SMARTROC D65 TIER 4 FINAL

Maintenance

Translation of the original instructions

2015-12-17 | No: 713991051.3 en

Reference

! ***NOTE:*** *Always read the information in the Safety document before starting to use the rig or starting maintenance work.*

Table of Contents

2 General

2.1 General

2.1.1 Safety

When maintenance work is carried out on the rig, observe the following points:

- Never carry out service or maintenance work while the drill rig is running.
- To prevent personal injury during service and maintenance work, all components that can be brought into motion or fall down must be thoroughly secured.
- Ensure that the hydraulic and pneumatic systems are depressurised before starting work on them.
- All controls must be inactivated during service and maintenance.
- When changing hydraulic hoses, ensure they are replaced with hydraulic hoses fitted with the correct crimp couplings of correct quality and dimension. All pressurised hydraulic hoses have crimped couplings and should therefore be purchased ready made from Atlas Copco. Quality classes and hose dimensions are specified in the spare parts catalogue. Ensure also that all hose connections are clean, undamaged and securely tightened.

2.1.2 Target group and objective

! ***NOTE:*** *This chapter (General) contains general recommendations for maintenance of the drill rig and its peripheral equipment. This means that certain sections may not be fully adapted to individual components.*

The maintenance instructions are intended for mechanics and personnel in maintenance and service. The user should have undergone Atlas Copco's training courses for the equipment concerned.

The objective of these maintenance instructions is to detect and rectify faults at an early stage so that breakdowns, costly secondary damage and accidents can be prevented. Regular maintenance is a precondition for planning necessary interruptions in operation such as reconditioning and repairs. This allows maintenance to be carried out when most suitable with regard to production instead of causing complete breakdown.

2.1.3 Contact details

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Austria	Postfach 108 A-1111 Wien	Phone: + 43- (0)1 -76 01 20

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Mexico	Apartado Postal Box 104 54000 Tlalnepantla Edo. De Mexico	Phone: + 52 - (0) 55 - 22 82 06 00 Fax: + 52 - (0) 55 - 53 90 15 20
Morocco	P O Box 13 844 20 100 Casablanca	Phone: + 212 - (0) 522 -63 40 00 Fax: + 212 - (0) 522 - 60 05 22
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Table 1: Addresses, telephone numbers and fax numbers to Atlas Copco companies

2.1.4 Signs for outsourced components

Signs are placed on the larger components of the drill rig. When ordering spare parts or making enquiries in regard to the drill rig, the type designation and serial number must always be stated. Type designations and serial numbers are specified in a separate document, MI (Machine Identification). Spare parts can always be ordered through Atlas Copco.

2.1.5 Dismantling and assembly

⚠ CAUTION

Risk of injury

Exercise extreme caution when slinging and hoisting heavy objects

- Can cause personal injury
- Hoisting must take place at the centre of gravity
- Only use slings which are intact and designed for the load they shall carry
- Fasten the straps to lifting eyes, when available

Before transporting in shafts or the like it may be necessary to fully or partially dismantle the drill rig. Observe the following when dismantling, hoisting and assembling:

- Before dismantling, hose the entire rig clean with water and/or detergent containing a grease solvent.
- Observe the strictest cleanliness when dismantling hydraulic, compressed air and water flushing hoses. Immediately plug all hoses, nipples and hydraulic oil pipes, or seal and protect them from dirt in some other suitable way.
- Mark hoses, pipes and other connections, where this has not already been done, to make reassembly easier and prevent mix-ups.
- Use properly secured lifting tackle of generous dimensions.

! ***NOTE:*** *When the drill rig is scrapped, all materials that are harmful to the environment must be disposed of in a manner prescribed by the authorities.*

2.1.6 Long-term storage

The following points must be observed for long-term storage of the drill rig. In the event of special conditions e.g. a dusty or corrosive environment, additional measures may be necessary.

- The rig must have protection from rain, snow and strong sunshine.
- Untreated steel surfaces must be rustproofed.
- The water mist system must be drained and rinsed with antifreeze.
- The battery must be disconnected. If the temperature falls below freezing point then the battery must be stored indoors.
- The rock drill's shank adapter must be greased.
- The rock drill's gas accumulator must be drained.
- If the rig is to be shutdown for a long time then the rock should drill should be removed and stored protected.
- Fuel and oil tanks must be filled.

Inspection and maintenance during the shutdown period

The following action must be carried out every month.

- Check oil and coolant levels.
- Start the diesel engine and let it run until normal operating temperature has been reached.
- Operate the rig a few metres back and forth so that the tramming gears are lubricated.
- Operate the tilt cylinders, boom, feeder, drill support and rod handling so that all cylinders reach their end positions.
- Drain condensed water from the hydraulic oil tank and compressor oil tank.

2.1.7 Scaling

When the entire drill rig or part of the rig is to be scrapped, local regulations in force regarding handling, waste management, recycling and destruction must be followed. Collect and dispose of:

- Rest oil and oil spill
- Oil waste such as filters
- Rest fuel and fuel spill
- Rest grease and grease spill
- Batteries
- Discarded refrigerant, air conditioning
- Chemicals such as flushing additives, other additives and coolants
- Metals, e.g. steel and aluminium (metals that are recyclable)
- Plastics and rubber (often marked in various classifications for recycling)
- Electrical components such as cables, electronics
- Emissions cleaning unit

2.1.8 Tightening torque in bolted joints.

All joints are tightened to the torque required by Atlas Copco Standard K 4369 unless otherwise specifically stated. In such cases, this will be specified in the maintenance instructions of the module in question.

Size	Strength class	Torque in Nm.	Tolerance ±
M6	8.8	8	2
M8	8.8	20	5
M10	8.8	41	10
M12	8.8	73	18
M14	8.8	115	25
M16	8.8	185	45
M20	8.8	355	85
M24	8.8	600	150
M12 x 1.25	10.9	135	6
M16 x 1.25	10.9	315	15
M18 x 1.25	10.9	460	20

Size	Strength class	Torque in Nm.	Tolerance ±
M6	12.9	14	3
M8	12.9	34	8
M10	12.9	70	17
M12	12.9	120	30
M14	12.9	195	45
M16	12.9	315	75
M20	12.9	600	150
M24	12.9	1020	250

Table 2: Atlas Copco Standard torques.

2.1.9 Work on painted surfaces

WARNING

Serious injury

This rig has been painted with oxyran ester paint and polyester powder.

- Substances are formed when the paint is heated which are hazardous to health and amongst other things could cause eczema, eye irritation, respiratory system difficulties and in severe cases asthma or other illnesses.
- Welding, grinding and other hot work involving paint being heated must only be carried out where sufficient ventilation can be used. In addition, use personal safety equipment: compressed air powered breathing protection, eye protection and gloves.

2.1.10 Welding

- **Applies to drill rigs equipped with one of the following engines:**
  - CAT C13, Tier 4
  - CAT C15, Tier 4

NOTE: *It is important to consult Atlas Copco for approval of welding and choice of electrodes.*

Connections that must be disconnected prior to welding

- Alternator
- Battery
- All sensors on boom and feeder
- All cables in the cabin
- All connections to electric cabinet, A1
- Engine electronic unit - ECM. See the instructions for diesel engine.
- All contacts to GPS and ProCom units.

Points to be observed when welding

- Grind off rust and paint from the area that is to be welded and carefully prepare the joint.
- Weld in a dry area.
- Connect the welding ground cable to a clean surface as close as possible to the welding area. Avoid welding close to bearings and bushes. If these cannot be removed, connect ground cables on both sides of the weld.
- Alterations and reinforcements must not be made without previous consultation with Atlas Copco.
- **DO NOT** weld the hydraulic oil tank, valve block, compressed air tank, pressure lines or the engine exhaust cleaning unit (CEM).
- See separate instructions for diesel engines for work on the exhaust cleaners soot sensors.
- Welding on the exhaust cleaning unit frame and bracket is prohibited.
- Always keep a fire extinguisher for oil fires near at hand during all types of welding, cutting and grinding. Screen off the work area from flammable materials.
- Always protect hoses, cables and electric components.
- Grind off spatter after welding. If possible, also grind the surface of the weld smooth and treat it with anti-corrosion paint.

Electrode recommendations

Use only intact and clean electrodes that have been stored in a dry place. The generally recommended type of electrode is ESAB OK 48.00, ESAB OK 48.30 or the equivalent in accordance with the standard below:

ISO:	2560 E51 5B 120 20 H
SS:	14 3211 H10
DIN 1913:	E51 55 B10
AWS:	A/SFA 5.1 E 7018

Table 3: Electrode recommendations

The use of MIG welding equipment is perfectly acceptable. The generally recommended type of electrode is ESAB-OK Autrod 12.51 or the equivalent in accordance with the standard below:

SS:	14 3403 3423
DIN 8559:	SG 2
AWS:	A/SFA 5.18: ER 70 S-6

Table 4: MIG electrodes

If in any doubt, contact Atlas Copco for advice.

2.1.11 Welding CAN BUS

Preparations before welding

Disconnect the supply voltage to all modules, both + and -, as follows:

- Cable KC50A is removed from the right-hand rear pillar outside the cabin.
- Cable KC50B is removed from the right-hand rear pillar outside the cabin.

- Cable D530X1 is removed from D530/X1
- Cable D511X25 is removed from D511/X25
- Cable D102X25 is removed from D102/X25
- Cable D510X25 is removed from D510/X25
- Cable D101X25 is removed from D101/X25
- Cable D103X25 is removed from D103/X25
- Cable D512X25 is removed from D512/X25
- Contact P61 is removed from J61 "Customer connection" to the ECM.
- The battery ground cable is removed.

2.1.12 Diagnostics

Fault finding is a logical sequence of activities to locate a fault, thereby making it possible to rectify the fault as soon as possible.

Always try to investigate the location of the fault in order to limit fault finding to a certain system or function.

2.2 Battery

2.2.1 Environmental considerations regarding batteries

NOTICE

Environmental effect

Think of the environment!

- Batteries contain acids and heavy metals. For this reason, expended batteries can be hazardous to the environment and to health.
- Expended batteries must be sent for destruction in accordance with local regulations.

2.2.2 Charging the battery

WARNING

Serious injury

Risk of fire and explosion

- May cause serious personal injury and damage to property
- Flammable hydrogen gas
- Corrosive fluid
- Avoid naked flames and sparks
- Always detach the negative terminal first, and connect it last

The battery is normally charged by the drill rig's alternator. If the battery is fully discharged for some reason, it must be recharged using a battery charger. Follow the instructions carefully. Cell plugs should be unscrewed but left in the holes during charging.

Explosive gas is formed in the battery during charging. A short circuit, naked flame or spark in the vicinity of the battery could cause a serious explosion. Ensure good ventilation. Always turn off the charge current before disconnecting the clips. If the density has not risen noticeably despite a number of hours of recharging, the battery is probable expended.

Rapid charging, when carried out correctly, will not damage the battery. However, it should not be undertaken too often and is not recommended for old batteries.

Repeated discharging for long periods, especially with low current such as leaving the lights on while the engine is stationary, will impair the service life of the battery. Discharging with high current is not normally harmful. The battery must be left to rest between start attempts, however.

Since the drill rig's 24V electrical system is powered by two 12V batteries in series, the following points should be observed:

- The batteries must have the same capacity (Ah).
- The batteries must be the same age. This is because the charging current required to bring a battery up to a certain voltage changes with age.
- The batteries must not be loaded unevenly.
- Series coupling maintains the same capacity but increases the voltage (double). When 2 x 12V 60Ah batteries are connected in series, the voltage will be 24V but the capacity remains at 60Ah.
- Ensure that the correct voltage is used before connecting a battery charger. Use a 24V charger when recharging both batteries and a 12V charger when charging each battery individually.

Proceed as follows (24V charger)

Before charging

1. Inactivate battery isolation switch S300.
2. Detach the cable between chassis ground and the negative cable on the battery G1B.
3. Connect the positive battery charger cable to the positive terminal on G1A.
4. Connect the negative charger cable to the negative terminal on G1B.
5. Start the battery charger.

After charging

1. Turn off the battery charger
2. Detach the battery charger's negative lead from the negative terminal on G1B.
3. Detach the battery charger's positive lead from the positive terminal on G1A.
4. Connect the cable between chassis ground and the negative terminal on G1B.
5. Activate battery isolation switch S300.

Proceed as follows (12V charger)

Before charging

1. Turn off the battery isolation switch S300.

2. Remove the jumper lead between the negative terminal on battery G1A and the positive terminal on battery G1B.
3. Connect the positive battery charger cable to the positive terminal on G1A.
4. Connect the batter charger's negative lead to the negative terminal on G1A.
5. Start the battery charger.
6. **Once battery G1A is fully charged:** Turn off the battery charger.
7. Detach the battery charger's negative lead from the negative terminal on G1A.
8. Detach the battery charger's positive lead from the positive terminal on G1A.
9. Detach the cable between chassis ground and the negative cable on the battery G1B.
10. Repeat steps 3 - 8 on G1B.

After charging

1. Turn off the battery charger.
2. Reconnect the jumper lead between the negative terminal on battery G1A and the positive terminal on battery G1B.
3. Connect the cable between chassis ground and the negative terminal on G1B.
4. Activate battery isolation switch S300.

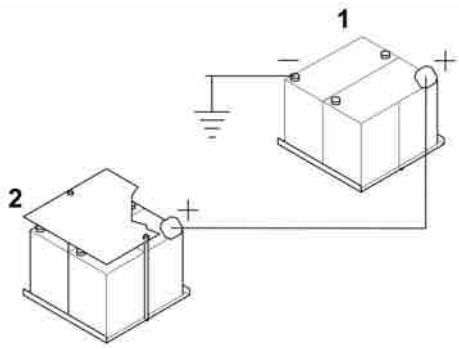
2.2.3 Starting with an auxiliary battery

! ***NOTE:*** *Owing to the surge of current, the batteries could explode if a fully-charged battery is connected to a completely flat one.*

NOTE: *The connections to the drill rig's batteries must under no circumstances be broken during operation as this could lead to faults arising in the alternator.*

Condition ✓ For this reason, proceed as follows:

1. Check that the auxiliary starting batteries (1) have the same voltage as the batteries on the chassis.



Starting assistance

1	Auxiliary batteries
2	Chassis batteries

2. First connect the positive terminal of the auxiliary battery to the positive terminal of the chassis battery (2).
3. Then connect the negative terminal of the auxiliary battery (1) to ground on the chassis (not to the chassis battery's negative terminal).
4. Once the engine has started, first remove the starter cable between the chassis and the negative terminal on the auxiliary battery (1).
5. Then remove the cable between the positive terminals of the batteries.

2.3 Steel ropes

2.3.1 Scrapping guidelines for steel cables

Steel cables should be scrapped when they display any of the following:

- Wire break at attachment
- Occurrence of strand breaks
- Concentrations of wire breaks
- Effects of heat
- Occurrence of wire breaks due to operating time.
- Reduced elasticity
- Decreased cable diameter
- Certain number and type of wire breaks
- Corrosion
- Surface wear
- Deformation of the cable
- Permanent extension of the cable

Wire break at cable mounting

Broken wires at cable ends indicate that they have been heavily loaded and can be caused by faulty end mountings.

Shorten the cable and reattach it. Check that the remaining cable is sufficiently long.

Occurrence of strand breaks

If there are strand breaks, the cable must be scrapped.

Concentrations of wire breaks

If there are concentrations of cable breaks, the cable must be scrapped.

If such concentrations occur within a length less than 60 cm or on an individual strand, the cable must be scrapped.

If this is the case, the cable must be scrapped even if the number of wire breaks is less than the maximum specified in the table.

Effects of heat

Cables exposed to extreme heat must be scrapped. The effects of heat can be established through annealing colour.

Occurrence of wire breaks due to operating time.

Wire breaks occur first after a certain operating time depending on operating conditions and subsequently occur more frequently.

If this is the case, the number of wire breaks in relation to the operating time should be determined and documented.

This can then be used to estimate the future increase in wire breaks and the foreseeable time point for scrapping.

Reduced elasticity

Under certain conditions, the cable loses its elasticity.

Reduced elasticity is difficult to detect. If in doubt, consult a specialist.

If the cable has lost elasticity, the following characteristics usually appear:

- Decrease in cable diameter
- Extension of the cable
- No gap between individual wires and between the strands. This is caused by its components being pressed together.
- Fine, brown dust inside the strands.
- Even if there are no visible wire breaks, the cable is noticeably stiffer.
- The cable's diameter decreases more quickly than during normal wear of the individual cable strands.

Reduced elasticity can lead to sudden cable breaks during heavy loads. The cable should be scrapped.

Decrease in cable diameter

Decrease in cable diameter through material fatigue in the cable can have the following causes:

- Inner surface wear and surface wear nicks
- Inner surface wear through friction between the strands and wires in the cable
- Fatigue of plastic core
- Break in steel core
- Break in inner layer in multi-strand cable

If the cable's diameter decreases more than 10% in relation to the nominal diameter of the cable, it must be scrapped.

It should be scrapped even if no wire breaks have been detected.

Certain number and type of wire breaks

The cable drums are designed in such a way that the cables do not have an unlimited service life. Wire breaks can therefore occur during operation.

On 6 and 8-strand cables, wire breaks are primarily superficial.

The cables should be scrapped if the number of wire breaks specified in the table have been detected

Number of load-bearing wires in the outer strand [1]	Number of visible wire breaks [2] that require scrapping	
	Machine groups M1 and M2	
n	Cross lay	Equal lay

	Over a length of		Over a length of	
	6d	30d	6d	30d
201 - 220	9	18	4	9
221 - 240	10	19	5	10

d = Cable diameter

[1] = Filler wire is not considered load-bearing.

In cables with several layers of strands, only the outer, visible layer is considered.

In cables with steel cores, the core is regarded as an inner strand and is not included.

[2] = In the event of a wire break, two ends can be visible.

Corrosion

Corrosion is especially problematic in marine environments and in areas where the air is polluted by industrial emissions.

Corrosion can reduce operational strength through rust spots and static tensile strength through a reduction in the cross section of the metallic cable.

Severe corrosion can reduce elasticity.

Outer corrosion: Outer corrosion can be easily detected through visual examination.

Inner corrosion: Inner corrosion is more difficult to detect. Inner corrosion is characterised by the following:

- Absence of gap between the strands in the outer layer of the cable, often in combination with wire breaks in the strands.
- The cable diameter varies.

The parts of the cable that are bent over discs usually have a decreased diameter. At any sign of corrosion, the cable should be checked by an authorised person. If inner corrosion is detected, the cable must be scrapped.

Surface wear

Inner surface wear is caused by friction between the wires and the strands.

Outer surface wear is caused by friction between the cable drums (rolls) and the cable under pressure (acceleration and braking). Outer surface wear is visible through the formation of reflected images on the outer wires.

Surface wear is increased through faulty or no lubrication, thereby increasing the effect of dirt and dust.

Surface wear reduces static tensile strength through reduction in the cable's metallic cross section and dynamic strength through surface wear nicks.

If the cable's diameter decreases more than 7% in relation to the nominal diameter of the cable, it must be scrapped.

It should then be scrapped even if no wire breaks have been detected.

Deformation of the cable

Deformations are characterised by visible deviations from the cable's normal form that lead to uneven voltage distribution in the cable.

The following are the primary types of deformations:

- Wire displacement

- Strand displacement
- Waviness
- Cracking
- Kinks
- Flattening
- Local cable diameter decrease
- Local cable diameter increase
- Basket formation

Wire displacement

Individual wires or wire groups stick out like hairpins on the side facing away from the drum. Wire displacement is caused by spasmodic loads.

Cables with wire displacement must be scrapped.

Example of wire displacement

Strand displacement

Strand displacement, which often occurs in conjunction with basket formation, is when the steel core pushes out between the strands.

Cables with strand displacement must be scrapped.

Waviness

Waviness is a deformation that gives the cable's longitudinal axis a helical curve.

Even though wave formation does not necessarily cause weakening of the cable, such a deformation can cause a pulsing movement.

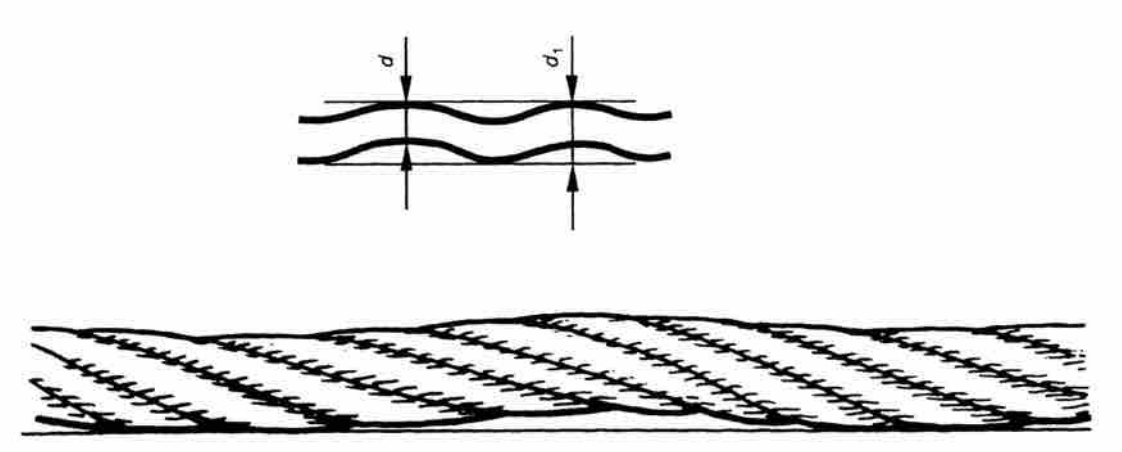
After a long time of operation, this can increase surface wear and wire breaks.

In the event of waviness, the cable should be scrapped if

$d_1 > 4d/3$

d = Cable's nominal diameter

d_1 = Diameter of the circle that would be formed if the cable were not deformed. Check over a length not exceeding 25d.



Waviness

Cracks

Cracks are deformations through outer, violent influences.

Cables with cracks must be scrapped.

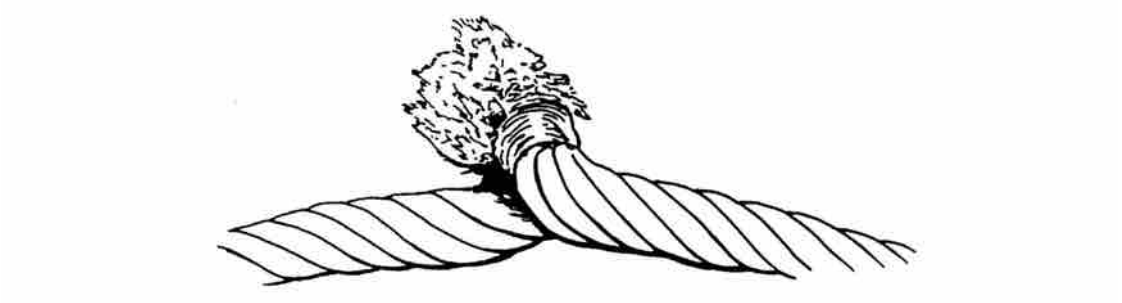
Cracks

Kinks

A kink is a deformation caused by the cable forming an eye that is contracted with out the cable being able to rotate around its own axle.

Strand pitch is altered, which leads a great deal of surface wear and, in severe cases, very low static strength.

Cables with kinks must be scrapped.



Kinks

Flattening

Flattening is deformation caused by mechanical damage.

Cables with severe flattening must be scrapped.

Flattening

Local cable diameter decrease

Local decrease in cable diameter is often connected to core break.

The area near the end attachments must be inspected especially carefully as it can be difficult to detect cable diameter decrease at these spots.

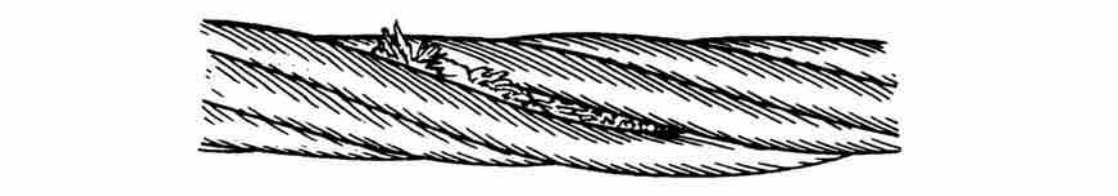
Cables with severe cable diameter decrease must be scrapped.

Local cable diameter decrease

Local cable diameter increase

This means repeated thickening of the cable over a long stretch. At the thicker spots, the core pushes out of the cable and causes unevenness of the outer strands.

Cables with severe cable diameter increase must be scrapped.



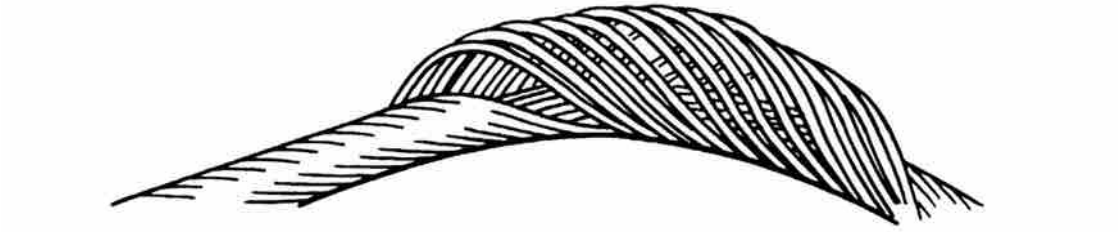
Local cable diameter increase

Basket formation

Basket formation occurs on cables with steel reinforcement or steel core when the outer strand layer becomes longer than the inner strand layer.

Basket formation can also be caused by shock loads on slack cables.

Cables with basket formation must be scrapped.



Basket formation

2.4 Air conditioning

2.4.1 Safety

WARNING

Serious injury

Refrigerant under pressure

- Risk of serious personal injury
- Service of refrigerant must always be carried out by authorised personnel

NOTE: *Do not use the system with too little refrigerant, leakage or any other fault until it is rectified. Otherwise, there is risk of the compressor breaking down.*

2.4.2 Environmental issues when handling refrigerant

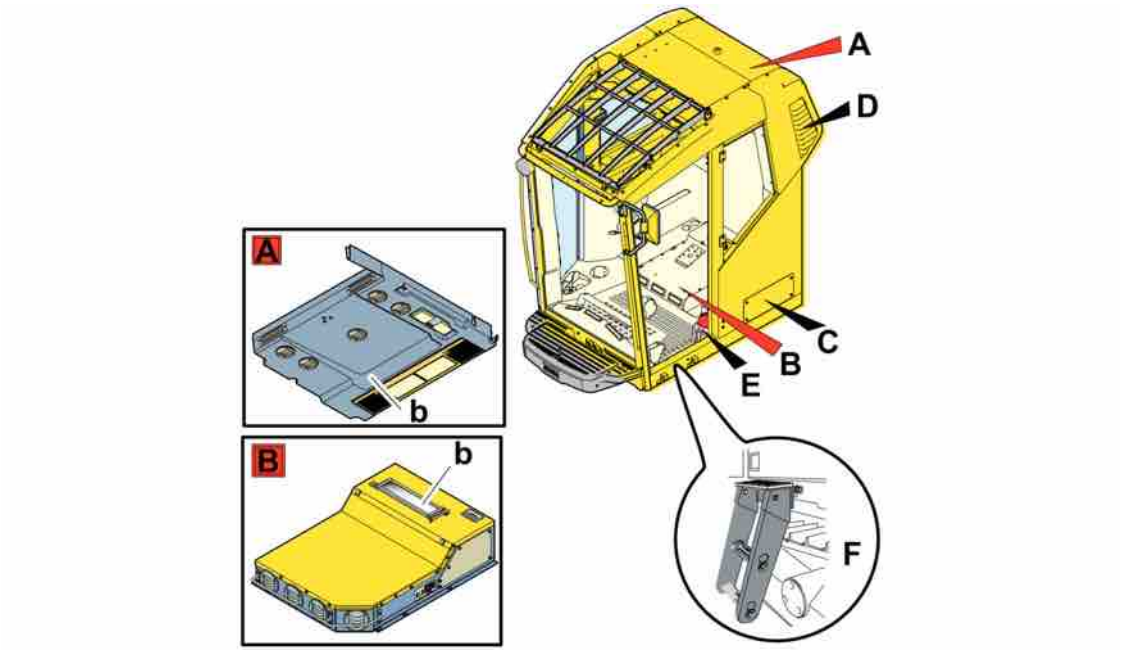
NOTICE

Environmental effect

Care for the environment!

- Discarding air conditioning refrigerant can be hazardous to the environment.
- Air conditioning refrigerant must be sent for destruction in accordance with applicable local regulations.

2.4.3 Changing air filter



Filter - air conditioning.

Changing the main filter:

- Undo the screws around the cover (C).
- Open the cover and lift out the filter.
- Fit the new filter in place and screw back the cover.

Changing the prefilter:

- Undo the screws on the louvre cover (D).
- Lift away the louvre cover and the filter.
- Fit the new filter in place and screw back the louvre cover.

Changing the circulation filters:

- Undo the screws on the covers (b).
- Lift away the covers and the filters.
- Fit the new filters in place and screw back the covers.

2.4.4 Diagnostics

No cooling

Check the following points:

- Fuses, electric connections, compressor ground, electromagnets, switches and pressure switches
- V-belt and compressor
- Expansion valve and temperature control valve
- Coolant hoses

Poor cooling

Check the following points:

- Fresh-air fan and V-belt tension
- That the air does not evade the evaporator in the unit
- That the evaporator and condenser are not clogged by rubbish and the filter in the air intake is not dirty
- That the expansion valve capillary tube is firmly against the evaporator outlet pipe
- That the thermostat does not cut out too early

Uneven cooling

Check the following points:

- That connections to circuit breaker, magnetic coupling or pressure switch are not loose
- That the expansion valve is not clogged
- That the system is filled and the thermostat is not defective

Abnormal noise

Check the following points:

- That the multi-V-belt to the compressor is thoroughly tightened and that the compressor retaining bolts are tightened.
- That the system is filled sufficiently and not overfull
- That the expansion valve is in working order
- That the airflow across the evaporator is sufficient
- That the condenser is clean and the airflow is sufficient

Abnormal system noise is often connected to incorrectly assembled components. If the compressor is noisy at a certain speed, for instance, and the noise disappears when the speed increases or decreases, there is probably nothing wrong with the compressor itself.

The difference between the pressure on the suction side and the pressure side also affects the level of noise. A compressor with low suction makes more noise than a compressor with high suction. Likewise, a compressor with high high-pressure makes more noise because it puts more load on bearings, etc.

3 Transport instructions

3.1 Hoisting

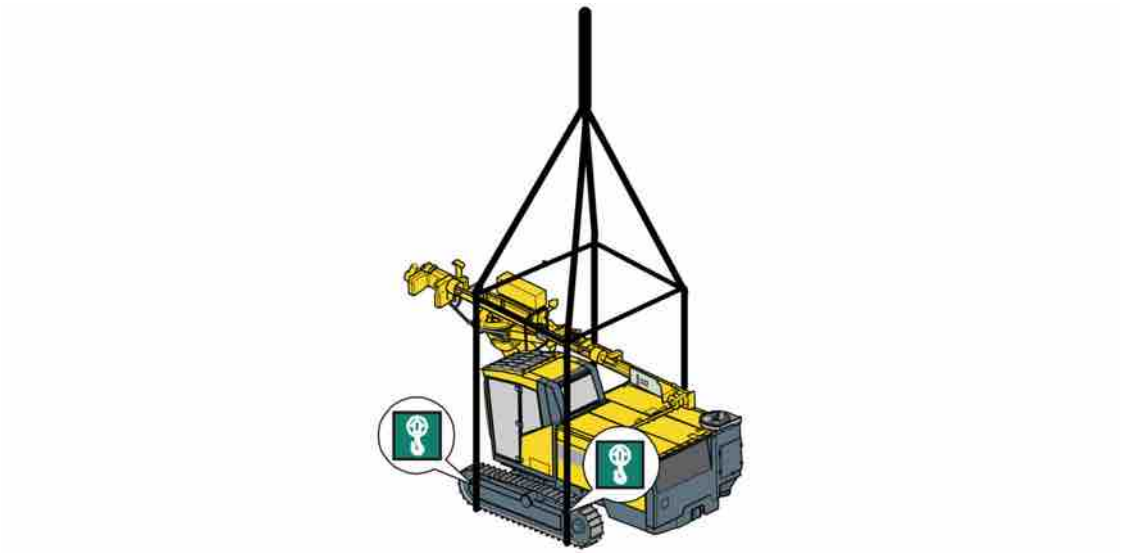
3.1.1 Single-section boom version

WARNING

Serious injury

Hanging load

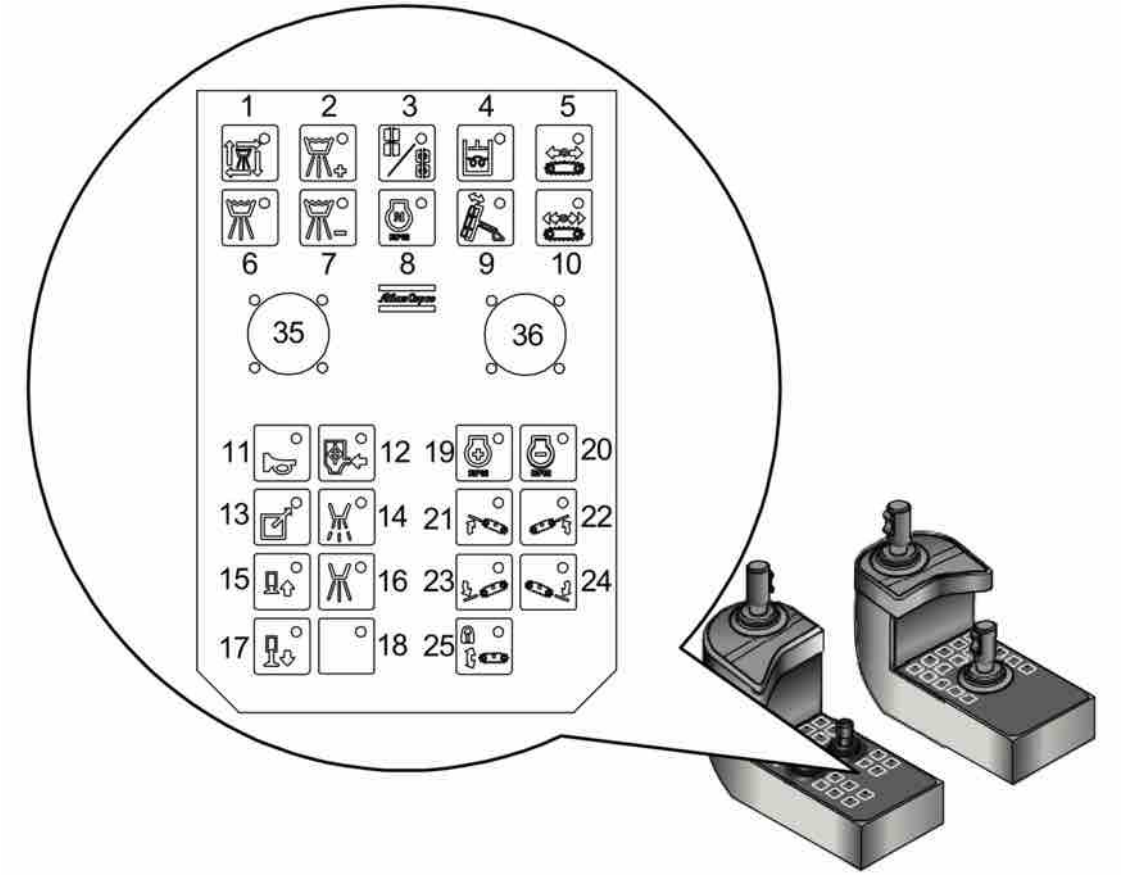
- May cause serious personal injury and damage to property
- Do not approach a hanging load
- Only use lifting equipment and lifting straps with adequate lifting capacity
- Risk of dumping
- Lock the track oscillation cylinders before the drill rig is raised



Hoisting

Make sure the chassis is not damaged when you position the feed in the transport/hoisting position.

- Run the rock drill/rotation unit to is rearmost (upper) position
- Use the boom and feed controls to lower the feed onto the feed support.
- Make sure that the hydraulic jack is retracted.
- **Track oscillation cylinders** to LOCKED position (Button 25).



Left control panel

- Make sure that none of the hoses, controls or any other components can fasten or sustain damage when the hoisting slings are tensioned and under load.
- Place the hoisting slings under both crawler tracks at points A and B as shown in the illustration Hoisting.

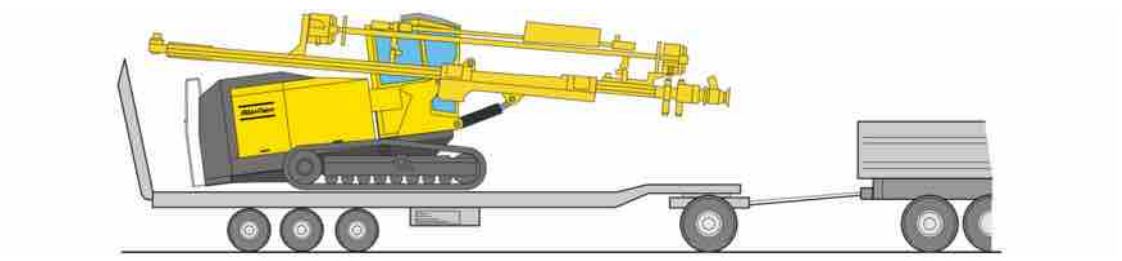
3.2 Transport

WARNING

Serious injury

Risk of dumping

- May cause serious personal injury and damage to property
- Lock the track oscillation cylinders before the drill rig is raised
- Transportation equipment must be adapted for the dimensions and weight of the drill rig



Normal tramming position

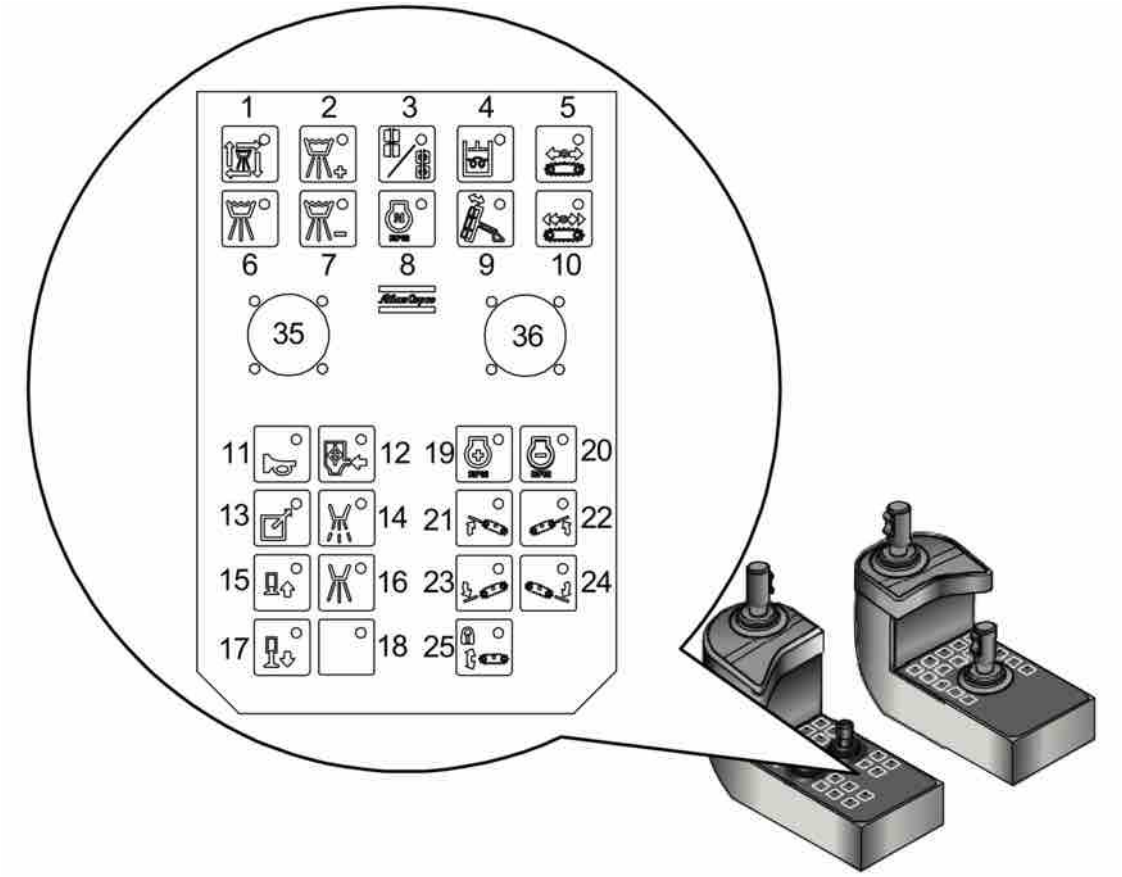
3.2.1 Before loading the drill rig onto the transport vehicle

- Run the rotation unit/rock drill to its lowest position.

Use the boom and feed controls alternately to bring the feed down into the transport position and firmly down on its jack (A).

3.2.2 Once the drill rig is loaded onto the transport vehicle

- Lower the hydraulic jack (extra equipment).
- **Track oscillation cylinders** to LOCKED position (Button 25).



Left control panel

- Support the feed beam against the vehicle to prevent overloading.
- Switch off the diesel engine.
- Strap the drill rig securely onto the vehicle.

Attach straps or chains to the lifting eyes on the machine and vehicle.

3.3 Towing

WARNING

Serious injury

Danger of moving parts

- May cause serious personal injury and damage to property
- Position a wedge under both of the track frames, before disengaging the traction gears

NOTICE

Risk of damage

Risk of damage if the machine is towed with low oil level in the traction gears.

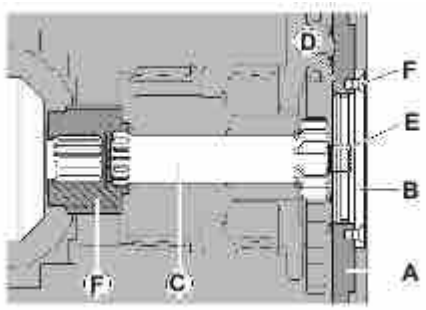
- Make sure that there is sufficient oil in the traction gears before disengagement takes place.

NOTICE

Risk of damage

The traction gears may be damaged if dirt or mud gets into them.

- Make sure that the track frames are completely free of all dirt and mud before the cover plate for the traction gears is removed.



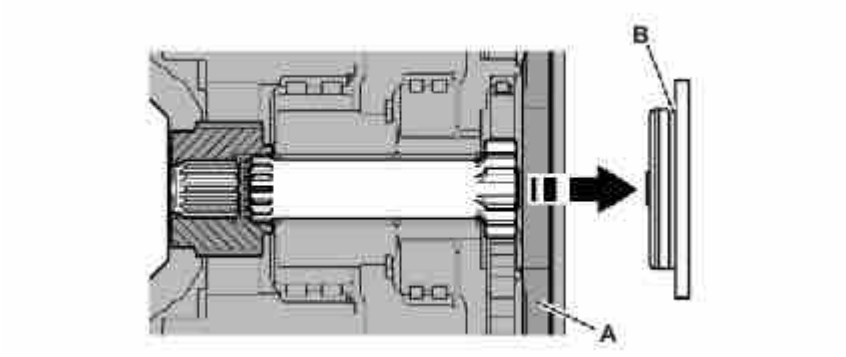
Traction gear for track frames

A	Cover for traction gear
B	Cover
C	Centre shaft
D	O-ring
E	Cylinder barrel
F	Countersunk screw
G	Carrier

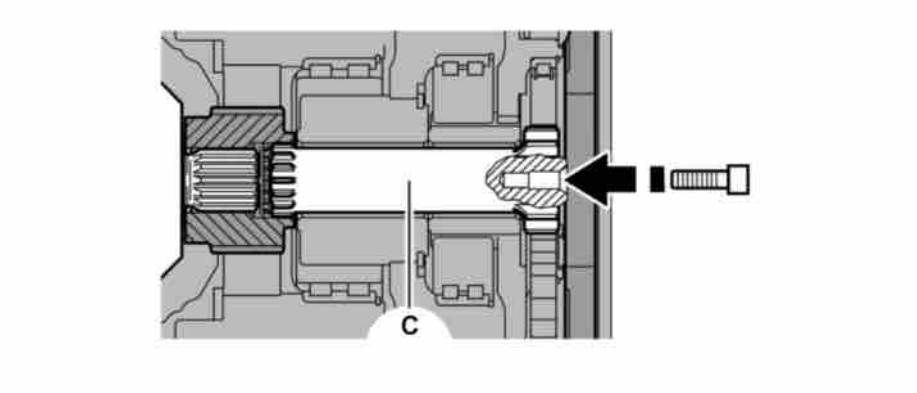
Before the machine can be towed, the centre shaft (C) on both track frames must be disengaged.

