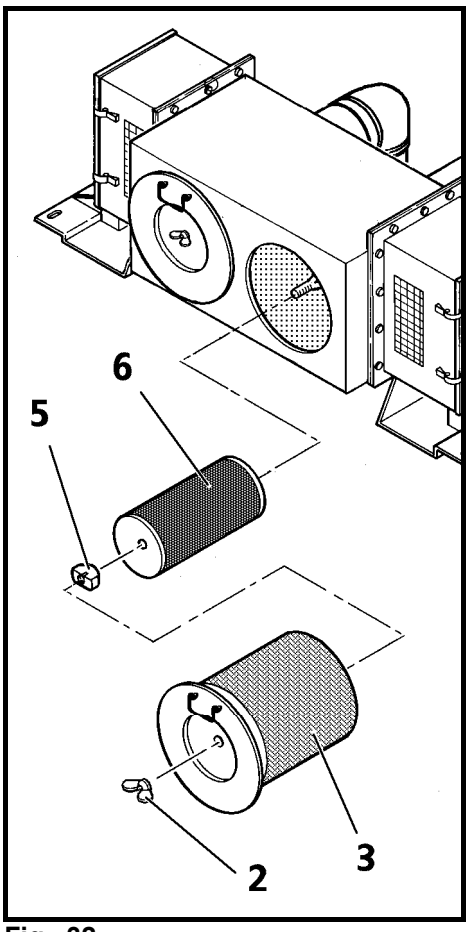


Fig. 32

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. 30).

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. 31, Fig. 33,pos. 16) stores the maximum recorded vaccum pressure on the filter outlet, during the diesel engine operation.

When the red stripe (Fig. 33, 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. 32).

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 special wing nut with built in maintenance indicator (Fig. 34, 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 special wing nuts.

Install the primary filter element 3, as outlined before.

TO CLEAN THE AIR CHANNELS FOR THE PRECLEANER (Fig. 35)

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. 31, 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. 36). If necessary, include the visual inspection of the air intake system in the daily maintenance.

