en

Service Manual

Hydraulic excavator
R 9150 E

from serial number 38120

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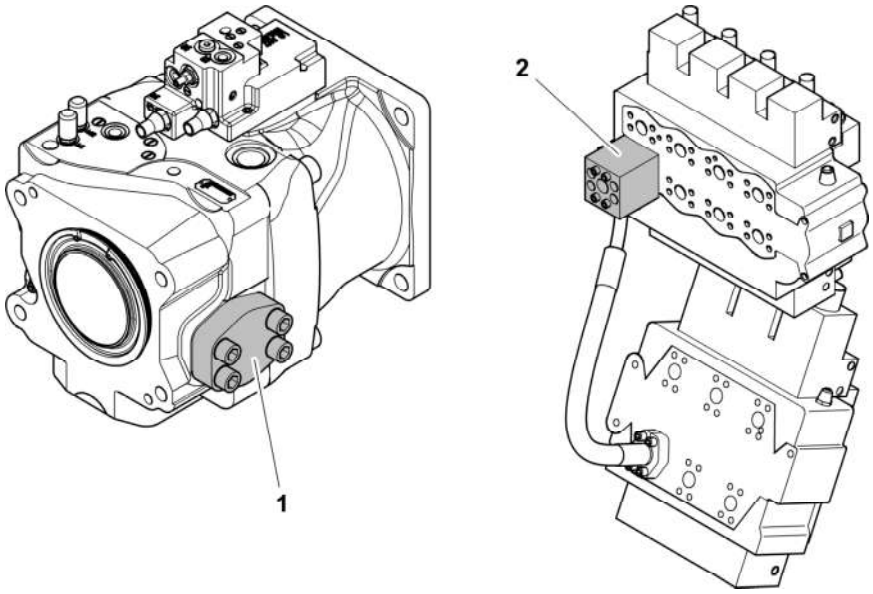
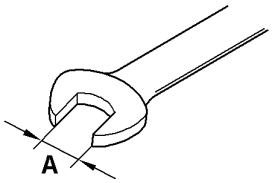
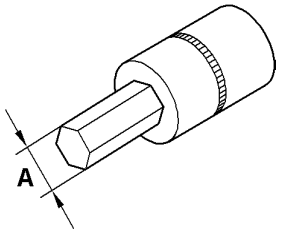


Fig. 2 *Sealing flange **1** and hydraulic block **2***

3.3 Dimensions of the wrenches/tools

				
Size of the screw	**A (mm)**	**A (in)**	**A (mm)**	**A (in)**
M8	13	1/2	6	
M10	16 or 17	11/16	8	
M12	18 or 19	3/4	10	
M14	22	7/8	12	
M16	24	61/64	14	9/16
M18	27	1-1/16	14	9/16
M20	30	1-3/16	17	43/64
M22	32	1-9/32	17	43/64
M24	36	1-7/16	19	3/4
M27	41	1-5/8	19	3/4
M30	46	1-13/16	22	7/8
M33	50	2	24	61/64
M36	55	2-3/16	27	1-1/16
M39	60	2-3/8	27	1-1/16

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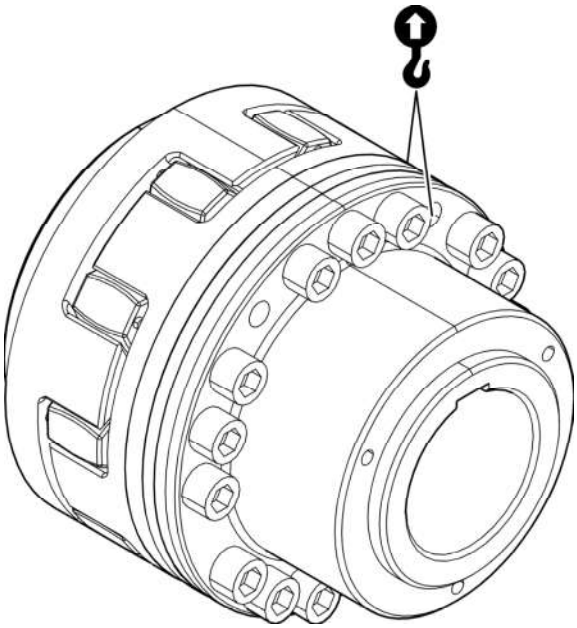

Fig. 2 *Coupling lifting points of inner part*

Weight: 75 kg

Thread of the lifting nut: M12

▶ Install the lugs on the applicable threads.

Do not lift the total mass with only one lug.

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3.1.2 Adjust the servo pressure

- ▶ Install a 100 bar gauge on **M1**.
- ▶ Start the electric motor.
- ▶ Turn the adjustment screw **1** on the servo unit until you get the correct servo pressure on **M1**.

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- ▶ Set the current of the solenoid valve **YR517** to 100% with the software "Sculi".
- ▶ As an alternative to the step above, you can select in the submenu "**Tool control**" a setting with the parameters that follow, refer to the Operating Manual:
- – maximum pressure: 380 bar
- – maximum flow: 100%
- ▶ Make sure that the pedal control mode is activated.
- ▶ Push left pedal **7d** on **U20**. Refer to the Operating Manual.
- ▶ Turn the adjustment screw of the solenoid valve **YR517** until you get the correct pressure **P**.
- ▶ Adjust again the primary relief valve **PRV23** as given in the section "Primary valves adjustment".

Adjust the secondary valve VB2.1A

- ▶ If the pressure ports **VA1** and **VA2** are installed, make sure that they are not opened.
- ▶ Close the two valves **VA3** and **VA4**.
- ▶ Turn the three-way valve **VA5** to connect the hose **2** to the hose **3**.
- ▶ Install a 600 bar gauge on **HPF3**.
- ▶ Start the electric motor.
- ▶ Set the current of the solenoid valve **YR517** to 0% with the software "Sculi".
- ▶ As an alternative to the step above, you can select in the submenu "**Tool control**" a setting with the parameters that follow, refer to the Operating Manual:
- – maximum pressure: 140 bar
- – maximum flow: 100%
- ▶ Make sure that the pedal control mode is activated.
- ▶ Push left pedal **7d** on **U20**. Refer to the Operating Manual.
- ▶ Turn the adjustment screw of the secondary valve **VB2.1A** until you get the correct pressure **P**.

Adjust the secondary valve VB2.1B

- ▶ If the pressure ports **VA1** and **VA2** are installed, make sure that they are not opened.
- ▶ Close the two valves **VA3** and **VA4**.
- ▶ Turn the three-way valve **VA5** to connect the hose **2** to the hose **3**.
- ▶ Install a 600 bar gauge on **HPF3**.
- ▶ Start the electric motor.
- ▶ Set the current of the solenoid valve **YR517** to 0% with the software "Sculi".
- ▶ As an alternative to the step above, you can select in the submenu "**Tool control**" a setting with the parameters that follow, refer to the Operating Manual:
- – maximum pressure: 140 bar
- – maximum flow: 100%
- ▶ Make sure that the pedal control mode is activated.
- ▶ Push right pedal **7c** on **U20**. Refer to the Operating Manual.
- ▶ Turn the adjustment screw of the solenoid valve **VB2.1B** until you get the correct pressure **P**.

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4.40: Non-Destructive Test (NDT)

1 Structural inspection - Backhoe Attachment

1.1 Range of use

This inspection chart is valid for the inspection (visual check and non-destructive test) of the machine's structure parts.

This document describes the inspection procedure and includes external views of the structural components to be inspected in order to detect the possible defects as follow:

– Any obvious and visible damage to the structure parts,
– Cracks in welding seams, plates, casting parts.

1.2 Scope of inspection

The inspections must be done at recommended intervals as described below, or earlier if necessary.

The applicable safety rules have to be followed when preparing and conducting the inspections, taking into account dangerous situations (for example working in height, working in confined space, etc...). Before any inspection, it is recommended to isolate the machine and to perform a "Job safety analysis", as per applicable procedures.

Inspection every 500 hours:

Do a visual inspection of the external structural parts of the machine (see list in section "Inspection documents - Components sketches")

Every year or at least every 7500 hours:

Do a detailed visual inspection of the external structural parts of the machine (see list in section "Inspection documents - Components sketches")

For the attachment (boom, stick), an internal inspection must be done, depending on the access possibilities.

This inspections must be more detailed than the 500 hours.

Enough time has to be scheduled to provide a complete and a careful inspection.

During the 500 hours and 7500 hours, a visual inspection must be realized as described in section "Inspection procedure - Visual inspection".

A detailed visual inspection of the following points must be checked:

– All welding seams of the structure,
– Junctions between the casting parts and the steel plates,
– All casting parts,
– All threaded plates.

If a defect is suspected or detected, follow the instruction in section "Inspection procedure - Dye penetrant test".

These visual inspections and recommendations provided by Liebherr, the Original Equipment Manufacturer (OEM) shall only be treated as a guideline. More intensive inspections (such as ultrasonic testing, magnetic particle inspection), on a yearly basis or to scrutinize a visually detected defect, are strongly recommended by the OEM. Such methods may be possible for some specific area only.

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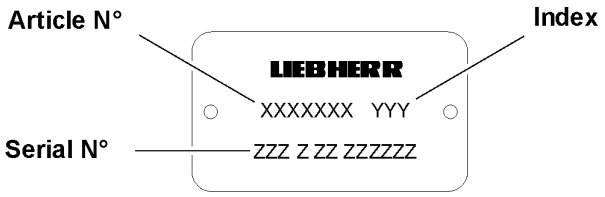
Component identification:

The welded parts are identified with a nameplate as described below.



2.4.2 Components sketches

The following sketches (see pages hereafter) show the different components of the machine to be inspected.

- Front shovel boom,
- Front shovel stick,
- Shovel bucket back,
- Shovel bucket sole,
- Undercarriage
- Rotating deck,
- Hydraulic tank,
- S1, S2 high voltage box,
- Cab elevation,
- Cabin.

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LIEBHERR

Built for Maximum Profitability

Electro-Hydraulic System Efficiency
Liebherr hydraulic technology in combination with the precision of electronic control contributes to the R 9150 B's efficient use of energy. The high-pressure hydraulic system and the optimized pipe and hose layout maximize usable power transmission. Hydraulic pumps are electronically managed to provide optimal pressure compensation and oil flow management. The hydraulic system is independently regulated over the engine circuit for the best operational efficiency.

Closed Loop Swing Circuit
All Liebherr Mining excavators are equipped with a closed loop swing circuit. Kinematic energy is recovered when the swing motion is used during deceleration, to drive the main and auxiliary pumps, reducing fuel consumption and allowing faster boom lift motion.

Independent Cooling System
Oil and water cooling fans are independent and electronically managed. The on-demand cooling control enables to maximize available power for the working process. This technology contributes to maintaining sustainable temperature of all hydraulic components extending their life.

Comfortable Cab for Efficient Work

Superior Operator Comfort
The modern large cab provides ideal working conditions and optimal operator's comfort. Mounted on silent blocks, the R 9150 B's cab design reduces vibrations. The new headliner limits noise pollution to provide a quiet working environment.

Extended Components Lifetime

The R 9150 B's high pressure hydraulic oil filtration systems remove contaminants from the fluid to offer the highest rate of hydraulic system efficiency. To maintain the oil quality, all return hydraulic oil flow goes through a 15/5 µm fine filtration system, while the grease and fuel tanks are sized to considerably extend the time between service intervals.

Advanced Machine Monitoring
- 10.5" LCD color screen
- Information interface to operator
- On-board diagnostics to service staff
- Real text information
- Long term data storage for maintenance

First-Class Service Arrangements
Service friendly design allows for easy and fast maintenance for maximum uptime:
- Service from one-side
- Large catwalks and walkways
- Refillable grease tanks instead of drums to be changed
- Centralized lubrication system
- Enhanced single-line lubrication system

Comfort-Oriented Cab Design
An array of features:
- Tinted laminated safety glass
- Armored front window
- Adjustable air suspended seat
- A/C with dust filter in fresh/recirculated air
- Pressurization to prevent dust penetration (optional)
- Operator Comfort Kit (optional): sun blinds, bottle cooler, reading light, automatic operator's seat weight adjustment
- Pre-heating system (optional)

2 Safety instructions

Working with the machine holds dangers to which you as the owner, machine operator or maintenance expert could be exposed. If you regularly read and note the safety information, however, you can prevent danger and accidents. This is particularly true for those who are only occasionally in contact with the machine, e.g. for maintenance work. The following information comprises safety regulations which, if followed conscientiously, will contribute to your safety and that of other persons, as well as avoiding damage to the machine.

Following these precautions does not release you from the responsibility to take note of safety regulations which apply on site or of guidelines given by legal bodies or professional associations.

For EU countries, guideline 2009 / 104 / EC contains the minimum required safety information applicable to the owner.

2.1 Meaning of the symbols in this manual

Work processes and actions that could cause danger are accompanied by safety informations in these operating instructions. These safety informations describe various dangers which are emphasized by the terms **Danger**, **Caution** and **Note**.

These terms are identified by symbols in the operating instructions and have the following meaning:

Danger!
Warning relating to a danger that carries with it a high risk of death or serious injury if the appropriate preventative measures are not taken.

Caution!
Warning relating to dangers that could result in physical injury and/or damage to the machine if the appropriate preventative measures are not taken.

Note!
This symbol identifies user tips and operating and maintenance procedures whose use will guarantee a high degree of user-friendliness and longevity to the machine or which will considerably simplify working procedures.

– This symbol identifies a listing.
  • This symbol identifies a sub-listing.

❑ This symbol signifies the following: “The precondition must be fulfilled”.
The machine operator or the maintenance personnel must first fulfil the precondition described, i e. the machine must be brought into a particular work position in order to be able to carry out the actions subsequently described.

▶ This symbol identifies an action.
The machine operator or the maintenance personnel should be active at this location and carry out the action described.
↳ This symbol means “Carry out an activity".

rubber parts or seals.

Process materials

- When working with oils, greases and other chemical substances, observe the appropriate current safety regulations for the product.
- Ensure that process materials and replacement parts are disposed of in a safe and environmentally acceptable manner.
- Take care when handling hot process materials
  (Risk of burning and scalding).

Repair work

- Do not attempt to lift heavy parts. Use devices which are suitable for this purpose and which have sufficient load capacity. When replacing single parts and larger subassemblies, carefully secure them on lifting devices so that they do not present a risk. Only use suitable and correctly functioning lifting devices and load take-up devices with adequate load capacity.
  Do not stand or work under swinging loads.
- Do not use lifting devices which are damaged or do not have sufficient load carrying capacity.
  Wear work gloves when working with wire cables.
- Authorize only experienced people to attach load and to give indications to the crane operator. This people must be in the operator's sight or in radio contact with him.
- When working above body height, use safe climbing devices and working platforms which are appropriate for the job.
  Do not use machine parts as climbing devices if they are not designed for this purpose.
  When working at height, wear a harness to prevent falling.
  For further information, see section "Maintenance anchor points" or contact Liebherr customer service.
- Ensure that all grips, steps, rails, platforms and ladders are free of dirt, snow and ice.
- Pneumatic cylinders do not have to be used as handles. Open doors and covers carefully, so that pneumatic cylinders do not hit their stops, because this could cause mechanical damages.
- Make sure the equipment on which you will operate is securely supported before working (e.g. replacing teeth). Prevent metal touching metal when doing this.
- For safety reasons, never open and remove a track chain unless having previously totally released the pretension of the chain tensioning unit.
- Never lay under the machine if it is raised with work equipment and has not been securely supported with appropriate supports.
- Always jack the machine up in such a way that any weight displacement does not jeopardize stability and prevent metal touching metal while doing this.
- Work on the suspension, brake and steering systems may only be carried out by trained specialist personnel.
- If the machine has to be repaired on a slope, secure the crawler with chocks and connect the upper structure to the chassis using stop bolts.
- Only personnel with special training and experience may work on hydraulic equipment.
- When searching for leakage, wear protective gloves. A fine jet of liquid under pressure can penetrate the skin.

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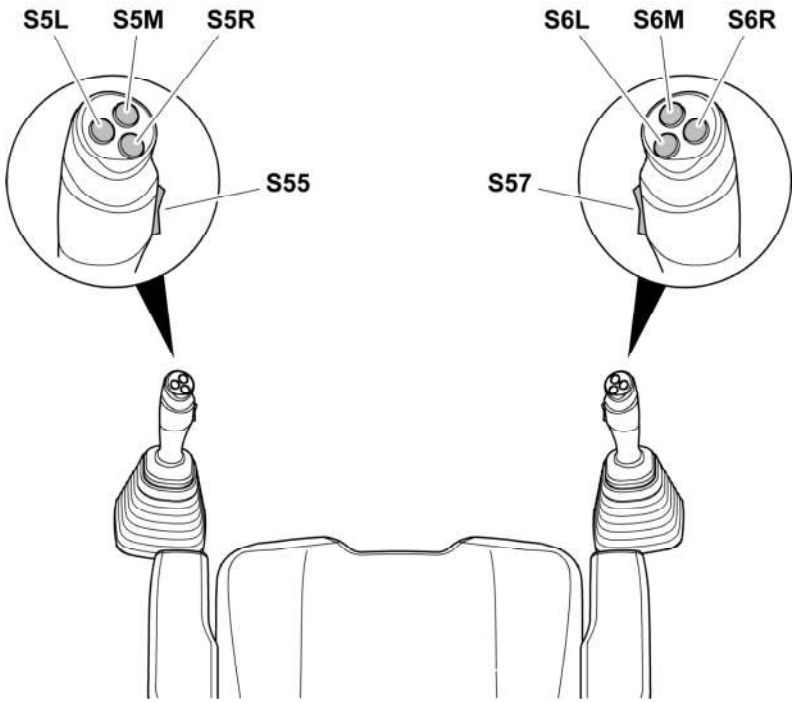

Fig. 3-3 *Configuration of the switches on the joysticks*

S5L Horn switch

S5M Not used

S5R Assistance Systems switch (optional equipment)*

S55 Up: Assistance Systems rocker switch (optional equipment)*

S55 Down, depending on the machines**:

– Deactivation of the attachment damping system

– Not used

S6L Semi-automatic flap closing switch (for shovel attachment only)

S6M Not used

S6R Boom down with pressure switch

S57 Semi-automatic swing brake rocker switch (optional equipment)

* If installed, refer to the Operator's manual for the Assistance Systems.

** For more information, refer to the related sections of this manual.

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Status lights		Numerical values	
AC	Status of the air conditioning	B53	Swing speed
S6R	Status of boom down with pressure	B84	Control pressure
S7	Status of the safety lever		
S57	Status of the optional semi-automatic swing brake		

If a value connected to a position is out of the possible range:

– It is replaced by dots.

If a value is missing:

– "**-1**" is shown.

▶ In these cases, contact LIEBHERR customer service.

Last page

YR10_2	Regulating solenoid valve of hydraulic oil cooling	YR4 LR	Regulating solenoid valve of power regulator of working pumps
SD	Flow control valves		

Submenu "Steering"

This submenu shows the information that follows:

First page

Y150	Solenoid valve of swing left (status light)		Pedals left (**L**) and right (**R**) movements in forward and rearward directions

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extended and retracted from the uppercarriage with the control box **E1022_3**. Depending on the excavators and the access ladder configuration, the control box **E1022_3** can be in different locations.

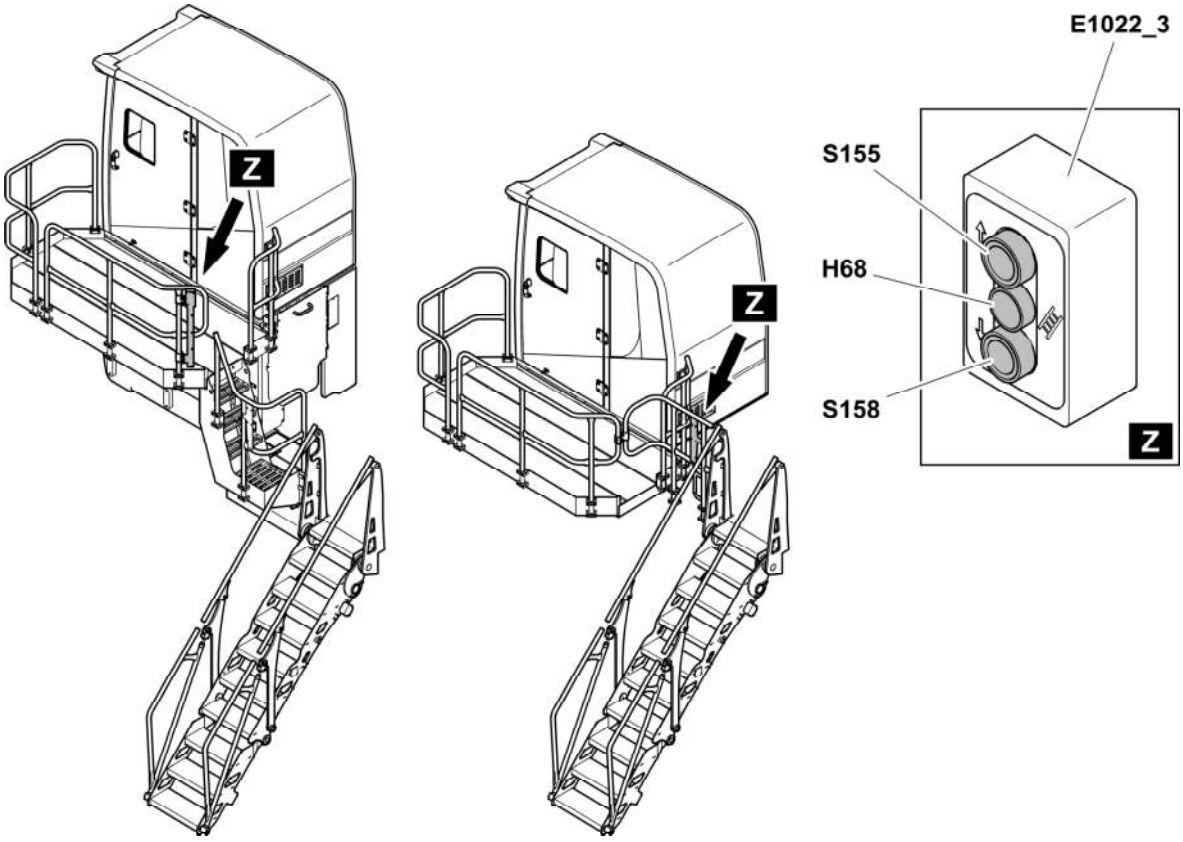

Fig. 3-21 *45° access ladder and control box E1022_3*

H68 Warning light
S155 Push-button / access ladder up
S158 Push-button / access ladder down

If the control box **E1022_4** is installed as an additional option, you can also move the ladder from the ground.

Danger!
Before using the excavator, make sure that the cameras and the outside mirrors are correctly adjusted.

- ▶ Regularly check mirrors and cameras for condition. If necessary:
  - – Clean them with a soft, dry cloth.
  - – Use an external safety device to get access to them.
- ▶ Regularly check mirrors and cameras for correct adjustment.
- ▶ For maintenance intervals, refer to the control and maintenance chart.
- ▶ Replace damaged mirrors and cameras immediately.

To cover the correct area:

- ▶ Set the cameras and adjust the outside mirrors so as to be able to see a person standing out of the hatched area defined by the four checkpoints given on the fig. above.

Additional cameras (optional)

Optional forward-oriented cameras can be installed on the counterweight.

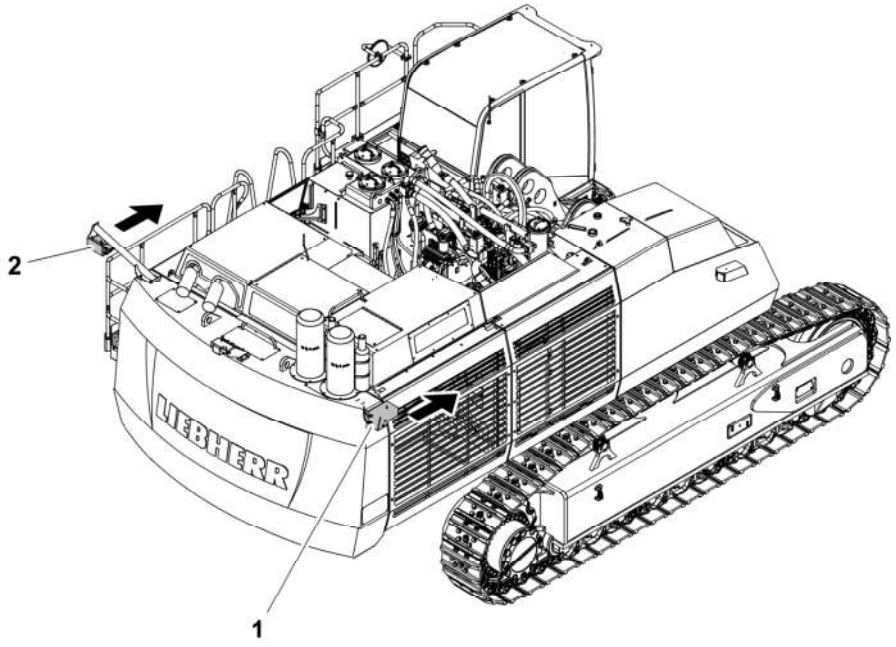

Fig. 3-40 *Additional cameras locations*

1 Right side camera
2 Left side camera

Under this option:

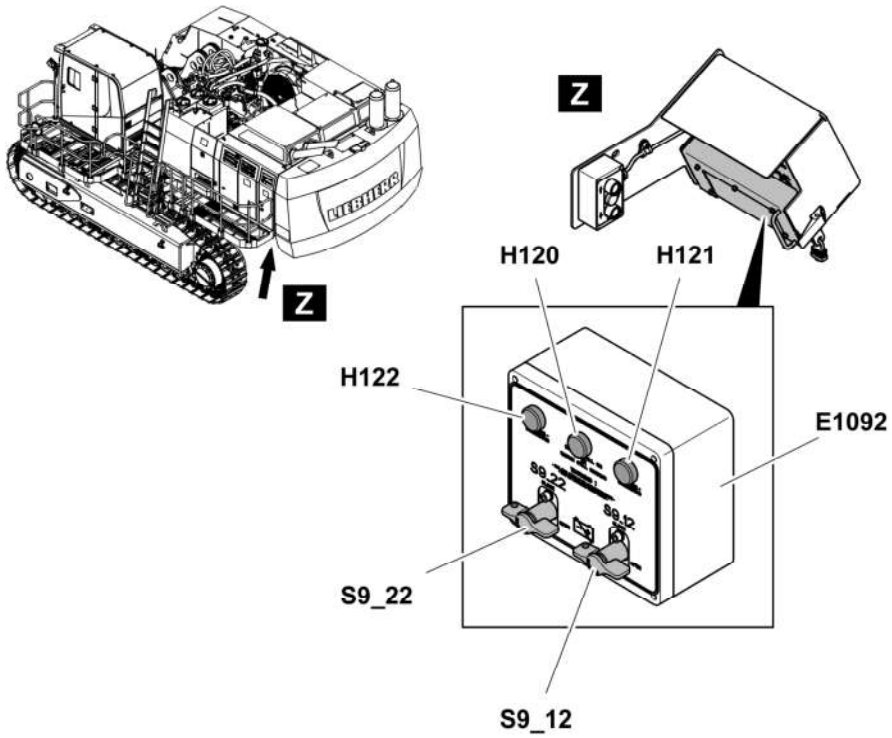

Fig. 3-56 *Principal battery switches under the counterweight (E1092)*

H120	Indicator light of ignition key and electric motor
H121 / H122	Indicator lights of batteries status
S9_12 / 22	Principal battery circuit breakers

- ▶ Make sure that the electric motor is stopped. Refer to the section above.
- ▶ Make sure that the indicator light **H120** is off.
  - ↳ If not, the ignition key **S1** stays in contact position.
- ▶ Turn the principal battery switches **S9_12** and **S9_22** in position "**OPEN**".
  - ↳ The principal batteries stay connected during 5 minutes.
  - ↳ Then, the principal batteries are automatically disconnected and the two indicator lights **H121** and **H122** go off.

