en

Service Manual

Hydraulic excavator
R 9400 E

from serial number 30619

Document identification

Order number: 12201223
Version: 08 / 2019
Valid for: R 9400 E from serial number 30619
Author: LEC - Technical documentation department

Product identification

Manufacturer: Liebherr-Mining Equipment Colmar SAS
Type: R 9400 E
Type no.: 1277
Conformity: CE

Address

Liebherr-Mining Equipment Colmar SAS
49 rue Frédéric Hartmann

LEC / en / Version: 08 / 2019

4.3 Classification of the welding electrodes

Use only lime based (Kb) type electrodes for repair welding.

Important :

If steel with a tensile strength above 550 N/mm² is welded to each other, a Kb - electrode according to ASTM - AWS : E 110 18 - G must be used.

ASTM = American Society Technical Material

AWS = American Welding Society

Choose the appropriate electrodes from the following chart :

Basic Machine and Attachments **Undercarriage - Uppercarriage - Boom - Stick -Bucket**	
Material	**Electrode**
Q St E 380 N Steel with a tensile strength between 490 - 630 N/mm² and a minimum yield point of 375 N/mm² Analysis : C = 0,18% Si = 0,5% Mn = 1,6%	E 51 53 B 10 DIN 1913 (E Kb IXs) per ASTM - AWS : E 7018 Lime Based type electrodes can be used. Symbol : E = Arc welding rod electrode 51 = Strength (500 - 638 N/mm²) 53 = Value for expansion and tensile strenght B 10 = Basic cooting Kb = Lime based IX = Value for tenacity s = Heavily coated Analysis : C = 0,1% Si = 0,6 Mn = 0,85% Note : Weld, using either AC or DC current. For DC current, connect the electrode with the positive terminal (+)
LH 690 (Ste 690) Water tempered steel with a tensil strenght of 690 mm² Analysis : C = 0,2% Si = 0,5% Mn = 1,5% Lightly alloyed with Cr, Ni, Mo	

Wear items **Wear plate over backhoe back plate**	
Material	**Electrode**
Hardox (OXAR 360 S) 400 Hardox (OXAR 360 S) 500 Weldable, low alloy special steel, highly wear resistant and tensile strength of 1250 N/mm² and a yield point of 900 N/mm² with 400 HB (Brinell hardness) Analysis : C = 0,2%-0,3% Si = 0,15% Mn = 1,7% Lightly alloyed with Cr and Mo	E 51 53 B 10 DIN 1913 (E Kb XIIs) See the chart «Basic machine and attachments» for properties and analysis

	Hazards identified	Precautions to be taken	Illustrations	Tools	Check Off
gs		Follow tag-out and lockout procedure			☐
				Out-of-service tag	☐
ır	Personnel still working on machine	Ensure that all tags are re-moved			☐
		Stand clear of repair area			☐

oment is large and heavy. It is mandatory that all work be done in a safe manner.
out a procedure, always check with your supervisor before proceeding.

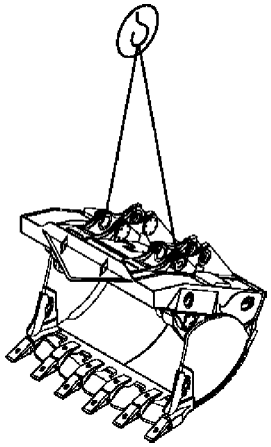
azards identified	Precautions to be taken	Illustrations	Tools	Check Off
eavy attachment in novement	Keep Clear			☐

s large and heavy. It is mandatory that all work be done in a safe manner.
rocedure, always check with your supervisor before proceeding.

R9400E - Backhoe cylinder exchange

	Hazards identified	Precautions to be taken	Illustrations	Tools	Check Off
e-	Hydraulic and electric energy	Ensure hydraulic pressure released and isolator turned off		PPE Out-of-service tag	☐
	Mobile lifting devices may have trouble with uneven ground during component removal	Ensure work area is flat, free of holes & rocks		Grader Cone road-signs	☐
n-	Personnel injury while attachment is moving 	Keep Clear		PPE Crane Manlift Harness Cylinder stand/ wedges.	☐
		Keep people away from area under cylinder & manlift		Cone road-signs	☐
s th	Height Weight Improper tool 	Use harness and manlift See tool listing in service manual for LEC tool ident Ensure tool is in good condition		Manlift Harness Pin-puller support	☐

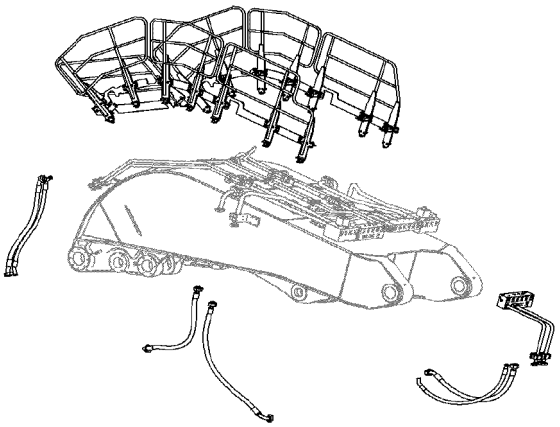
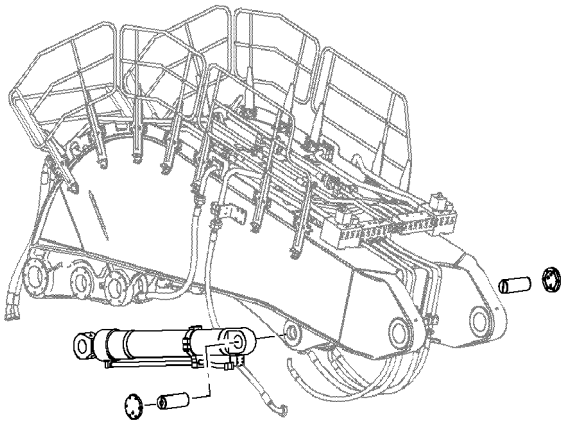
oment is large and heavy. It is mandatory that all work be done in a safe manner.
out a procedure, always check with your supervisor before proceeding.

azards identified	Precautions to be taken	Illustrations	Tools	Check Off
eavy machinery in ovement ucket rolling eavy load in move- ent nproper tool 	Stand clear Use correct lifting proce- dures and attachment See tool listing in service manual for LEC tool ident Ensure tool is in good con- dition		Pin-puller support	☐
eavy machinery in ovement ucket rolling rushing /eight nproper tool 	Keep personnel clear Use correct lifting proce- dures and attachment See tool listing in service manual for LEC tool ident Ensure tool is in good con- dition		Pin-puller	☐

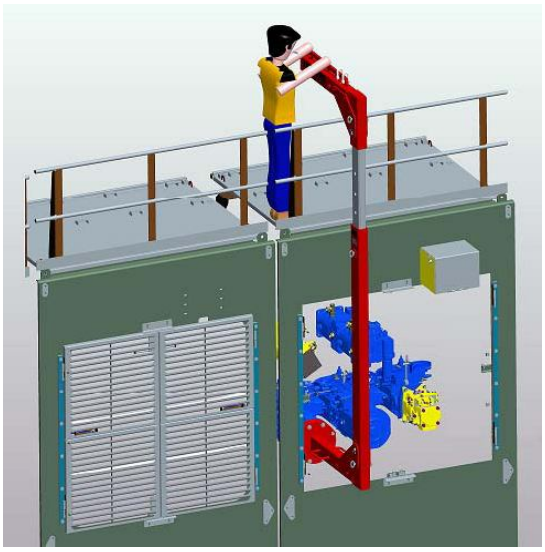
s large and heavy. It is mandatory that all work be done in a safe manner.
rocedure, always check with your supervisor before proceeding.

	Hazards identified	Precautions to be taken	Illustrations	Tools	Check Off
	Heavy attachment in movement Falling objects 	Keep personnel clear from the load Use stand or wedge to sit boom correctly		Crane Slings Stand/ Wedge	☐
					☐

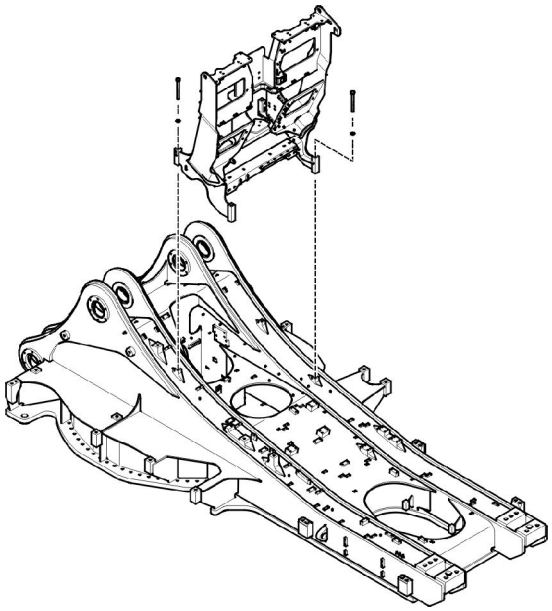
oment is large and heavy. It is mandatory that all work be done in a safe manner.
out a procedure, always check with your supervisor before proceeding.

azards identified	Precautions to be taken	Illustrations	Tools	Check Off
Veight eight verhead loads bjects falling 	Use harness and manlift Require assistance as needed Use correct lifting procedures and attachment Keep clear		Manlift Harness	☐
eavy attachment in ovement rushing ylinder falling mproper tool 	Use cylinder stands. Keep clear of the load. Rest rod head on wedges See tool listing in service manual for LEC tool ident Ensure tool is in good condition		Pin-puller Cylinder stand Wedges	☐

s large and heavy. It is mandatory that all work be done in a safe manner.
rocedure, always check with your supervisor before proceeding.

azards identified	Precautions to be taken	Illustrations	Tools	Check Off
rushing rushed fingers alling mproper tool	Keep clear of the tool Use harness Be careful Keep clear of the path of the tool when guiding it in position. Keep visual and/or radio contact with the crane operator. For tool configuration and use see Tool instruction manual It is mandatory to have read and understood the tool instruction manual before using it! See tool listing in service manual for LEC tool ident Ensure tool is in good condition		Pump Mounting Tool Tool instruction manual PPE	☐

s large and heavy. It is mandatory that all work be done in a safe manner.
rocedure, always check with your supervisor before proceeding.

	Hazards identified	Precautions to be taken	Illustrations	Tools	Check Off
	Crushed fingers Heavy component in movement Crushing Valve bank swinging Valve bank toppling over 	Keep in contact with crane operator Keep clear Use ropes to prevent swinging Be carefull when lowering the valve bank Ensure the valve bank is properly seated/secured on the stand		Ropes Stands	☐
nd	Crushed fingers Heavy component in movement Crushing Valve bank swinging 	Use correct lifting procedures and equipment. Keep in contact with crane operator Keep clear use ropes to prevent swinging		Ropes	☐

oment is large and heavy. It is mandatory that all work be done in a safe manner.
out a procedure, always check with your supervisor before proceeding.

azards identified	Precautions to be taken	Illustrations	Tools	Check Off
Veight luid loss estricted access rushing	Use correct lifting proce-dures and equipment Be careful Proceed with appropriate tools			☐
Veight alling down the hole 	Use correct lifting proce-dures and equipment Wear harness			☐
orget a step	Follow SWP carefully			☐
il loss	Clean as you work			☐
ersonnel still working n machine eaks	Ensure ALL personnel clear Keep clear			☐
				☐

s large and heavy. It is mandatory that all work be done in a safe manner.
rocedure, always check with your supervisor before proceeding.

LEC / en / Edition: 11 / 2018

s large and heavy. It is mandatory that all work be done in a safe manner.
rocedure, always check with your supervisor before proceeding.

	Hazards identified	Precautions to be taken	Illustrations	Tools	Check Off
		Make sure to install isolation tags			☐
s	Height Finger crushing Hytorc use	Use manlift Ask for assistance Follow SWP 0.07: HY-TORC tool use carefully		Hytorc	☐
x-	Forget a step	Follow SWP carefully to close tracks			☐
el	Noise Oil pressure Heat	See service manual		Service manual	☐
	Personnel still working on machine Leaks Heavy equipment in movement	Ensure ALL personnel clear Keep clear			☐
		Sign contractor book			☐

oment is large and heavy. It is mandatory that all work be done in a safe manner.
out a procedure, always check with your supervisor before proceeding.

nder the common security rules and under the responsibility of one well-trained supervisor.
ne authorization for interventions on and handling of the electric excavator from their employer.
, all personnal must have read and understood all the instructions included in the manual.
ere to arise, contact Liebherr France.

LEC / en / Edition: 11 / 2018

s large and heavy. It is mandatory that all work be done in a safe manner.
rocedure, always check with your supervisor before proceeding.

R9400E - Lock out Level B, Low protection

ly maintenance

ll electrical devices and circuits under power:
le, Connecting box, Electric rotary connexion, S1 & S2 boxes and several heaters supplied by unprotected transformer T5M
Voltage wires (6kV and 400V) remain supplied from the connecting box to S1 box to S2 box.
ltage are connected by these wires. Only qualified, habilitated and authorized persons can access to these area!

	Hazards identified	Precautions to be taken	Illustrations	Tools	Check Off
				PPE	☐
	Powered devices	**Warning:** Several heaters, S1 & S2 boxes, HV cable, conenct-ing box, electric rotary connection are still alive.			☐

oment is large and heavy. It is mandatory that all work be done in a safe manner.
out a procedure, always check with your supervisor before proceeding.

MJF C I F S S

Chapter 3 - Technical data

Function / component	Nominal value	Measured value	Adjusted value
VB3 first stage	320 $^{+5}$ bar		
second stage	350 ±5 bar		
VB4 first stage	320 $^{+5}$ bar		
second stage	350 ±5 bar		
Travel gears (refer to § “Primary and secondary valves adjustment” on page 21)			
Left travel gear			
Secondary valves forward (SPRVF)	380 ±5 bar		
Secondary valves backward (SPRVB)	380 ±5 bar		
Right travel gear			
Secondary valves forward (SPRVF)	380 ±5 bar		
Secondary valves backward (SPRVB)	380 ±5 bar		
Boom hydraulic recovery system (refer to § “Boom hydraulic recovery system adjustment” on page 27)			
DBB1	2,3 turns / 22,5 mm		
DBB2	2,3 turns / 22,5 mm		
Throttle check valves (refer to § “Throttle check valves adjustment” on page 28)			
Backhoe			
Stick cylinders	95 $^{-10/+5}$ bar		
Bucket cylinders	85 $^{-10/+5}$ bar		
Shovel			
Stick cylinders	23 mm		
Attachment proximity switches (refer to § “Damping system adjustment” on page 31)			
Backhoe			
Boom up	120 mm		
Stick in	100 mm		
Stick out	150 mm		
Bucket close	95 mm		

▶ Adjust **LPRV2** so as to get pressure on **M2 = 60 bar.**

Note!
In the upright position, the ladder must be in contact with the mechanical stop but the ladder cylinder must not be on full stroke. Pressure must remain between the ladder and the mechanical stop.

3.8 Track tensioning adjustment

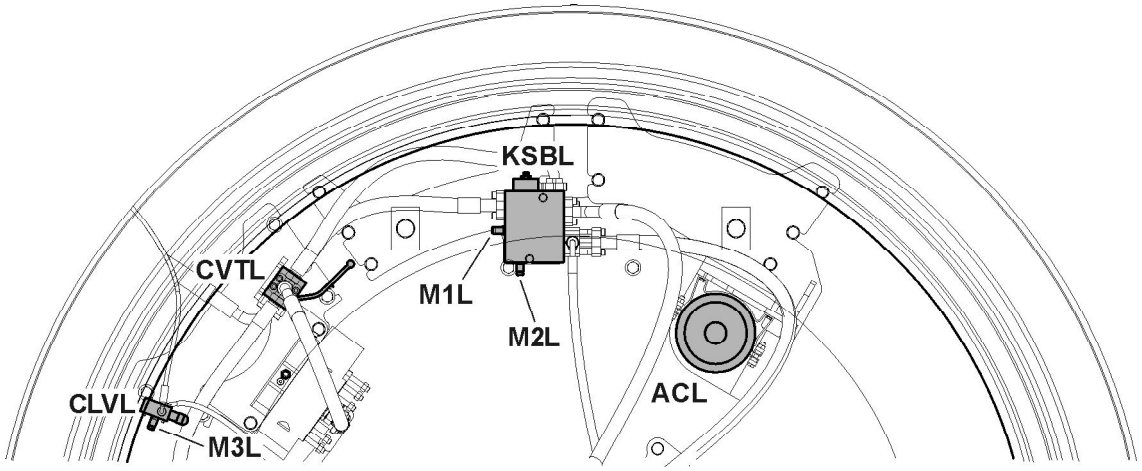


Fig. 23 *Hydraulic components for tensioning unit*

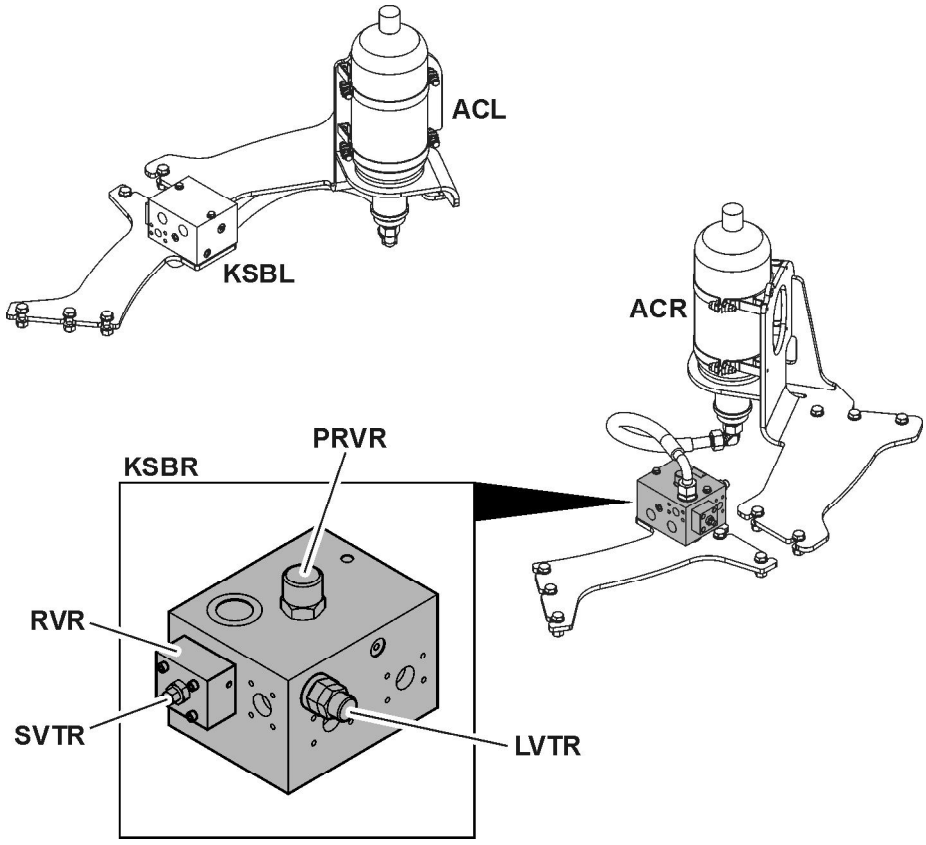
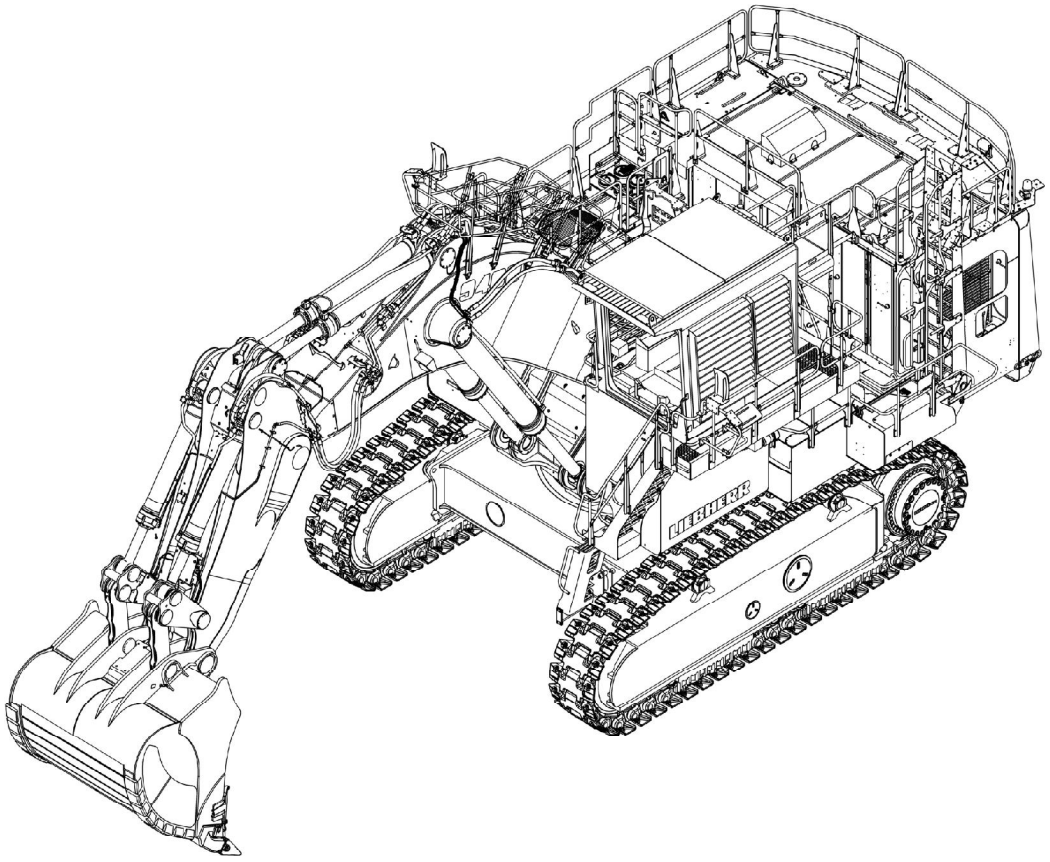


Fig. 24 *Accumulators **AC** and track tensioning blocks **KSB***

1.4 Inspection documents:



1.4.1 Machine / Components identification:

Data regarding the machine and the components identification have to be recorded on the attached inspection sheets.

Machine identification:

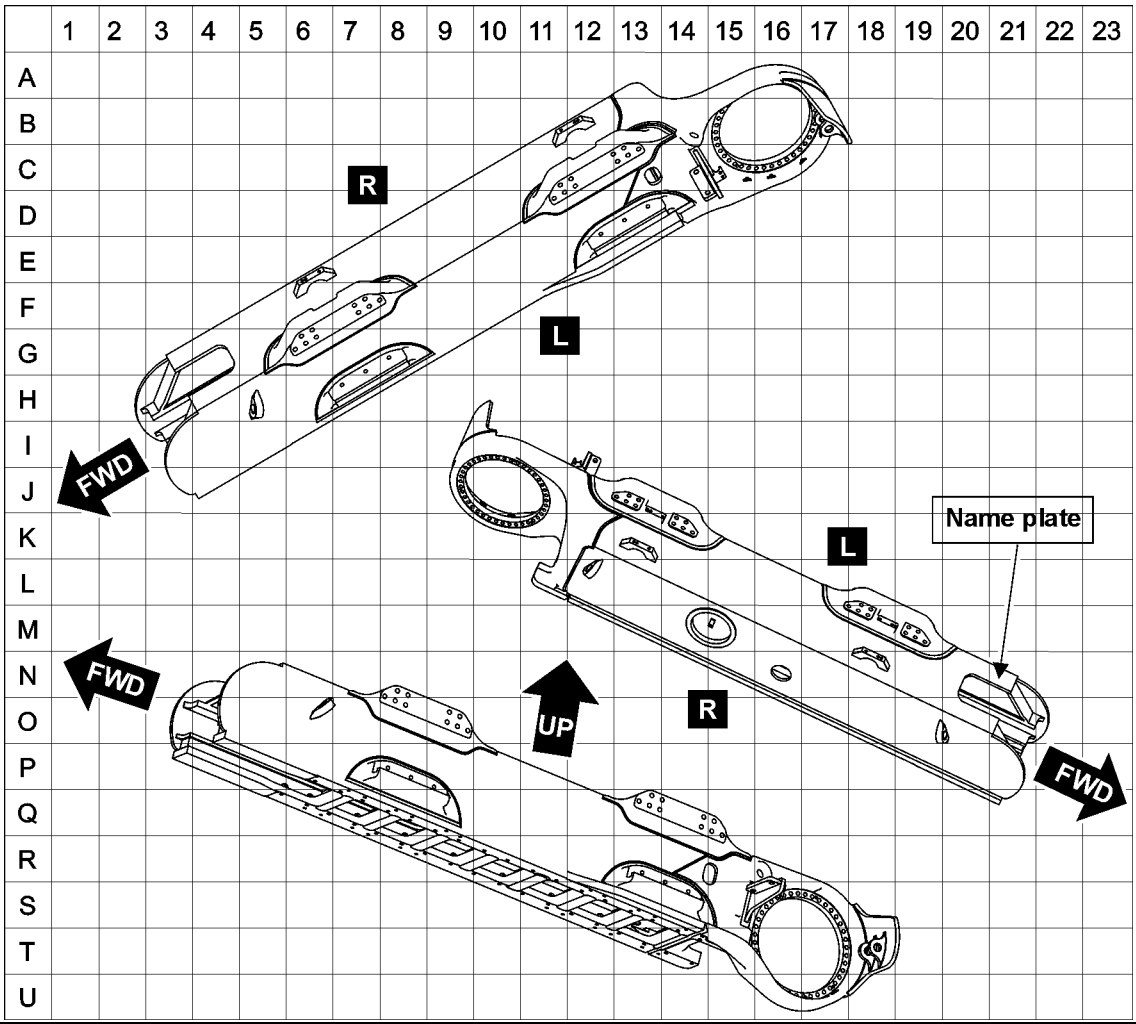
Customer:		Liebherr or Dealer:	Completed by:		Date:
Serial N°:	Fleet N°:		Machine hours	Travel hours	Travel ratio
Ore	Loaded material	Digging condition	Ground condition	Ambient T(°C)	Altitude (m)

Tab. 1 *Identification of the machine*

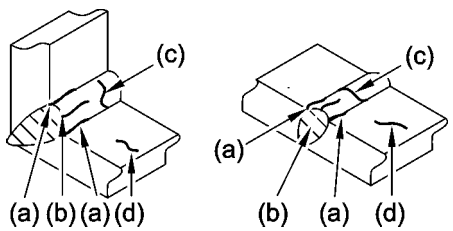
Machine serial N°:	Machine hours:	Travel hours:	Completed by:	Date:

Side frame	Article N°:		Index N°:	
	Serial N°:		Component hours:	

▶ Find the defect coordinates on the grid and report them in the following table.