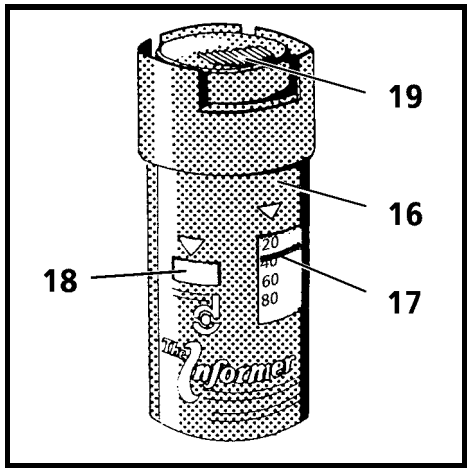


Fig. 33

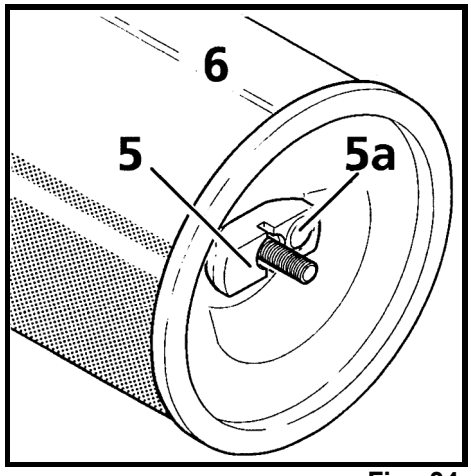


Fig. 34

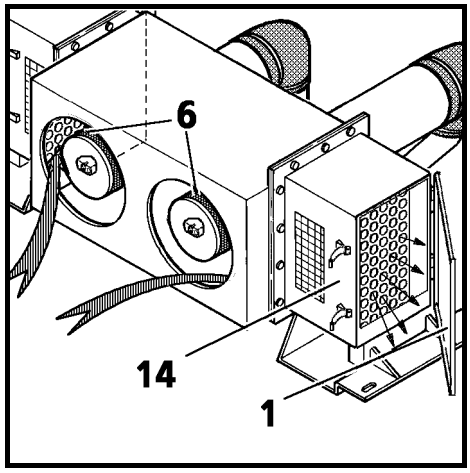


Fig. 35

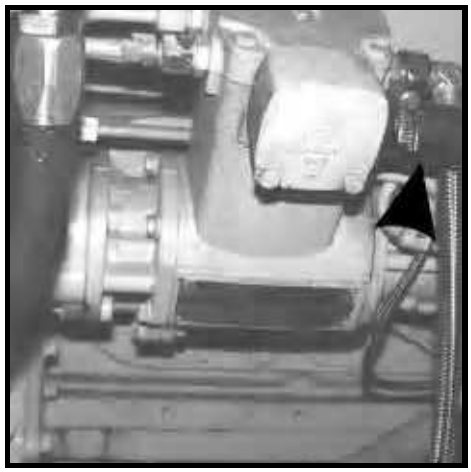


Fig. 36

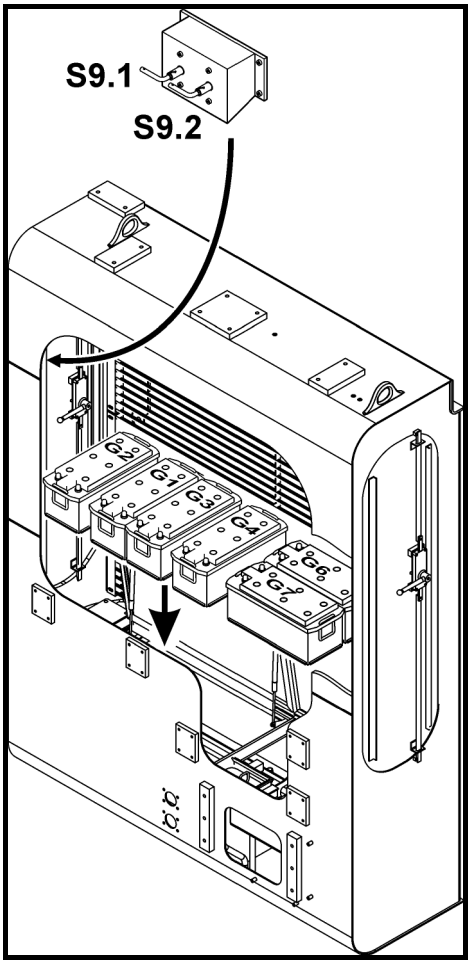


Fig. 37

THE ELECTRICAL SYSTEM

To insure trouble free 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, always disconnect the 2 cut off switches S9.1 and S9.2, which are located on the left catwalk above the door that leads to the cab.

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

BATTERY MAINTENANCE

The four main batteries and the two safety batteries are located in a compartment box (Fig. 37) on the floor at the top of the access ladder.

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. 37).

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.

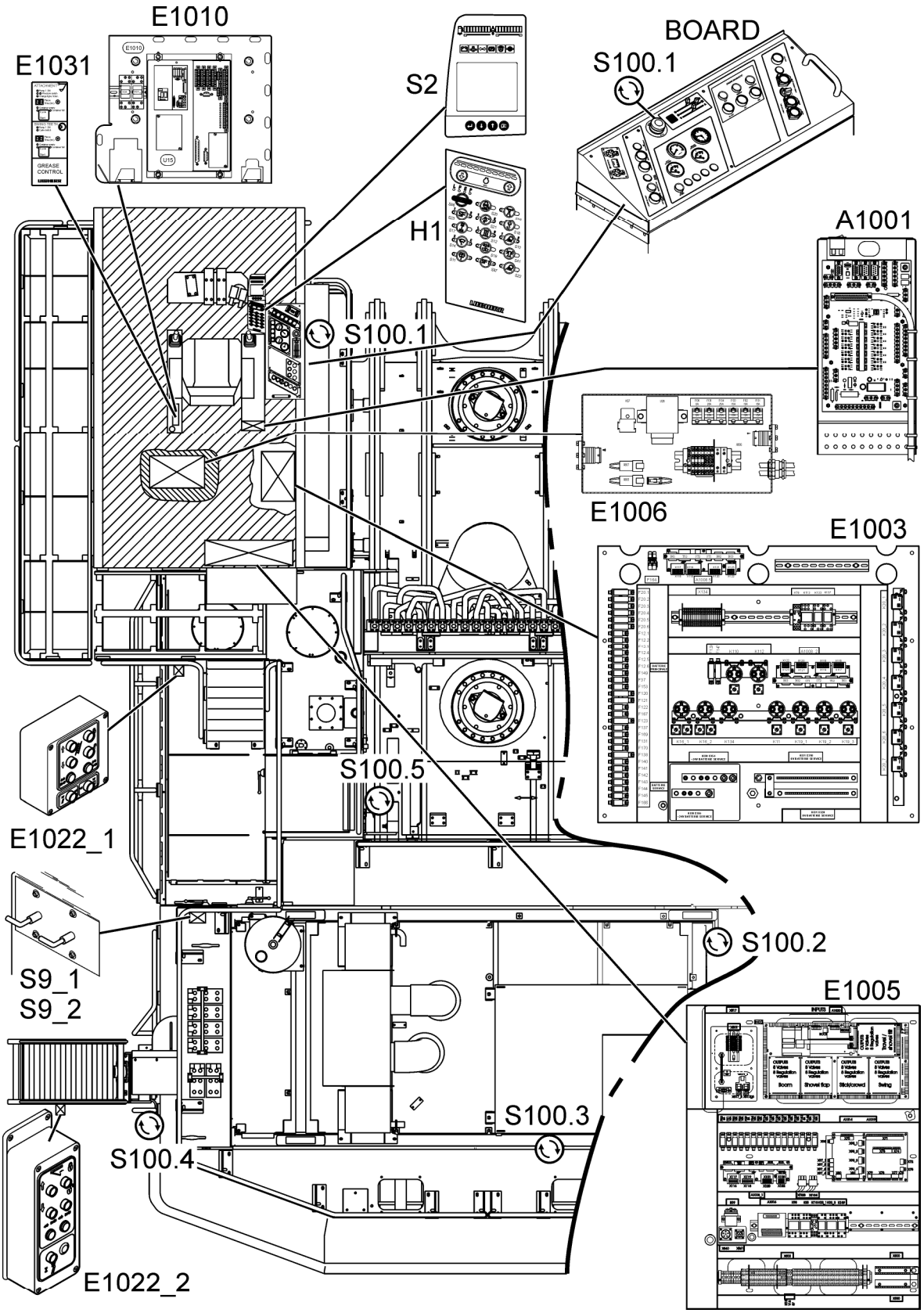
If the electrolyte level is low, add distilled water.