While the ignition key **S1** stays in contact position, the batteries stay connected.

Use the starting aids system

You can read the applicable working ambient temperature range of the machine on the special information label in the cab.

- ▶ Obey the preparatory measures given in this section.
- ▶ Obey the applicable preheating procedure given below in this manual.
- ▶ For automatic functions and devices, refer to the Service Manual.

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holes and uneven surfaces jeopardize the stability of the machine.
- Adjust vehicle handling to suit the altered machine characteristics (high centre of gravity) and environmental conditions.
- Reduce your speed to prevent the need for sudden braking and steering manoeuvres.
- Avoid sudden speed changes, such as braking, accelerating and changing direction.
- Ascending gradients and obstacles may only be approached in the longitudinal direction in order to prevent unacceptable banking of the machine.
- Special care should be taken when driving through narrow passages - drive slowly!

When loading and unloading:
- The machine must be supported and aligned horizontally before moving (swing) the uppercarriage out of the transport position.
- It is imperative that you check the contact surface of the support (load carrying capacity of the substrate). A support subsiding would have disastrous consequences!
- Carry out all movements with increased care.
- To slew the load, move the attachment as close as possible to the machine **(Caution! swinging grab)** and hold the load close to the undercarriage and above the substrate.
- Avoid braking or accelerating the attachment or uppercarriage abruptly.
- Do not lift any loads which are heavier than those given in the load chart.

Protection from vibration

– Vibrational loads on mobile building machinery are mainly the result of the type and method of use. The following parameters in particular are decisive influences:
  - Terrain conditions: Uneven areas and potholes;
  - Operational techniques: Speed, steering, brakes, controlling the machine's control elements when driving and working.
– To a large extent, the machine operator determines the vibrational loads since he selects the speed, gearbox ratio, working method and route himself.
  This means that there is a wide range of different vibrational loads for the same machine type.

Whole-body vibrational load for the machine operator can be reduced if the following recommendations are observed:

– Select suitable machines, attachment parts and auxiliary devices for each part of the job.
– Use a machine that has a suitable seat (i.e. for earth-moving machinery such as hydraulic excavators, this should be a seat which corresponds with EN ISO 7096).
– Keep the seat in good condition and adjust it as follows:
  - The seat and its damping action should be adjusted depending on the weight and height of the operator.
  - Check the seat's damping action and adjustment mechanisms regularly and ensure that these seat characteristics remain as per the seat manufacturer's instructions.
– Check the maintenance status of the machine, particularly with respect to: tyre pressure, brakes, steering, mechanical connections etc.
– Do not steer, brake, accelerate, shift gears, move or load the machine's attachment jerkily.
– To reduce vibrational load, adjust the machine speed to suit the route as follows:
  - Reduce speed when driving on difficult terrain;
  - Drive around obstacles and avoid driving on very difficult terrain.

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▶ Make sure that you obey all the precautions to prevent accidents.

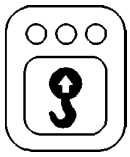
▶ Check the permitted load capacity of the machine on the related load chart label, which is located into the cab.

The load values can change if attachment parts and/or work tools are attached or disconnected. Thus:

▶ Make sure that the attachment parts weights you use are always included in the load chart.

Start the overload warning device

You can start the overload warning device with the keyboard.



▶ Push the "**Overload warning device**" button.
  ↳ The overload warning device is activated.
  ↳ All the LED in the button come on.

If the machine gets its maximum load capacity:
  ↳ You hear a continuous warning signal in the cab.

  ↳ This symbol is shown on the display.

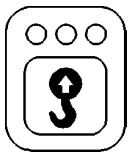
▶ Stop the movement immediately.

These warnings are on until the load is into the specified limit. In this case, the deactivation of the overload warning device is not possible.

If you switch to off the machine when the overload warning device is on, this status is recorded for the next start.

Deactivation of the overload warning device

You can stop the overload warning device. But, to prevent the accidental deactivation of the system, two steps are necessary to stop it.



▶ Push the "**Overload warning device**" button.
  ↳ The overload warning device continues to operate.
  ↳ All the LED in the button flash.

  ↳ This symbol is shown on the display.

The system waits that you confirm the deactivation.

Unload the shovel type bucket

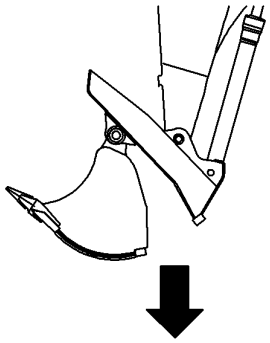


Fig. 3-110 *Unloading of the bucket*

When dumping the load, tip the bucket forward slightly as the clam opens. This helps direct the material to fall centrally into the tray and avoids spillage.

The position of the bucket backboard when the clam opens, directly affects the position of the load in the tray.

Bucket in ideal position resulting in material falling straight down. Loading centre of the haul truck.

3.6.6 Working with the clamshell bucket (construction equipment)

Danger!
Risk of fatal injury and damage to the machine due to a swinging shell type bucket.

- ▶ Ensure that the shell bucket does not swing too close to the cab.
  - ↳ The shell bucket could damage the cab when swinging and injure the machine's operator.
- ▶ Ensure that the shell bucket does not swing towards anyone in the working area.
  - ↳ The shell bucket could injure people standing in the vicinity when swinging.
- ▶ Move the joystick slowly and evenly to prevent the shell bucket swinging.
- ▶ Hold the stick in such a way that the shell bucket cannot swing towards the machine when driving or braking.
- ▶ Do not lift a load with the boom and stick extended too far and do not slew a heavy load too far to the left or right.
  - ↳ The stability of the machine could be affected.

❑ The machine must be in the working position.

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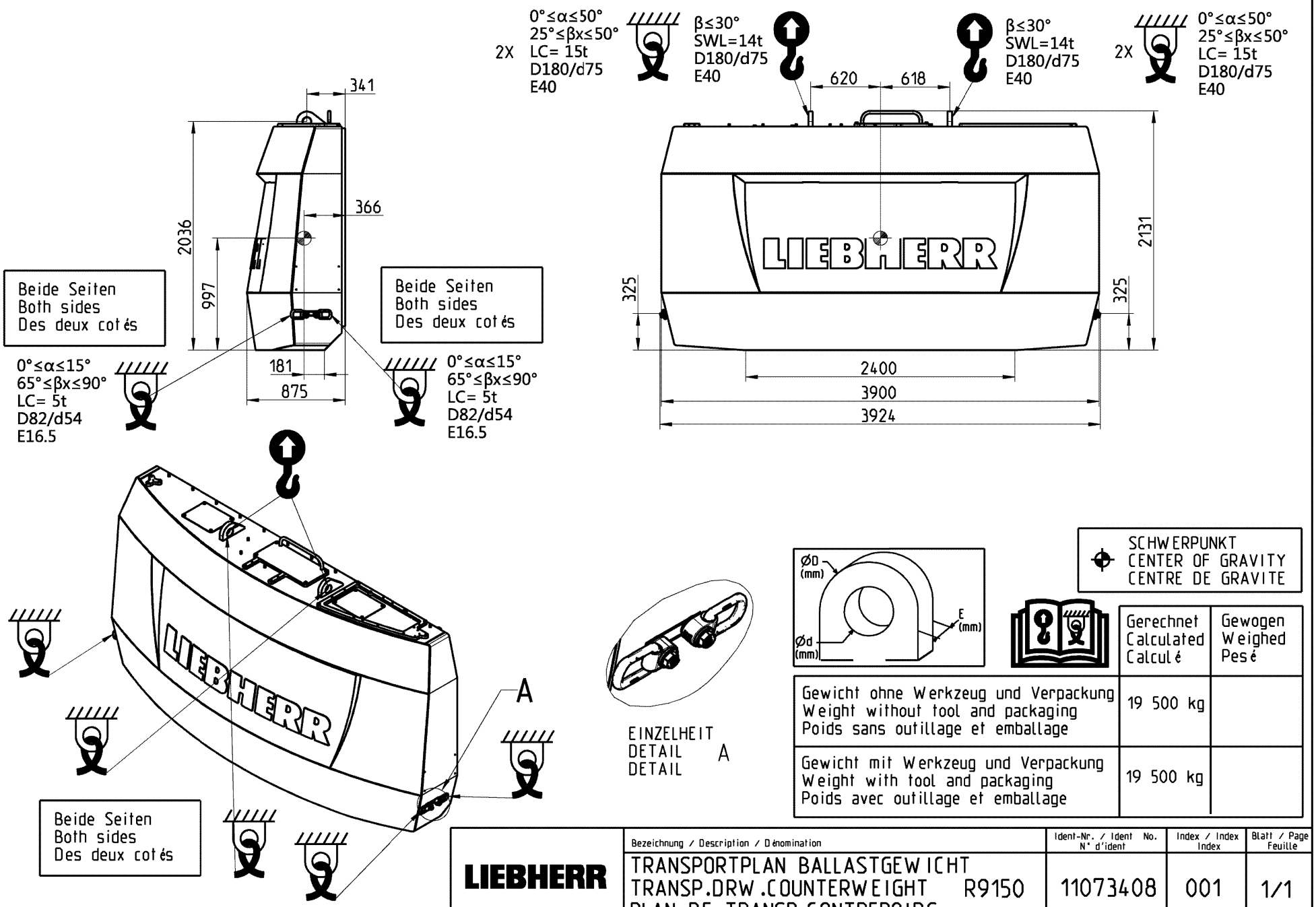

	Gerechnet Calculated Calculé	Gewogen Weighed Pesé
Gewicht ohne Werkzeug und Verpackung Weight without tool and packaging Poids sans outillage et emballage	19 500 kg	
Gewicht mit Werkzeug und Verpackung Weight with tool and packaging Poids avec outillage et emballage	19 500 kg	

LIEBHERR	Bezeichnung / Description / Dénomination	Ident-Nr. / Ident No. N° d'ident	Index / Index Index	Blatt / Page Feuille
	TRANSPORTPLAN BALLASTGEWICHT TRANSP.DRW.COUNTERWEIGHT R9150 PLAN DE TRANSP.CONTREPOIDS	11073408	001	1/1

Electrical plate SUPP_E1005

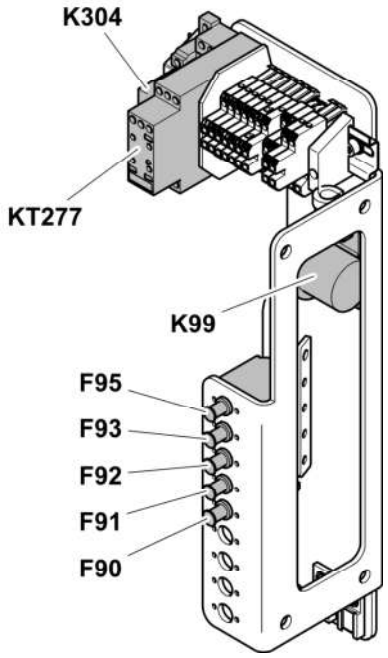

Fig. 4-5 *Fuses and relays of electrical plate SUPP_E1005*

F90	Fuse 15 A	**F95**	Fuse 15 A
F91	Fuse 15 A	**K99**	Relay
F92	Fuse 15 A	**K304**	Relay
F93	Fuse 15 A	**KT277**	Relay

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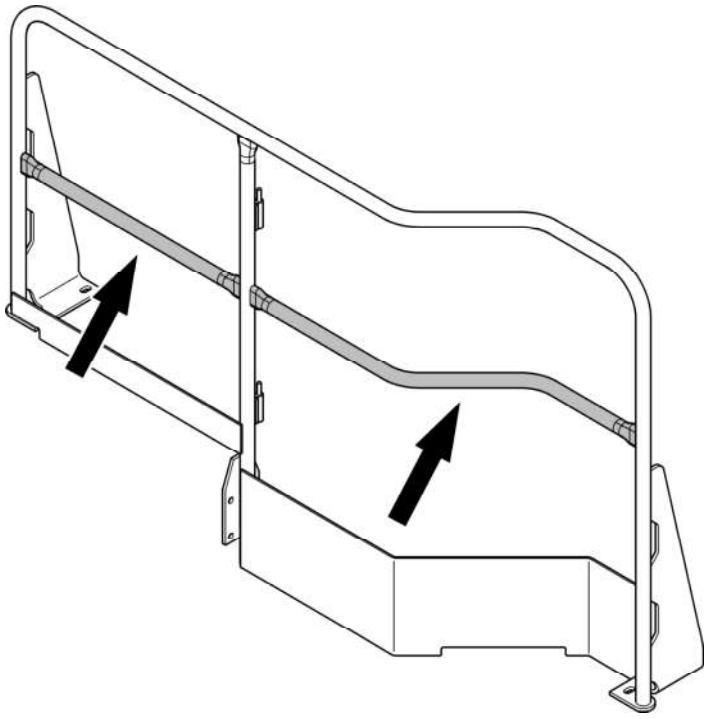

Fig. 5-5 *Horizontal middle bar on handrail (example)*

** COB-2: Gear oil according to DIN 51517, part 3, CLP		
Pour point temperature	ISO 3016	VG220: $T_{Pour\ point}$ < -15°C VG320: $T_{Pour\ point}$ < -15°C VG460: $T_{Pour\ point}$ < -10°C VG680: $T_{Pour\ point}$ < -5°C

Tab. 5-6

*** COB-3: Gear oil according to API classification GL5		
TEST / REQUIREMENT	STANDARD / REFERENCE	REQUIRED LEVEL / PERFORMANCE
API classification	GL 5	-
Scuffing load capacity FZG test A/8.3/90	DIN ISO 14635-1	>12
MIL-L	2105 B/C/D	-
MAN	342 type M1	-
Mercedes Benz	235.0	-
ZF Friedrichshafen	TE-ML 05A, 16C, 17B, 19B, 21A	-

Tab. 5-7

**** COB-4: Gear oil according to API classification GL5		
TEST / REQUIREMENT	STANDARD / REFERENCE	REQUIRED LEVEL / PERFORMANCE
API classification	GL 5	-
Scuffing load capacity FZG test A/8.3/90	DIN ISO 14635-1	>12
MIL-L	2105 D, PRF-2105E	-
MAN	342 type N	-
ZF Friedrichshafen	TE-ML 05A, 07A, 16D, 21A	-

Tab. 5-8

5.5.4 Splitterbox oil

Use gear oil with viscosity classification SAE 90 or SAE 80W90 and meeting specifications API-GL-5 and MIL-L-2105 B, C or D.

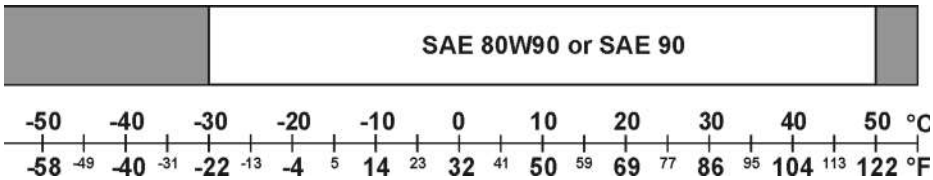

Fig. 5-18 *Gear oils for use as splitterbox oil*

5.8.3 Breather filter

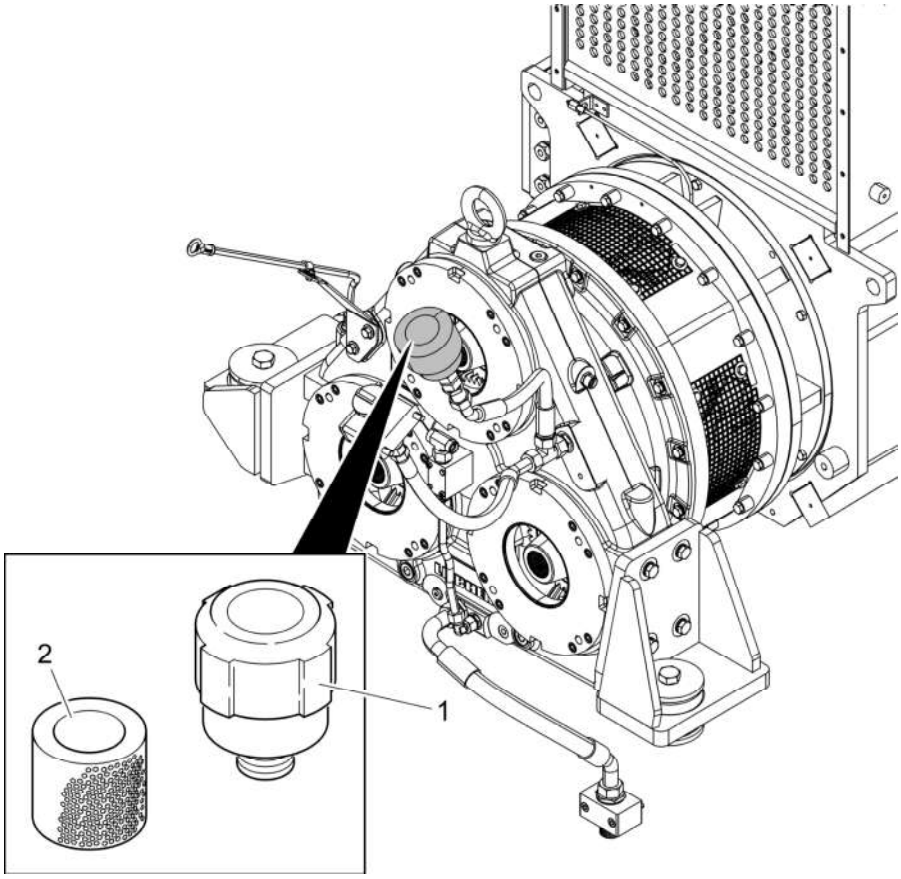

Fig. 5-27 *Breather filter on splitterbox*

The breather filter **1** on the splitterbox must be checked, cleaned and replaced regularly.

Clean the breather filter

- ▶ Open breather filter **1** by pushing it and turning it 1/4 turn.
- ▶ Remove the filter element **2** from the breather housing.
- ▶ Check filter condition and clean it with fuel.
- ▶ Reinstall the filter element in the breather housing.
- ▶ Close breather **1**.
- ▶ For check, clean and change intervals, refer to Control and maintenance chart.

5.9 Compressed air system (optional)

5.9.1 Pressurised attachment (optional)

When the machine works in a water environment, this optional system helps prevent

5.10.12 Bleed the hydraulic cylinders

Danger!
If the cylinder is not correctly bled, gas bubbles can form in the system (mixture of air and hydrocarbon). At high operating pressures in the cylinder, these gases can explode (Diesel effect).

You must bled the cylinders after each cylinder replacement and after work carried out on the cylinders (replacement of seals, etc.) or the hydraulic circuits (replacement of hose, etc.).

- ▶ Start the electric motor.
- ▶ If possible, move the attachment to put the cylinder side to be bled (**not-supplied side**) in the upper position.
- ▶ Slowly extend the cylinder to the extreme position and then slowly fully retract it again. Make sure that all movements are slow and smooth. Do this process a minimum of 5 minutes.

5.10.13 Bleed the valve blocks

After working on the control circuit (servo oil circuit), you must bleed the valve blocks. You can also do this procedure when the attachment moves jerkily.

- ▶ Make sure that the breather filter is closed. Refer to the related section above.
- ▶ Start the electric motor.
- ▶ Slowly move up and down the boom four times to pressurize the hydraulic system.
- ▶ Lay down the attachment on the ground.
- ▶ Stop the electric motor.

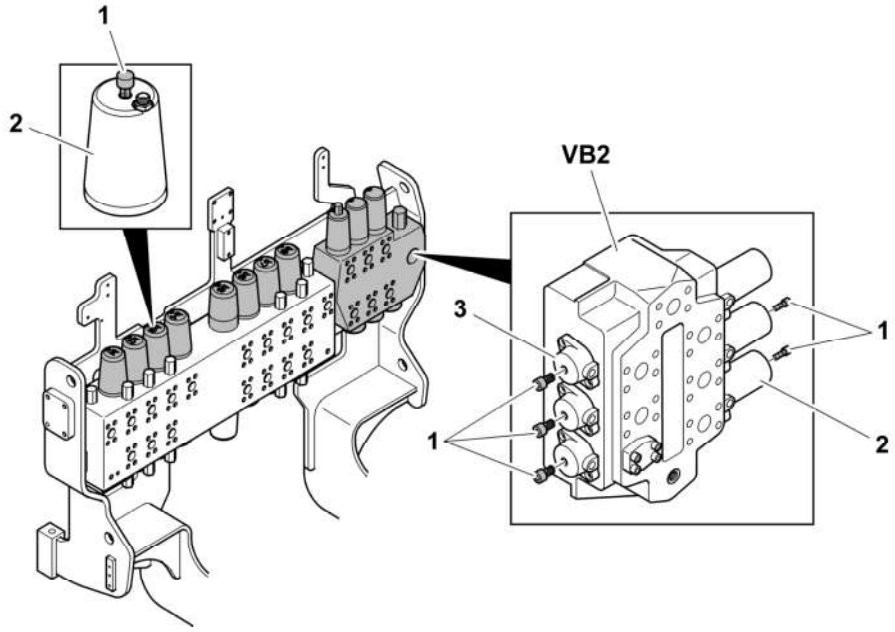

Fig. 5-45 *Bleeding of valve blocks*

5.11.5 Splitterbox - Oil change

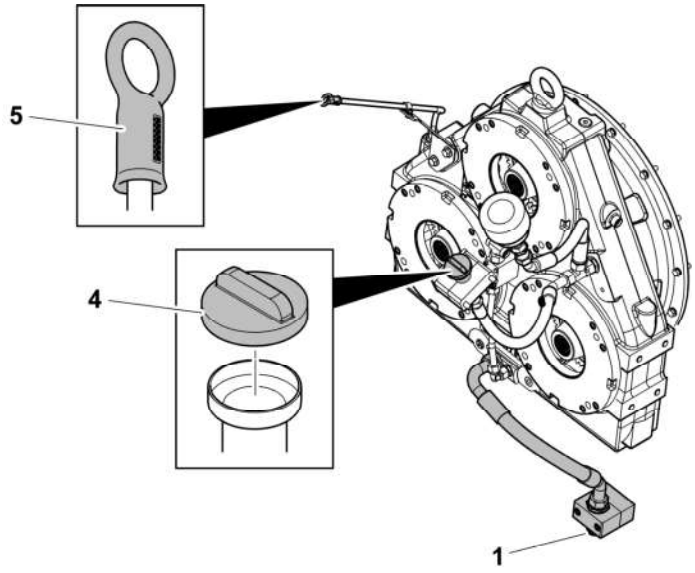

Fig. 5-60 *Oil change on the splitterbox*

1 Splitterbox connection
4 Oil inlet cap
5 Dipstick

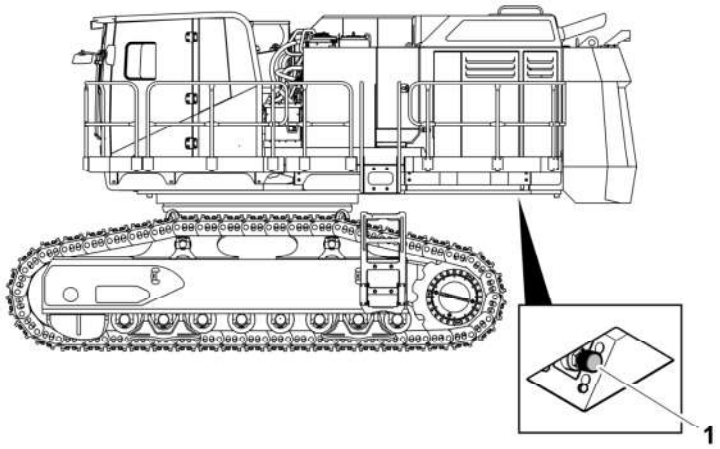

Fig. 5-61 *Splitterbox connection of the service station*

1 Splitterbox connection

▶ For oil specifications and oil quality, refer to the lubrication chart.

▶ For oil change intervals, refer to the control and maintenance chart.

Check the oil level

▶ Stop the electric motor.

Check the condenser

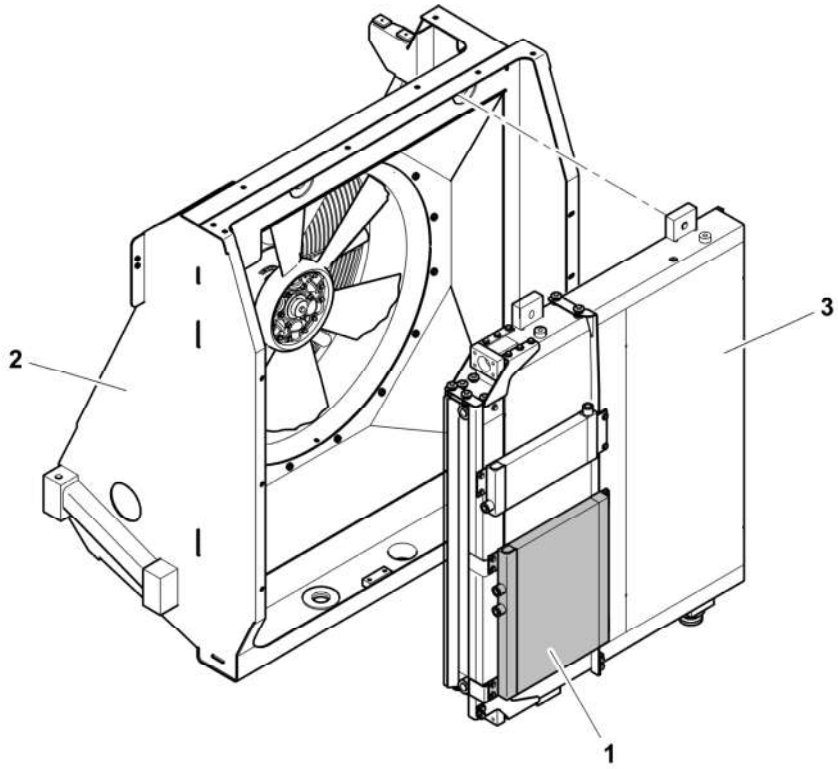

Fig. 5-80 *Condenser*

1 Condenser
2 Oil cooler box
3 Oil radiator

▶ Check the condenser **1**.