(Mark the following options: location a, b, c or d; defect longitudinal, perpendicular to the seam direction and/or on the plate or in another position.

Defect coordinates	Side of the defect(s) R or L		Details of the defect(s): (a),(b),(c),(d) or other	Picture N°

Do a description of the defect(s):

1.4 Technical data

1.4.1 Working technical data

	Backhoe	Shovel
Maximum working slope* (22 m^3)	4,0° - 7,0%	4,0° - 7,0%
Maximum travelling angle	22,1° - 40,6%	22,1° - 40,6%
Maximum tilt angle of electric motor	30°	30°
Working ambient temperature range	-12°C to +55°C	-12°C to +55°C
Noise emission** L_{pA} (inside cab)	78dB(A)	78dB(A)

Tab. 1-2 *Working technical data*

* The maximum working slope has been determined for a hydraulic excavator in standard configuration (with bucket volume as given in the table above) with a material density of 1,8 t/m^3.

Changing the excavator configuration or the material density has an impact on the maximum working slope. In this case, LEC recommends contacting Customer Service in order to determine specific working conditions and the maximum working slope in particular.
The machine stability has been defined relative to a horizontal surface and taking into account a safety factor. Operating the excavator with a different configuration will reduce this safety factor. When working on slopes, it is not permitted to overload the bucket and to work with a material density different from that intended for the bucket provided by LEC.

In order to use the excavator in material handling operations, LEC recommends also contacting the Customer Service.

** The sound pressure level (L_{pA}) is determined according to ISO 6396. The measurement uncertainty is defined in the above standard.

1.4.2 Technical description

This should be taken from the accompanying technical description.

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 lo-

↳ This symbol means “Carry out an activity".

Danger!
Never cross the extern limit distance of Danger Area with any tools or any body parts. The approach area can only be considered as the working area, in order to measure the voltage or check voltage presence. The area must be roped and tagged. Parts under voltage should be protected to avoid any electrifying.

The following figure illustrates the danger area **A** and the approach area **B** around a part with voltage according to DIN EN 50110-1 (which defines areas' outer boundaries D_L and D_V). Always observe local regulations concerning these areas according to the country you are working in.

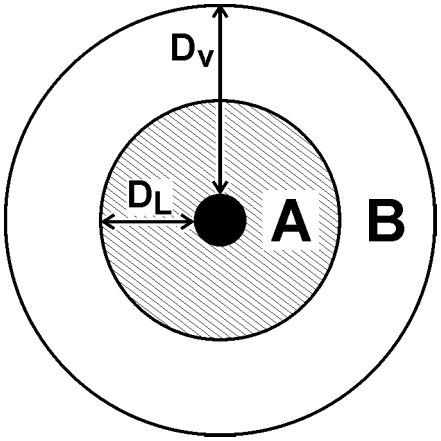


Fig. 2-1 *Danger area **A** and approach area **B***

Any job/maintenance at proximity of voltage must be done with all safety requirements presented in this manual and supplier's manuals.

THERE ARE NO SHORT CUTS IN SAFETY!

2.6 Safety guidelines to connect and start-up this electric machine

When connecting this machine to an electrical power source, as well as during the initial start-up, the following instructions and safety guidelines must be adhered to :

- The safety and accident prevention guidelines outlined in this manual, as well as all pertaining local, state and national standards, safety guideline, rules and regulations (such as ANSI, CIMA, DIN, IEC, INRS, ISO, NEC, NEMA, NF, OSHA, SAE, UL, VBG, VDE, EN, UTE, etc...) must be adhered to at all times.
- All works with regard to the electrical installation, particularly connecting the machine to an outside power source and the start-up procedure must be performed by a qualified and certified personnel.
- The entire electrical system must be properly protected against over-voltage and excessive current draw, short circuits and faulty ground.
- The entire installation must be switched off at the first fault (insulation, overcurrent, overload or ground fault) and this fault must be solved.
- To avoid electrical malfunctions, system or component damage, the supply volt-

- All electrical conductors and the ground wire must be of sufficient gauge (cross

S20 – No function

S21 – High speed gear

▶ Press button.
↳ Transfer from normal drive to fast drive is activated.
↳ LED **1** in the button illuminates.

While driving, the machine will automatically transfer from normal drive to fast drive. LED **2** illuminates after transfer to fast drive.

▶ Press button again.
↳ Transfer from normal drive to fast drive is disabled.
↳ LED **1** in the button goes out.

S22 – Counterweight floodlights

▶ Press button.
↳ Counterweight floodlights are activated.
↳ LED in the button illuminates.

▶ Press button again.
↳ Counterweight floodlights are disabled.
↳ LED in the button goes out.

S36 – Special function 1 (optional)

Configuration and activation according to kit.

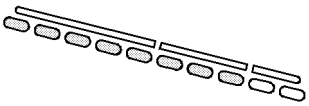
S41 – Dome light

▶ Press button.
↳ The interior lights are activated.

▶ Press button again.
↳ The interior lights are disabled.

S56 – No function

S86 – No function



P4 – Motor start display

LEDs come on only at motor start.

S228 – No function

S229 – No function

Access ladder

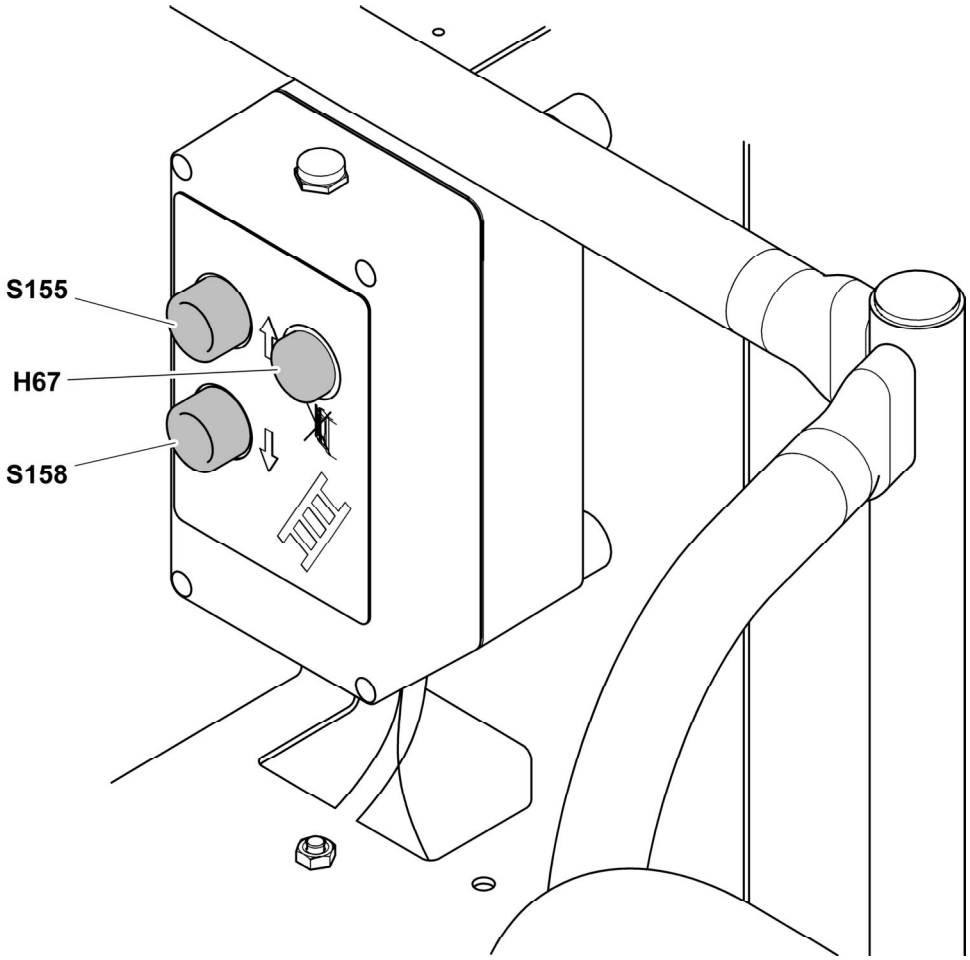


Fig. 3-27 E1022-1 *Access ladder control box*

H67 Control light red / ladder not up
S155 Push-button / access ladder up
S158 Push-button / access ladder down

Activities before starting

Caution!
It is only possible to extinguish a source of fire when this one is accessible.

▶ Before starting, unlock all locks on the panelling of the hydraulic excavator.
↳ In the event of fire, doors can be opened immediately and the fire extinguished.

▶ For locks arrangements, see chapter "Maintenance".

Caution!
The activities referred below involve scald or burn hazards due to high temperature of the oil when the machine is at operating temperature.

▶ Please read first the chapter "Maintenance" in order to get informations about carrying out these activities.

Before starting the machine, the following activities should be carried out on a daily basis:

– Check the oil in the hydraulic system.
– Check that the cameras and the outside mirrors are correctly adjusted.
– If required, remove any ice and snow from the motor hood in the area of the cooling air intake.

Switching on the electrical system

Ignition key switching positions

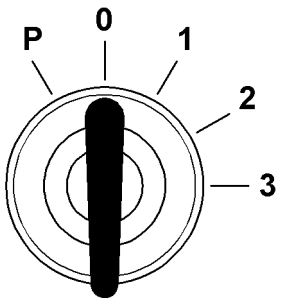


Fig. 3-47 *Ignition key* ***S1***

P Parking position
0 Off
1 Contact position
2 Not used
3 Start position

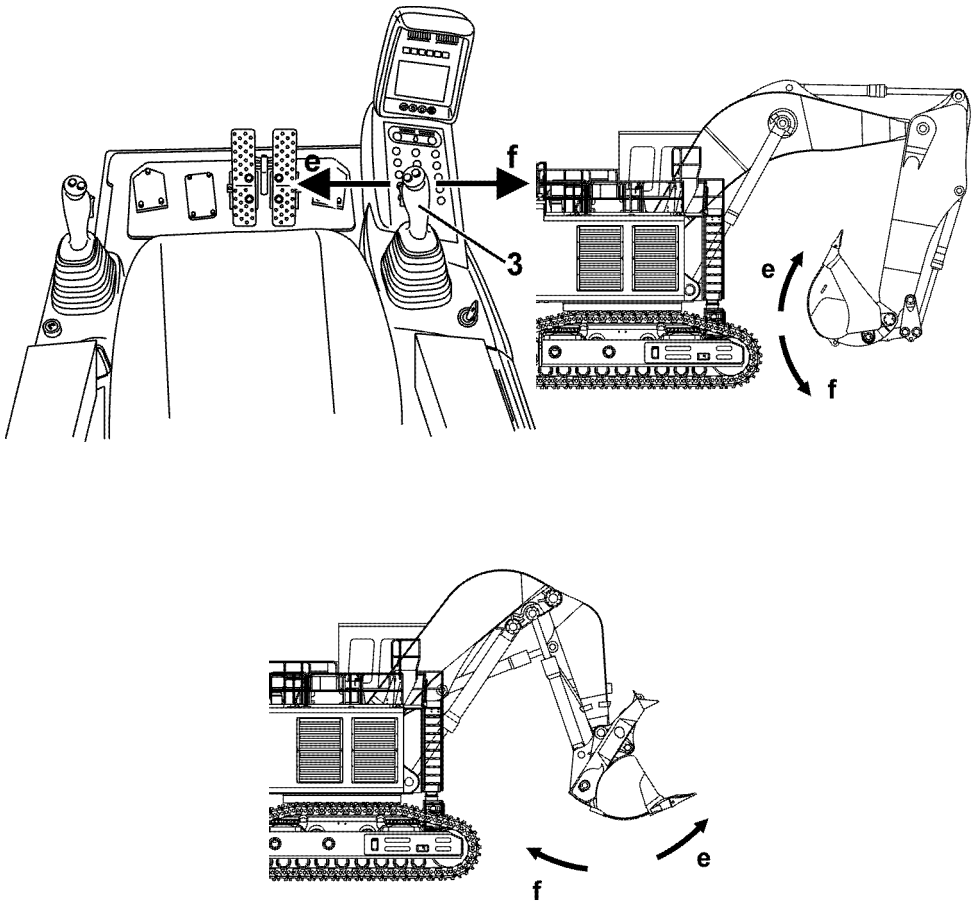


Fig. 3-63 *Operating the bucket cylinder*

▶ Push the joystick to the left **e**.
↳ Bucket will be tilted inwards.

▶ Push the joystick to the right **f.**
↳ Bucket will be tilted outwards.

Operating the bottom dump shovel bucket

Manual operation

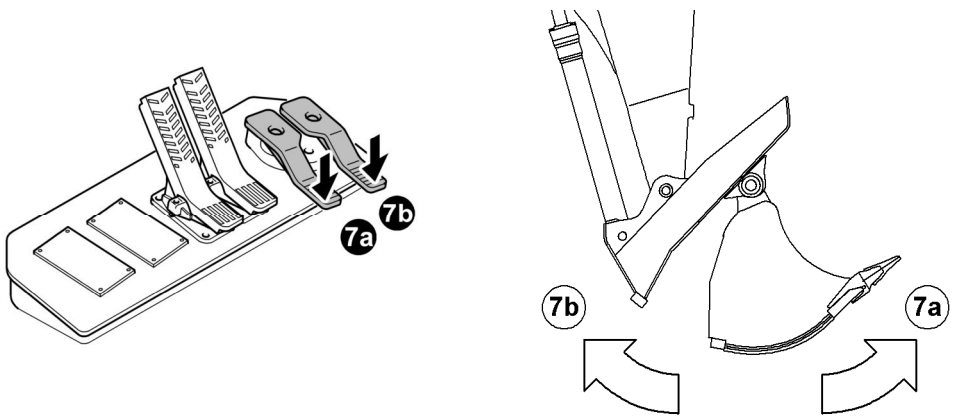
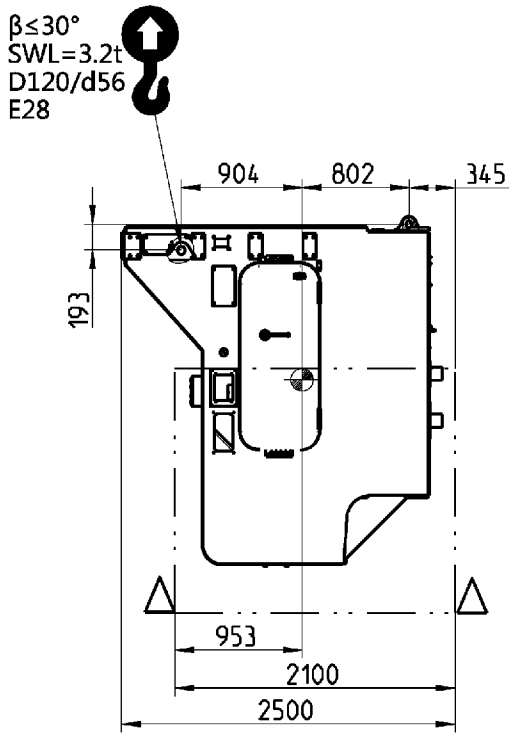
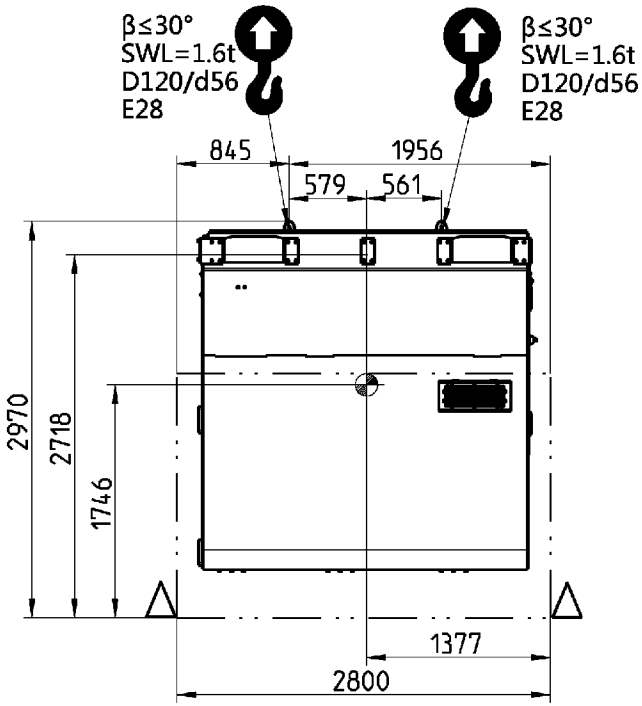
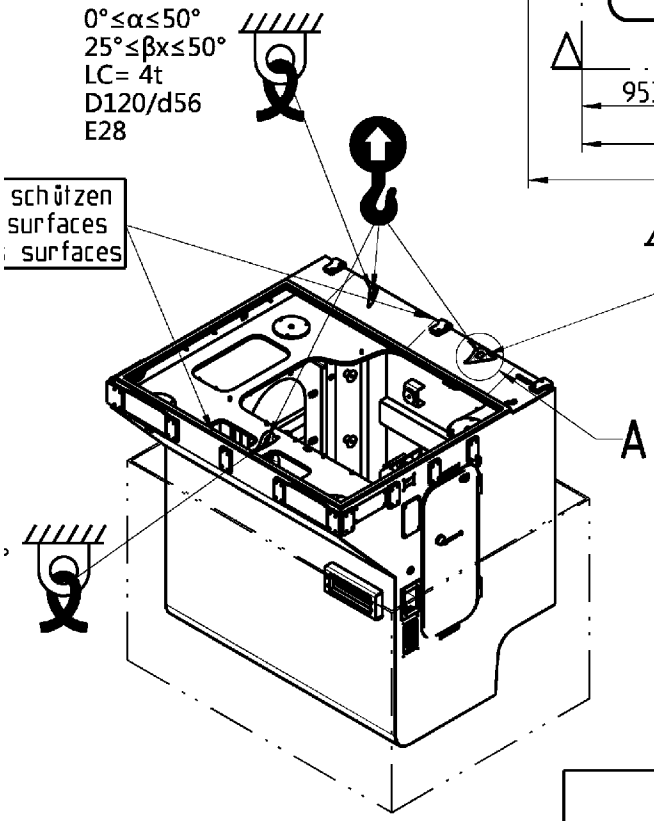
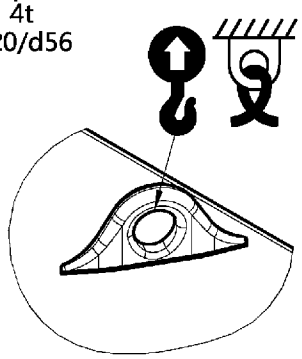


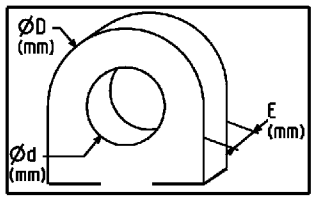
Fig. 3-64 *Operating the bottom dump shovel bucket*











△ Blockieren
Blocking
Blocage

⌖ SCHWERPUNKT
CENTER OF GRAVITY
CENTRE DE GRAVITE

	Gerechnet Calculated Calculé	Gewogen Weighed Pesé
Gewicht ohne Werkzeug und Verpackung Weight without tool and packaging Poids sans outillage et emballage	3 480 kg	
Gewicht mit Werkzeug und Verpackung Weight with tool and packaging Poids avec outillage et emballage	3 880 kg	

LIEBHERR

Bezeichnung / Description / Dénomination	Ident-Nr. / Ident No. N° d'ident	Index / Index Index	Blatt / Page Feuille
TRANSPORTPLAN KABINENERHOEHUNG TRANSP.DRW.CAB ELEVATION R9350 PLAN DE TRANSP.REHAUSSE CABINE	10405842	002	1/1

– When carrying out repair work, particularly when working under the machine, hang a “Do not start” warning sign in a clearly visible position on the control panel. Pull out the start key and shut off the main battery switch.
– Operate combustion motors and fuel operated heaters only in well ventilated areas. Before operating these units, check ventilation.
– In addition, always follow applicable local regulations.

Cleaning

– Clean oil, fuel or care products off the machine before starting maintenance or repair work and pay particular attention to connections and screw fittings.
Do not use aggressive cleaning products and use lint-free cleaning cloths.
– Do not use aggressive cleaning products or steam jet devices to clean the machine for the first two months after initial set-up of the machine (or after repainting).
– Do not use combustible liquids to clean the machine.
– Before cleaning the machine with water or steam jets (high pressure cleaner) or other cleaning materials:
  • lubricate all bearing points, bolt connections and the rim bearing to prevent water or steam entering the bearing points.
  • cover or glue shut all openings into which for safety or functional reasons water or steam may not be permitted to enter.
  Electric motors, electrical components, control boxes, plug connections and air filters are particularly at risk.
– Ensure that the fire warning systems and fire extinguishers of the engine compartment’s temperature sensor do not come into contact with hot cleaning products during cleaning work.
The fire extinguisher could start.
– If you use a high pressure cleaner with steam or hot water to clean the machine, observe following recommendations:
  • the distance between the nozzle and the surface to be cleaned must be no lower than 20 inches
  • the water temperature should not exceed 60°c (140°F)
  • limit the water pressure to 80 bar maximum (1160 PSI)
  • if you employ cleaning fluid, only use neutral cleaning agents such as customary car shampoos diluted to 2 or 3 percent maximum
– After cleaning:
  • remove all covers completely.
  • check all fuel, engine oil and hydraulic lines for leakage, loosened connections, chafing and damage.
  • rectify any defects found immediately.
  • lubricate all bearing points, bolt connections and the rim bearing to displace any water or cleaning products that may have entered.

Corrosion protection

– The corrosion protection of the machine must be inspected and renewed at regular intervals. For further information, refer to the Maintenance manual for corrosion protection.

Field of view

– Mirrors and cameras, which were possibly removed for the transport, must be in-

– Regularly check that the interior and exterior mirrors as well as the cameras are

properties (viscosity, pourpoint, flash point, ageing behaviour, lubricity, reaction with additives...).

▶ However, if mixing is absolutely necessary, respect the following maximum mixing proportions:

– Mixing LIEBHERR oils with hydraulic oils, or LIEBHERR oils with mineral oils, or hydraulic oils with mineral oils, or two different mineral oils together, or two different hydraulic oils together:

max. 10%

– Mixing HEES oils with hydraulic oils or mineral oils or LIEBHERR oils:

max. 2%

Hydraulic oil change intervals

Oil changes at pre-set intervals (mineral oils and PAO oils only)

This procedure is applicable only for mineral oils and PAO oils. If you use HEES biodegradable oil, refer to the next section.

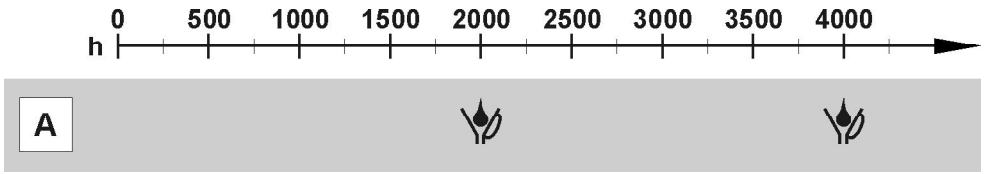


Fig. 5-11 *Oil changes at pre-set intervals*

A Mineral oils and PAO oils
h Operating hours

▶ Liebherr recommends that you sample the hydraulic oil every 500 operating hours (refer to the section "Condition monitoring with oil analysis").

▶ Change the hydraulic oil every 2000 operating hours.

Oil changes at optimized intervals

This procedure is applicable for mineral oils, PAO oils and HEES biodegradable oils.

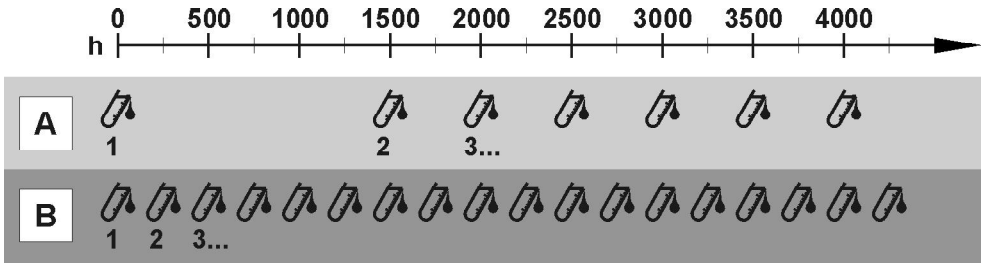


Fig. 5-12 *Oil changes at optimized intervals*

A Mineral oils and PAO oils
B HEES biodegradable oils
h Operating hours
1 First oil sample
2 Second oil sample
3 Next oil samples at regular intervals

You can extend the oil change intervals (up to 6000 operating hours and possibly

5.9.2 Air dryer

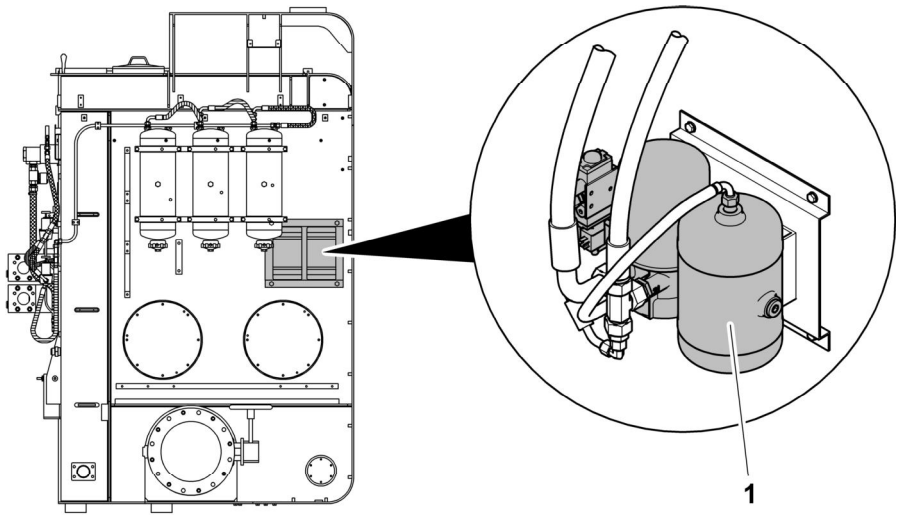


Fig. 5-25 *Air dryer*

1 Air dryer

Specific maintenance tasks are necessary for the air dryer **1**.