Condition ✓ The track frames must be clean and completely free of dirt and mud before the cover plate (B) for the traction gears is removed.

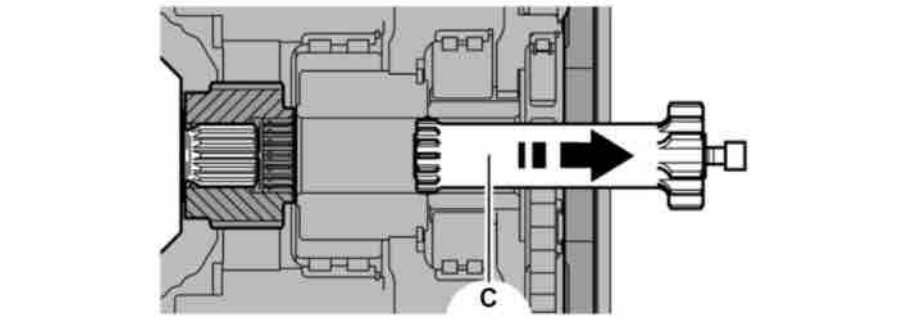
1. Remove the four countersunk screws (F) from the cover plate (B).



2. Screw two 80 mm M8 screws into the threaded holes in the cover plate (B). Screw the screws in evenly so that the cover plate (B) is pressed away from the cover for the traction gear.
3. Remove the cover plate (B), O-ring (D) and cylinder barrel (E).
4. Screw an 80 mm M8 screw into the thread in the centre of the centre shaft (C).



5. Use the screw head to pull out the centre shaft.

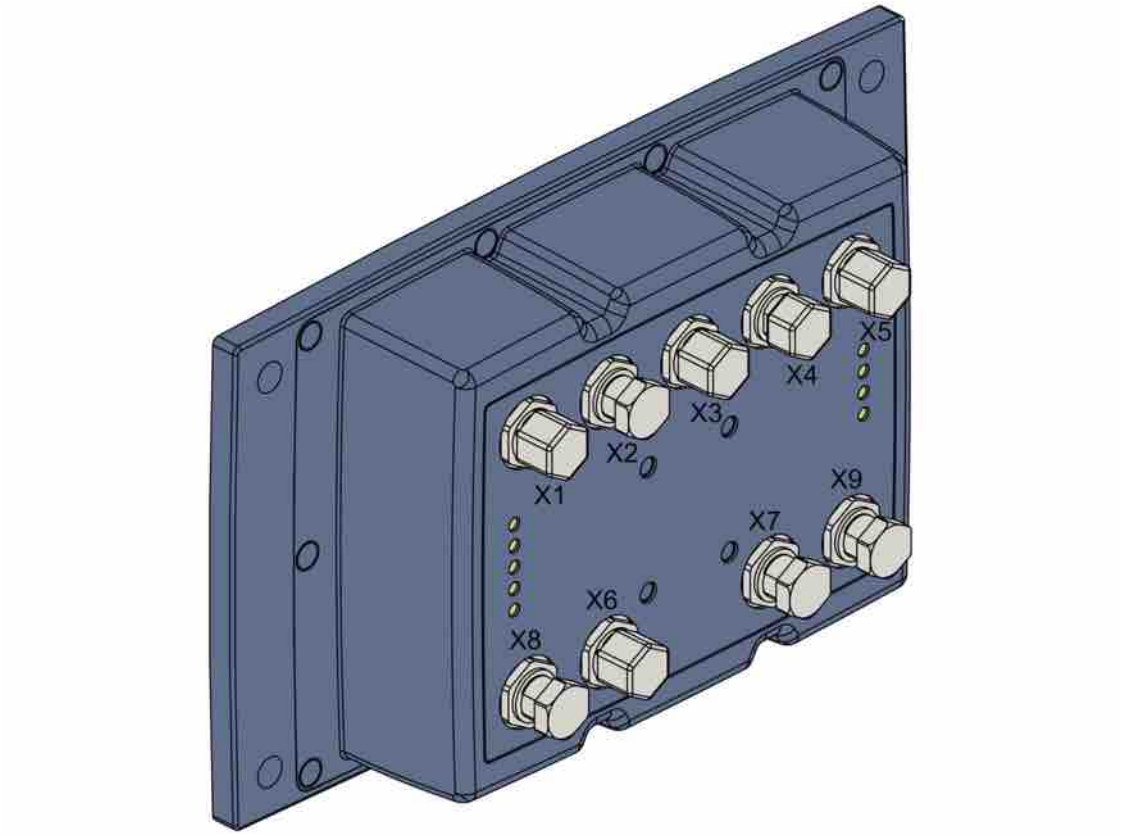


6. Remove and check the condition of the O-ring (D). Replace it with a new O-ring if it is damaged or worn.
7. Refit the O-ring (D) and the cylinder barrel (E). Reattach the cover plate (B) in position using the 4 countersunk screws.
8. Proceed in the same way on the other track frame.

The machine can now be towed.

4 Hardware RCS

4.1 Display, application and CCI module



Display/Application/CCI module

4.1.1 Connections

Contact	Function
X1	Power supply module
X2	CAN network 2
X3, X4	CAN network 1
X5	Address plug
X6	COM2
X7	USB/COM1
X8	Video
X9	Ethernet

Table 5: Functions of connections

4.1.2 Pin configurations

Contact	Type	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5
X1	Four-pin M12, male contact	+24V supply voltage	+24V supply voltage	GND	GND	
X2, X3, X4	Five-pin M12, male contact (X2, X4) or female contact (X3)	NC (Not Connected)	CAN +24V	CAN GND	CAN Hi	CAN
X5	Five-pin M12, male contact	Bit 2	Bit 1	GND	Bit 0	Bit 3

Each address bit is connected to GND (ground). The address plug can be connected to four different addresses.

4.1.3 LED functions

Module status (D16)

- LED colour is green.
- When the system starts the LED flashes twice per second.
- When CAN communication is in progress the LED will flash once per second.
- When there is no CAN communication or if the I/O module is starting up the LED will flash five times per second.

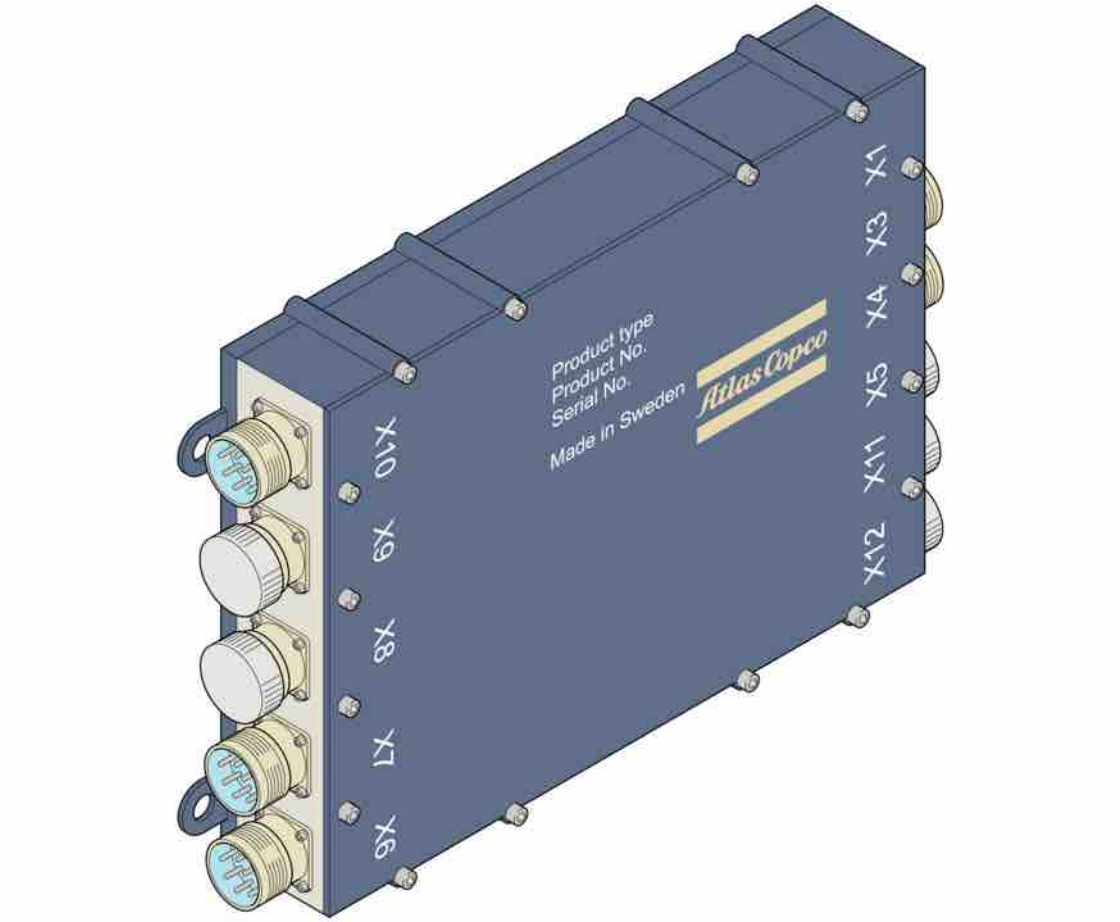
CAN status network 1 (D14) and network 2 (D15)

- LED colour is red.
- The LED flashes when communication is established.
- Black LED means no communication.

Supply voltage CAN network 1 (D19) and CAN network 2 (D20)

- LED colour is green.
- Fixed green glow means supply voltage maintained.
- Black LED means no supply voltage.

4.2 Resolver module



Resolver module

4.2.1 Connections

Contact	Function
X1	Power supply module
X3, X4	CAN network
X5	Address plug
X6-X9	Resolver inputs
X10	Encoder input
X11, X12	Analogue inputs

Table 6: Functions of connections

4.2.2 Pin configurations

Contact	Type	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6
X1	Four-pin M12, male contact	+24V supply voltage	+24V supply voltage	GND	GND		

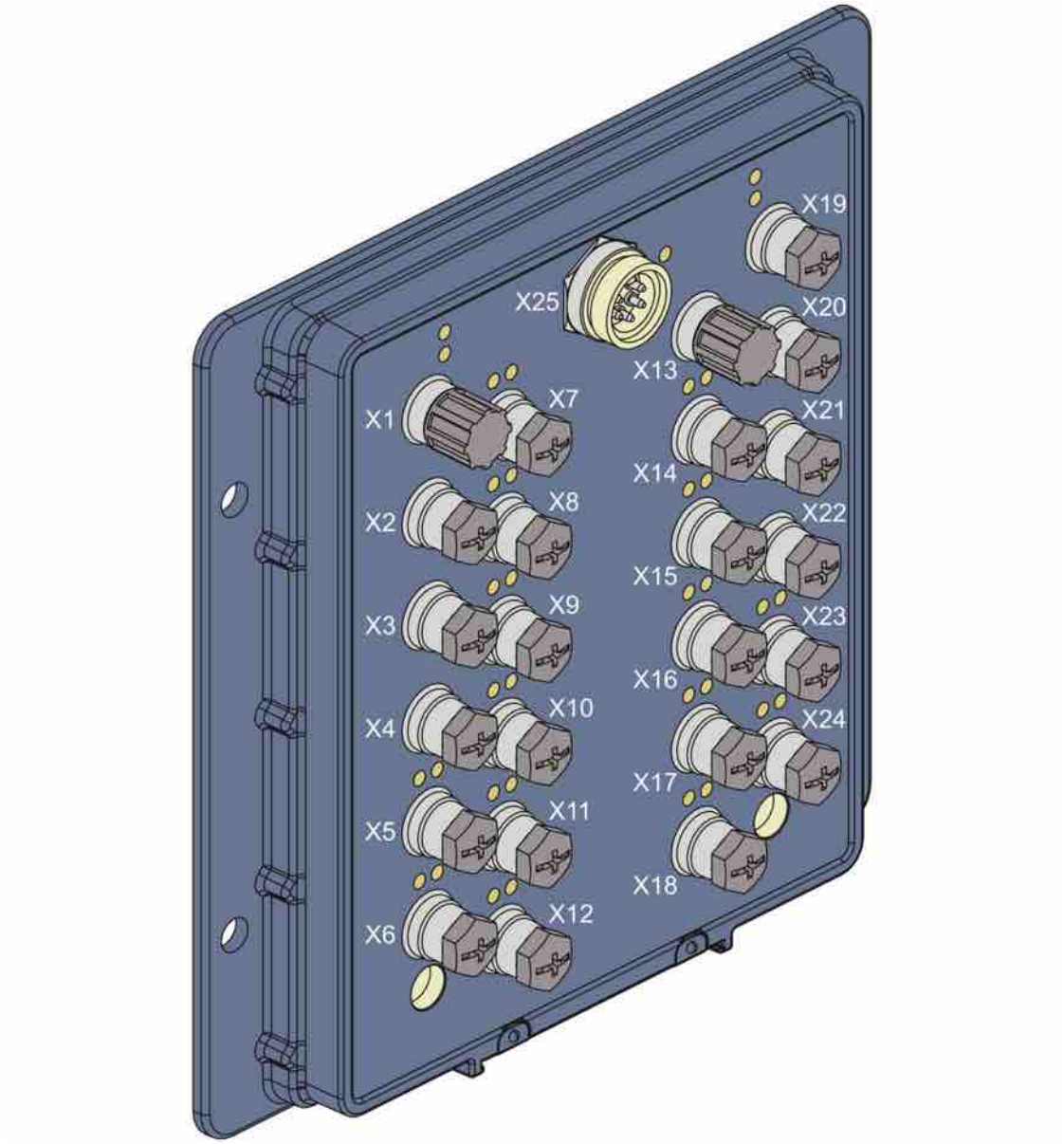
Contact	Type	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6
X3, X4	Five-pin M12, male contact (X3) or female contact (X4)	NC (Not Connec-ted)	CAN +24V	CAN GND	CAN Hi	CAN Lo	
X5	Five-pin M12, male contact	Bit 2	Bit 1	GND	Bit 0	Bit 3	
	Each address bit is connected to GND (ground). The address plug can be connected to four different addresses.						
X6, X7, X9	Six-pin conin-verse, male contact	Ref +	Ref -	Sine sig-nal	Sine GND	Cosine signal	Cosine GND
X10	Six-pin conin-verse, male contact	+15V	+15V	Signal A	GND	Signal B	GND
X11, X12	Five-pin M12, male contact	GND	+15V	NC	NC	Cosine GND	

4.2.3 LED functions

Status View

- Green
  - When the system starts the LED flashes twice per second.
  - When CAN communication is in progress the LED will flash once per second.
  - When there is no CAN communication or if the I/O module is starting up the LED will flash five times per second.
- Red
  - The LED flashes in the event of CAN communication error.

4.3 I/O module



I/O module

4.3.1 Connections

Contact	Function
X1, X19	CAN in (X1), CAN out (X19)
X2, X3, X4, X20, X21, X22	Analogue inputs
X5, X23	DI/DO NPN Encoder
X7, X8, X9, X10, X14, X15, X16, X24	DI/DO PWM
X11, X12, X17, X18	DI/DO PNP
X13	Address plug

Contact	Function
X25	Power supply module

Table 7: Functions of connections

4.3.2 Pin configurations

Contact	Type	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5
X1, X19	Five-pin M12, male contact	Screen (connected to ground)	CAN +24V	CAN GND	CAN Hi	CAN Lo
X2, X3, X4, X20, X21, X22	Five-pin M12, female contact	+24V supply voltage sensor	0 - 5V input signal	GND	0 - 20mA input A	+5V supply voltage sensor
X5, X23	Five-pin M12, female contact	+12V supply voltage sensor	Input or output B	GND	Input or output A	GND
X7, X8, X9, X10, X14, X15, X16, X24	Five-pin M12, female contact	+24V supply voltage	Output B	GND	Output A	GND
	There are two outputs per contact, but only one output can be activated at a time. Output current is between 50mA and 2.0A. The amplitude is adjustable from 0 to 500mA in steps of 50mA.					
X11, X12, X17, X18	Five-pin M12, female contact	+24V supply voltage	Input or output B	GND	Input or output A	GND
X13	Five-pin M12, male contact	Bit 2	Bit 1	GND	Bit 0	Bit 3
	Each address bit is connected to GND (ground). The address plug can be connected to four different addresses. Bit 3 is used for baud rate. Unconnected = 125 kbit, connected = 250 kbit					
X25	Five-pin 7/8", male contact	+24V supply voltage	+24V supply voltage	GND	GND	+24V logic voltage for CPU and communication
	The current output for the contact is up to 18A.					

4.3.3 LED functions

Module status (X25)

- When the system starts the LED flashes twice per second.
- When CAN communication is in progress the LED will flash once per second.

- When there is no CAN communication or if the I/O module is starting up the LED will flash five times per second.
- 5V supply for CAN control.
- 24V supply for valves and sensors.

Analogue inputs

- Green LED indicates 5V and 24V supply voltage.
- Red LED indicates short circuit to ground of sensor supply voltage.

The supply voltage must be reset after one second when the short circuit is broken.

Digital inputs and outputs

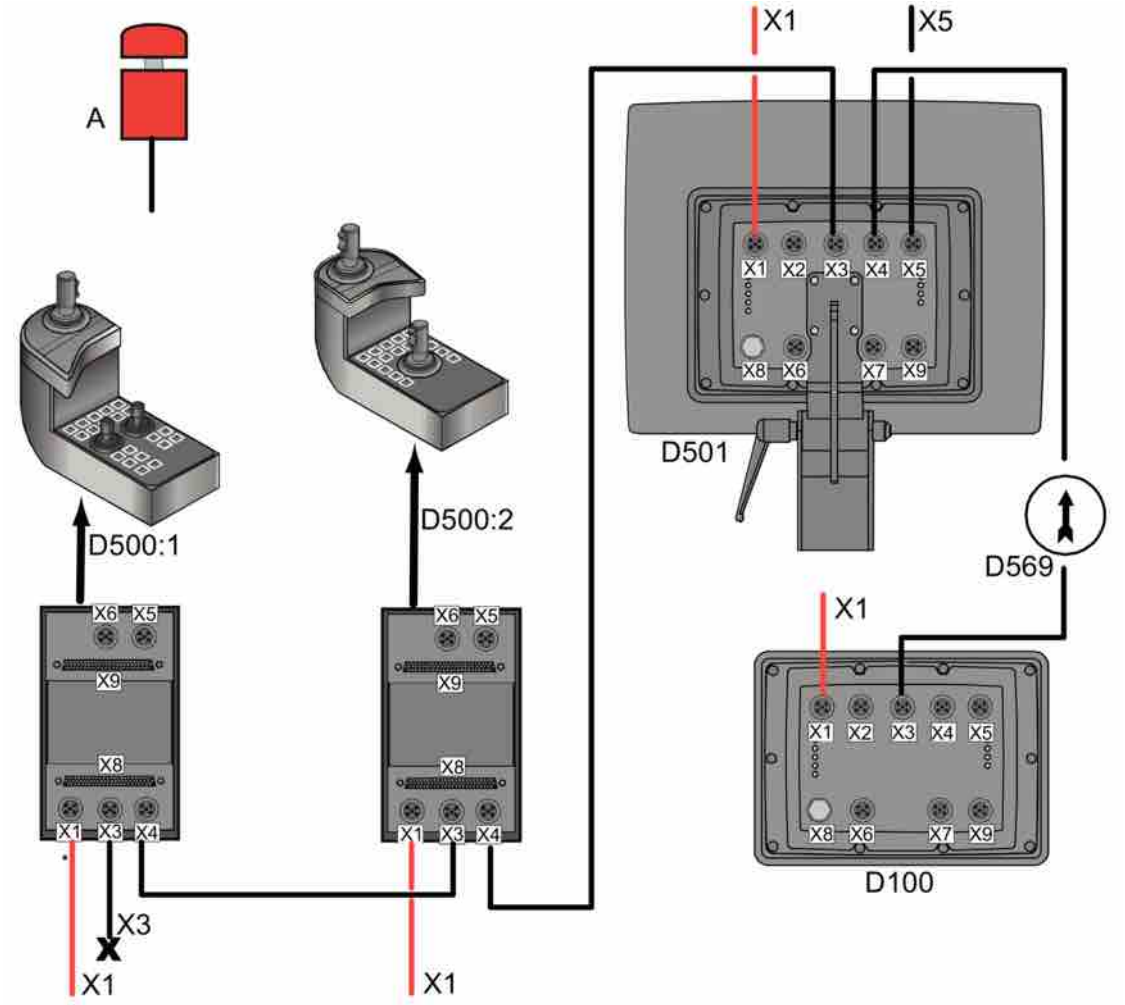
! ***NOTE:*** *The left-hand LED has a signal from pin 2 (B) and the right-hand LED has a signal from pin 4 (A).*

Function/Contact	Black	Green	Orange*	Red
PNP output	Load not activated	Open circuit Output not activated	Output activated and actuated	Output activated, but short circuit to ground
PNP input	Input voltage low No signal on input	Voltage on input Input active	Does not arise if the port is initialised as input.	Does not arise if the port is initialised as input.
NPN output	Not activated	Output activated externally Short circuit to ground.	The output is activated and actuated	Output activated, but short circuit to ground
NPN input	No signal Input voltage too high.	Input activated (closed to ground)	Does not arise if the port is initialised as input.	Does not arise if the port is initialised as input.
PWM output	Not activated Load present	Open circuit Output not activated	Output activated and actuated	Output activated (low current) or short circuit to ground
PWM input	Input voltage low No signal on input	Voltage on input Input active	Does not arise if the port is initialised as input.	Does not arise if the port is initialised as input.

* Orange appears by means of the LED emitting red and green simultaneously.

4.4 Operator panel

4.4.1 Connections

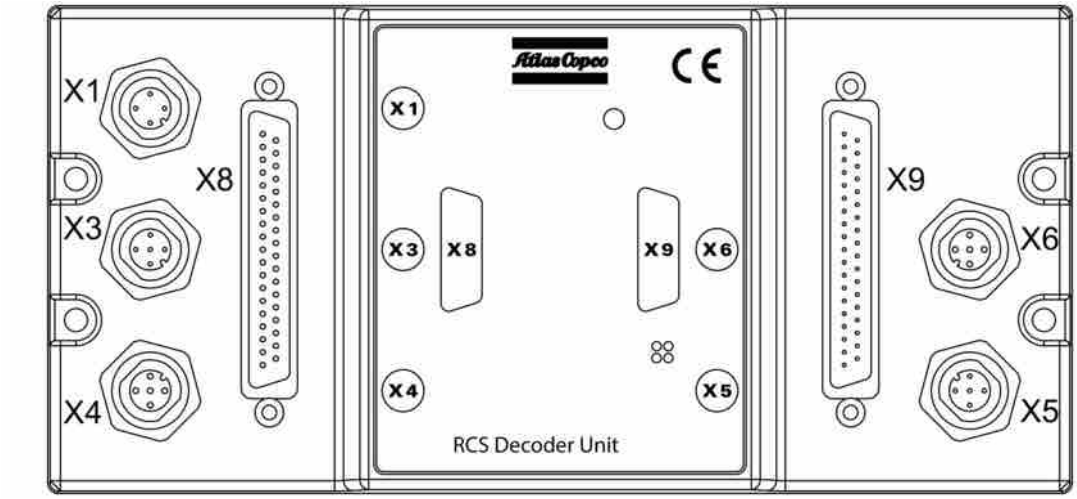


Operator panel

Contact	Function
X1	Supply voltage
X3	CAN network end plug
X4	CAN network (to display D501)
X5	Address plug
D569	Aim Device
A	Emergency stop (NOT CAN network)

Table 8: Functions of connections

4.5 Decoder, operator panel



Decoder, operator panel

4.5.1 Connections

Contact	Function
X1	Supply voltage
X3	Can network
X4	Can network
X5	Address plug
X6	RS232
X8, X9	Input/output contacts

Table 9: Functions of connections

4.5.2 Pin configurations X1 - X6

Contact	Type	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5
X1	Four-pin M12, male contact	+24V supply voltage	+24V supply voltage	GND	GND	
X3	Five-pin M12, male contact	NC (Not Connected)	CAN +24V	CAN GND	CAN Hi	CAN Lo
X4	Five-pin M12, female contact	NC (Not Connected)	CAN +24V	CAN GND	CAN Hi	CAN Lo
X5	Five-pin M12, male contact	ID 2	ID 1	GND	ID 0	ID 3

Contact	Type	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5
	Each address ID is connected to GND (ground). The address plug can be connected to four different addresses.					
X6	Five-pin M12, male contact	RXD 1	GND	TXD 1	RXD 0	TXD 0

4.5.3 Pin configurations X8 - X9

Pin	X8	X9	Pin	X8	X9
1	GND	LED FEED	20	Ain 10	LED OUT 19
2	Ain 1	LED OUT 1	21	GND	LED OUT 20
3	POT FEED	LED OUT 4	22	Din 1	LED OUT 21
4	Ain 2	LED OUT 3	23	Din 2	LED OUT 22
5	GND	LED OUT 4	24	Din 3	LED OUT 23
6	Ain 3	LED OUT 5	25	GND	LED OUT 24
7	POT FEED	LED OUT 4	26	Din 4	LED OUT 25
8	Ain 4	LED OUT 3	27	Din 5	LED FEED
8	GND	LED OUT 4	28	Din 6	Kbd IN 1
10	Ain 5	LED OUT 9	29	GND	Kbd IN 2
11	POT FEED	LED OUT 4	30	Din 7	Kbd IN 3
12	Ain 6	LED OUT 3	31	Din 8	Kbd IN 4
13	GND	LED OUT 4	32	Din 9	Kbd IN 5
14	Ain 7	LED OUT 13	33	GND	Kbd OUT 1
15	POT FEED	LED OUT 4	34	Din 10	Kbd OUT 2
16	Ain 8	LED OUT 3	35	Din 11	Kbd OUT 3
17	GND	LED OUT 4	36	Din 12	Kbd OUT 4
18	Ain 9	LED OUT 17	37	GND	Kbd OUT 5
19	POT FEED	LED OUT 4			

4.5.4 LED functions

Status View

- When the system starts the LED flashes twice per second.
- When CAN communication is in progress the LED will flash once per second.
- When there is no CAN communication or if the I/O module is starting up the LED will flash five times per second.

5 RCS drilling system

5.1 Drill system

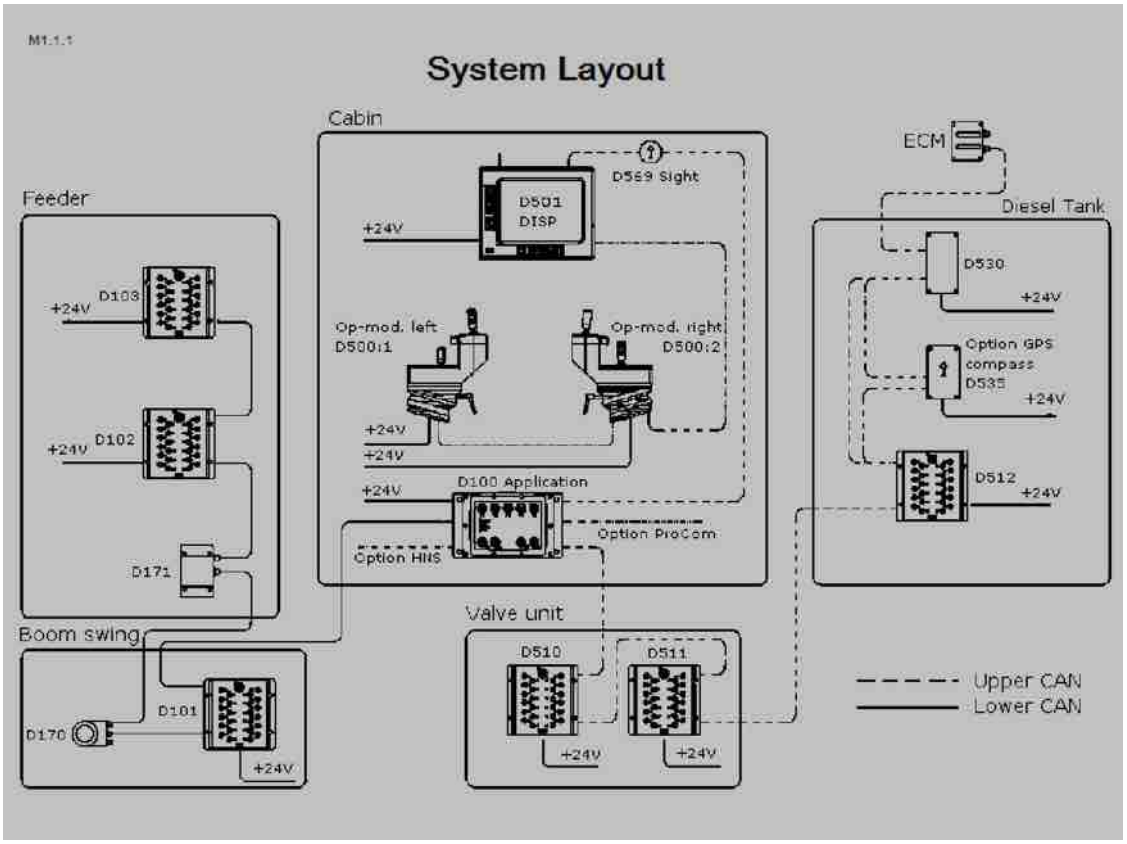
5.1.1 RCS

RCS (Rig Control System) is a system that controls and monitors drilling functions as well as various drill rig functions. The RCS system is based on CAN technology (CAN = Controller Area Network).

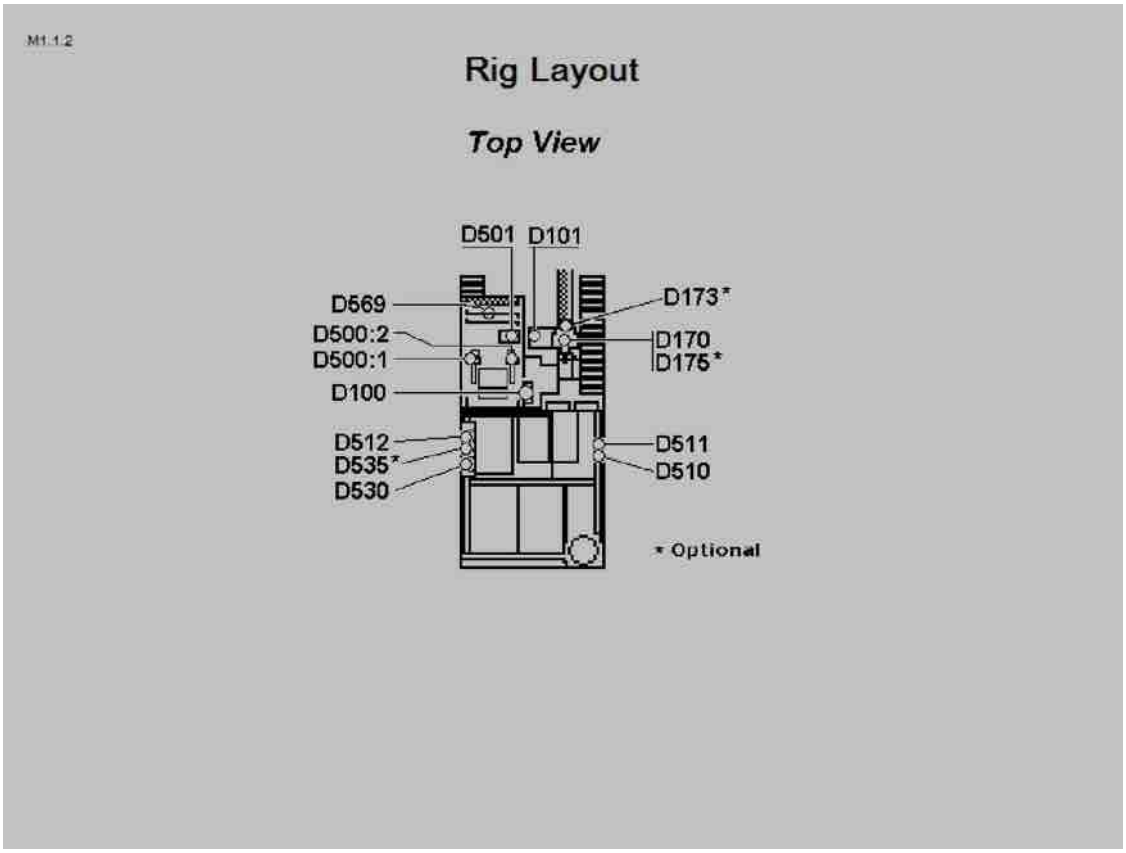
The number of electronic modules varies from rig to rig depending on the options it has been equipped with.

- Lever modules 500:1, 500:2. Display D500.
- Application modules: D100
- I/O modules: D101, D102, D510 and D511
- CAN bridge D530

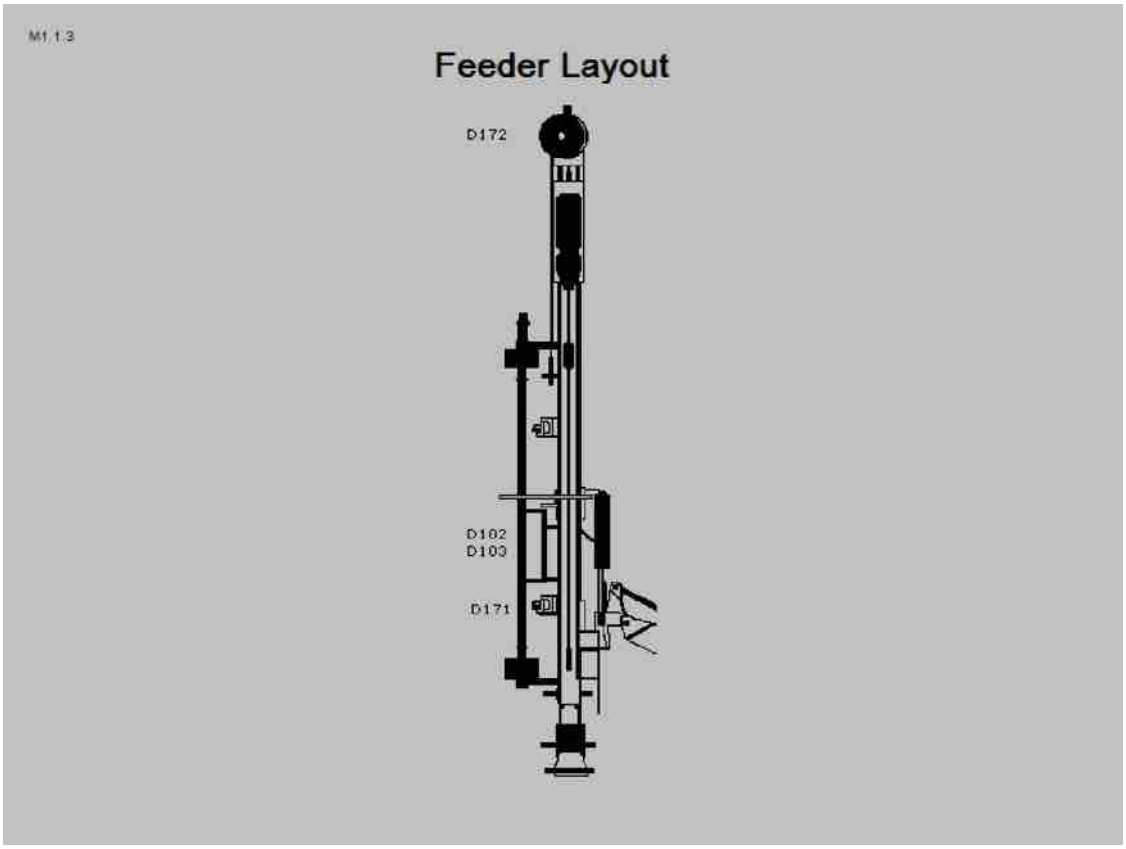
System layout and component locations are shown in the following figures, which are also in the menu system.



System Layout



Rig Layout



Feeder Layout

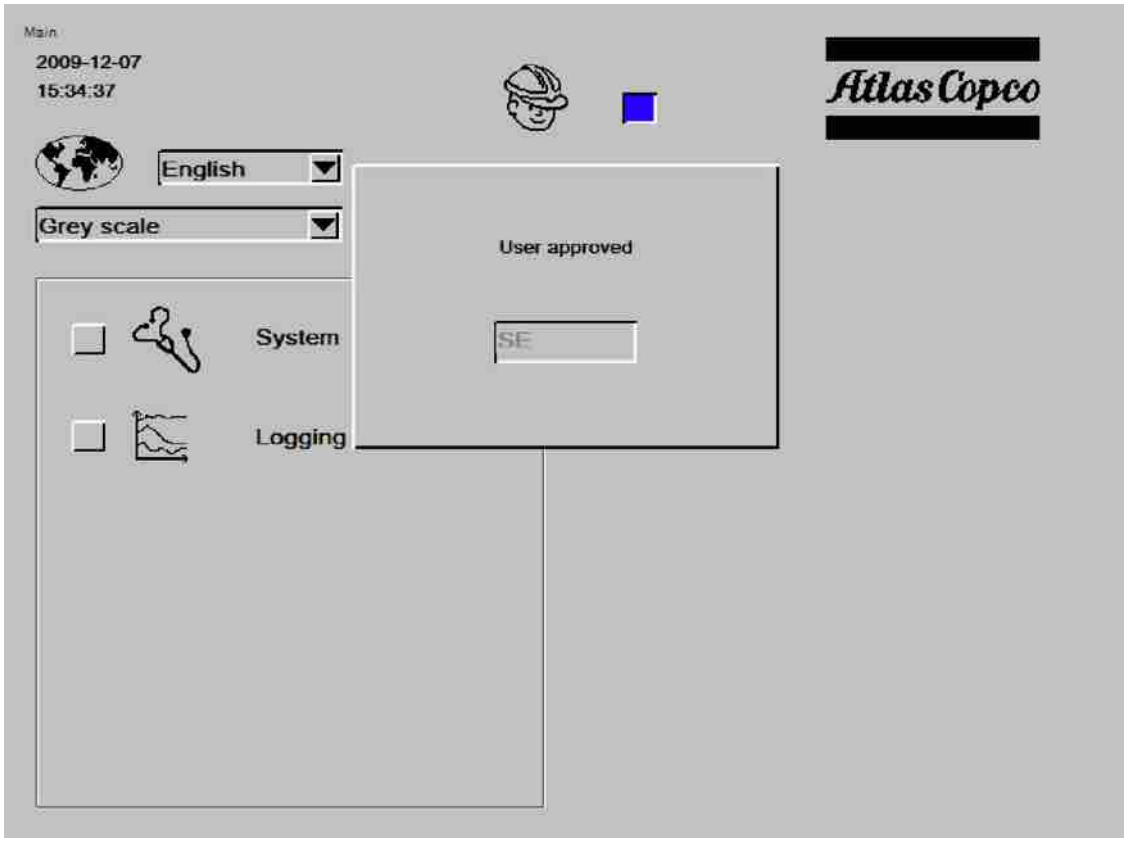
The operator display panel is the main computer that controls all the information to the application module. The application module processes and governs the information from the operator panel, the I/O modules and the resolver module, and provides the correct information to the I/O modules. The I/O modules provide each valve with the correct signal in order to obtain the right motion or function, while they are receiving information from various sensors, e.g. the pressure sensors.

5.1.2 Logging in

! ***NOTE:*** *The service menus in these instructions are intended for service personnel that have completed Atlas Copco's training for the drilling system. Incorrect handling can lead to the system becoming inoperative.*

A user code that only service personnel should have access to is required in order to access the service menus. After starting the drilling system, press the Enter button while you are in the start menu.

This will display a box in which you can enter your access code and confirm with Enter. A message **User approved** will be displayed. Press ESC.



Menu, Logging in.

A start screen with different menus is now displayed.

There are four possible access levels when logging in.

- Operator (OP)
- Service (SE)
- Atlas Copco sales (AC)
- Atlas Copco production (ACP)

5.2 Overview of menus

5.2.1 Menu structure

Direct selection menu F1		
Direct selection menu F2.1		
Direct selection menu F2.2		
Direct selection menu F3		
Direct selection menu F3	Performance log	
Direct selection menu F4		
Direct selection menu F5		

Main menu

System		
System	Modules	Status View
System	Modules	System layout
System	Modules	Rig Layout
System	Modules	Feeder Layout
System	Levers	
System	Levers	Calibration
System	Guards	
System	Administration	
System	Engine status	
System	Service interval	
System	Configuration	
System	Configuration	Rig Options
Logging		
Logging	Event Log	
Logging	Save	

Logging	MWD		
Logging	Trace Log		
Logging	Signal Log		
Logging	Auxiliary Temperature Logging		
Positioning			
Positioning	Sensors		
Positioning	Sensors	Calibration	
Positioning	Actuations		
Positioning	Parameters		
Positioning	Parameters	Valve parameters	
Positioning	Parameters	Auto parameters	
Drilling	Sensors		
Drilling	Sensors	Calibration	
Drilling	Actuations		
Drilling	Parameters		
Drilling	Parameters	Feed Speed	
Drilling	Parameters	Feed pressure	
Drilling	Parameters	Feed pressure	Calibration
Drilling	Parameters	Rotation	
Drilling	Parameters	Rotation	Calibration
Drilling	Parameters	Lubrication	
Drilling	Parameters	Times	
Drilling	Parameters	Drill bit	
Drilling	Parameters	Miscellaneous	
Drilling	DCT		
Drilling	DCT	Parameters	
Drilling	DCT	Actuations	
Rig			
Rig	Sensors		
Rig	Sensors	Power Pack	
Rig	Sensors	Power Pack	Calibration
Rig	Sensors	Wagon Frame	

Rig	Sensors	Wagon Frame	Calibration
Rig	Actuations		
Rig	Actuations	Power Pack	
Rig	Actuations	Wagon Frame	
Rig	Actuations	Cooling fan	
Rig	Parameters		
Rig	Parameters	Tramming	
RHS			
RHS	Sensors		
RHS	Sensors	Calibration	
RHS	Actuations	Left Digital Lever	
RHS	Actuations	Right Digital Lever	
RHS	Actuations	Bit Breaker	
RHS	Parameters	RHS	
RHS	Parameters	Threading	
RHS	Parameters	Length Sensor	
RHS	Cradle positions		
RHS	Auto RHS parameters		
RHS	Auto RHS parameters	Feed Speed	
RHS	Auto RHS parameters	Rotation	
RHS	Auto RHS parameters	Times	

Table 10: Menu structure

5.3 Settings

5.3.1 General and specific settings

The speed of the hydraulic cylinders is set separately for each cylinder. These menus have a choice list from which you can choose the desired cylinder (boom extension, feed extension, etc.).

Pressure and flow settings for drilling are divided into a number of menus. Several of these settings can be done specifically for different types of drill bit. The parameters that can have different values for different types of drill bit are marked with a drill bit symbol. These menus have a choice list from which the drill bit can be selected.