▶ If necessary, blow it out with pressurised air or steam from the inner (fan side) to outside.

Check the dryer/receiver unit

The dryer/receiver is located on the oil cooler box.

The maintenance works below must be done:

– at least once a year
– by a specialist in refrigeration engineering

5.25.3 Daily Maintenance Schedule - R 9150 E

Serial Number: Fleet Number: SMU HOURS: Travel Hours:	Completed by : Date and Signature :

WORK TO BE PERFORMED DAILY Check ❑ for first and only interval *or* Check ❍ for repeat interval	Check	Initials	Comments
GENERAL HYDRAULIC SYSTEM			
Do a visual check of all hoses, pipes and fittings for any external damage or leakage	❍		
Do a visual check of the hydraulic components for leaks and/or damages	❍		
Do a visual check of the hydraulic cylinder rods for leaks and good condition	❍		
GENERAL FASTENING			
General hydraulic: Do a visual check for missing, broken or loosen mounting screws of all hoses, pipes, fittings and clamps, tighten if necessary	❍		
Track components: Do a visual check for missing, broken or loosen mounting screws of the sprockets, rollers, idlers, track guides and track pads, protection covers and final drives, tighten if necessary	❍		
Undercarriage: If the undercarriage has removable side frames, do a visual check for missing, broken or loosen mounting screws, tighten if necessary	❍		
Undercarriage: Do a visual check for missing, broken or loosen mounting screws of all parts, tighten if necessary	❍		
Attachment: Do a visual check for missing, broken or loosen mounting screws of the handrails, pin covers fastening and greases connections, tighten if necessary	❍		
Uppercarriage: Do a visual check for missing, broken or loosen mounting screws of the counterweight, tanks, Powerpack, control valve console, cab, cab elevation, high and low voltage boxes, catwalks, handrails, grease box, ladder, tighten if necessary	❍		
Swing gear: Do a visual check for missing, broken or loosen mounting bolts of the swing gear and hydraulic motors, tighten if necessary	❍		
TRACK COMPONENTS			
Clean track chains (after the end of each shift)	❍		
Do a visual check of the tensioning cylinders, idler, carrier and track rollers for leaks	❍		
Do a visual check of the track chains tension	❍		
TRAVEL GEAR			
Do a visual check of the gear for leaks, if there are leaks, check oil level	❍		

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WORK TO BE PERFORMED AT 1000, 3000, 5000 HOURS, ... Check ❑ for first and only interval *or* Check ❍ for repeat interval	Check	Initials	Comments
Electrical system: Check indicator lights and gauges on the control panel when starting	❍		
Electrical system: Check for warning and fault messages on display (monitoring, grease, air conditioning, ...). If necessary refer to chapter 4 in the Operating Manual to identify and rectify faults and errors.	❍		
Cabin: Check if the safety lever is working properly	❍		
Cabin: Check the horn	❍		
Cabin: Check for green flash light on control module if fire fighting system is installed	❍		
Cabin: Check the heater function (before the cold season)	❍		

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6.2 Centralized lubrication system

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- in a potentially explosive atmosphere, unless the centralized lubrication system or its components are expressly suitable for it and have been approved accordingly.
- in a working environment or condition that corresponds to the required protection types IP (International Protection) and Nema (National Electrical Manufacturers Association) only in parts or not at all.
- to use the CLS to feed, forward, or store hazardous substances and mixtures in accordance with annex I part 2-5 of the CLP regulation (EC 1272/2008).
- For the supply, transport, stockpiling of gases, liquefied gases, dissolved gases, vapours, and fluids whose vapour pressure exceeds normal atmospheric pressure (1013 mbar) by more than 0.5 bar at the maximum admissible operating temperature.
- to use the CLS to feed, forward, or store glycol- or polyglycol based oils and greases.
- to use inadmissible components or components expressly not suitable for the purpose.

2.6 Unauthorised activities

The following activities may be carried out by SKF manufacturer specialists or authorized persons only due to potential sources of faults that may not be visible for the user, or due to legal regulations:

- Removal, replacement or changes to the centralized lubrication system or components integrated or connected to it.
- Changes to the control printed circuit board or the power supply board exceeding the adjustment of lubrication and pause times or the replacement in case of defects.
- Dismantling of individual components of the centralized lubrication system.
- Changes to the power supply or to the admissible input voltage.
- Changes to the admissible or specifically required operating pressure for the supplied centralized lubrication system.

2.7 Conversions or modifications

Unauthorized conversions or modifications may result in unforeseeable impacts on safety and functionality. Therefore, any unauthorized reconstructions or changes are expressly prohibited.

2.8 Inspections

The following inspections were carried out prior to delivery:

- Electrical inspections following EN 60204-1
  (depending on the type of component supplied)
- Tests made in accordance with ATEX
  (depending on the type of component supplied)
- Safety and functional tests
  (depending on the type of component supplied)

6 Standard operation

6.1 Daily start-up

Below find the activities to be carried out in case of standard operation.

6.2 Inspections

With regard to the actions listed below "Inspections prior to commissioning" the operator has to determine adequate control intervals depending on the respective operating situation of the pump or centralized lubrication system.

6.3 Filling of the reservoir during operation

Fill the reservoir as described in chapter "Installation and commissioning".

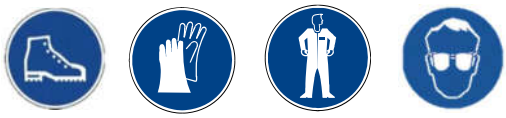
6.4 Cleaning

Execution, required protective clothes, cleaning agents and devices following the valid operational regulations of the operator.

DANGER

Danger to life

Risk of fire and explosion when using inflammable cleaning agents. Do not use steam jet or high pressure cleaners. Electrical components may be damaged. Do not touch cables or electrical components with wet or damp hands. Cleaning work on energized components may be carried out by electrical specialists only. Wear personal protective equipment always.



Exterior cleaning

- Thorough cleaning of all surfaces.
- Mark and secure wet areas.

Interior cleaning

- Normally, interior cleaning is not required.

ATTENTION

Risk of damage to the machine

If using solvents for cleaning, ensure compatibility with plastic parts and painting. Do not use polar organic solvents such as alcohol, methanol or acetone.

10.2 System P1: Automatic lubrication

	**CAUTION!**
	Operation by authorized and instructed personnel only! Never exceed the admissible system pressures! Refill clean lubricant on time!

	**CAUTION!**
	Do not interrupt the power supply (main switch of battery) while the pump is operating.

When starting the excavator, the centralized lubrication systems are connected to the power supply automatically. Each lubrication pump then starts a full lubrication cycle and is stopped during the preset pause time only, etc.

The pump P1 delivers lubricant via a single-line system to the lubrication points according to Chapter 9.2 Configuration.

Regarding the control and monitoring of the system refer to: Chapter 9.2. Cabin greasing module U4-1 or Electronic Controller

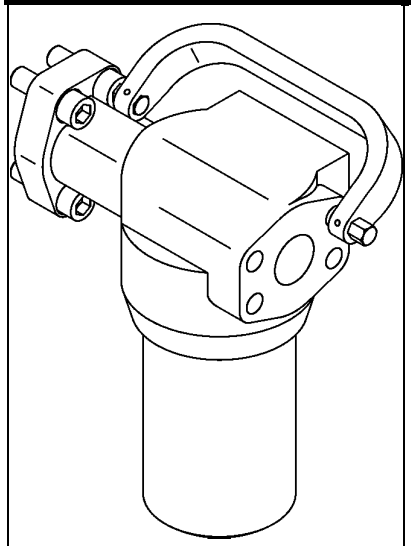
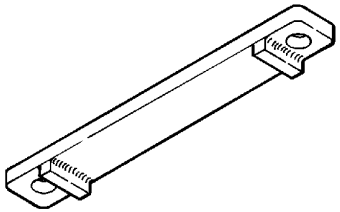
If required, the operator can force the greasing cycle: for details refer to the respective data sheets.

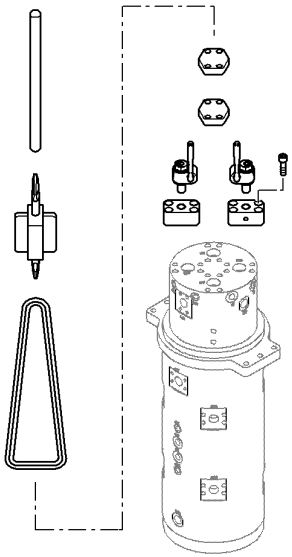
See the characteristics of each lubrication points: Characteristics of lubrication points on the excavator.

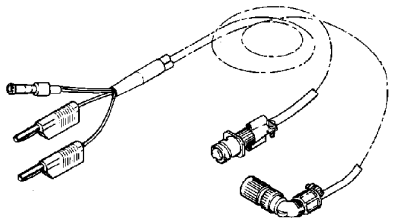
For more details:

- Chapter 9.2 Greasing cycle

Representation	No.	Description	Size	Order No.	Model										Application
					R9100	R984C	R9150	R994	R9200	R9250	R9400 R9350 R994B	R995	R996B R996	R9800	
	89	ADR spill kit		7023359	X	X	X	X	X	X	X	X	X	X	Pads, absorbent socks, disposable bag, pair of gloves, instruction sheet.

Representation	No.	Description	Size	Order No.	Model										Application
					R9100	R984C	R9150	R994	R9200	R9250	R994B R9350 R9400	R995	R996B	R9800	
	489 490	Clamping fixture	CHC M14 CHC M16	11466819 10372086	X	X	X	X	X	X	X	X	X	X	
	500	Tool for swing box brake		9393900						X	X	X	X		For disassembly and assembly of brake housing / disk brake on swing gear SAT. For details, see the part 6.2 "Mounting device for disassembly and assembly of brake housing / disk brake on swing gear Liebherr SAT 220 / 225 / 250 / 275 / 300 / 325 / 350 / 400 / 450".

Representation	No.	Description	Size	Order No.	Model										Application
					R9100	R984C	R9150	R994	R9200	R9250	R9350 R994B R9400	R995	R996B	R9800	
	775	Lifting device for rotary connection		10393047										X	

Representation	No.	Description	Size	Order No.	Model										Application
					R9100	R984C	R9150	R994	R9200	R9250	R9400 R9350 R994B	R995	R996B R996	R9800	
	950	Multimeter with digital display	Chauvin Arnoux Max 3000	10018500	X	X	X	X	X	X	X	X	X	X	For voltage, current and resistance measurements of electrical systems and electrical valves.
	960	Test fitting for pump		6001232	X	X	X	X	X	X	X			X	To check the electronical horsepower limiter.

6.00: Electric motor

1 Technical data

Motor	Unit	
Trademark		General Electric
Model		F 3 RXC 355 LL/4GH/5
Type		3 phase AC squirrel cage motor
Voltage (± 10%)	V	6000 (or 7200)
Frequency (± 5%)	Hz	50 (or 60)
Power Output	kW	565 (757 HP)
Nominal speed	RPM	1484 (or 1800)
Maximal torque (at 1484 RPM)	Nm	4316
Efficiency	%	95,3
Nominal current	A	137
Power factor (cosφ)		0,88
Protection class		IEC - IP 55 EN 60529
Motor cooling		Integrated air-to-air heat exchanger
Starting method		Inrush current limited to 2,2 full load current with starting transformer
Mounting		Horizontal

2 Specific recommendations for motor starts

Number of starts from cold within 1 hour	3
Number of starts from hot within 1 hour	2
External temperature under which the motor doesn't start	-40°C (-40°F)

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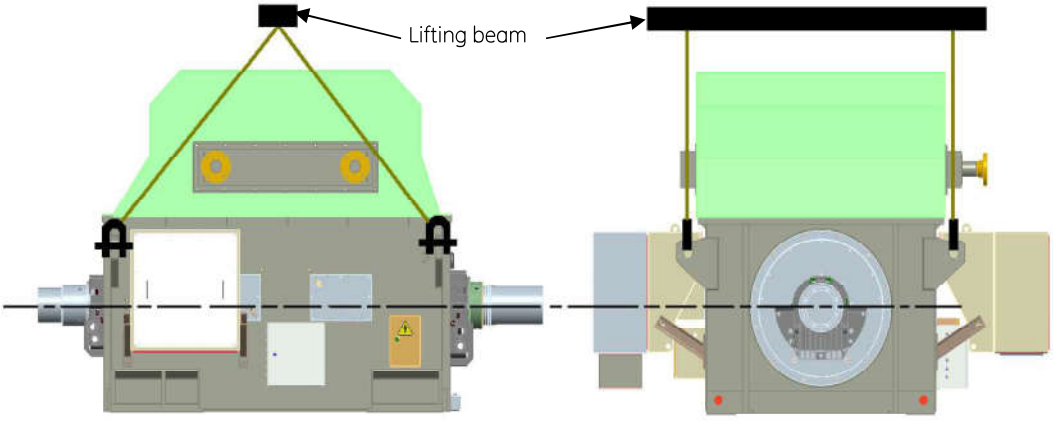
1.2.2.3 Safety pictograms

Definition of main pictograms used on machine:

Symbol	Key
	Electrical hazards
	Ground connection point
 KEEP AWAY	Stay at a safe distance
	EC protection marking relative to an explosive atmosphere

Machine with Air to Water Heat exchanger



Recommended minimum angle to be maintained between lifting sling and horizontal plane for N37 motor with water cooler:

Design Input	630 frame	710 frame	800 frame	900 frame
Worst case lifting angle with horizontal considered	55 degrees	55 degrees	55 degrees	60 degrees

CAUTION

9

Shipping of N37 motor:
The N37 motor is designed to take up to 2G loads during shipping. Care should be taken to ensure that appropriate transport is used to meet this requirement.

4.3.3.6 Systematic check of machine alignment

The indications given by the coupling manufacturers concern the misalignment tolerated for proper functioning of their own supply. Whereas the bearings and rolling element bearings of the machines cannot accept such misalignments as these will result in an abnormal work rate on the rolling element bearings and bushes, or even the shaft.

Precise instruments are required to measure the misalignment (dial gauges, laser) and the instruments must be correctly mounted (free of any deformation of supports, etc.).

The measurement resources used should make it possible to cancel the effects of run-out.

4.3.3.7 Pinning the motor

Pin the motor. This will be useful for reinstallation of the machine at a future date (see principle described in **paragraph *"4.3.2.2 Motor positioning"***).

4.3.3.8 In case of low speed rotation (barring phase) of the shaft line

CAUTION

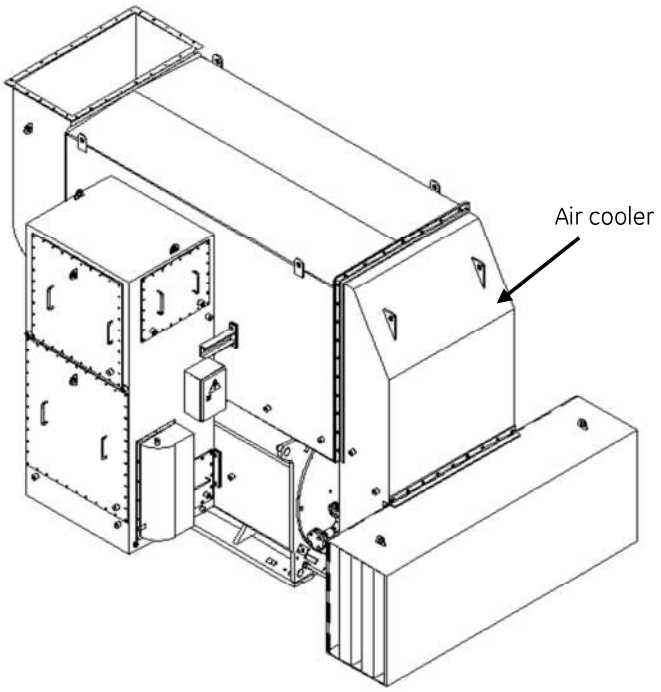
6

Before starting, ensure that the jacking unit is in use for each bearing of the motor while respecting the indications mentioned in the documentation supplied with the jacking unit.

4.3.3.9 Cooling system alignment check (for motor equipped with air cooler)

This procedure has to be performed before starting the motor for motors equipped with air cooler (see example below).

8



Check the vibration and temperature at the bearings after 1, 2, 3, 4, 5, 8, 12 and 24 hours of operation. Record these values in the installation report.

If a malfunction is observed, refer to **paragraph "*7.2.4 What to do if a malfunction is observed*"**.

Case of induction motors with slip rings:

Where slip rings are implemented, the following is systematically required:
- use of a variable resistance starter adapted to the resisting torque of the driven machine and to the permissible start-up current.
or
- use of an appropriate electronic speed regulation system (Varotor or other).

Before start-up, be sure to check that:
- the contact area of the earthing brushes has been cleaned (cleaning of the protection product with a **SOLVASEC** type solvent),
- the brushes have been properly lapped,
- the brushes are correctly positioned on the rings and in their brush holders,
- the brush holder springs press correctly against the brushes.

On start-up, check:
- for absence of sparks on rings. Any inappropriate contact could cause sparks resulting in complete damage to the slip ring system.
- that the patina (brownish colour of rings in contact with the brushes) forms properly on the rings after a few hours of operation.

5.3.2 On-going checks

The indications given by the protection instruments (temperature, vibration, speed sensors, etc.) must remain below the threshold values specified on the connection diagram.

5.3.3 Initial use

Once the test start-up procedure has been completed, the driven machine can be coupled to the motor.

This initial use of the motor under actual operating conditions must be monitored and maintained continuously during the first days of operation.

The information given by the protection sensors must therefore be checked continuously to ensure that the parameters remain stable with respect to the values given on the connection diagram during the first hours of operation. In general, stabilisation of the stator and bearing temperatures is only effective after the first 4 to 8 hours of operation at full load.

During operation, it is also important to check that the cooling and lubrication fluid systems (oil, water, air) do not leak and are not obstructed.

CAUTION

- Performing walk-downs / inspections during start-up sequence to observe for any potential leakage prior to operation as stated in this instruction manual is the end users responsibility.
- Proper housekeeping to maintain work environment free of slip / trip / fall hazards, per Safe Site Work Practices, are the end users responsibility.

In practice, each orifice plate must be provided with a hole ensuring a flow which is sufficient to achieve:

- an optimum oil level in each bearing (see **paragraph *"7.2.4.5 Check for oil leaks at bushed bearings"***),

- and, a bearing and oil temperature compatible with normal operation, i.e. an operating temperature below 90°C (alarm threshold) and 95°C (tripping threshold).

Oil return

The oil return pipe between the bearings and the lubrication system must not generate any backups in the circuit.

The oil return pipe must have a minimum slope of 15°. Any obstacle in the circuit can result in an increase in the oil level inside the bearings, and subsequent leaks.

Oil change

CAUTION

Environment hazard

Do not dispose of oil indiscriminately.
Observe all instructions provided by the oil manufacturer. The manufacturer will indicate the method to dispose of the used oil.

The lubrication system installation must undergo a complete oil change every 20 000 hours, and in compliance with the instructions given by the manufacturer.

Oil change for 2 bearings

Use a recipient having a sufficient volume to allow the oil to fully flow out.

Remove the plug located at the lower part of the bearing (see sectional drawing).

Reinstall the plug using a new seal, observing the tightening torques indicated below:

Size of bearings	9	11	14	18	22	28
Tightening torque in Nm	30	30	30	40	60	60

Before starting up, run the lubrication unit to establish a correct oil level in the bearings (**paragraph *"7.2.3.2 Oil supply"***).

8.2.3 "Major" replacement parts

Depending on the importance given to the availability of the motor within its installation, it may be financially beneficial to consider the procurement of "major" replacement parts should an emergency replacement become necessary.

The replacement parts to be considered are:
- 1 rotor
- 1 stator

or

- 1 replacement motor

Disassembly of rotor

WARNING

THIS PROCEDURE MUST BE CARRIED OUT BY AN EXPERIENCED, QUALIFIED TECHNICIAN UNDER POWER CONVERSION SUPERVISION.

WARNING

ROTOR LIFTING MUST ALWAYS BE CARRIED OUT BY FULLY QUALIFIED LIFTING PERSONNEL, USING LIFTING EQUIPMENT AND MATERIALS THAT ARE SUITABLE FOR THE JOB.
PROPER LIFTING TECHNIQUES / EQUIPMENT / PROCEDURES, PER SAFE SITE WORK PRACTICES, ARE THE END USERS RESPONSIBILITY.

WARNING

WHERE APPLICABLE, WEATHER CONDITION SHOULD BE ALSO ASSESSED, ESPECIALLY WHEN THE MACHINE IS INSTALLED IN AN OPEN AIR OR WITHIN A VESSEL. HIGH WIND OR WAVE ACTION CAN CAUSE SUSPENDED LOADS TO SWING DANGEROUSLY, SO IT IS NOT RECOMMENDED TO PERFORM ANY FORM OF HEAVY LIFTING IN ADVERSE WEATHER CONDITIONS.
IT IS THE RESPONSIBILITY OF THE OWNER TO ENSURE SUCH ASSESSMENTS ARE CARRIED OUT PRIOR TO THE DISASSEMBLY OF THE ROTOR.

NOTE

The following procedure provides a guidance of the steps to follow to remove the rotor. If specified in the contract, a rotor withdrawal drawing specific to the order can be provided. In this case, this drawing take precedence over the manual.

NOTE

If the customer is not confident to perform this procedure on its own, he can ask for GE Power Conversion assistance for a detailed procedure (rotor withdrawal drawing) or for GE service provision. Contact Power Conversion Services department for quotation (§***8***).

6 – SATISFACTION DEGREE OF THE CLIENT

Excellent ❑ Very good ❑ Good ❑ Indifferent ❑ Bad ❑

PRINCIPAL REMARKS

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7. MODIFICATION RECORD

Revision	Date	Author	Checking	Approving	Details
-		S. Richardet			Initial issue
A	05 dec 07	S. Richardet	M. Dubas	Y. Wazylezuck	Complete rewriting
B	26 oct 09	S. Richardet			Reformulation §3.3.
C	14 dec 09	S. Richardet			Recommendation for dismantled terminal box (§3.1.3)
D	06 apr 12	I. Schneider	E. Virot	B. Schnabel	Addition of recommendations for the anti-oxidizing protection (§3.1), for the pressurization system (§3.1.5) and for the destocking (§6.)
2.0	02 feb 15	I. Schneider	V. Feron	C. Grosselin	Spelling corrections New GE template Update of recommendations for bearings storage Addition of motor covered by a tarpaulin New numbering for document revision number
3.0	30 march 17	I. Schneider	V. Alnot	E. Ourion	Update of SEI4C packing guaranteed preservation time

Electronic components

- In each servo control device (joystick or pedal), the output signal of each stroke sensor is applied to a component. This component supplies an output proportionally to the movement of the servo control device.
- This signal is then amplified by the **A61, A62** and **A63** output modules in order to be sufficient to supply the regulating solenoid valves on the control valve console (attachment and travel movements) and on the swing pump (swing movements).

The influence of the changes of the resistance in the coils (for example, due to temperature differences) is stopped until the regulating solenoid valves are driven with impressed current.

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The axial piston unit moves the oil via kidney shaped control inlets in the control lens **4**. During the revolution of the cylinder **3**, oil corresponding to the area and stroke of the piston **1** is sucked in by four pistons through the kidney shaped control ports on the suction side of the pump. The other four pistons displace the oil that is supplied via the kidney shaped oil outlets to the pressure side of the pump, moving oil via pressure connection into the hydraulic system. A ninth piston is moving between the upper and the lower limit, at dead centre, i.e. just changing directions.

4.1.2 Axial pump displacement

The oil flow of the pump depends on the stroke of the piston **1**.

When the positioning piston is shifted from its minimum to its maximum position, it swivels out the swash plate **6** and the pump flow is increased correspondingly.

The port **X1** of the positioning piston is always connected with the pump working pressure **A1** (or with the servo pressure if the value of **A1** is less than the servo pressure value).

Through the different regulators, the port **X2** of the positioning piston is connected with the pump working pressure **A1** or with the tank pressure:

- When the chamber **X2** is at tank pressure, the pump is in minimum flow.
- When the chamber **X2** is at working pressure, the pump is swivelled to maximum flow.