▶ For maintenance tasks description, maintenance intervals and for further information, refer to the control and maintenance chart and to the EMS Concept User manual for air dryer LA6700 at the end of this manual.

5.9.3 Air tanks

To drain the air tank:

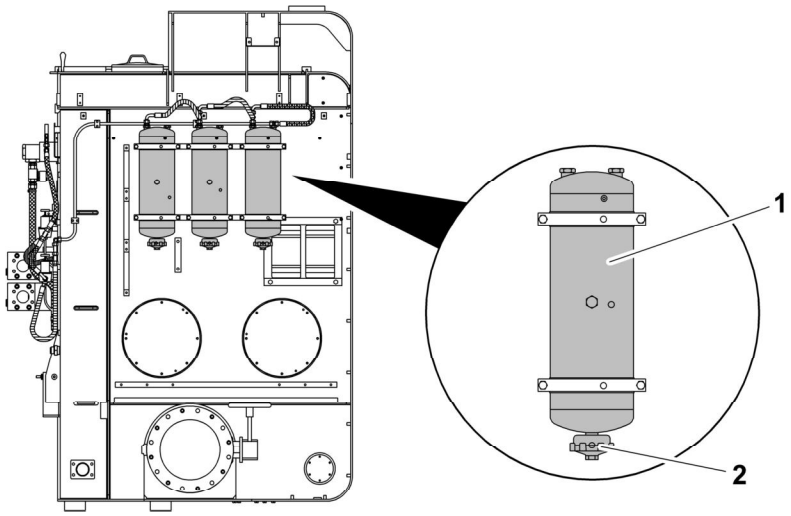


Fig. 5-26 *Air tanks (installed on hydraulic tank)*

1 Air tank **2** Drain valve

Condensation in the air tank **1** is automatically discharged via the drain valve **2** when

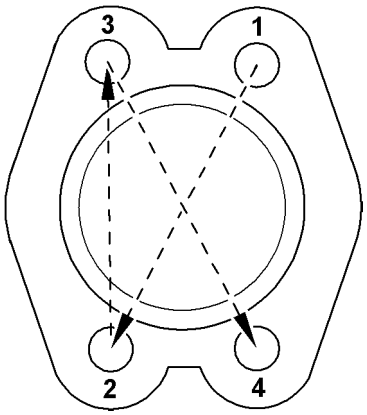


Fig. 5-48 *Criss-cross tightening*

- ▶ Make sure that all mounting surfaces have no damage, grease or contamination.
- ▶ Install the O-ring without grease in the groove of the hose fitting.
- ▶ Put the hose in position onto the mounting surface (be careful that you do not cause damage to the O-ring or remove the O-ring).
- ▶ Pre-install the flange and pre-tighten the mounting screws by hand.
- ▶ Tighten the screws progressively in a criss-cross pattern:
  - – first to 50% of the prescribed torque value,
  - – then to 100% of the prescribed torque value.
- ▶ Check the tightening torque clockwise.

5.11 Oil changes on components

5.11.1 General information

- ❑ The machine must be standing level.
- ▶ Stop the electric motor.
- ▶ Wait briefly until the oil has collected in the oil sump.
- ▶ Drain off the oil (preferably when oil is at operating temperature)
- ▶ Add the oil.
- ▶ Check the oil level.
- ▶ For oil quality and quantity, refer to the lubricant chart.
- ▶ For change intervals, refer to the lubrication chart and to the control and maintenance chart.

5.13.7 Electrical components location

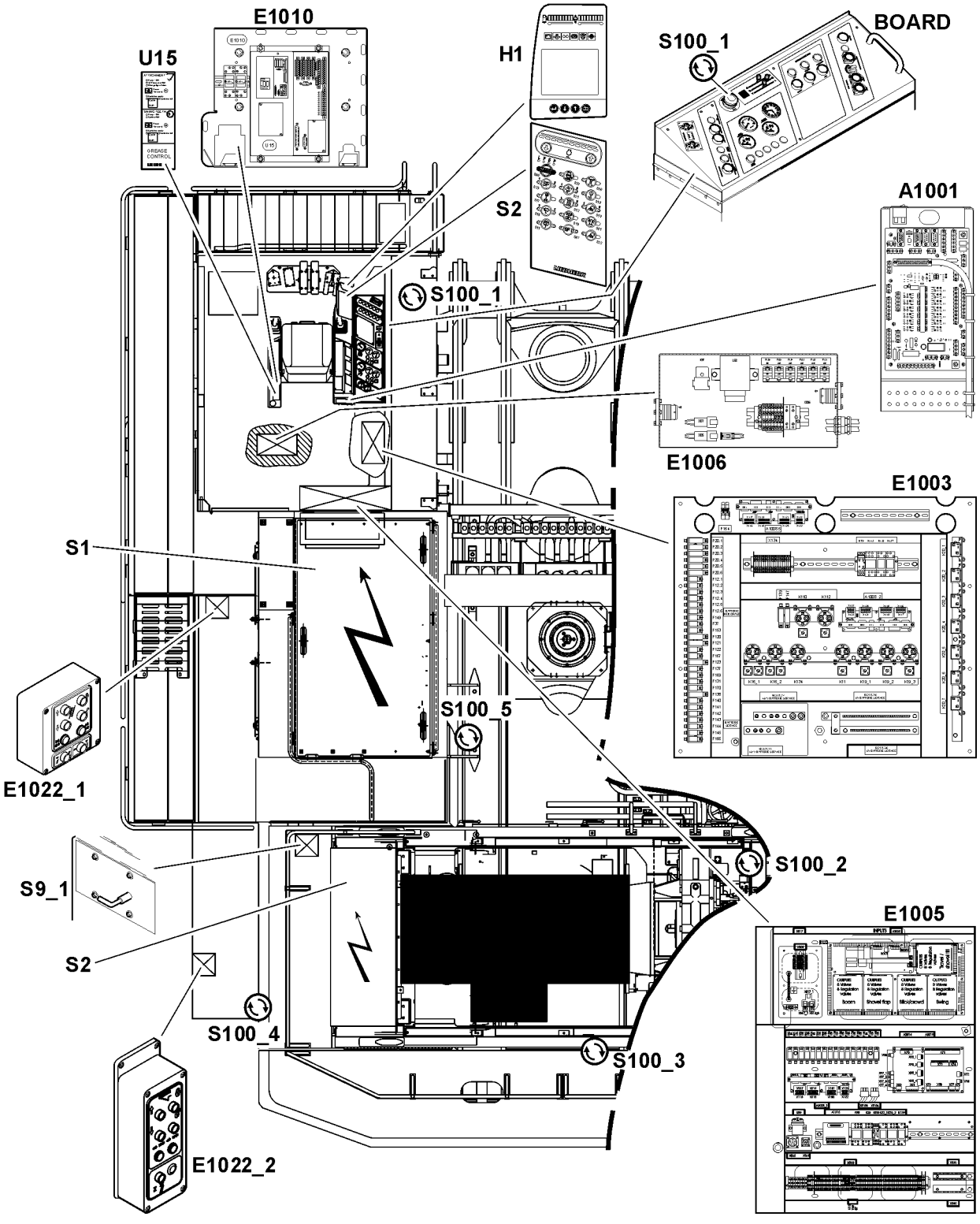


Fig. 5-66 *Electrical components location*

A1001 ESP01 Platine
E1003 Power connection box
E1005 Cabin connection box
S2 Keyboard
S9_1 Battery switch
S100_1 Emergency stop cabin

5.17 General maintenance points

5.17.1 Replacing working parts

In addition to the normal maintenance and repair work that is to be carried out at the given intervals, the machine operator and maintenance personnel can also carry out the repairs referred to below:

– Replacing defective sealing material on the pipe and hose system and on the hydraulic unit connections (not, however, on pressure relief valves which are lead sealed at the works).
– In addition, high pressure hoses, hydraulic lines and bolt connections on the hydraulic system can be replaced.

It should be noted that only original Liebherr replacement parts are to be used.

This is particularly relevant for hoses and hydraulic lines, which must be preassembled at the works. For all other repairs, particularly when dismounting the counterweight, works and dealership fitters are to be consulted.

5.17.2 Welding work on the machine

Welding work on all main components serving the power transmission (such as the chassis frame, rotating platform, equipment parts etc.) may only be carried out by the manufacturer or by an authorized workshop.

▶ Disconnect the batteries before starting any electric arc welding work on the machine.

▶ Always disconnect the negative terminal (-) first and reconnect it last.

▶ Switch off the main battery switch!

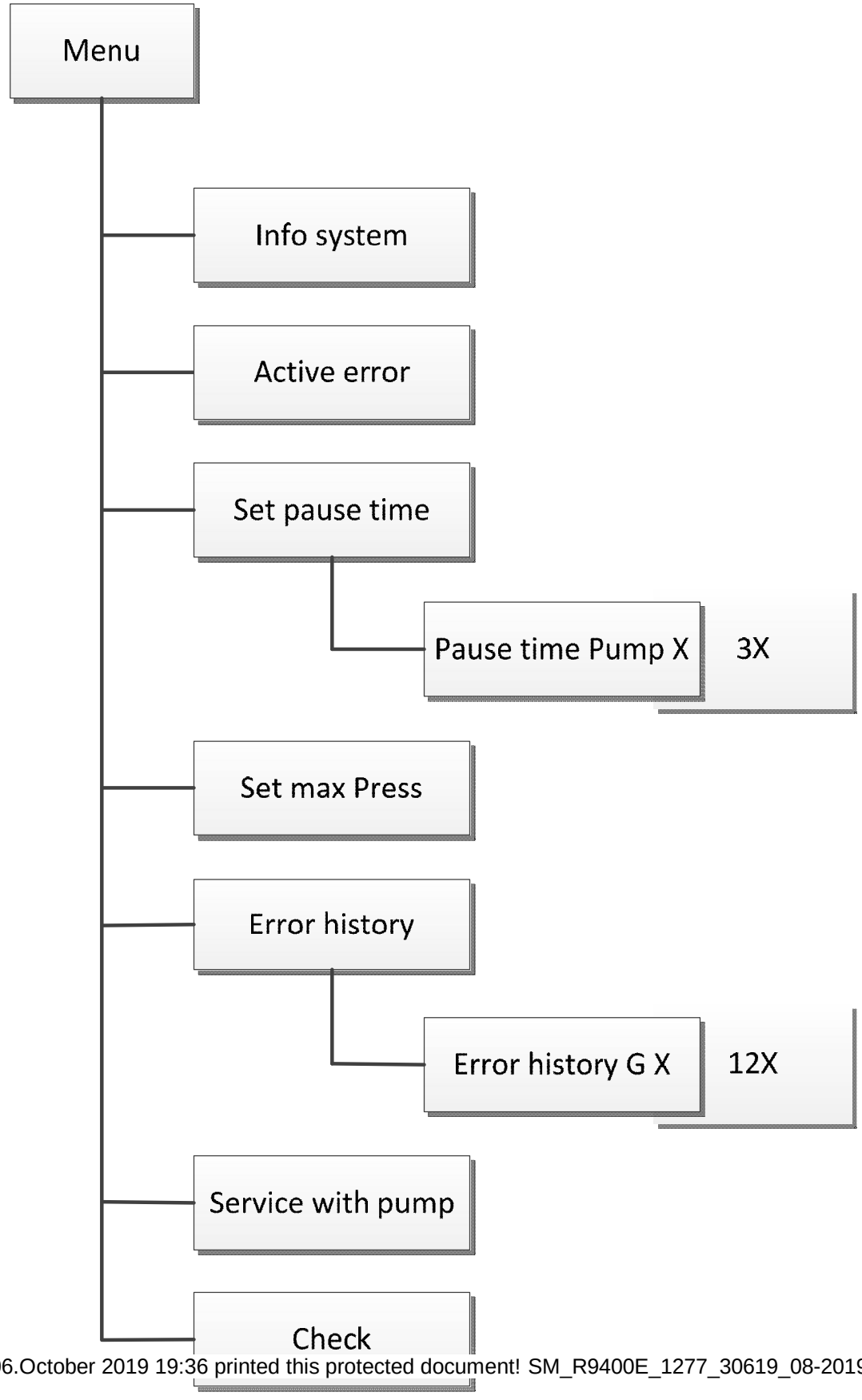
Nevertheless if welding repair should be done on components which may contain inflammable gases (welded counterweight, hydraulic tank, fuel tank, ...) these components must be previously and sufficiently ventilated with pressurized air to avoid all fire or explosion hazard.

Caution!
If high currents flow through the bearings or sealing elements, these could be burnt.

▶ Move the earthing cable of the welding tool as close as possible to the welding surface so that the welding current cannot flow over parts like the swing ring, rotary connection, gears, bushings, bearings, hinges, joints, hydraulic hoses, sockets, rubber parts or seals.

WORK TO BE PERFORMED AT 1000, 3000, 5000 HOURS, ... Check ❑ for first and only interval *or* Check ❍ for repeat interval	Check	Initials	Comments
Do a visual check of the cabin for oil/fluids leaks	❍		
Operate air conditioner every week for 10 minutes	❍		
Do a visual check of the condenser unit and evaporator filter	❍		
Do a visual check of the refrigerant level, if necessary refill circuit	❍		
Replace if necessary the air conditioner filter/dryer (at least once a year)	❍		
Yearly check condition of the refrigerant receiver, if necessary replace it	❍		
Perform maintenance for the second air-conditioning system (optional equipment)	❍		
Lubricate all doors seals with silicone or talc (before cold season)	❍		
Do a visual check of the AC for leaks or rubbing hoses or pipes	❍		
Do a visual check of the locks and hinges on doors and windows (lubricate if necessary)	❍		
Do a detailed check of the cabin rubber mounts	❍		
FIRE FIGHTING SYSTEM			
Do a visual check of the fire fighting system condition (optional equipment, refer to the fire fighting system documentation) If any issue contact fire fighting local dealer	❍		
Follow the inspection intervals recommended by the specific Health and Safety rules existing in country and/or on mine site	❍		
START THE MOTOR TO CHECK THE FOLLOWING ACTIONS			
General: Maintenance work must include the check of the correct functions of hydraulic and electric systems before starting operation	❍		
Attachment: Check function of the working attachment lubrication system during operation	❍		
Attachment: Check if the damping system on equipment is working correctly	❍		
Uppercarriage: Check position of the hydraulic shut-off valve	❍		
Uppercarriage: Check movement and locking of the access ladder	❍		
Uppercarriage: Check that the swing movement of the uppercarriage is locked when the access ladder is lowered	❍		
Swing Gear: Check function and operation of the swing brake	❍		
Swing Ring: Check function of the swing ring bearing lubrication system during operation	❍		
Swing Ring: Check function of the swing ring teeth lubrication system during operation	❍		
Electrical system: Clean and check LCD screen of the display for proper	❍		

4. Architecture of Menus



- Repairs or modifications to machines which are protected against explosions may be carried out only by the manufacturer or by a workshop recognized by a named institution and confirmed in writing.

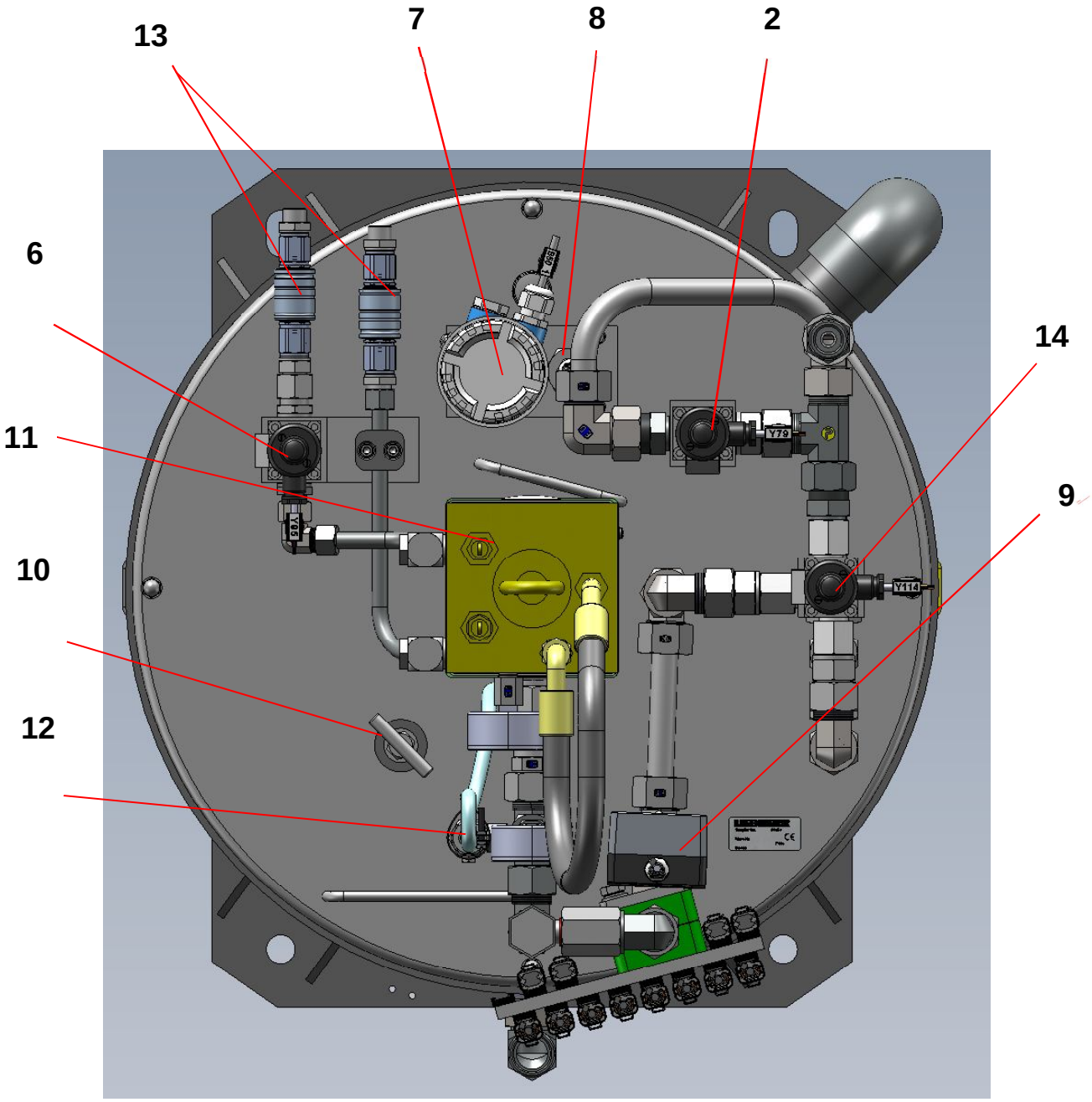
  If the work is not carried out by the manufacturer, the repairs must be approved by a named expert and confirmed in writing. The repairs are to be marked by a repair sign on the machine, stating the following:

  - Date
  - Executing company
  - Type of repair
  - If applicable, expert's code

- Transport damages can result in the loss of the explosion protection. If transport damages can be seen, do not assemble the machine or put it into operation
- All parts of the earthing concept must be correctly available and connected with the superordinate machine.
- If transport lugs are dismantled after set-up, the threaded bores must be permanently sealed in accordance with the protection class.
- Handle the materials so that no sparks are generated by tilting, falling, sliding, rubbing, impacting, etc. If needed, cover materials with suitable means.
- Never disconnect plug-in connections when energized. Secure plug-in connections against inadvertent manual disconnection with the safety clips included in the delivery.
- The operator must check critically whether operation without a low-level signal might lead to a new risk potential (e.g. through heat-up of bearing points on the machine in the area of ignition temperature, poor lubrication or bearing damage). If this cannot be ascertained, provide a low-level signal or suitable organisational measures for monitoring of the bearing point temperature.
- Avoid dust accumulation and remove dust immediately. Dust accumulations have a thermally insulating effect and, if whirled up, generate the formation of a potentially explosive atmosphere.
- The pump should be integrated into the operator's lightning protection concept.
- All parts are to be checked regularly for corrosion. Replace the affected parts.
- Terminal boxes must be firmly closed and the cable breakthroughs correctly sealed.
- Additional electrical monitoring devices must be firmly connected and correctly adjusted.
- Protect the motor with a motor circuit breaker against inadmissible heating up. When reaching their nominal life, the motor bearings have to be replaced or inspected to ensure their suitability for further utilisation.

3.3 Transport / installation / maintenance / repairs / servicing

- All relevant persons (e.g., operating personnel, supervisors) must be informed of the respective activity prior to starting any work. Observe the precautionary operational measures and work instructions.
- If protective and safety equipment has to be dismantled, it must be reassembled immediately after finishing the work, and then checked for correct function.
- Ensure through suitable measures that movable or detached parts are immobilized during the work and that no limbs can be caught in between by inadvertent movements.
- Carry out transport using only suitable hoisting equipment.



Central lubrication pump 200L (top view)

6	Solenoid valve (pump control)
7	Level sensor
8	High-level sensor
9	Pressure switch
10	Dip stick (grease reservoir)
11	Pump P1 – Model ContiMaster
12	Relief valve
13	Hydraulic coupling
14	Electric 3/2 ways valve (winter circuit)*

For information and descriptions of the components, refer to chapter 13.

* refer to the user manual 9.3EN-98002-xx (page 19)

1.2. Operation

1. Flexible air connections should be of the correct diameter and appropriate for the service pressure. Never use flexible hosing that is scratched on the surface, deteriorated or damaged in any other way. Use only connections and sleeves of a suitable type and size. When applying an air supply connection to flexible hosing or an air line, check that the free end is firmly held. A free end can whip round dangerously and cause bodily injury. Check that the piping is fully decompressed before disconnecting.

2. Never play around with compressed air. Do not direct compressed air towards your skin or a person. Never use compressed air to clean any clothing that you or other people may be wearing. Take the greatest care when using compressed air for cleaning any equipment. Wear protective eye-glasses.

3. The compressor is not designed to produce breathable air. To obtain air of breathable quality, the compressed air should be duly filtered in line with local legislation and standards.

4. Never use the unit when there is a risk of inhaling toxic smoke or inflammable fumes.

5. Never make the unit run at pressures lower or higher than the nominal limits indicated on the "main specifications" sheet.

6. Periodically check that :

   a. All protective devices are in place and firmly attached.
   b. All hosing and other pipework is in good condition, fixed or tied down and is not rubbing.
   c. Sealing is perfect.
   d. Bolt work and collars are securely tightened.
   e. Safety valves and other decompression devices are not clogged with dirt or paint.
   f. The air output valve and air circuits, i.e., pipework, connectors, collectors, valves and hosing are in good condition and are not worn or damaged.

7. Take precautionary measures against the air being polluted - and breathable air being contaminated - when recovering hot cooling air from the compressors for use with any heating installation such as for a workshop.

8. Do not remove or modify any sound insulating material.

1.3. Maintenance

Any maintenance and repair work should be done under the surveillance of a competent person.

1. Use only the correct tooling to carry out maintenance and repair work.

2. Use only original and genuine spare parts.

3. Carry out any maintenance work outside routine checks only if the unit has been shut down. Take all necessary precautions against the unit starting up unexpectedly. Furthermore, display a **"Work in progress! Do not start!"** sign near the start control box.

4. Before putting any piece of equipment under pressure, effectively isolate the unit from any pressure source and fully decompress the system.

5. Do not use any inflammable solvent or carbon tetrachloride for cleaning parts. Take precautions against toxic vapor coming from detergents.

6. Cleanliness must be strictly observed when doing any maintenance or repairs. Avoid any dirt getting in by covering up any detached parts and any openings using clean cloths, paper or adhesive strip.

7. Never carry out any welding or other work that might create a heat source near the oil circuit. If there is a heat source, completely purge oil reservoirs - using steam for example - before undertaking such work. Never weld or modify a pressure vessel in any way. If there is any sign or fear of overheating of a machine internal part, stop machine and **open up inspection covers only after a reasonable cooling period.**

   These precautions will help prevent the risk of spontaneous explosion of any oil vapor coming into contact with air. Never use a naked flame to inspect the inside of the machine, pressure vessel etc.

8. Make sure you don't lose any tools, objects or cloths in or on the unit.

9. Before the unit is authorized for use following a maintenance or servicing procedure, check that the service pressures, temperatures and time delay settings are correct, and check whether the control console and the emergency stop system operates correctly.

10. After any replacement of a separator element, check for any carbon deposits in the backflow pipework and inside the oil separator tank if there is one. Remove any carbon deposits if they are significant.

11. Protect motor, air filter and regulatory devices against water ingress, when carrying out steam cleaning for example.

12. Check the condition of the sound insulation material around the unit, and around the compressor intake and output systems.

13. Do not use caustic solvents. They attack parts of the air system such as polycarbonate bowls.

1. Safety precautions for air dryer

Read this carefully and act on the directives before installing, operating or maintaining the unit.

These recommendations apply to machines processing or consuming air or an inert gas.
The processing of any other gas requires extra precautionary measures, depending on the type of application.
These extra measures are not included in the text below.

In addition to the normal safety measures that are needed for air dryers, the following safety directives and precautions have a particular importance.