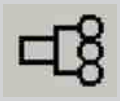
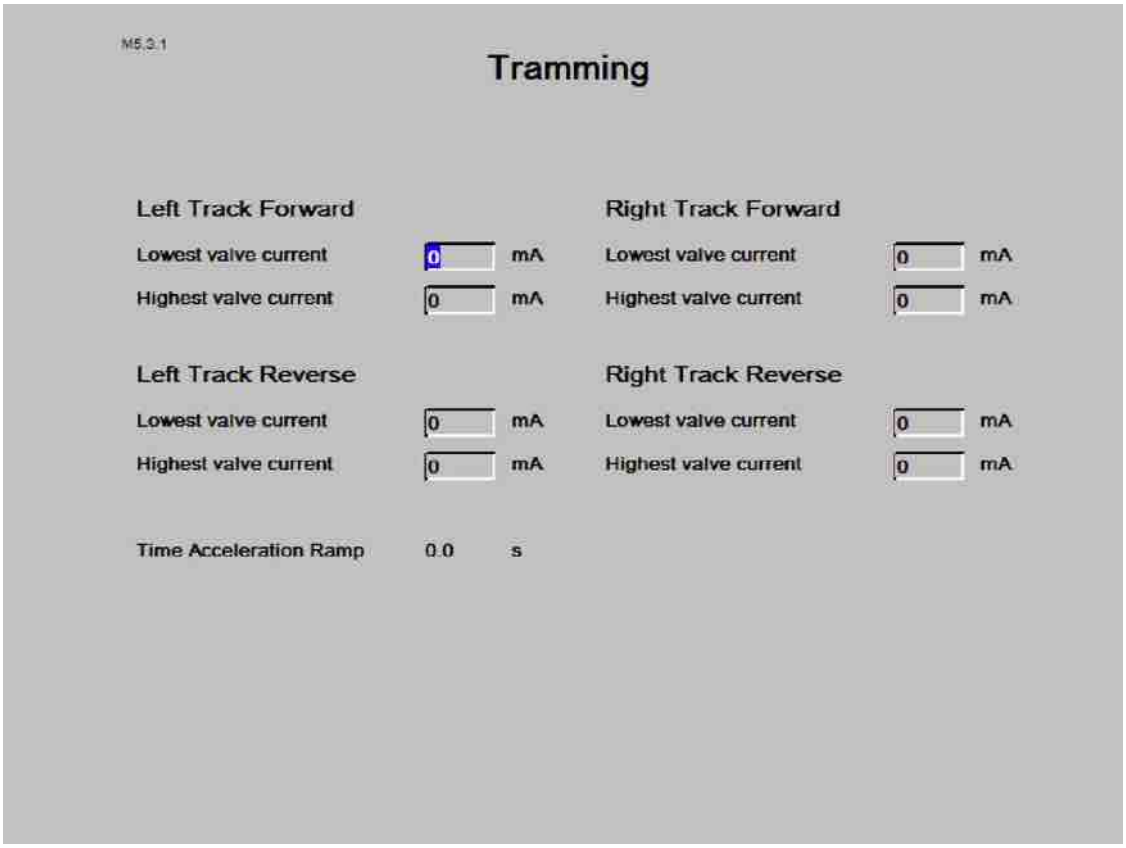
Symbol	Explanation
	Drill bit. This symbol is next to various parameters and indicates that they are drill bit specific. The symbol can also be found together with a list of options from which the desired type of drill bit can be selected.

Table 11: Symbols

5.3.2 Parameters

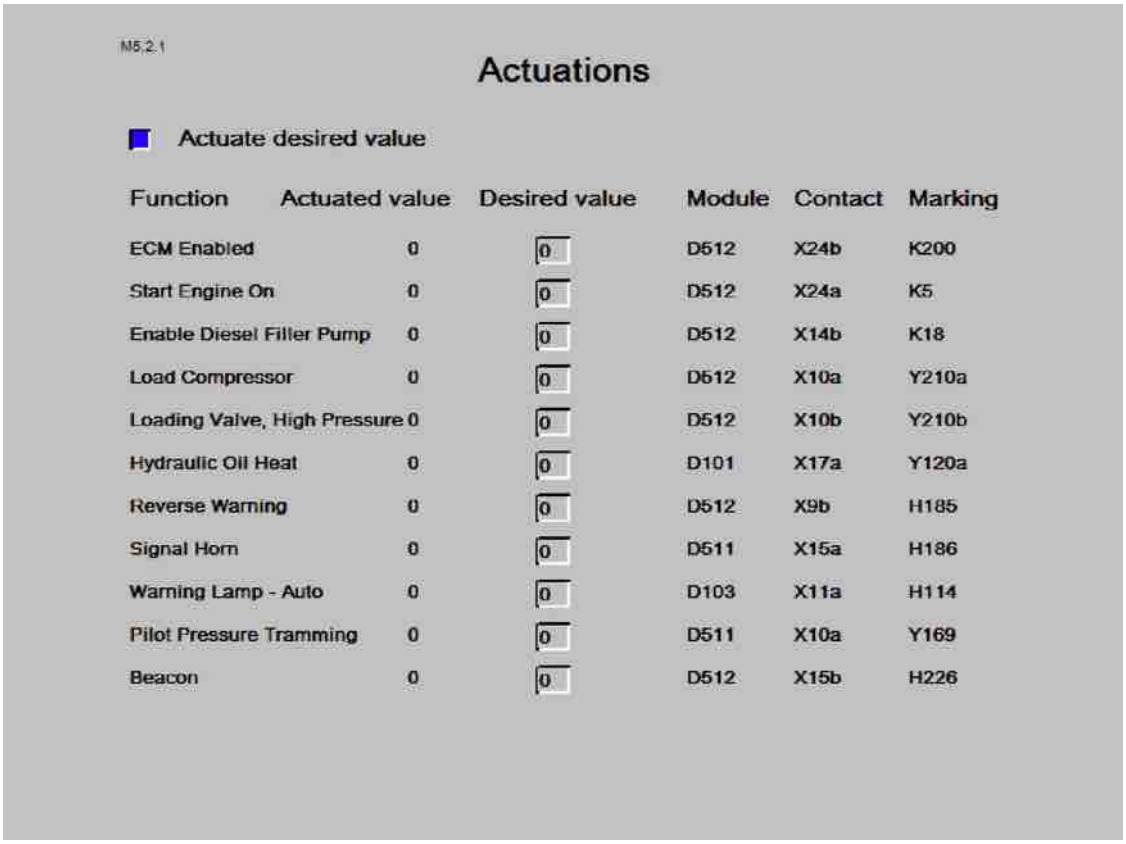


Example of **Parameters**

The parameter menus are used for settings of different values.

- Highlight the desired function using the cursor keys and press ENTER.
- Specify the desired parameter value with the arrow keys. The value may be in milli-amps (mA) or in some cases 1 (on) or 0 (off).
- Press Enter to confirm the selected value.

5.3.3 Actuations



Example of **Actuations**

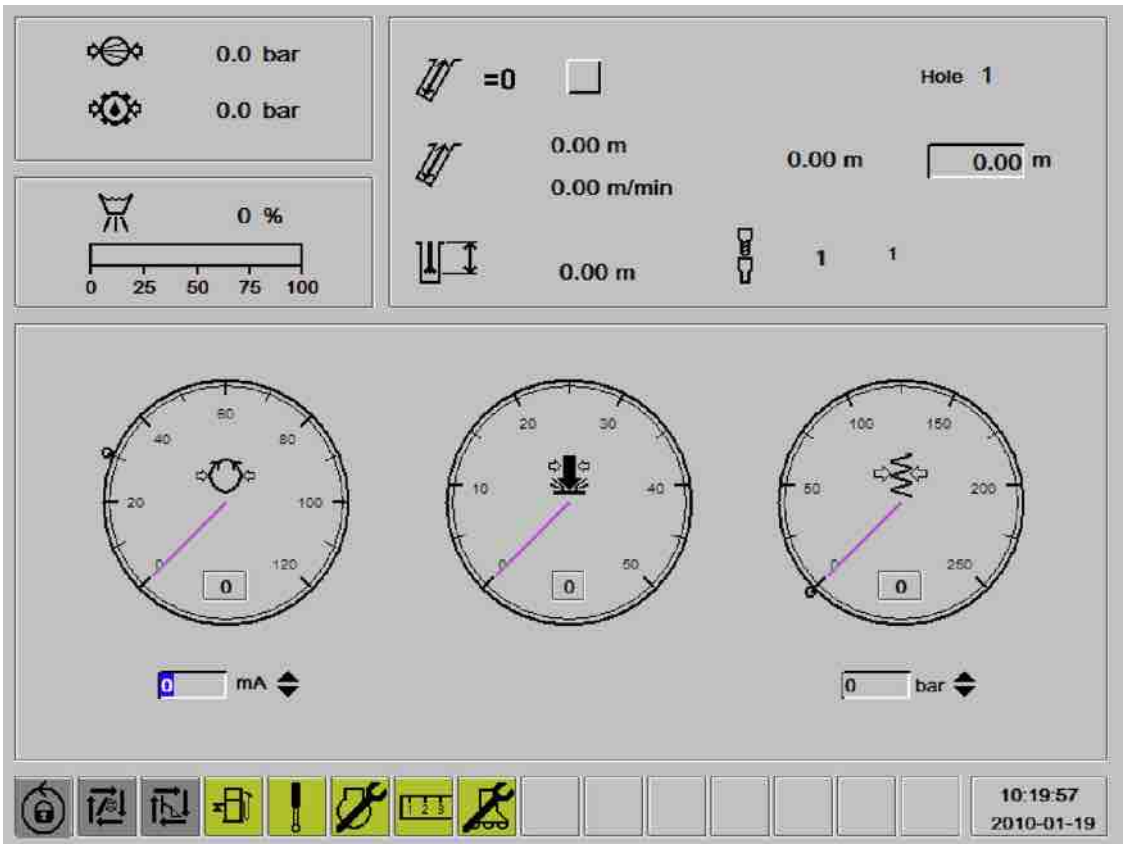
The actuation menus are used for forced operation of a certain function or to test a function, e.g. for fault finding on components. This function can also be used if you want to check that a certain function is actuated from the I/O module outputs.

- Highlight the desired function using the cursor keys and press ENTER.
- Specify the desired actuation value. The value may be in milliamps (mA) or in some cases 1 (on) or 0 (off).
- Select the **Actuate desired value** box. Press Enter and hold it depressed. The desired value is actuated as long as Enter is kept depressed.

! ***NOTE:*** *The actuation menus should only be used by personnel from Atlas Copco or other trained personnel.*

5.4 Direct selection menus

5.4.1 Direct selection menu F1.



Direct selection menu F1.

Symbol description for direct selection menu F1

> ***NOTE:*** *GPS is covered separately in the chapter entitled Options*

The following is an explanation of the symbols shown in direct selection menu F1.

Symbol	Name	Explanation
	Tank pressure	Shows the current tank pressure (bar).
	Lubrication oil pressure	Shows the current lubricating oil pressure (bar).
	Water amount	Shows the percentage loading of the watermist pump.

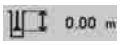
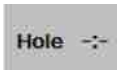
Symbol	Name	Explanation
	Resetting hole length	Zeroes the measured hole length. Length measurement should be reset with the drill bit against the ground before beginning to drill a new hole.
	Current hole length Penetration rate	The value at the top shows the current hole length (m) and the bottom value the penetration rate (m/min). During auto drilling, the average penetration rate for the latest rod is shown. If the automatic drill stop for attained hole length has been reached, the average penetration rate for the entire hole will be shown.
	Drill bit position	Shows the position of the drill bit in metres.
	Shortcut, drill plan	Here you can get direct access to the drill plan, if applicable.
	Desired hole depth	This is where the value for the desired hole length (0-99.9m) is entered. Drilling will be stopped automatically once this hole depth has been reached.
	Rod indication	Shows the number of drill steel in the hole.
	Hole number	Current hole number in the drill plan if used.
	Feed pressure	Shows the current feed pressure while forward and reverse feed is being used (bar).

Table 12: Explanation of the symbols in direct selection menu F1.

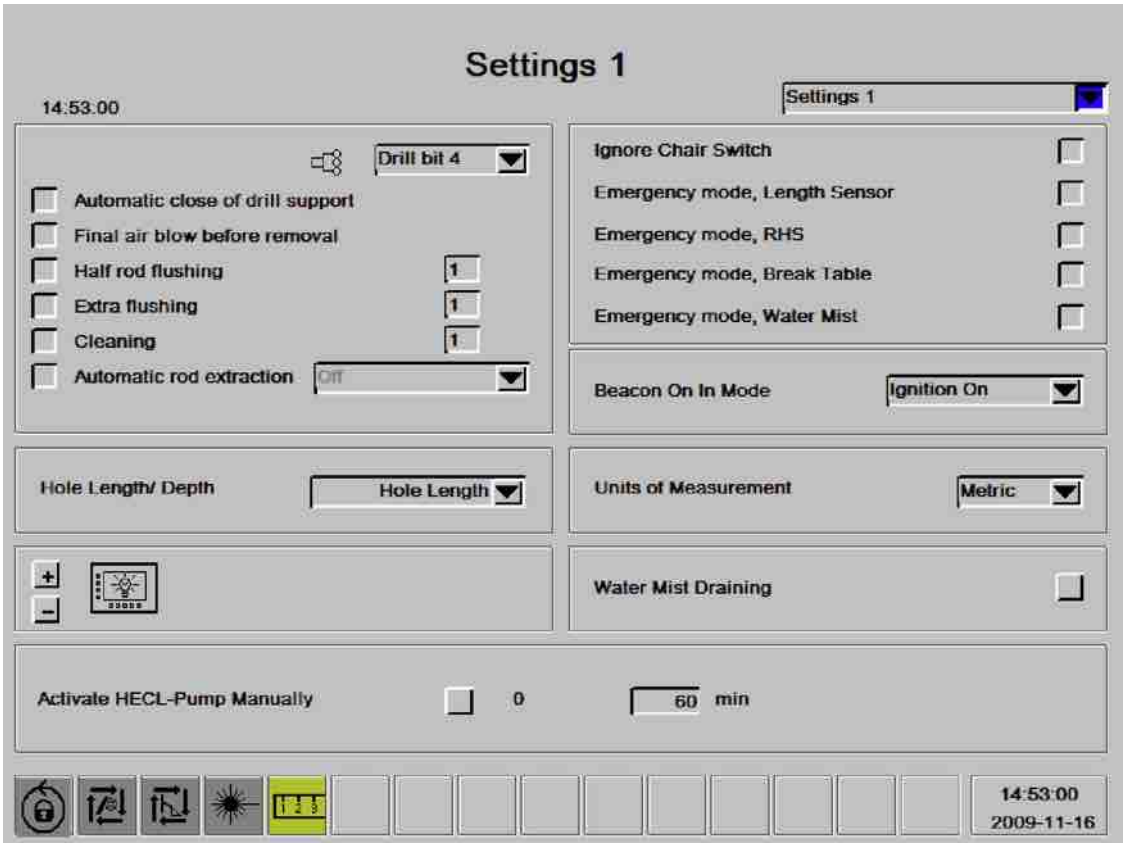
- **Pressure gauges:** The pressure gauges show, from left: rotation pressure, percussion pressure and drill feed pressure.

Under the pressure gauge for rotation pressure is a box where you can set the amperage that controls the flow to the rotation unit.

Under the pressure gauge for drill feed pressure is a box where you can directly set the drill feed pressure.

- **Status bar:** Shows directly warnings and information on the engine and drilling system. A green box indicates that an automatic function is active. A red box immediately turns off the diesel engine while a yellow one provides information that there is something that must be seen to (see status bar icon).

5.4.2 Direct selection menu F2.



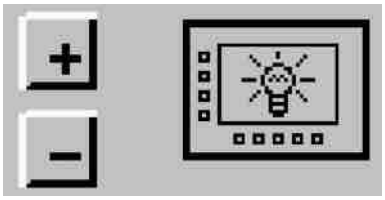
Direct selection menu F2. **Settings 1**

Quick Settings

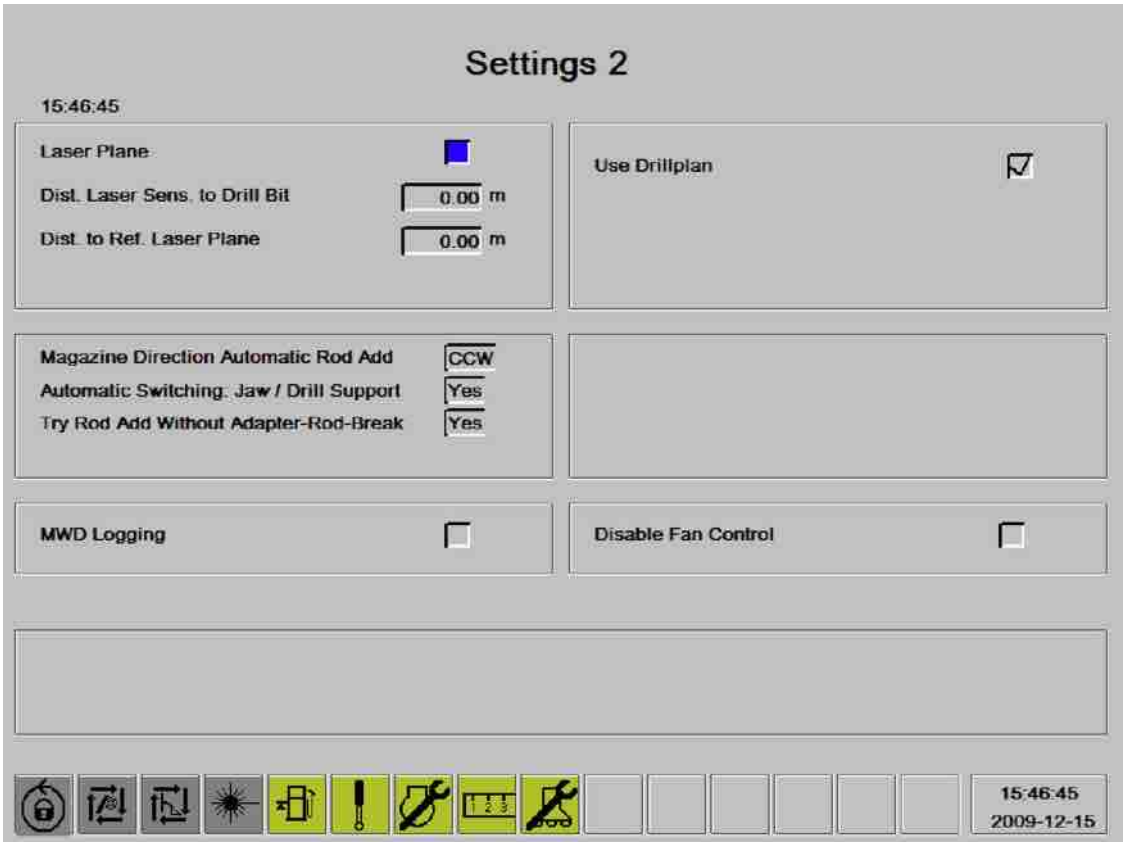
In F2 a choice can be made between **Settings 1** (see illustration above) and **Settings 2** (see next illustration).

- **Automatic close of drill support:** The drill supports are closed automatically after a certain drilling length following collaring.
- **Final air blow before removal:** Extra blow-cleaning of the borehole when drill depth is achieved.
- **Half rod flushing:** Extra blow-cleaning of the borehole when half of the rod is drilled. The number indicates for how many rods blow-cleaning should apply. For example, number 3 indicates that the blow-cleaning will be for the first three rods.
- **Extra flushing:** Extra blow-cleaning of the borehole when half of the rod is drilled. The number indicates for how many rods blow-cleaning should apply. For example, number 3 indicates that the blow-cleaning will be for the first three rods.
- **Cleaning:** When the rod is fully drilled the whole rod is fed up and then down during blowing before auto drilling takes place. The number indicates for how many rods the cleaning should apply. For example, number 3 indicates that the blow-cleaning will be for the first three rods.
- **Automatic rod extraction:**.
  - **Off:** Normal extraction
  - **Rotation:** Rotation and blowing during extraction
  - **Rotation and air:** Rotation during extraction
- **Hole Length/Hole depth:** Selection of method of measurement.
- **Activate HECL-Pump manually:** Pump up oil to the rotation unit for a certain time without flushing air being on. Used for example when you have a new down-the-hole drill.

- **Ignore chair switch:** Normally you have to sit in the seat to operate the positioning levers. If the box is checked, you can leave the seat for 10 seconds and still carry out positioning.
- **Emergency mode, Length Sensor:** Used if the length sensor has stopped working. None of the pre-programmed stops will work but the rig can be used until the length sensor has been rectified. Use rapid feed with great care as none of the stops are working.
- **Emergency mode RHS:** Used if an RHS sensor has stopped working. No stops are working but the rig can still be used with great care.
- **Emergency mode, Break Table:** Normally, the breaking is semi-automatic. Activation allows full manual breaking.
- **Emergency mode, Water Mist:** Normally the watermist system is switched off when the water level in the tank is low (warning in the status bar). If, for example, the level sensor is inoperative then the watermist system can still be used.
- **Beacon on:** Indicates when the warning beacon should be switched on.
- **Units of Measurement:** Select Metric/Imperial units.

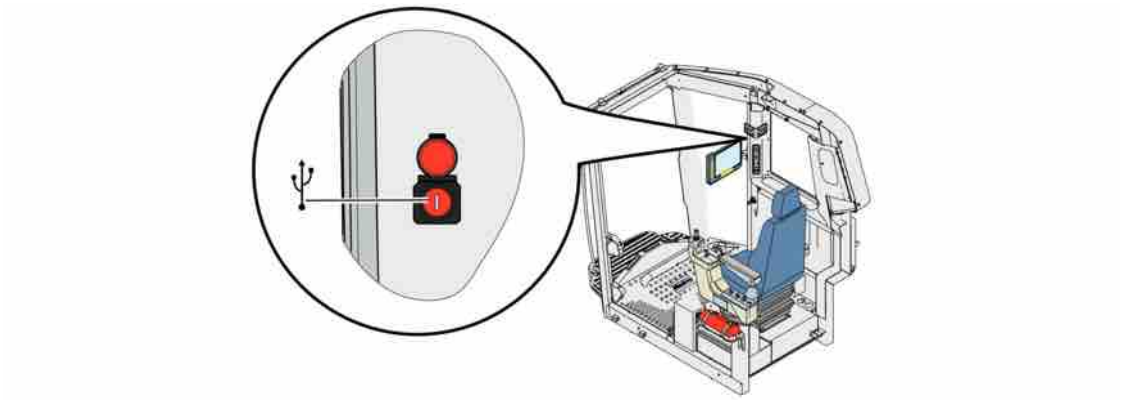


- Increase (+) or decrease (-) the brightness of the display.
- **Activate HECL-Pump manually:** Pump up oil to the rotation unit for a certain time without flushing air being on. Used for example when you have a new down-the-hole drill.
- **Ignore chair switch:** Normally you have to sit in the seat to operate the positioning levers. If the box is checked, you can leave the seat for 10 seconds and still carry out positioning.
- **Emergency mode, Length Sensor:** Used if the length sensor has stopped working. None of the pre-programmed stops will work but the rig can be used until the length sensor has been rectified. Use rapid feed with great care as none of the stops are working.
- **Emergency mode RHS:** Used if an RHS sensor has stopped working. No stops are working but the rig can still be used with great care.
- **Emergency mode, Break Table:** Normally, the breaking is semi-automatic. Activation allows full manual breaking.
- **Emergency mode, Water Mist:** Normally the watermist system is switched off when the water level in the tank is low (warning in the status bar). If, for example, the level sensor is inoperative then the watermist system can still be used.
- **Beacon on:** Indicates when the warning beacon should be switched on.
- **Units of Measurement:** Select Metric/Imperial units.
- **Water Mist Draining:** When Enter is pressed the watermist system is blown clean for 20 seconds. The compressor must be switched on and flushing air must be switched off. After blow-cleaning the watermist system must be switched off and flushing air must be switched on in order to blow away the water from the flushing air hose.



Direct selection menu F2 **Settings 2**

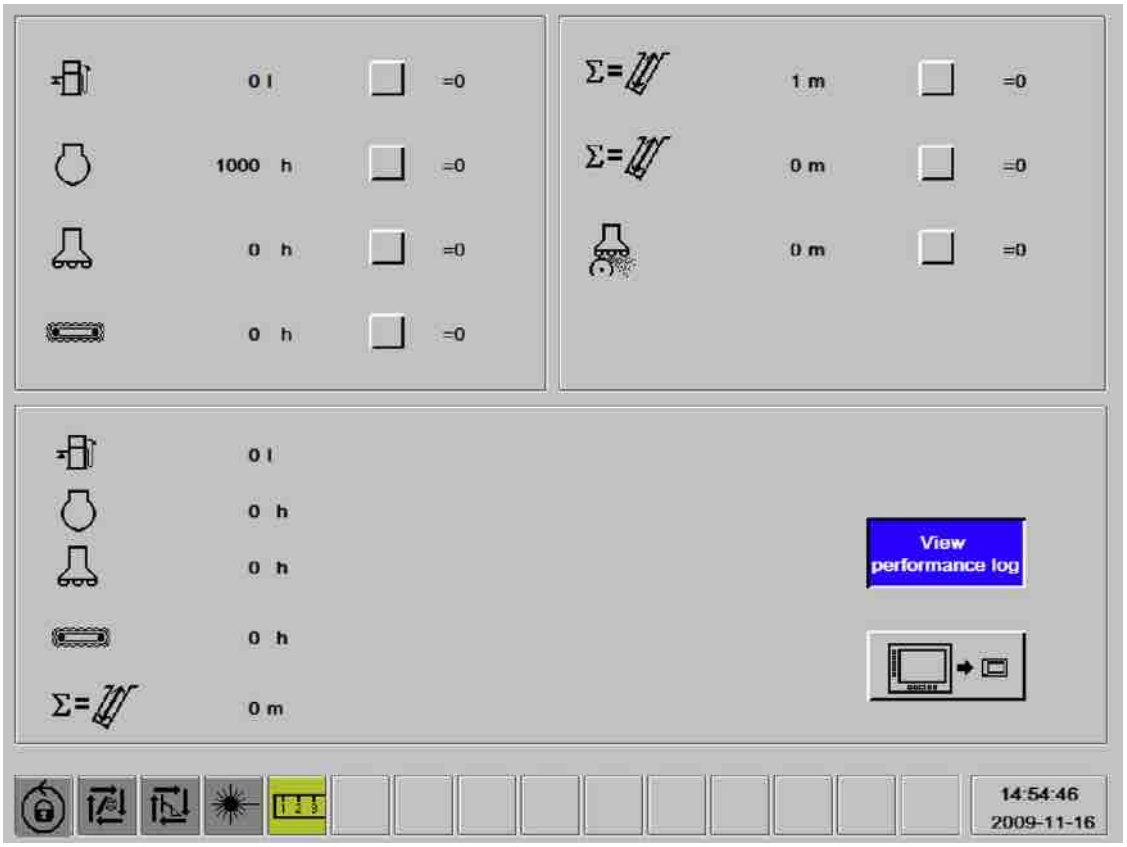
- **Laser Plane:** Selection of laser plane function.
- **Dist. Laser Sens. to Drill Bit**
- **Dist. to Ref. Laser Plan:**Used when there are several laser planes present. The reference plane is always the uppermost laser plane.
- **Magazine Direction Automatic Rod Add**
  - **CW:** The carousel rotates clockwise
  - **CCW:** The carousel rotates anticlockwise
- **Automatic Switching: Jaw / Drill Support:** Automatic function switching for Lever 36 on the left-hand operator's panel. In manual mode Button 3 must be used.
- **Try Rod Add Without Adapter-Rod-Break:** Simplified unthreading without breaking. If unthreading does not succeed then full breaking takes place automatically. Only applies during automatic drilling.
- **MWD logging** (Option): Activates the MWD function. MWD presents a range of values from drilling in the ROC Manager. Requires a USB memory stick in the socket on the right post at the display.



USB Socket

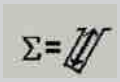
- **Use Drillplan:** Used if import of drill plan from ROC Manager is executed.

5.4.3 Direct selection menu F3.



Direct selection menu F3.

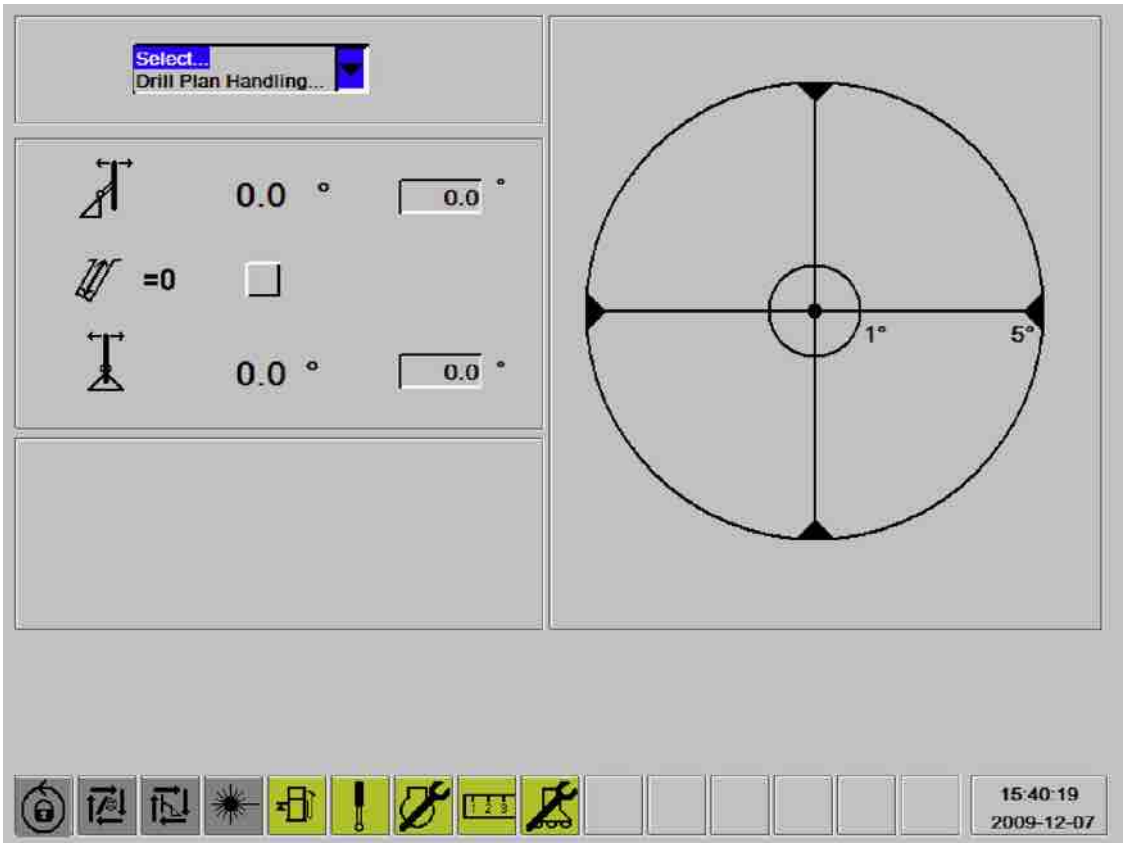
Symbol description for direct selection menu F3

Symbol	Name	Explanation
	Diesel consumption	Resettable counter for showing diesel consumption since last reset.
	Diesel engine hours	Counter for diesel engine hours. Resettable upper, total number of hours below.
	Percussion hours	Counter for percussion hours. Resettable upper, total number of hours below.
	Tramming hours	Counter for tramming hours. Resettable upper, total number of hours below.
	Drill meter	Counter for number of drill metres. Two resettable upper, total number of metres below.

Symbol	Name	Explanation
	Save	Save to USB memory stick for printing on PC.
	Grinding interval	Resettable counter for grinding interval.

- **View performance log:**

5.4.4 Direct selection menu F4.



Direct selection menu F4.

- **Angle position:** Upper value on left shows current tilt of feeder. Next to this value is an adjustable field where the desired tilt angle can be set.
- **Resetting drill meter:** Resetting number of drill metres.
- **Angle position:** The bottom value shows the current swing position of the feeder. Next to this value is an adjustable field where the desired tilt angle can be set.

In order to change the setting, this field must be highlighted and the field activated by pressing the enter button on the display screen or the right drill panel. The value can then be changed using the arrow keys on the display screen or on the right drill panel. Once the desired value has been set, it must be confirmed by pressing the enter button.

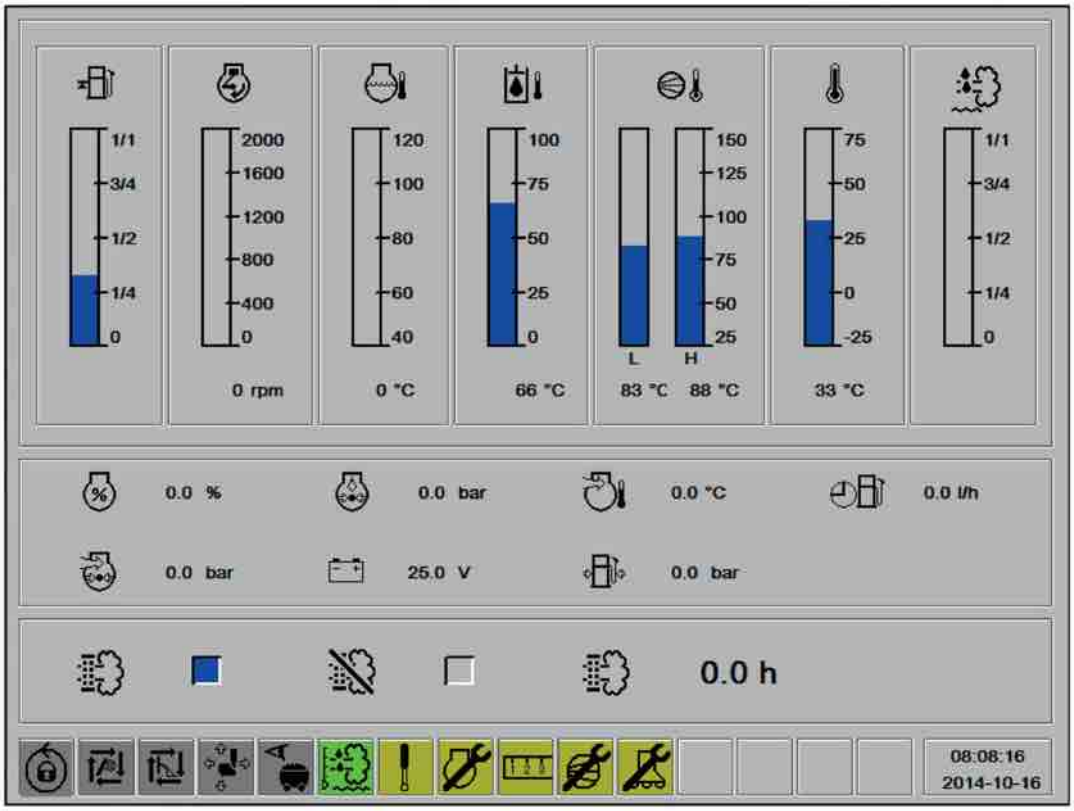
- **The graphic on the right:** Used as a working tool or aid to quickly find the correct angle setting.

To get the lever to the desired value, the positioning lever must be moved in the opposite direction to the way the needle is pointing. This will make the end of the needle shown on the display screen move towards the centre of the graphic image.

The end of the needle reaching the centre of the graphic image means the feeder position is at the desired value.
This setting can also be made using "Automatic feeder positioning" (Extra equipment).

- **Drill Plan Handling:** Create and change drill plan.

5.4.5 Direct selection menu F5



Direct selection menu F5

Direct selection menu F5 activated by pressing the button **Fn** , and then button **F1** on the display. (The Fn button is active for 3 seconds after each press)

This menu shows the values for the diesel engine.

Symbol description for direct selection menu F5

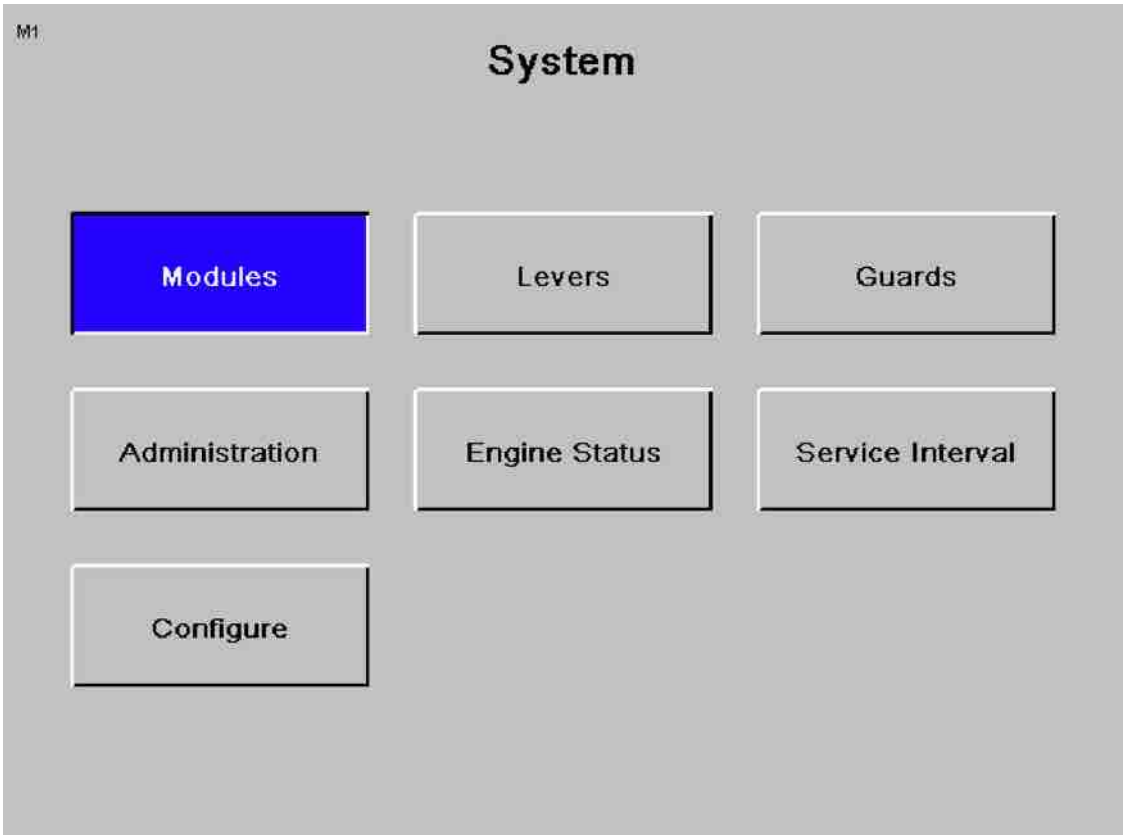
Symbol	Name	Explanation
	Fuel gauge	Shows the level of diesel fuel in the tank. There is a safety level of 80 litres to prevent the tank from running dry. A warning will be shown on the display when the fuel level becomes too low.
	Diesel engine rpm	Reads and displays the current engine speed

Symbol	Name	Explanation
	Coolant temperature	Displays temperature of coolant
	Hydraulic Oil Temp	Displays the temperature of the hydraulic oil
	Compressor temperature	Reads and displays the current compressor temperature. If the compressor attains a high air temperature (120 ºC), the diesel engine will be switched off automatically and an information box will be shown on the display.
	External temperature	Displays the external temperature
	DEF gauge	Shows the level of DEF (Diesel Exhaust Fluid) in the tank
	Engine load	Displays the instantaneous load the diesel engine is exerted to in percent
	Oil pressure	Displays the engine oil pressure when running. Low oil pressure will automatically turn off the diesel engine and an information box will be shown on the display
	Charge air temperature	Displays the instantaneous charge air temperature when running
	Fuel rate	Displays the instantaneous fuel consumption when running
	Boost pressure	Displays the instantaneous boost pressure when running
	Battery status	Displays the charge status of the battery. If there is no charge, an information box will be displayed in the status bar.