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.

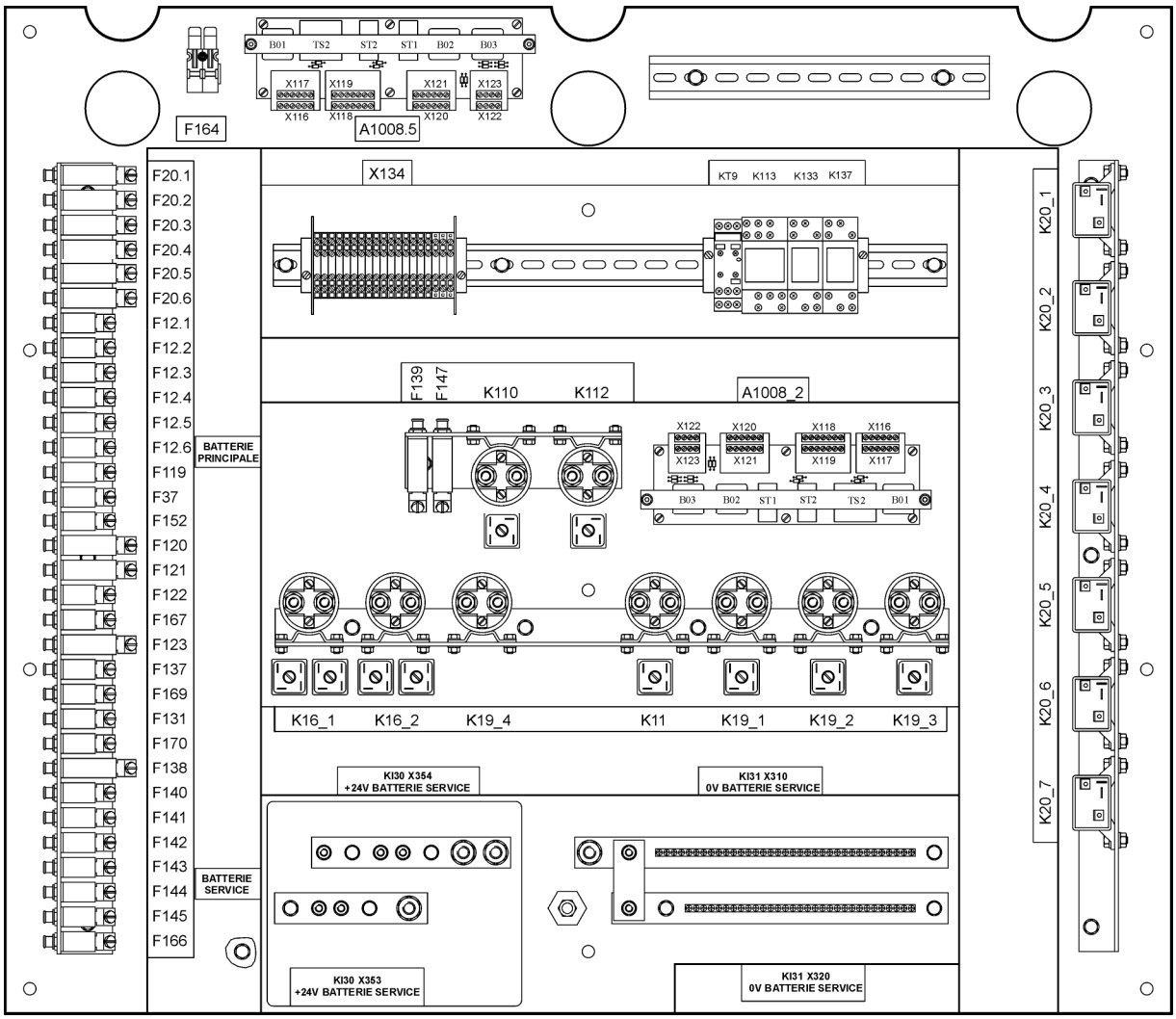


E1003	Power connection box	E1031	Greasing control unit
E1005	Cabin connection box	H1	Monitoring display
E1006	Cabin connection box / air conditioner	S2	Control unit
E1010	Cabin connection box / greasing	S9-1	Engine battery switch
E1022-1	Connection box / ladder control	S9-2	Switch quantum
E1022-2	Connection box / trap control	S100-1, 2, 3, 4 and 5	Emergeny stop