The user should apply safe and reliable methods when operating this air dryer, and observe all local requirements and regulations in force.

The owner has the responsibility of keeping the air dryer in good safety and operating conditions. If any items or accessories are unsuitable for being used in complete safety, they should be replaced.

Delegate the installation, running and maintenance of the unit to an authorised competent and trained person.

All standard operating data (pressures, temperatures, time delays, etc.) should be indicated and displayed in a lasting way.

For any modification to be made to the air dryer, the approval of the supplier and the supervision of a competent authorised person is required.

If any declaration in this manual - in particular concerning safety - does not comply with local legislation, the stricter version should be applied.

All precautionary statements are general and cover various types of machine and equipment. Because of this, some declarations cannot be applied to the air dryer described in this manual.

1.1. Installation

Beyond the general technical practices related to the regulations of the local authorities, please observe the following directives in particular:

1. Only lift the air dryer using suitable equipment that complies with the local safety regulations. Any detachable or pivoting parts should be safely secured before lifting. It is strictly forbidden for any person to pass through or remain in the dangerous area under a suspended load. Any acceleration or braking movements when handling the air dryer should remain within safe limits.

2. All blank flange covers, plugs and caps along with any dehydrating sachets should be taken out before connecting up the pipework. The distribution pipes and connections should be of the correct section and appropriate for the service pressure.

3. Install the air dryer in a place where the ambient air is as cool and clean as possible.

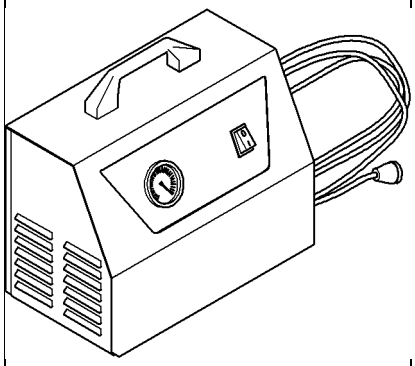
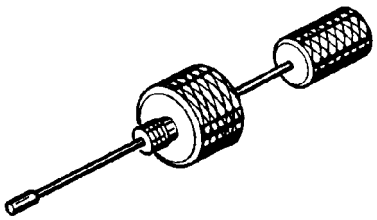
4. The incoming air should be free of smoke or inflammable vapour such as paint solvent. This could cause an internal fire or an explosion.

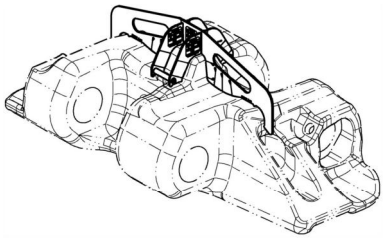
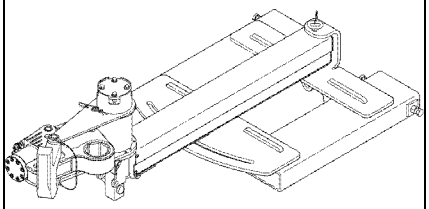
5. Check that the discharge piping linking the air dryer to the final cooler or air network can tolerate any swelling under the action of heat, and will not be in contact with, or near to, inflammable materials.

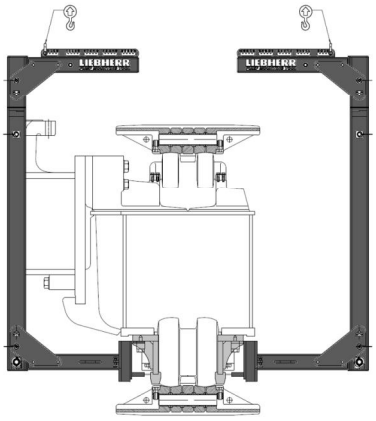
6. Never take out or touch any safety, protection or insulating device fitted to the air dryer.

7. Pipework and other components the temperature of which could be greater than 80°C and which personnel might accidentally touch in normal operation should be protected and insulated. Indicate clearly with notices any other pipework that may be at a high temperature.

8. Any electrical connections should comply with local regulations. Units should be earthed and protected against any short-circuits using fuses.

Representation	No.	Description	Size	Order No.	Model							
					R9100	R984C	R9150	R994	R9200	R9250	R994B R9350 R9400	R995
	130	Vacuum pump	30 l/min 24V	7405073	X	X	X	X				
	131		60 l/min	11181951	X	X	X	X	X	X	X	
	132		120 l/min	11181952	X	X	X	X	X	X	X	X
	140	Spool travel measuring tool		8007363	X	X	X	X				

Representation	No.	Description	Size	Order No.	Model						
					R9100	R984C	R9150	R994	R9200	R9250	R9350 R9400
	582 583	Track chain template - Single pin Dual pin		11477421 11477361							
	587 588 589 590 591 592 593 594 595	Track roller mounting tool Track roller tightening tool Reducer	 30XLCT HEX 90mm HEX 95mm 95/90 mm	10408110 10403446 10821437 10821147 10391760 11000110 10816889 11000111 11000128					X	X	X

Representation	No.	Description	Size	Order No.	Model							
					R9100	R984C	R9150	R994	R9200	R9250	R9400 R9350 R994B	R995
	950	Chain guide mounting tool (pump lifting tool not included)		11477039								
	960	Swing bearing lifting tool		11474186						X	X	X

6.00: Electric motor

1 Technical data

Motor	Unit	
Trademark		General Electric
Model		N 3 RXC 450 L4G
Type		3 phase AC squirrel cage motor
Voltage (± 10%)	V	6000 (*)
Frequency (± 5%)	Hz	50 (or 60)
Power Output	kW	1350 (1810 HP)
Nominal speed	RPM	1487 (50 Hz) or 1787 (60 Hz)
Maximal torque (at 1487 RPM)	Nm	8670
Efficiency	%	96,1
Nominal current	A	154
Power factor ($\cos\varphi$)		0,88
Protection class		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

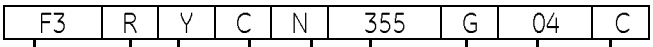
(*): Other voltages available on request.

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)

Designation model - F3 series:

Example:



Series name

Cooling

- **R** : air-air exchanger
- H : air-water exchanger
- M : fan and motor
- P : open without filter
- N : open with filters (*NEMA WPII*)
- G : connected by duct to ventilation

Voltage

- T : low voltage U < 1000 V
- X : medium voltage 1 000 V < U < 10 000 V
- **Y** : high voltage 10 000 V < U < 11 000 V

Rotor type

- **C** : copper cage
- A : aluminum cage
- S : rings without retraction of brushes or permanent contact type
- L : rings with retraction of brushes

Protection (*only if applicable*)

- P : internal overpressure
- E : enhanced safety
- **N** : anti-spark machine

Sizes (Height of shaft in mm for horizontal machines)

355; 400; 450; 500; 560

Magnetic circuit length code

G; J; K; L

Number of poles

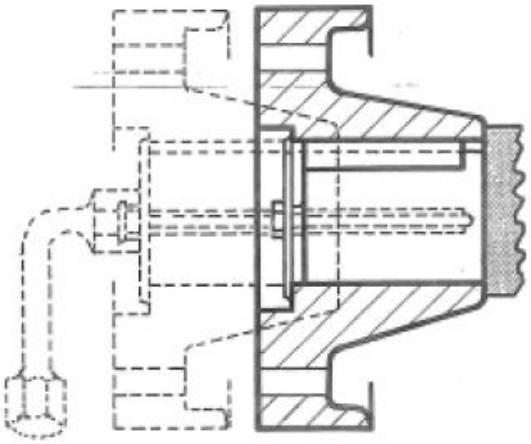
02; **04**; 06; 08; 10; 12

Types of bearings

- G : ball-bearings lubricated by grease
- **C** : self-lubricated bushes, or force-feed oil circulation

- Fit the transmission component (sleeve) without impacts to prevent any deterioration to the shaft and/or bearings.

Use of a special lubricant (Molikote) is recommended except for taper fit assemblies which must be performed dry.



In general, the sleeve can be heated in an oil bath or oven to 80/100°C, then placed in position by hand and maintained in position (or fully in if a stop is used) by the shaft end screw. A shrink fit is always performed when the sleeve is intended for mounting on a plain shaft without key (do not forget removal system).

Immediately cool the shaft end, sleeve and bearing using a compressed air jet. Install the sleeve locking system if necessary (example: washer and shaft end screw).

4.3.1.2 Coupling by hydraulic coupler

This coupling method requires the written authorization of Power Conversion. To check that it is possible to fit the primary of the coupler directly on the motor shaft end, you must inform us of the weight which will be effectively supported by the shaft end and the distance from the point of application of the weight to the shaft collar.

4.3.1.3 Coupling by pulley and belts

As indicated above, the coupling method is subject to the written authorization of Power Conversion in order to check that there will not be any unwanted effect on correct operation of the motor.

We will need the following information:
- Pitch diameter of pulley.
- Width of pulley.
- Number of belts to be used and their characteristics.
- Intensity and direction of pulling force which will be applied.
- Weight of pulley.

The pulley hub must be locked on the shaft to prevent it from moving axially.

The centre of gravity of the pulley must also be as near as possible to that of the motor shaft collar.

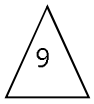
5.2.2 Vibration protection

Where requested, vibration sensors will be installed in compliance with the contractual specifications.

The vibration limits must always be no greater than those of standard CEI 34-14. (accelerometers mm/s RMS) or API 541/546/ISO 7919 for shaft movement values (peak-to-peak microns).

The values acceptable by Power Conversion for the alarm and tripping thresholds are defined in the connection diagram.

WARNING



SETTING UP THE PROPER THRESHOLD LIMITS (ALARM AND TRIP) IN THEIR CONTROL EQUIPMENT FOR VIBRATION AND/OR DISPLACEMENT SENSORS IS THE END USERS RESPONSIBILITY.

Any overshoot of the limit thresholds can result in destruction of the bearings (rolling element or bushed), and possibly of the shaft.

These values should be recorded to draw up a diagnostic and correct the vibration malfunction.

5.2.3 Electrical protection

Where current transformers (CT) are integrated in the neutral or supply terminal boxes of the motors in accordance with contractual specifications, make sure the electrical protection system is compatible with the protection class, power and ratio of the current transformers.

As a general rule, the relays of the motor electrical protection system must be adjusted to prevent any phase unbalances, overloads, and any other functioning outside the specifications; the thresholds should be adjusted in accordance with the data given in the table below.

Function	Threshold	Time delay	Remarks	Alarm	Motor shutdown
Maximum voltage	1,2 Un	1 - 5 s	Unless existent on power supply station	*	*
Minimum voltage	0,75 Un	1 - 3 s	Unless existent on power supply station	*	*
Unbalance	5 %	1 - 3 s Inverse curve		*	*
Maximum current	1.2 Id (*start-up current*)	1 s		*	*
Overloads	Values acceptable for class B operation: 1,1 In = 1h 1,2 In = 15 min 1,3 In = 7 min 1,5 In = 4 min 2 In = 1 min	Time constant	If used at nominal rate with heating class F: the thresholds must be set consistent with the thermal limit curves for the stator in overload operating conditions, supplied by Power Conversion	*	*
Differential	5% In, Slope 5 – 25 %	0		*	*
Differential (transformers – motor unit)	20 – 50 % In, Slope 10 – 50 %	0	In accordance with characteristics of transformer and operation	*	*

8

Oil quality: ISO VG 46

	Kinematic viscosity in centiStokes at:			Dynamic viscosity in centiPoises at:	
	40°C	50°C	60°C	50°C	60°C
AGIP Ote 46	44		20	17.4	
ARAL Degol CL 46	46	30		26.5	
B.P. Energol CS 46	47	30.7	20.5	26.3	17.4
CASTROL Perfecto T 46	46		20.4		17.2
CHEVRON Mechanism LPS 46	46		22		19
DEA Astron HL 46	46	29.5		25.4	
ELF Elfolna 46*	46		20		17.5
ESSO Teresso 46	44.7	30	19.6	26	17
FUCHS Renolin DTA 46	46	31		25.8	
KUBLER LUBRICATION Lamora HLP 46	46	29.5		25.4	
MOBIL DTE Oil Medium	46	28.7	19	24.4	16.6
SHELL Turbo T 46 Tellus oil C 46	46 46	30	20.1	21.9	17.6
TEXACO Regal R et O 46	47.6		21.2		18
TOTAL Azolla ZS 46	46		22		18.7

* This oil can be suitable for the bearings but it is not recommended by the bearing manufacturer.

FAX MESSAGE	
DEST: GE Power Conversion	Fax N°: +33 (0) 3. 83. 38. 42. 99. Page 1 Total: 1 page(s)
ATTENTION: PROJECTS DEPARTMENT	
FROM:	DATE:
COMPANY:	

RECEPTION REPORT

For a better quality of our allowances, please transmit this document to the receiver of the motor, to complete it and return it to us by fax or eventually by mail to: GE – Power Conversion – Projects Department - 442, rue de la Rompure – BP 90 - 54250 Champigneulles - FRANCE.

Type of motor: .....

Serial number: .....

Installation address: .....

RECEPTION

Is the motor inside a thermosealed packaging?	YES ❑	NO ❑
The packaging state is:	Correct ❑	Defective ❑ (*)
Will the motor be stored more than 6 months?	YES ❑	NO ❑

If you answer 'YES', clarify the number of months: .....
Ask the procedure of long-term storage to GE – Power Conversion and plan to complete report of storage below.

At the opening of boxes:

Painting state	Correct ❑	Defective ❑	(*)
Locking of the rotor	Correct ❑	Defective ❑	(*)
Instrumentation	Correct ❑	Defective ❑	(*)
Are the supplies in conformity with shipping documents?	YES❑	NO ❑	(*)

(*) Detailed description of the defects

.....

.....

.....

.....

- **Protect** the face of the shaft end with **a layer of 60 to 100 microns of intermediate or final paint**, after having properly takes any grease marks out from all surfaces to paint.

b) Section of shaft not enclosed in frame and bearings sealing systems
Protect the whole of the shaft sections with a product **Tectyl 506 Valvoline type**, including under instrumentation

Ex.: **Earthing brushes**: Remove the earthing brush(es) from the shafting and temporarily protect the surface. Store the earthing brush(es) in the main terminals box.

NOTE The surface under shaft displacement instrumentation (ex.: Bently Nevada sensor) does not require additional protection.

c) Keys at shaft end
- **Protect** keys with a product **TECTYL 506 VALVOLINE type**.
- **Pack** each key in oiled paper.
- **Put** the keys in a plastic bag and store it in the packing case provided with the motor.

3.1.2 Bearings

3.1.2.1 Sleeve bearings

If the rotor can be rotated

- The oil is drained from motors prior to shipment.
Refill the bearing oil tanks to indicated level with oil specified on the motor name plate.

- Every two months: pre-oil the bearing by the filling hole and turn the rotor 10 revolutions to keep the bearing in good conditions.

CAUTION
- Before rotation, remove possible bearing locking device.
- Avoid to reposition the rotor at the same place (rotate for example ¼ turn more than the position before rotation)

- Check the bearing locking periodically.
Tighten the shaft end locking screw to the required degree according the tightening torques table (see MSIMMA).
CAUTION: A too tight fixing can damage the bearing.

- Spray Tectyl 511 or other anti-corrosion film-forming oil to the bearing through the filling hole.

- Every 1 - 2 years (if the anti-corrosion has been applied regularly): dismount the upper cover of bearing housing. Check the anti-corrosion oil layer of the shaft and the inside of the bearing. Repeat the anti-corrosion protection.

NOTE If the motor is stored in a SEI 4C packing, there must be a special packaging (opening of the box system, internal cover size adapted) for access to the rotor for rotation.

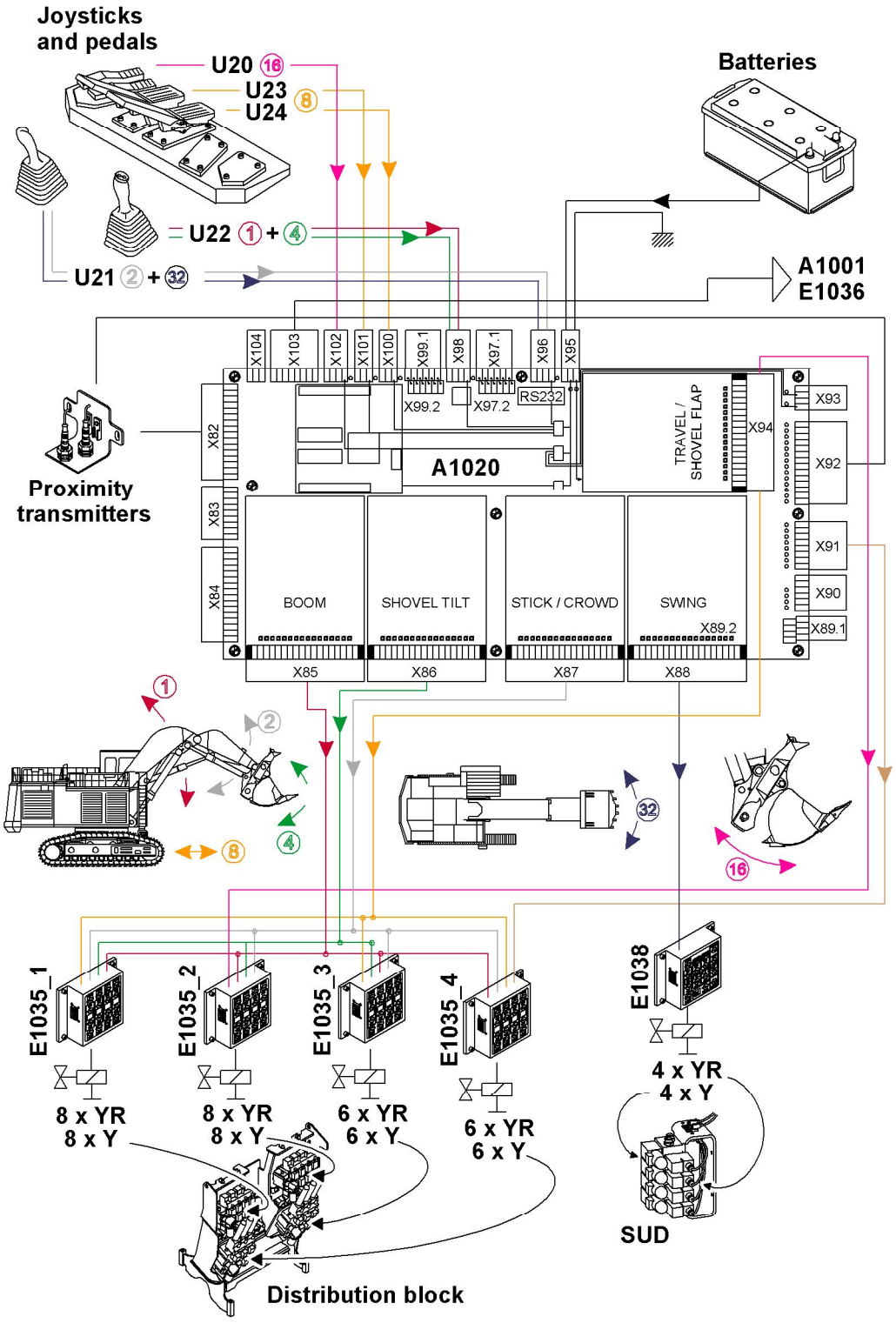


Fig. 11 *Electronic components*

3.3.2 Servo oil circuit

The servo pressure is used for:

- spool valves movements,
- pressureless falling for boom,
- swing brake,

The purpose of this power reduction stage is to limit the overload of the motor.

The adjustment of the power regulator is made with **XLR** = 0 bar (see working pump adjustment). The regulation beginning is adjusted to occur at a system pressure of about 55 bar if **XLR** = 0 bar (the spring in the power regulator **LR** just balances the force of the servo pressure **P** applied to the lever **4.1** via the position feedback piston **3.1**).

4.2.4 Flow limitation stage

This function makes it possible to shift the pump to reduced or to minimum flow even at low pressure, as an example when operating an hydraulic hammer (reduced flow), or when no movement is actuated (flow mini, no joystick or pedal signal).

The port **X2** of the positioning piston is connected via the pressure cut off regulator **DR** and the power regulator **LR** to the middle groove of the regulation piston **DW.**

When the piston **DW** is moved to the right, the middle groove (and thus the port **X2**) of the regulator piston is connected to the pump high pressure: the pump swivels to minimum angle.

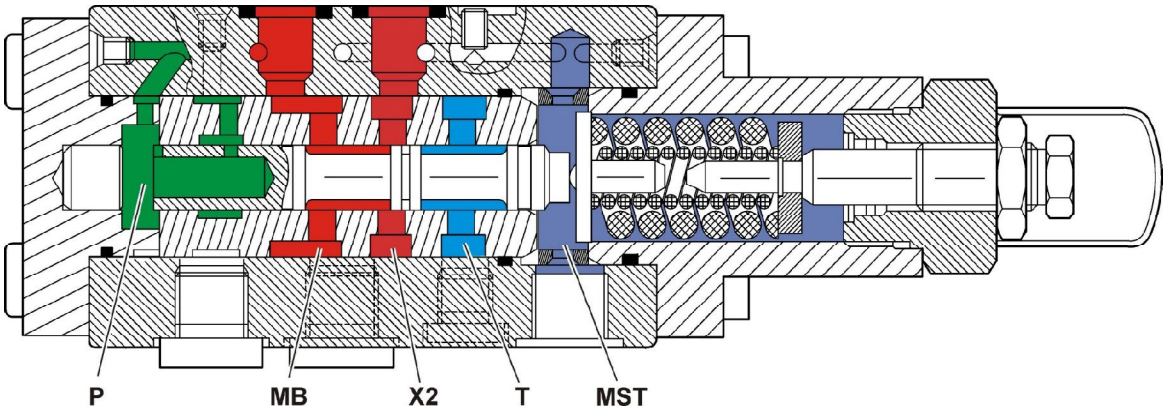
When the piston **DW** is moved to the left, the middle groove (and thus the port **X2**) of the regulator piston is connected to the tank pressure: the pump swivels to maximum angle.

The piston of the regulator **DW** is pushed permanently to the right by the force of the servo pressure **P** (55 bar) applied on the piston surface.

The piston of the regulator **DW** is pushed to the left by the force of the spring and by the force of the pressure **MST** applied on the piston surface.

The **MST** pressure is given by the regulator **5**, the **MST** line is connected to the servo pressure **P** (via the throttle) and to the lower groove of the regulator **5.**

When the piston **5.8** of the regulator **5** is moving up in comparison to its sleeve **5.6**, the lower groove is connected to the tank pressure, the pressure **MST** decreases: the piston **DW** is moved to the right.

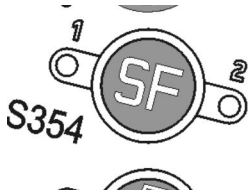


When the piston **5.8** of the regulator is in lower position in comparison to its sleeve **5.6**, the lower groove is closed, the pressure **MST** than increase to the pressure **P**: the piston **DW** is moved to the left.

lically, i.e. if there is no brake pressure, the disks are pressed together by springs and the brake is mechanically closed.

The brake is negatively acting, hydraulically actuated and serves as a holding or parking brake.

The travel brake is operated by using the button **S354** on control keyboard.



- ▶ Press button.
  - ↳ Travel movement stops and travel brakes engage after 3 seconds.
  - ↳ Undercarriage is locked.
  - ↳ LED in the button illuminates.
- ▶ Press button again.
  - ↳ Travel brakes are released.
  - ↳ After 1 second, undercarriage is unlocked and travel movement is possible.
  - ↳ LED in the button goes out.

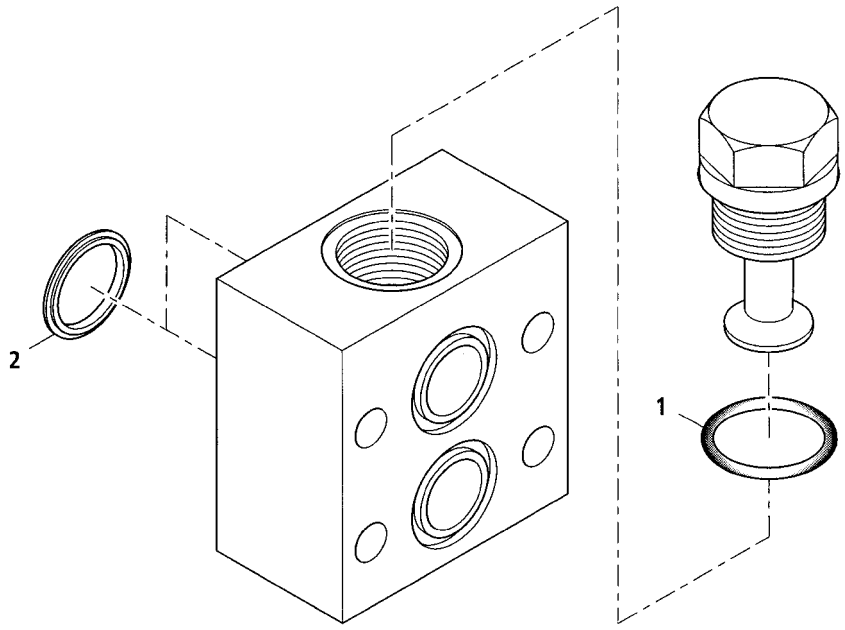
When the travel brake function is operated with the button **S354** on the control keyboard, the solenoid valve **Y6** is activated and a part of the oil issued from the charging distribution bloc **DBCC** (and so charging pumps **P10.1** and **P10.2**) flows to the brakes via the rotary connection **RC.**

The travel brake is engaged if the safety lever is operated or if the access ladder or the service trap is down.

6.5.2 Travel brake test

The travel brake function is a safety device. If you are not sure of the condition of the travel brakes, do the procedure that follows.

Caution!
Do the test of the travel brake very carefully because it can cause damage to the brakes.