Symbol	Name	Explanation
	Fuel pressure	Displays the operating fuel pressure to the injectors
	Forced regeneration	Start forced regeneration
	Block regeneration	Block automatic regeneration
	Max. time left before regeneration	Shows maximum time remaining until automatic regeneration of the diesel engine's particulate filter

5.5 System

5.5.1 Menu System



System

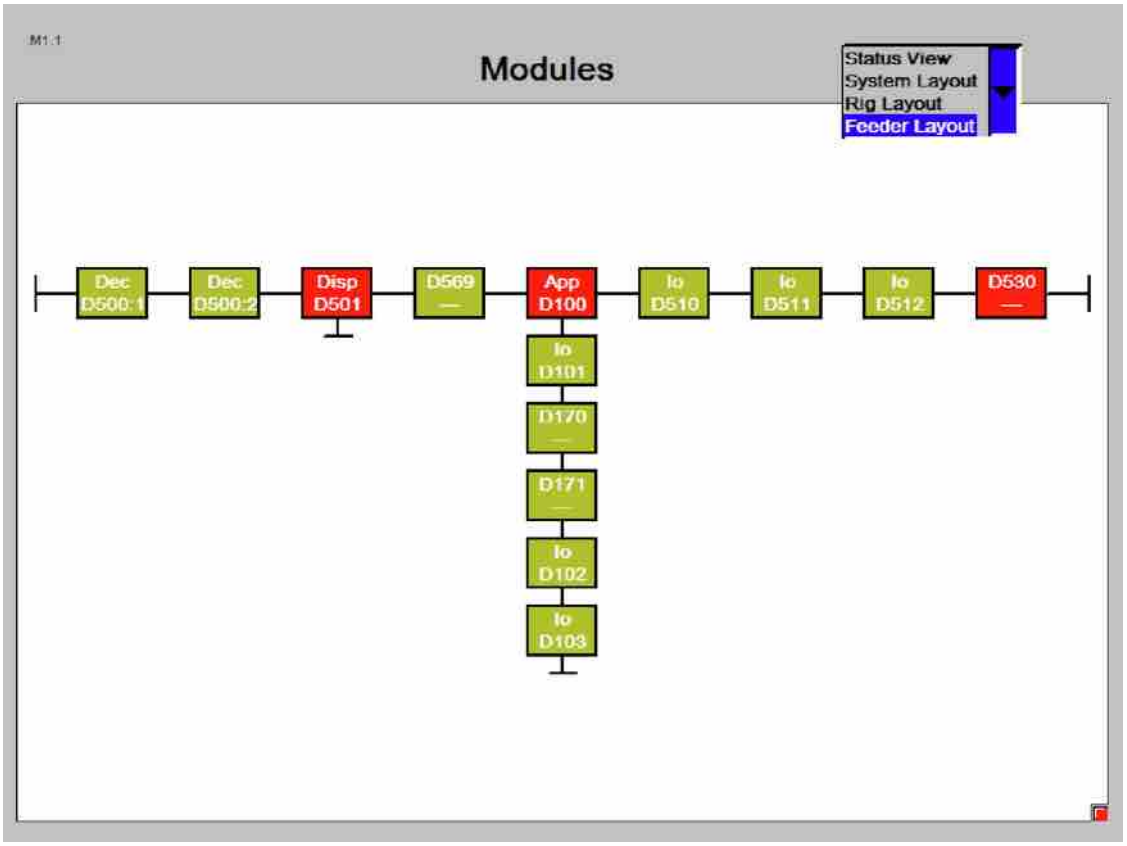
- **Modules**
- **Levers**
- **Guards**
- **Administration**

- **Engine Status**
- **Service Interval**
- **Configure**

5.5.2 System - Modules

Four different views can be selected:

1. **Status View**
2. **System Layout**
3. **Rig Layout**
4. **Feeder Layout**



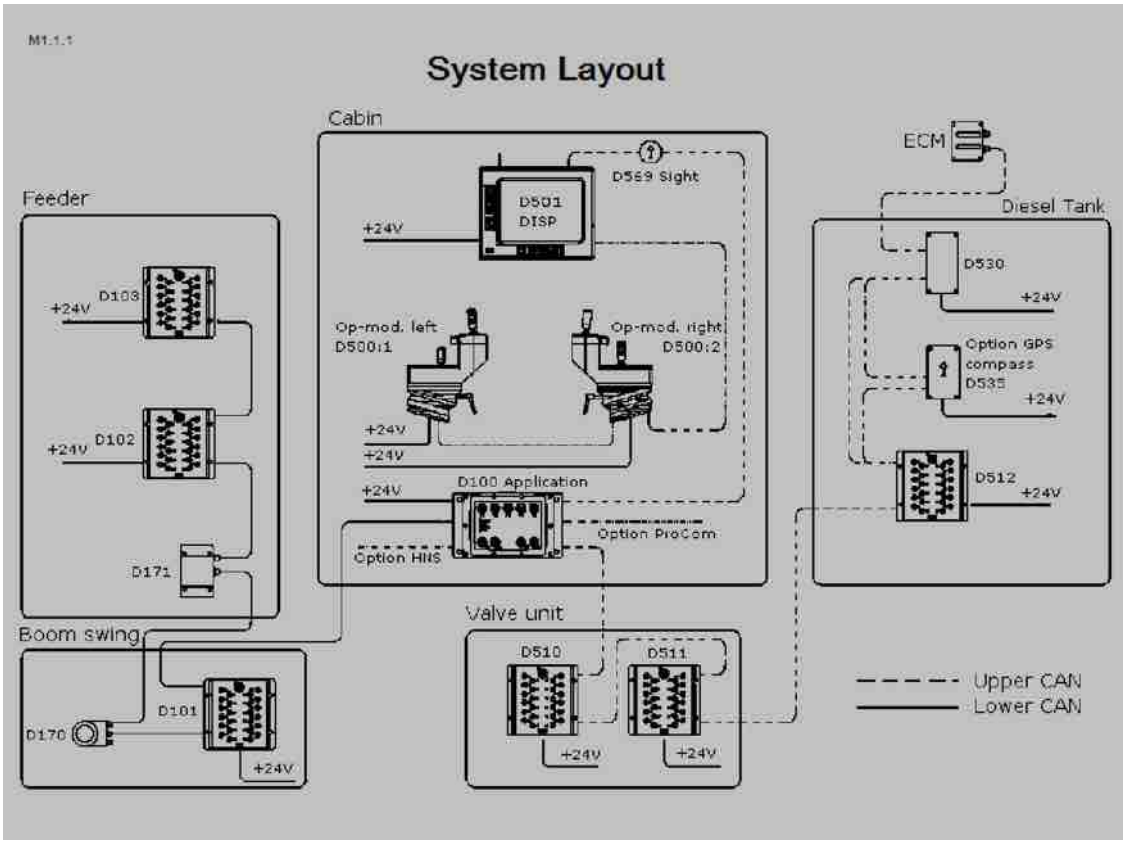
Status View

The status of all the modules can be checked in this menu:

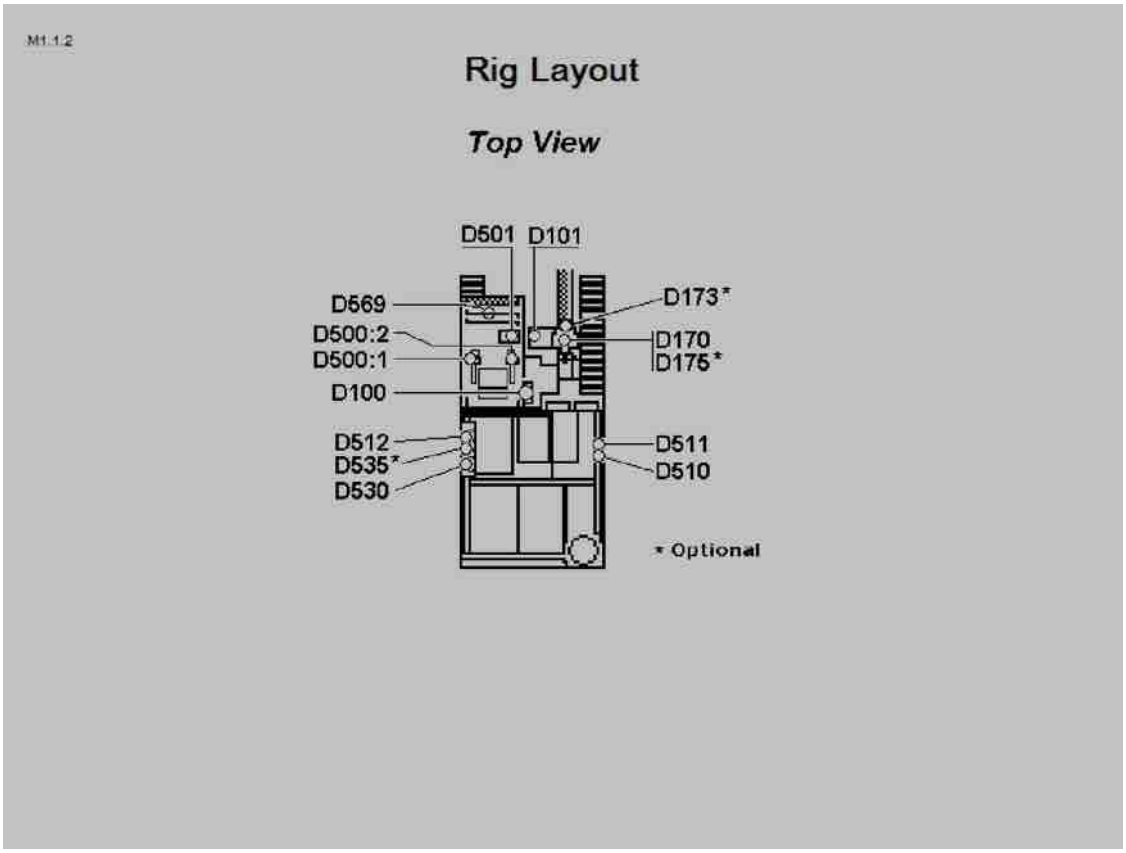
- D500:1 Left lever module
- D500:2 Right lever module
- D501 Operator's display
- D569 Aim
- D100 Application module
- D510 I/O module
- D511 I/O module
- D512 I/O module
- D530 CAN bridge
- D101 I/O module
- D170 Boom articulation sensor
- D171 Feed Inclinometer Sensor

- D102 I/O module
- D103 I/O module

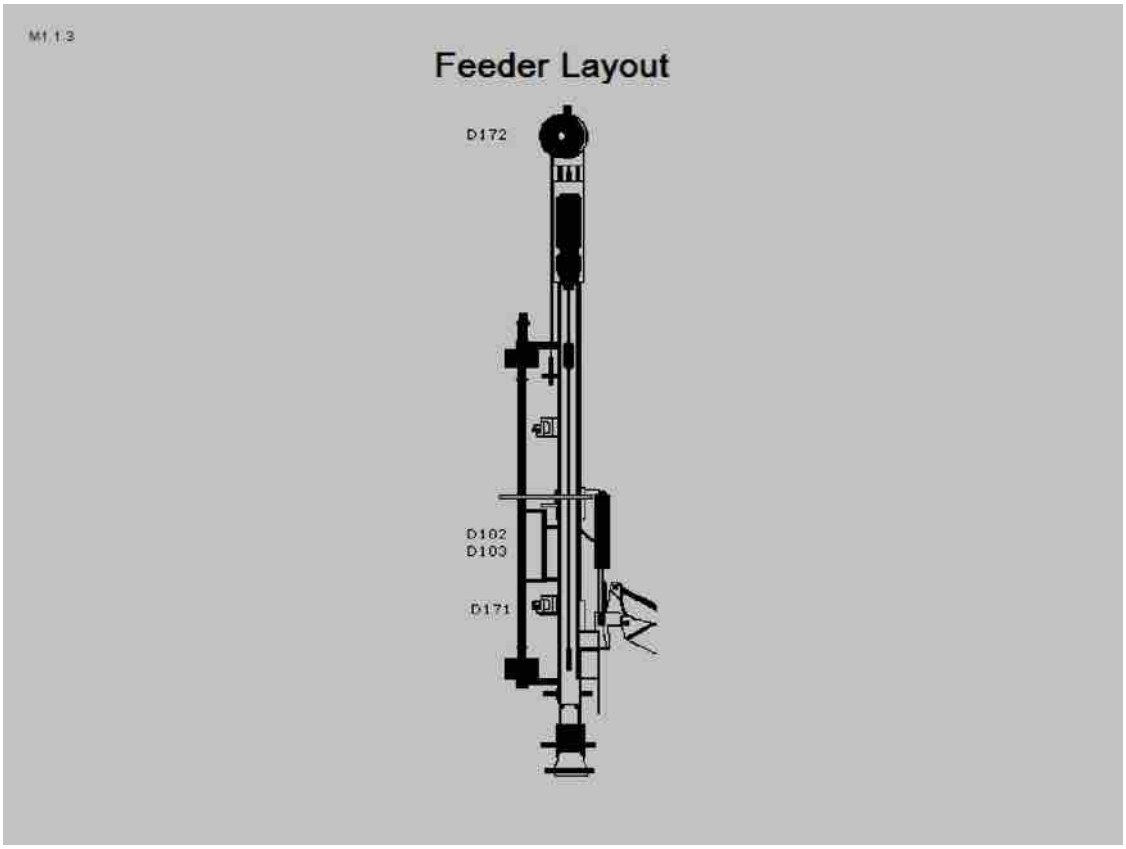
Select the module using the arrow keys and open it with Enter to see the message that the system has written for the module. (These figures are not shown.)



System Layout

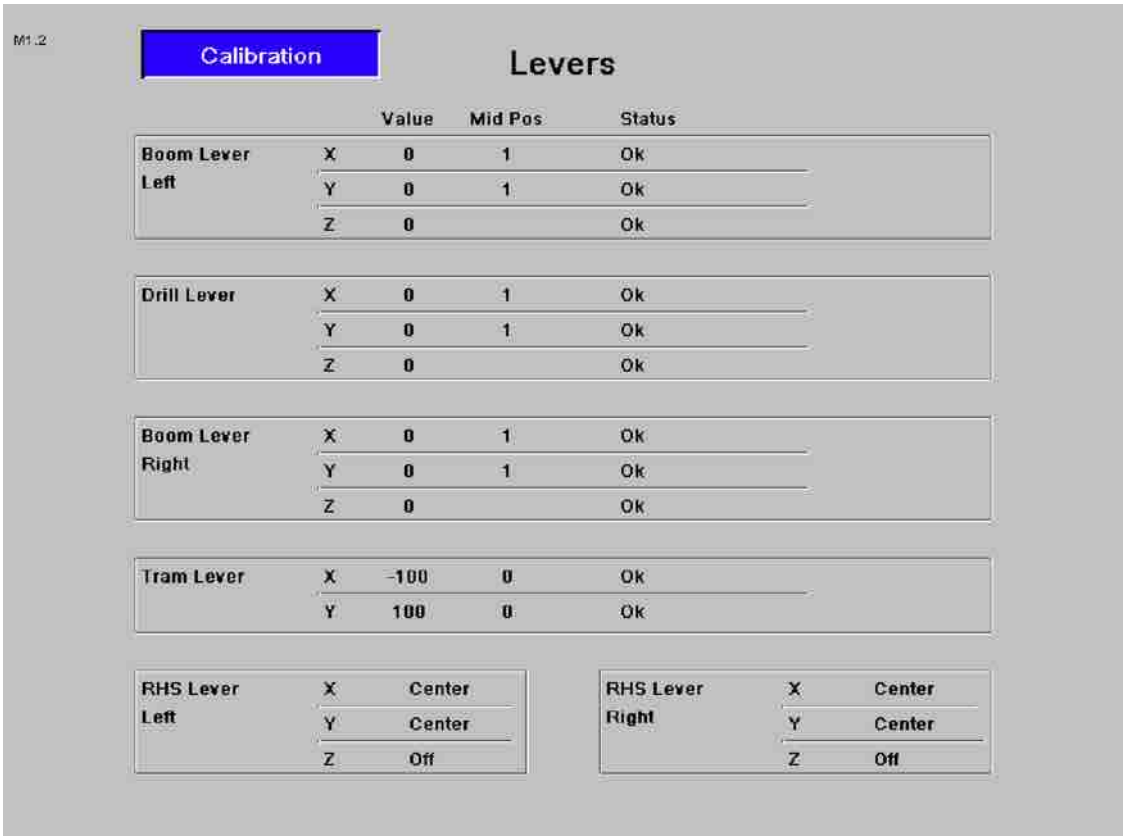


Rig Layout



Feeder Layout

5.5.3 System - Levers

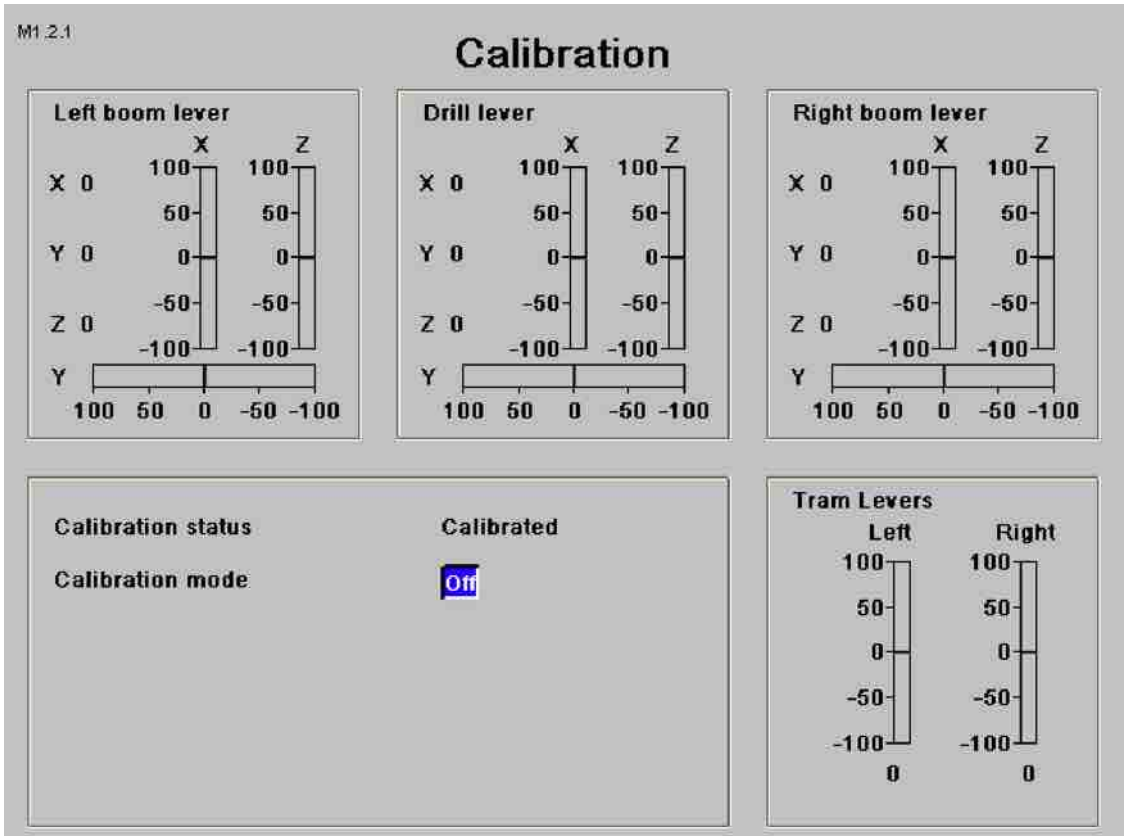


Levers.

The lever function can be checked in this menu by moving the lever in its X axis (rotation left/right) and Y axis (feed forward/back). If the lever is working, you should see its actuation value, 0 - 127 units. If a lever is replaced or if the lever gives an actuation value lower than 115 or higher than 127 units, all the levers must be recalibrated (see **Calibration** levers below). The function of the rocker switch can also be tested by pressing in the left/right-hand side of the lever head and the button **Left**/**Right** should then be indicated on the display screen.

- **Boom Lever Left**
- **Drill Lever**
- **Boom Lever Right**
- **Tram lever**
- **RHS Lever Left**
- **RHS Lever Right**

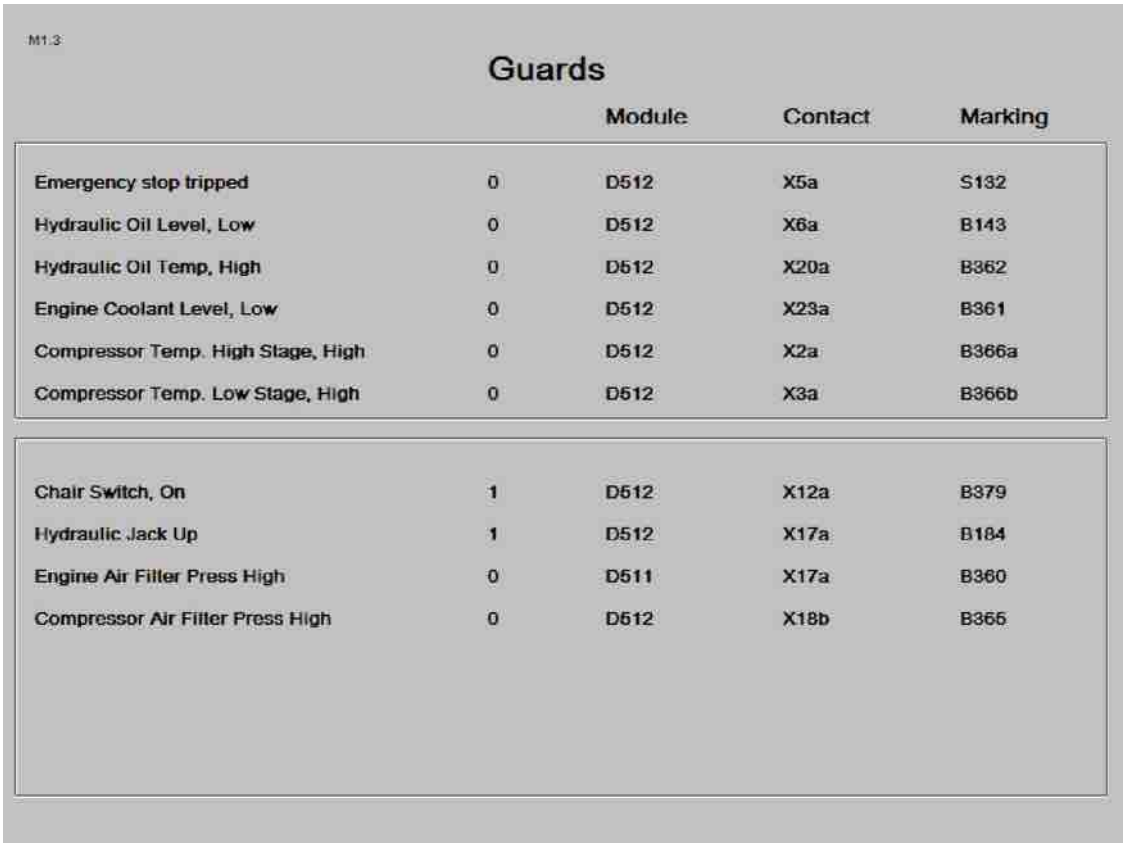
System - levers - calibration



Calibration

- **Calibration status:** Indicates whether the levers have been calibrated
- **Calibration mode:** With calibration mode activated, none of the functions will be actuated, and it will only be the lever movements that will be shown as a reading on the display.
- **Calibrated:** Calibration is performed by moving the levers to their end positions on all axes, also the lever's side button.

5.5.4 System - Monitors



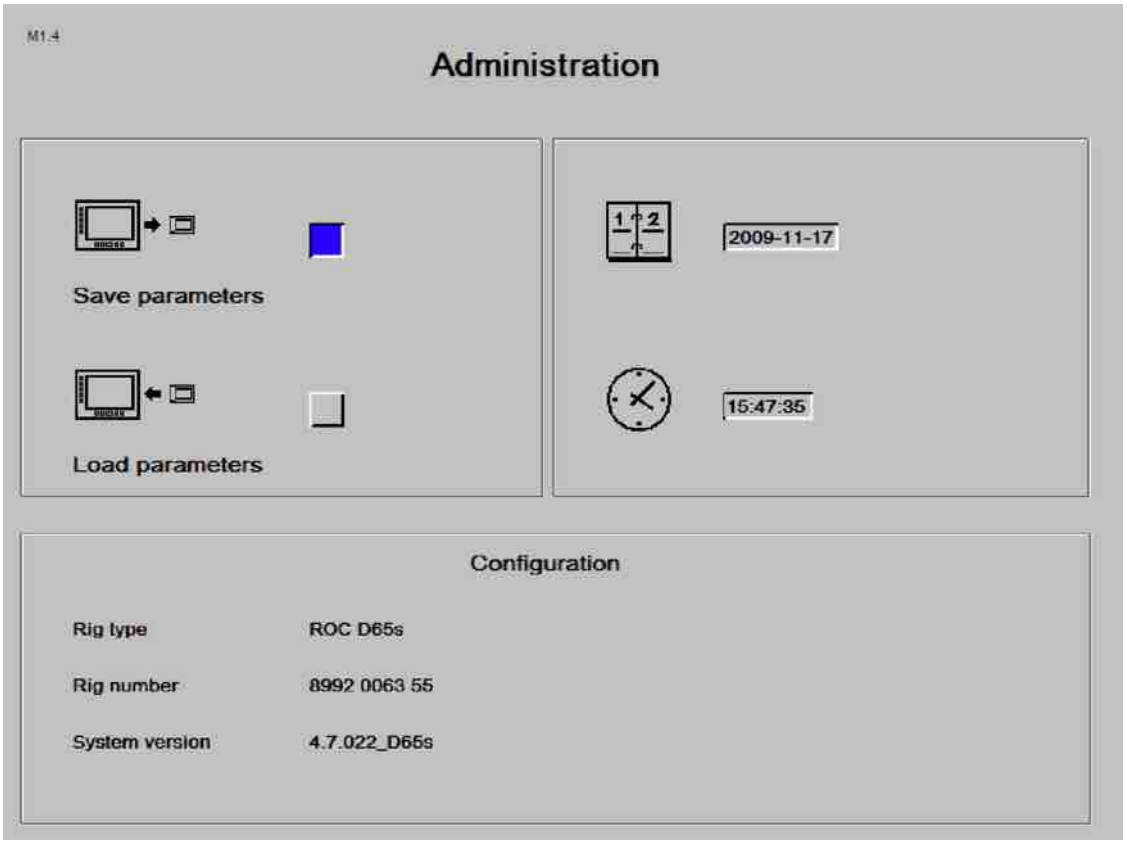
Guards.

The status of the various guards (On/Off) can be read from the **Guards** menu. The module, marking and connector each sensor has on the module is also specified here. This means it is easier to locate the source of the fault so that it can be rectified more quickly.

The monitors in the top box turn off the diesel engine.

- **Emergency stop tripped**
- **Hydraulic Oil Level, Low**
- **Hydraulic Oil Temp, High**
- **Engine Coolant Level, Low**
- **Compressor Temp. High Stage, High**
- **Compressor Temp. Low Stage, High**
- **Chair Switch, On**
- **Hydraulic Jack Up**
- **Engine air filter press. high**
- **Compressor Air Filter Press High**

5.5.5 System - administration



Administration

In this menu, you can save drill parameters for later retrieval in case of fault finding or upgrading of existing software to a later version. The information is saved on a USB memory stick.

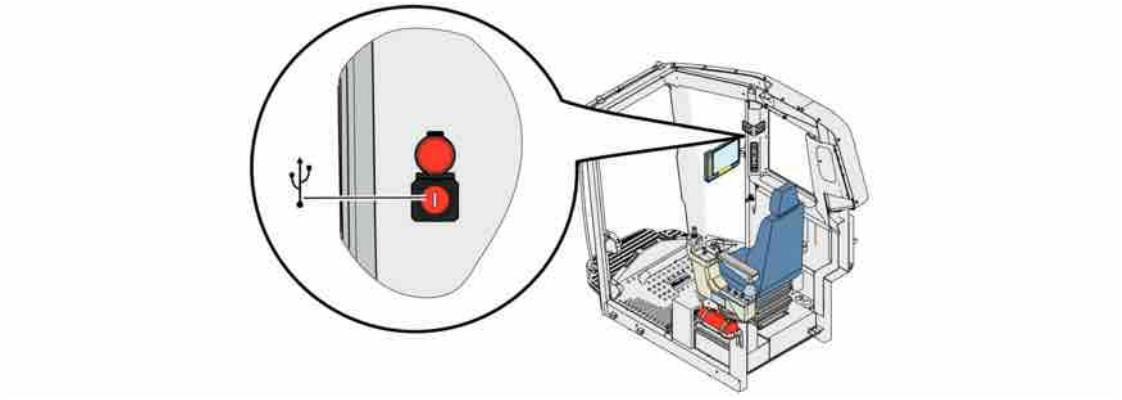
! ***NOTE:*** *Only use USB memory sticks from Atlas Copco.*

Save parameters: Parameters are saved on a USB memory stick.

Load parameters: Parameters are retrieved from a USB memory stick.

! ***NOTE:*** *For all reprogramming, first make sure that all the parameters are saved on a USB memory stick so they can be downloaded into the new version of the software later.*

Saving and loading parameters



USB Socket

Save parameters is used when all settings have been made and you want to save a back-up copy on a USB memory stick.

Load parameters is used when you want to read parameters into the RCS system from a USB memory stick.

1. Insert the USB memory stick into the USB socket.
2. Use the arrow keys to move to **Save parameters** or to **Load parameters** and press Enter.

> ! ***NOTE:*** *A text box will appear on the screen and when the operation is complete "OK" will be displayed.*

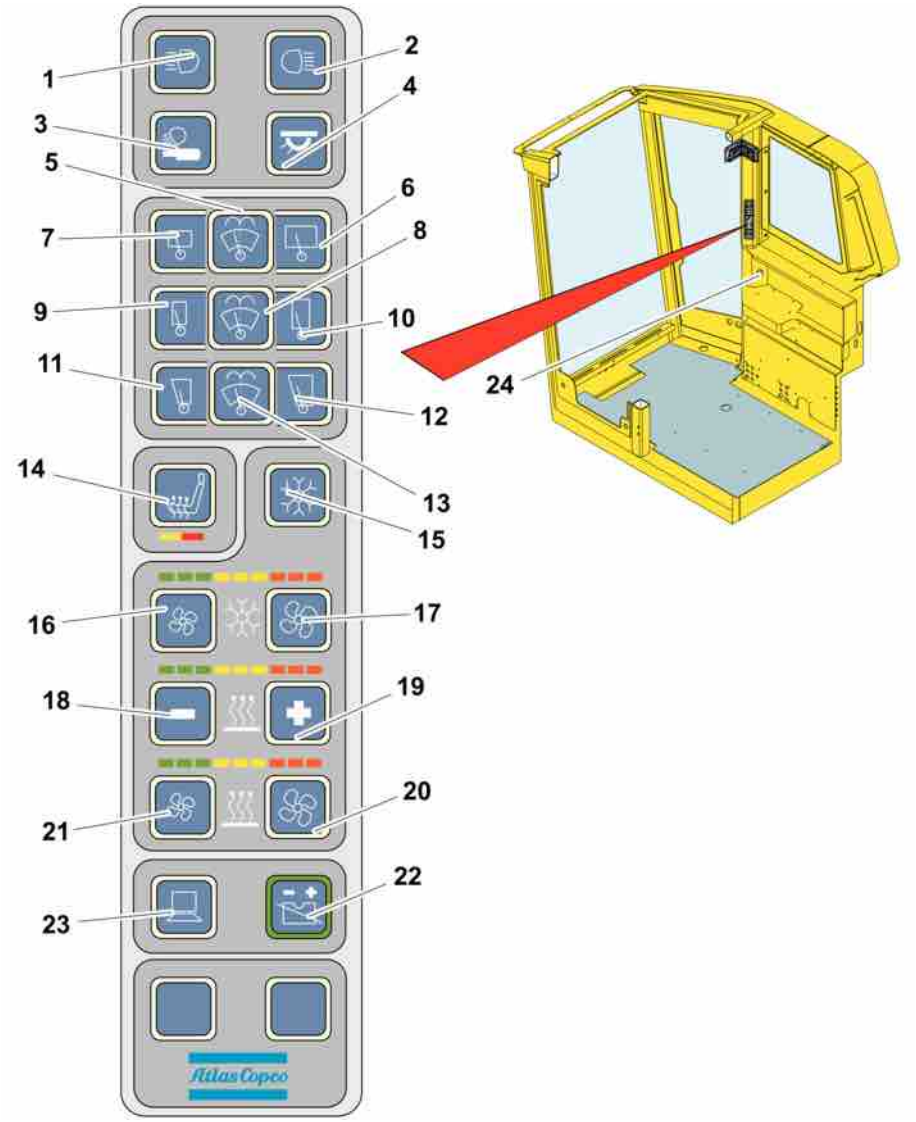
3. Remove the USB memory stick.

5.5.6 Loading new software

> ! ***NOTE:*** *All settings are deleted when new software is loaded. Before loading new software, the parameter settings must therefore be saved onto a USB memory stick.*

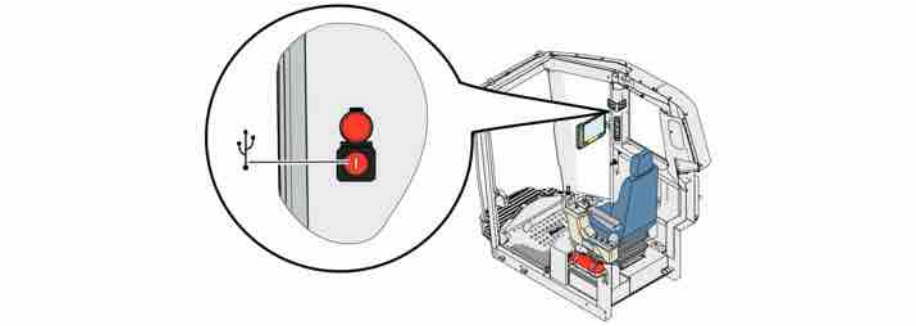
In certain cases a new "boot program" must be loaded in conjunction with new software. The boot program is loaded as described below. The boot program must always be loaded first.

1. Turn off the RCS system with button (23) RCS.



Control panel for operator's cabin.

2. Insert the USB memory stick with the new software into the USB socket.



USB Socket

3. Start the RCS system.

> **NOTE:** *The system now reads the new software and displays the "Load ready!" message on the screen when finished. Remove the USB memory stick and restart the control system.*

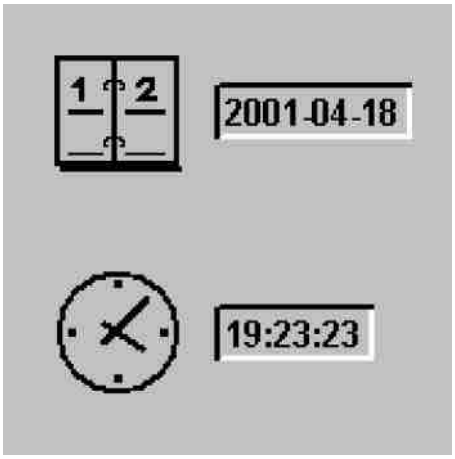
4. Remove the USB memory stick and switch off the RCS system again.
5. Restart the RCS system.
6. If you want to use the same settings as previously and they are saved on a USB memory stick, they can now be loaded into the system. See the section Saving and loading parameters.

! ***NOTE:*** *Only use USB memory sticks from Atlas Copco.*

Date and time

The date and time may have to be set on a new rig or if new software has been loaded.

Many settings are made by changing an existing numerical value, e.g. setting the date and time in the **Administration** menu.

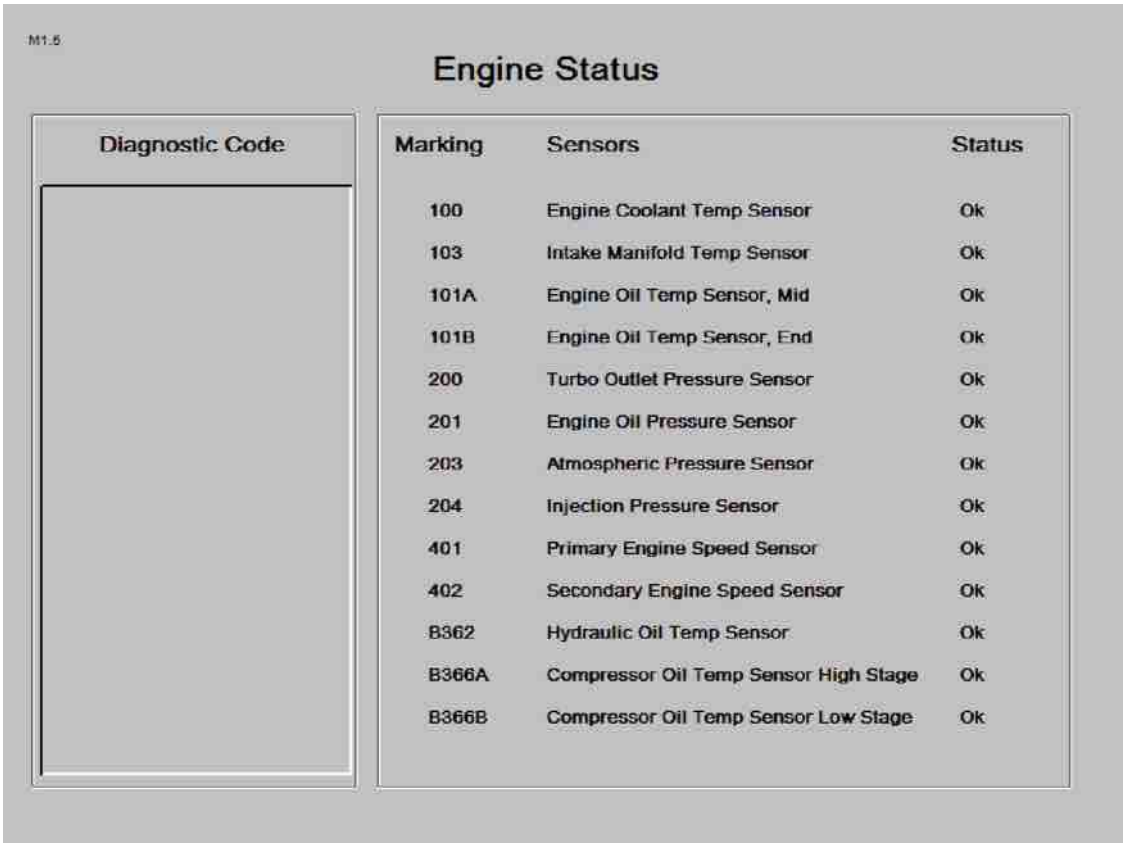


Date and time in the **Administration** *menu*

1. Move the cursor to the current numerical value using the arrow keys. The entire value will be highlighted.
2. Press the enter button. One individual number will now be highlighted in another colour.
3. Increase the value with the up-arrow key and lower the value with the down-arrow key.
4. Complete by pressing Enter.

In certain cases the numerical value may have several digits. In such cases, change one digit at a time. Use the left and right arrow keys to move the cursor to the desired digit (ones, tens, etc.).

5.5.7 System - Engine status



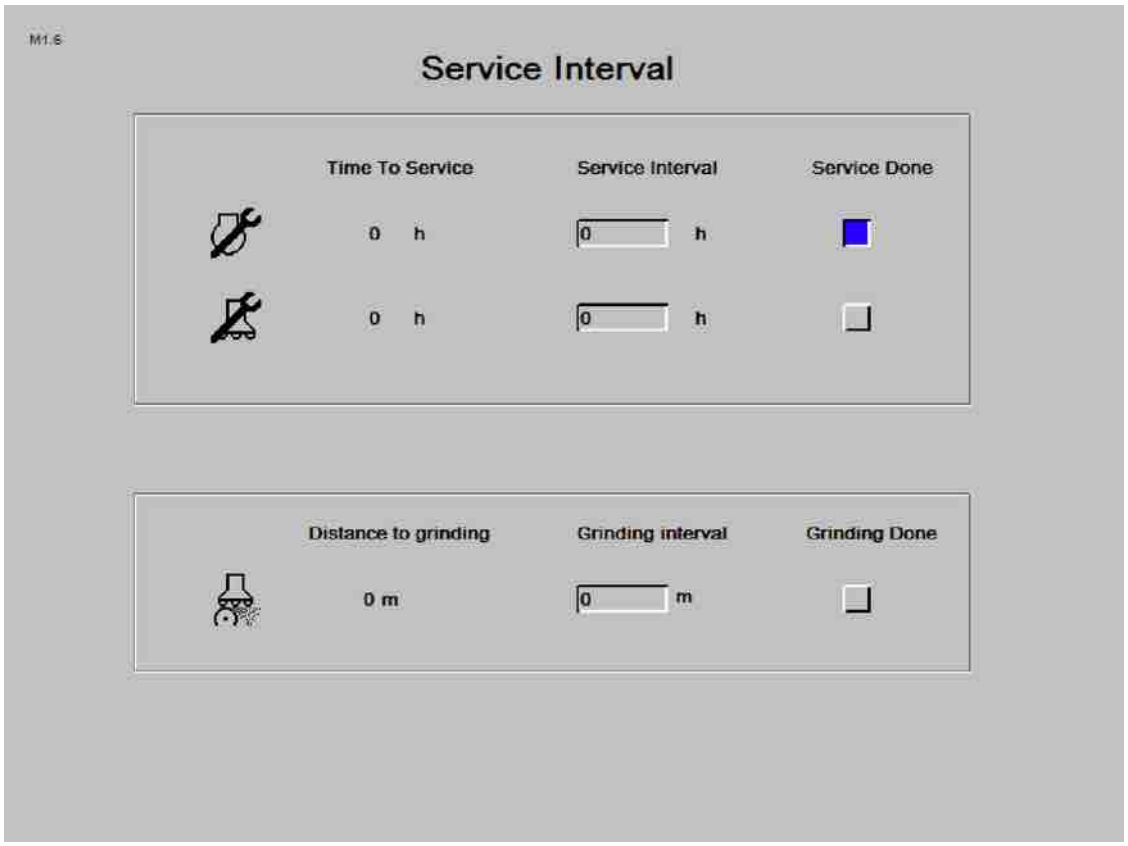
Engine Status

The status of all the sensors associated with the engine can be checked in the **Engine Status** menu.

In conjunction with each fault, a diagnostic code will appear on the scroll list on the left. This code can be translated to clear text in the diesel engine manufacturer's manual.

- 100 **Engine Coolant Temp Sensor**
- 103 **Intake Manifold Temp Sensor**
- 101A **Engine Oil Temp Sensor, Mid**
- 101B **Engine Oil Temp Sensor, End**
- 200 **Turbo Outlet Pressure Sensor**
- 201 **Engine Oil Pressure Sensor**
- 203 **Atmospheric Pressure Sensor**
- 204 **Injection Pressure Sensor**
- 401 **Primary Engine Speed Sensor**
- 402 **Secondary Engine Speed Sensor**
- B362 **Hydraulic Oil Temp Sensor**
- B366A **Compressor Oil Temp Sensor High Stage**
- B366B **Compressor Oil Temp Sensor Low Stage**

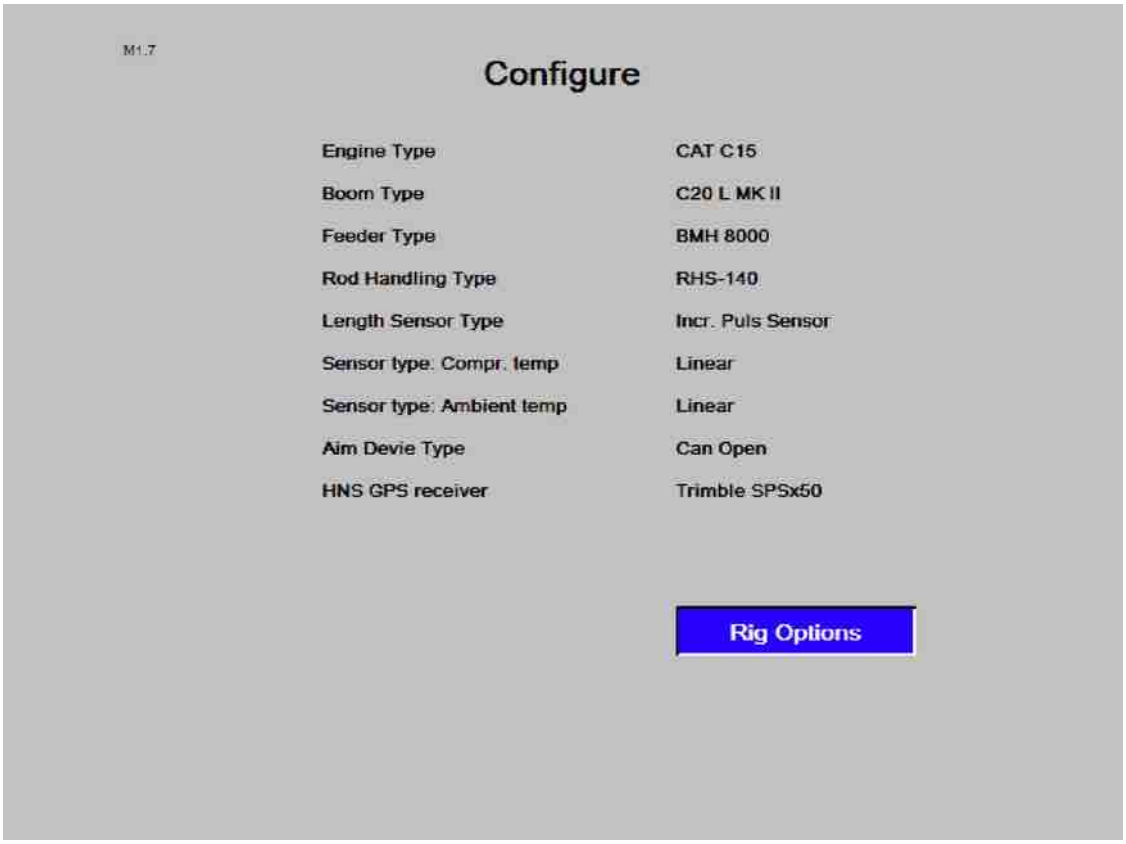
5.5.8 System - Service Interval



Service Interval

- **Time To Service**
- **Service Interval**
- **Service Done**
- **Distance to grinding**
- **Grinding interval**
- **Grinding Done**

5.5.9 System - Configuration



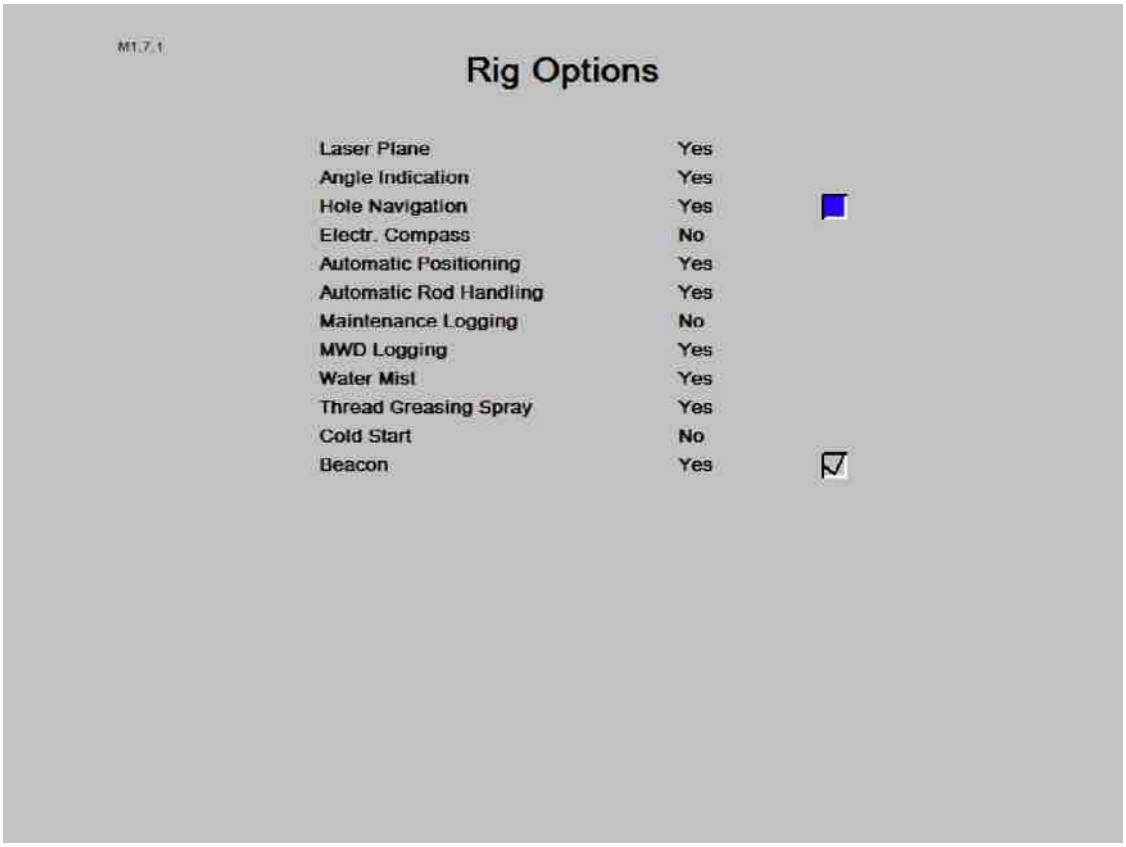
Configure

In the **Configuration** menu you can see how the rig is equipped.

Configuration file: An approved configuration file means that the rig's software is consistent with the equipment on the rig.