LOCATION OF SAFETY SWITCHES AND FUSES

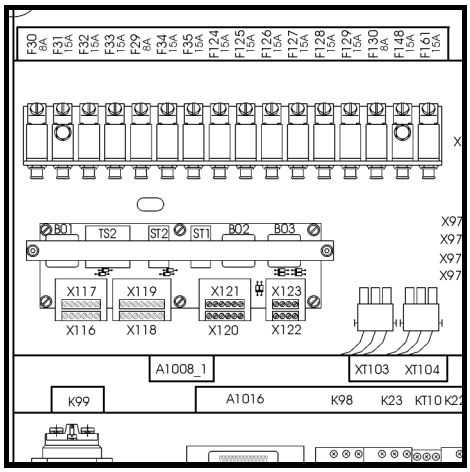
Safety switches in control box E1003 under the cab (…)

	In (A)	Fused circuits and components
F12.1	**25**	Attachment floodlight E3, E5
F12.2	**25**	Attachment floodlight E2, E4
F12.3	**25**	Fuel tank flood light, E1-1, E1-2, top of cabin floodlight E58-1
F12.4	**25**	Hydraulic tank floodlight E6-1, E6-2, top of cabin floodlight E58-2
F12.5	**25**	Counterweight floodlight E18-1, E18-2
F12.6	**25**	Optional counterweight floodlight E8-1, E8-2,E23-1, E23-2
F20.1	**100**	Supply cabin kl15
F20.2	**100**	Supply E1005 kl15
F20.3	**100**	Service battery charging current
F20.4	**100**	Kl30 floodlight
F20.5	**100**	Kl30 counterweight floodlight
F20.6	**100**	Engine
F37	**25**	Ether control
F119	**8**	Starting switch S1/kl30 prelub
F120	**50**	Air conditioning
F121	**50**	Air conditioning
F122	**15**	Optional windshield wiper
F123	**50**	Supply printplate A1020
F137	**8**	Quantum
F138	**100**	Service circuit supply
F139	**100**	Electro-hydraulic motor ladder and trap M10 supply
F140	**15**	Board
F141	**15**	Cigar lighter
F142	**15**	Lighting
F143	**25**	Lighting
F144	**15**	Ladder / trap
F147	**100**	Electro-hydraulic motor ladder and trap M11 supply / reserve
F152	**25**	Quantum
F164	**7,5**	Power connection box E1003
F167	**25**	Elevation pressure fan M15
F169	**15**	Charging



In control box E 1005 in the cab are safety switches for :

F30	8A	Attenuation plate supply reserve
F31	15A	A1020 boom / shovel tilt
F32	15A	A1020 stick / swing
F33	15A	A1020 travel / trap
F34	15A	A1020 FSG
F35	15A	A1020 FSG controller
F124	15A	Safety switch servo cut off S7 ESP01 plate A1001
F125	15A	Regulation plate A1019 Electronic box BST U16
F126	15A	ESP01 plate A1001
F127	15A	Greasing
F128	15A	Board
F129	15A	Cabin
F130	8A	ESP01 plate A1001
F148	15A	Regulation plate A1019
F161	15A	Connection box pump transmitters E1036



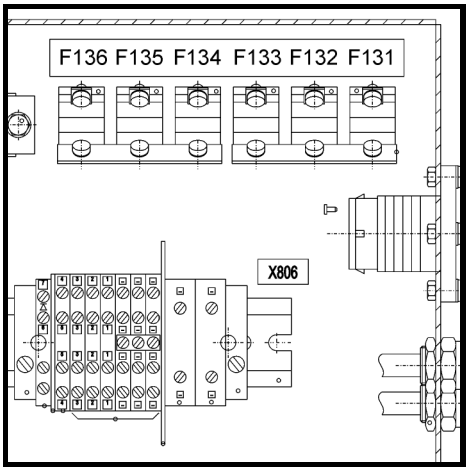


Fig. 38

The safety switches for the air conditioner are in control box E1006 in the ceiling of the cab (Fig. 38).

F131	15A	Evaporator motor 1
F132	15A	Evaporator motor 2
F133	15A	Evaporator motor 3
F134	25A	Reserve E1006
F135	25A	Reserve E1006
F136	8A	Reserve E1006

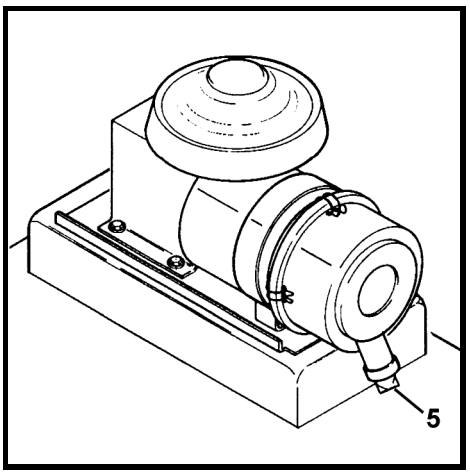


Fig. 39

To clean the air filters for electrical box and cab pressurisation, press to open the dust discharge valve 5.