Item	Description
1	O-ring
2	Seal

Secondary pressure relief valve 30

To remove check valves:

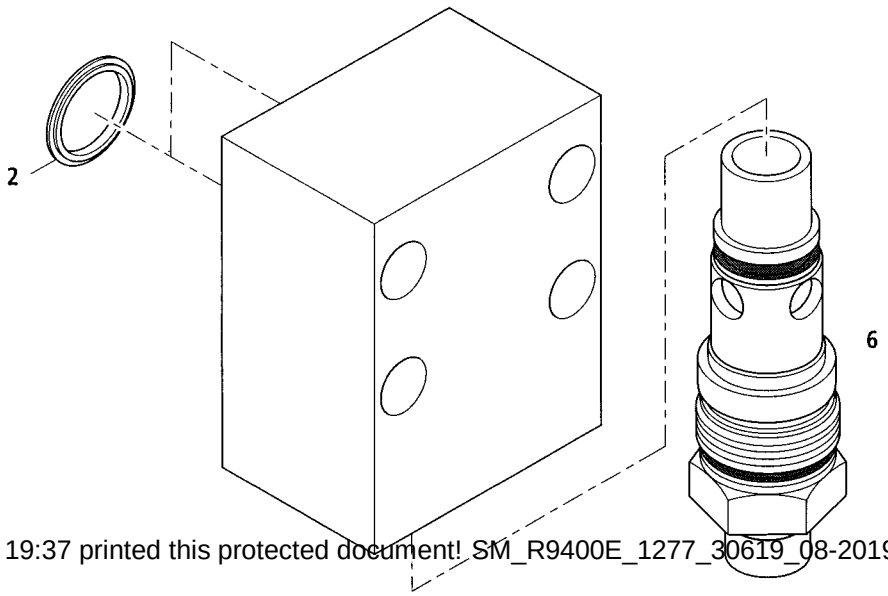
▶ Remove screws **31** and lift off the corresponding check valves **29**.

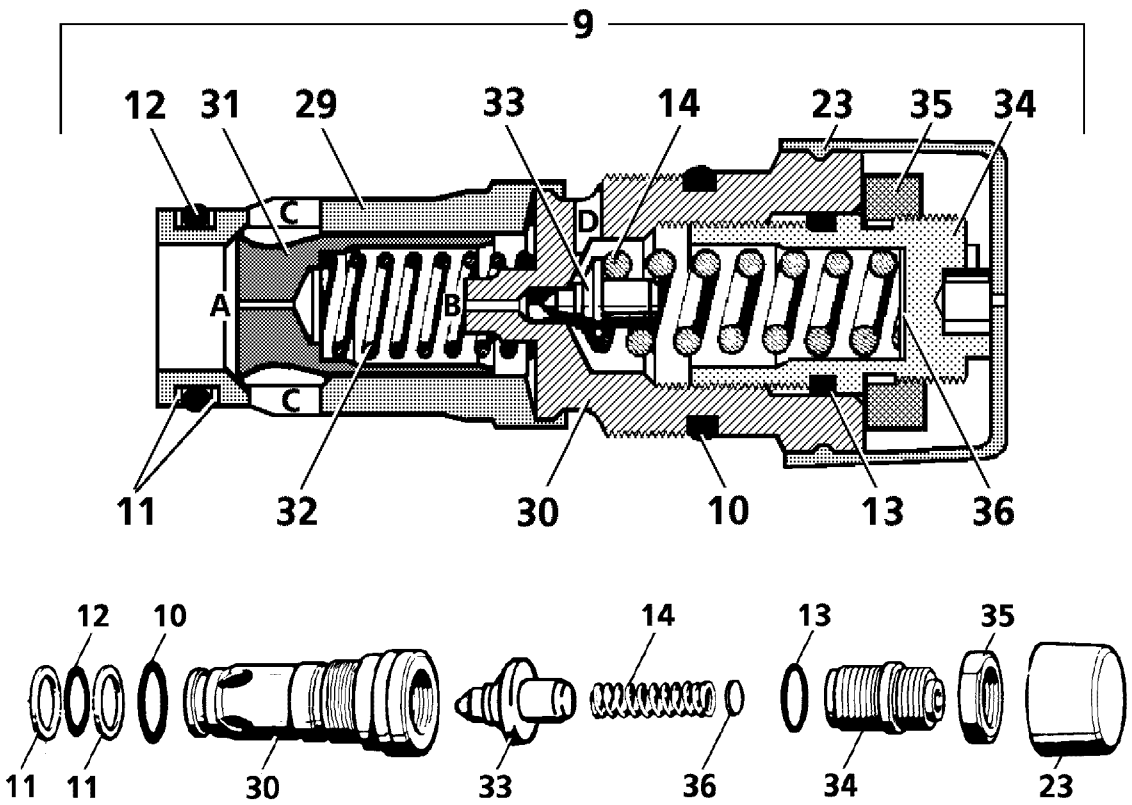
To replace secondary pressure relief valve:

▶ Assemble the different parts of the valve, making sure that the o-rings are seated correctly.

▶ Tighten the screws **31** to the prescribed value.

The seal kit consists of:





9	Primary valve	**14**	Spring	**32**	Spring
10	O-ring	**23**	Cap	**33**	Poppet
11	Support ring	**29**	Valve seat	**34**	Adjustment screw
12	O-ring	**30**	Valve body, incl. Items 31 and 32	**35**	Lock nut
13	O-ring	**31**	Main piston	**36**	Disc

9.5 Primary valve: 2-stage pilot operated pressure limiting valve

9.5.1 Use

The basic function and working principle of a two-stage relief valve is the same as the primary relief valve. In order to have a higher pressure for certain functions the standard relief valves are replaced with two-stage relief valves.

9.5.2 Function

Stage I - Reduced pressure

At this position **NO** servo pressure is applied to the piston **12** via the connection **X.**

The pressure of the spring **21** keeps the pistons **12** and **13** in the original position, which means that as long as the piston **12** contacts the shoulder of the adjustment screw **11**, the spring **21** retains a preload equal to the « reduced pressure».

Stage II - High pressure

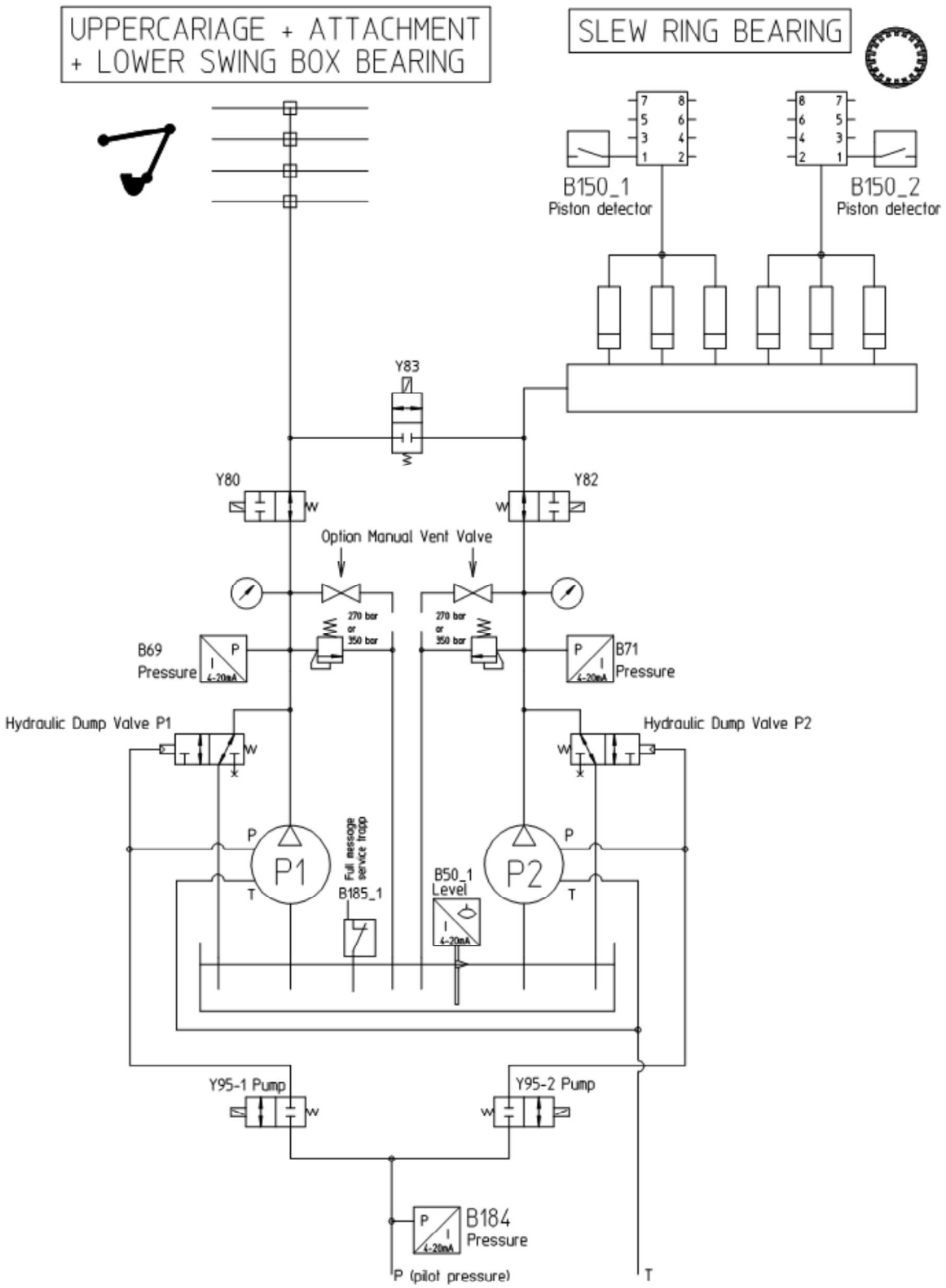
A servo pressure is applied to the piston **12.**

This pressure increases the preload on the spring **21** to the «high pressure» by pushing the two pistons **35** and **36** down.

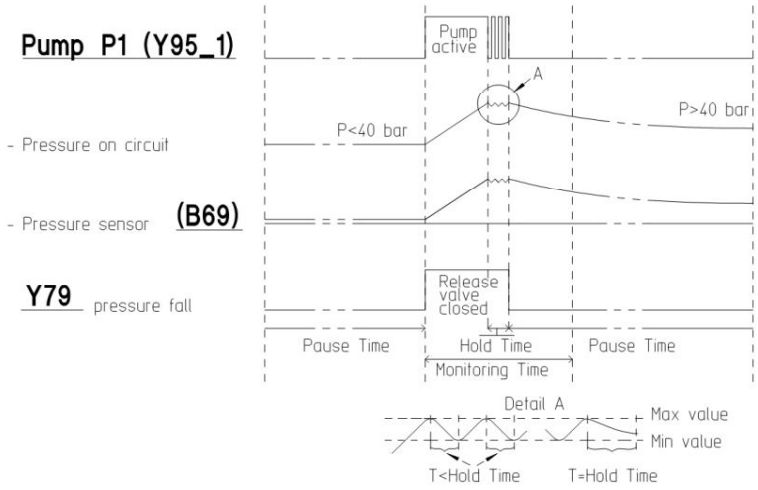
24V	Supply
0V	Ground
4 - 20X	4 - 20mA handle swing
4 - 20Y	4 - 20mA handle stick
A1020	FSG plate
E1003	Power connection box
E1005	Cabin connection box
E1037	Connection box solenoid valves ladder/trap door
E1038	Connection box regulation
F32	15A fuse / **A1020** stick/swing
U21	Left joystick
X88	Connector 18 poles / **A1020**
X96	Connector 4 poles / **A1020**
X113	Connector 24 poles / **E1003** ground
X116	Connector 70 poles / **E1003**
X118	Connector 40 poles / **E1003**
X122	Connector 70 poles / **E1005**-elevation
X128	Connector 70 poles / elevation-ladder
X300	**KI31** electronic ground **E1005**
X310	**KI31** principal ground **E1003**
X450	Connector 2 poles / **Y150**
X455	Connector 2 poles / **Y155**
X461	Connector 12 poles / **U21**
X650	Connector 24 poles / **E1037**
X676	Connector 2 poles / **Y151**
X678	Connector 2 poles / **Y156**
X756	Connector 40 poles / rotating deck
X858	Connector 24 poles / **E1038**
XR450	Connector 2 poles / **YR150**
XR455	Connector 2 poles / **YR155**
XR676	Connector 2 poles / **YR151**
XR678	Connector 2 poles / **YR156**
Y150	Solenoid valve swing left
Y151	Solenoid valve swing left
Y155	Solenoid valve swing right
Y156	Solenoid valve swing right
YR150	Adjustment solenoid valve swing left
YR151	Adjustment solenoid valve swing left
YR155	Adjustment solenoid valve swing right
YR156	Adjustment solenoid valve swing right

Chapter 9 - Cooling system

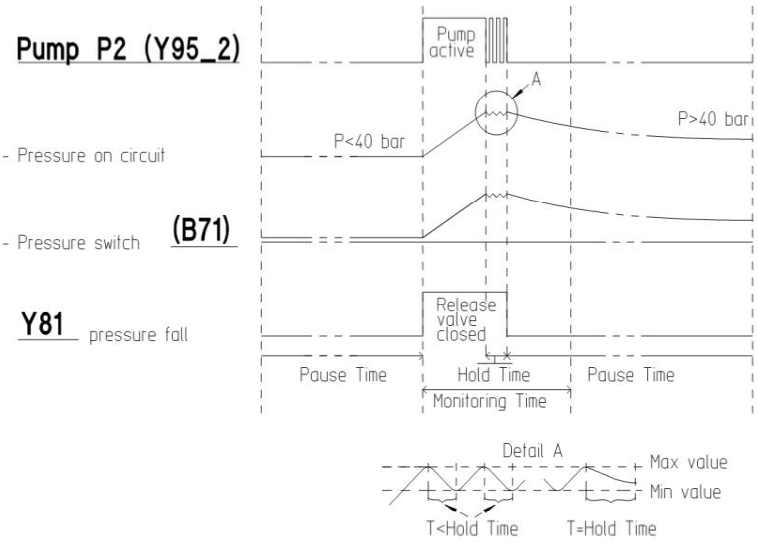
Pump P1 and P2 - 2P/Execution 1



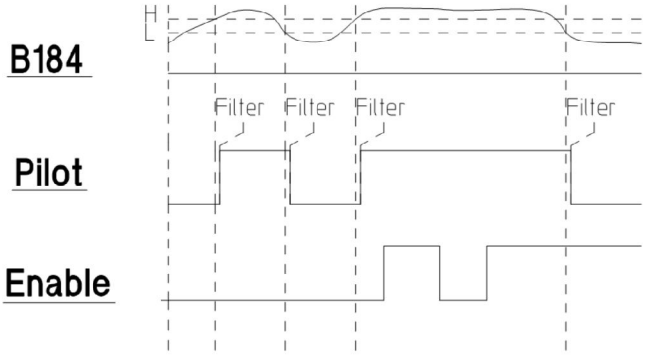
Grease circuit P1 - error G4



Grease circuit P2 - error G5



Grease circuit P1/P2/P3 - error G36



1 Guidelines

As you read these instructions, you will notice a number of depictions and symbols which are to facilitate the navigation and understanding of these instructions.

For reasons of better legibility, in these instructions we mainly use the male form for general references. Of course, the female form is also always intended.

Please read these instructions thoroughly and heed the warning and safety notes. Please observe the warning and safety notes and exercise particular caution in these cases.

Inform also other users accordingly.

Text representations	Meaning
Bold print	Highlighting of particularly important words or passages
• List 1	Marks lists
o List 2	Marks lists
(parenthesis)	Item numbers
➢ Instructions	Instructions to personnel. These always appear in chronological order.

1.1 Explanation of symbols and signs

Activities which generate actual hazards (to life and limb or possible damage to the material) are marked by warnings. Definitely observe the instructions given in the warnings.

You will find these symbols, which warn of specific dangers to persons, material assets, or the environment, next to all safety instructions in these operating instructions.

Please read these instructions thoroughly and heed the warning and safety notes. Please observe the warning and safety notes and exercise particular caution in these cases.

Inform also other users accordingly.

The following warnings are possible.

Warning level		Consequence	Probability
⚠	DANGER	Death/ serious injury	imminent
⚠	WARNING	Serious injury	possible
⚠	CAUTION	Minor injury	possible
⚠	ATTENTION	Property damage	possible

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

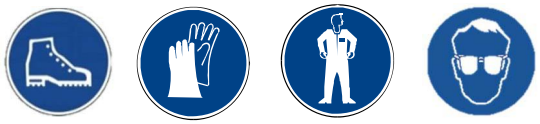
Fill the reservoir as described in chapter "Installation and commissioning".

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.

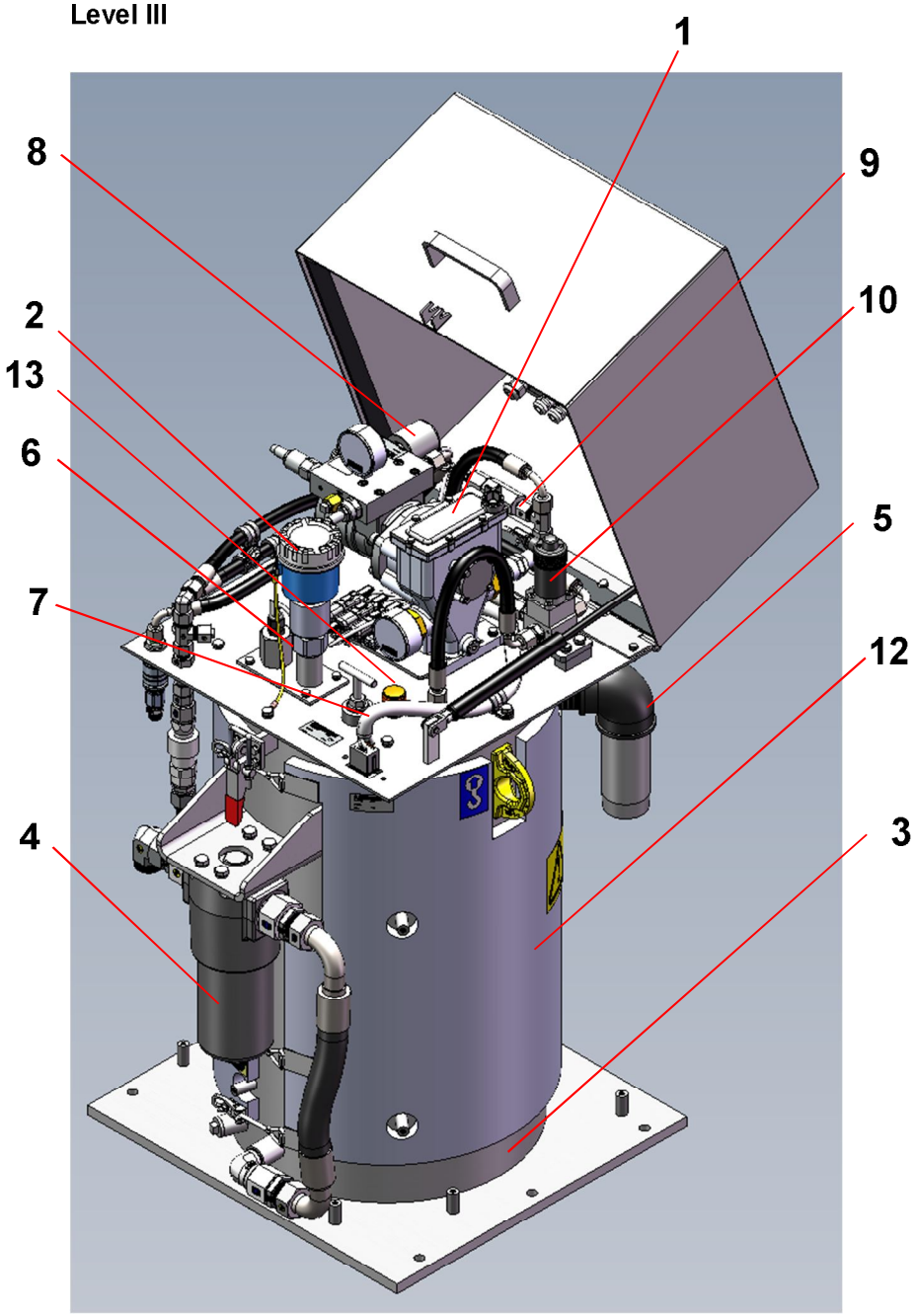
Interior cleaning

- 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.

Level III



1 FlowMaster II pump
2 Level sensor
3 Grease reservoir 80L for FlowMaster II-pump
4 Lubricant filter, refilling
5 Overflow pipe
6 High-level sensor
7 Dip stick (grease reservoir)
8 Solenoid (pump control)
9 Relief/safety valve
10 Electric 3/2 ways valve (winter circuit)*
11 Heating Jacket
12 Thermostat (not shown)
13 Air filter/breather

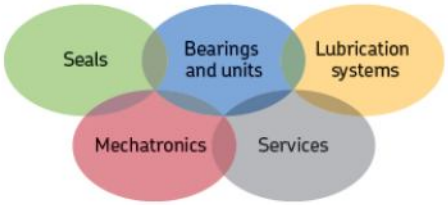
Fig. 10 80L Pump station Level III

For information and descriptions of the components, refer to chapter 13.

* refer to the user manual 9.3EN-98002-xx (page 21)

14 Component data sheets

Component	No. of document
Progressive metering device SSV	22EN-20001-xxx
ContiMaster pump	MON 951-171-035-EN
Capacitive Level Measurement	TI00401FEN_1517
Hydraulic pump FlowMaster II	404432_C8_352A
Hydraulic vent (relief) valve	C8-313A (404211)
Single line injector LM5	42A-18002-xxx
Single line injector SL-1	42A68351xxx SL-1
Electronic controller	93EN-98002-xxx
Pressure switch	93DE_EN_-FR-58003-xxx
Piston detector	93A-20014-xxx
Refilling filter	528-32616-1 (-40°) SP-List Filter 528-32616-1
Lubricant filter (pressure line)	4.3A-64110-xxx
Solenoid Valves	9.3A-68001-xxx
Thermostat – only for level III	TSW3



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:
SKF Lubrication Systems Germany GmbH
Werk Walldorf
Heinrich Hertz-Str. 2-8
D-69190 Walldorf
Tel. +49(0) 6227 33-0
Fax: +49 (0) 6227 33-259
E-Mail: Lubrication-germany@skf.com

5. Delivery, returns, and storage

5.1 Delivery

After receipt of the shipment, check the shipment for damage and completeness according to the shipping documents. Immediately report any transport damages to the forwarding agent.

Keep the packaging material until any discrepancies are resolved. During in-house transport ensure safe handling.

5.2 Returns

Clean all parts and pack them properly (i.e. following the regulations of the recipient country) before returning them.

Protect the product against mechanical influences such as impacts. There are no restrictions for land, sea or air transport.

Mark returns on the packaging as follows.

5.3 Storage

SKF products are subject to the following storage conditions:

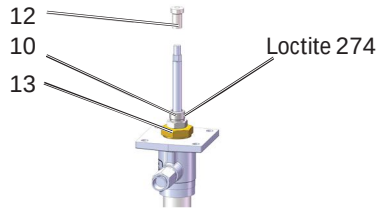
- dry, dust- and vibration-free in closed premises
- no corrosive, aggressive materials at the place of storage (e. g. UV rays, ozone)
- protected against pests and animals (insects, rodents, etc.)
- possibly in the original product packaging
- shielded from nearby sources of heat and coldness
- in case of high temperature fluctuations or high humidity take adequate measures (e. g. heater) to prevent the formation of condensation water.
- the admissible storage temperature range corresponds to that of the operating temperature (see Technical data of the pump)

Before application inspect the products with regard to possible damages occurred during their storage. This particularly applies for parts made out of plastic and rubber (embrittlement).

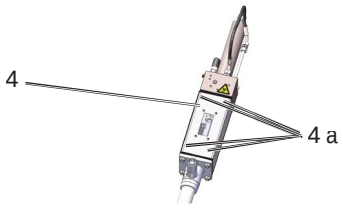
- Turn screw M30x1,5 (10) with fork wrench AF 36 into coupling (11). When doing so fix coupling (11) with a second fork wrench AF 36 against torsion.
- Use fork wrench AF 22 to verify firm seat of connection lines on oscillating cylinder and retighten, if necessary.
- Reinstall the two angled casings (4) by means of the screws (4a).

The pump is ready again for installation at the place of use.

Mount parts Fig. 41



Reinstall casings Fig. 42



	Thread G	Thread NPT	Threaded pipe joint	Tri-Clamp	Tri-Clamp clad	
Dimensions	H3 = 85 H4 = 25 AF = 55	H3 = 85 H4 = 25 AF = 55	–	–		
Additional information	Seal: elastomer	–	–	–		

* EHEDG, 3A: Certificate only applies for probes without an inactive length and with a fully insulated probe rod.
** In the event of CRN approval, the maximum permitted process pressure is 11 bar.
*** Not in conjunction with inactive length.
**** Process connection: Tri-Clamp (47 mm) with seal (2 mm) and removable clamp (49 mm).