- **Engine type**
- **Boom type**
- **Feeder type**
- **Rod Handling Type**
- **Length Sensor Type**
- **Sensor type: Compr. temp**
- **Sensor type: Ambient temp**
- **Aim Device Type**
- **HMS GPS receiver**

5.5.10 System - Rig Options



Rig Options

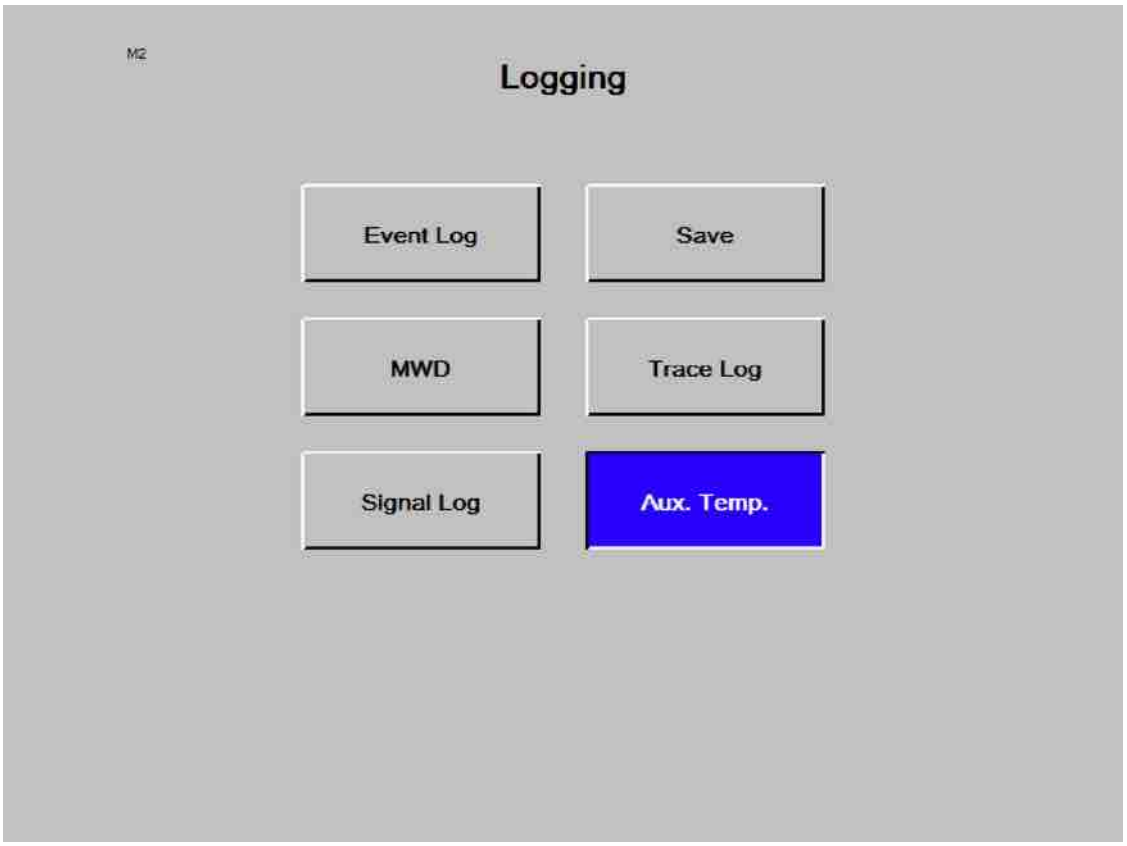
This menu shows which **Rig Options** are active on the rig

Certain rig options can be activated or deactivated by checking the box to the right and pressing Enter.

- **Laser plane**
- **Angle Indication**
- **Hole navigation**
- **Electr. Compass**
- **Automatic positioning**
- **Automatic rod handling**
- **Maintenance Logging**
- **MWD logging**
- **Water mist on**
- **Thread Greasing Spray**
- **Cold Start**
- **Beacon**

5.6 Logging

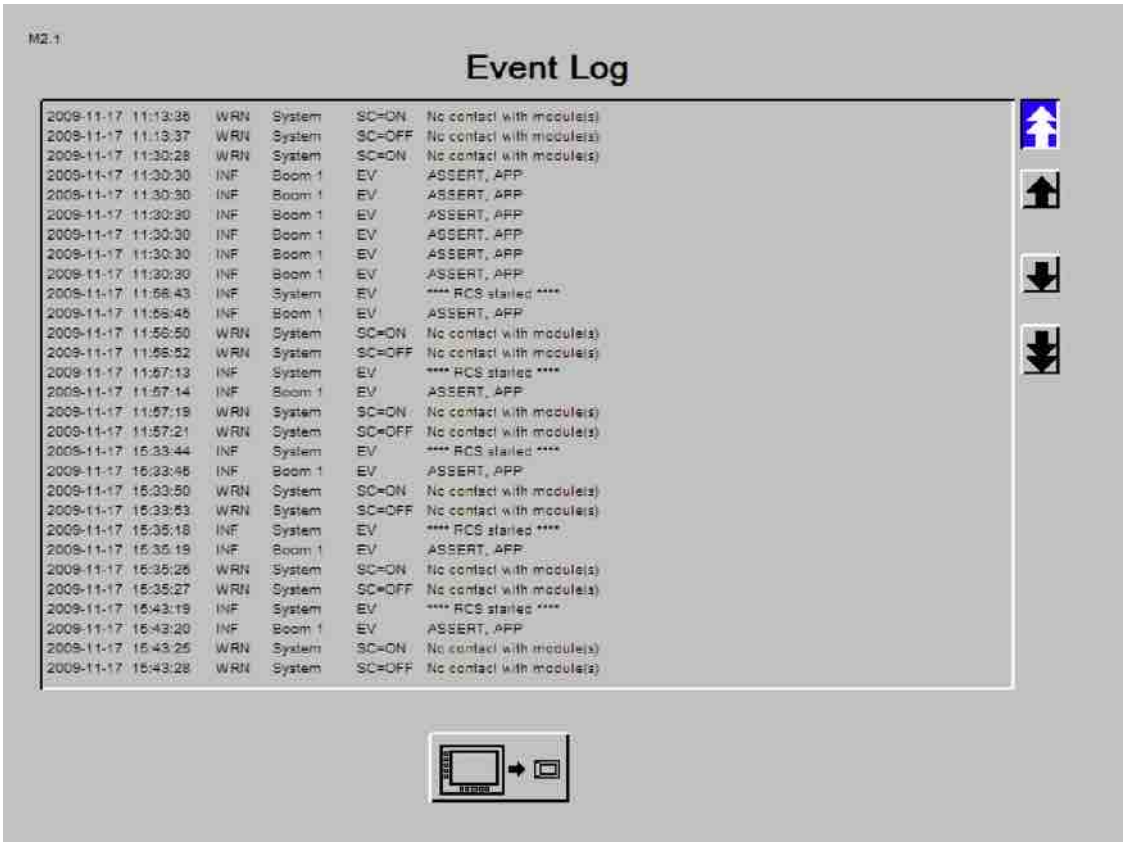
5.6.1 Logging Menu



Logging

- **Event Log**
- **Save**
- **MWD**
- **Trace Log**
- **Signal Log**
- **Aux. Temp.**

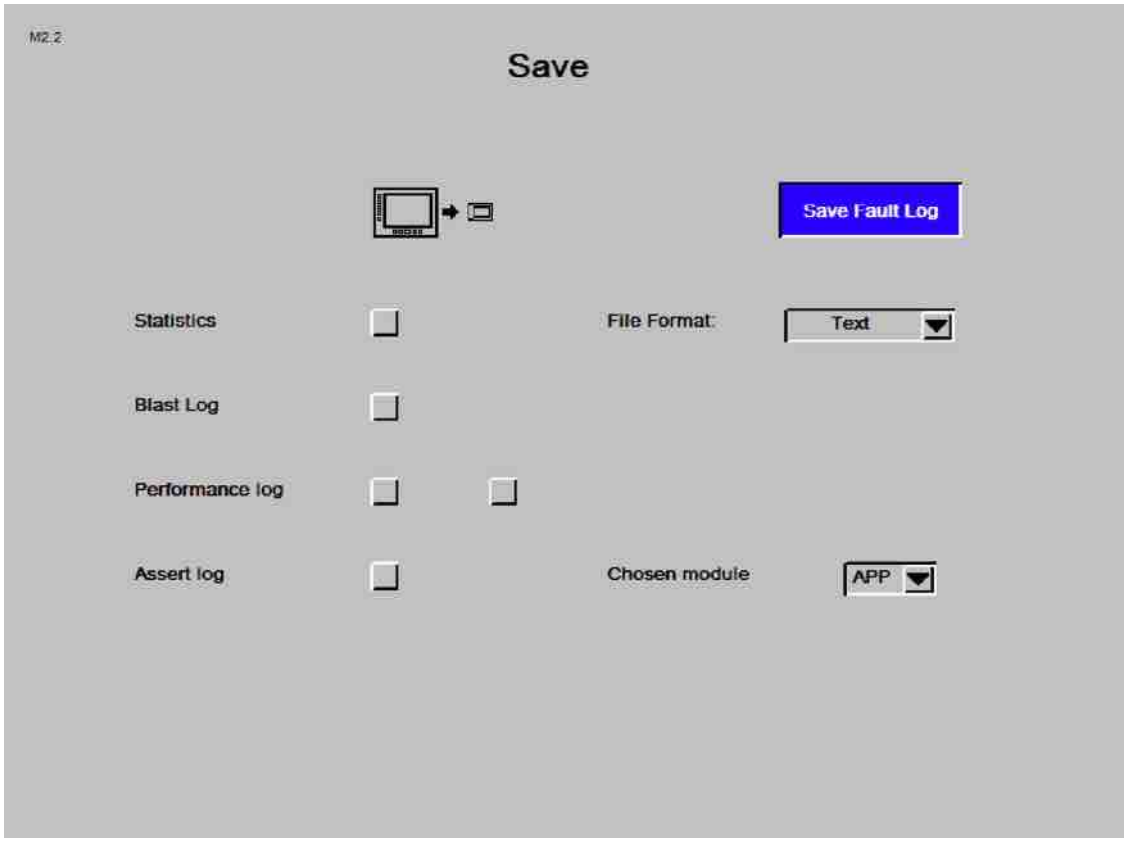
Logging - Event Log



Event Log

Save **Event Log** by inserting a USB memory stick into the USB socket on the right-hand pillar behind the display and select the button at the bottom of the display using the arrow keys, press Enter.

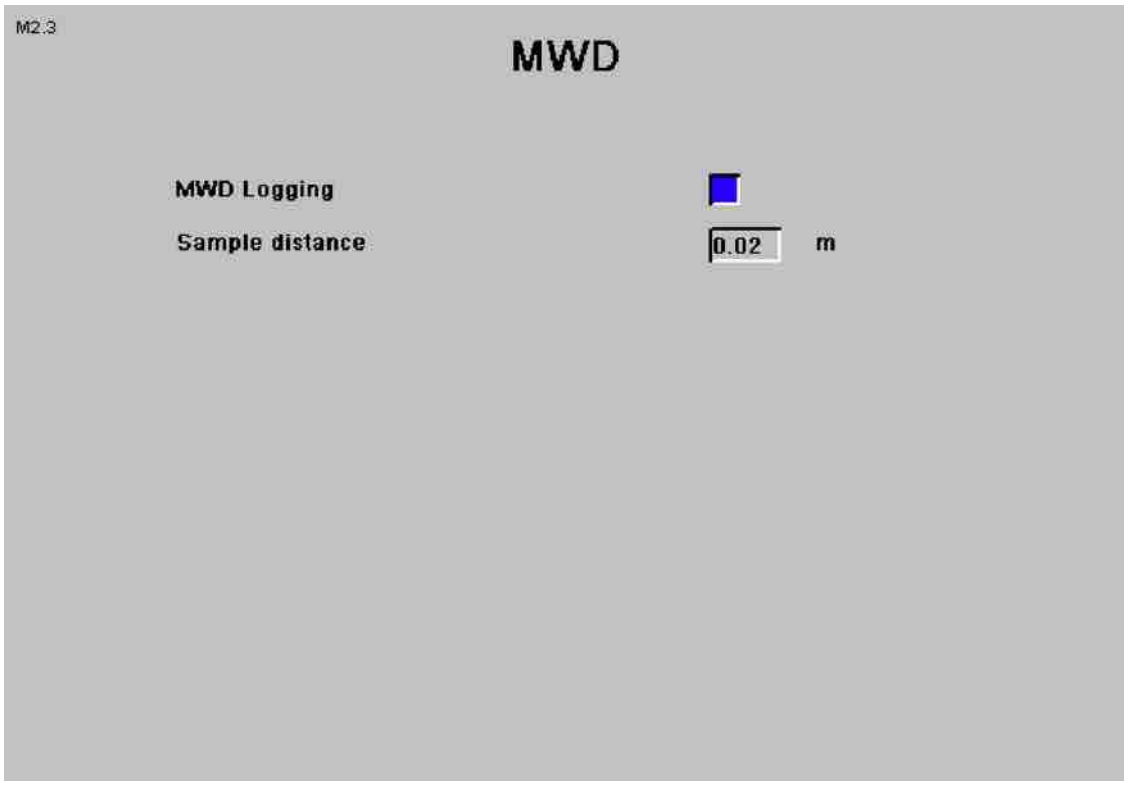
Logging - Save



Save

- **Statistics:** Save statistics from the rig. Can be saved as text or spreadsheet depending on what it is going to be used for.
- **Blast log:** Used when the log from the round is to be exported to ROC Manager.
- **Performance log:** Used when saving the last thirty holes.
- **Assert log**

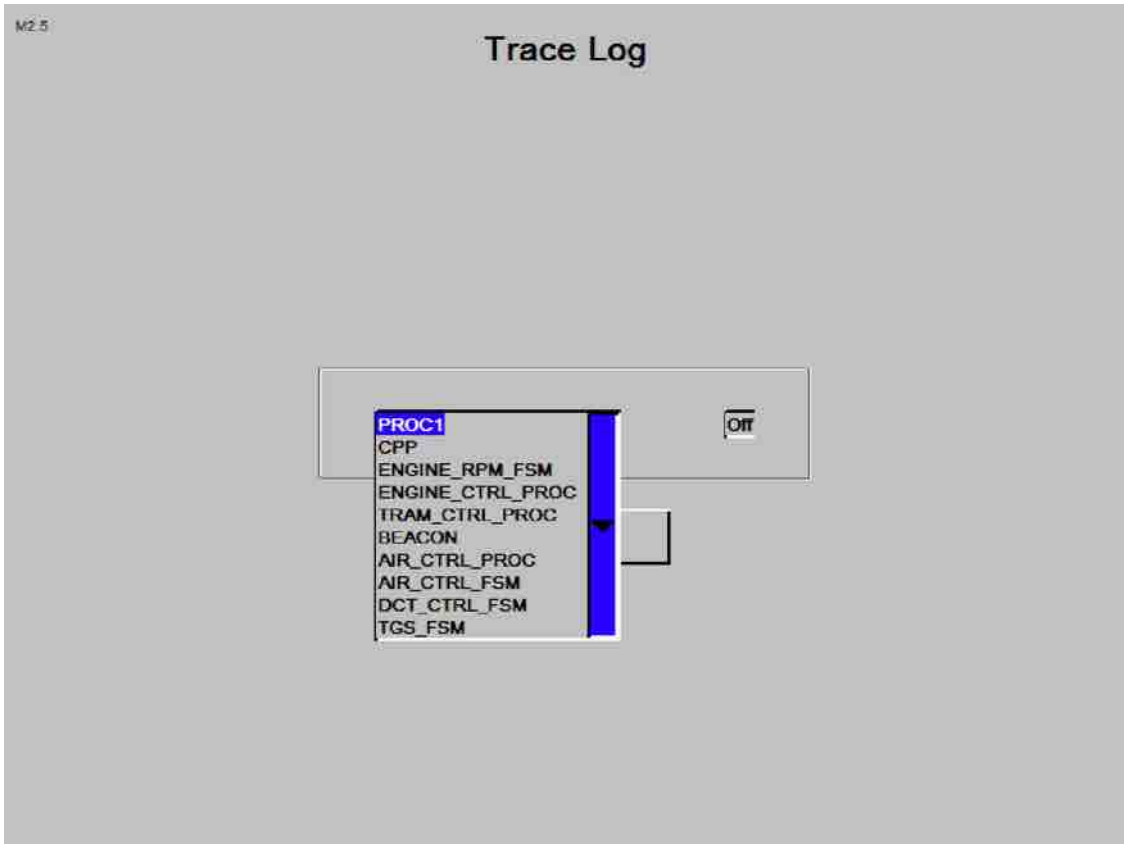
Logging - MWD



MWD

- **MWD Logging:** Off or On.
- **Sample distance:** The interval with which MWD is saved.

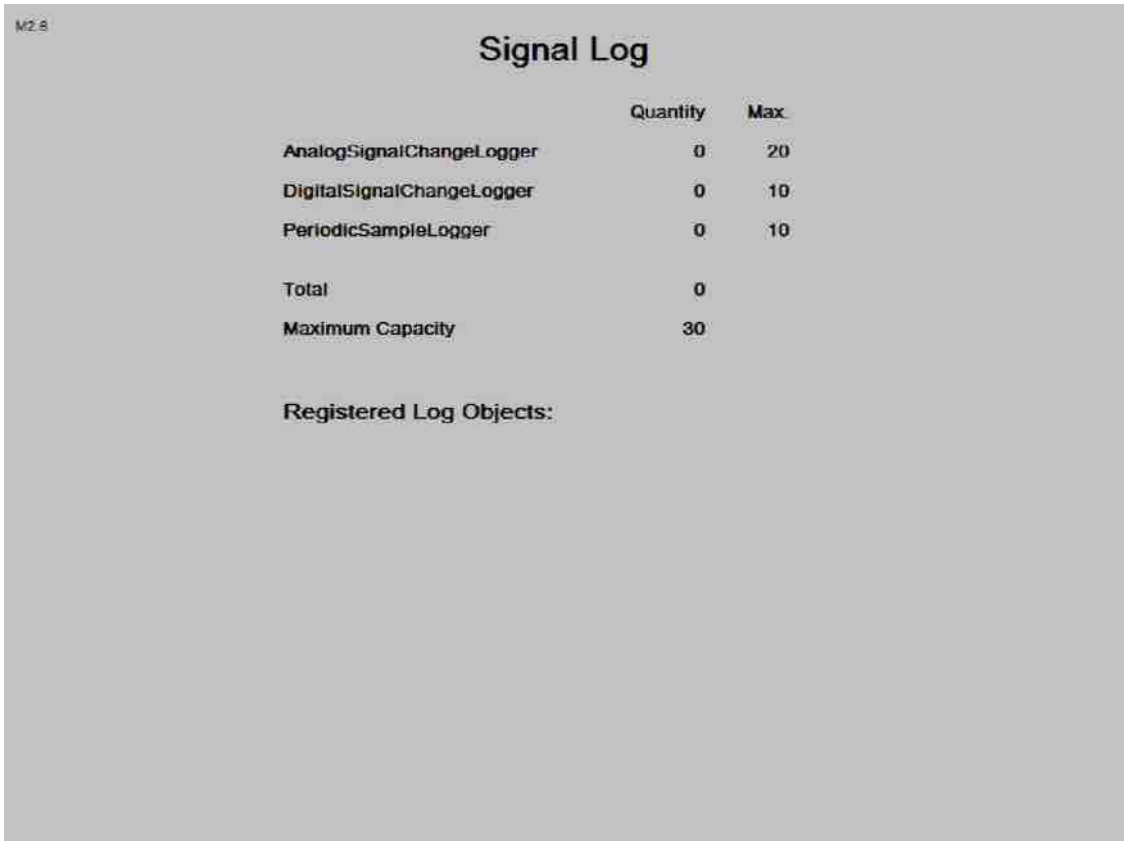
Logging - Trace Log



Trace Log

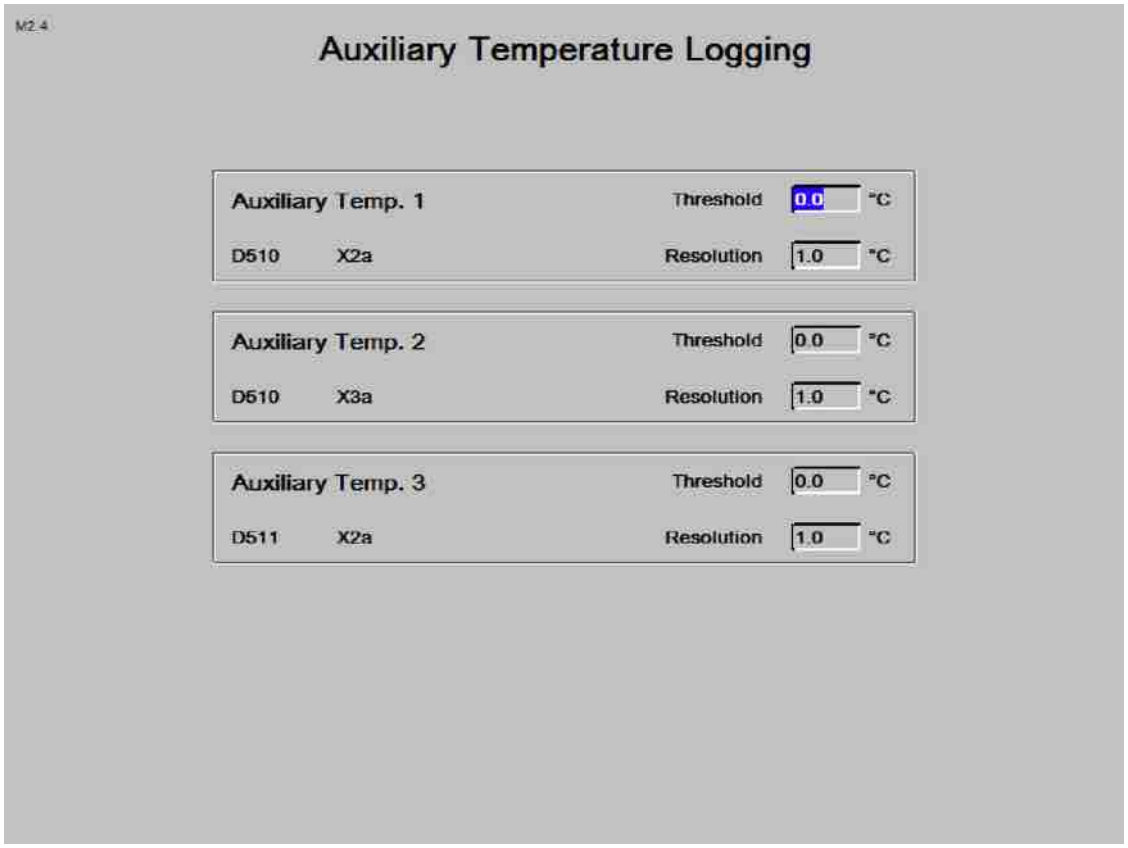
Only used after contact with staff from Atlas Copco.

Logging - Signal Log



Signal Log

Logging - Auxiliary Temperature Logging

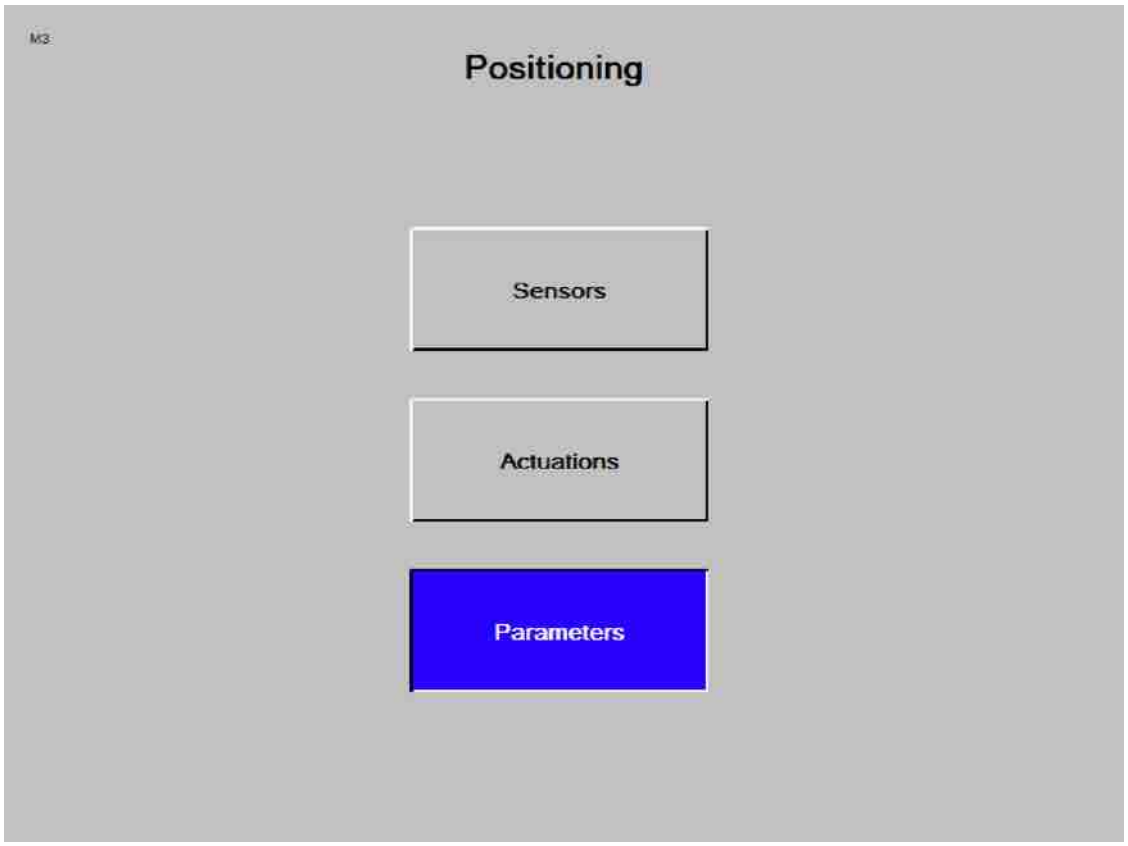


Aux. Temp.

- **Threshold**
- **Resolution**

5.7 Positioning

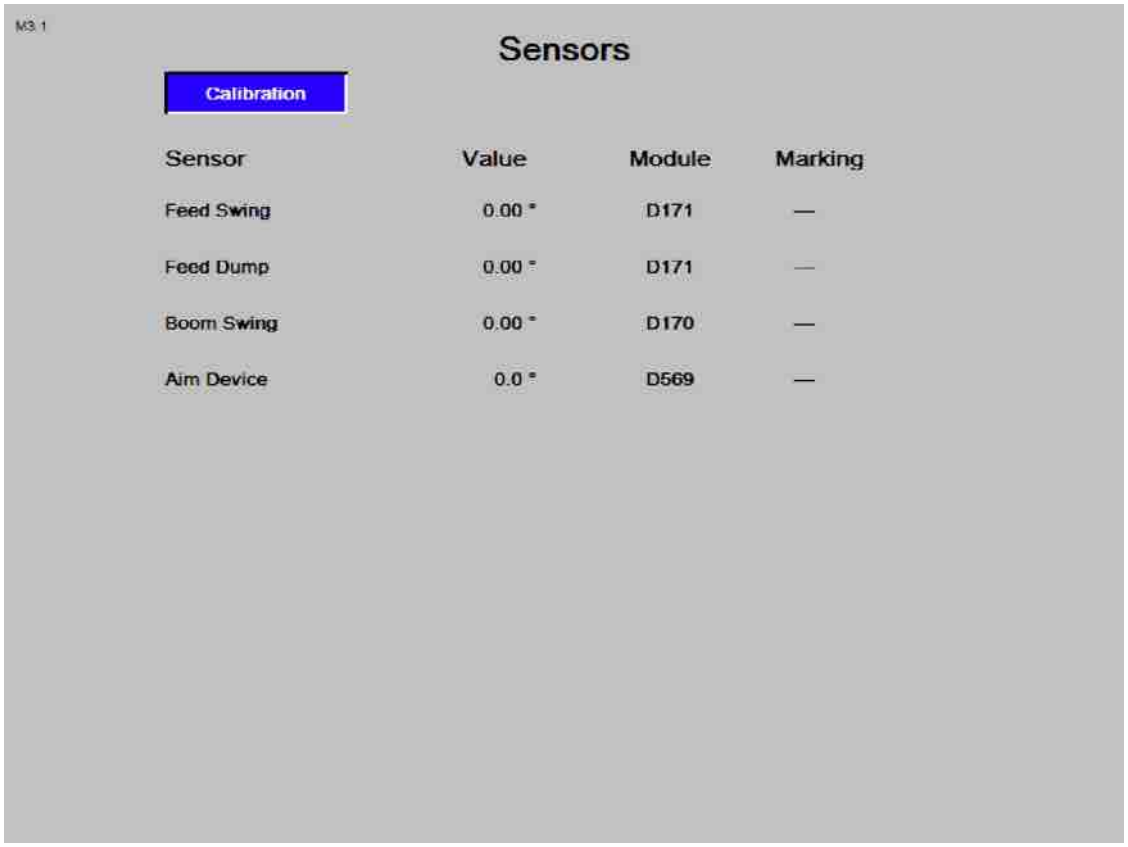
5.7.1 Positioning menu



Positioning.

- **Sensors**
- **Actuations**
- **Parameters**

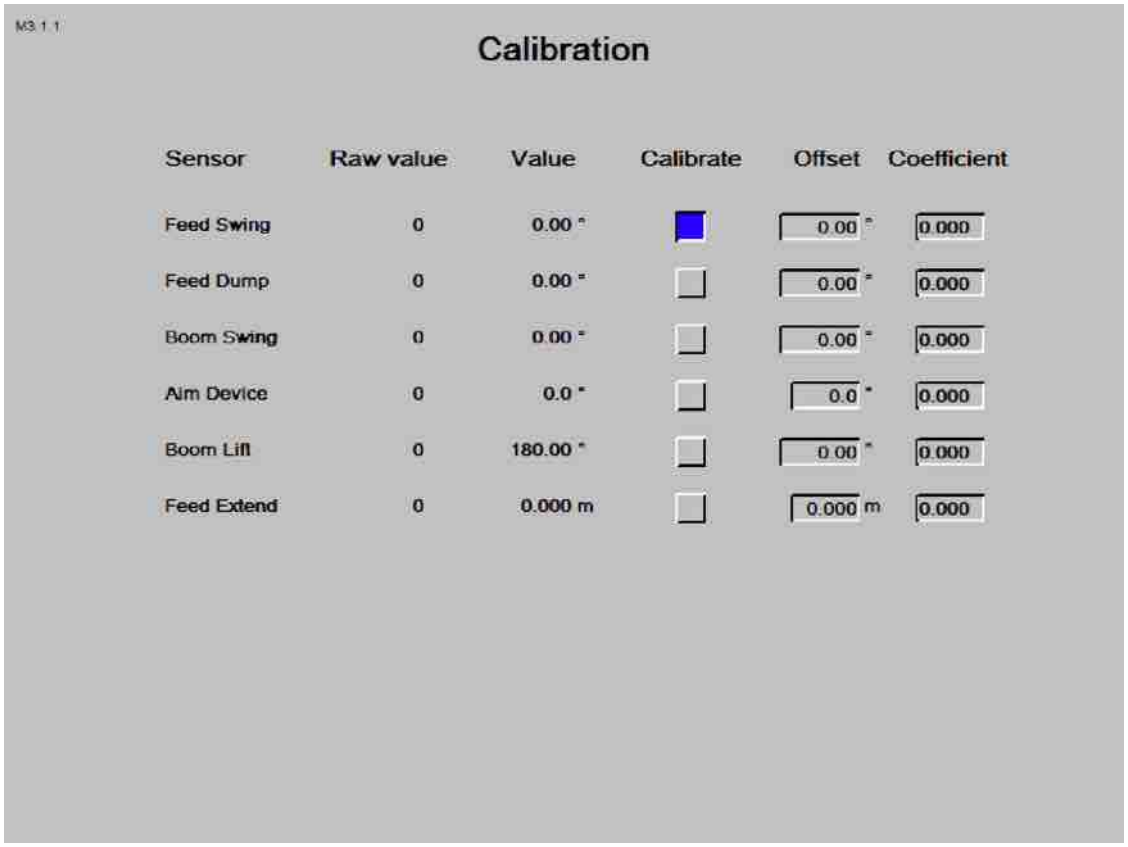
Positioning - sensor



Positioning - sensor.

- Adjustable sensors are:
  - **Feed swing**
  - **Feed dump**
  - **Boom swing**
  - **Aim device**

Positioning - Sensor - Calibration



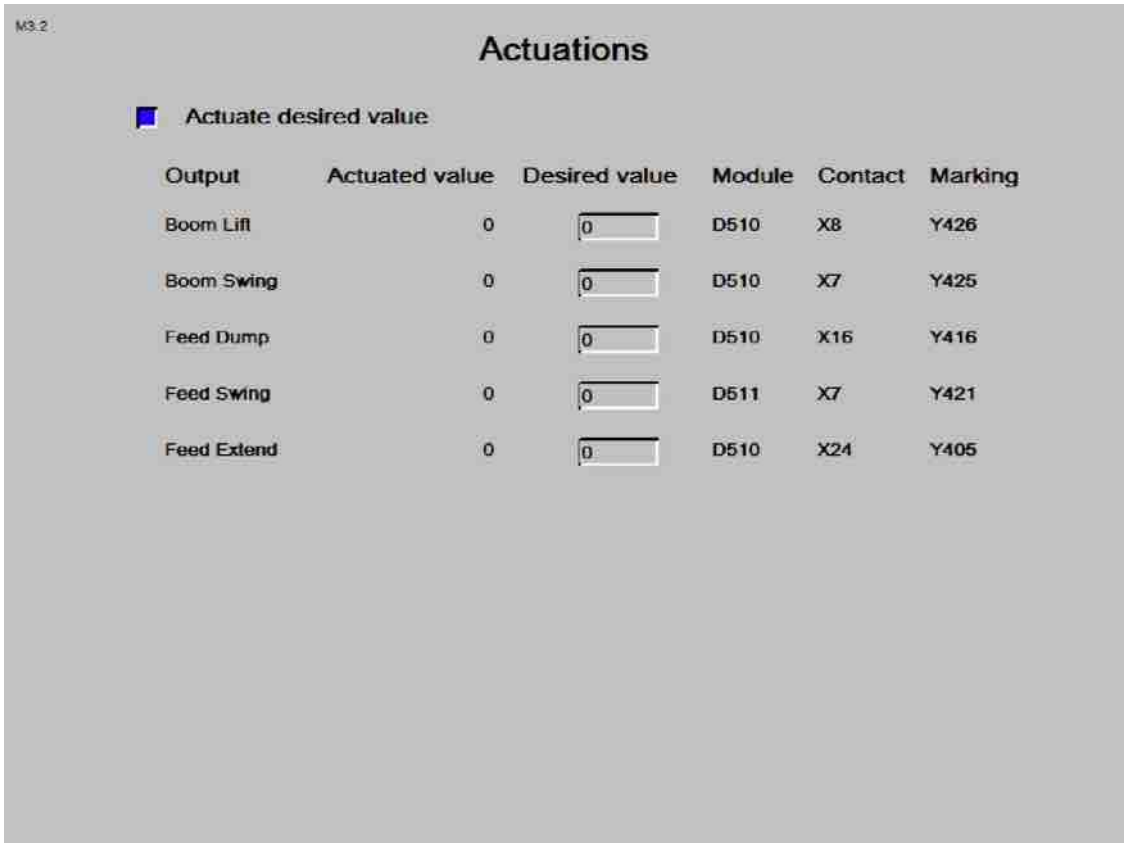
Calibration

- **Sensors**
  - **Feed swing**
  - **Feed dump**
  - **Boom swing**
  - **Aim device**
- **Raw val**
- **Value**
- **Calibrate**
- **Offset**
- **Coefficient**

The sensors for the angle instrument can be reset in the **Calibration** menu.

- Be sure to adjust the cabin's aim device directly forward 90° towards the cabin windscreen.
- Adjust the boom straight forward so that it is parallel with the cabin's aim device inside the cabin.
- Use a spirit level and adjust the feeder vertically in both feed swing and feed tilt modes.
- Now the sensors can be reset by selecting the relevant sensor and resetting by pressing the Enter key.

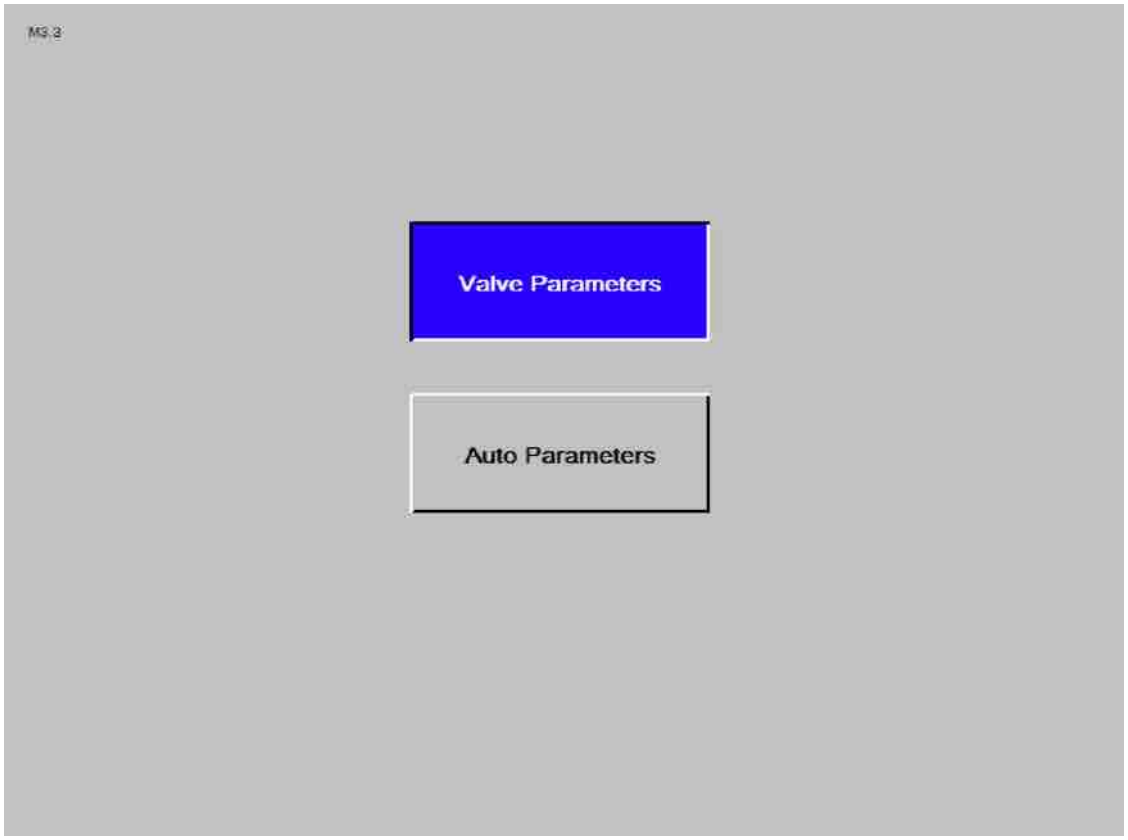
Positioning - Actuations



Actuations.

- **Boom lift**
- **Boom swing**
- **Feed dump**
- **Feed swing**
- **Feed extend**

Positioning - Parameters



Parameters

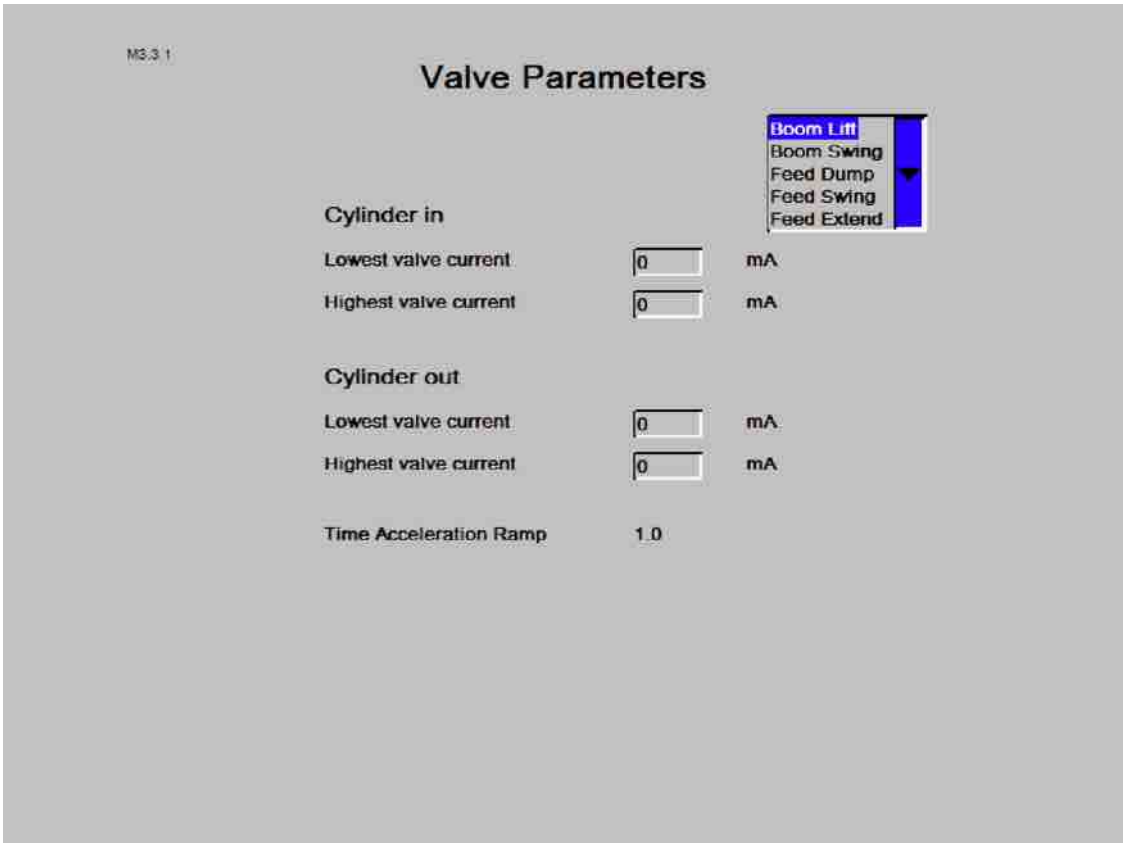
- **Valve Parameters**

The parameters used when the positioning cylinders are operated manually.

- **Auto Parameters**

The parameters used when the Semi-automatic boom positioning (optional equipment) is used.