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. 41, pos. 2).
- Remove and clean the fresh air filter of the heater (Fig. 41, 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. 40). Otherwise the heater core must be vented correctly after refilling.

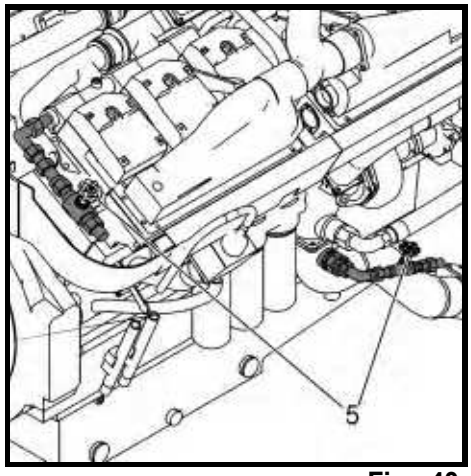


Fig. 40

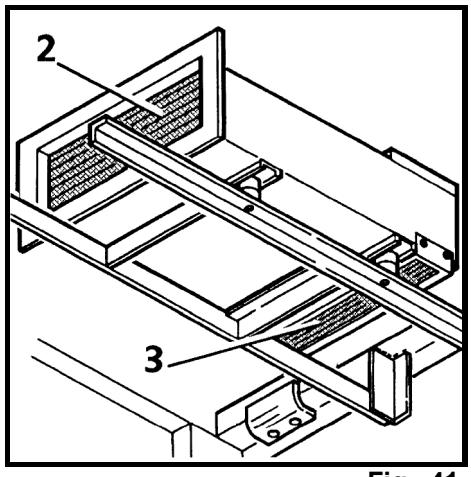


Fig. 41

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 located on the engine radiator (Fig. 42, pos 30) and if necessary blow it out with pressurised air or steam, from the inner (fan side) to outside.
- Clean the recirculating air filter on the evaporator in the cab (Fig. 43).