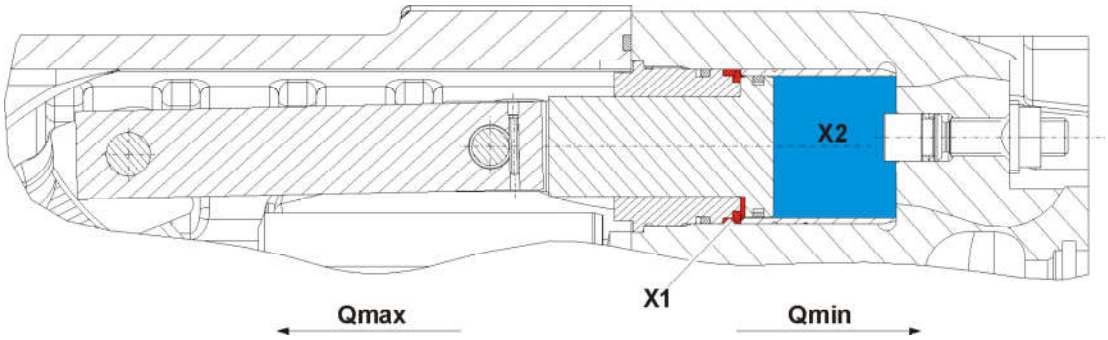

Fig. 26 *Positioning piston section*

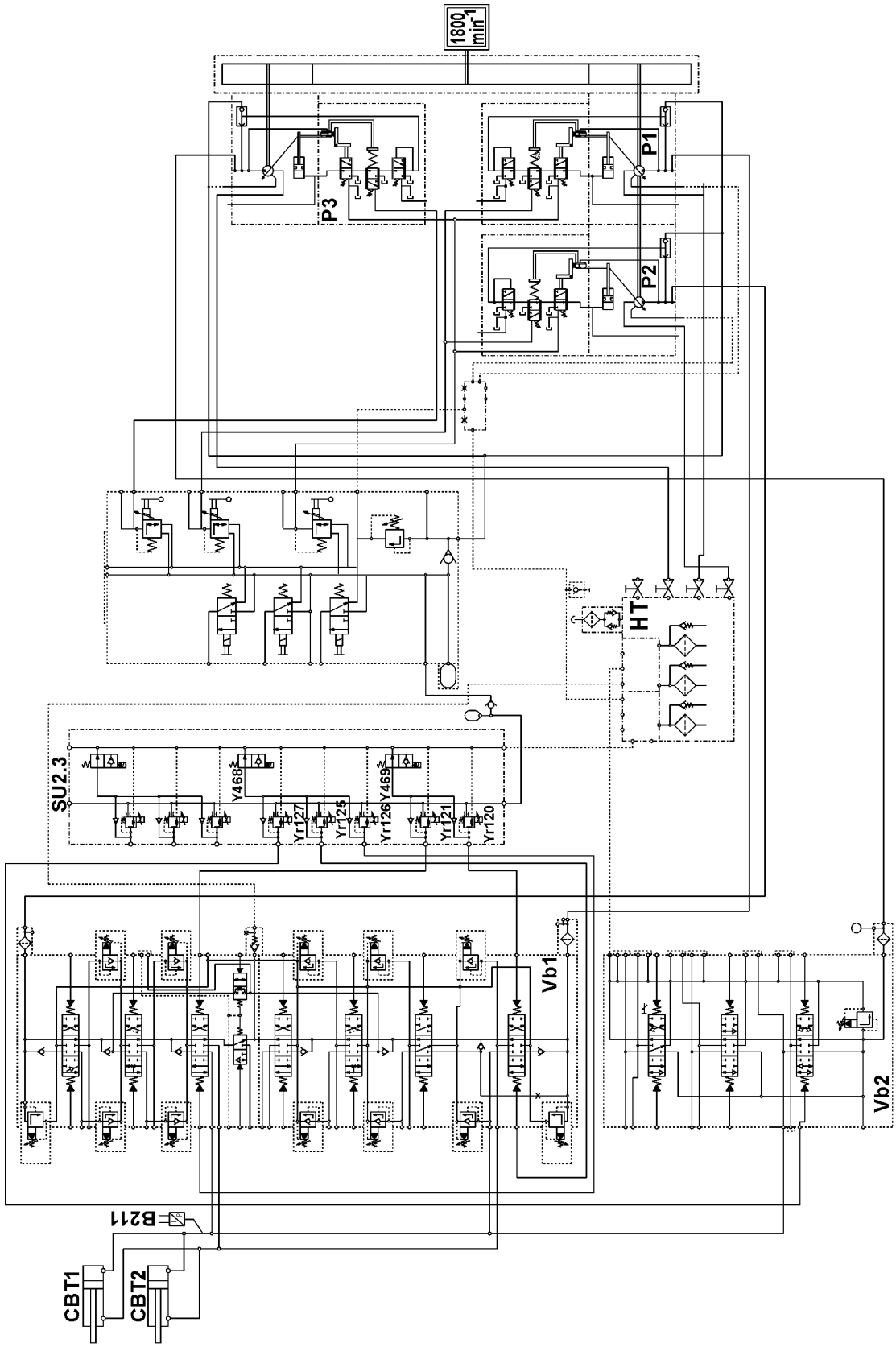

Fig. 41 *Hydraulic scheme of bucket tilt cylinders for backhoe attachment*

Number of pumps and oil flow max for the different movements

Movement	Excavator type	Nb of pumps	Flow max (l/min)
Boom cylinders extend (cylinder out)	Backhoe	3	1536
Boom cylinders retract (cylinder in)	Backhoe	2	1024
Stick cylinders extend (cylinder out)	Backhoe	3	1536
Stick cylinders retract (cylinder in)	Backhoe	2	1024
Bucket tilt cylinders extend (cylinder out)	Backhoe	3	1536
Bucket tilt cylinders retract (cylinder in)	Backhoe	2	1024

Movement	Excavator type	Nb of pumps	Flow max (l/min)
Boom cylinders extend (cylinder out)	Shovel	3	1536
Boom cylinders retract (cylinder in)	Shovel	2	1024
Crowd cylinders extend (cylinder out)	Shovel	2	1024
Crowd cylinders retract (cylinder in)	Shovel	3	1536
Bucket tilt cylinders extend (cylinder out)	Shovel	2	1024
Bucket tilt cylinders retract (cylinder in)	Shovel	2	1024
Flap cylinders extend (cylinder out)	Shovel	1	512
Flap cylinders retract (cylinder in)	Shovel	1	512

Calculation examples

D: cylinder piston diameter

d: piston rod diameter

Example 1: On a backhoe R9150, determination of extension time of boom cylinders if:

H = 2000 mm

D = 240 mm

Oil flow (3 pumps and 2 cylinders): Q = 1536 / 2 = 768 l/min

$T_{(s)} = (60 \times \pi \times H_{(dm)} \times D_{(dm)}^2) / (4 \times Q_{(l/min)})$

$T_{(s)} = (60 \times \pi \times 20 \times 2{,}4^2) / (4 \times 768)$

$T_{(s)}$ = 7,1 s

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Primary pressure relief valve

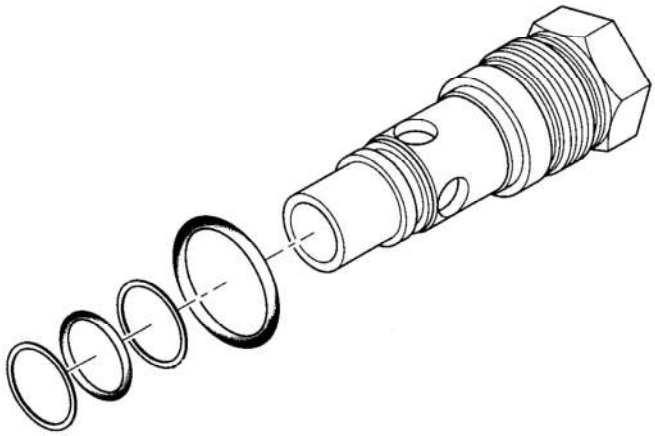

Fig. 59 *Assembly of pressure relief valve*

The complete pressure relief valve can be removed from the control valve block.

Replace primary relief valve

▶ Refer to the section "8-ways control valve 8M8-32" above.

9.2.6 Control valve installation

▶ Refer to the section "8-ways control valve 8M8-32" above.

9.2.7 Maintenance

▶ Refer to the section "8-ways control valve 8M8-32" above.

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10	O-ring
11	O-ring
12	O-ring
13	O-ring
14	Spring
23	Cap
31	Main piston
32	Spring
33	Poppet
34	Adjustment screw
35	Lock nut

9.7 Secondary valve: 2-stage pilot operated pres. limiting valve

The basic function and working principle of a two-stage secondary relief valve is the same as the secondary relief valve.

A second stage, hydraulic controlled via pressure port is added to the standard relief valve in order to obtain a reduced hydraulic system pressure for certain functions (two stage relief valve).

For use and function of pilot controlled pressure relief valve **9**, refer to subgroup primary relief valve.

9.7.1 Function of pressure cut off

Stage 2 (normal pressure = high pressure)

At this position, no servo pressure is applied to connection **Pst** and the working surface of control piston **11** is at tank pressure via the bore "**a**".

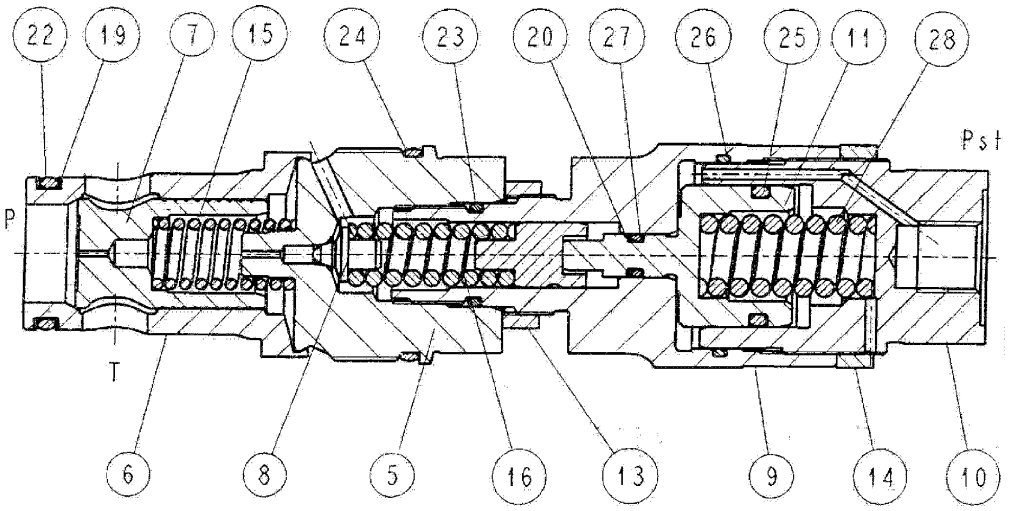
The force of spring **28** pushes the piston **11** to the left.

In this position, the pretension of spring **16** is maximal and so is the relief pressure.

Cut off stage or stage 1 (low pressure)

Servo pressure can be applied to connection "**Pst**". It depends on specific application.

The pressure **Pst** builds up on working surface of control piston **11**, which is pushed against the spring **28**, this decreasing the pretension of the springs **16** and thus the relief pressure.



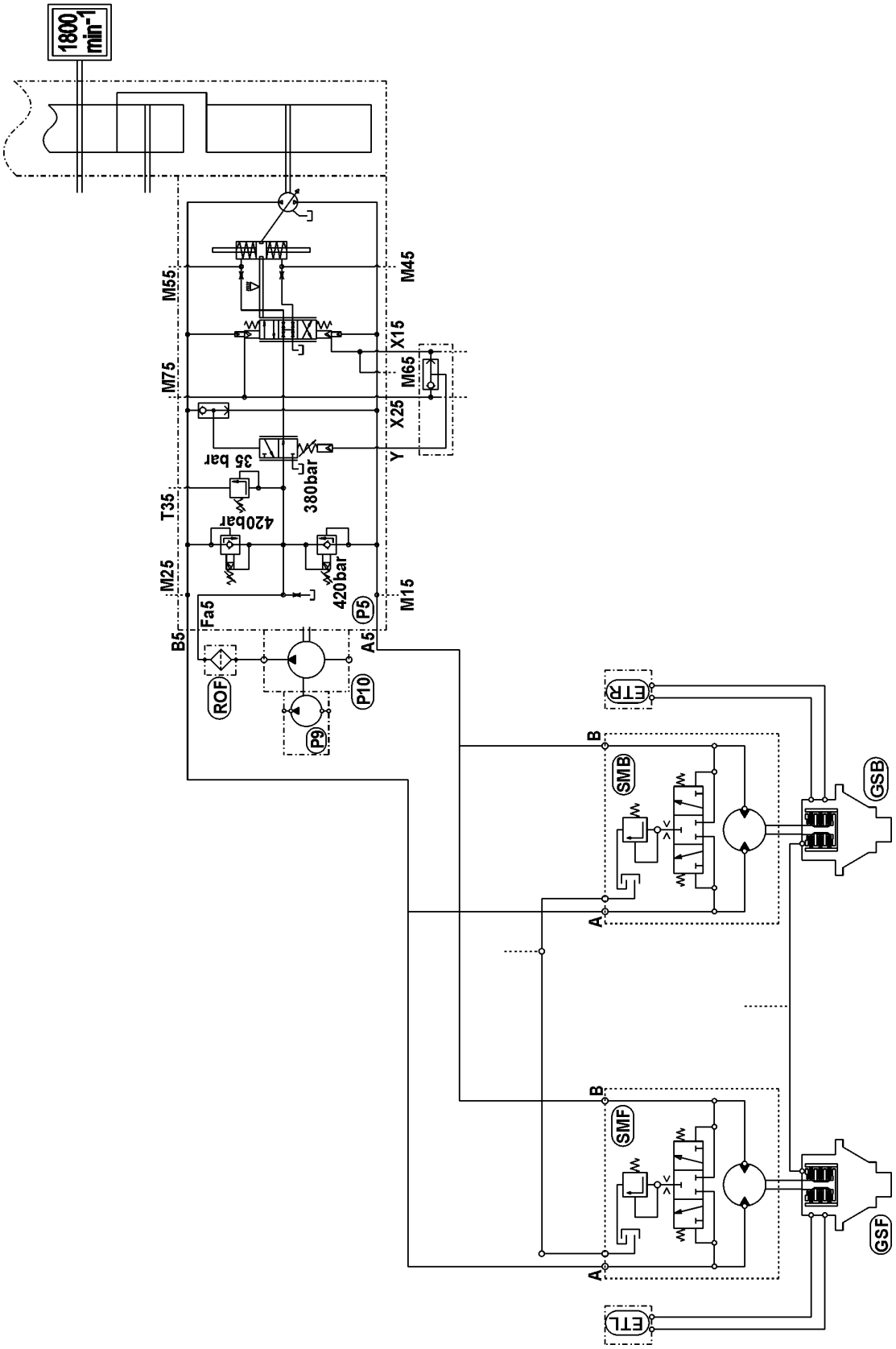
Pressure check and adjustment

For know how to measure pressure in circuit of relief valve, refer to subgroup "Adjustment".

To check and adjust high pressure (stage 2):

- ❑ Be sure that connection "**Pst**" is at tank pressure (otherwise you could screw in all way to the stop the adjustment screw **10**).

2.2 Hydraulic



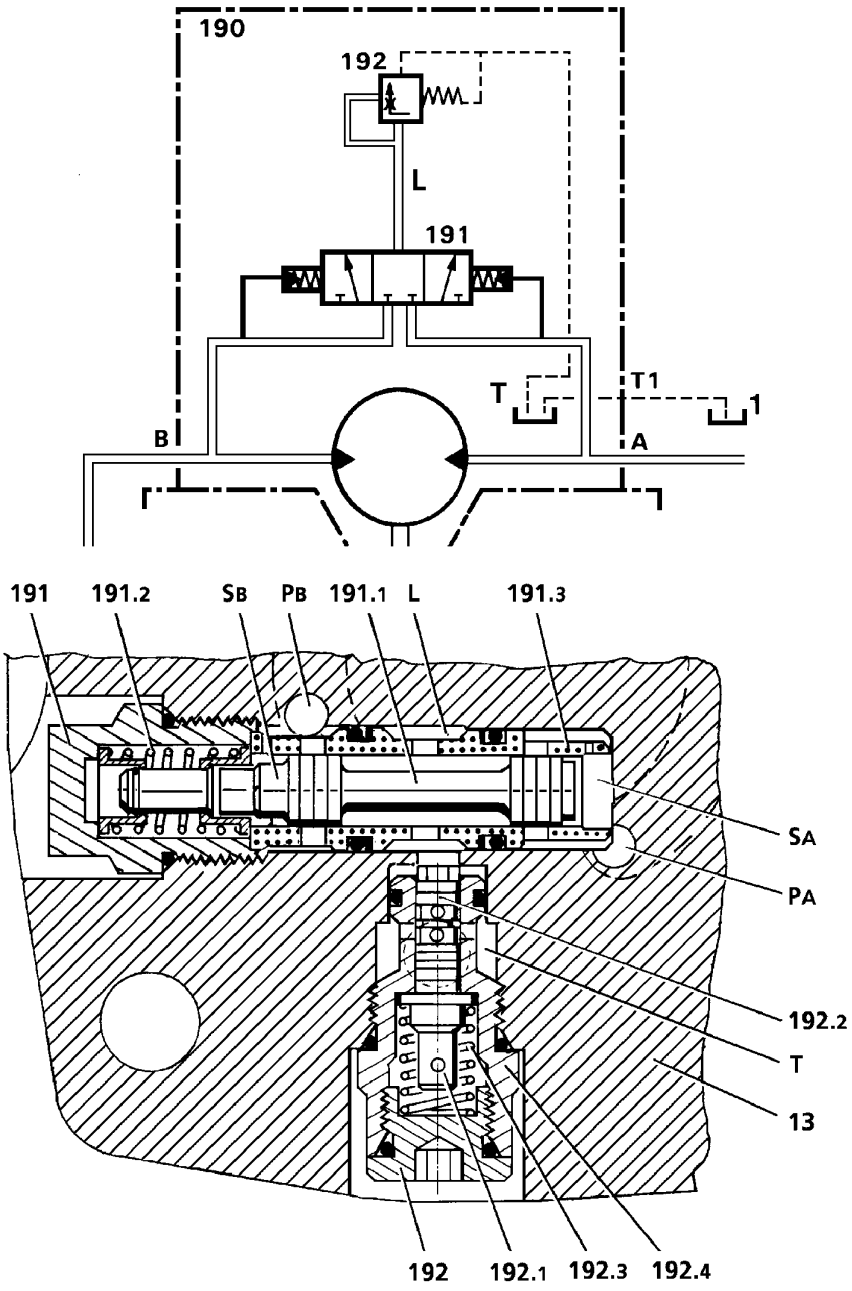


Fig. 9 *Section of discharge two ways check valve*

13	Connector plate - discharge two way check valve	**192**	Discharge pressure - flow regulator
191.1	Piston	**192.1**	Piston
191.2	Spring	**192.2**	Flow regulator
191.3	Bushing	**192.3**	Spring
		192.4	Bushing

6.2.5 Function of discharge valves in connector plate

The discharge valves **191** and **192** allows a small amount of oil from the low-pressure connection on the motor to escape into the motor housing.

4 Functional description

The variable displacement pump **P6** (for hydraulic oil cooling) supplies oil to the constant volume hydraulic motor **FMF** (**MF2**) for cooler fan control. The control pressure for the pumps displacement regulation is supplied by the regulation solenoid valve **Y10_2**.

These valves control the pressure applied on the pressure cut off valve and so the pump angle. The opening of the regulation solenoid valve **Y10_2** depends on the hydraulic oil temperature (see section about temperature regulation).

Each hydraulic motor **FMF** is equipped with a suction valve to prevent cavitation and with a pressure cut off valve to prevent mechanical damages if the corresponding fan is blocked.

A suction valve is installed on each hydraulic motor **FMF** to prevent cavitation, and a pressure cut off valve is installed to prevent mechanical damages if the related fan is blocked.

4.1 Hydraulic pump

4.1.1 Description

The pump **LH30VO045** is described in the section "Hydraulic pump LH30VO045".

4.1.2 Regulation

The regulation solenoid valve **Y10_2** is installed between the port **Fa** (replenishing pressure) and the regulators.

Pressure regulation

This regulation lets to adjust the pump flow in function of the pump high pressure **Hd**.

- The pump high pressure **Hd** is applied on the regulator **Da** via a disk.
- The port of the control piston **20** is linked so that the pressure supplied by the pump drives the motor (and so the fan) at the prescribed speed.
- While the nominal value of the pressure is not got, the regulator **Da** connects the bottom side of the control piston **20** to the pump high pressure **Hd** via the regulator **Da**. The pump is then swivelled out.
- As soon as the nominal pressure value in the circuit is got, the pump high pressure **Hd** pushes the regulator **Da** to the left. The regulator **Da** connects the bottom side of the control piston **20** to the pump tank pressure **T**. The pump is then swivelled in and the equilibrium is reached.

Flow regulation

This regulation lets to adjust the pump flow in function of the opening of the regulation solenoid valves. The solenoid valves receive a regulating current from the **A54** output module depending on set parameter (the oil temperature for **YR10_2**). Refer to the section about temperature regulation.

- The pilot oil pump **P9** supply the pilot pressure to the cooling pumps.
- Acting like a variable throttle, the regulation solenoid valve **YR10_2** changes the pilot pressure into the positioning pressure **Pst**.
- The positioning pressure **Pst** is applied on the regulator via a circle (this surface is bigger as the crown surface on which the pump high pressure **Hd** is applied).
- Depending on its position (and so on the value of the positioning pressure), the regulator **Da** makes the value of the regulation pressure **Preg** change. It connects the bottom side of the control piston **20** either with the pump high pressure **Hd** or with the tank pressure **T**. The pump is then swivelled out or back until a new equilibrium is got.

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Chapter 10 - Grease system

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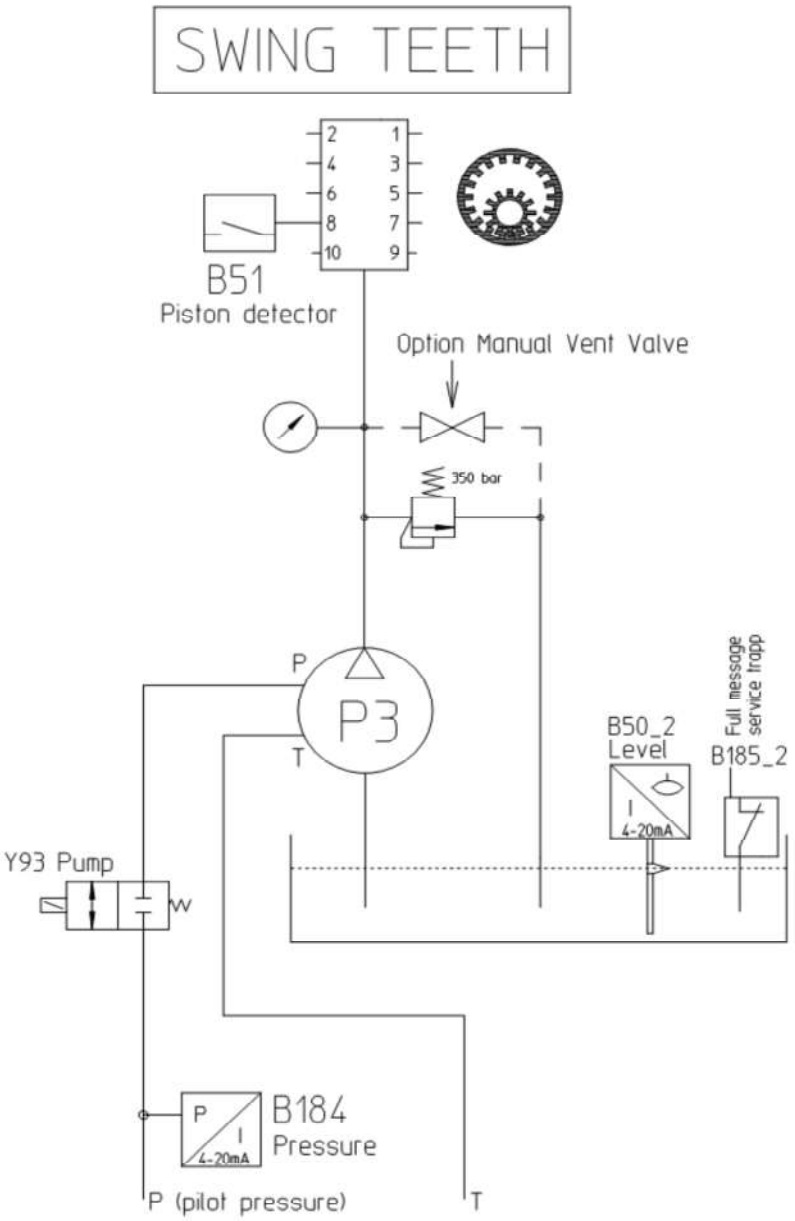
Pump P3 - SV = fault configuration



2.1 Error codes list

G	Error	Output	Signals	Greasing mode
1	Working phases to lubricae the circuit P1 (pressure increase and stabilization) has not succeeded (B69)	1	H38 lighting H109 active Display Err_1 active	Safety mode
2	Working phases to lubricae the circuit P2 (pressure increase and stabilization) has not succeeded (B71)	1	H38 lighting H109 active Display Err_1 active	Safety mode
3	No feedback from the lubrication distributor (B51) in circuit P3.	1	H38 lighting H109 active Display Err_1 active	Safety mode
4	Pressure in the circuit P1 does not fall sufficiently (B69)	1	H38 lighting H109 active Display Err_1 active	Safety mode
5	Pressure in the circuit P2 does not fall sufficiently (B71)	1	H38 lighting H109 active Display Err_1 active	Safety mode
14	Grease level sensor P1 / P2 barrel (B50_1) disconnected.	1	H38 lighting H109 active Display Err_1 active	Unchanged
17	Grease level sensor P3 barrel (B50_2) disconnected.	1	H38 lighting H109 active Display Err_1 active	Unchanged
28	Grease level in P1/P2 barrel few (B50_1)	1	H38 lighting H109 active Display Err_1 active	Unchanged
29	Grease level in P3 barrel few (B50_2)	1	H38 lighting H109 active Display Err_1 active	Unchanged
33	Grease level in P1/P2 barrel low (B50_1)	2	H38 lighting H109 active Display Err_2 active	Unchanged
34	Grease level in P3 barrel low (B50_2)	2	H38 lighting H109 active Display Err_2 active	Unchanged
36	Pilot pressure too low (B184)	1	H38 lighting H109 active Display Err_1 active	Unchanged
37	No feedback from the lubrication distributor (B150_1)	1	H38 lighting H109 active Display Err_1 active	Safety mode
38	No feedback from the lubrication distributor (B150_2)	1	H38 lighting H109 active Display Err_1 active	Safety mode

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G1 : 0- 3- 3

G2 : 0- 0- 0

G3 : 2- 3- 5

G4 : 0- 0- 0

G5 : 0- 0- 0

G14: 0- 0- 0

G17: 0- 0- 0

G28: 5- 3- 8

G29: 6- 1- 7

G33: 11- 4- 15

G34: 9- 3- 12

G36: 8- 12- 20

G37: 2- 1- 3

G38: 2- 1- 3

Fig. 12 *Example of error codes history*

Note!

- The first column displays the number of errors occurred in the last hour.
- The second column displays the number of errors occurred in the last 10 hours.
- The third column displays all errors which occurred before.

To know the error code description, go to the menu "error history", on the interface, see paragraph "menu" of software menus description.

Life cycle - operation, maintenance, repair	
Residual risks	**Remedy**
Contact to the shovel foot during change of barrel of a pneumatic, hydraulic or electric barrel pump.	Change barrel only with the centralized lubrication system and pump being de-pressurized. Switch off the pump before changing the barrel and relieve existing system pressure.
Contact with the stirring paddle when filling a reservoir pump from the top during pump operation.	Fill preferably via the filling connection. Filling from the top or changing of barrel in case of barrel pumps only while the pump is idle. When filling, do not reach into the reservoir.
Electrical shock due to defective connection cable	Switch off the centralized lubrication system and check connection cable for damage.
People slipping due to floor contamination with spilled or leaked lubricant	Exercise caution when connecting the system. Promptly apply suitable binding agents to remove the leaked or spilled lubricant. Follow the operational instructions for handling lubricants and contaminated parts.
Tearing or damaging of lines	Switch of the centralized lubrication system, check the routing of the hose lines and optimize or replace defective hose or line, if necessary. Should this not be possible, use flexible hose lines of sufficient lengths.

Fault lifecycle	
Too strong heating up of the motor or other electrical components.	Switch off the pump and system. Let parts cool down, eliminate cause. Replace defective motor or other defective components.
Too strong heating up of hydraulically driven components	Switch of the system or the affected component. Ensure proper functioning of the oil cooler.
Strong cooling down and formation of ice on sound absorber and air leakage on pneumatically driven pumps or other components	Check the compressor and the drier of the compressed air supply. Reduce the operating speed of the affected pump. Shortly switch off the system or heat it, if necessary.
Inadmissible lubricant leakage on components or lubricant lines of the centralized lubrication system	Switch off the centralized lubrication system and determine cause. Replace defective lines or components.