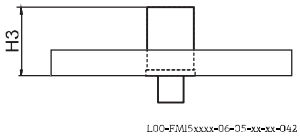
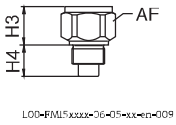
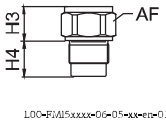
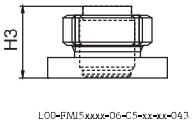
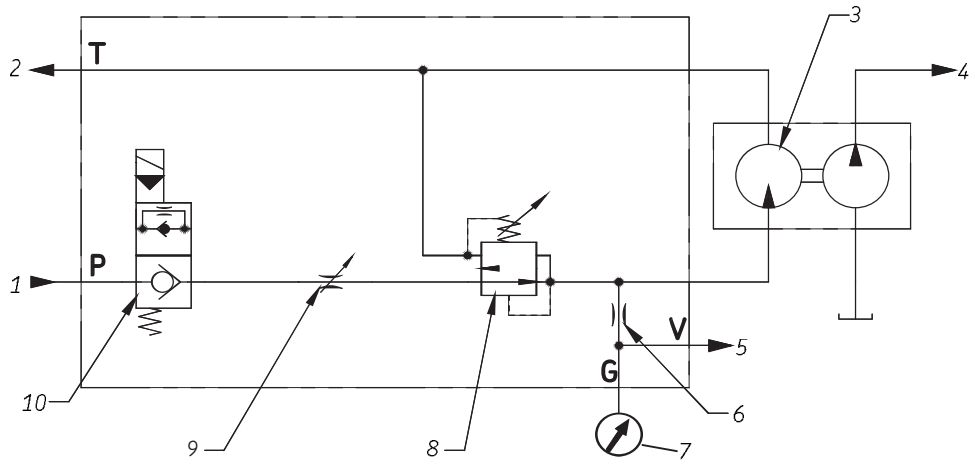
	Flanges	Hygiene connection	Hygiene connection	Hygiene connection
				
	(EN1092-1) (ANSI B 16.5) (JIS B2220)	Thread with flush-mounted seal	Thread with flush-mounted seal	Adapter 44 mm with flush-mounted seal
Rod probes Ø10, rope probes				
For pressures up to	Max. 25 bar (depends on flange)	25 bar	25 bar	–
Version / order code	EN / B## ANSI / A## JIS / K##	G¾ / GQJ	G1 / GWJ	–
Dimensions	H3 = 57	H3 = 31 H4 = 26 AF = 41	H3 = 30 H4 = 27 AF = 41	–
Additional information	Also clad (PTFE)	Weld-in adapter see "Accessories" Page 33 EHEDG*, 3A*	Weld-in adapter see "Accessories" Page 33 EHEDG*, 3A*	–
Rod probes Ø16, rope probes				
For pressures up to	Max. 100 bar (depends on flange)	–	–	16 bar (tightening torque 10 Nm)
Version / order code	EN / B## ANSI / A## JIS / K##	–	–	Universal adapter / UPJ
Standard dimensions: Dimensions with inactive length:	H3 = 66 H3 = 56	– –	– –	H3 = 57 –
Additional information	Also clad (PTFE)	–	–	Universal adapter see "Accessories"→ ≡ 34
Rod probes Ø22, rope probes				
For pressures up to	Max. 50 bar (depends on flange)	–	–	–
Version / order code	EN / B## ANSI / A## JIS / K##	–	–	–
Dimensions	H3 = 111	–	–	–
Additional information	Only clad (PTFE)	–	–	–

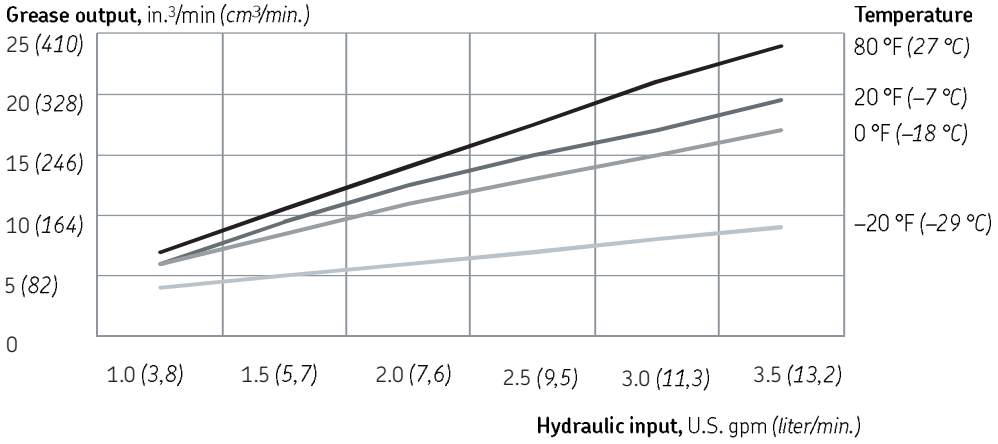
Fig. 1



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



Americas:
One Lincoln Way
St. Louis, MO 63120-1578
USA
Phone +1.314.679.4200
Fax +1.800.424.5359

Europe/Africa:
Heinrich-Hertz-Str 2-8
D-69183 Walldorf
Germany
Phone +49.6227.33.0
Fax +49.6227.33.259

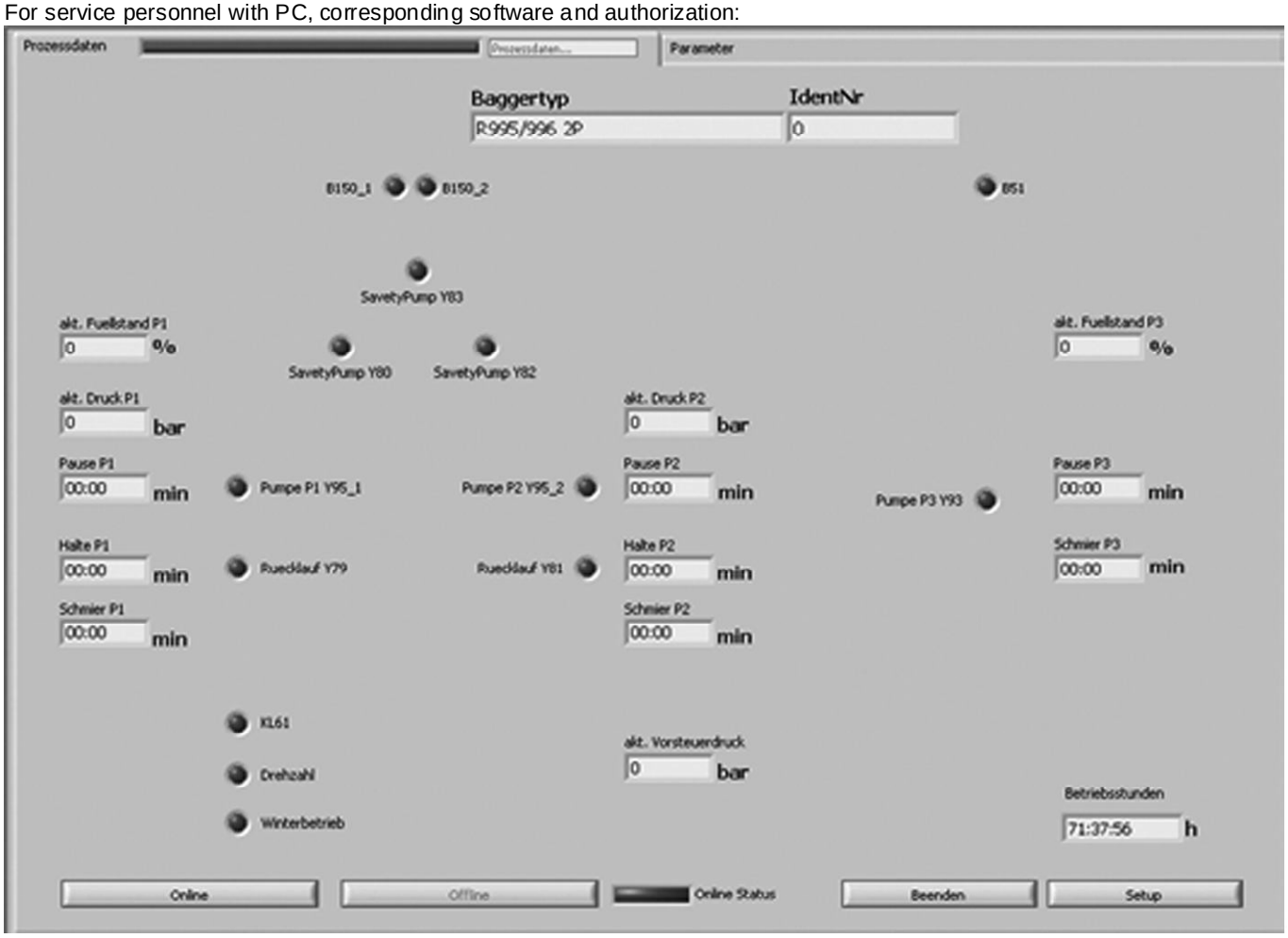
Asia/Pacific:
No. 3 Tampines Central 1
#04-05, Abacus Plaza.
Singapore 529540
Tel +65.6588.0188
Fax +65.6588.3438

Web site:
www.lincolnindustrial.com

Description, continuation

Process data tab sheet: status display

For service personnel with PC, corresponding software and authorization:

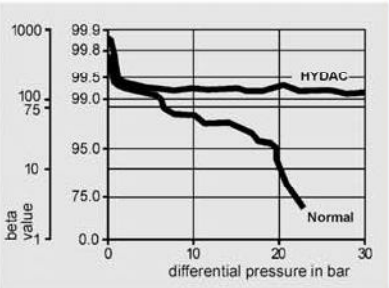


B-LFR-020c11

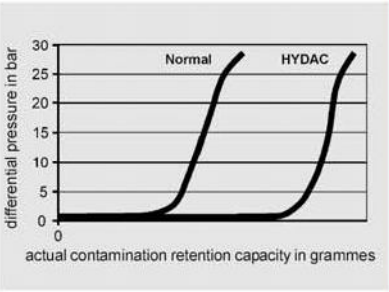
B. Filter Element (Model 0240 D 200 T /-03088803)

Technical details:

- Absolute filtration $\beta_x \geq 200$ from 3-20 micron
- Stable β_x-values across a wide range of differential pressures



- High differential pressure stability up to 210 bar



- High contamination retention capacity
- Disposable elements and cleanable elements
- Filtration of mineral oils, non-flam fluids and rapidly biodegradable fluids

1. …D… ../.. elements - suitable for use with the following filter types: DF, LF, MDF, DFDK, DFF, DFG, DF…P, DF…Z, DF…MA, DF...QE, filter module

General

The ISOPAD electronic temperature controller Series ICon-TSW3 can be used for either air or surface sensing temperature control.
It is suited for both 'frost protection' and 'product temperature maintenance' within a range of +5°C to +120°C (+41°F to +248°F).
The range of temperature control depends upon the type of Pt100 sensor used (please refer to ‘Technical Data').

The two switching contacts can be connected in a number of ways so that the following options are available:

- Control within temperature range
- Control with low-temperature indication
- 2-stage control

Due to the high breaking capacity (ca. 3700 VA) of the device, the heating can be switched directly. Direct connection of the heating unit into the device is also possible. The temperature controller is located within an IP65 (only with closed lid) PC-polycarbonate enclosure.

Attention:
In case of direct entering of heating cable or any other device ensure that the maximum temperature of 70°C (158°F) inside the box is never exceeded! In doubt, take cold lead-in sleeves into consideration!

Additional Safety Instructions

Opening the device

Always isolate from the electricity supply before removing the temperature controller's lid!

Earthing

The temperature controller must be earthed via the earth terminal provided. Supply cables without a protective earth conductor must not be connected.

Supply voltage

Prior to connecting the temperature controller, ensure that the mains voltage matches that of the controller (refer to specification plate).

Location

This device is not designed for operation inside hazardous areas! Use only in combination with a residual current circuit breaker (ELCB or RCD, 30mA)!

Malfunction and Excessive Strain

If it has been assumed that safe operation is no longer possible, the installation must be permanently shut down and secured against being inadvertently put back into operation.

This is the case, if…

- the device shows visible signs of damages
- the device is not operating according to specification
- the device is not operating (no visible indication of reason).
- after excessive strain of any kind, the admissible limits are exceeded (e.g. storage, transportation, operating temperature).

A1008_5	Plate relay **E1003**
B92	Temperature switch for **M10**
B100	Proximity switch / trap door up
B101	Proximity switch / trap door locked
E57	Trap door lighting
E1003	Power connection box
E1022_1	Connection box principal ladder control
E1022_2	Connection box trap door control
E1037	Connection box solenoid valve ladder / trap door
E1043	Connection box grease full message
F139	100A fuse / **M10** supply
F143	25A fuse / lighting
F144	15A fuse / ladder/trap door
F164	7,5A fuse / **E1003**
G6	Service battery
G7	Service battery
H69	Indicator / Trap door not locked
H70	Indicator / Trap door not up
K110	Relay for **M10**
K137	Relay ladder
KT9	Relay timer lighting
M10	Hydraulic motor ladder up/down
S122	Switch control without safety ladder and trap door
S127	Switch timer top of cabin lighting
S159	Switch trap door up
S160	Switch trap door locking
S161	Switch trap door unlocking
S162	Switch trap door down
V57	Diode bridge
X113	Connector 24 poles / **E1003** Ground
X116	Connector 70 poles / **E1003**
X118	Connector 40 poles / **E1003**
X120	Connector 9 poles / Elevation
X128	Connector 70 poles / Elevation -ladder
X134	Terminal block **E1003**
X638	Connector 4 poles / **B101**
X643	Connector 4 poles / **B100**
X645	Connector 2 poles / **B92**
X645_1	Connector 2 poles / **B92**
X649	Connector 24 poles / **E1022_2**
X650	Connector 24 poles / **E1037**
X651	Connector 2 poles / **Y68**
X652	Connector 2 poles / **Y69**
X653	Connector 2 poles / **Y70**
X654	Connector 2 poles / **Y71**
X663	Connector 40 poles / solenoid valve ladder-trap door
X668	Connector 40 poles / solenoid valve trap door up-down
X669	Connector 40 poles / solenoid valve trap door lock-unlock
X670	Connector 2 poles / **E57** trap door
X671	Connector 1 pole / **M10**
X680	Connector 40 poles / ladder
X310	Kl31 principal ground **E1003**
Y68	SV trap door up
Y69	SV trap door locking
Y71	SV trap door down

CLVL - CLVR Cylinder leak valves		
Pressure	bar	35
CTTL - CTTR Tensioning cylinder		
Diameter	mm	300
Total displacement	mm	550

1.2 Two-cylinders system

ACL - ACR Hydro accumulator		
Pressure range	bar	110 - 220
Volume	l	13
LVTL - LVTR Track tensioning limiting valves		
Pressure	bar	220
PRVL - PRVR Pressure regulator valves		
Pressure	bar	110
CTTL - CTTR Tensioning cylinder		
Diameter	mm	320
Total displacement	mm	155
GCL - GCR Grease cylinder		
Diameter	mm	240
Total displacement	mm	330

A1008_2	Plate relay **E1003**
A1008_5	Plate relay **E1003**
E1003	Power connection box
F12_1	25A fuse / attachment floodlight
F12_2	25A fuse / attachment floodlight
F12_3	35A fuse / fuel tank floodlight
F12_4	35A fuse / hydraulic tank floodlight
F12_5	25A fuse / counterweight floodlight
F12_6	25A fuse / counterweight floodlight
F20_1	100A fuse / supply cabin KI15
F20_2	100A fuse / supply **E1005** KI15
F20_3	100A fuse / charging current
F20_4	100A fuse / KI30 floodlight
F20_5	100A fuse / KI30 counterweight floodlight
F20_6	100A fuse
F37	25A fuse
F119	8A fuse / **S1**/KI30
F120	50A fuse / air conditioning
F121	50A fuse / air conditioning
F122	15A fuse / optional windshield wiper
F123	50A fuse / supply **A1020**
F137	8A fuse / reserve
F138	100A fuse / service circuit supply
F139	100A fuse / **M10**supply
F140	15A fuse / board
F141	15A fuse / **E14**
F142	15A fuse / lighting
F143	25A fuse / lighting
F144	15A fuse / ladder trap door
F145	15A fuse / access lighting
F152	25A fuse / reserve
F164	7,5A fuse / **E1003**
F166	25A fuse / foot heating option
F167	25A fuse / **E1003** lighting
F169	15A fuse / charging
F170	25A fuse / reserve
F172	25A fuse / reserve
K11	Relay current charging
K16_1	Start relay **E1003** reserve
K16_2	Start relay **E1003** reserve
K19_1	Relay KI15
K19_2	Relay KI15
K19_3	Relay KI15
K19_4	Relay KI15
K20_1	Relay attachment floodlight
K20_2	Relay attachment floodlight
K20_3	Relay fuel tank floodlight
K20_4	Relay hydraulic tank floodlight
K20_5	Relay counterweight floodlight
K20_6	Relay counterweight floodlight
K20_7	Relay reserve
K110	Relay for **M10**
K113	Relay lighting
K133	Relay lighting
K137	Relay ladder
K141_1	Relay reserve
K141_2	Relay reserve
K141_3	Relay reserve
K184	Relay KI15
K190	Relay pump water reserve
K409	Relay
KT9	Relay timer lightening
V57	Diode bridge

- Functional description

- **Supply station connection**

Connect the excavator to the supply station via the connecting box. If breaker **Q1a** is closed, the 6kV voltage supplies the 65kVA transformer **T5M**. The transformer delivers 400 or 230V and supplies the relays **Q1b**, **Q2** and **Q3**, the transformer **T6M** and the preheating devices (if the arctic kit option is installed). **T6M** delivers 24V for **S1** (lighting, air overpressure).

- **Start**

When turning the key in contact position, it is necessary that the emergency stops are not switched in order to have the current KI15.

Push button «Control ON 6kV» **S183**. The indicator light **H113** comes on. If no failure is found before relay **K27** (**F50**, **K5**, **S50Q**, **S51Q**, **S52Q** and **F59** supervision devices), the current can go through **K27** and supplies the main circuit breaker **Q2A**. Then, **Q2A** closes the circuit and allows the current coming from the supply station to supply the transformer **T2**. The transformer delivers 400 or 230V and supplies the low voltage electrical box **S2**.

Push button «Control ON 400V» **S207**. The indicator light **H120** comes on. The 400V breaker **Q1M** is supplied and allows the current coming from electrical box **S1** to supply the transformer **T12** and the batteries charging system **BC**, which is located in the elevation.

Push button «Control Motor ON» **S181**. The indicator light **H112** comes on. If no failure is found before relay **K29** (**B142**, **K31**, **K14**, **F0A**, **F52** and **Q1c** supervision devices), the current can supply the relay **K29**. Then, **K29** supplies and closes **Q18**, which allows the compressor **M2M** to be supplied by **Q1c**. Relay **K29** also allows to do movements with the joysticks 8 seconds after the safety lever **S7** has been pushed down. Finally, relay **K29** closes the relays **Q1b**, **Q2** and **Q3** in **S1**, which allows the starter transformer **T1** to start the electric motor.

Caution
In order to prevent the motor from overheating, the motor starts within a given lapse of time are limited and you must wait enough time before starting the motor again. Refer to Operating Manual.

- **When the motor is running**

Please note that if any failure is found before relay **K27** or **K29**, the motor will be shut down automatically.

- **Stop**

Push button «Control Motor OFF» **S182**. The indicator light **H112** comes off.

4.2 The sensors

4.2.1 The motor

There are 6 temperature sensors on the windings' phases. They are connected to 2 alarms:

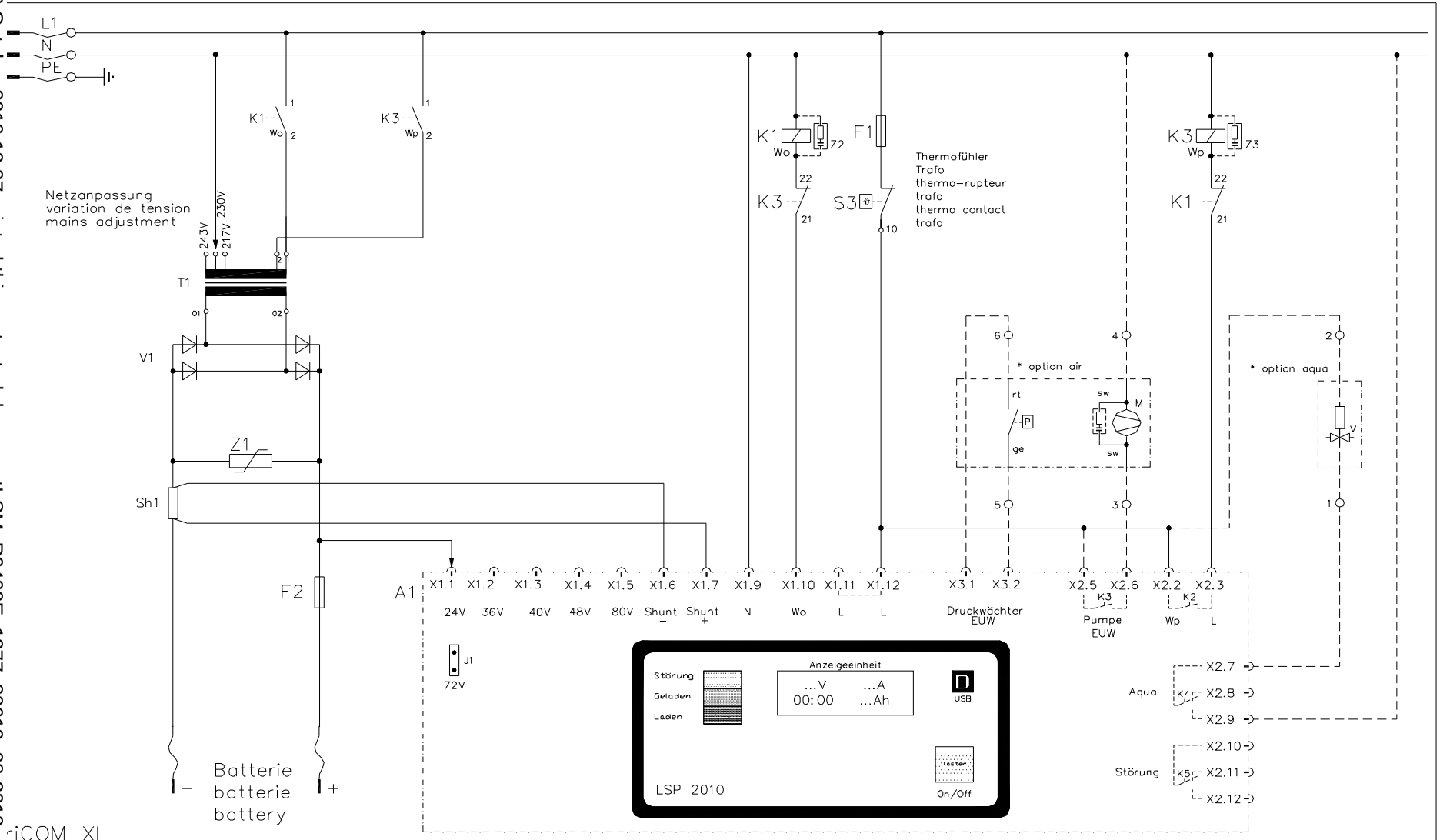
– **B4N**: winding's temperature higher than 130°C,
– **B1N**: winding's temperature higher than 150°C.

There are 4 temperature sensors on the bearings. They are connected to 2 alarms:

– **B3N**: bearing's temperature higher than 80°C,
– **B2N**: bearing's temperature higher than 100°C.