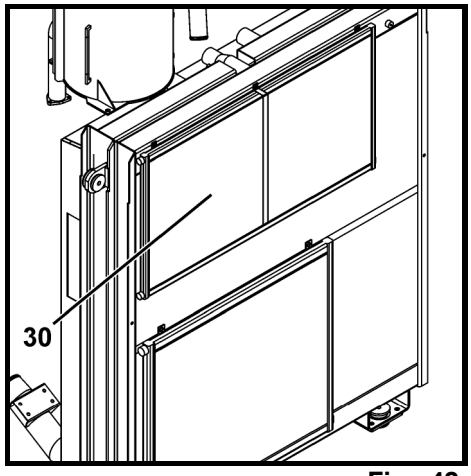


Fig. 42

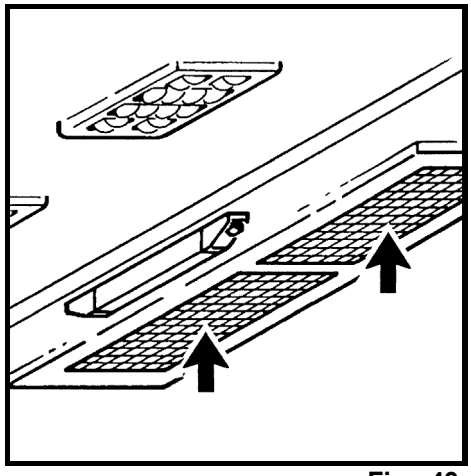


Fig. 43

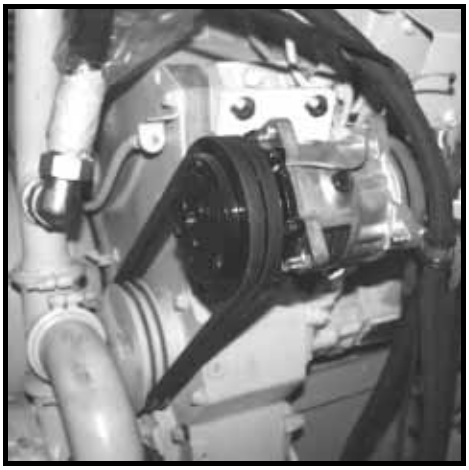


Fig. 44

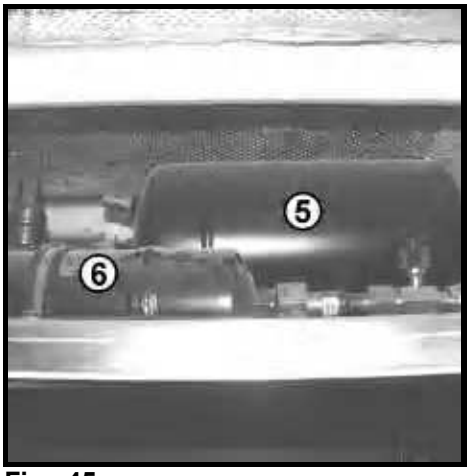


Fig. 45

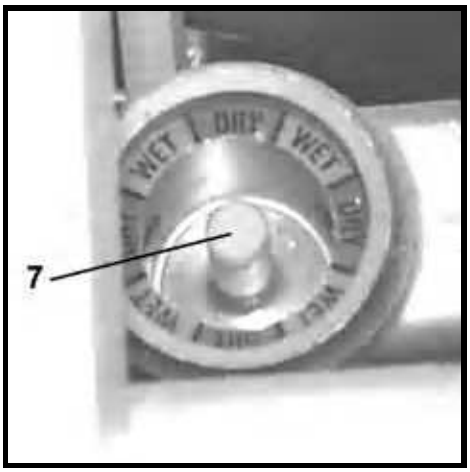


Fig. 46

- Check the V-belts of the compressor (Fig. 44) 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 eight mounting bolts M42 (Fig. 48, pos. 1) must be torqued to 5400 Nm (3982 ft.lbs).

MOUNTING BOLTS OF THE SWING RING

The stud bolts M36 (Fig. 49, pos. 4) for the mounting of the swing ring 10 to the uppercarriage 11 must be tensioned to 570 kN. The stud bolts M36 (pos. 3) for the mounting of the swing ring 10 to the undercarriage 12 must be tensioned to 570 kN. Tighten the protection nuts 5 on the bolts 3 and 4 between 500 and 1000 Nm.
The use of special tensioning procedure and tool is necessary to obtain the correct bolt tension (LIEBHERR recommends the employ of the special bolt tensioning cylinder ident. Nb. 5617448, at the required hydraulic pressure of 1350 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 M30 of the hydraulic tank and the fuel tank must be torqued to 1900 Nm (1400 ft.lbs). the six mounting bolts M36 of the powerpack must be torqued to 3300 Nm (2434 ft.lbs) the thread of the screws must be greased under its head and both sides of the washer with Mobiltalc 81's grease (ident. 8503279).
For the excavators equipped with the Centinel system, the tightening of the mounting bolts of the Centinel tank is described page 8.1.

MOUNTING BOLTS OF THE SWING GEAR AND MOTOR

The mounting bolts M30 of the swing gear (Fig. 51, pos. 7) must be torqued to 1900 Nm (1400 ft.lbs).
The mounting bolts M24 of the swing motor (pos. 8) must be torqued to 960 Nm (708 ft.lbs).