9.2 System P1: Automatic lubrication

In the automatic system, a central lubrication pump provides lubricant to each lubrication point through a single line via injectors model LM5 and subsequent metering devices model SSV.

Configuration

Injector model LM5 supplies lubricant to the progressive metering devices model SSV which distributes the lubricant to each lubrication point evenly. A control unit commands and monitors the entire system.

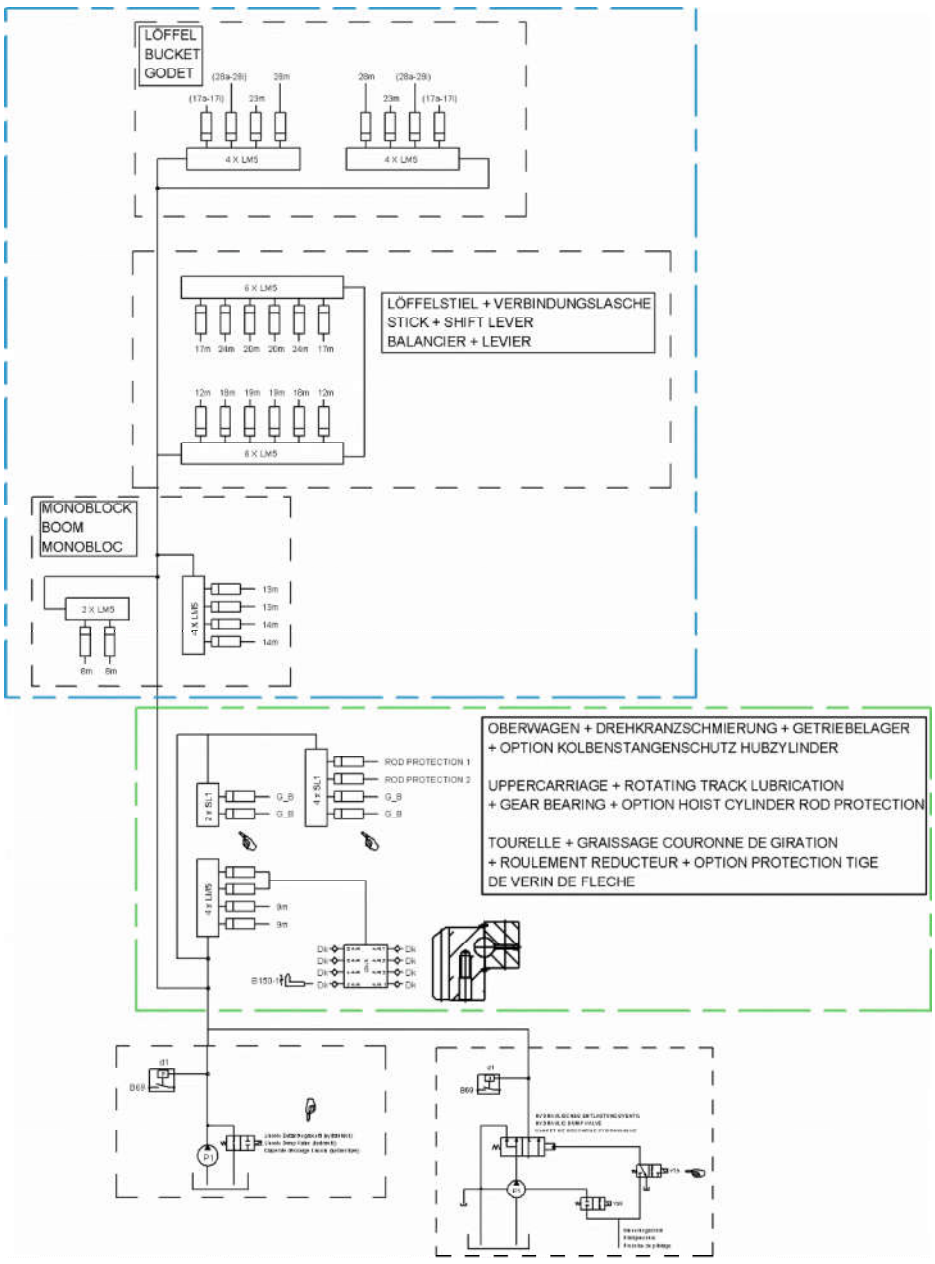
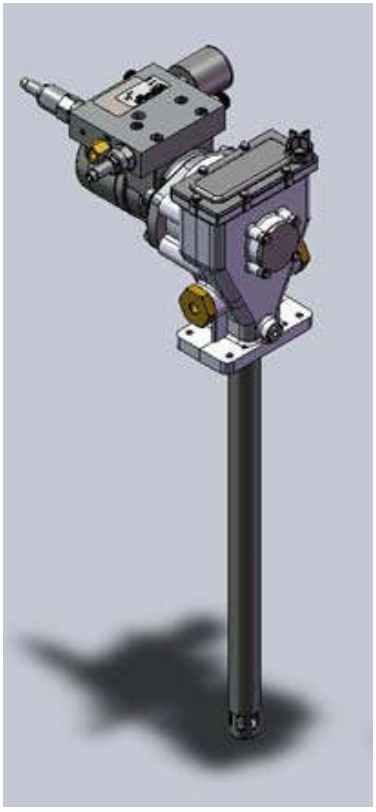


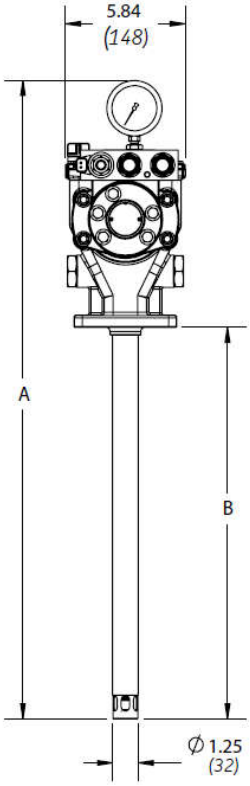
Fig. 3 Automatically operated single-line system with LM5 and subsequent progressive divider valve for backoe attachment

13 Components description

13.1 Pump – P1 (FMII)



Hydraulic inlet flow	7,6 l/min (2 U.S. gpm)
Operating temperature	-40 to 65 °C
Operating working hydraulic pressure	21 bar
Solenoid voltage, for the on/off solenoid (Y34_1)	24 V DC
Hydraulic inlet port	SAE 4
Tank return port	SAE 6
Supply inlet hydraulic pressure	maximum 200 bar
Pump outlets	¼" NPTF
Maximum hydraulic fluid temperature	121 °C
Pump ratio with manifold	10:1



Dimensions:
Refer to Operation Guide

For more details:

- Operation
- Setting and adjustment
- Troubleshooting

Refer to Operation Guide 404432_C8_352A.

Fig. 14 Pump model FlowMaster II

Safety Instructions

Appropriate Use

Use the SSV, SSV-E and SSV M lubricant metering devices only for dispensing lubricants in centralized lubrication systems.

Suitable Lubricants

- The progressive metering devices model SSV can be used for dispensing
  - mineral oils of at least 40 mm^2/s (cST) or
  - greases up to the penetration class NLGI 2

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IMPORTANT

It must nevertheless be ensured that the oils or greases used do not alter their consistency significantly in the course of time or under the influence of temperature or pressure.

General Safety Instructions

- The progressive centralized lubrication system connected to the Quicklub pump model 203 must always be secured with a pressure relief valve.
- Lincoln SSV, SSV-E and SSV M lubricant metering devices are state of the art.
- Incorrect use may result in bearing damage caused by poor or over-lubrication.
- Each outlet which will be used must be equipped with a check valve.
- In the case of the metering devices model SSV 6 to 12 or SSV6-E to 12-E and SSVM 6 to 12 the outlets 1 and/or 2 must never be closed.
- Unauthorized modifications or changes to an installed system are not admissible. Any modification must be subject to prior consultation with the manufacturer of the lubrication system.
- Use only original Lincoln spare parts (see Parts Catalogue) or the parts approved by SKF.

Operation, Repair and Maintenance

Authorized and instructed personnel who are familiar with the centralized lubrication systems should only perform repair.

Installation

- Install the metering devices at a suitable location in accordance with the lubrication diagram.
- It is recommended that the metering devices be installed in such a way that the outlets are not close to the chassis or the attaching plate. This will facilitate troubleshooting in the case the system is blocked.
- The main metering devices with indicator pin must be installed in such a way that the indicator pin is easily visible.

When the push-in type fittings are used, note the following:

- For the metering **device inlet** use only **push-in type fittings** (R 1/8) with **reinforced collar** and sealing ring.
- For the **outlet tube fittings** of the **SSV divider valve** (M 10x1) depending on the design of the lubricant line, for example
  - high-pressure plastic hose (Ø 4.1 x 2.3) use valve bodies with reinforced collar only, or,
  - pressure plastic tube (Ø 6 x 1.5) use valve bodies with knurled collar only
- For the **outlet fittings** of the **SSV M divider** divider valve (M 8x1) pressure plastic tube (Ø 4 x 1) use valve bodies with knurled collar only.

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NOTE

In the case of construction machines or agricultural machines use high pressure plastic hoses for the lubricant feet lines. In such cases the outlet fittings of the secondary metering devices and the connection fittings to the lubricant points must have a reinforced collet.

- Use only the main and feed lines specified by SKF and adhere to the specified system pressures.

Regulations for Prevention of Accidents

- To prevent accidents, observe all city, state and federal safety regulations of the country in which the product will be used.
- Avoid the operation with
  - unapproved parts.
  - insufficient or contaminated lubricants.

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CAUTION!

Danger of injury in the case of serious corrosion of metering device surfaces: An increasing corrosion of the surfaces will cause the balls pressed in to lose their hold. Under pressure, they may suddenly burst out and cause injuries.
For applications in corrosive environments, use metering devices in stainless steel version only.

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The Power of Knowledge Engineering

Drawing on five areas of competence and application-specific expertise amassed over more than 100 years, SKF brings innovative solutions to OEMs and production facilities in every major industry worldwide. These five competence areas include bearings and units, seals, lubrication systems, mechatronics (combining mechanics and electronics into intelligent systems), and a wide range of services, from 3-D computer modelling to advanced condition monitoring and reliability and asset management systems. A global presence provides SKF customers uniform quality standards and worldwide product availability.

Important information on product usage

All products from SKF may be used only for their intended purpose as described in this brochure and in any instructions. If operating instructions are supplied with the products, they must be read and followed.

Not all lubricants are suitable for use in centralized lubrication systems. SKF does offer an inspection service to test customer supplied lubricant to determine if it can be used in a centralized system. SKF lubrication systems or their components are not approved for use with gases, liquefied gases, pressurized gases in solution and fluids with a vapor pressure exceeding normal atmospheric pressure (1 013 mbar) by more than 0,5 bar at their maximum permissible temperature.

Hazardous materials of any kind, especially the materials classified as hazardous by European Community Directive EC 67/548/EEC, Article 2, Par. 2, may only be used to fill SKF centralized lubrication systems and components and delivered and/or distributed with the same after consulting with and receiving written approval from SKF.

Status of information:
07/2014

Manufacturer:
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E-Mail: Lubrication-germany@skf.com

SKF

Mode of Operation, continuation

Fig. 5-2 Pressure relief valve with grease return

T-P203Fp-020d08
B-P603M-030e08

... with grease return (optional)

- If the system is blocked, grease will leak from the pressure relief valve. This grease quantity is returned to the reservoir.
- In the case of a blockage in the system, the grease pushes out the red pin at the pressure relief valve, thus indicating that there is a fault.

➲ Afterwards the fault has been removed the pin has to be pressed back to its starting position.

Return Line Connection

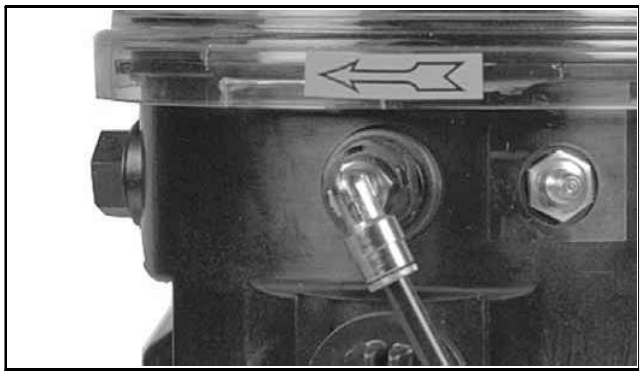

Fig. 6-1 Return Line Connection

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- The lubricant quantities which cannot be dispensed by the metering device must be returned to the pump via the return line connection.

Control Units

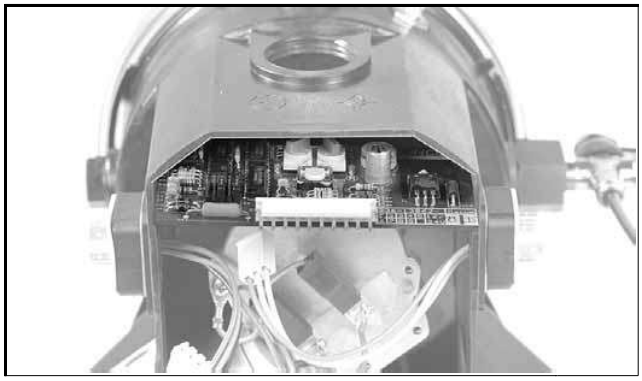

Fig. 7-1 Printed circuit board integrated in the housing

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NOTE

The present User Manual describes the pump without control unit Information concerning the design and operation of the individual control units (V10-V13, M08-M23, H) can be found in the respective User Manual.

- If the pump is to be equipped with a control unit, it is possible to use an integrated printed circuit board or an external control unit.

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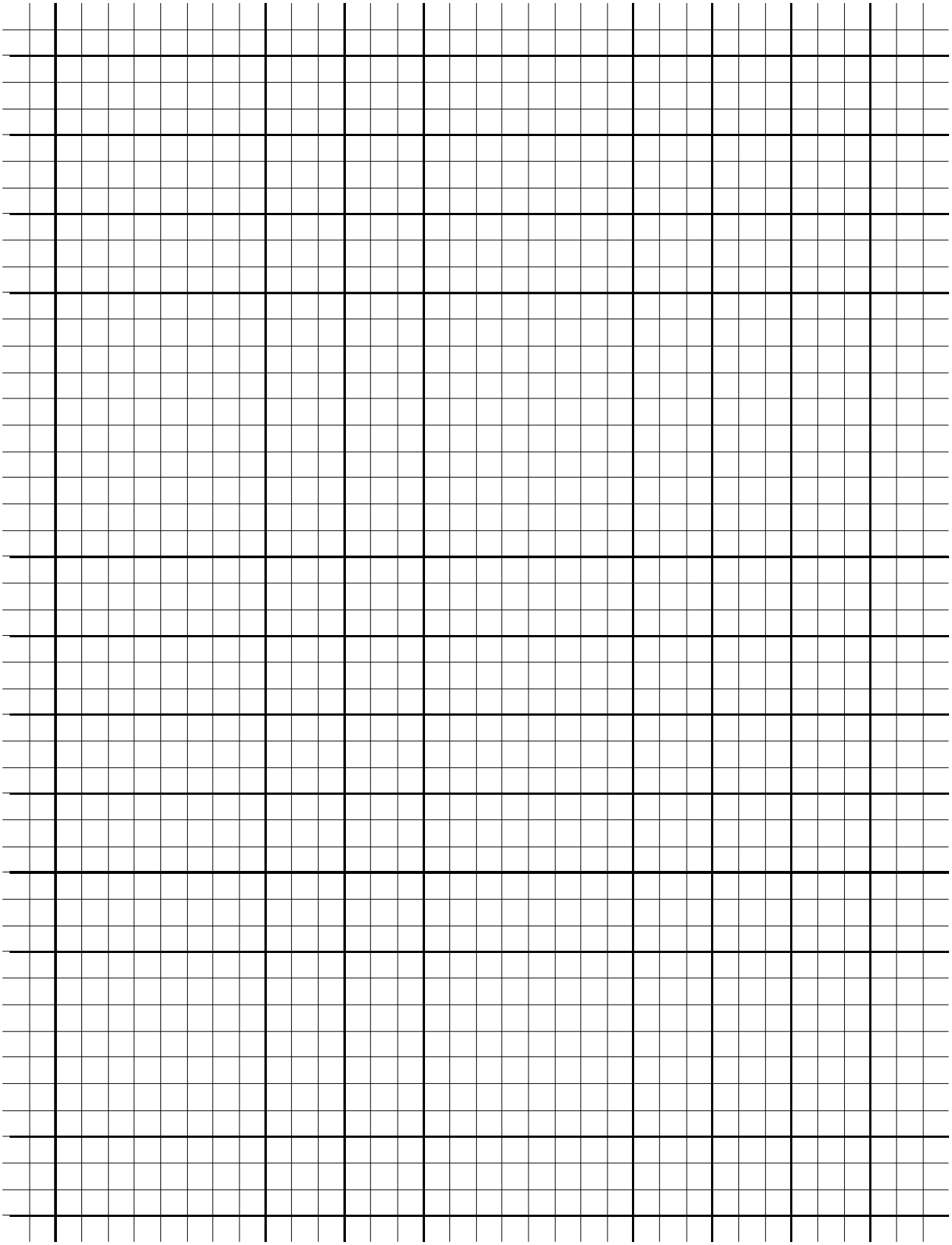
Notes:



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Technical Data, continuation

Connection Diagram – Industrial Applications M08-M15

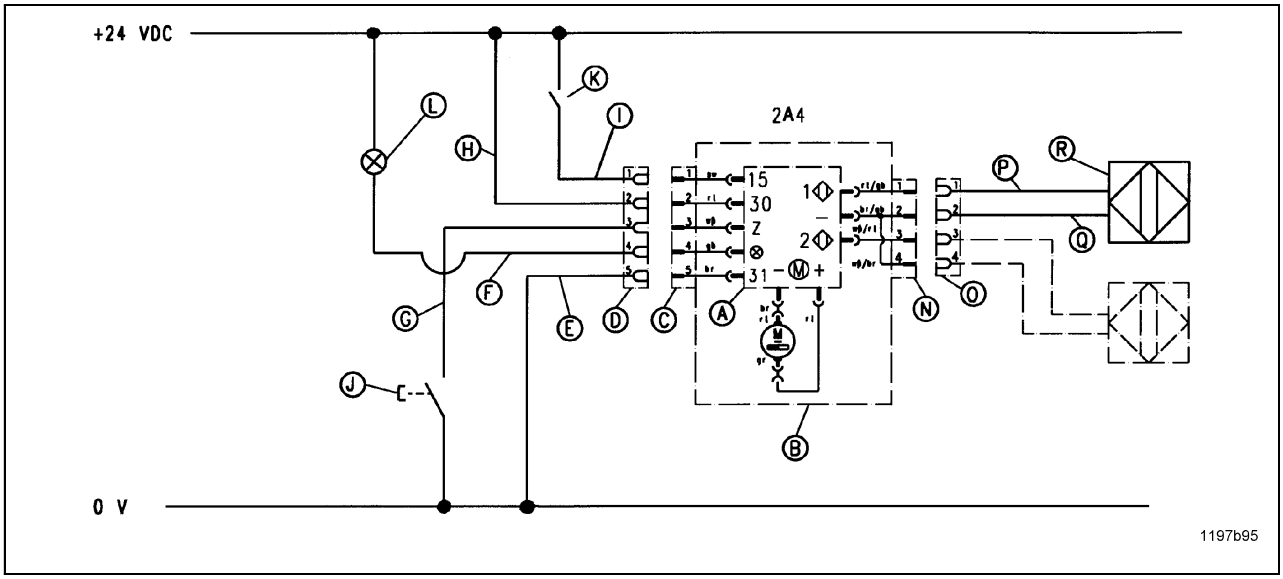

Fig. 21 Connection diagram QuickLub 203 with monitoring of the metering devices (industry), Connectors AMP, type Superseal

A - Printed circuit board
B - Pump housing
C - Cable connector 1
D - Line socket 1 with connection cable 5-wire
E - Cable, brown
F - Cable, yellow
G - Cable, white
H - Cable, red
I - Cable, black
J - Pushbutton for additional lubrication
K - Machine contact
L - Signal lamp
N - Cable connector 2
O - Line socket 2 with 1 or 2 connection cables, 2-wire
P - Cable, blue
Q - Cable brown
R - Piston detector (initiator), Monitoring circuit 1

Terminals of the printed circuit board

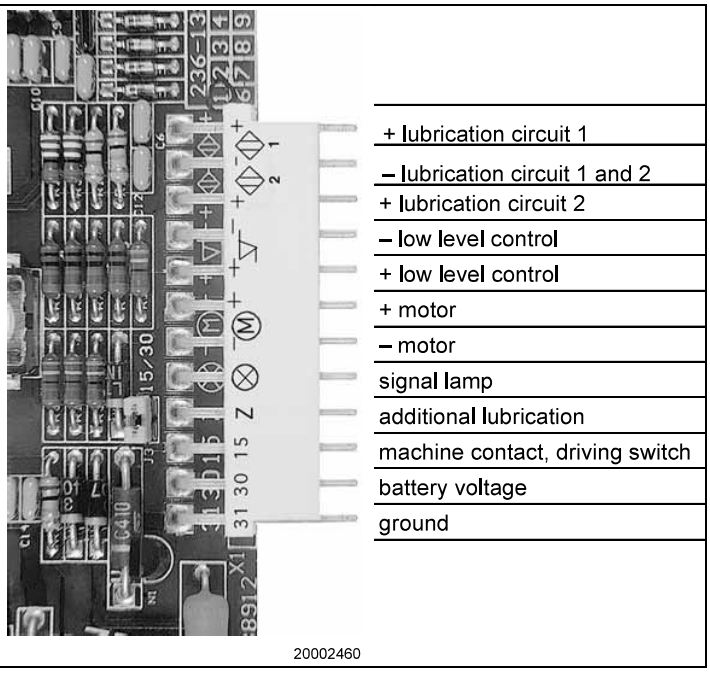

Fig. 22 Terminals of the printed circuit board

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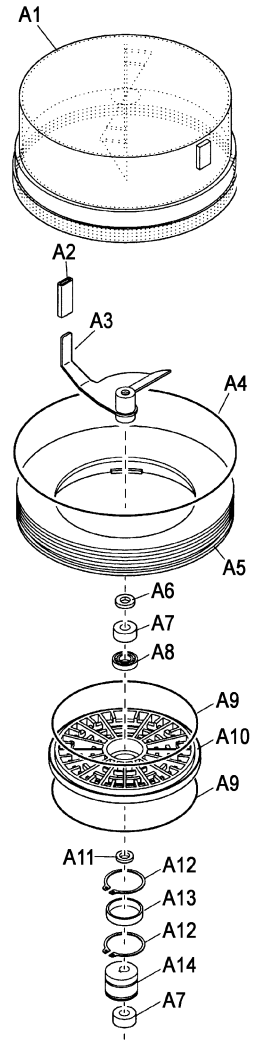
A … with 2 l flat-type reservoir for grease A

P203- & P223 /233-2XNFL-… (low-level control not possible)

- 2 l flat-type reservoir, closed
- with stirring paddle
- Control: V10-13 [1], V20-23 [1], H [1], V10-13 ADR [2], H ADR [3], MF/MDF01 [4], MF/MDF02 [5]
- Type of connection: 1A1.01/10 [1], 2A1.01/10 [1], 1A5.14 [1], 1A7.16 [1], 1A5.17 (ADR) [1], 2A5.14 [4], 2A6.15 [5]



K-P203-021b12

Pos.	Designation	Qty.	Part no.
A	**Reservoir assbembly**		
A1	2 l flat-type reservoir	1	544-31997-1
A2	Hose 3 cm	1	111-35089-2
A3	Stirring paddle incl. pos. A2	1	544-31929-1
A4	O-ring Ø 210 x 5	1	219-13730-9
A5	Adapter ring	1	444-24235-1
A6	Washer 8.4	1	209-13072-6
A7	Inner ring	2	444-24168-1
A8	Grooved ball bearing D 10 / 26 x 8	1	250-14009-7
A9	O-ring Ø 142 x 4	2	219-13730-7
A10	Intermediate bottom	1	444-24167-1
A11	Shim 10 x 16 x 0.5	1	209-13047-5
A12	Snap ring SW 32	2	211-14100-1
A13	Pressure ring Ø 33 x 37 x 13	1	444-24439-1
A14	Eccentric	1	444-24170-2

[1] for P203
[2] for P203, V10-13 ADR with type of connection 2A1 or 1A5.17
[3] for P203, H ADR only with type of connection 2A1
[4] for P223/233, PCB terminals 15 + 30 bridged
[5] for P223/233, PCB terminals 15 + 30 not bridged

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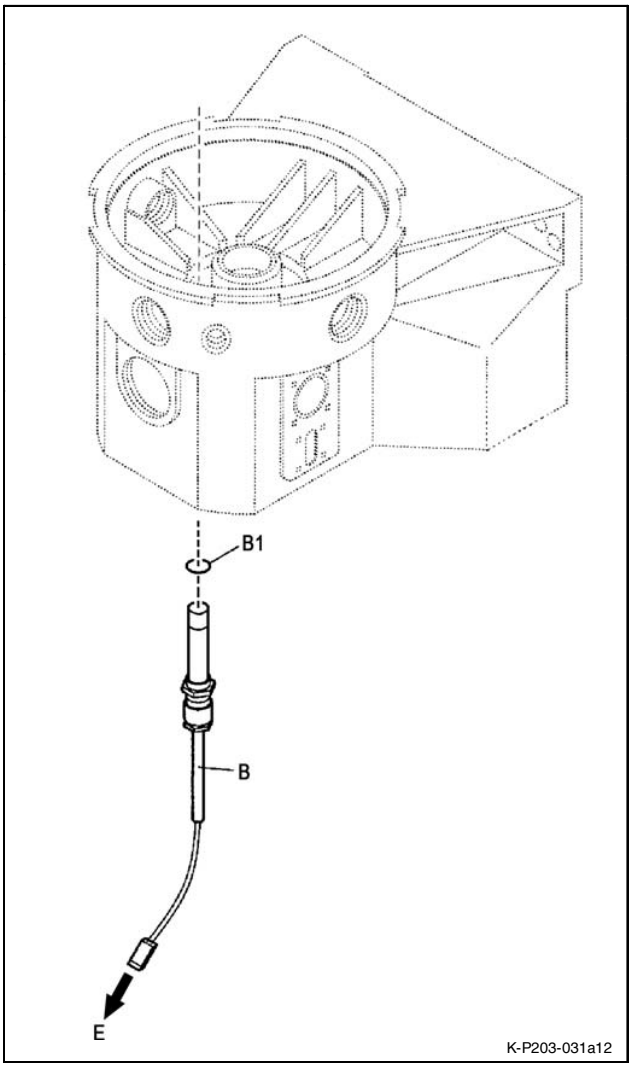
B … with magnetic switch for low-level control B