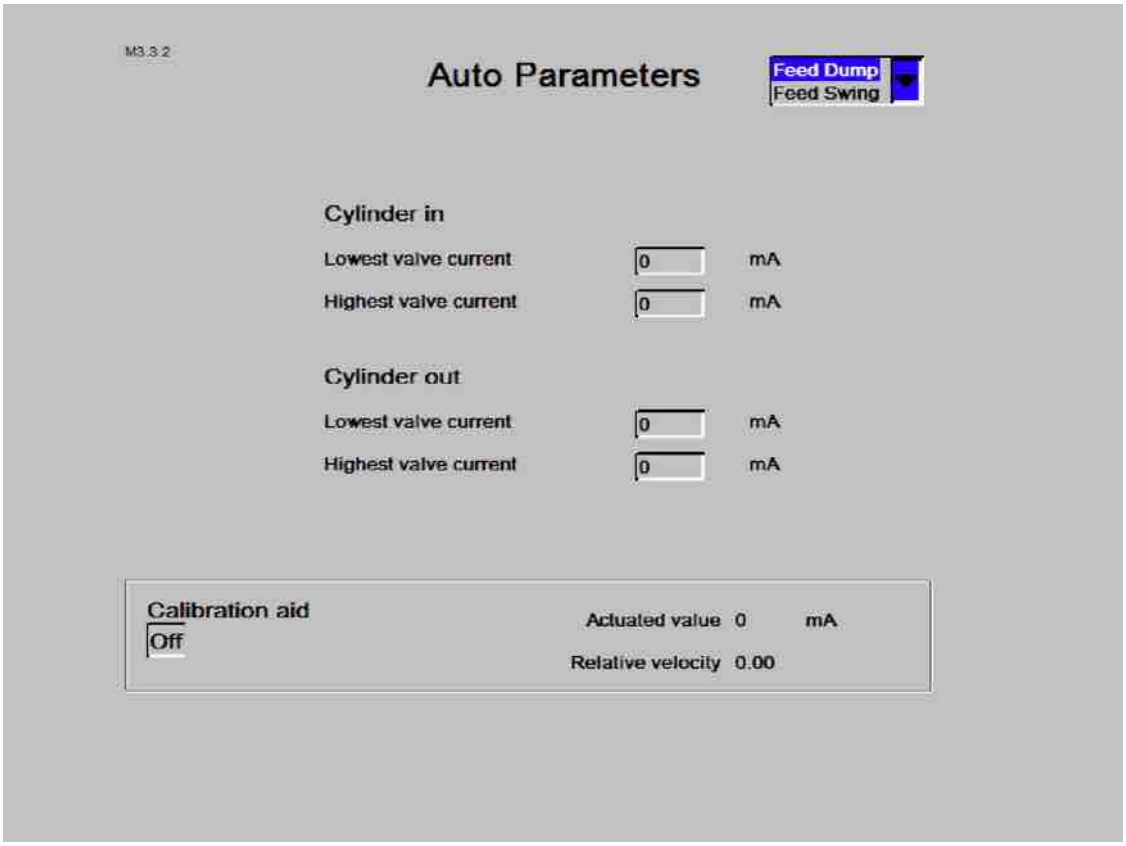
Positioning - Parameters - Valve Parameters



Valve Parameters

- **Boom lift**
- **Boom swing**
- **Feed dump**
- **Feed swing**
- **Feed extend**
- **Cylinder in**
  - **Lowest valve current**
  - **Highest valve current**
- **Cylinder out**
  - **Lowest valve current**
  - **Highest valve current**
- **Time Acceleration ramp**

Positioning - Parameters - Auto Parameters

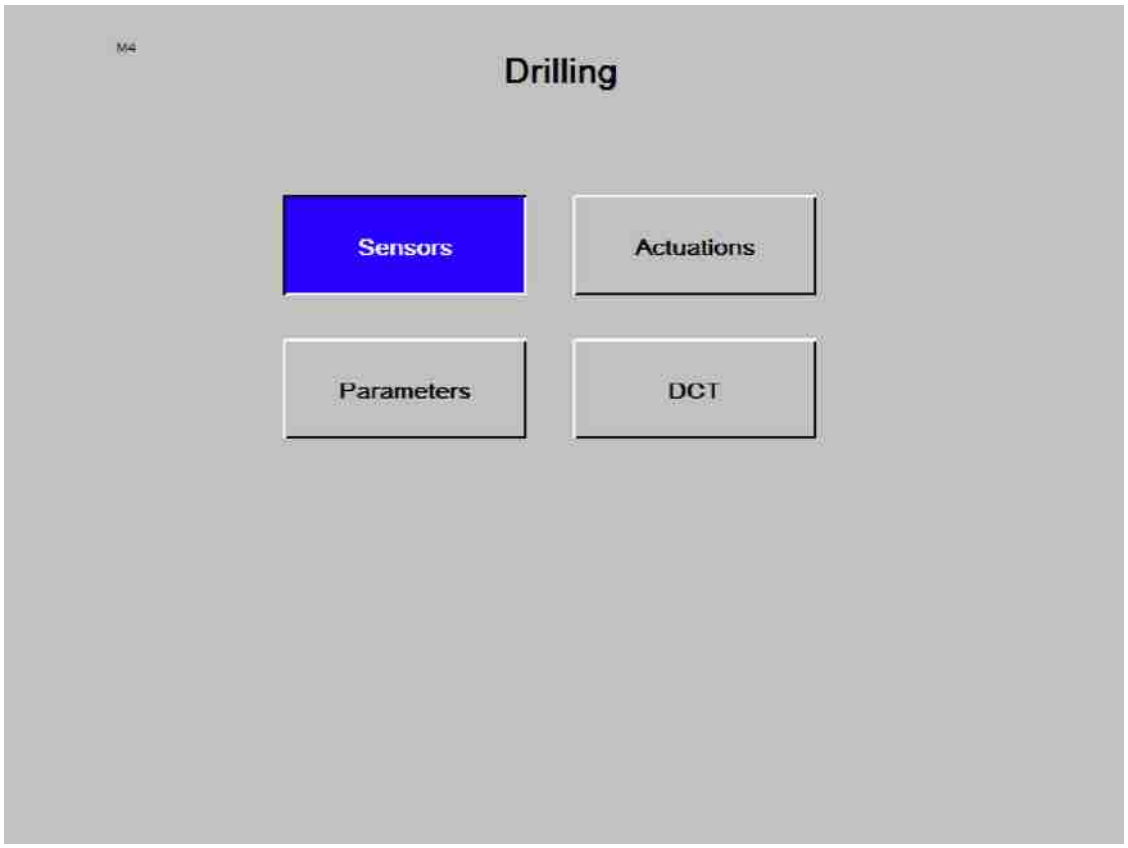


Auto Parameters

- **Feed dump**
- **Feed swing**
- **Cylinder in**
  - **Lowest valve current**
  - **Highest valve current**
- **Cylinder out**
  - **Lowest valve current**
  - **Highest valve current**
- **Calibration aid**
  - **Actuated value**
  - **Relative velocity**

5.8 Drilling

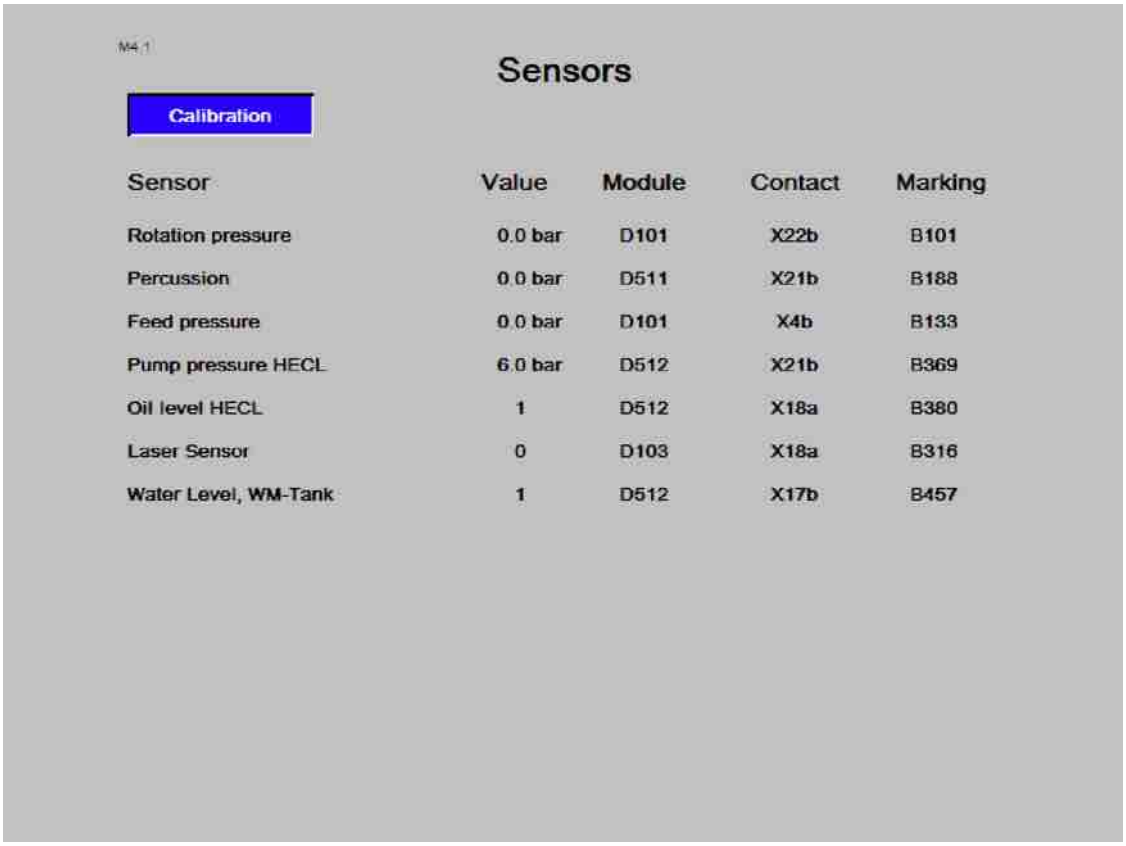
5.8.1 Menu Drilling



Drilling

- **Sensors**
- **Actuations**
- **Parameters**
- **DCT**

Drilling - Sensor

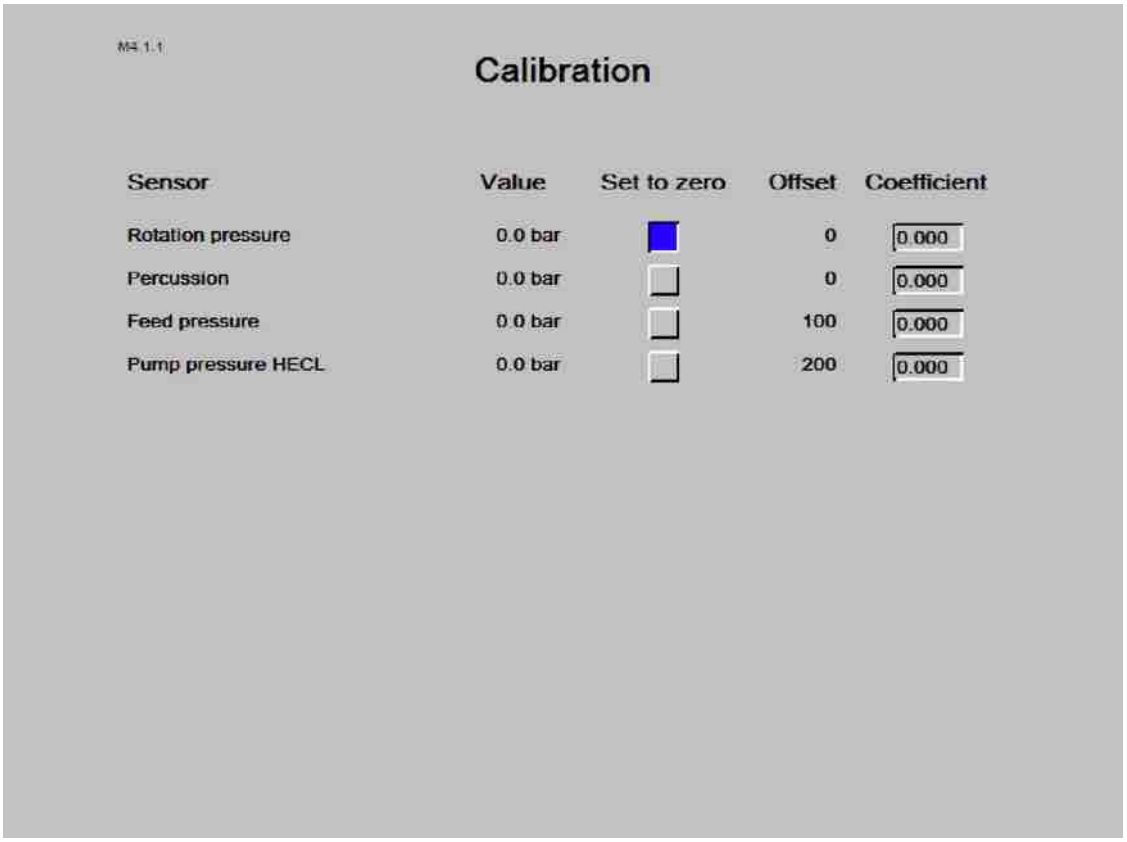


Sensors

- **Rotation pressure**
- **Percussion**
- **Feed pressure**
- **Pump pressure HECL**
- **Oil level HECL**
- **Laser Sensor**
- **Water Level, WM-Tank**

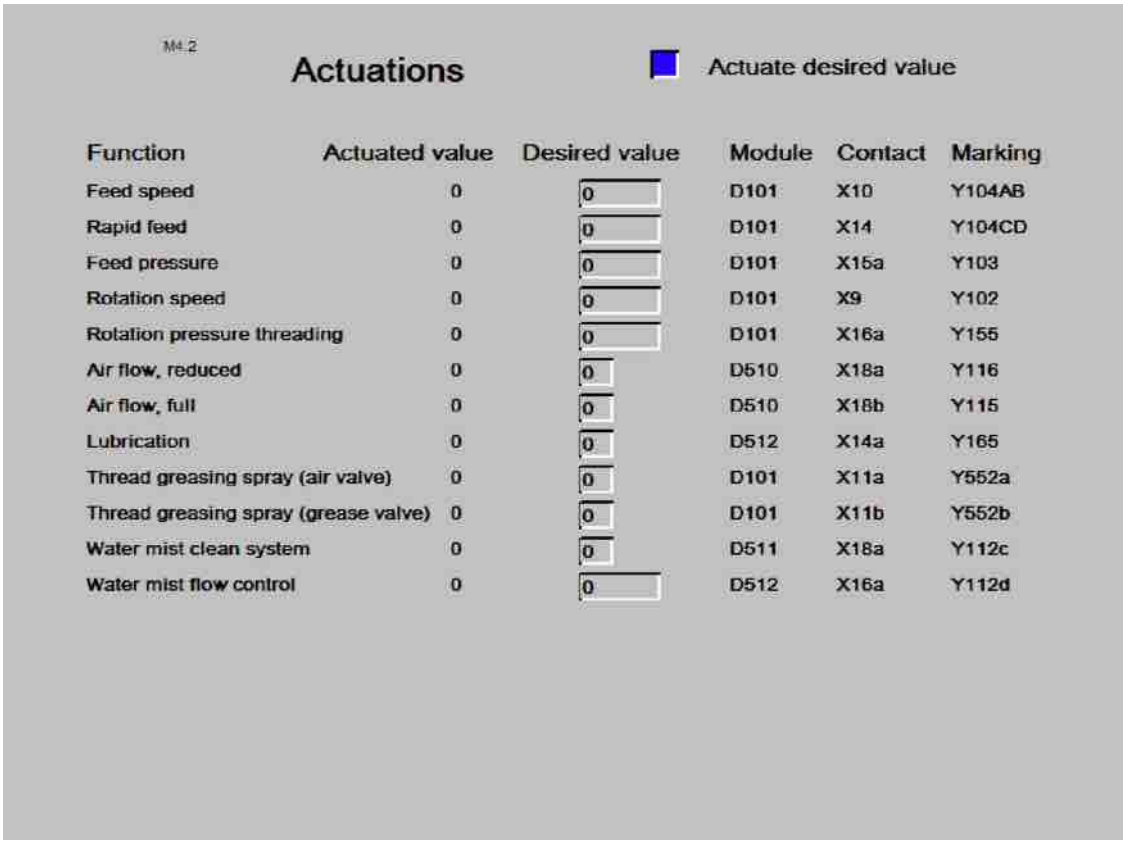
Drilling - Sensor Calibration

Calibration of the sensors involved in the drilling process can be carried out in the **Calibration** menu.



- Ensure that the system is depressurised.
- Select the **Set to zero** by the relevant pressure sensor.
- Press Enter to **Set to zero** the sensor. The pressure sensor is then reset and automatically receives an offset value and a coefficient.

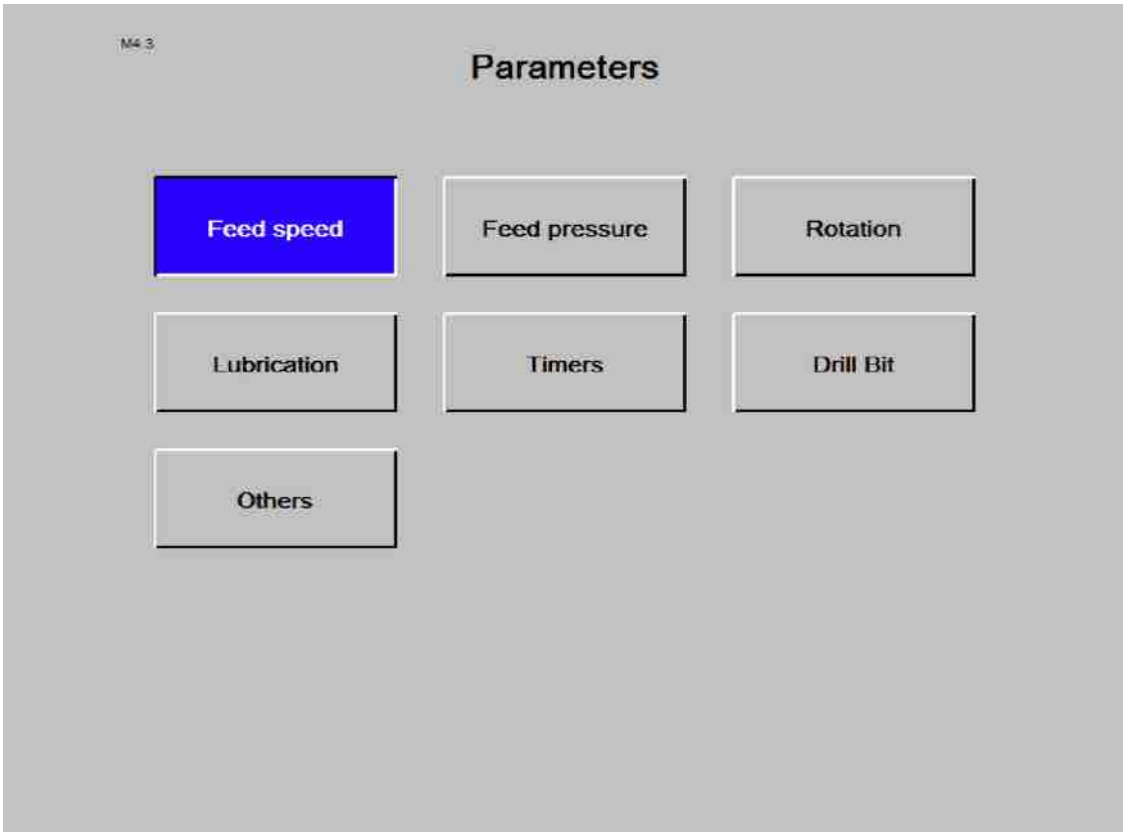
Drilling - Actuations



Actuations

- **Feed speed**
- **Rapid feed**
- **Feed pressure**
- **Rotation Speed**
- **Rotation pressure threading**
- **Air flow, reduced**
- **Air flow, full**
- **Lubrication**
- **Thread greasing spray (air valve)**
- **Thread greasing spray (grease valve)**
- **Water mist clean system**
- **Water mist flow control**

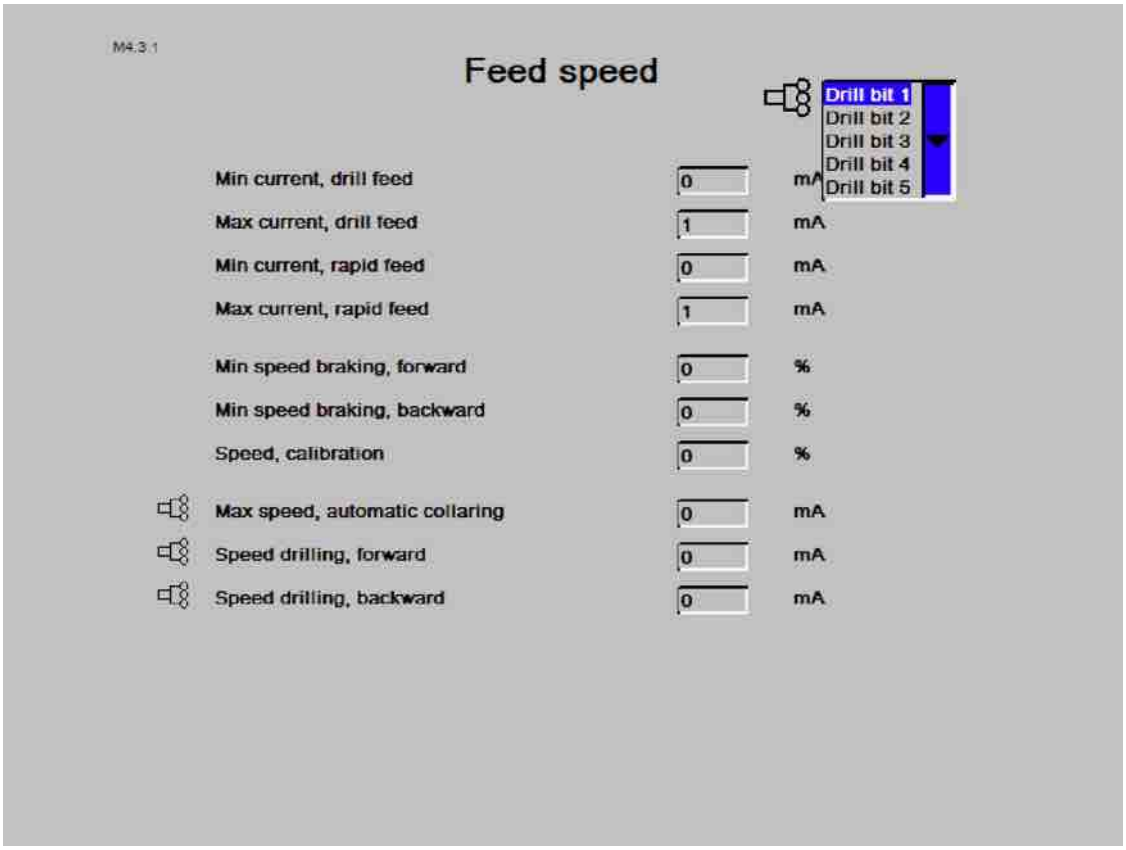
Drilling - parameters



Parameters

- **Feed speed**
- **Feed pressure**
- **Rotation**
- **Lubrication**
- **Timers**
- **Drill bit**
- **Others**

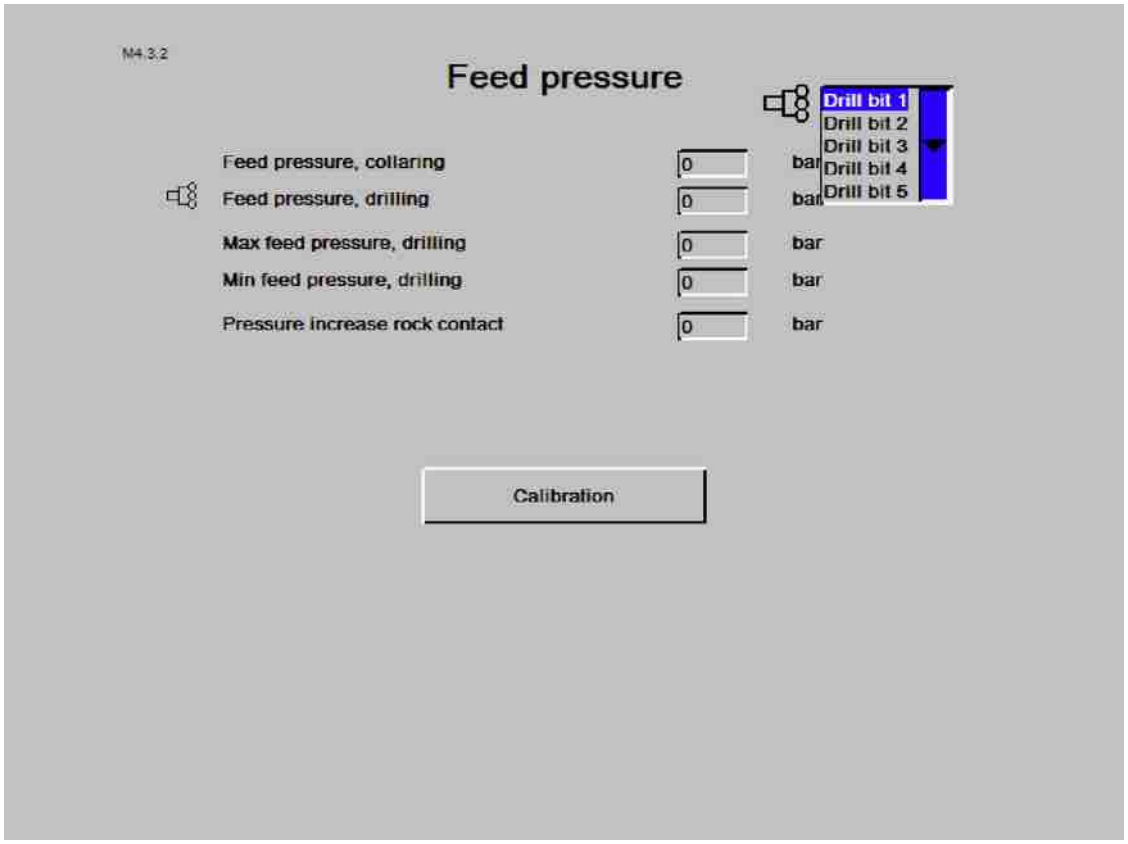
Drilling - Parameters - Feed Speed



Feed speed

- **Min current, drill feed**
- **Max current, drill feed**
- **Min current, rapid feed**
- **Max current, rapid feed**
- **Min speed braking, forward**
- **Min speed braking, backward**
- **Speed, calibration**
- **Max speed, automatic collaring**
- **Speed drilling, forward**
- **Speed drilling, backward**

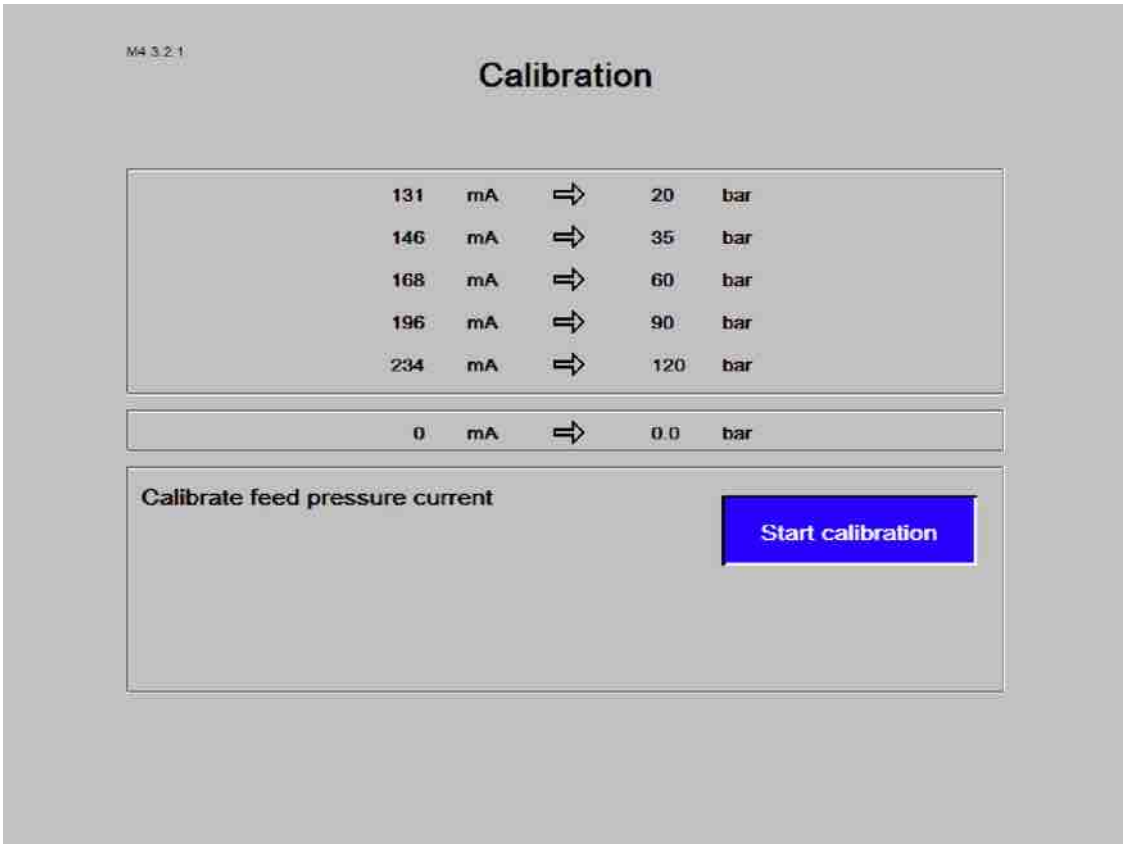
Drilling - Parameters - Feed Pressure



Feed pressure

- **Feed pressure, collaring**
- **Feed pressure, drilling**
- **Max feed pressure, drilling**
- **Min feed pressure, drilling**
- **Pressure increase rock contact**

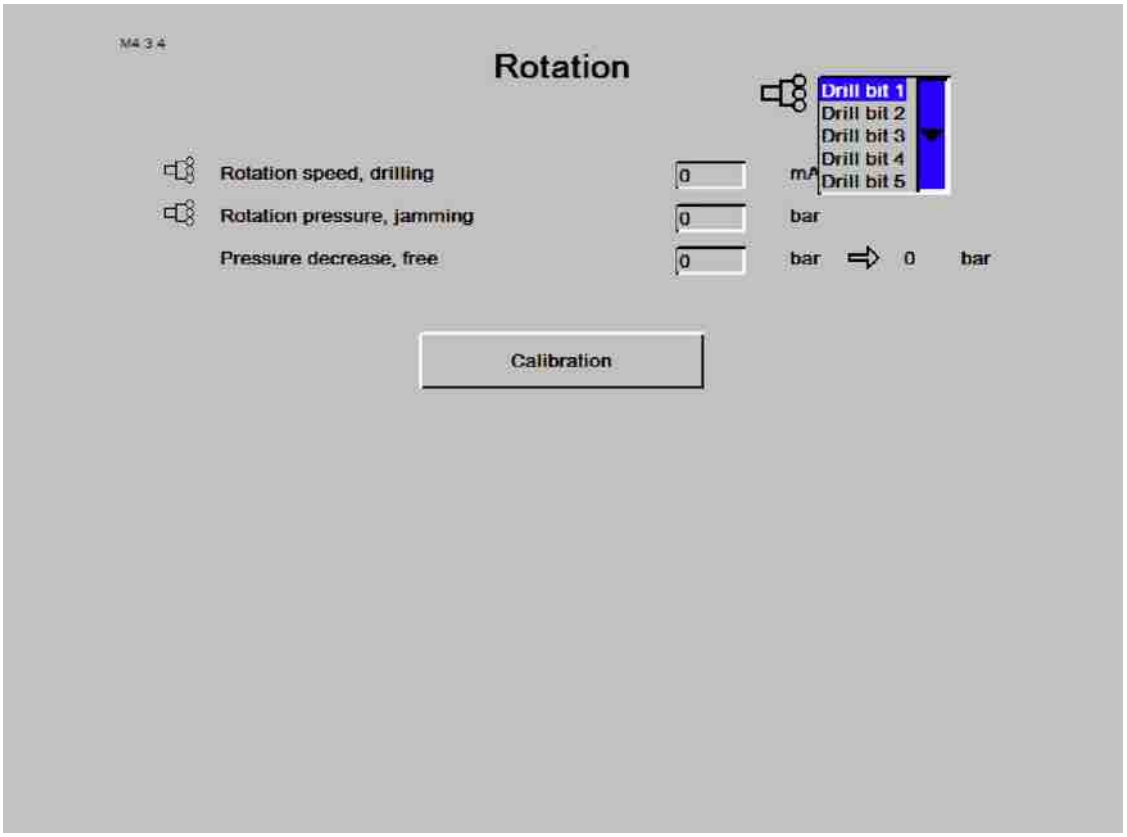
Drilling - Parameters - Feed Pressure - Calibration



Calibration

- **Calibration of feed pressure:** Operate the cradle down to mechanical stop. Select **Start calibration**. The system will now automatically read the different pressures for the different currents and enter them into the system. A flag will then appear when calibration is finished.

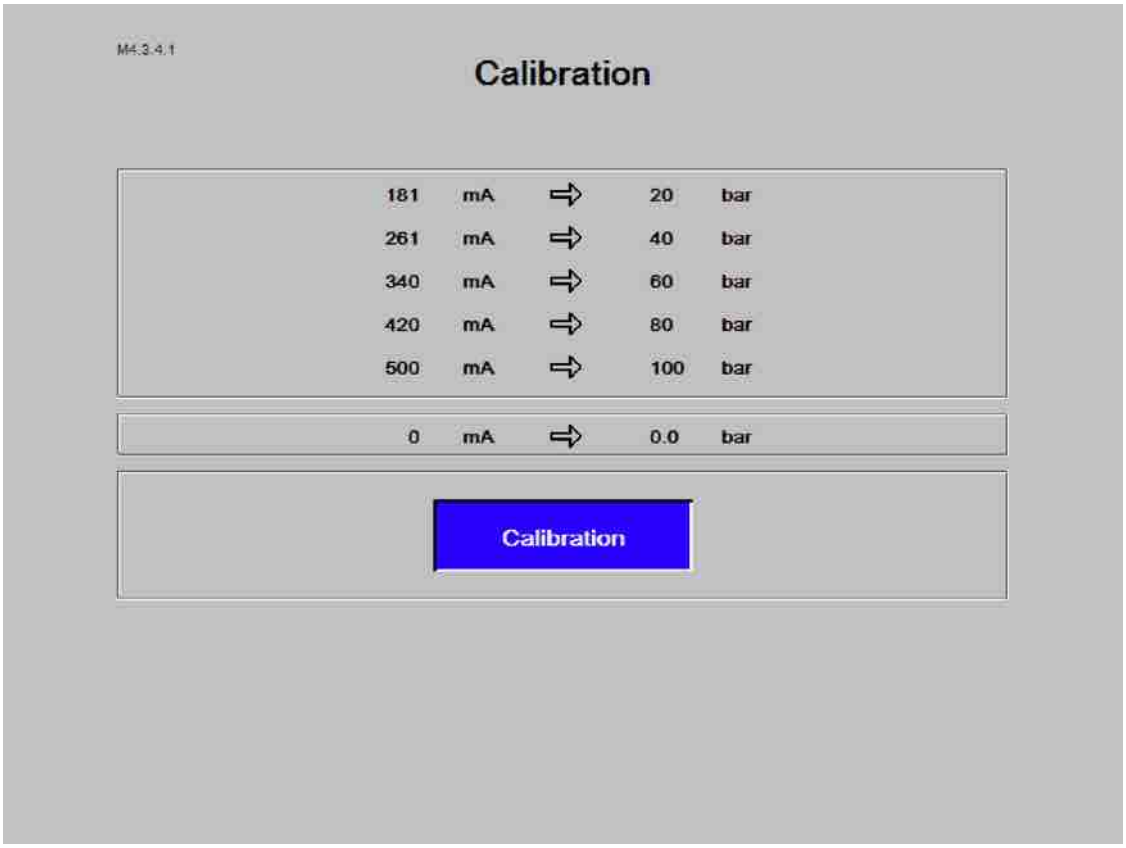
Drilling - Parameters - Rotation



Rotation

- Rotation speed, drilling
- **Rotation pressure, jamming**
- **Pressure decrease, free**

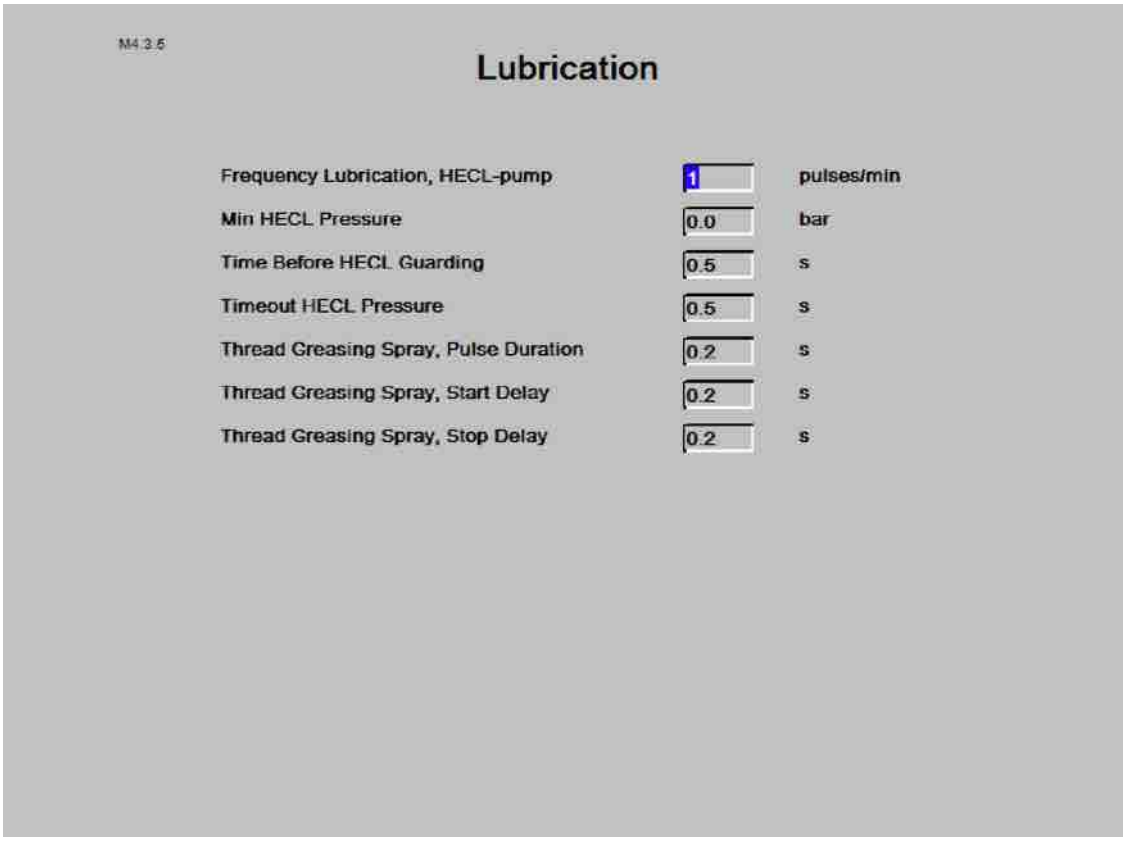
Drilling - Parameters - Rotation - Calibration



Calibration

Clamp the adapter in the break table and start the calibration.

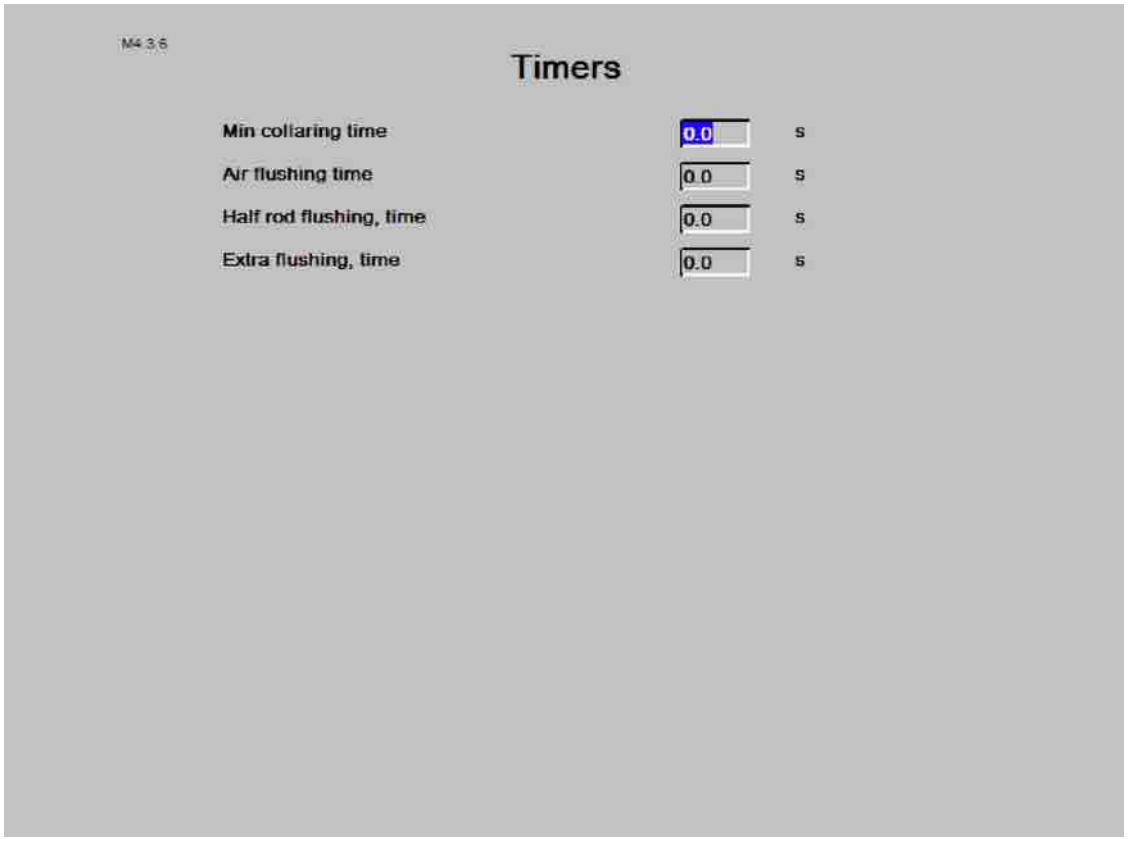
Drilling - Parameters - Lubrication Oil



Lubrication

- **Frequency lubrication, HECL-pump**
- **Min HECL Pressure**
- **Time Before HECL Guarding**
- **Timeout HECL Pressure**
- **Thread Greasing Spray, Pulse Duration**
- **Thread Greasing Spray, Start Delay**
- **Thread Greasing Spray, Stop Delay**

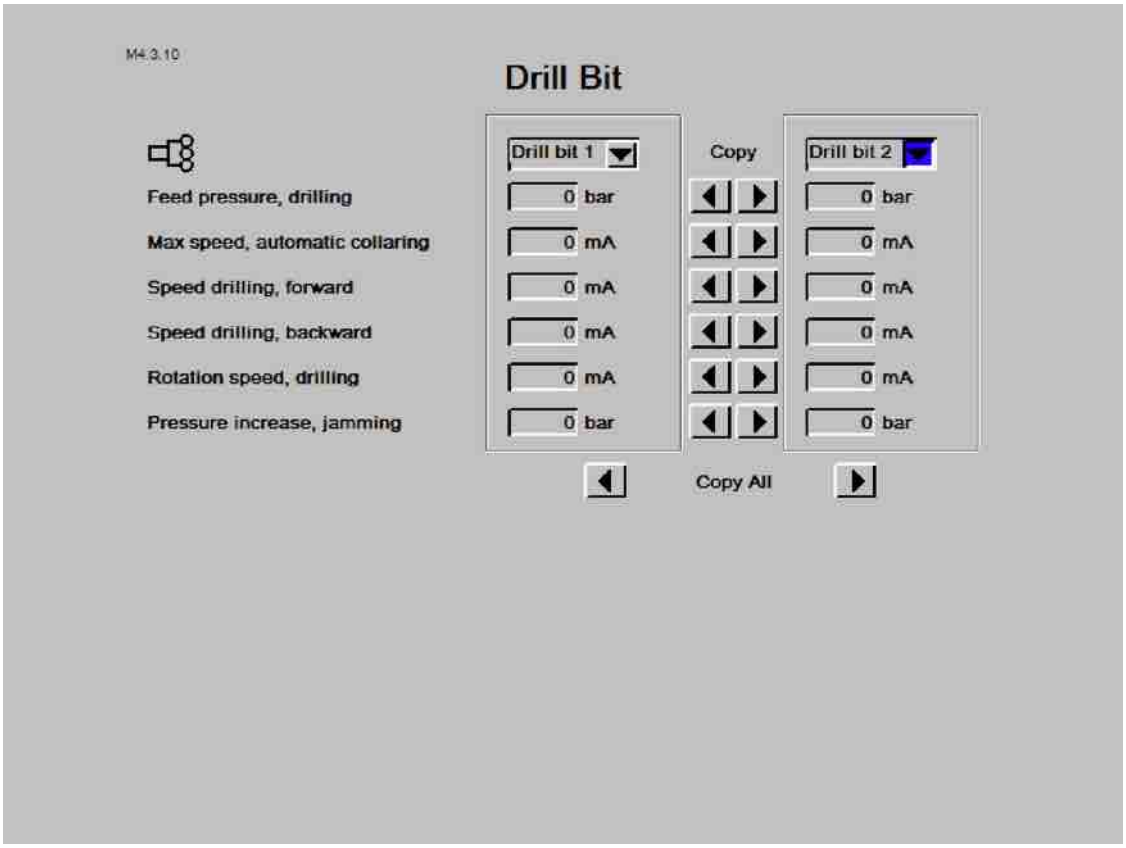
Drilling - Parameters - Times



Timers

- **Min collaring time**
- **Air flushing time**
- **Half rod flushing, time**
- **Extra flushing, time**