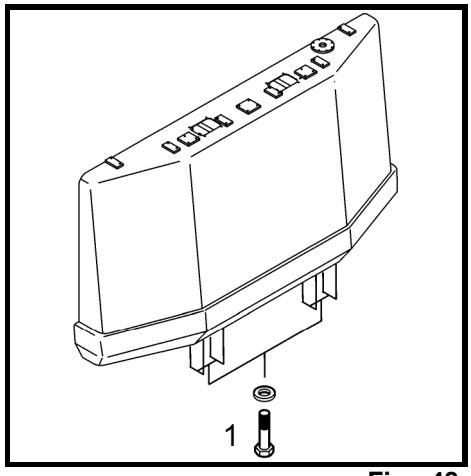


Fig. 48

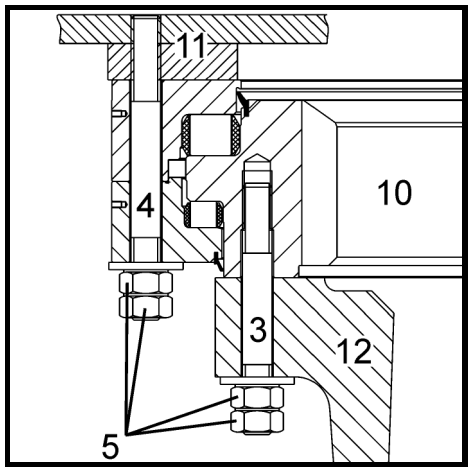


Fig. 49

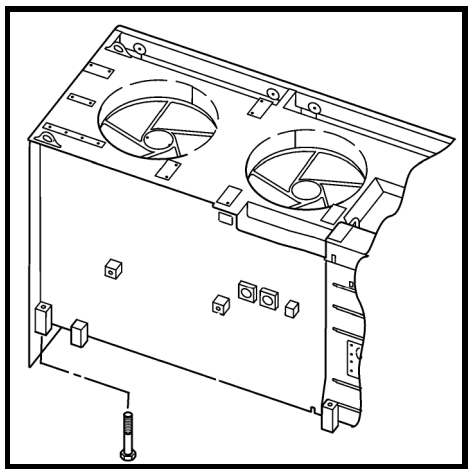


Fig. 50

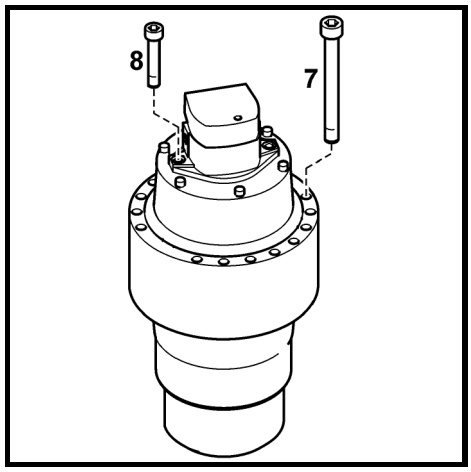


Fig. 51

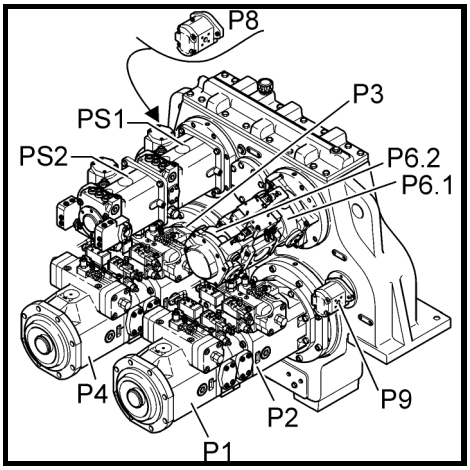


Fig. 51

MOUNTING BOLTS OF HYDRAULIC PUMPS

The mounting bolts M20 of the main working pumps (Fig. 51, P1, P2, P3 and P4) must be torqued to 425 Nm (315 ft.lbs).

The mounting bolts M20 of the swing pumps (Fig. 51, PS1 and PS2) must be torqued to 425 Nm (315 ft.lbs).Nm.

The mounting bolts M16 of the water cooler fan pump (P6.1) and the oil cooler fan pump (P6.2) must be torqued to 210 Nm (155 ft.lbs).

The mounting bolts M12 of the splitterbox lube oil pump (P8), of the control oil pump (P9) and of the replenishing oil pumps (P10.1 and P10.2) must be torqued to 85 Nm (63 ft.lbs).

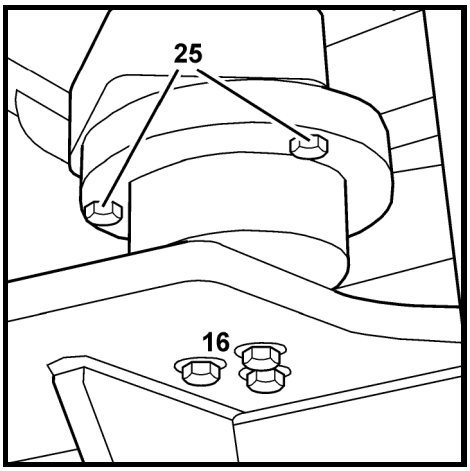


Fig. 52

MOUNTING BOLTS OF THE DRIVER'S CAB

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

This screw (Fig. 52, pos. 16 and 25) are of size M16 and must be torqued to 280 Nm (206 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.

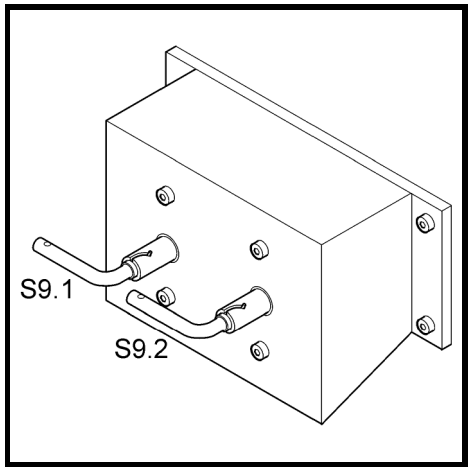


Fig. 53

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 2 cut off switches S9.1 and S9.2 to protect the electrical components.

S9.1: switch battery / ground isolator

S9.2: switch QUANTUM.

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.

DAILY / WEEKLY MAINTENANCE SCHEDULE P 994B

Daily	Weekly		WORK TO BE PERFORMED O repeat interval ☐ 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		
			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 filter (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 – 7,25 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 P 994B

Daily	Weekly		WORK TO BE PERFORMED O repeat interval □ 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
			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 (on the engine)		OM 6.24
			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 994B_1001a.4a		OM 5.24
	O		**Weekly:** perform a complete weekly maintenance as stated on page 994B_1001a.4a		OM 5.24

MAINTENANCE SCHEDULE P 994B

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 ○ repeat interval ☐ first and only interval	Adjustment, Values, Quantities in liters (US Gal.)	For description refer to: **OM:** ○ ti
○	○	○	○	○	○	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
	☐		○	○		Check the oil quality in splitterbox, change if necessary	75 (19,8)	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 To extend the oil change interval, it is advised to use the chart method (see CUMMINS Manual page 19 (QSK45 with 75 US Gallon sump)). This method allows to extend the oil change interval.		
						Every 10000 hours or 2 years, perform a complete “10000 hrs” Maintenance Echelon, as stated in CUMMINS Operation and Maintenance Manual		
						See CUMMINS Operatin and Maintenance Manual for other maintenance (Eliminator, Centinel, Fleetguard, valves and injectors adjustment)		
						Every 20000 hours, perform a complete “20000 hrs” Maintenance Echelon, as stated in Geislinger (coupling manufacturer) Manual		
						HYDRAULIC SYSTEM		
		☐	○	○		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 6.10
		☐	○	○		Check mounting of components (pumps, motors, clamps,…)		OM 6.24
○			○	○		Check and adjust primary and secondary pressure relief valves		
				○		Replace hydraulic oil	2500 (794)	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 994B_1001a.4a		OM 5.24
					○	**Every 7500 hours**, perform a complete 7500 hrs Maintenance Echelon as stated on page 994B_1001a.4a		OM 5.24