P203 & 223/233 & P243-XL & XLBO

- all reservoir sizes (excepting flat-type reservoir)
- for grease
- with stirring paddle
- Control: V10-13 [1], V20-23 [1], V10-13 ADR [1], external [2], M00-23 [3], MF/MDF01 [4], MF/MDF02 [4], MD20/21 [5]
- Type of connection: see below [1] - [5]



Pos.	Designation	Qty.	Part no.
B	**Magnetic switch** incl. pos. B1	1	
1)	- for control V10-13, V20-23		234-13162-5
2)	- for external control		234-10423-4
3)	- for control M00-23		234-10423-6
4)	- for control MF01, MF02, MDF01, MDF02		
5)	- for control MD21, MD20-1 … -8		
B1	O-ring	1	
E	see chapter **… with Control Unit**	1	

1) **P203 type of connection C**:
- with square-type plug 2A1.01/10, 2A1.11 (ADR)
- with bayonet plug 1A7.16

2) **P203 type of connection C**:
- with square-type plug 2A1.01/10

3) **P203 type of connection C**:
- with AMP plug 2A4.12/13
- with cable gland PG9 1A8.00, 2A8.00
  + with AMP plug (wire-to-wire) 2A9.12/13
- with bayonet plug 2A6.15

4) **P223/233 type of connection C** (with bayonet plug):
- for control MF01 and MDF01 2A5.14
- for control MF02 and MDF02 2A6.15

5) **P243 type of connection C**:
- with M12 plug 2A2.01
- with bayonet plug 2A7.16

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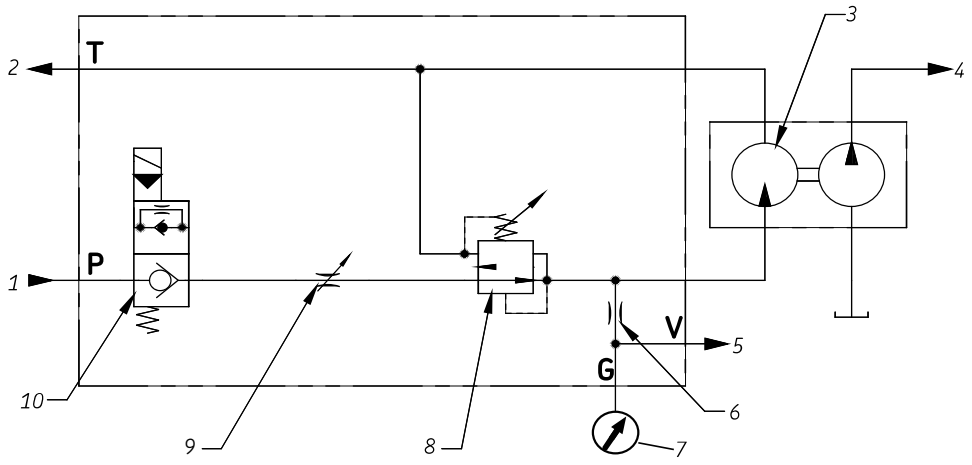
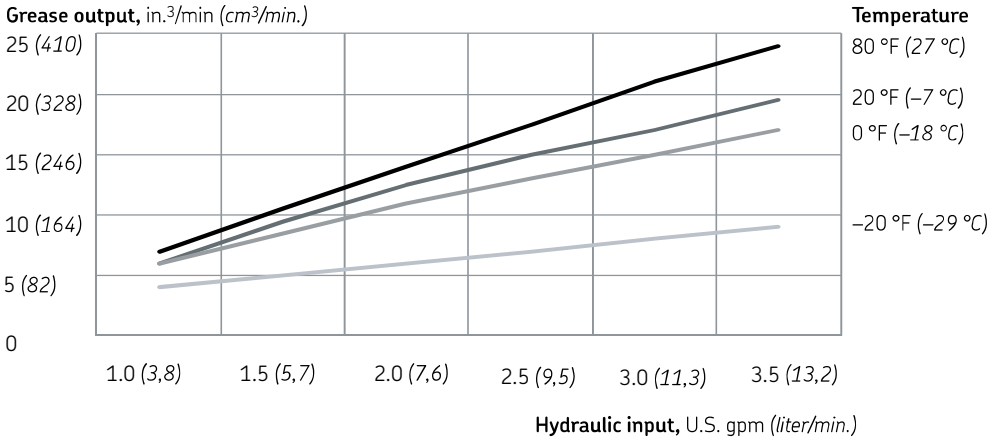
Fig. 1



Call out	Nomenclature
1	Hydraulic fluid inlet port SAE 4 ORB
2	Hydraulic fluid return to tank SAE 6 ORB
3	Hydraulic motor
4	Lube outlets .25 in. NPTF
5	Hydraulic fluid to vent valve
6	Orifice 0.013 in. (*0.33 mm*) diameter
7	Pressure gauge
8	Pressure reducing valve
9	Flow regulator
10	Solenoid valve

Diagram 1

Grease output vs hydraulic input



Lincoln industrial standard warranty

Standard limited warranty

Lincoln warrants the equipment manufactured and supplied by Lincoln to be free from defects in material and workmanship for a period of one (1) year following the date of purchase, excluding there from any special, extended, or limited warranty published by Lincoln. If equipment is determined to be defective during this warranty period, it will be repaired or replaced, within Lincoln's sole discretion, without charge.

This warranty is conditioned upon the determination of a Lincoln authorized representative that the equipment is defective. To obtain repair or replacement, you must ship the equipment, transportation charges prepaid, with proof of purchase to a Lincoln Authorized Warranty and Service Center within the warranty period.

This warranty is extended to the original retail purchaser only. This warranty does not apply to equipment damaged from accident, overload, abuse, misuse, negligence, faulty installation or abrasive or corrosive material, equipment that has been altered, or equipment repaired by anyone not authorized by Lincoln. This warranty applies only to equipment installed, operated and maintained in strict accordance with the written specifications and recommendations provided by Lincoln or its authorized field personnel.

This warranty is exclusive and is in lieu of any other warranties, express or implied, including, but not limited to, the warranty of merchantability or warranty of fitness for a particular purpose. Warranty on items sold by Lincoln, but not manufactured by Lincoln are subject to the warranty consideration, if any, of their manufacturer (such as hoses, hydraulic and electric motors, electrical controllers, etc.) Assistance in making such warranty claims can be offered as required.

In no event shall Lincoln be liable for incidental or consequential damages. Lincoln's liability for any claim for loss or damages arising out of the sale, resale or use of any Lincoln equipment shall in no event exceed the purchase price. Some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages, therefore the above limitation or exclusion may not apply to you.

Special limited warranties

Special limited 2 year warranty

SL-V series, single injectors-85772, 85782,replacement injectors-85771, 85781 and FlowMaster II 85731, 85732, 85733 and 85734

Lincoln warrants the SL-V Injector series and bare FlowMaster II "pump only" models to be free from defects in material and workmanship for two (2) years following the date of purchase. If an injector model (single or replacement) or "bare" FlowMaster II pump is determined to be defective by Lincoln, in its sole discretion, during this warranty period, it will be repaired or replaced, at Lincoln's discretion, without charge.

Special limited 5 year warranty

series 20, 25, 40 bare pumps, pmv bare pumps, heavy duty and 94000 series bare reels

Lincoln warrants series 20, 25, 40 bare pumps, PMV bare pumps, heavy duty (82206), mini bench (81133, 81323), and all 94000 LFR series (single arm and dual arm) bare reels to be free from defects in material and workmanship for five (5) years following the date of purchase. If equipment is determined by Lincoln, in its sole discretion, to be defective during the first year of the warranty period, it will be repaired or replaced at Lincoln's discretion, without charge. In years two (2) and three (3), the warranty on this equipment is limited to repair with Lincoln paying parts and labor only. In years four (4) and five (5), the warranty on this equipment is limited to repair with Lincoln paying for parts only.

Lincoln Industrial contact information

To find Lincoln Industrial's nearest service center in the United States, call customer service at 314-679-4200. For international callers dial 01-314-679-4200. You may also use our website lincolnindustrial.com.

Declaration of conformity according to machinery Directive 89/392/EEC

This is to declare that the design of the FlowMaster II rotary driven hydraulic pump in the version supplied by Lincoln Industrial, One Lincoln Way, St. Louis, MO. 63120, U.S.A., complies with provisions of Directive 89/392/EEC.

Applied harmonized standards in particular:

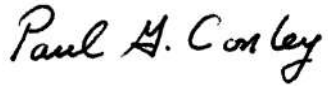
EN 292-1 Safety of machinery part 1 Basic terminology, methodology

EN 292-2 Safety of machinery part 2 technical principles and specifications

EN 982 Safety of machinery, safety requirements for fluid power systems and their components, hydraulics,

EN 1050 Safety of machinery, principles for risk assessment

CE



Paul G. Conley, Chief Engineer
December 16th, 2003

9.3EN-98002-A11

LIEBHERR LFR Controller for Lubrication of Mining Excavators

via Single-Line Centralized Lubrication Systems

Part No. 664-36957-7

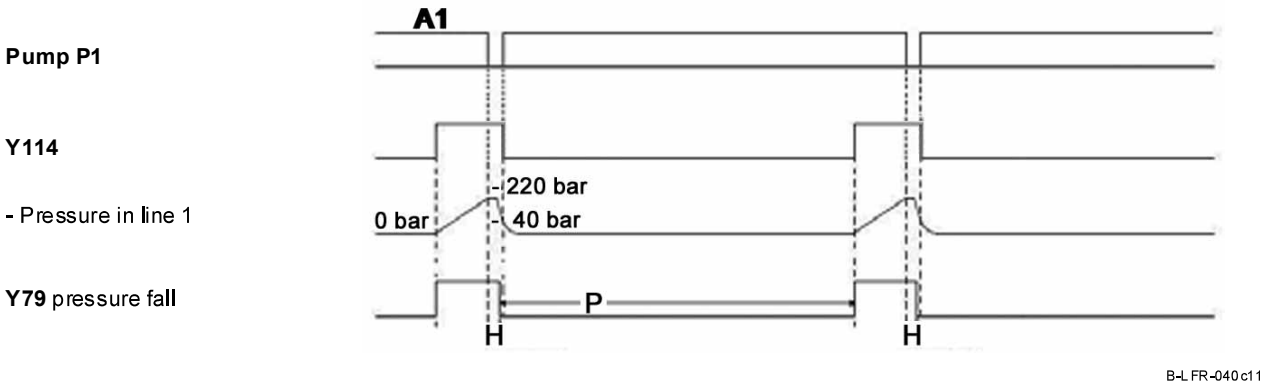
B-LBHM-0 00a09

Subject to modification

Mode of Operation, continuation

Lubrication procedure of the P1 pump with low-temperature kit during winter operation

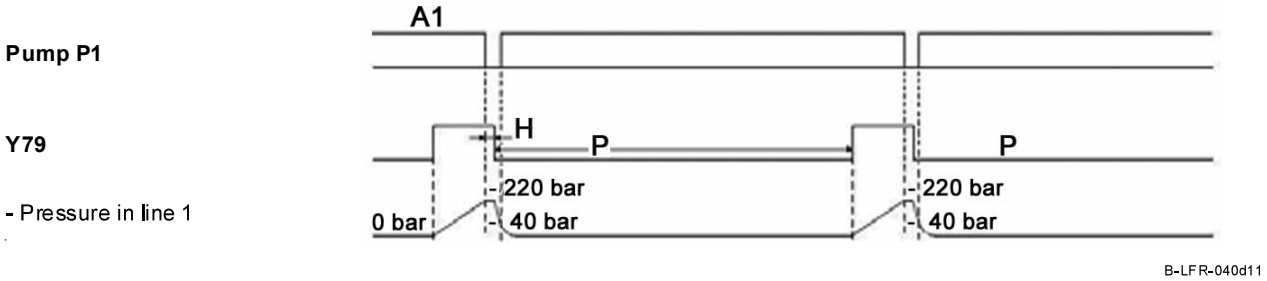
The Y95_1 solenoid valve activates the P1 pump.
For pressurization, valve Y114 is activated and the Y79 solenoid valve blocks the grease return to the barrel. The P1 pump is activated. As a consequence pressure in the grease circuit rises until a pressure of 220 bar (parameter: pressure B69 upper limit) is reached, which is then displayed by the pressure sensors B69 (for P1). As soon as the pressure reaches 220 bar, the P1 pump are switched off. The Y79 solenoid valve continues to block the grease return until the so-called hold time (parameter: hold time P1 winter) has lapsed. However, the circuit is still under pressure to allow lubrication to continue. When the hold time has lapsed, the pause time starts (parameter: pause time P1 standard) and the grease return is released by switching off the Y79 and the Y114 solenoid valves. The lubrication circuit is depressurized. As soon as the pressure falls below 40 bar (parameter: pressure B69 lower limit), circulation is started by the P1 pump. As soon as the pause time has lapsed, another lubrication cycle is possible.



A1 - Pump active line 1 **H** - Hold time **P** - Pause time

Lubrication procedure of the P1 pump without low-temperature kit during winter operation

The Y95_1 solenoid valve activates the P1 pump.
For pressurization, solenoid valve Y79 blocks the grease return to the barrel. Pump P1 is activated. As a consequence pressure in the grease circuit rises until a pressure of 220 bar (parameter: pressure B69 upper limit) is reached, which is then displayed by the pressure sensor B69 (for P1). As soon as the pressure reaches 220 bar, the P1 pump is switched off. The Y79 solenoid valve continues to block the grease return until the so-called hold time (parameter: hold time P1 winter) has lapsed. However, the circuit is still under pressure to allow lubrication to continue. When the hold time has lapsed, the pause time starts (parameter: pause time P1 normal) and the grease return is released by switching off the Y79 solenoid valve. The lubrication circuit is depressurized. As soon as the pressure falls below 40 bar (parameter: pressure B69 lower limit), circulation is started by the P1 pump. As soon as the pause time has lapsed, another lubrication cycle is possible.



A1 - Pump active line 1 **H** - Hold time **P** - Pause time


6001a02

IMPORTANT NOTE

Codings "B…", "H…", "S…", "X…", and "Y…" refer to the wiring diagram (see annex).

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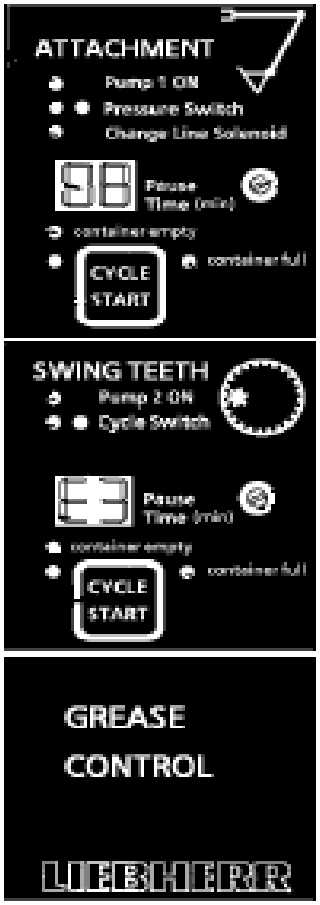
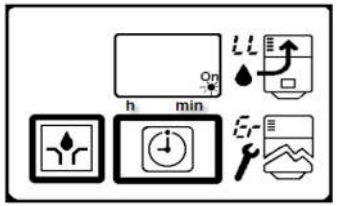
VALID ONLY WITH THE OLD GREASE PILOTING SYSTEM

S1	=	bor
Und	=	oFF
SP1	=	Std
on1	=	220
OF1	=	40
dS1	=	0
dr1	=	0
lu1	=	HFS
SP2	=	Std
on2	=	0
OF2	=	0
d52	=	0
dr2	=	0
lu2	=	HFS
AO2	=	0
AOF	=	0
nAH	=	0
Clr	=	no
Err	=	No value to set



OR



2.1.3 **Type of construction**
Inline filter

2.1.4 **Mounting method**
4 mounting holes in filter head

2.1.5 **Approx. weights**

	with element	without element
DF 30	1.9 kg	1.8 kg
DF 60	4.1 kg	3.9 kg
DF 110	6.0 kg	5.7 kg
DF 140	6.6 kg	6.2 kg
DF 160	9.6 kg	9.1 kg
DF 240	11.3 kg	10.6 kg
DF 280	15.9 kg	14.5 kg
DF 330	22.6 kg	21.4 kg
DF 500	26.9 kg	25.2 kg
DF 660[2]	30.5 kg	28.3 kg
DF 660[3]	36.2 kg	34.0 kg
DF 990	43.4 kg	40.0 kg
DF1320	52.4 kg	48.0 kg
MDF 30	1.9 kg	1.8 kg
MDF 60	3.2 kg	3.0 kg
MDF110	3.7 kg	3.2 kg
MDF160	7.2 kg	6.7 kg
MDF240	8.1 kg	7.4 kg
LF 30	0.8 kg	0.7 kg
LF 60	1.5 kg	1.3 kg
LF 110	1.8 kg	1.5 kg
LF 160	3.7 kg	3.2 kg
LF 240	4.3 kg	3.6 kg
LF 330	8.2 kg	7.0 kg
LF 660	17.8 kg	15.6 kg

2.1.6 **Housing volumes**
Filter type LF and DF

Size	Volume
30	0.13 l
60	0.20 l
110	0.33 l
140[1]	0.40 l
160	0.60 l
240	0.80 l
280[1]	1.45 l
330	1.50 l
500[1]	2.30 l
660	3.00 l
990[1]	4.20 l
1320[1]	5.60 l

Filter type MDF

Size	Volume
30	0.10 l
60	0.18 l
110	0.32 l
160	0.55 l
240	0.79 l

[1] for DF series only
[2] size 660, type code 2
[3] size 660, type code 1

2.1.7 **Pipe connection sizes**
(threaded connection to ISO 228) and the relevant type codes

DF	30	G	G ½	1.1
DF	60	G	G ¾	1.1
DF	110	G	G ¾	1.1
DF	140	G	G ¾	1.1
DF	160	G	G 1 ¼	1.1
DF	240	G	G 1 ¼	1.1
DF	280	G	G 1 ¼	1.1
DF	330	G	G 1 ½	1.1
DF	330	F	SAE flange DN 50 / 6000 psi	1.1
DF	500	G	G 1 ½	1.1
DF	500	F	SAE flange DN 50 / 6000 psi	1.1
DF	660	G	G 1 ½	1.1 2.1
DF	990	G	G 1 ½	2.1
DF	990	F	SAE flange DN 50 / 6000 psi	2.1
DF	1320	G	G 1 ½	2.1
DF	1320	F	SAE flange DN 50 / 6000 psi	2.1
MDF	30	G	G ½	1.1
MDF	60	G	G ¾	1.1
MDF	110	G	G ¾	1.1
MDF	160	G	G 1 ¼	1.1
MDF	240	G	G 1 ¼	1.1
LF	30	G	G ½	1.1
LF	60	G	G ¾	1.1
LF	110	G	G ¾	1.1
LF	160	G	G 1 ¼	1.1
LF	240	G	G 1 ¼	1.1
LF	330	G	G 1 ½	1.1
LF	660	G	G 1 ½	1.1

2.1.8 **Mounting position**
Vertical

2.1.9 **Flow direction**
Inlet and outlet: side connection
At the same level, on opposite sides.

2.2. HYDRAULIC DATA

2.2.1 **Operating pressure/ temperature**
The operating pressure is generally dependent on the operating temperature.
The following apply:

δ min…δ max…= -10 °C…+100 °C

DF 30 - 660[3]: p_{max} = 420 bar
DF 660[2] - 1320: p_{max} = 315 bar
(420 bar available on request)
MDF all sizes: p_{max} = 210 bar
LF all sizes: p_{max} = 100 bar

δ min…δ max…= -30 °C…-10 °C
only possible with Perbunan (NBR) seals.

DF 30 - 660[3]: p_{max} = 210 bar
DF 660[2] - 1320: p_{max} = 157.5 bar
LF sizes 30 - 330: p_{max} = 100 bar
LF size 660: p_{max} = 75 bar

Proof of fatigue strength for complete filters to HYDAC test standard. Min. 1 mill. stress cycles, from 0 bar to permissible operating pressure (= p_{max}).

For other temperature ranges, please contact our sales/technical department.

2.2.2 **Permissible Δp across element**
Betamicron®-H (BH3HC): 210 bar
Betamicron®-N (BN3HC): 25 bar
Metal fibre (V): 210 bar
Wire mesh (W): 30 bar

2.2.3 **Compatibility with hydraulic media**
Mineral oils:
test criteria to ISO 2943

Lubricating oils:
test criteria to ISO 2943

Suitable for use with non-flam fluids, synthetic oils and rapidly biodegradable oils. For use with water please check with our sales/technical department.

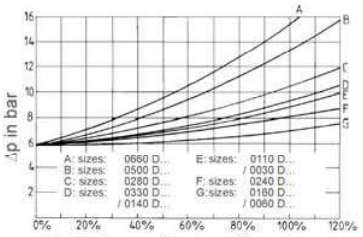
2.2.4 **Flow fatigue resistance to ISO 3724**
High fatigue resistance due to solid filter material supports on both sides and high inherent stability of filter materials.

2.2.5 **Pressure setting of clogging indicator**
Δp_a = 5 bar - 10%

2.2.6 **Cracking pressure of bypass valve**
Δp_o = 6 bar + 10%

2.2.7 **Bypass valve graphs**
The bypass valve graphs apply to mineral oil with a density of 0.86 kg/dm³.

The differential pressure of the valve changes proportionally to the density.



Q in l/min as a % value of the size

Ultrasonic sensors
237-11204-4 / 237-11204-5

Operating Instructions
following EMC Directive 2014/30/EU

EN

Product description
The ultrasonic sensors:
- measure the distance to the medium without contacting it and according to their detection area.
- emit an analogous output signal which is proportional to the distance of the medium.
- have a blind zone from which distance measuring is not possible.
- indicate whether an object is positioned within the unchangeably factory-set window limits. LED 1 (lights green).
- indicate whether an object is positioned outside the unchangeably factory-set window limits. LED 2 (lights red).
- have an internal temperature compensation. Due to the self-heating of the ultrasonic sensors the temperature compensation reaches its optimum operating point after an operating time of about 30 minutes.

Regulatory notes
Electrical equipment according to EMC 2014/30/EU

no safety components acc. to machinery directive 2006/42/EC

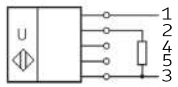
Enclosure type 1
For use in industrial machinery
NFPA 79 applications only

Intended use
Non-contact distance measurement of lubrication oils and greases in the frame of the technical data.

Safety instructions
Read these operating instructions before the installation and commissioning.
Installation and electrical connection by authorized qualified personnel only.

Installation and commissioning
- Clean the installation surface. When doing so make sure that no dirt enters the reservoir.
- Mount the ultrasonic sensor with the sensor surface (white area) centrically above the bore (Ø 20 mm) into the reservoir lid.
- Connect the connection cable to the M12 plug.
- Switch the power supply on.

Electrical connection

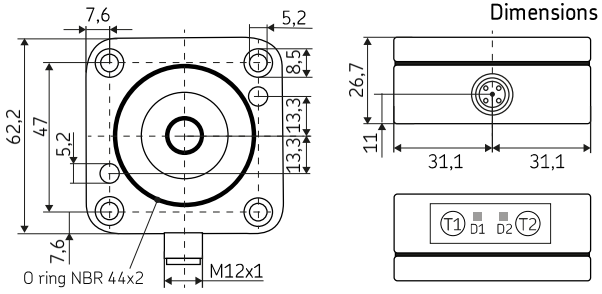


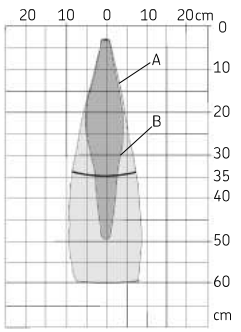
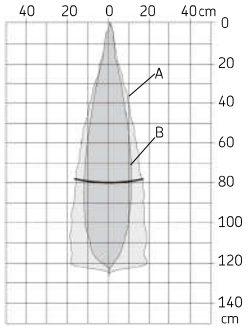
		Colour
1	+ U_B	brown
2	U	white
3	- U_B	blue
4	-	black
5	Sync/Com	grey

Cleaning
Clean the sensor surface (white area), if it is contaminated.

Maintenance
The ultrasonic sensors do not require any maintenance.