Drilling - Parameters - Drill Bit



Drill bit

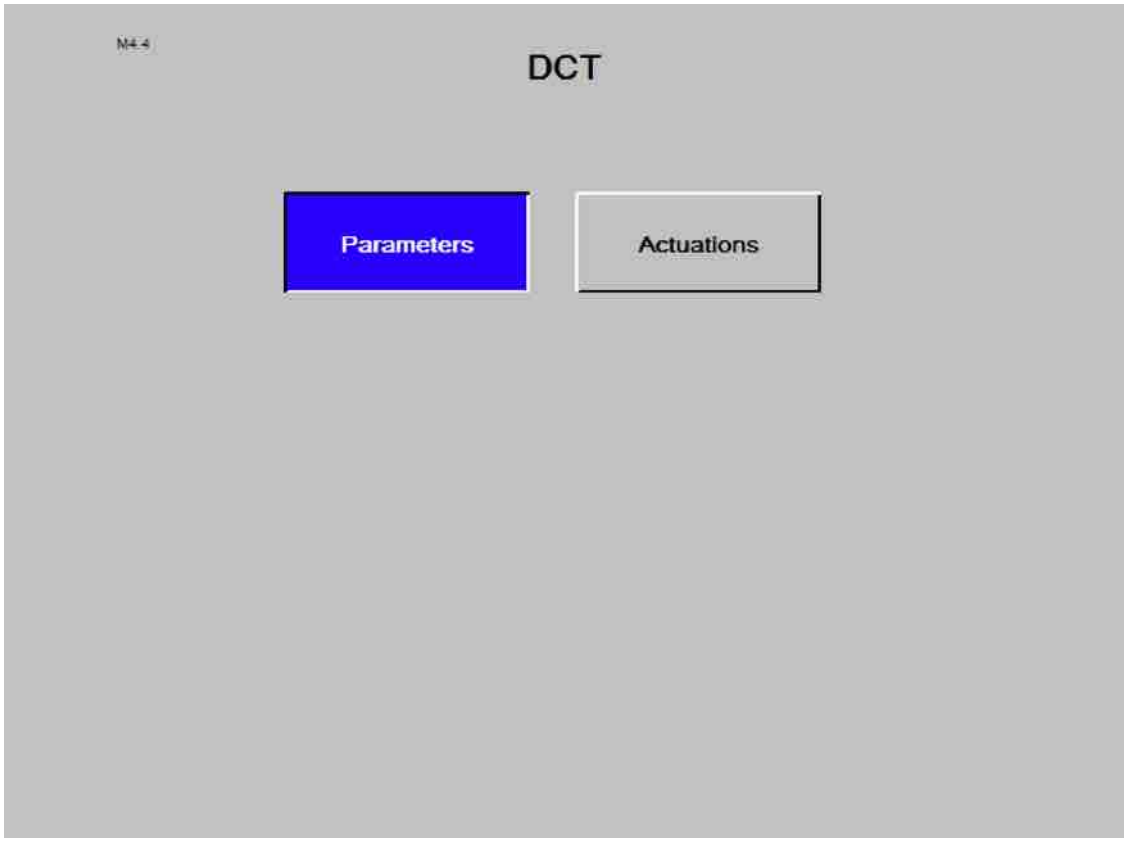
- **Feed pressure, drilling**
- **Max speed, automatic collaring**
- **Speed drilling, forward**
- **Speed drilling, backward**
- **Rotation speed, drilling**
- **Pressure increase, jamming**

Drilling - Parameters - Miscellaneous

Others

- **Min air pressure**
- **Air pressure, drill out**
- **Initial collar length**
- **M4 offset**

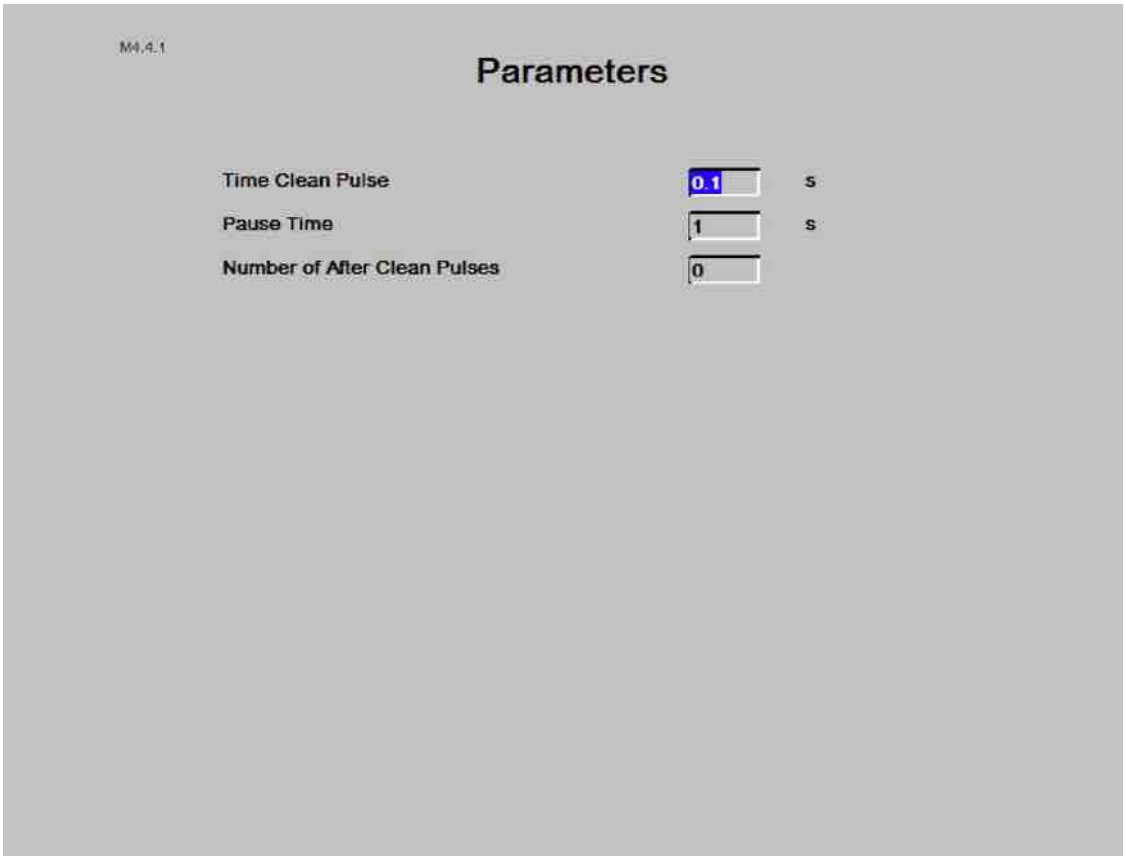
Drilling - DCT



DCT

- **Parameters**
- **Actuations**

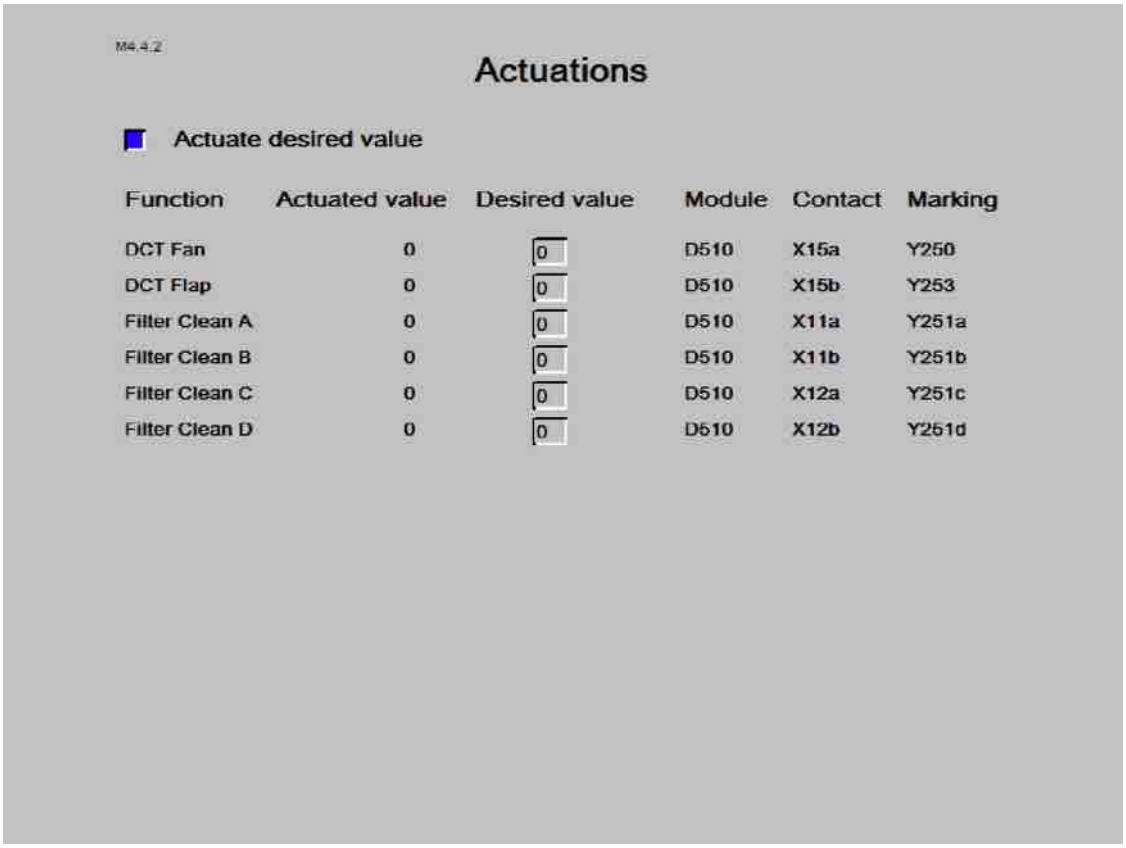
Drilling - DCT - Parameters



Parameters

- **Time clean pulse**
- **Pause time**
- **Number of after clean pulses**

Drilling - DCT - Actuations

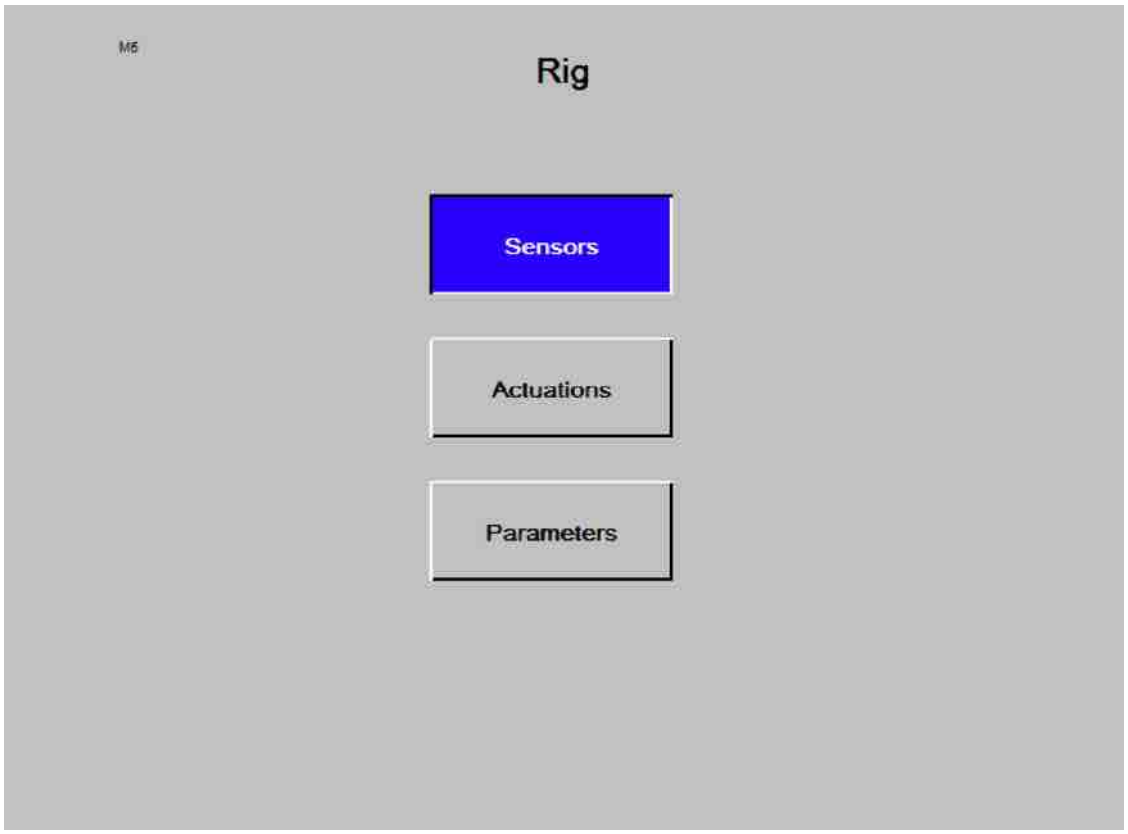


Actuations

- **DCT Fan**
- **DCT Flap**
- **Filter clean A**
- **Filter clean B**
- **Filter clean C**
- **Filter clean D**

5.9 Rig

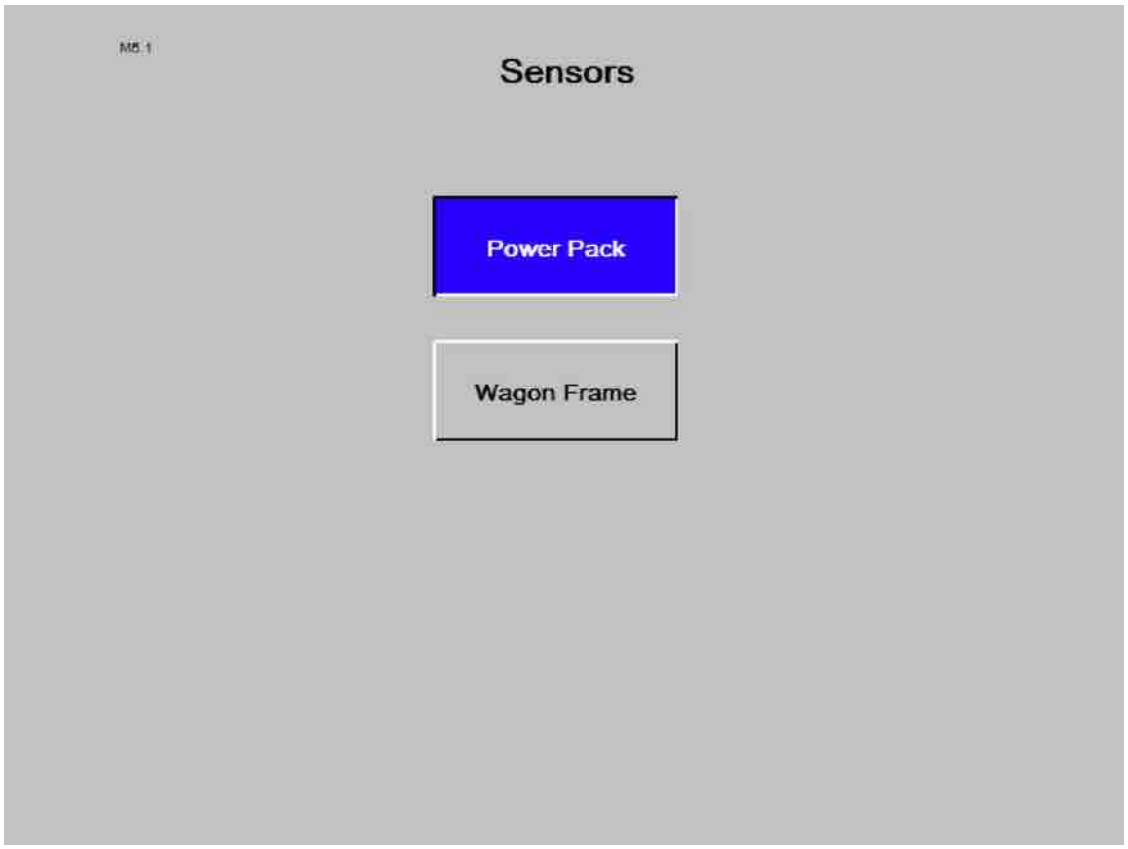
5.9.1 Rig menu



Rig *menu.*

- **Sensors**
- **Actuations**
- **Parameters**

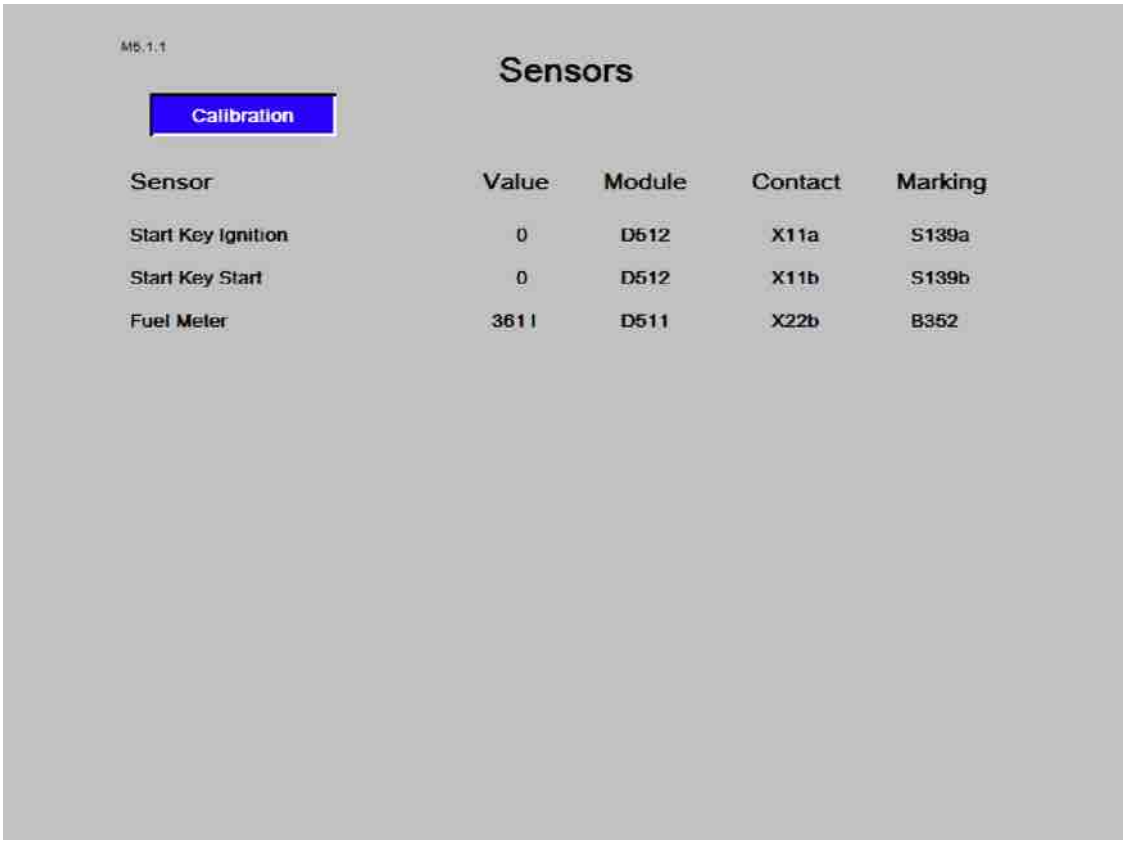
Rig - sensor



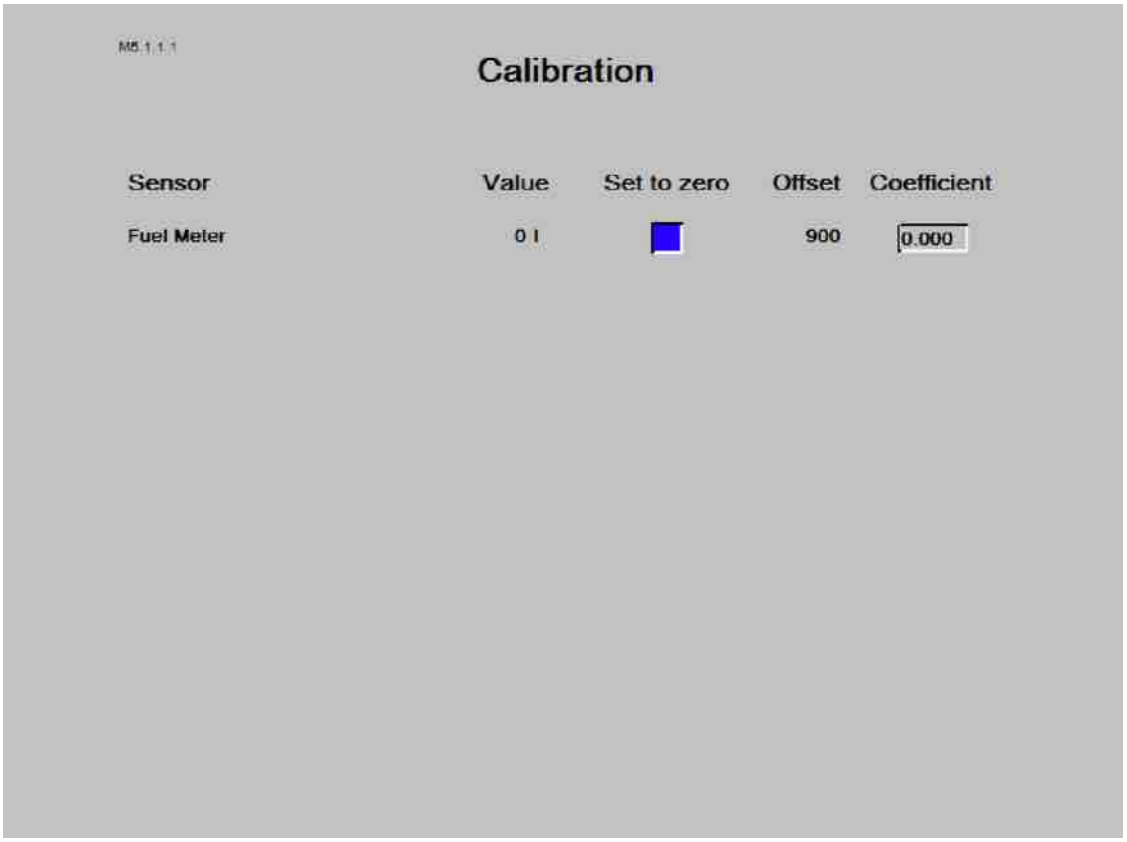
Rig - sensor

- **Power Pack**
- **Wagon Frame**

Rig - sensor - drive unit

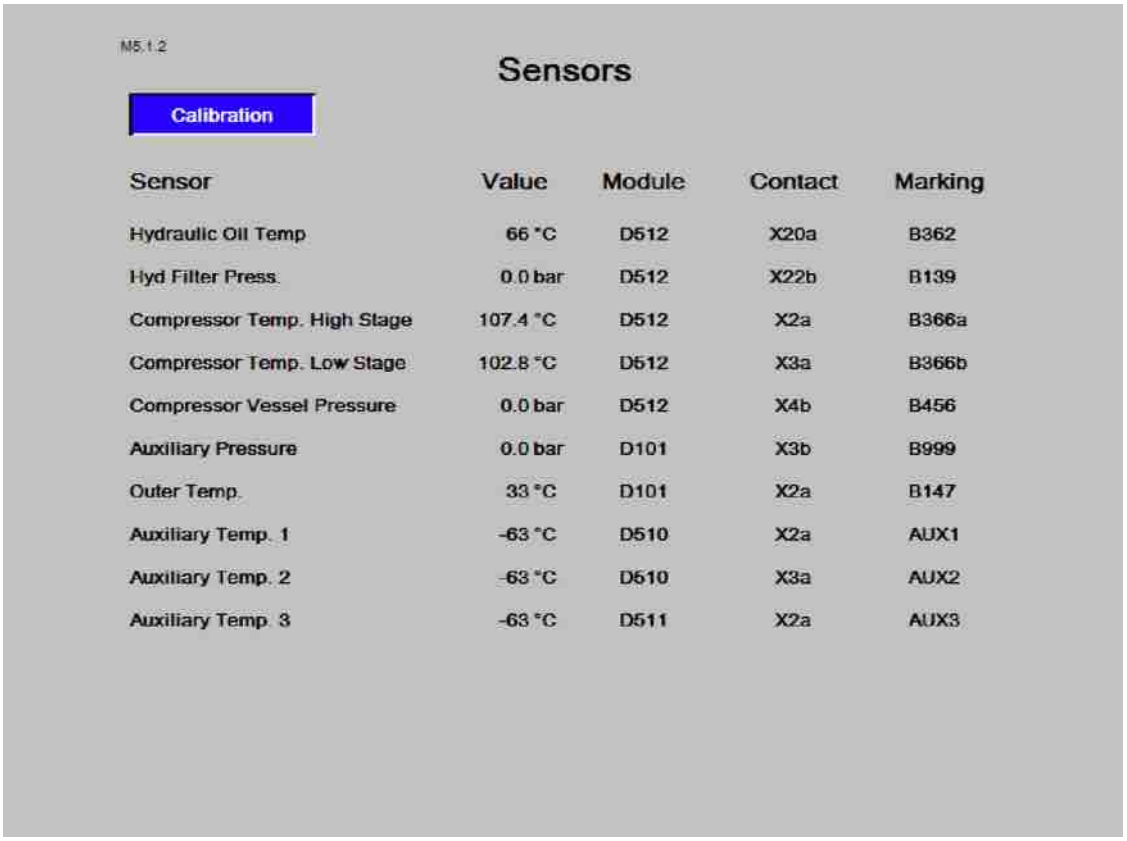


- **Start Key Ignition:**
- **Start Key Start:**
- **Fuel Meter:** Shows the volume in litres in the fuel tank.



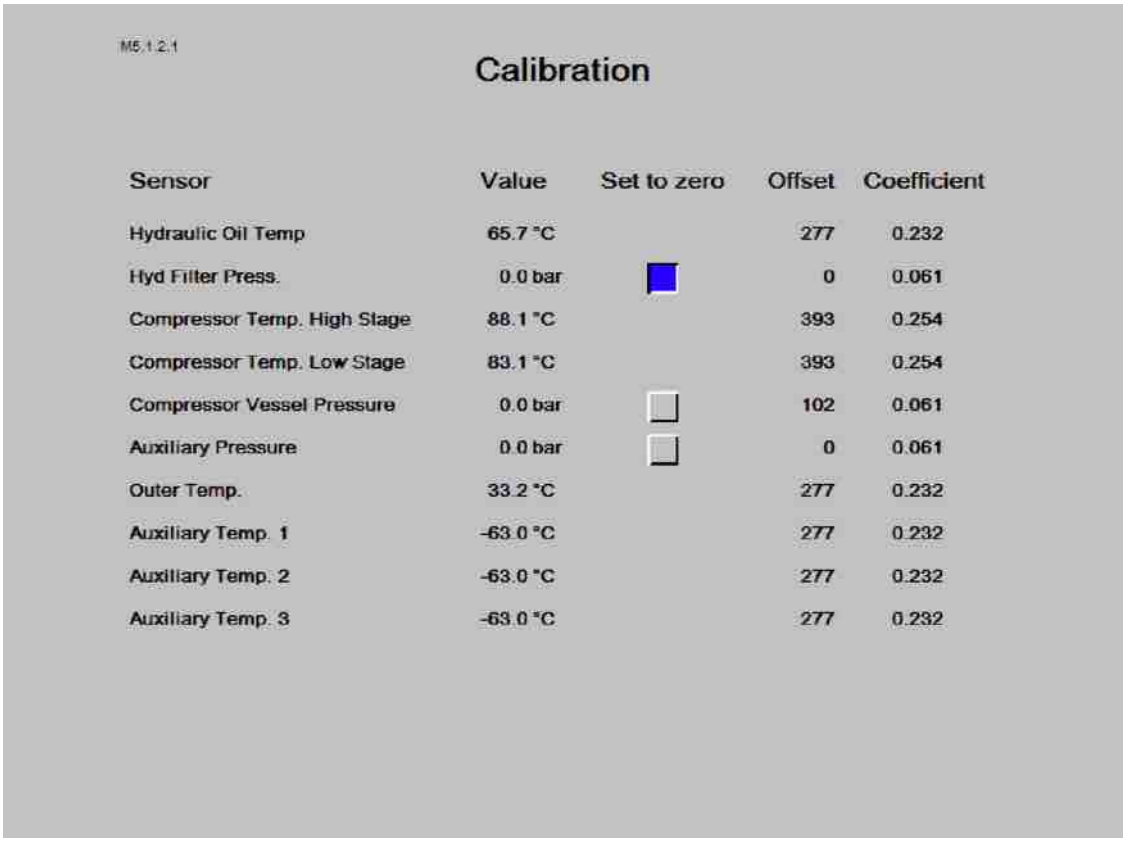
- Calibrate by selecting and setting the box to zero.

Rig - sensor - chassis frame



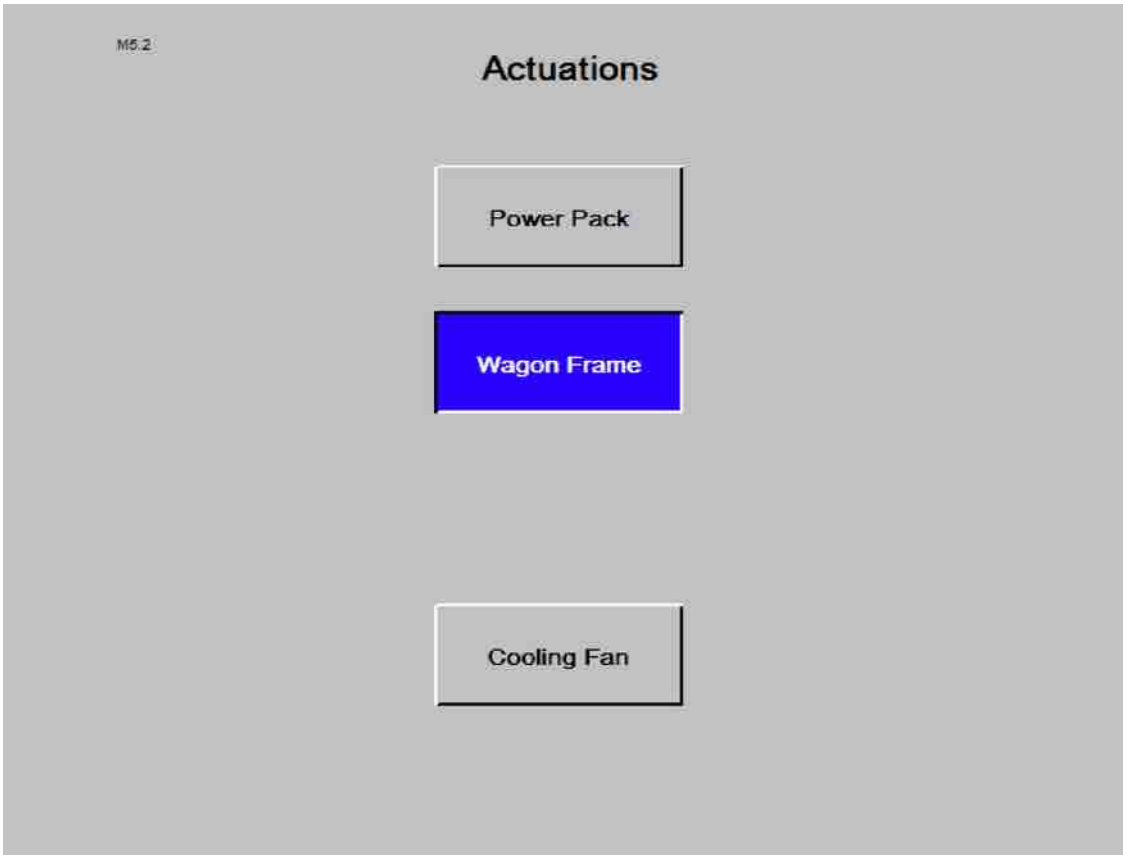
Rig - sensor - chassis frame.

- **Hydraulic Oil Temp:** Shows the temperature of the hydraulic oil.
- **Hyd Filter pressure:** Shows hydraulic filter pressure.
- **Compressor Temp. High Stage:** Shows the compressor temperature in the high-pressure stage.
- **Compressor Temp. Low Stage:** Shows the compressor temperature in the low-pressure stage.
- **Compressor Vessel Pressure:** Shows the tank pressure.
- **Outer Temp.:** Shows the outside temperature.



- Calibrate by selecting and setting the boxes to zero.

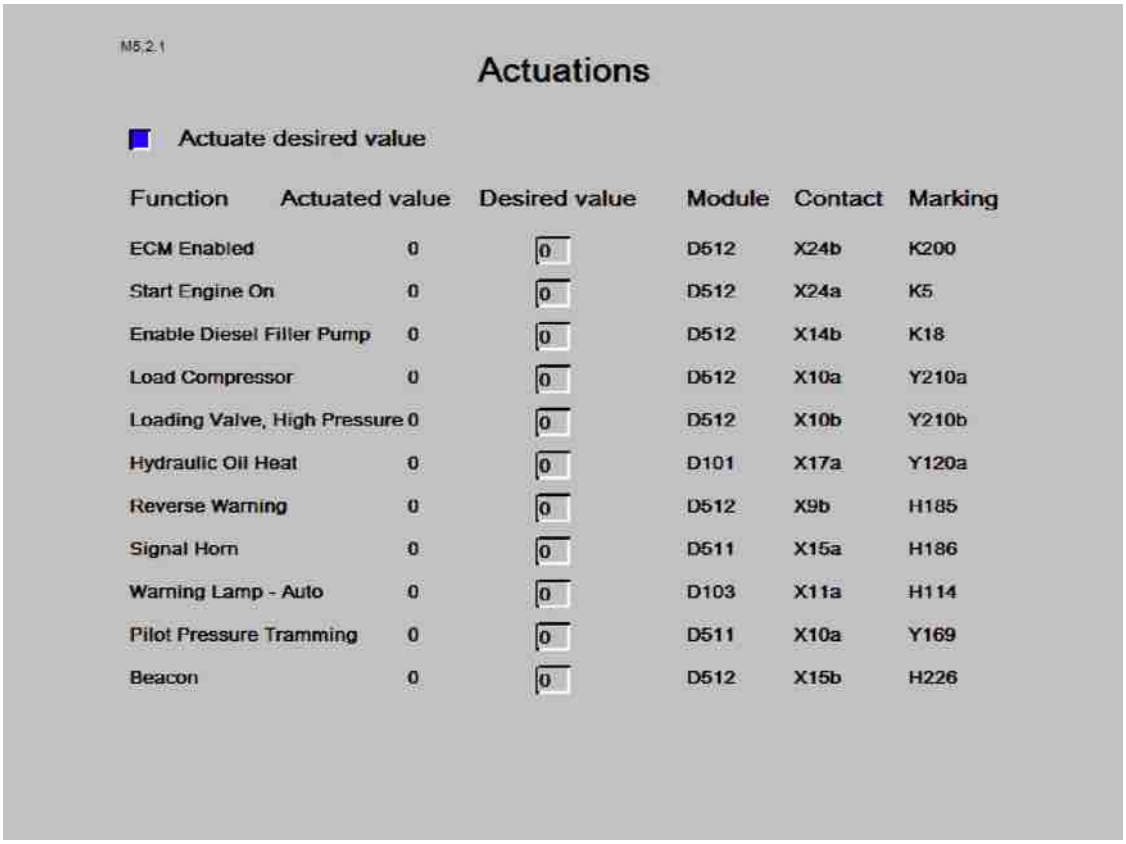
Rig - actuations



Actuations.

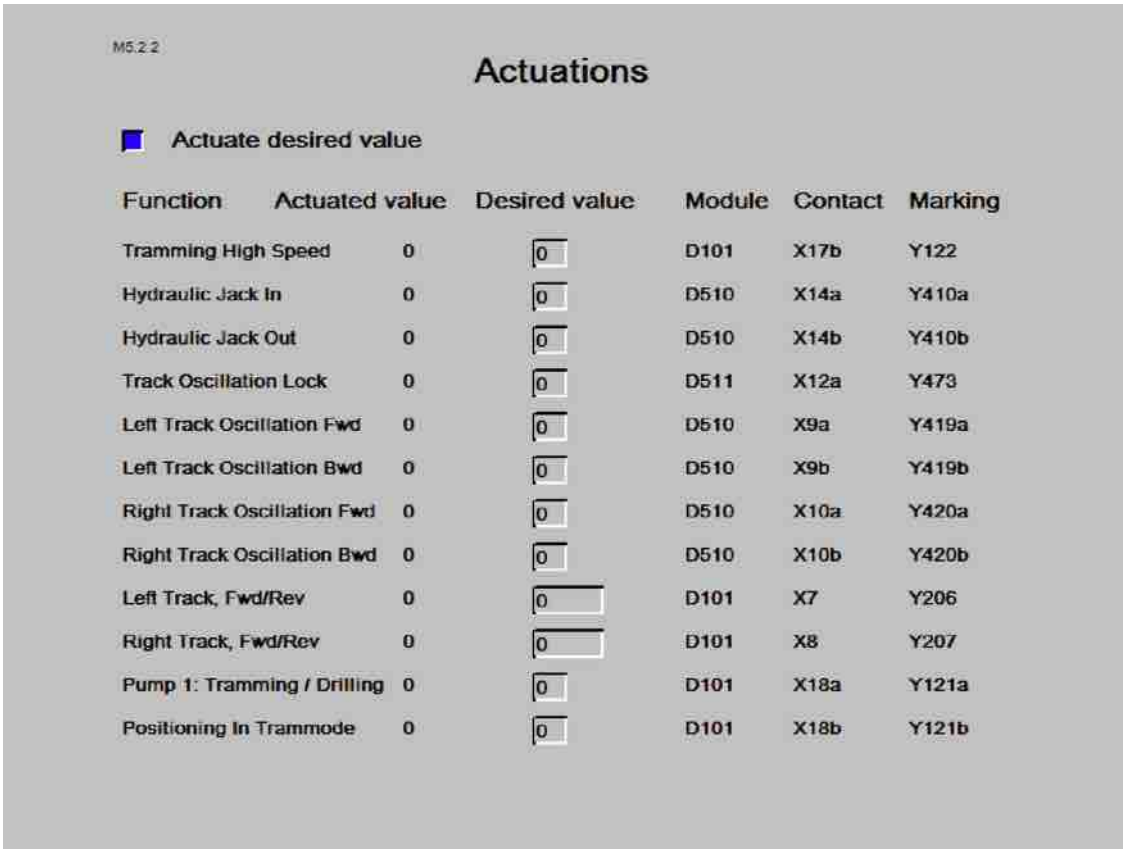
- **Power Pack**
- **Wagon Frame**
- **Cooling Fan**

Rig - actuations - drive unit



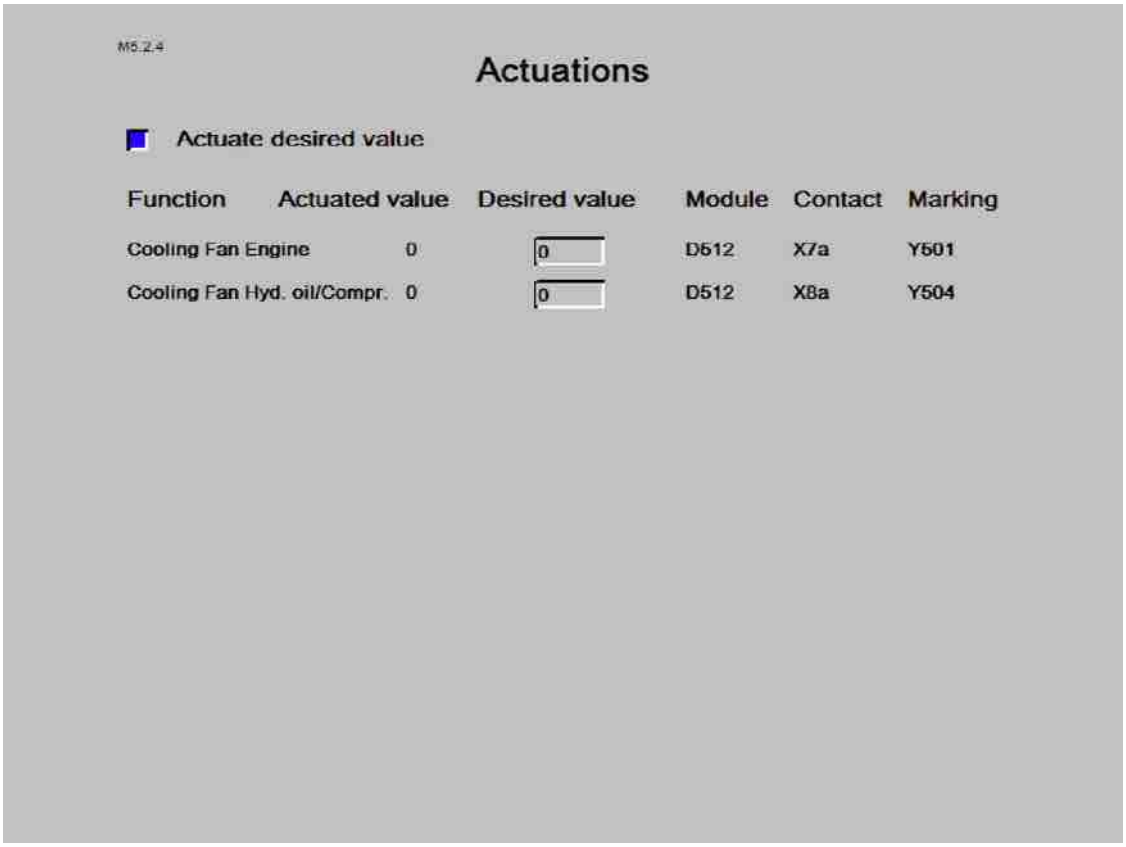
- **ECM Enabled**
- **Start Engine On**
- **Enable diesel filler pump**
- **Load Compressor**
- **Loading Valve, High Pressure**
- **Hydraulic oil heat**
- **Reverse Warning**
- **Signal horn**
- **Warning Lamp - Auto**
- **Pilot Pressure Tramming**
- **Beacon**

Rig - actuations - chassis frame



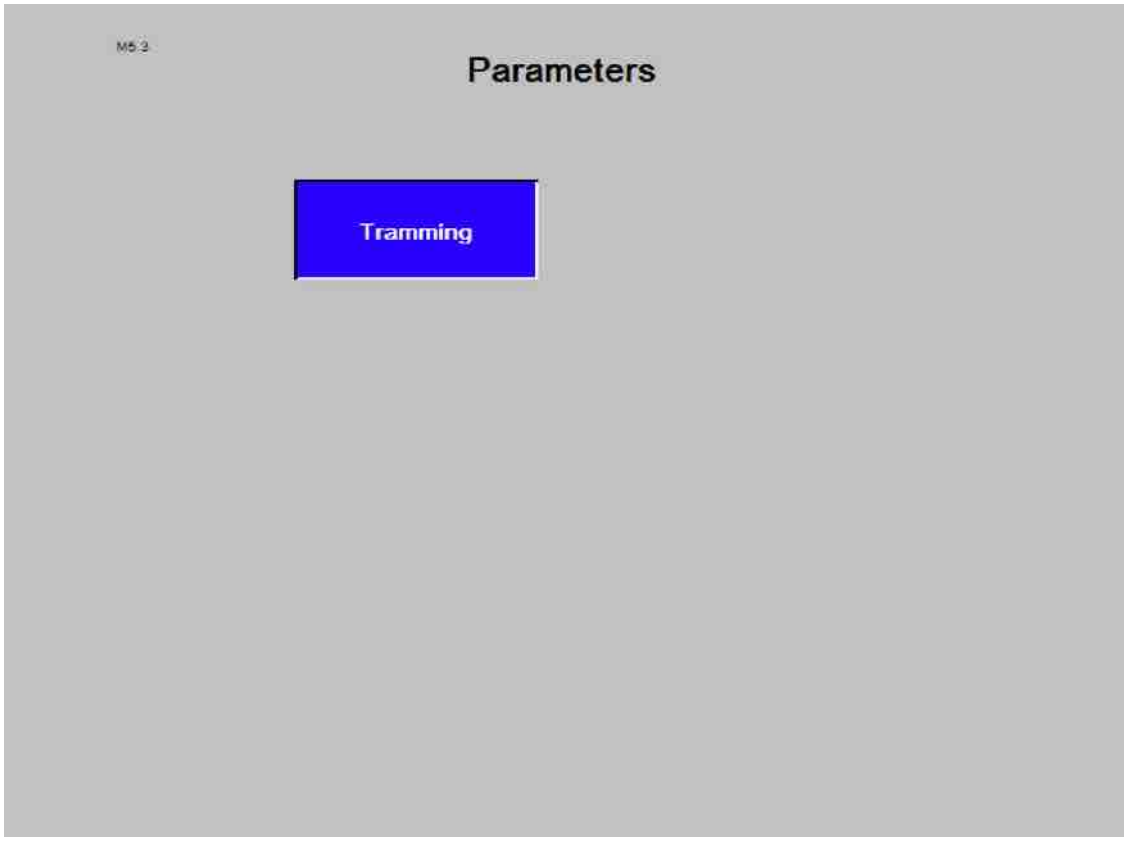
- **Tramming high speed**
- **Hydraulic Jack In**
- **Hydraulic Jack Out**
- **Track oscillation lock**
- **Left Track Oscillation Fwd**
- **Left Track Oscillation Bwd**
- **Right Track Oscillation Fwd**
- **Right Track Oscillation Bwd**
- **Left Track, Fwd/Rev**
- **Right Track, Fwd/Rev**
- **Pump 1: Tramming / Drilling**
- **Positioning In Trammode**

Rig - actuations - cooling fan



- **Cooling fan engine**
- **Cooling fan hyd. oil/compr.**

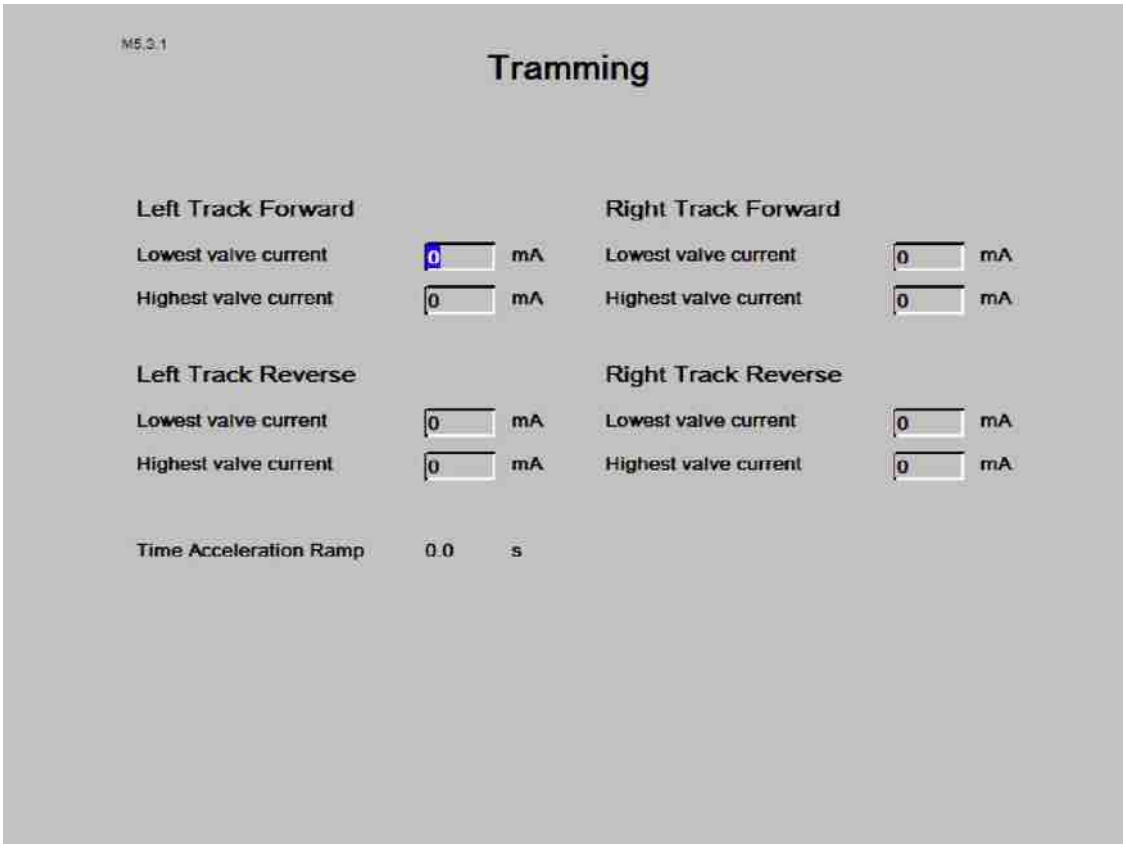
Rig - parameters



Parameters.