The electric motor is connected to a system monitoring device (Allen Bradley). This system analyses the data provided by the sensors mounted on the motor and is a motor protector. All the troubles appearing on the motor are centrally indicated on the control board or the display. The Allen Bradley controls:

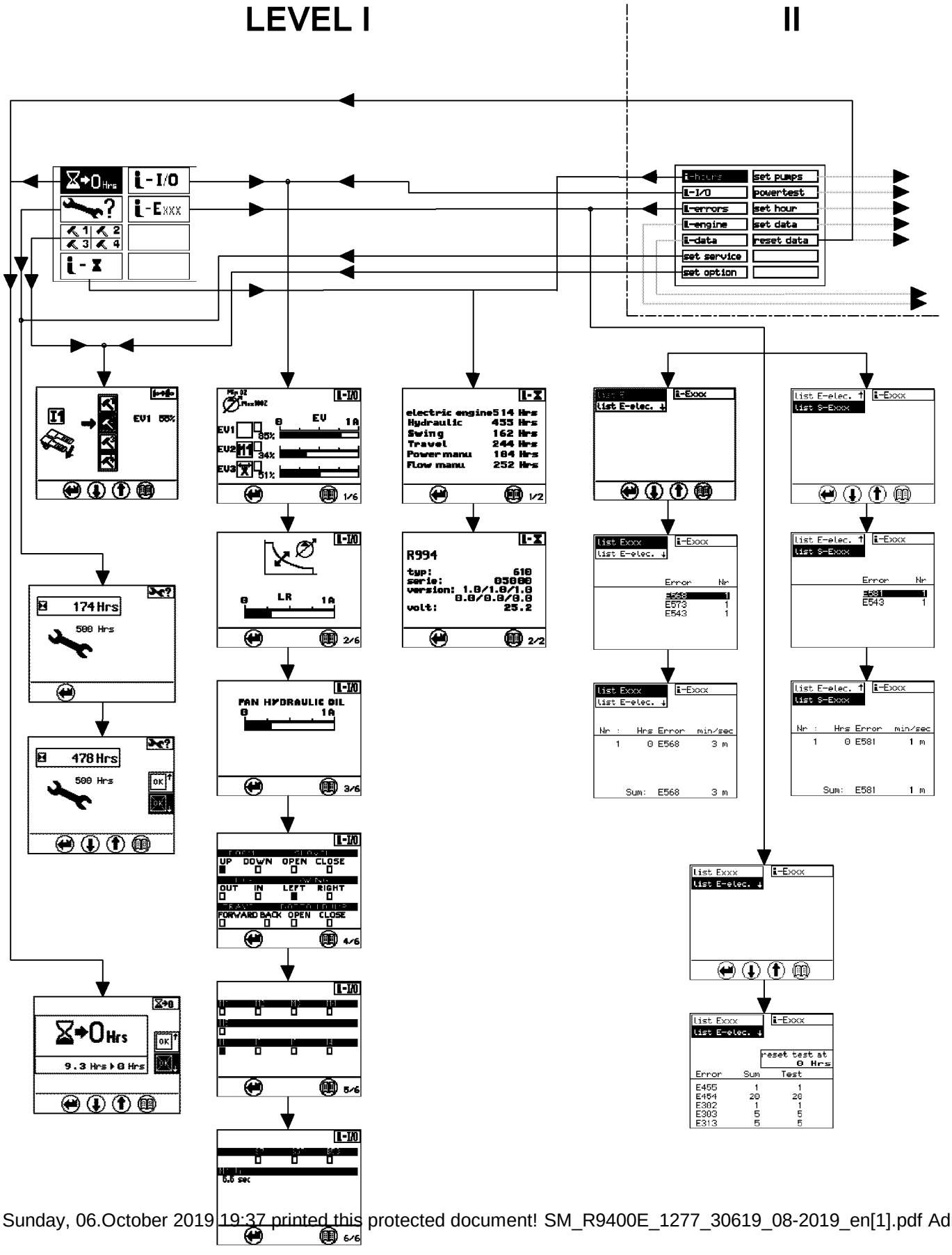
– Overload set
– Ground fault
– High over current



iCOM XL

			Datum	22.07.10	E 230 G .../... WoWp		LSP 2010	Z.-Nr.: pulse E USB	SBFZ/LSP2007
			Bearb	Bockstah.					
			Gepr.					A.Nr.:	BLATT
nderung	Datum	Name	Norm		Urspr	Ers.f.	Ers.d.		FOLGE

Access levels architecture



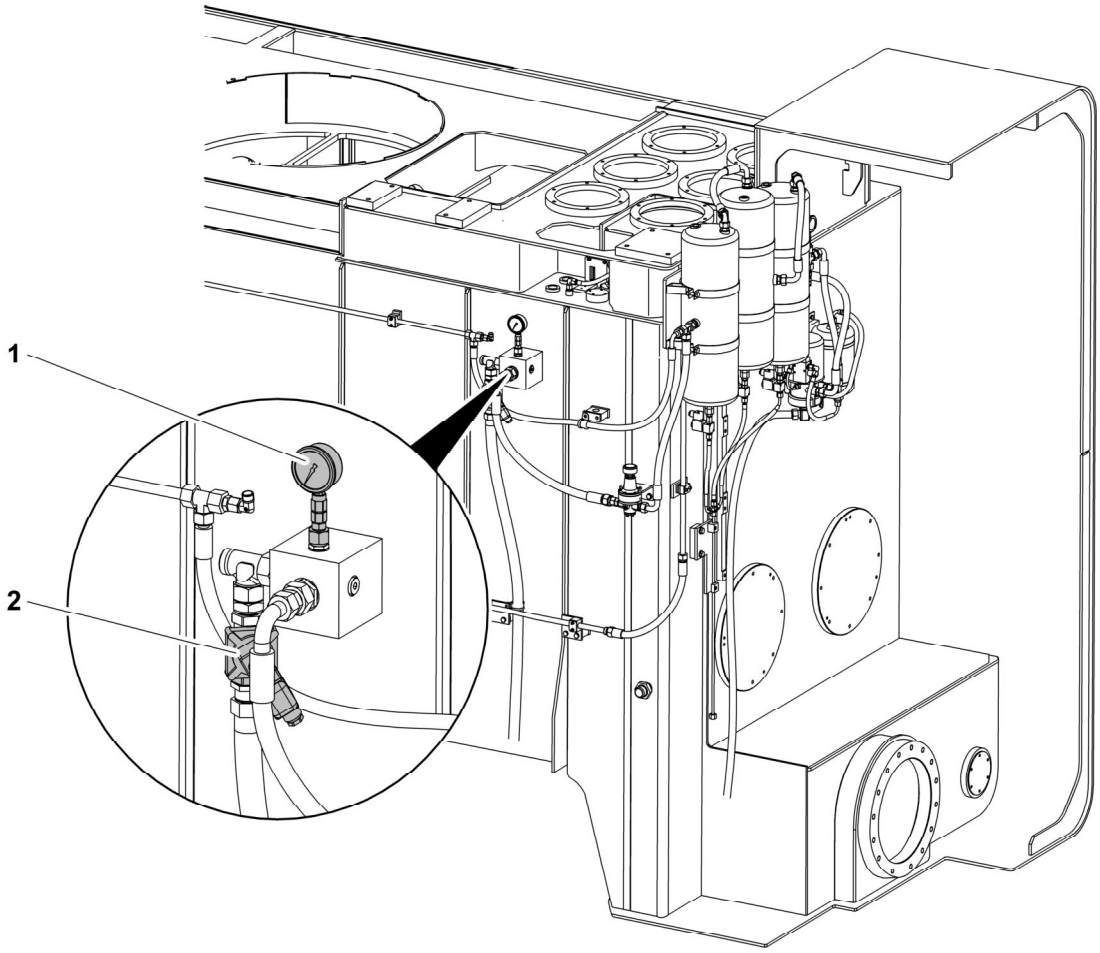


Fig. 5 *Hydraulic tank*

1 Pressure gauge

2 Quick air outlet magnet valve **Y13**

6. Compressor maintenance programme

BEFORE STARTING A MAINTENANCE OPERATION,

CHECK THAT THE POWER SOURCE IS CUT OFF AND THAT THE COMPRESSOR CANNOT BE STARTED UP.

PUT ALL COVERS BACK IN PLACE BEFORE STARTING UP THE INSTALLATION

THE FREQUENCIES BELOW CAN BE INCREASED IN THE CASE OF ANY USE IN A POLLUTED ENVIRONMENT

6.1. Preventive maintenance programme

This programme has a summary of the maintenance instructions. Read the chapter concerned before undertaking any work. When doing maintenance, replace all the seals, O-rings, washers etc. that are removed.

"Long-interval" services should also include "short-interval" services.

Machine running hours	Operations
250	☑ Check suction filter clogging indicator ☑ Check oil level ☑ Check air filter, clean or change cartridge if necessary
1 000	☑ Replace suction filter cartridge ☑ Change compressor oil. ☑ Check compressor ROTEX® coupling
4 000	☑ Replace seals and valves
20 000	☑ Replace safety valve ☑ Replace non-return valve

Use only authorised parts! Any damage or defective functioning resulting from the use of non-authorised parts is not covered by the Guarantee or any commitment concerning the responsibility of the product.

Depending on the environmental conditions and compressor service.

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.**

STIEBEL®
DIE TREIBENDE KRAFT

Inhalt

Contents

Sommaire

Fundamental notes

Observe the maintenance instructions

These maintenance instructions include important information regarding safe, correct and economical operation of the drive components. Your consideration helps to prevent dangers and damage, repair costs and down times and will increase the reliability and life-expectancy of the drive components. Please note also the notes on the enclosed **sectional drawing** and **installation drawing**.

The maintenance instruction does not replace data, details and technical interrelationships, shown on the sectional drawing and installation drawing. It is mainly used to assist in the maintenance of the component.

The maintenance instructions for the drive components must be on-hand at all times and must be read and applied by all persons contracted with maintenance tasks.

Note also the regulations and guidelines regarding accident-prevention and environmental-protection applicable for the building site.

Should you receive further information from us regarding the drive components, e. g. in the form of technical information letters, these notes must also be observed and supplemented to the operating instructions.

Designation of safety advices

	This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

The safety alert symbol appears always together with one of the following signal words

DANGER
WARNING
CAUTION

	**DANGER**	indicates a hazardous situation which, if not avoided, will result in death or serious injury.
	**WARNING**	indicates a hazardous situation which, if not avoided, could result in death or serious injury.
	**CAUTION**	indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
	NOTICE	indicates a hazardous situation which, if not avoided, could result in property damages.

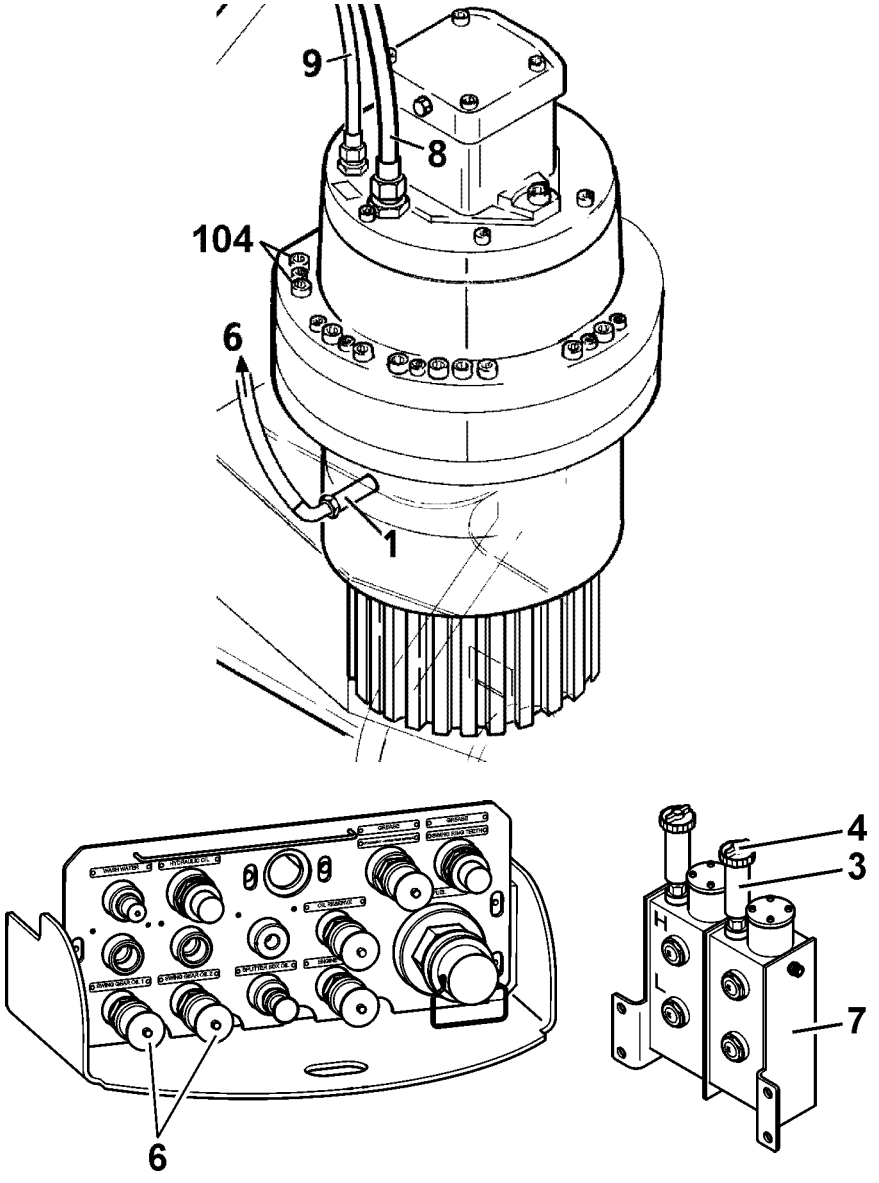
Other designations

3.3 Installation / removal of the swing gear

Caution!
After installation and prior to re-use of the excavator, always start a new lubrication cycle for the swing ring via the lubrication control unit so as to fill the bell around the output pinion of the swing gear with grease.

- ▶ For installation and removal instructions concerning the swing gear, refer also to Safe Work Procedure «Swing drive box exchange» in chapter 2 of this service manual.
- ▶ For first installation or repair requiring opening of the swing gear, refer to LIEBHERR «Repair instructions - SAT 450 / 207» manual.

3.3.1 Installation of swing gear



- ▶ Coat the lower part of the gear in the area of centering in the lower uppercarriage sheet with anticorrosive grease (preferably use «Optimol White T», ident no. 8500307).
- ▶ Lift the gear into the uppercarriage (watch that it is positioned correctly because of oil drain plug).
- ▶ Install screws **104** and torque to prescribed value.

6.2.5 Driver's cab

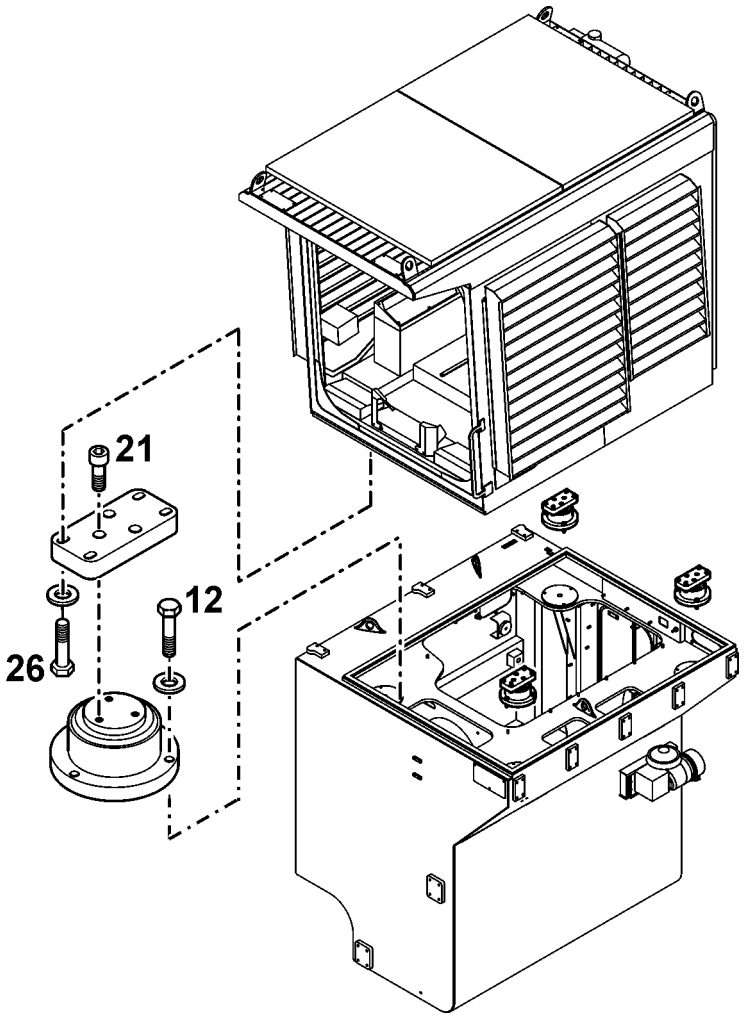


Fig. 17 *Driver's cab mounting screws*

		Torque	Quantity
12	Hexagonal head screw M16x70	270 Nm	12
21	Socket head screw M16x45	270 Nm	12
26	Hexagonal head screw M16x70	270 Nm	16

6.2.6 Counterweight

Danger!
The counterweight is mounted on the hydraulic excavator at the end, only when the rest of the upercarriage has been installed.

2	Bushing	**8**	O-ring	
3	Slider	**9**	Screw	
4	Shaft	**10**	Cross member wheel guiding	
5	Idler wheel	**12**	Washer	
6	Lifetime seal	**13**	Hex. head screw M36x200	3340Nm
7	Dowel pin			

2.4.2 Functional description

The idler is the second principal point of rolling of the track. It is also the intermediate part between the track and the tension unit.

The idler is blocked thanks to the dowel pin **7** and the hexagon bolt **13**. The tightening torque of the bolt is 3340 Nm. It must be checked regularly (refer to Operating Manual).

2.4.3 Lubricant

▶ For lubricant specifications, refer to the Operating manual.

2.5 Sprocket

2.5.1 Component location

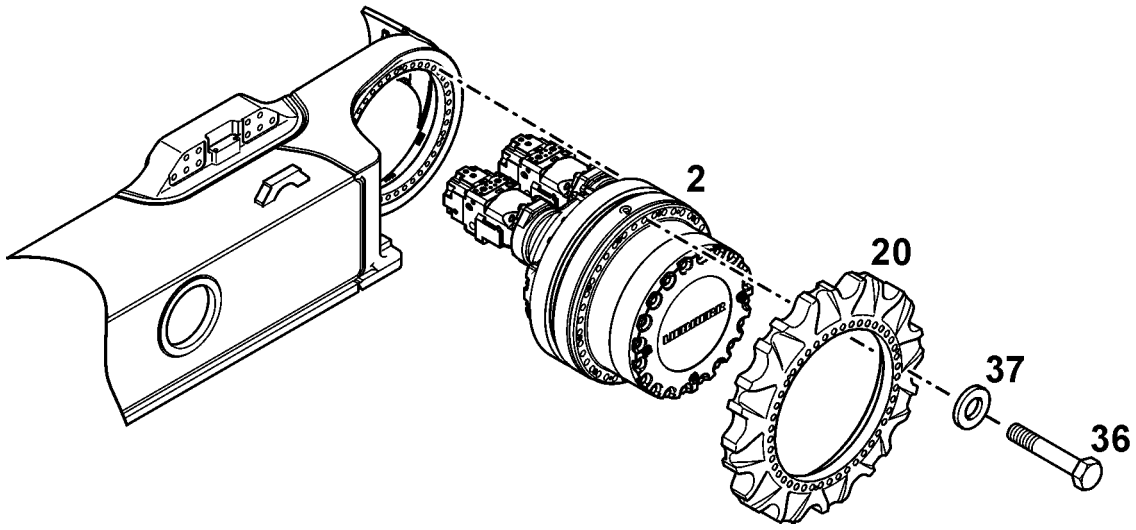


Fig. 12 *Sprocket assembly*

2	Travel gear	**36**	Hex. head screw M36x240	3340Nm
20	Sprocket wheel	**37**	Washer	

2.5.2 Functional description

The sprockets mesh with the track chains, and allow the excavator to translate.

The sprocket (pos. **20**) is fixed on the travel gear (pos. **2**) thanks to the 40 screws M36 (pos. **36**).

The tightening torque of the screw **36** is 3340 Nm. It must be checked regularly (refer to Operating Manual).

Remove the complete track-chain

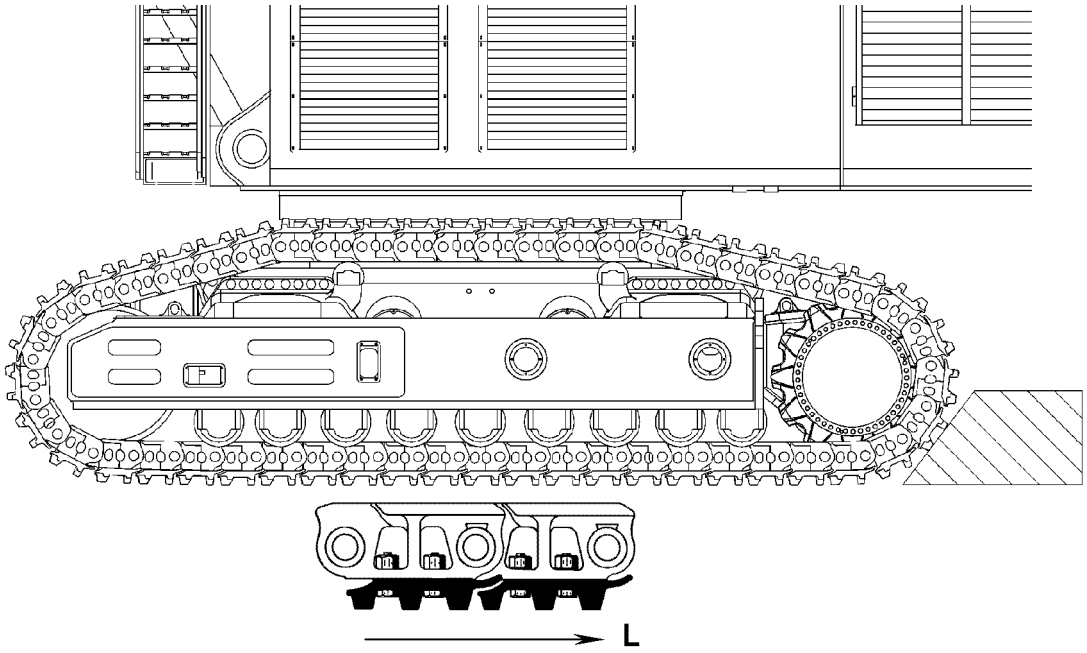


Fig. 38 *Wedge*

- ▶ Park the machine on a flat and solid ground. Insert a wedge.
- ▶ Disconnect and plug the hydraulic hose between cylinder shut-off valve **CVT** and track tensioning cylinder **CTT**.
- ▶ Turn the track tension tap **VTT** off (see “Track tensioning valves” on page 41), move the lever **VTL** or **VTR** to release the track tension pressure on the side you are working on.
- ▶ Use the track press (see § Tooling) to remove the pin located over the sprocket.
- ▶ Choose the track screws **6** where the track is damaged or is worn, and use Hy-torque to remove the screws and take the pins **4** out.

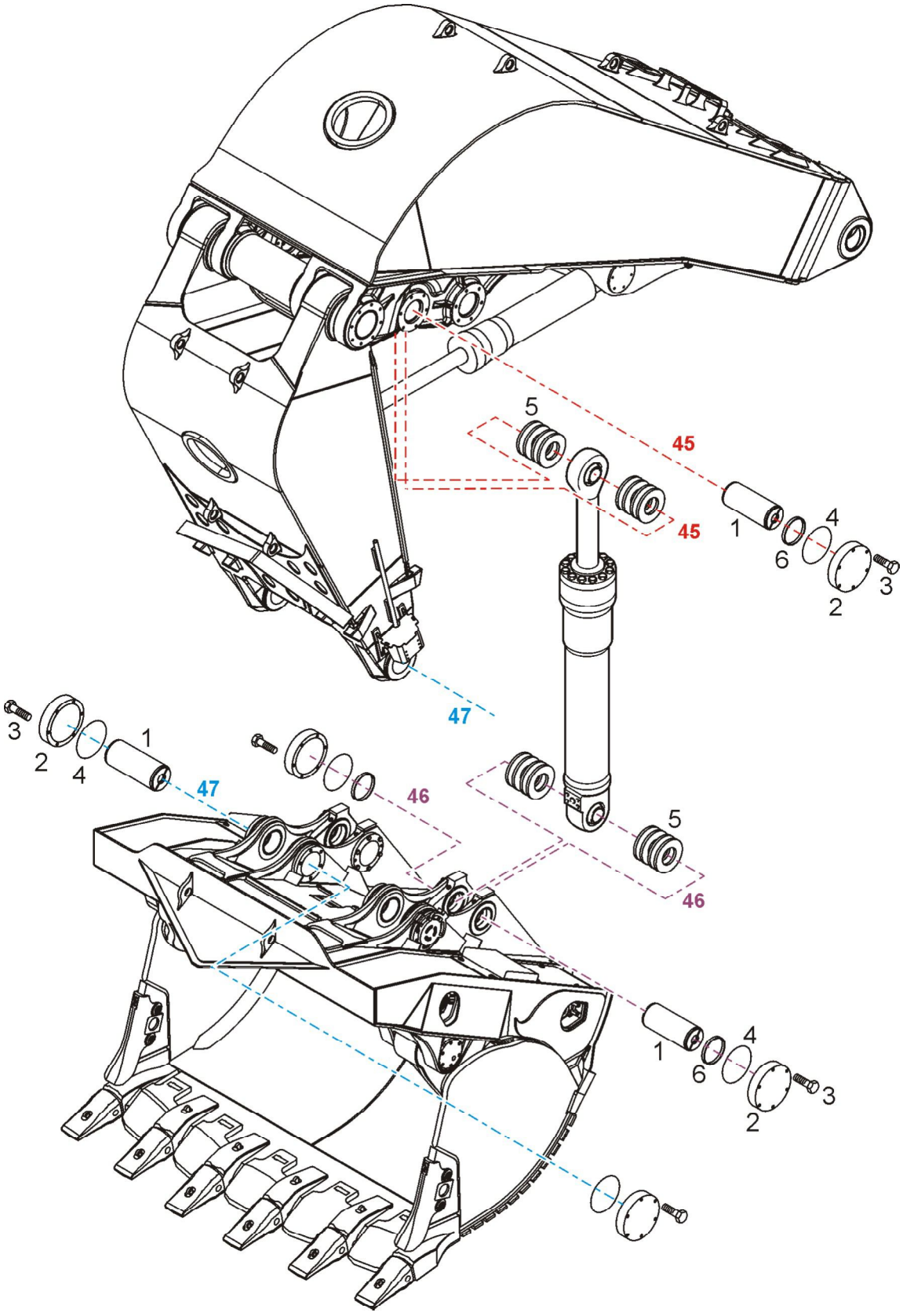
Danger!
The track could roll away quickly.

- ▶ To split the track-chain, start the machine. Move the excavator slowly to roll the track-chain out.
- ▶ Lift the side of the machine and using a tractor, pull the track-chain out.
- ▶ Install supports under the machine, lower machine onto supports.

Install the complete track-chain

- ▶ The pressure in the tensioning cylinder must be released.
- ▶ Start the electric motor and lift the machine.
- ▶ Drag the track-chain under the excavator.
- ▶ Lower the excavator on track-chains and position correctly.
- ▶ By lifting its first extremity with an appropriate equipment, wind the track-chain round the idler and make it lie on the carrier rollers.
- ▶ By lifting its second extremity with an appropriate equipment, wind the track-chain round the sprocket. Make sure that the chain is mounted in the correct travel direction and that the track

1.3.3 Shovel bucket assembly



1.3.4 Installation

► Park the machine on level flat ground, and check if the excavator is in a blast area.

2.3 Demontage

Zuerst den Zahn wie im Kapitel 1.3 entfernen, um die Kappe frei zu machen.

Die Kappe entfernen.

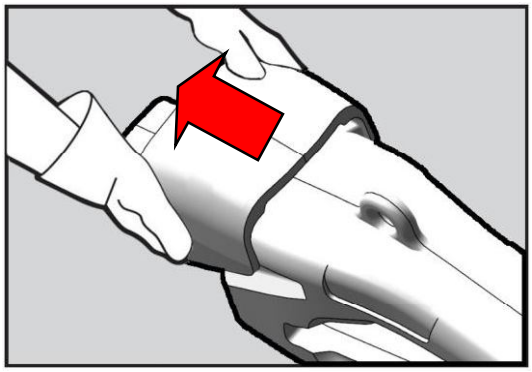
2.3 Disassembly

First remove the tooth following the chapter 1.3 to free the wear cap.

Remove wear cap.

2.3 Démontage

Dans un premier temps, démonter la dent comme décrit dans le chapitre 1.3, pour libérer le chapeau de protection.
Retirer le chapeau de protection.



3. Schneidenschild

3.1 Voraussetzungen

Für die Montage und Demontage eines Schneidenschildes wird ein Ausziehwerkzeug benötigt. Es sollte geeignete Schutzkleidung getragen werden: Helm, Sicherheitsschuhe, Handschuhe und Schutzbrille.
Zur leichteren Montage und Demontage des Schneidenschildes sollte der Tieflöffel so eingestellt werden, dass die Zähne nach oben zeigen.
Die Anschweißplatte (1) reinigen, um die erneute Montage zu erleichtern.