Dimensions



Technical data		
Order number	237-11204-4	237-11204-5
Blind zone	0 - 65 mm	0 - 115 mm
Scanning range limit	500 mm	1000 mm
Opening angle of the sound beam	see detection zone	
Ultrasonic frequency	approx. 400 kHz	approx. 200 kHz
Resolution	0, 18 mm	
Repeatability	±0.15 %	
Detection zone in centimetres The dark grey areas indicate the zone in which the standard reflector (pipe) is reliably detected. This is the typical operating range of the sensors, The light grey areas indicate the zone in which a big reflector – like, e.g. a plate – is still detected – provided it is optimally positioned to the sensor. Outside the light grey area an evaluation is not possible any more. A = aligned plate B = pipe		
Accuracy	±1 %	
Operating voltage U_B	9 - 30 V DC protected against reverse polarity	
Residual ripple	±10 %	
No-load current consumption	≤ 60 mA	
Housing material	PBT, polyester, ultrasonic transducer: PUR, epoxy resin with glass contents	
Type of connection	5-pole M12 circular socket connector	
Protection type following EN 60529	IP 67	
Display elements	LED D1 (green / red) LED D2 (green)	
Operating and storage temp. ranges	-40 °C to + 70 °C	
Weight	120 g	
Response delay	272 ms	340 ms
Readiness delay	< 300 ms	
Compliance with standards	DIN EN 60947-5-2	
Current output 4 - 20 mA	$R_L \leq 100\,\Omega$ at 9 V ≤ U_B ≤ 15 V / $R_L \leq 500\,\Omega$ at $U_B \geq 15$ V	
	rising/ falling characteristics	
Power consumption 0 - 10 V	$R_L \geq 100\,\Omega$ at $U_B \geq 15$ V short-circuit-proof rising/ falling characteristics	

Factory settings
Falling characteristic, analogous outlet to current 4-20 mA, 4 mA (emtpy) 20 mA (full), pushbuttons deactivated

Manufacturer: SKF Lubrication Systems Germany GmbH · Heinrich-Hertz-Str. 2-8 · DE-69190 Walldorf

Document no.: 951-181-008-00 / State of the information: 2015/11/09 / Version 01
Document no.: 951-181-008-EN

2 Schematics

2.1 Electric

2.1.1 45° access ladder (optional)

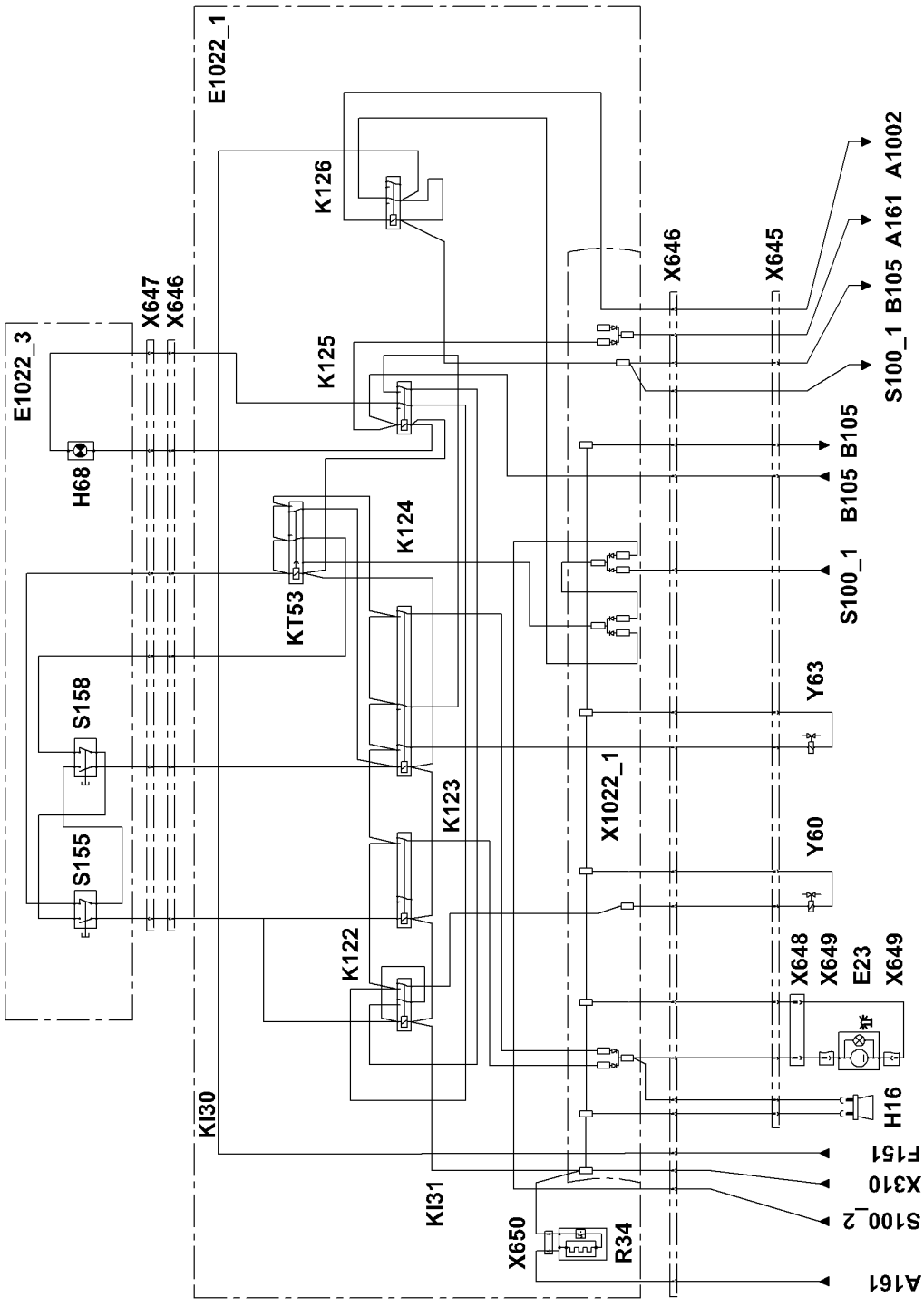


Fig. 6 *Electrical scheme of the 45° access ladder (optional)*

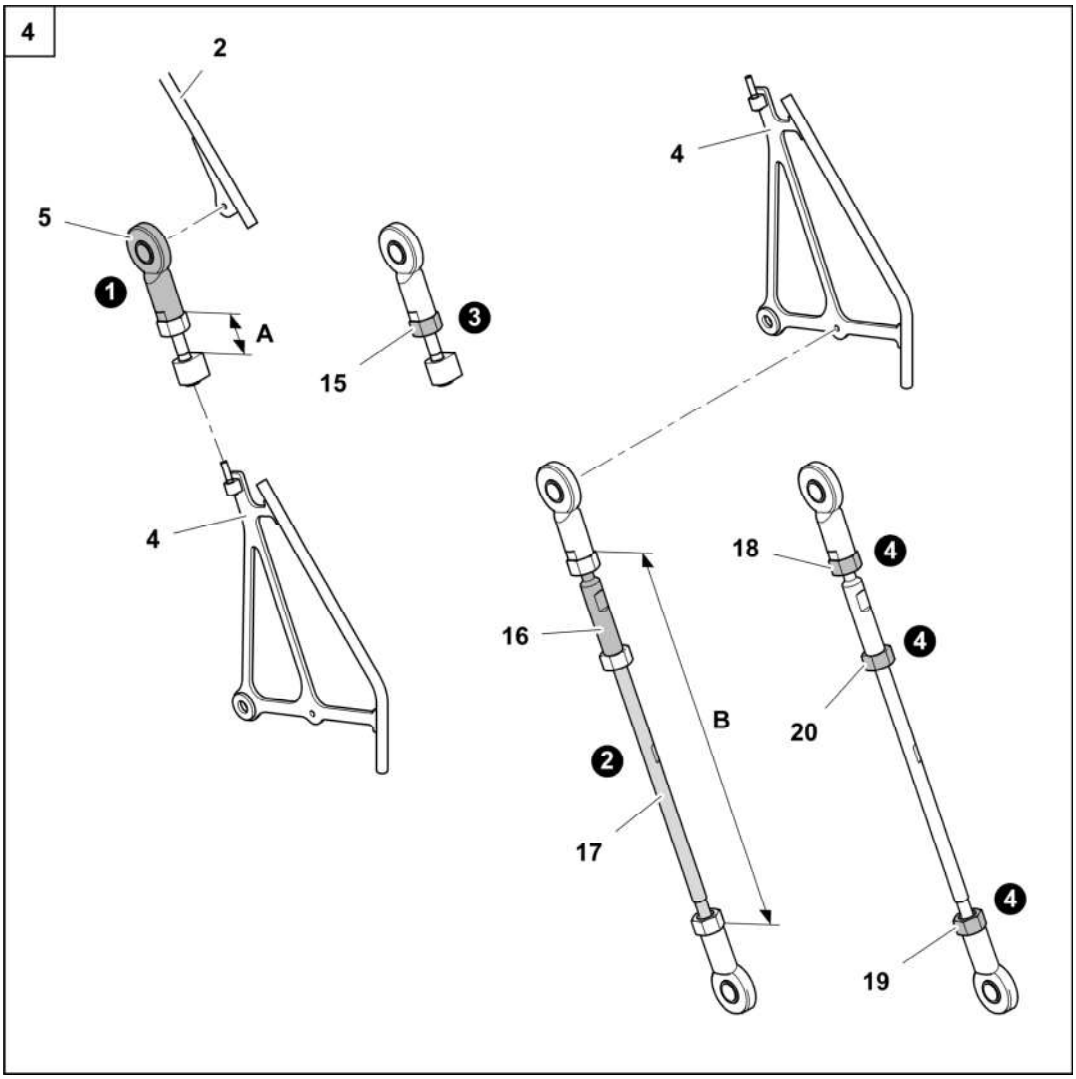


Fig. 21 *Step 4*

A	Distance to get = 46 mm	**16**	Rod (2x)
B	Distance to get = 620 mm	**17**	Rod (2x)
2	Guardrail (2x)	**18**	Pivot locknut (2x)
4	Handrail (2x)	**19**	Pivot locknut (2x)
5	Pivot (6x)	**20**	Rod locknut (2x)
15	Pivot locknut (2x)		

- ▶ Adjust the pivot **5** which is installed on the guardrail **2** to get the distance **A** between the threaded end of this pivot and the handrail **4**.
- ▶ Adjust the rods **16** and **17** to get the distance **B** between the threaded ends of the related pivots.
- ▶ Make sure that the two parts of the access ladder are horizontally aligned with each other.
- ▶ Tighten the locknuts **15**, **18**, **19** and **20** to lock these positions.

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2 Cabin electric

2.1 Control and cab instrumentation

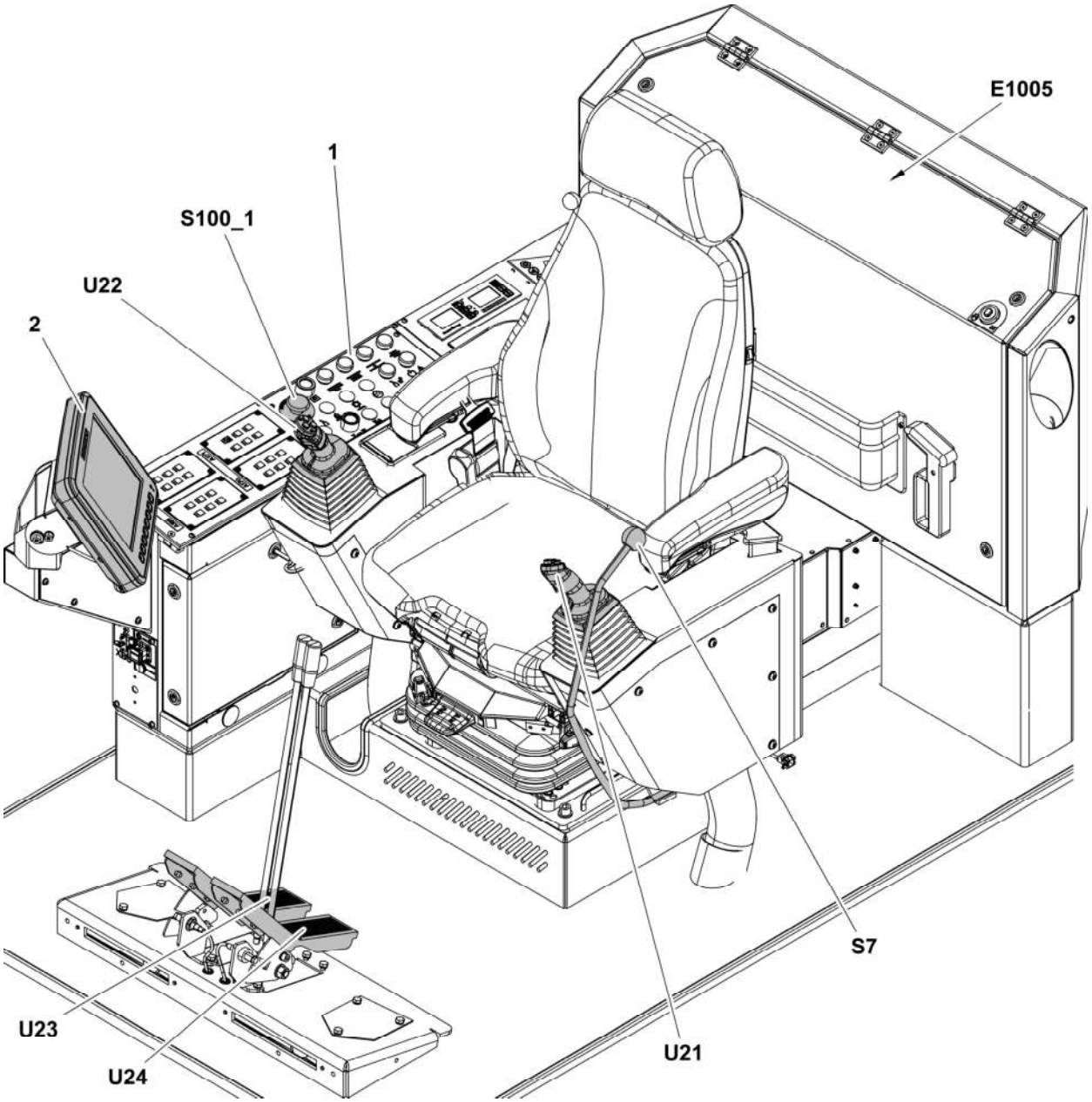

Fig. 2 *Control and cab instrumentation*

1	Control board	**U21**	Left joystick
2	Monitoring display	**U22**	Right joystick
E1005	Cab connection box	**U23**	Right travel pedal
S100_1	Emergency stop	**U24**	Left travel pedal
S7	Safety lever		

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- Components location

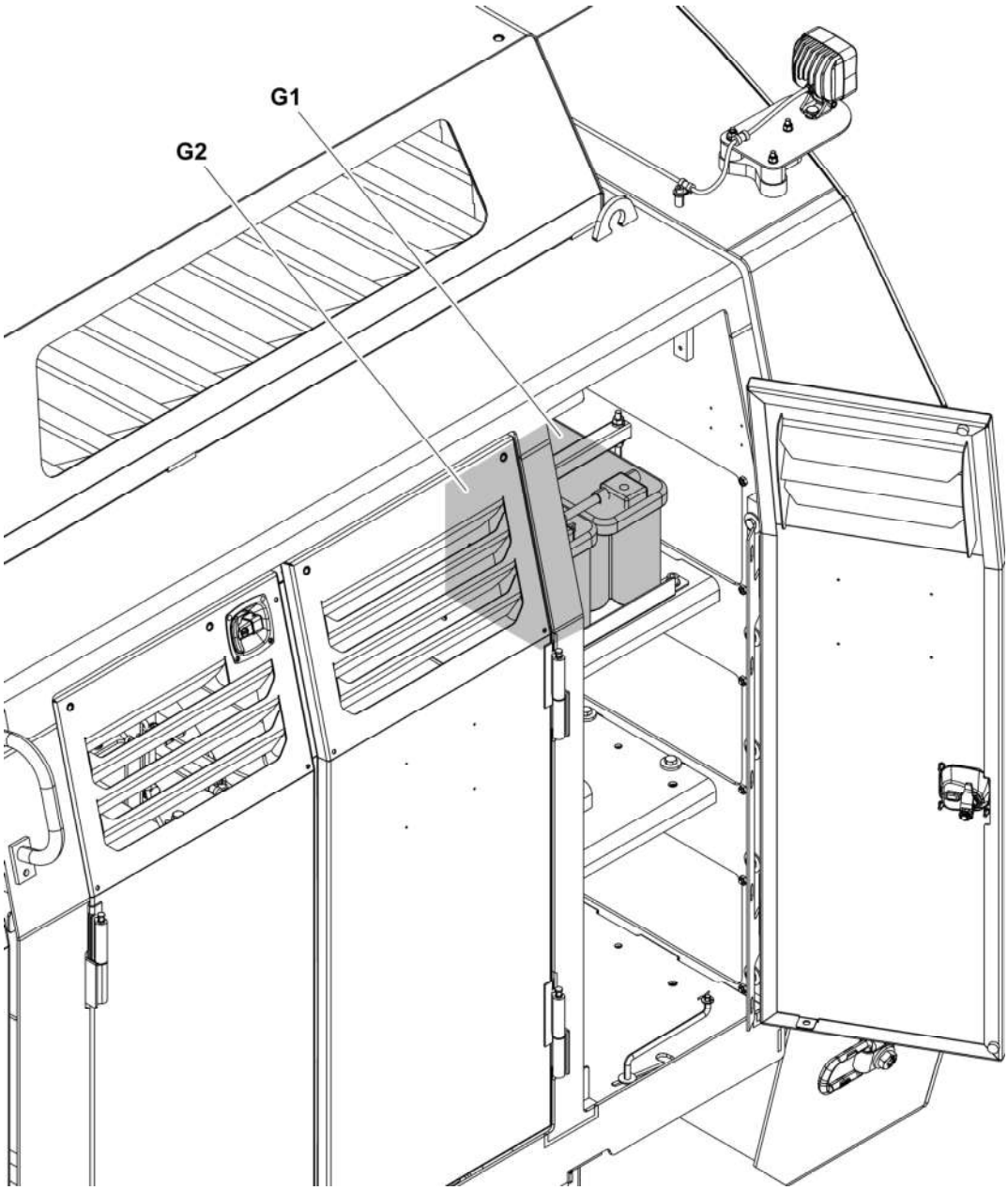

Fig. 16 *Batteries **G1** and **G2***

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A54	Output module	**A164**	Input module
A61	Output module	**A165**	Input module
A62	Output module	**A166**	Input module
A63	Output module	**A167**	Input module

6.4 Keyboard

▶ Refer to the Operating Manual.

6.5 Monitoring display

▶ Refer to the Operating Manual.

6.6 CAN Bus

6.6.1 Definition

A Bus is a wiring system connecting several terminals in the same way. The CAN (Controller Area Network) protocol is associated with a chip (5 x 5 mm) which is fast (100 kBd to 1 MBd) and can be used in severe conditions (vibrations, variable temperatures, ...) as it is the case with the Liebherr hydraulic machines.

6.6.2 Principle

The Bus is used to transmit, via a two cables system, numerical information between terminals. Several terminals can send out a message at the same time: there is no "master / slave" relationship. The messages are processed using an established priority order.

When a message is send, all terminals receive it but only the concerned terminal takes the message into account and processes it.

The high data transfer rate produces some signal distortion corrected at reception by the CAN processor. This processor allows each terminal to control the messages on the bus stopping those containing an error and sending an acknowledgement message when the message is correct. This system enables the detection of faulty terminals and minimises the perturbation generated by them to the detriment of the other terminal transmissions.

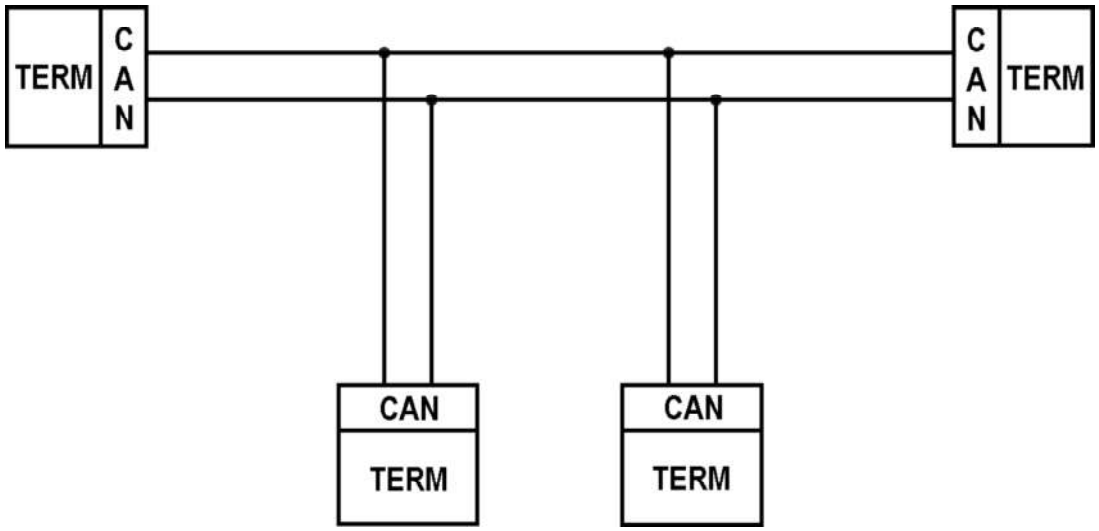

Fig. 30 *CAN system representation*

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2 Hints

2.1 Coupling Selection

C A U T I O N !
For a continuous and troublefree operation of the coupling it must be designed according to the selection instructions (according to DIN 740 part 2) for the particular application (see ROTEX® catalogue).
If the operating conditions (performance, speed, changes at engine and machine) change, the coupling selection must be checked again.
Please make sure that the technical data regarding torque only refers to the spider. The transmissible torque of the shaft/hub connection must be checked by the orderer, and he is responsible for the same.

For drives with endangered torsional vibration (drives with periodical load on torsional vibration) it is necessary to make a torsional vibration calculation to ensure a perfect selection. Typical drives with endangered torsional vibration are e. g. drives with diesel engines, piston pumps, piston compressors etc. On request KTR makes the coupling selection and the torsional vibration calculation.

2.2 General Hints

Please read through these mounting instructions carefully before you set the coupling into operation.
Please pay special attention to the safety instructions!

The **ROTEX®** coupling is suitable and approved for the use in hazardous areas. When using the coupling in hazardous areas please observe the special hints and instructions regarding safety in enclosure A.

The mounting instructions are part of your product. Please keep them carefully and close to the coupling.

2.3 Safety and Advice Hints

STOP	**D A N G E R !**	**Danger of injury to persons.**
!	**C A U T I O N !**	**Damages on the machine possible.**
☞	**A T T E N T I O N !**	**Pointing to important items.**
Ex	**P R E C A U T I O N !**	**Hints concerning explosion protection.**

2 Splitterbox

2.1 Technical data

	Units	Value
Trademark		Liebherr
Type		PVG 450 C 486
Direction of rotation (as seen when facing the flywheel)		Clockwise
Ratio to pump connection 1		0,632
Ratio to pump connection 2		0,632
Ratio to pump connection 3		0,662
Weight (without pumps)	kg	340
Oil quantity in gear	▶ Refer to the Operating Manual	
Oil classification	▶ Refer to the Operating Manual	
Oil viscosity	▶ Refer to the Operating Manual	

▶ For more information about the splitterbox, refer to the related documentation below.

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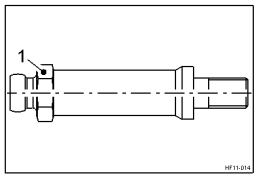
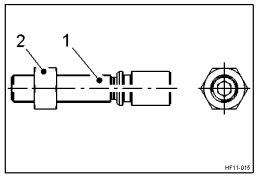
Thread	DIN 6912 8.8	DIN 7984 8.8	ISO 7380 10.9	ISO 10664 10.9	ISO 14580 10.9
M16	180	110	-	-	245
M20	280	200	-	-	475
M24	420	390	-	-	820

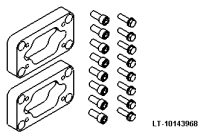
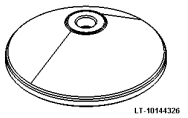
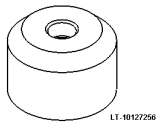
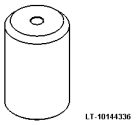
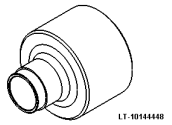
3.2 Regulating pin torque

Size	Item 1 torque Nm	
M8x1	15	
-	-	

Note
Glue in regulating pin item 1 with Loctite 262.

3.3 Hex nut torque Qmin. limit stop screw

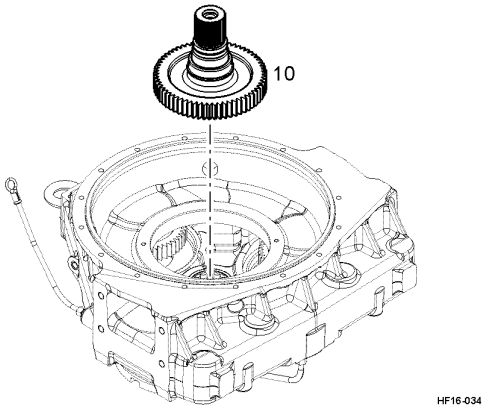
Size	Standard	Item 2 torque Nm	
M10	**ISO 4032**	50	
M12	**ISO 4032**	70	
M12x1	**ISO 8673**	40	
M14	**ISO 4032**	130	
M16	**ISO 4032**	195	

Item	Pieces	Name	Identification number	Use (Chapter)	
LT7	1	Adapter plate	10143968	All	
LT8	1	Assembly mandrel only in connection with LT0	10144326	6	
LT9	1	Assembly sleeve only in connection with LT0	10127256	7	
LT10	1	Assembly sleeve only in connection with LT0	10144336	6	
LT11	1	Assembly sleeve	10144448	5	

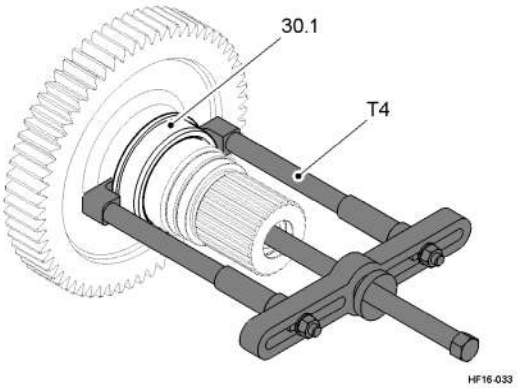
6.2 Removing the drive shaft bearing

Previous work
Remove bearing cover and rotary shaft lip seal.
see chapter 5.3.1

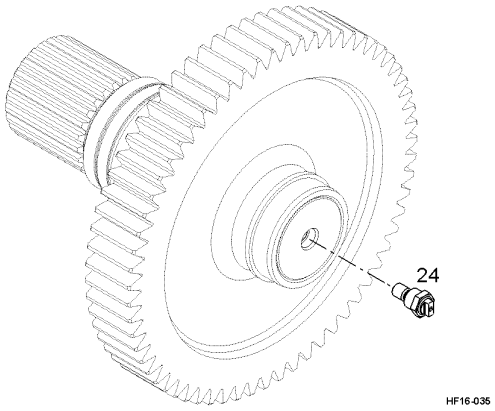
- Turn pump distribution gear.
- Lift drive shaft 10 with bearing internal rings from the housing.



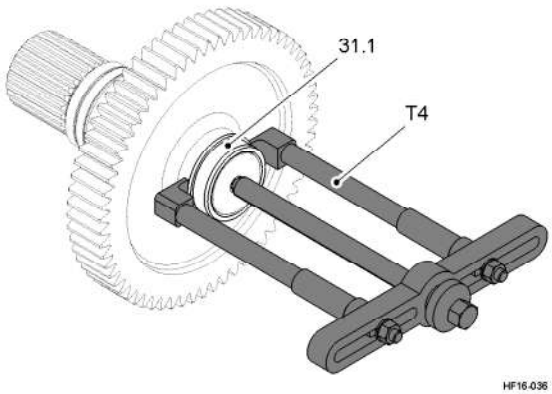
- Using external puller [T4], pull off internal ring 30.1 from the drive shaft.
- Check bearing seat for damage.



- Unscrew screw coupling 24.



- Using external puller [T4], pull off internal ring 31.1 from the drive shaft.
- Check bearing seat for damage.



▶ Monitor the deflection of the dial gauge **3**:

– in new condition, no deflection on the dial gauge is allowed.

– after operation, the deflection on the dial gauge must not be more than the limit value given in the table at the beginning of this section.

↳ If the measured axial play is more than the limit value, change the swing gear.

▶ The dial gauge deflection must be recorded at each measuring with the related serial number.