MAINTENANCE SCHEDULE P 994B

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 ○ repeat interval □ 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		OM 6.18
			○	○		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)	2×37 (9,8)	OM 5.21
				○		Check mounting screws of gear and oil motor		OM 6.25
						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		OM 6.23
					○	Replace the filter / drier (at least every two years)		OM 6.24
						Yearly check condition of the refrigerant receiver, if necessary replace it		OM 6.24
						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		

8. OPTIONAL ATTACHMENTS

CENTINEL SYSTEM

The Centinel system allow to increase the engine oil change interval. This system is described in the Operation and Maintenance Manual CUMMINS.

TO REFILL THE CENTINEL TANK

Refill via the quick change coupling 6 (Fig. 1), until the level reaches the upper sight glass on the tank (Fig. 1). For oil quantities, oil specifications, see lubrication and maintenance charts.

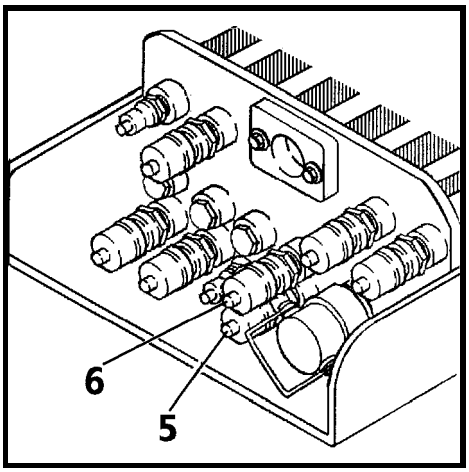


Fig. 1

TO ADD OIL IN THE ENGINE SUMP VIA THE CENTINEL VALVE

By opening the valve (Fig. 2), it is possible to refill the engine sump with oil of the centinel tank.

DANGER

This valve must be opened only to refill the engine sump. In others cases, it must always remain closed.

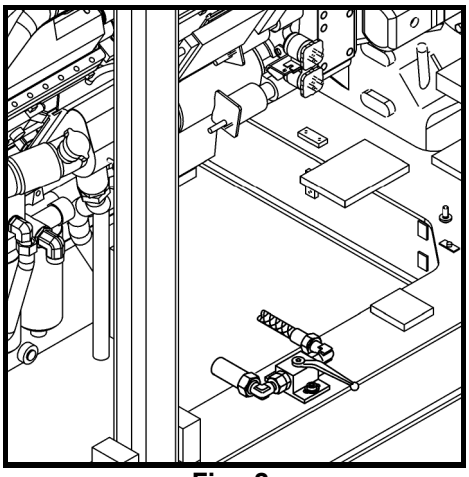


Fig. 2

TO CHECK MOUNTING BOLTS OF THE CENTINEL TANK

The mounting bolts M20 of the centinel tank (Fig. 3) must be torqued to 560Nm.

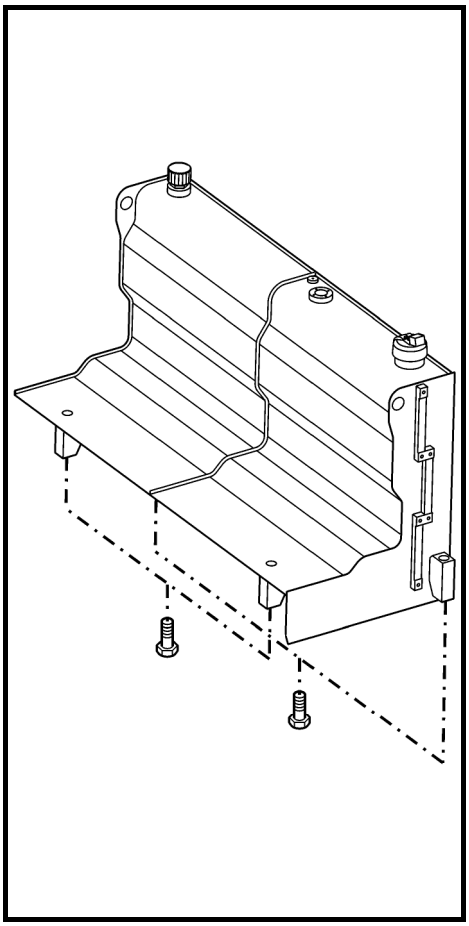


Fig. 3

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.

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.