3. Lip Shroud

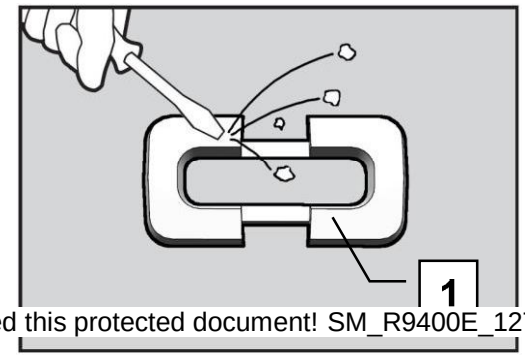
3.1 Prerequisites

For the assembly and disassembly of a lip shroud an extraction tool is required. The use of protective clothing is recommended: helmet, safety shoes, gloves and goggles.
In order to facilitate the assembly and disassembly of the lip shroud, it is recommended to place the bucket so that teeth are facing slightly upwards.
Clean the whole weld base (1) to allow the subsequent assembly of the lip shroud.

3. Bouclier de lame

3.1 Prérequis

Pour le montage et le démontage d'un bouclier de lame, un outil d'extraction est nécessaire. L'utilisation de vêtement de protection est recommandée : casque, chaussures de sécurité, gants et lunettes.
Afin de faciliter le montage et le démontage du bouclier de lame, il est recommandé de placer le godet de manière à ce que les dents soient dirigées vers le haut.
Nettoyer la base soudée (1) afin de faciliter le nouveau montage.



2.2 Heating water circuit scheme

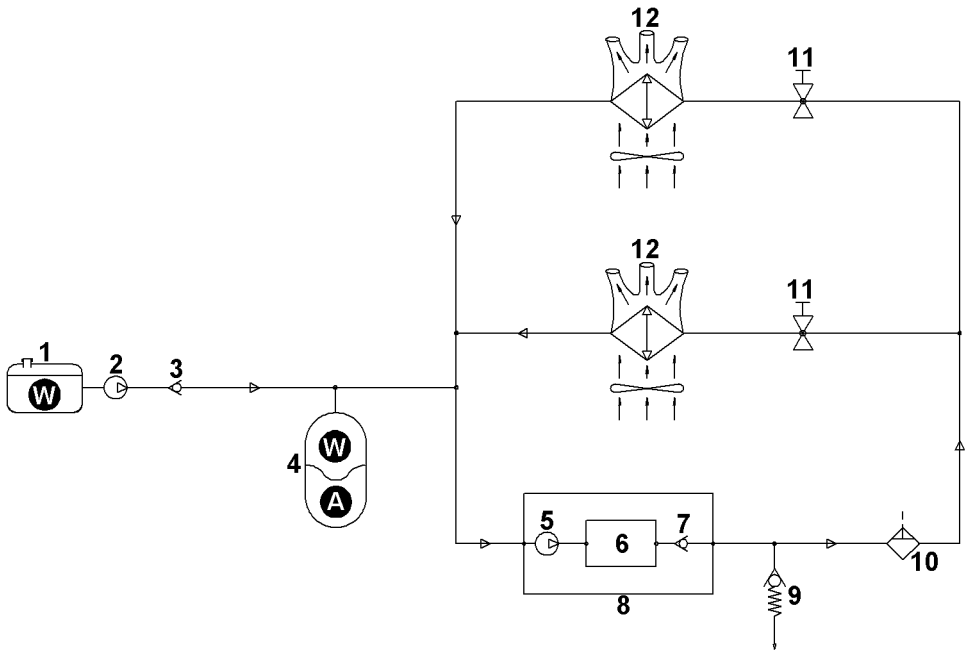


Fig. 2 *Heating scheme*

A Air

W Water

In the cabin elevation

1 Container for heater coolant mixture
2 Filling pump
3 Non return valve
4 Diaphragm pressure expansion vessel
5 Pump
6 Heating resistor
7 Non return valve
8 Heating device
9 Non return valve
10 Automatic air outlet valve

In the cabin

11 Air drainer
12 Radiator / water exchanger

5. Technical Data

24 Volt DC Version
KONVEKTA Item-no.: H11-004-495

Operating voltage	**Ambient temperature area**	**Storage temperature area**
Ubmin.: 18 V/DC Ubmax.: 32 V/DC	Min.: -40°C Max.: +85°C	Min.: -40°C Max.: +105°C
Display	**Range**	**Set value adjustment**
customised LCD-Display	Min.: -30°C / -22°F Max.: +85°C / +185°F	15°C *up to* +35°C 59°F *up to* 95°F
Linear error	**Temperature sensor**	**Operating settings**
max.: +/- 1° *at* -25°C max.: +/- 1° *at* -13°F *as well as* max.: +/- 1° at +25°C max.: +/- 1° *at* +77°F	S863/10K Tol. +/- 1 % 97 K at -20°C 55 K at -10°C 32 K at 0°C 19 K at +10°C 12 K at +20°C 10 K at +25°C	Over membrane keypad in control panel. Resolution set value adjustment 1K
Output magnetic clutch	**Output heating valve**	**PWM1 EBM-heating blower**
Imax.: 3A/24 Volt DC	Imax.: 3A/24V DC	0V - 24V DC f= 4,0 kHz +/- 10 %
PWM2- EBM evap. blower	**Output U/F – flap (-)**	**Output K/F – flap (+)**
0V - 24V DC f= 4,0 kHz +/- 10 %	Imax.: 0,6A/24 Volt DC	Imax.: 0,6A/24 Volt DC
Input clamp 15:	**Input D+ release:**	**Input fault HP/LP**
24V DC Imax.: 8A	24V DC Imax.: 100 mA	24V DC Imax.: 100 mA
Input (n.c)	**analogue input air temperature sensor (foot area):**	**analogue input exhaust air temperature sensor**
	0V - 5V DC Ityp.: 16 mA	0V - 5V DC Ityp.: 16 mA
analogue input exhaust air temperature sensor (head area):	**analogue input outside temperature sensor:**	***n.c***
0V - 5V DC Ityp.: 16 mA	0V - 5V DC Ityp.: 16 mA	

25. General Instructions for Repair and Maintenance

1. Before mounting, all O-rings and tube fittings as well as hose fittings have to be lubricated with compressor oil (Ester oil or PAG oil).

2. Please use new O-rings for each mounting.

3. For tube and hose connection please always use 2 spanners, so that tube ends will not be damaged.

4. Fittings have to be tightened only according to the tightening torque moment.

5. As the compressor oils are very hygroscopic, keep the oils only in closed oil cans.

6. Remove protecting caps only directly before mounting.

7. Check the connections of the tubes, fittings or components carefully, if they are damaged, do not use them.

8. After tightening of all connections; the drier, as the last construction part, has to be installed in the refrigerant circuit.

9. Never keep the refrigeration circuit open to the atmosphere longer than necessary.

10. Never try to repair bent or burst tubes.

11. When replacing a heat exchanger (condenser or evaporator), the oil which has fallen away by exchanging, the components has to be added again. Too much oil affects refrigeration capacity and less oil affects the working life of the compressor.

12. If an A/C unit is opened, the drier should in any case always be exchanged.

13. Only open compressor valves if the density of the system is established.

14. work at refrigeration circuits should only be done with unobjectionable tools inorder to avoid destruction of connections.

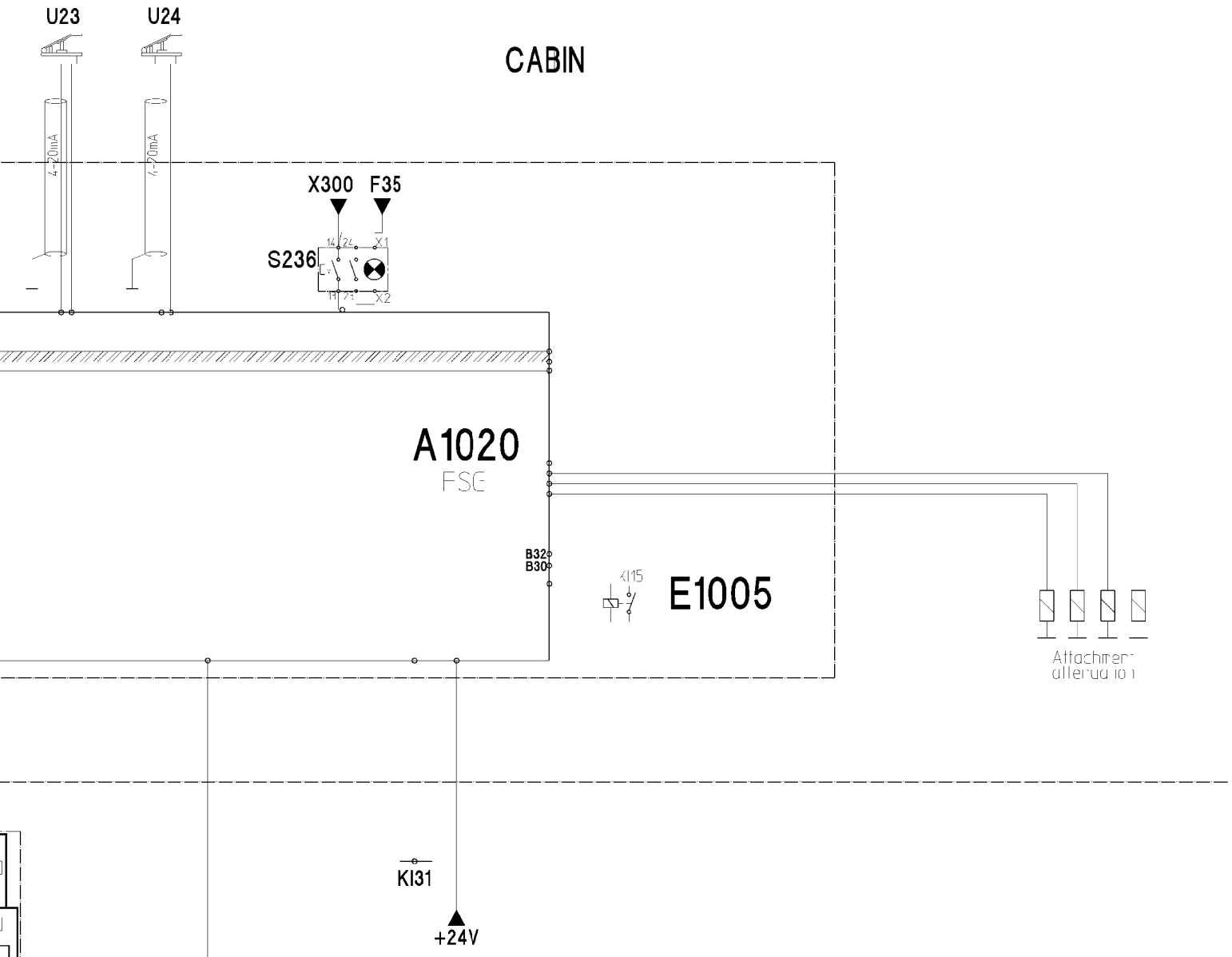
STEP	LABEL	DESCRIPTION
65,67	X461	Connector 12 poles / U21
61,63	X462	Connector 12 poles / U22
68	X463	Connector 8 poles / U23
69	X464	Connector 8 poles / U24
16,17,20,34,35 36,38,39,40,41 42,46,55,66,69 88,90,92,11A,85A	X500	Terminal block E1005
38,41,43,59,71 71A	X501	Terminal block attenuation
46	X514_1	Connector 3 poles / CAN
46	X514_2	Connector 3 poles / CAN
46	X514_3	Connector 3 poles / CAN
70	X517_1	Connector 3 poles / CAN 1
70	X517_2	Connector 3 poles / CAN 1
70	X517_3	Connector 3 poles / CAN 1
35,43,56,57,59 88	X528	Connector 70 poles / Board
36,58,11A	X528_2	Connector 24 poles/Board
56	X529	Terminal block 24V T1
56	X530	Terminal block 12V T1
55	X533	Connector 2 poles / E31
20	X534	Connector 2 poles / E21
17	X535_1	Connector 2 poles / E58_1
17	X535_2	Connector 2 poles / E58_2
17	X535_3	Connector 2 poles / E58_3
17	X535_4	Connector 2 poles / E58_4
19	X536	Connector 2 poles / E59
35	X538	Connector 2 poles / E8
39	X550	Connector 2 poles / M3
39	X552	Connector 4 poles / M5
38	X553	Connector 2 poles / M20
38	X556	Connector 2 poles / M7
38	X557	Connector 2 poles / R20
41	X560	Connector 6 poles / Diagnostic E1005 QUANTUM
41	X561	Connector 3 poles / Diagnostic E1005 CENSE
35	X590	Connector 2 poles / Fire alarm
17	X620_1	Connector 2 poles / E1_1
17	X620_2	Connector 2 poles / E1_2
16	X621_1	Connector 2 poles / E2
16	X621_2	Connector 2 poles / E4
16	X622_1	Connector 2 poles / E3
16	X622_2	Connector 2 poles / E5
17	X623_1	Connector 2 poles / E6_1
17	X623_2	Connector 2 poles / E6_2
71,71A	X624_1	Connector 4 poles / Attenuation boom 1
71,71A	X624_2	Connector 4 poles / Attenuation boom 2
71,71A	X625_1	Connector 4 poles / Attenuation crowd 1
71,71A	X625_2	Connector 4 poles / Attenuation crowd 2
71,71A	X626_1	Connector 4 poles / Attenuation shovel tilt 1
71,71A	X626_2	Connector 4 poles / Attenuation shovel tilt 2
71A	X626_3	Connector 4 poles / Attenuation shovel tilt in 3
71A	X626_4	Connector 4 poles / Attenuation shovel tilt in 4
71,71A	X627_1	Connector 4 poles / Attenuation shovel flap 1
71,71A	X627_2	Connector 4 poles / Attenuation shovel flap 2
71,71A	X628	Connector 12 poles / Attenuation boom/crowd
71,71A	X629	Connector 12 poles / Attenuation boom/crowd
71A	X630	Connector 12 poles / Attenuation flapp
71A	X632	Connector 12 poles / Attenuation flapp
71	X635	Connector 8 poles / Attenuation crowd
71	X636	Connector 8 poles / Attenuation boom
79	X638	Connector 4 poles / B101
78	X641	Connector 4 poles / B103
79	X643	Connector 4 poles / B100
21,76,78	X644	Connector 40 poles / Ladder-trap door
76	X645	Connector 2 poles / B92
76	X645_1	Connector 2 poles / B92
78	X648	Connector 40 poles / E1022_1
79	X649	Connector 24 poles / E1022_2
67,78,79	X650	Connector 24 poles / E1037
79	X651	Connector 2 poles / Y68
79	X652	Connector 2 poles / Y69
79	X653	Connector 2 poles / Y70
79	X654	Connector 2 poles / Y71
78	X655	Connector 2 poles / Y64
78	X656	Connector 2 poles / Y65
78	X657	Connector 2 poles / Y66
78	X658	Connector 2 poles / Y67
78	X659	Connector 2 poles
78	X662	Connector 2 poles
76,78,79,85A	X663	Connector 40 poles / SV ladder-trap door
78	X666	Connector 4 poles
78	X667	Connector 4 poles / SV principal ladder lock./unlock.
79	X668	Connector 4 poles / SV trap door up/down
79	X669	Connector 4 poles / SV trap door lock./unlock.
79	X670	Connector 2 poles / E57 trap door
76	X671	Connector 1 pole / M10
67	X676	Connector 2 poles / Y151
67	X678	Connector 2 poles / Y156
78,79	X680	Connector 40 poles / Ladder
21	X681	Connector 2 poles / E16_5
21	X682	Connector 2 poles / E19
85,85A	X712	Terminal block E1010
13,17,22,35,38 42	X720	Connector 24 poles / Hydraulic tank
13,17,22,35,38 42	X721	Connector 24 poles / Hydraulic tank ground
42	X722	Connector 4 poles / B67-B14

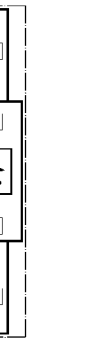
STEP	LABEL	DESCRIPTION
13	X726	Connector 3 poles / B73-B74
13	X727	Connector 3 poles / B73-B74
85	X730	Connector 4 poles
85A	X731	Connector 12 poles / H39
85	X732	Connector 4 poles / B69
85	X733	Connector 4 poles / B50_1
85	X734	Connector 2 poles / Y95
85	X735	Connector 2 poles / Y79
85	X736	Connector 2 poles / Y114
85	X737	Connector 4 poles
85A	X739	Connector 8 poles / Greasing Pump 3
85A	X742	Connector 2 poles / B51
85A	X744	Connector 2 poles
85A	X750_1	Connector 2 poles / Reserve E1043
12,15,18,19,21 23,26,29,35,41 42,44,55	X755	Connector 70 poles / Rotating deck
18,23,28,42,44 56,67,85A	X756	Connector 40 poles / Rotating deck
22	X758_1	Connector 2 poles / E17_1
22	X758_2	Connector 2 poles / E17_2
22	X758_3	Connector 2 poles / E17_3
22	X758_4	Connector 2 poles / E17_4
22	X758_5	Connector 2 poles / E17_5
33	X760	Connector 2 poles / Y13
89,91	X800_1	Connector 40 poles / E1006
88,89,92	X800_2	Connector 40 poles / E1006
88	X801	Connector 1 pole / +24V E1006
89	X802	Connector 1 pole / +24V E1006
88	X803	Connector 1 pole / Ground E1006
44	X804	Connector 1 pole / Ground E1006
88	X804	Connector 1 pole / E1006 Ground
89,90,91,92	X806	Terminal block E1006
42	X807	Connector 2 poles / E1038
88,91	X810	Connector 40 poles / E1006
12	X810	Connector 4 poles / Reserve
44	X811	Connector 2 poles / E1038
88	X811_1	Connector 4 poles / E10
91	X811_2	Connector 4 poles / E10
44	X812	Connector 2 poles / Y10_2
89	X812_1	Connector 4 poles / E10_1
91	X812_2	Connector 4 poles / E10_2
42	X813	Connector 2 poles / Y136
89	X813_1	Connector 4 poles / E10_1
91	X813_2	Connector 4 poles / E10_2
89	X814_1	Connector 4 poles / Heater
90	X815_1	Connector 3 poles / E11_1
92	X815_2	Connector 3 poles / E11_2
90	X816_1	Connector 4 poles / E11_1
92	X816_2	Connector 4 poles / E11_2
90	X817_1	Connector 2 poles / B187_1
92	X817_2	Connector 2 poles / B187_2
90	X818_1	Connector 2 poles / E11_1
92	X818_2	Connector 2 poles / E11_2
89	X819	Connector 12 poles / Heater
28	X830	Connector 2 poles / B84
44	X831	Connector 2 poles / Y3_1
44	X832	Connector 2 poles / Y3_2
44	X833	Connector 2 poles / Y3_3
18,41	X834	Connector 12 poles / Counterweight
18,21,22,35	X835	Connector 24 poles / Ground engine
21,35	X836	Connector 12 poles / Battery
18	X837	Connector 4 poles / E8_1,E8_2
18	X841_1	Connector 2 poles / E18_1
18	X841_2	Connector 2 poles / E18_2
18	X842_1	Connector 2 poles / E23_1
18	X842_2	Connector 2 poles / E23_2
41	X843_2	Connector 2 poles / H13_2
41	X843_3	Connector 2 poles / H13_3
18	X844_1	Connector 2 poles / E61_1
18	X844_2	Connector 2 poles / E61_2
23	X850	Connector 6 poles / Compressor
12,18,19,22,23 42,67	X852	Connector 24 poles / Engine ground
28	X853	Connector 2 poles / B15
28	X855	Connector 4 poles / B66
26,27,29	X857	Connector 40 poles / E1036
42,44,67	X858	Connector 24 poles / E1038
13,18,21,22,23 35	X860	Connector 24 poles / Engine
13,19,35,42,44 55	X861	Connector 24 poles / Engine
26	X863_1	Connector 2 poles / B63_1
27	X863_2	Connector 2 poles / B63_2
27	X863_3	Connector 2 poles / B63_3

Freimaßtoleranz / Tolerances not specified ISO 2768 T1-T2 / Tolérance générale mK
Stahlbauteile "sehr grob" / Non-machined dimensions "very coarse" / Pièces mécano soudées "très large"
Fertiggewicht / Weight / Poids 0,0 kg
Modell od. Gesenk Nr. / Pattern or die No. / Modèle ou matrice N°
Bearbeitung/Finish/Usinage
Projektion / Datum Date/Date / Name Name/Nom
Normgeprüft / Inspected standards / Vérifié normes
LIEBHERR WERK FACTORY USINE LEC
A0
Maßstab / Scale Echelle %
Werkstoff/Material/Matière
Bezeichnung/Description/Dénomination
Zeichnungs Nr./Drawing No./N° de dessin

60

Attachment control

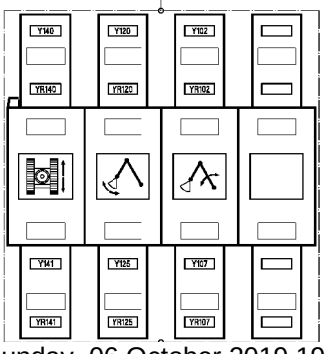




KI31

+24V

P3_E1035

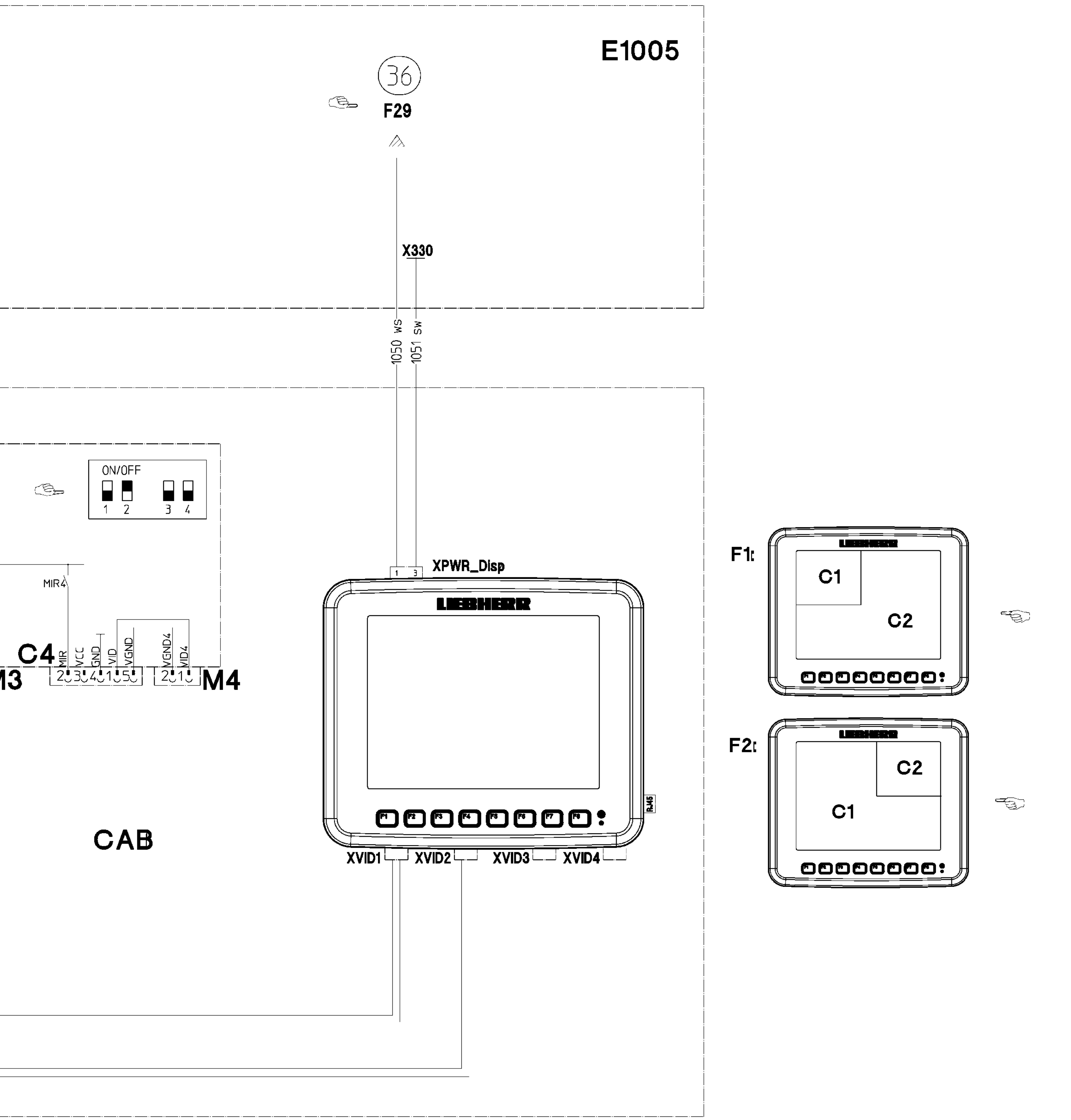


ELECTRO VALVES CONSOLE

EXPLANATION WIRE CROSS-SECTION

-Wire ‘.25mm2 - AWG16 Raychem typ.47
-Wire 2mm2 = AWG14 Raychem typ.47
-Wire 3mm2 - AWG12 Raychem typ.47
-Wire 6mm2 = TR16-6 Raychem
Wire ‘0mm2 - TR16 10 Raychem
-Wire ‘6mm2 = TR16-16 Raychem
Wire 35mm2 - TR16 35 Raychem
-Wire 70mm2 = TR16-70 Raychem

LIEBHERR
WERK FACTORY USINE LEC
A0
KEIN-NONE-SANS



LIEBHERR
WERK FACTORY USINE LEC
A0
Maßstab / Scale Echelle %
KEIN-NONE-SANS
0.0 kg
LETZTE ÄNDERUNG
LAST MODIFICATION