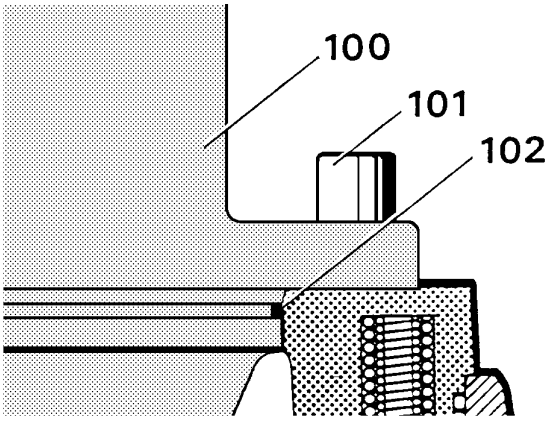
3.5 Sealing of the swing brake

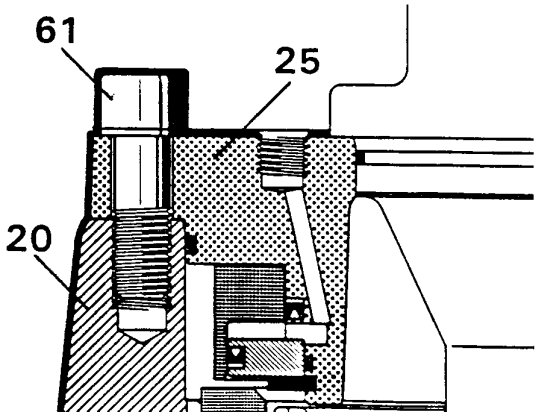
3.5.1 Seal the gear

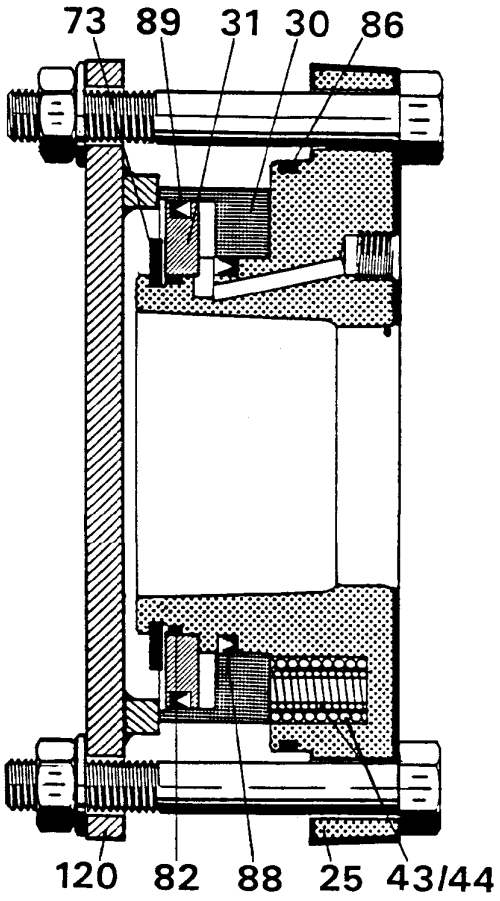
Caution!

▶ Check and carefully clean all parts before installation.

▶ All the seals must be lightly oiled or greased before installation.







Drive

▶ Remove all lines which can be in the way.

The hydraulic and leak oil lines and control lines on the oil motor can possibly stay connected.

▶ Remove screws **101** and lift oil motor **100** from gear.

▶ Replace the O-ring **102** on the oil motor.

Chapter 16 - Undercarriage - Mechanical

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LIEBHERR

2.4 Tensioning unit of the track chain

2.4.1 Components location

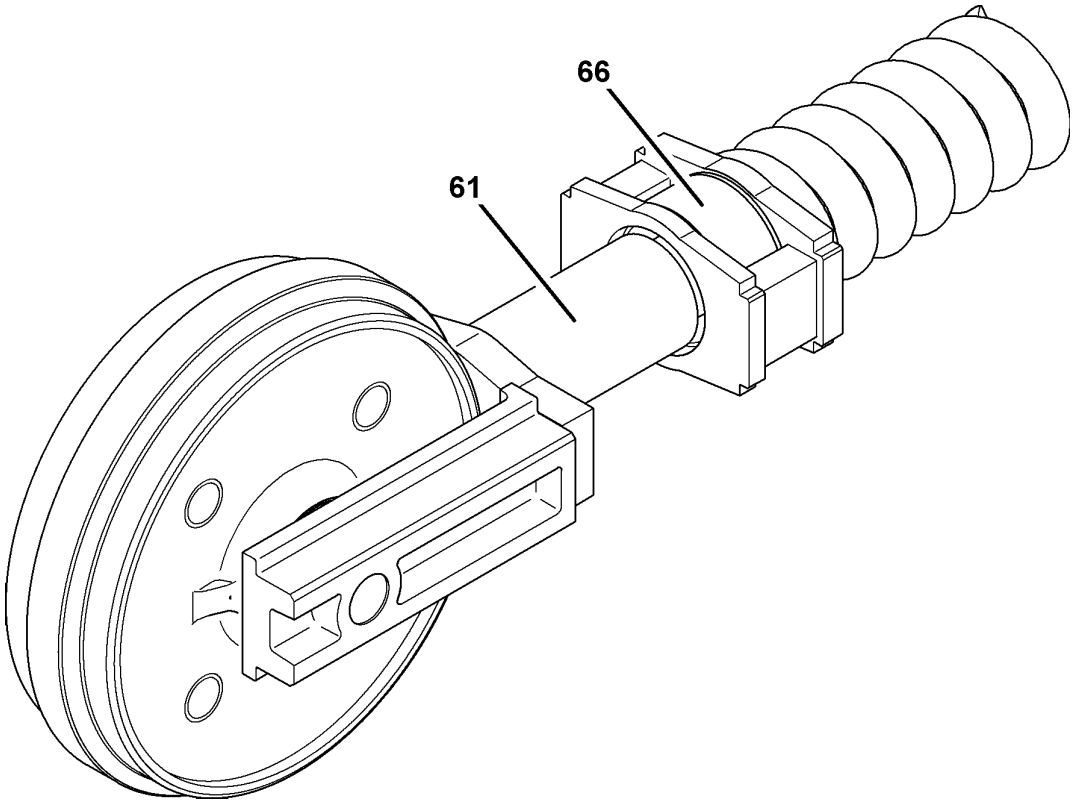

Fig. 11 *Tensioning unit of the track chain*

61 Grease tensioner
66 Limit stop

2.4.2 Functional description

To tighten the track chains, the grease tensioner **61** pushes the idler wheel. The tensioning unit is installed into the side frame and it is moved in translation through a guide rail. The grease tensioner is used to adjust the track tension with a grease gun (refer to the Operating Manual).

▶ For the tightening torques and control intervals, refer to the Operating Manual.

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Danger!
Sudden rolling away of the track chain!
Risk of death or serious injury.

- ▶ Make sure that no not approved persons are in the danger zone.

- ▶ Remove the master pin **1** with the applicable tool (refer to chapter 5 of this Service manual). Also refer to the tool instruction manual.
- ▶ Be careful not to let the track chain fall on the side frame.
- ▶ Remove the track chain in the forward travel direction.
- ▶ Lift the related side of the machine.
- ▶ Pull the track chain away with a tractor.
- ▶ Install applicable supports under the machine.
- ▶ Lower the machine onto the supports.

Install the complete track chain

- ▶ Make sure that the machine is on level and hard ground.
- ▶ Align the uppercarriage with the undercarriage.
- ▶ Make sure that the track tensioning system on the side you are working on is released.
- ▶ Lift the related side of the machine.
- ▶ Make sure that the track chain is installed in the correct travel direction and track pads are in the correct position.
- ▶ Pull the track chain under the machine.

Danger!
Metal projectiles during side frame lowering!
Risk of death or serious injury.

- ▶ Make sure that the side frame is correctly aligned with the track chain.
- ▶ Make sure that the track chain is correctly engaged on the sprocket.
- ▶ Make sure that no not approved persons are in the danger zone.

- ▶ Lower the machine on the track chain and set correctly.
- ▶ Lift the end of the track chain on the idler side with an applicable tool.
- ▶ Wind the track chain on the idler.
- ▶ Put it on the carrier rollers.
- ▶ Lift the end of the track chain on the sprocket side with an applicable tool.
- ▶ Wind the track chain on the sprocket.
- ▶ Set the two remaining track links in alignment.
- ▶ Install the master pin with the applicable tool (refer to chapter 5 of this Service manual). Also refer to the tool instruction manual.
- ▶ When the track chains are installed on each side of the machine, set the track tension. Refer to the Operating Manual.

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4 Backhoe boom

5 Pin

b Connection between rod bushing of stick cylinder and the stick

1.2.3 Shovel crowd assembly

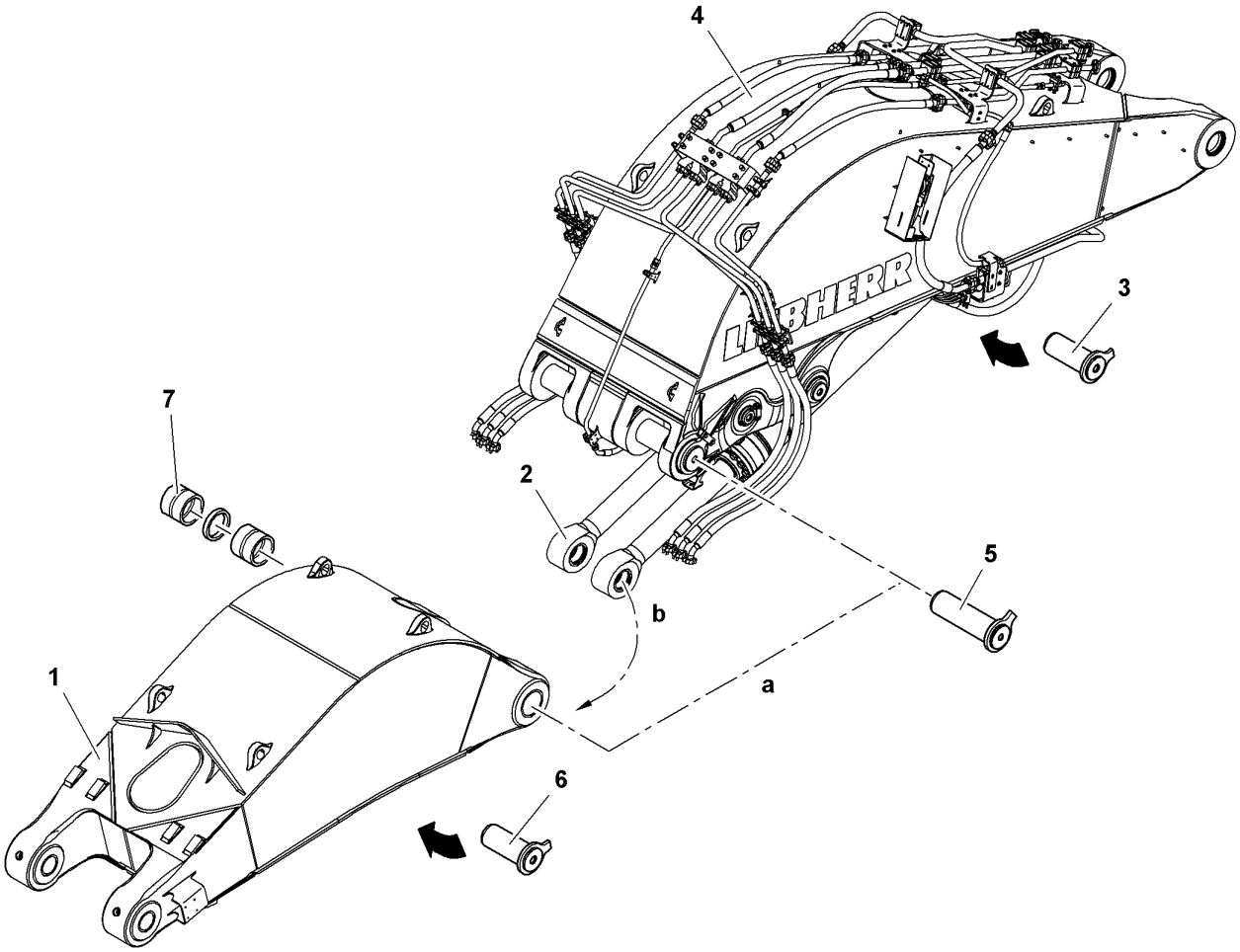


Fig. 6 *Shovel crowd assembly*

1 Shovel crowd

2 Crowd cylinder

3 Pin

4 Shovel boom

5 Pin

6 Pin

7 Bush

a Connection between boom bushings and crowd bushings

b Connection between rod bushing of crowd cylinder and the crowd

1.2.4 Install the stick (crowd)

- ▶ Make sure that stick (crowd) cylinder **2** is installed on the boom **4** (pins **3**).
- ▶ Make sure that the machine is on level and hard ground.
- ▶ Make sure that the excavator is not in a blast area.
- ▶ Use the applicable tools (refer to chapter 5 of this Service Manual) and jacking equipment. Also

LIEBHERR GROUND ENGAGING TOOLS (GET)
Anweisung zur Montage und Demontage
Installation and removal instructions
Instructions de Montage et de Démontage

Anwendungsbereich
Diese Anweisung bestimmt die Montage und die Demontage der LIEBHERR GET: Zähne, Verschleißkappen, Schneiden- und Seitenschilder.

Range of use
This instruction specifies how to install and remove the LIEBHERR GET: teeth, wear cap, lip and wing shrouds.

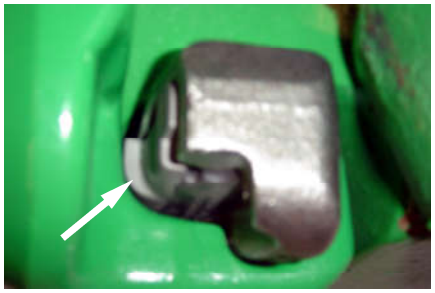
Domaine d'application
Cette instruction spécifie le montage et démontage des GET LIEBHERR : dents, chapeaux de protection, boucliers de lame et latéraux.

ESCO® SV2™ Tooth System Installation, Removal, and Pin Inspection

Tooth Removal continued

For 70SV2, 75SV2, and 85SV2 Teeth

4. Rotate tool handle toward the tip of the tooth. As tool is rotated, latch will release and pin will lift up and out of the ear. Pumping tooling as it is rotated helps loosen packed fines.



5. Latch disengagement

6. Visually inspect pin prior to reuse. Clean and inspect for wear, and replace if worn or damaged.

Inspecting and Rebuilding the SV2™ Pin

For 70SV2, 75SV2, and 85SV2 Teeth

The SV2 pin can be reused unless on the unacceptable conditions exist.

1. Inspect for top wear.

2. Inspect for missing or damaged latch or rubber.

3. Check for bending by comparing with a new pin.

⚠ ***WARNING:*** *ESCO's warranty is void when points and adapters are repaired or hardfaced.*

All persons performing maintenance work should wear OSHA-approved hard hat, safety glasses, steel-toed shoes, and gloves. To avoid injury to others, keep people not directly involved well out of the way.

1. Introduction

The control unit K6 is a controller for air conditioning- heating systems in modern vehicles. Through its compact construction it fits into every DIN radio duct. The simple and clear handling of all tasks for optimal air conditioning relieves the driver.

1.1. Installation

1. After carrying out the installation (wires laid out along the vehicle and 24-pole connecting plug positioned in the dashboard control seat), the installation frame is inserted and adjusted in the dashboard opening.
2. Connect the plug to the control unit and insert the control unit K6 into the frame (KONVEKTA part. no.: T11-000-108).

1.2. Self-test

If the voltage supply to the control unit is interrupted, it starts a self-test immediately after being reset. After ending the self-test the last stored adjustment is indicated.

Type of refrigerant

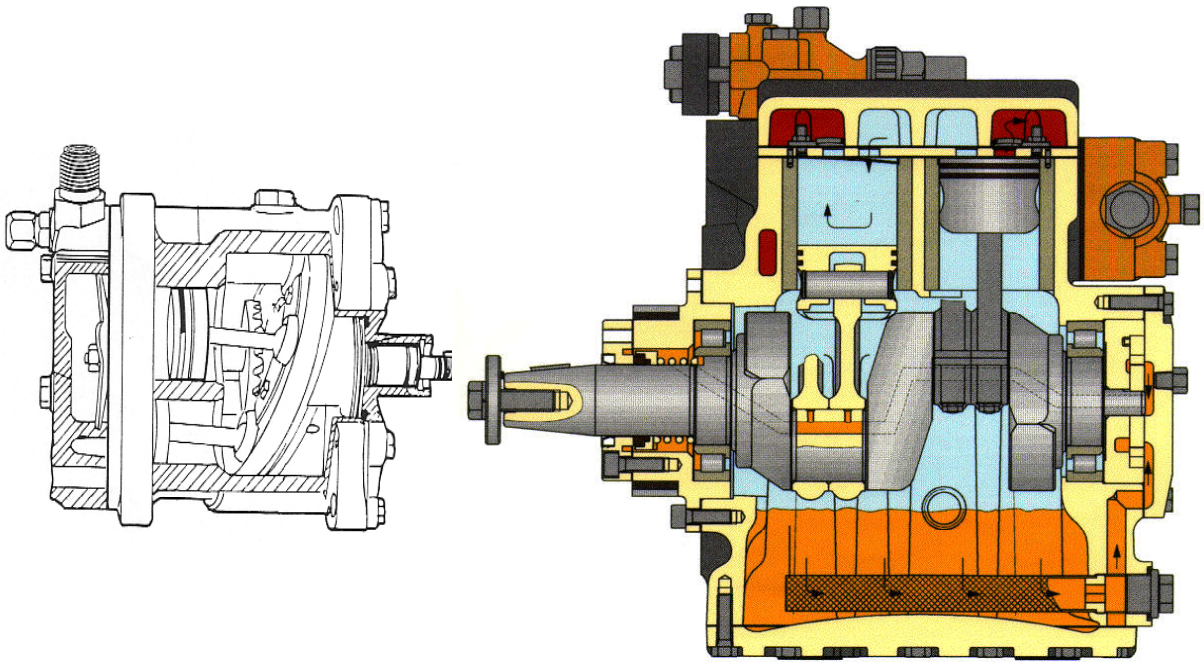
After product category, capacity class and version, the type of refrigerant will be indicated in the product name.

/2: Refrigerant R12
/3: Refrigerant R22
/4: Refrigerant R134a
/5: Refrigerant R744, CO_2
/6: Refrigerant R404

e.g. KL70T/4

2. Compressor

The main component of a unit is an open compressor which transports the refrigerant within the circuit and compresses the refrigerant to an energetically higher level. It is driven by a V-belt.



16. Check temperature on the evaporator unit:

    - Check suction air
    - Check exhaust air
    - Difference in temperature should be at least 8 - 10K.

18. For units operated with main power supply also check electric installation.

19. Check fastening and function of the main powered compressor (cooling down also with main powered compressor).

20. Check the V-belt from the electric motor to the main powered compressor.

21. In case there is a DWM-Copeland compressor installed to be operated with main power supply, oil balancing pipes must be provided between the crankcase of the main powered compressor and the T-piece on the suction side.

22. For units with hot gas defrosting please also check function of solenoid and return valves.

23. Check setting and function of defrosting thermostat.

24. Check pressostat for condenser fans for shift mode fast/slow.

25. Check pressure switches.

26. Check condensed water outlet.

27. Check condensed water filter (on the evaporator).

28. Clean return air filter, replace if necessary.

Achtung – Wichtig!

Zusätzliches Einfüllen von Kälteöl in Kühlanlagen, welche mit SANDEN - Kompressoren in Verbindung mit Kältemittel R134a betrieben werden.

Die Kälteölfüllung der Kompressoren sollte abhängig von Kältemittelfüllmenge und Länge der Saugleitung folgender Tabelle entnommen werden.

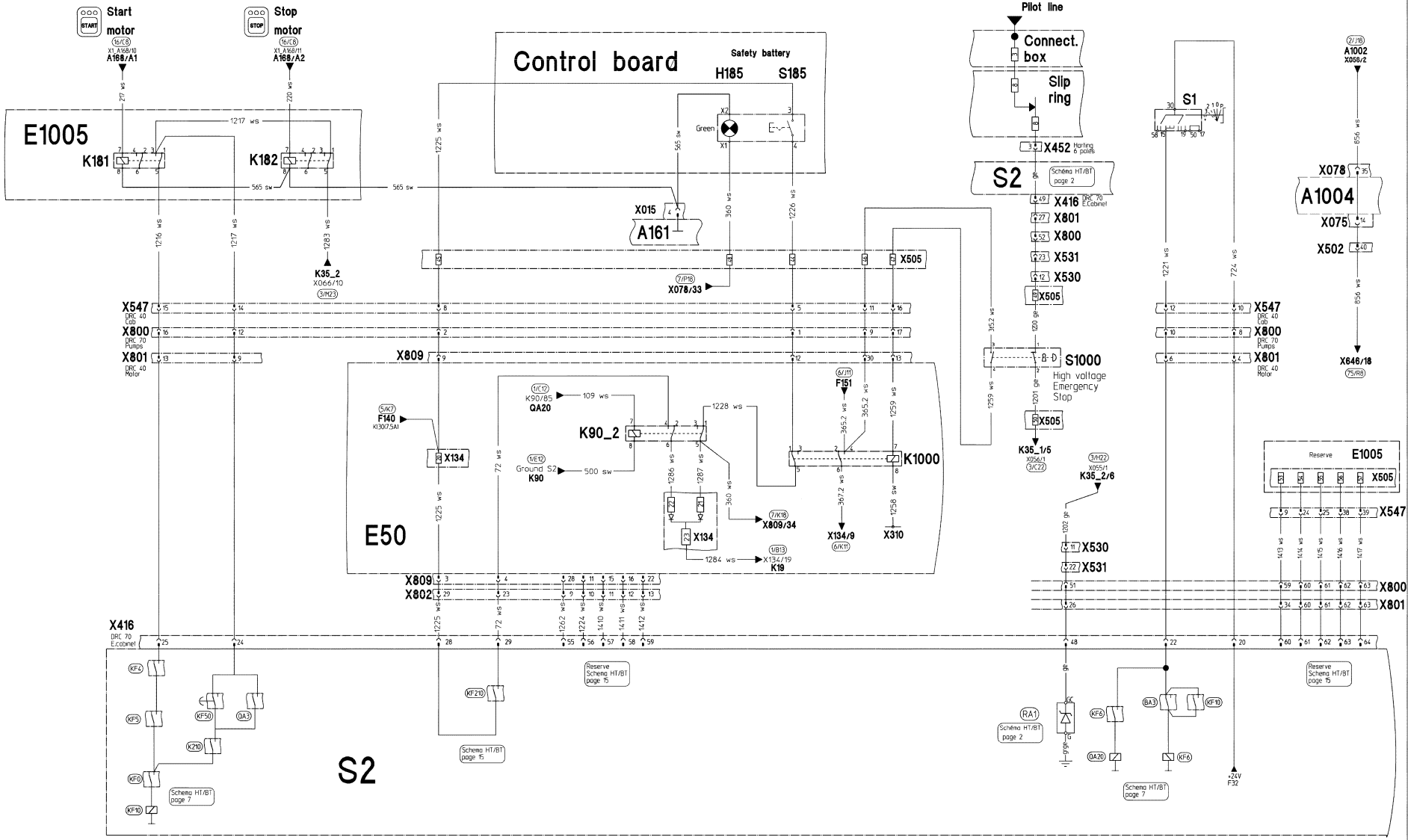
Berechnung der Ölfüllung Sanden SD Kompressoren im kpl. Klimasystem
Calculation of oil charge for Sanden SD compressors in the entire climate system
Calcul du remplissage d'huile des compresseurs Sanden SD dans le système climat complet

Formel: ((Kältemittelmenge in g x 0,06)+66) : 0,9 + (10ccm x Länge Saugleitung in m x 1,1)
Formula: ((refrigerant quantity in g x 0,06)+66) : 0,9 + (10ccm x length suction duct in m x 1,1)
Formule: ((quantité réfrigérant en g x 0,06)+66) : 0,9 + (10ccm x longueur de la conduite d'aspiration en m x 1,1)

Kältemittelmenge in g *Refrigerant quantity in g* *Quantité réfrigérant en g*	**Länge der Saugleitung in m** *Length suction duct in m* *Longueur de la conduite d'aspiration en m*								
	2	3	4	5	6	7	8	9	10
500	129	140	151	162	173	184	195	206	217
1000	162	173	184	195	206	217	228	239	250
1100	169	180	191	202	213	224	235	246	257
1200	175	186	197	208	219	230	241	252	263
1300	182	193	204	215	226	237	248	259	270
1400	189	200	211	222	233	244	255	266	277
1500	195	206	217	228	239	250	261	272	283
1600	202	213	224	235	246	257	268	279	290
1700	209	220	231	242	253	264	275	286	297
1800	215	226	237	248	259	270	281	292	303
1900	222	233	244	255	266	277	288	299	310
2000	229	240	251	262	273	284	295	306	317
2100	235	246	257	268	279	290	301	312	323
2200	242	253	264	275	286	297	308	319	330
2300	249	260	271	282	293	304	315	326	337
2400	255	266	277	288	299	310	321	332	343
2500	262	273	284	295	306	317	328	339	350
2600	269	280	291	302	313	324	335	346	357
2700	275	286	297	308	319	330	341	352	363
2800	282	293	304	315	326	337	348	359	370
2900	289	300	311	322	333	344	355	366	377
3000	295	306	317	328	339	350	361	372	383
3100	302	313	324	335	346	357	368	379	390
3200	309	320	331	342	353	364	375	386	397
3300	315	326	337	348	359	370	381	392	403
3400	322	333	344	355	366	377	388	399	410
3500	329	340	351	362	373	384	395	406	417
3600	335	346	357	368	379	390	401	412	423
3700	342	353	364	375	386	397	408	719	430
3800	349	360	371	382	393	404	415	426	437
3900	355	366	377	388	399	410	421	432	443
4000	362	373	384	395	406	417	428	439	450
4100	369	380	391	402	413	424	435	446	457
4200	375	386	397	408	419	430	441	452	463
4300	382	393	404	415	426	437	448	459	470
4400	389	400	411	422	433	444	455	466	477
4500	395	406	417	428	439	450	461	472	483
4600	402	413	424	435	446	457	468	479	490
4700	409	420	431	442	453	464	475	486	497
4800	415	426	437	448	459	470	481	492	503
4900	422	433	444	455	466	477	488	499	510
5000	429	440	451	462	473	484	495	506	517
	Gesamt Ölfüllmenge in ccm im kompl. System *Total oil charge of the complete system (ccm)* *Contenance totale d'huile mesurée en centimètre cube dans le système complet*								

9

High voltage and motor control



LIEBHERR	LEC	A0	
ELEKTROSCHEMA ELECTRIC SCHEME SCHEMA ELECTRIQUE		1134 9010 01 000	
		12718074	4 / 20

75	76	77	78
Versorgung Ausgang Modul A62 / Supply output module A62	Versorgung Ausgang Modul A63 / Supply output module A63	Versorgung Ausgang Modul A61 / Supply output module A61	Versorgung Handgeber/ Supply joysticks