- **Tramming**

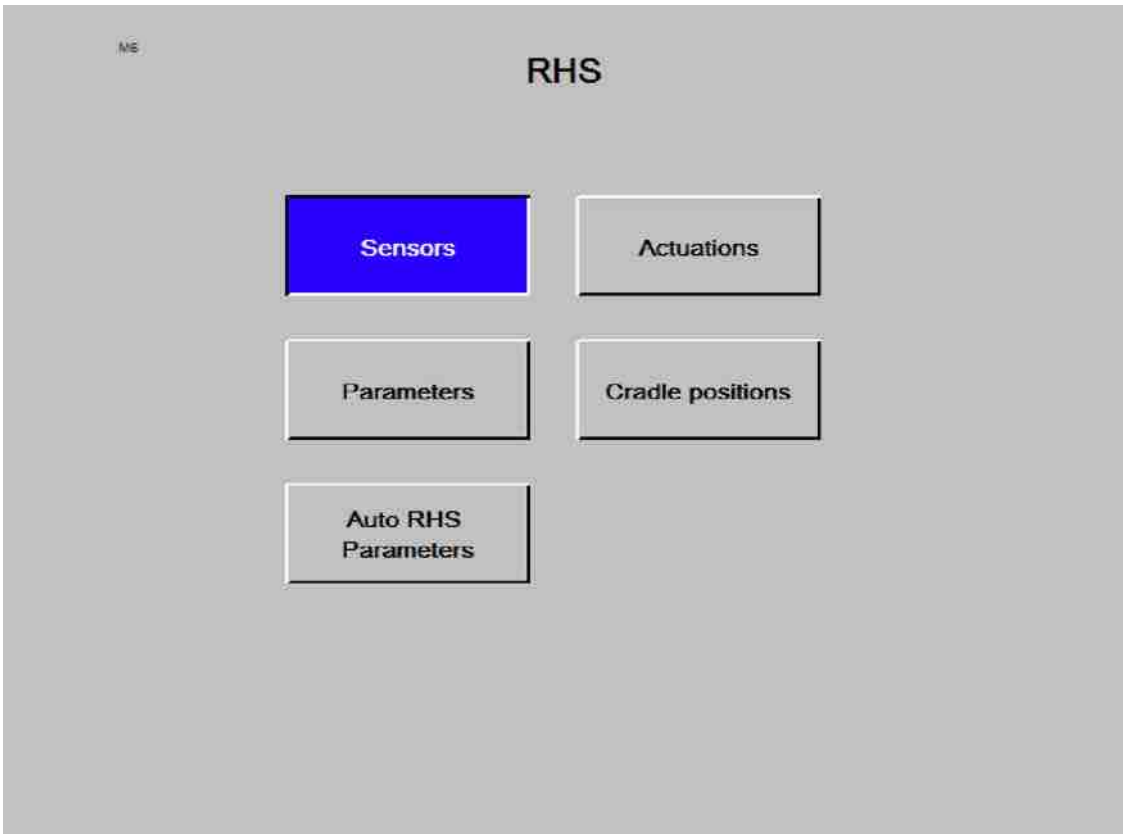
Rig - parameters - tramming



- **Left Track Forward**
  - **Lowest valve current**
  - **Highest valve current**
- **Right Track Forward**
  - **Lowest valve current**
  - **Highest valve current**
- **Left Track Reverse**
  - **Lowest valve current**
  - **Highest valve current**
- **Right Track Reverse**
  - **Lowest valve current**
  - **Highest valve current**
- **Time Acceleration Ramp**

5.10 RHS

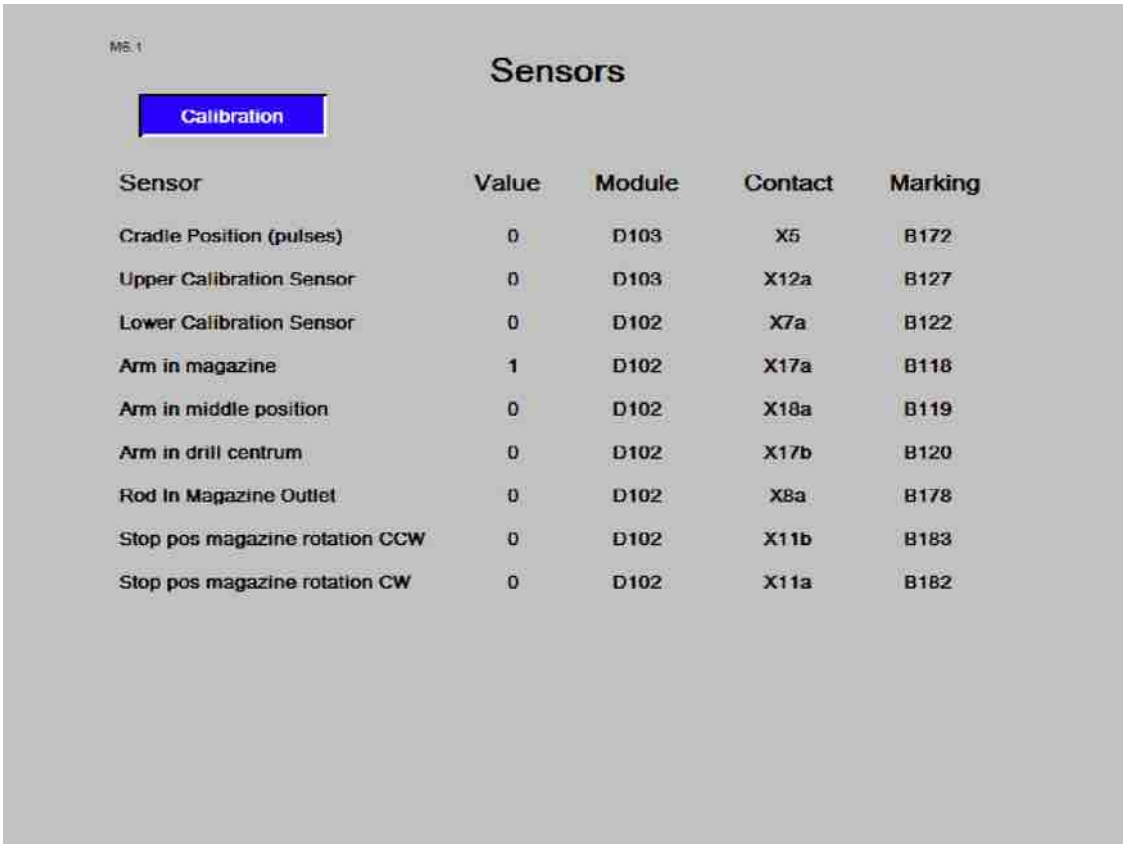
5.10.1 RHS menu



RHS

- **Sensors**
- **Actuations**
- **Parameters**
- **Cradle positions**
- **Auto RHS Parameters**

RHS - Sensor

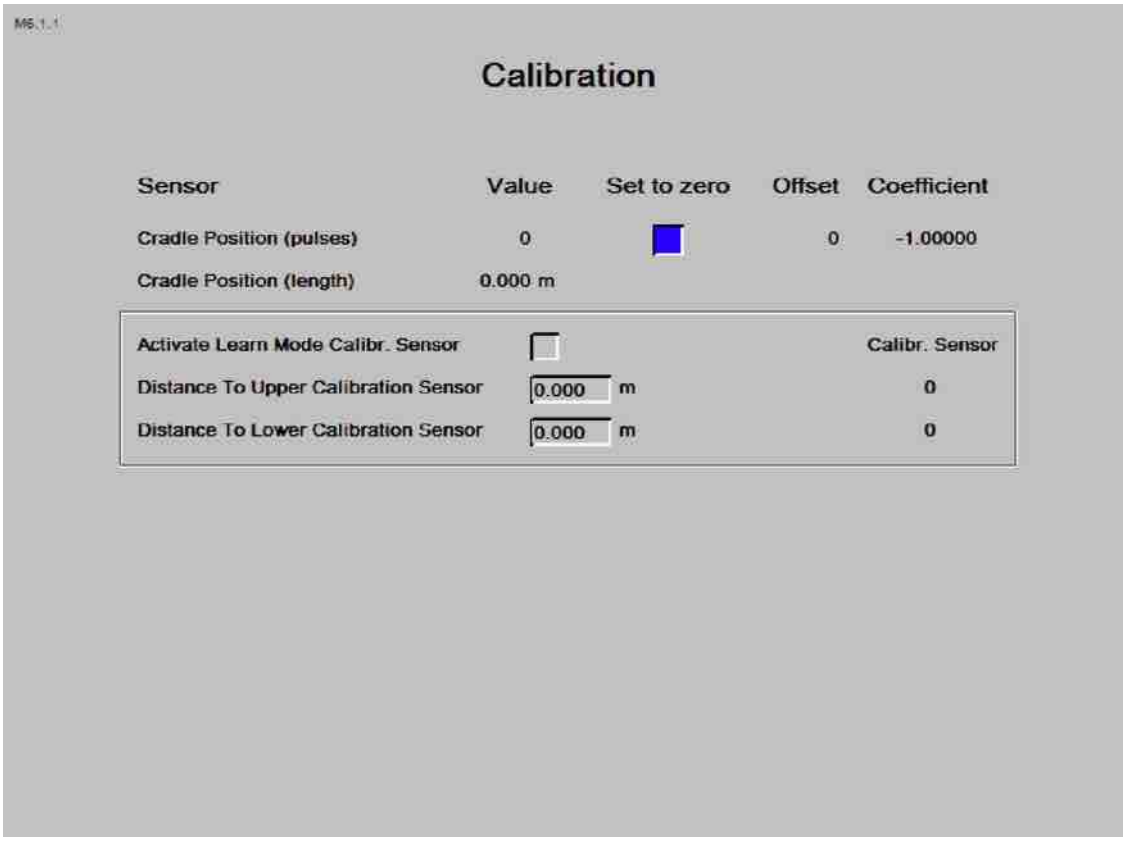


Sensors

The status of all the sensors involved in rod handling can be checked from this menu. The sensor module location, connector and marking are shown to facilitate fault finding where appropriate.

- **Cradle Position (pulses)**
- **Upper Calibration Sensor**
- **Lower Calibration Sensor**
- **Arm in magazine**
- **Arm in middle position**
- **Arm in drill centre**
- **Rod in Magazine Outlet**
- **Stop pos magazine rotation CCW**
- **Stop magazine rotation CW**

RHS - Sensor - Calibration



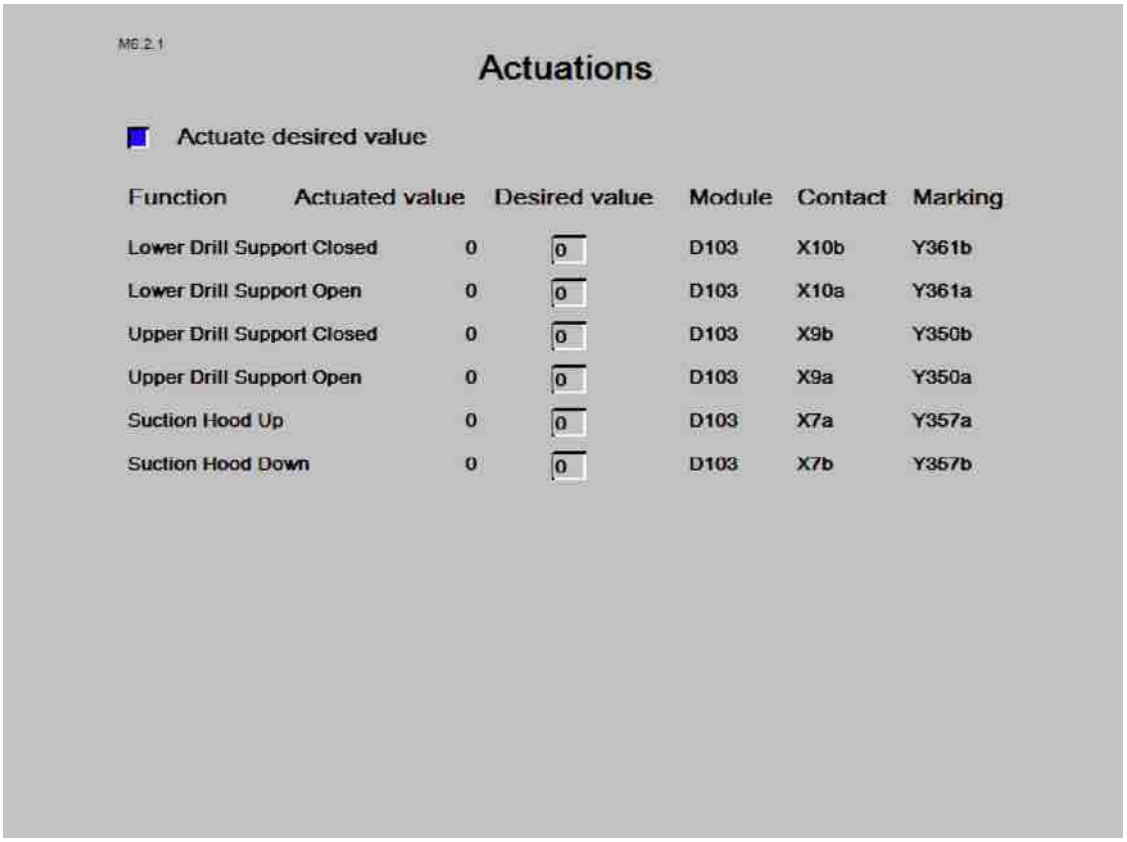
Calibration

- **Sensors**
  - **Cradle position (pulses)**
  - **Cradle position (length)**
- **Value**
- **Set to zero**
- **Offset**
- **Coefficient**
- **Activate learn mode calibr. sensor**
- **Distance to upper calibration sensor**
- **Distance to lower calibration sensor**
- Operate the cradle to mechanical stop.
- Set to zero by checking the boxes **Set to zero** and **Activate learn mode calibr. sensor**.
- Slowly operate the cradle down until it has passed the lower calibration sensor.
- The distance will automatically appear in boxes.
- Exit with ESC.

RHS - Actuations

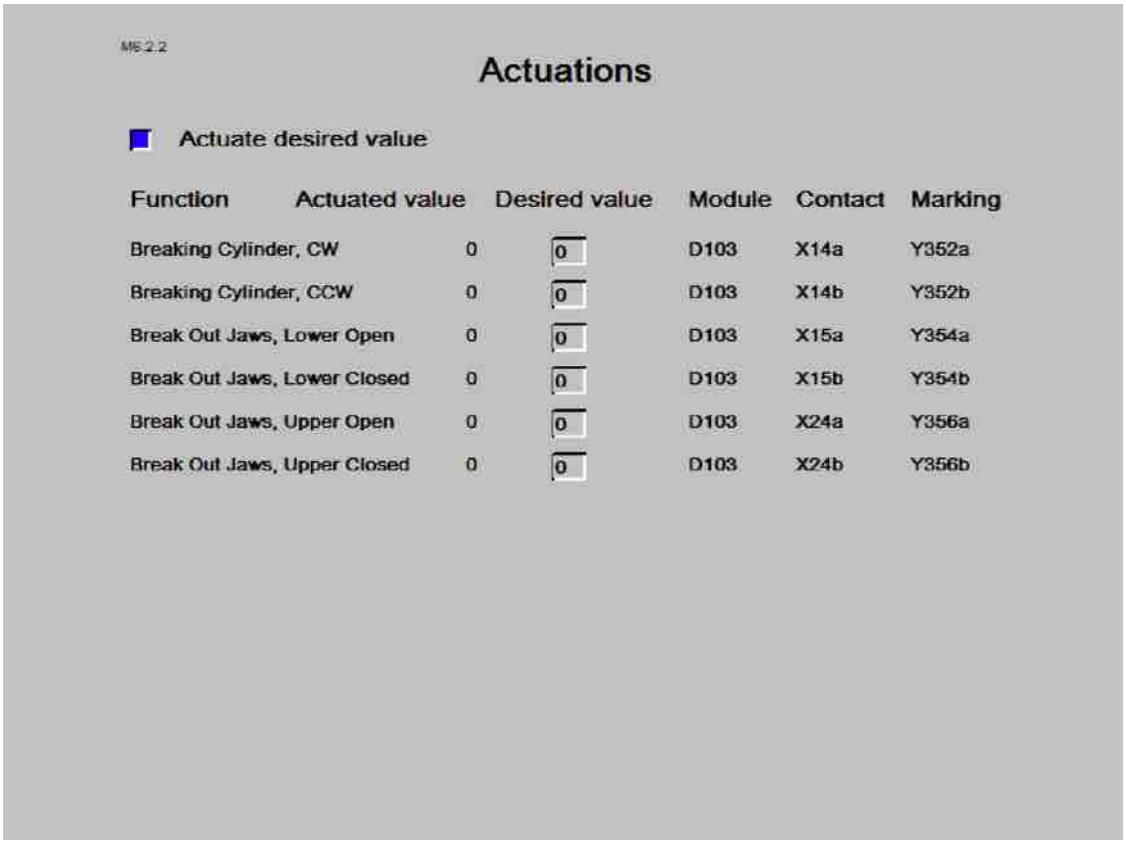
Actuations - Left Digital Lever

- **Actuate desired value**
- **Function**
  - **Grippers in Guide Position**
  - **Grippers open**
  - **Magazine outlet open**
  - **Rotate Gripper Towards Drill Centre**
  - **Rotate Gripper Towards Magazine**
  - **Arm to drill centre**
  - **Arm to magazine**
  - **Magazine rotation CW**
  - **Magazine rotation CCW**
- **Actuated value**
- **Desired value**
- **Module**
- **Contact**
- **Marking**



Actuations - Right Digital Lever

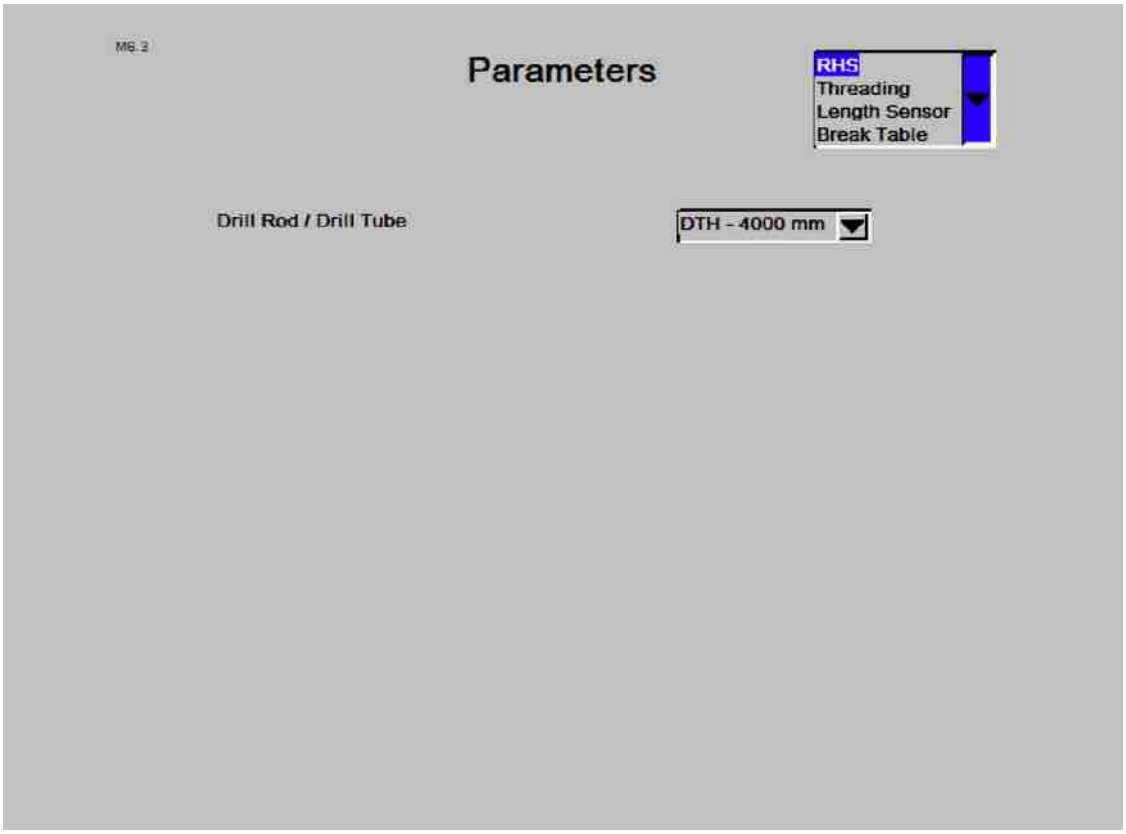
- **Actuate desired value**
- **Function**
  - **Lower Drill Support Closed**
  - **Lower Drill Support Open**
  - **Upper Drill Support Closed**
  - **Upper Drill Support Open**
  - **Suction Hood Up**
  - **Suction Hood Down**
- **Actuated value**
- **Desired value**
- **Module**
- **Contact**
- **Marking**



Actuations - Break table

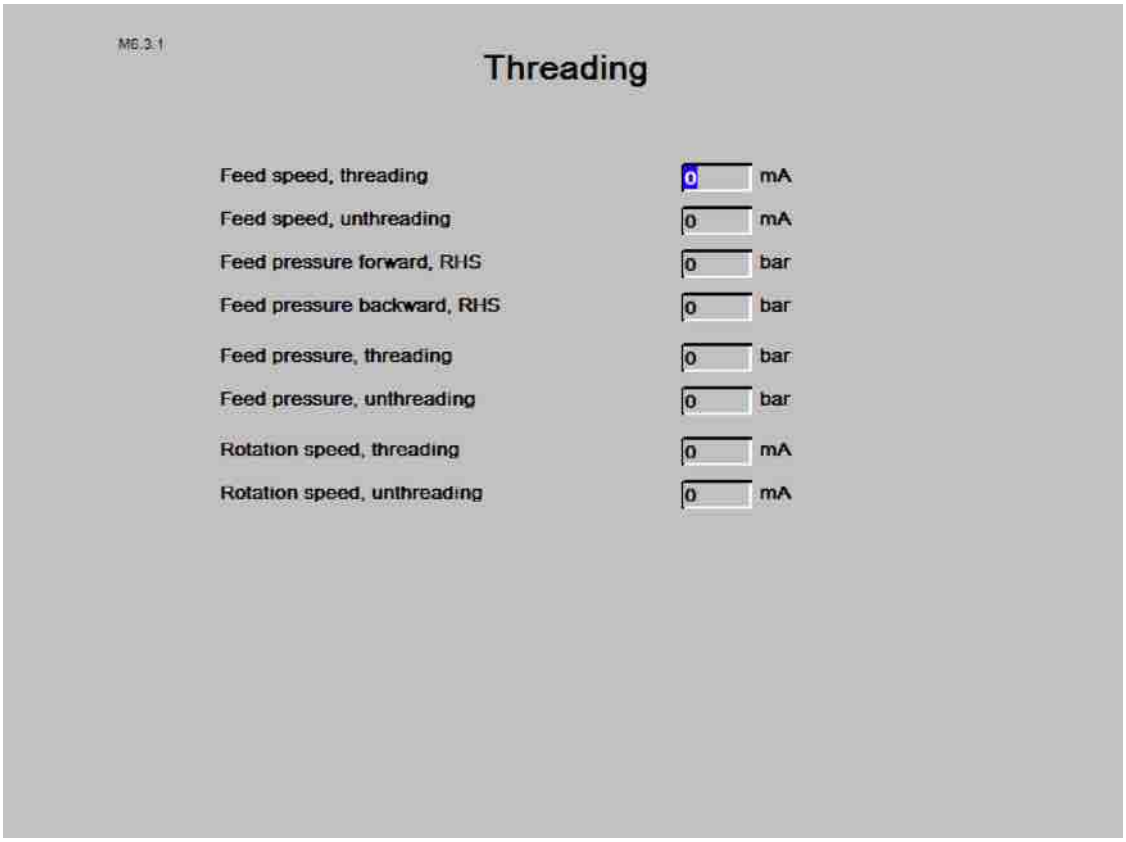
- **Actuate desired value**
- **Function**
  - **Breaking cylinder, CW**
  - **Breaking cylinder, CCW**
  - **Break out jaws, lower open**
  - **Break out jaws, lower closed**
  - **Break out jaws, upper open**
  - **Break out jaws, upper closed**
- **Actuated value**
- **Desired value**
- **Module**
- **Contact**
- **Marking**

RHS - Parameters



Parameters - RHS

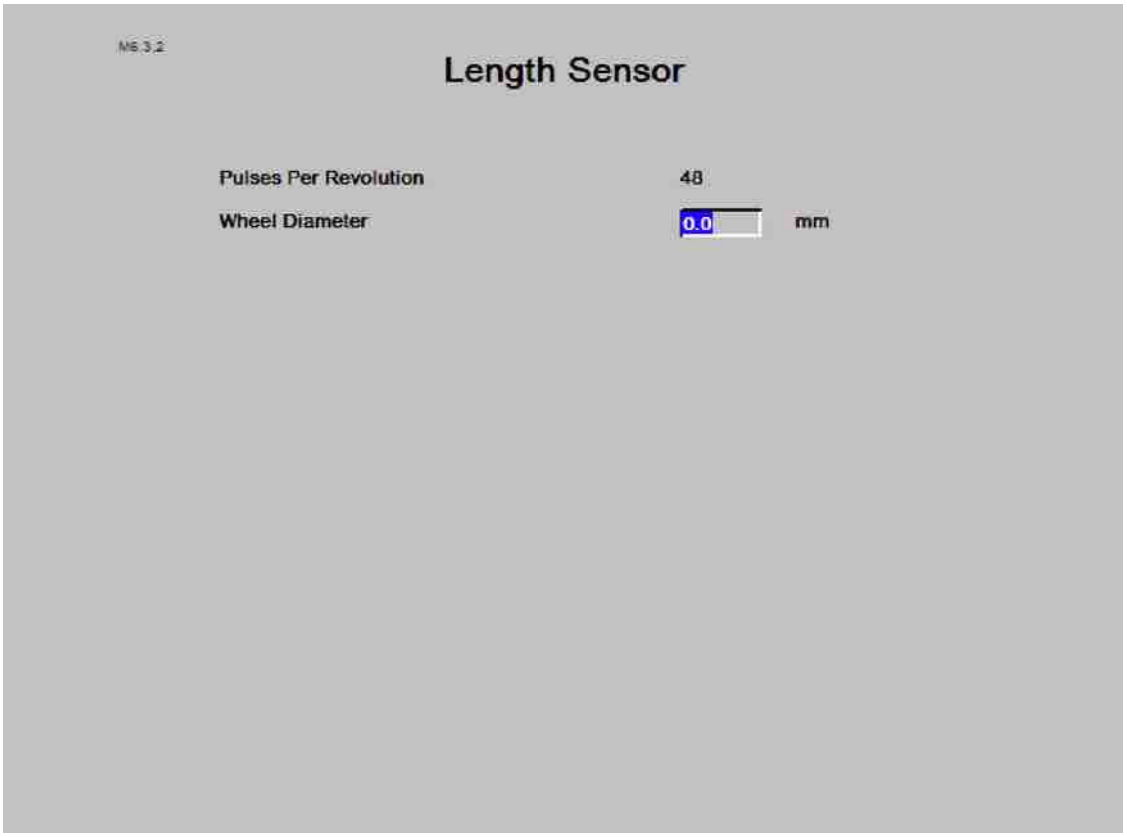
- **Drill Rod / Drill Tube**



Parameters - Threading

- **Feed speed, threading**

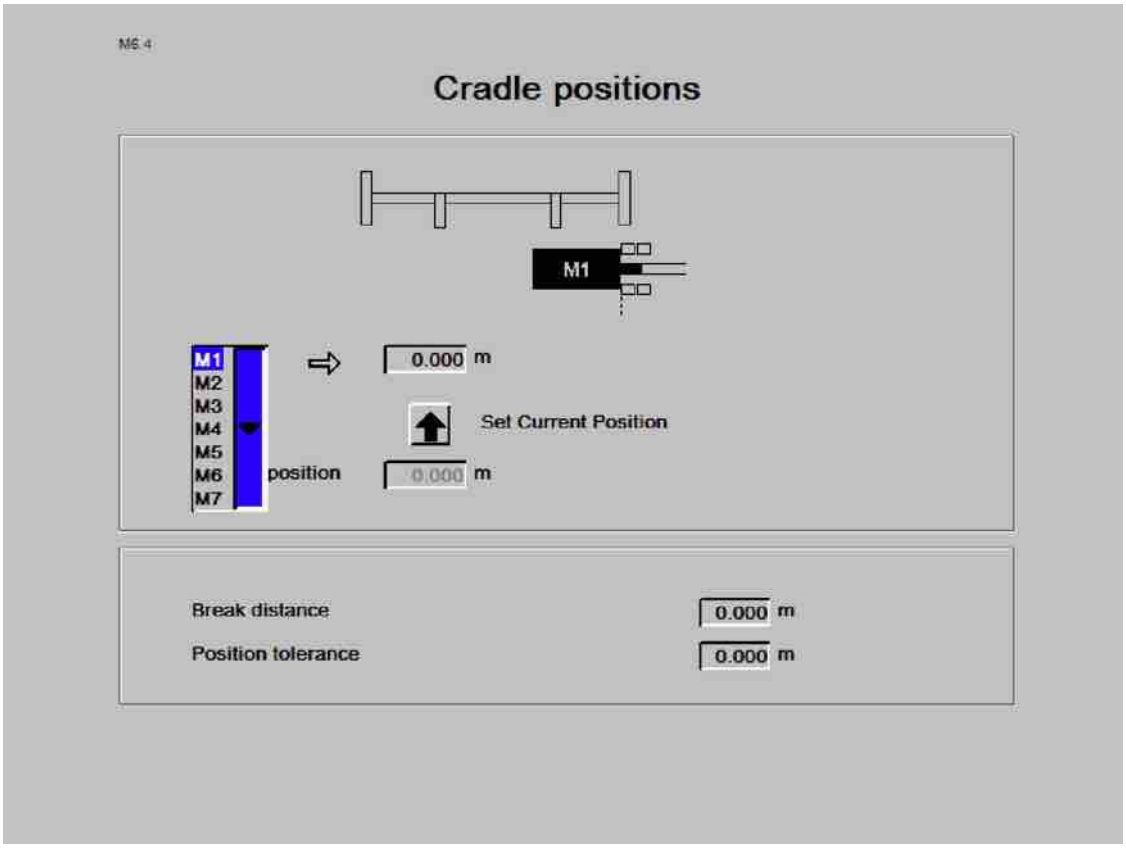
- **Feed speed, unthreading**
- **Feed pressure forward, RHS**
- **Feed pressure backward, RHS**
- **Feed pressure, threading**
- **Feed pressure, unthreading**
- **Rotation speed, threading**
- **Rotation speed, unthreading**



Parameters - Length Sensor

- **Pulses per revolution**
- **Wheel diameter**

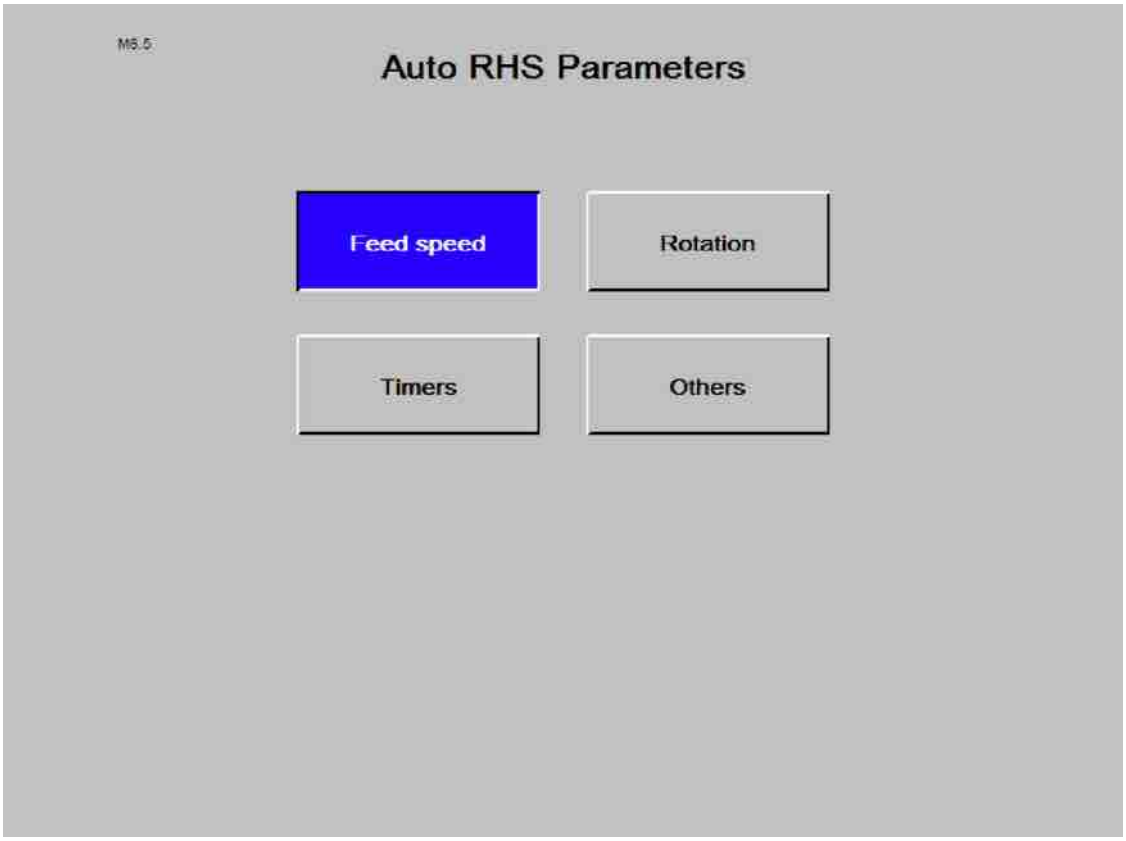
RHS - Cradle positions



Cradle positions

- **Current position**
- **Set Current Position**
- **Break distance**
- **Position tolerance**
- **M1:** Cradle in the lower position (should be about 3 cm above mechanical stop) (applicable when automatic rod handling is activated on the right-hand control panel).
- **M2:** Position for breaking of adapter-rod (applies when automatic rod handling is activated on the right-hand control panel).
- **M3:** Rapid feed stop forward.
- **M4:** Position for breaking rod-rod. Requires that **Automatic rod extraction** is activated in Direct selection menu F2.
- **M5:** Position for inserting rods into the carousel. Requires that **Automatic rod extraction** is activated in Direct selection menu F2.
- **M6:** Cradle in upper position.
- **M7:** Position when the upper drill-steel support can be closed when the first rod is drilled.

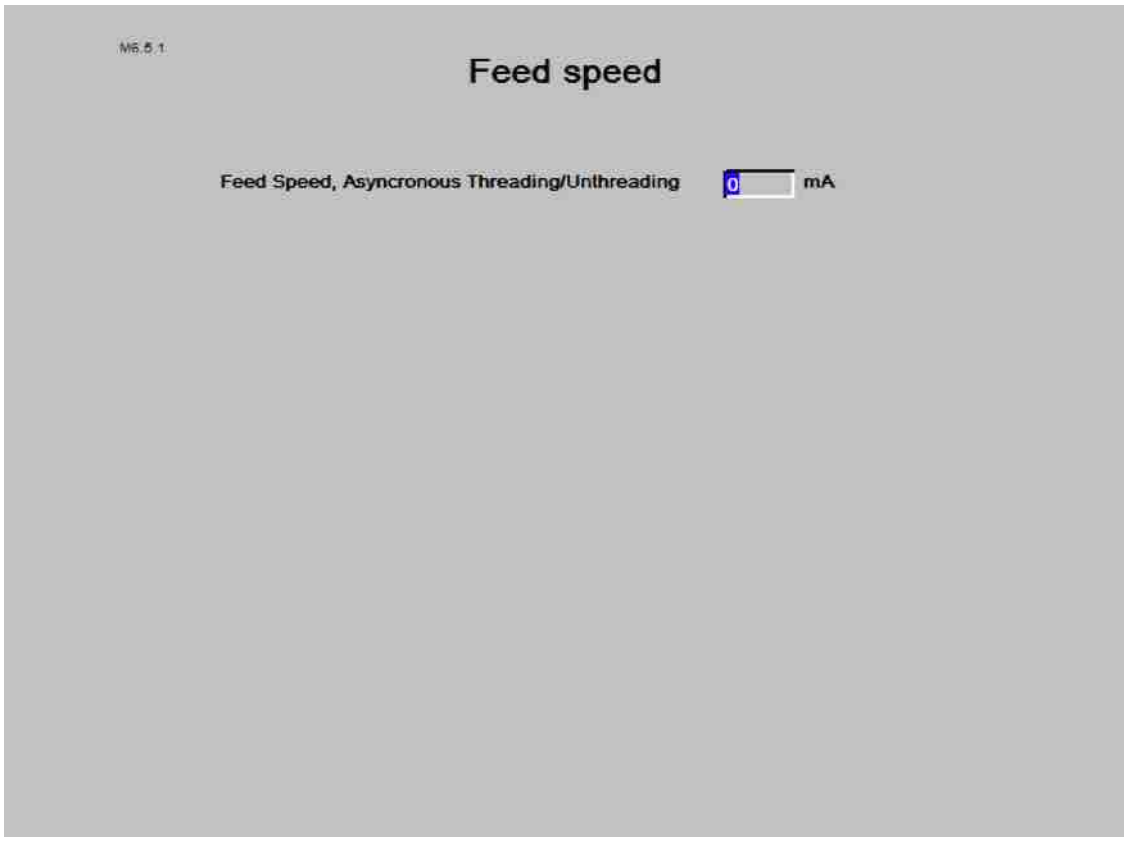
RHS - Auto RHS parameters



Auto RHS Parameters

- **Feed speed**
- **Rotation**
- **Timers**
- **Others** (Not used)

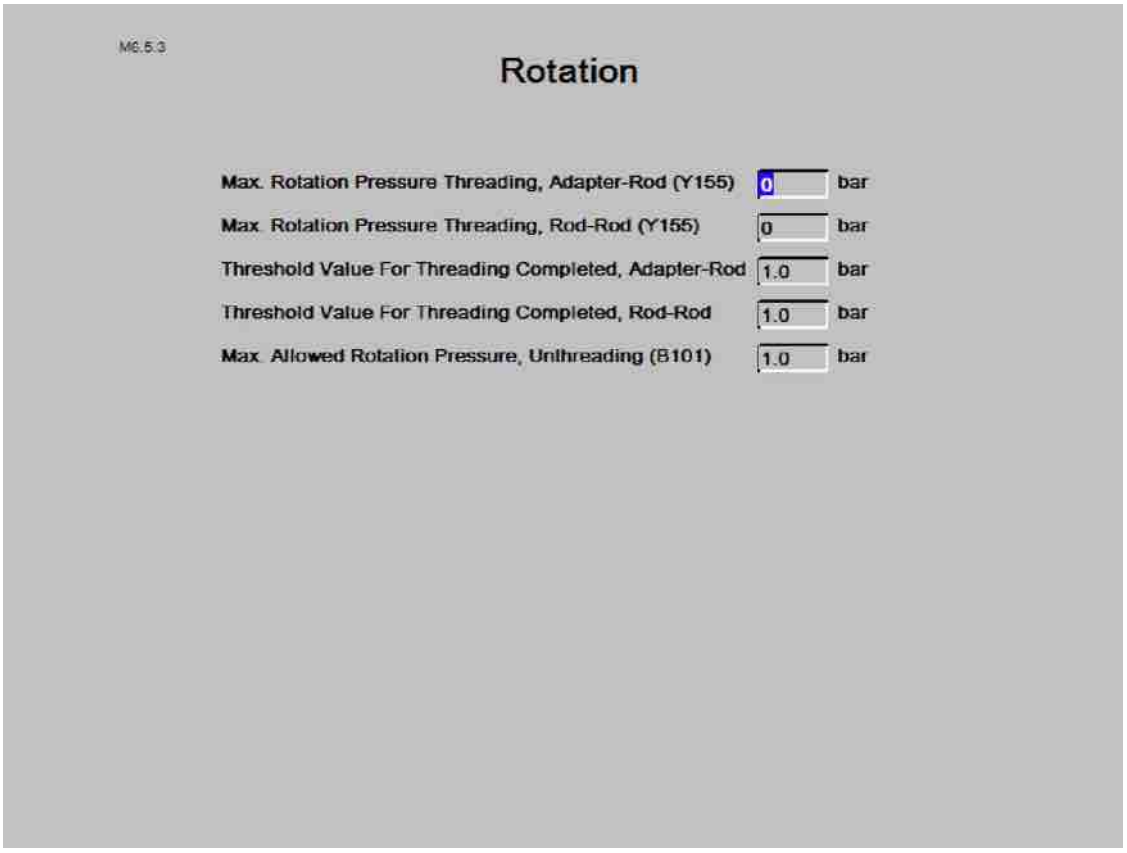
RHS - Auto RHS parameters - Feed speed



Feed speed

- **Feed Speed, Asyncronous Threading/Unthreading**

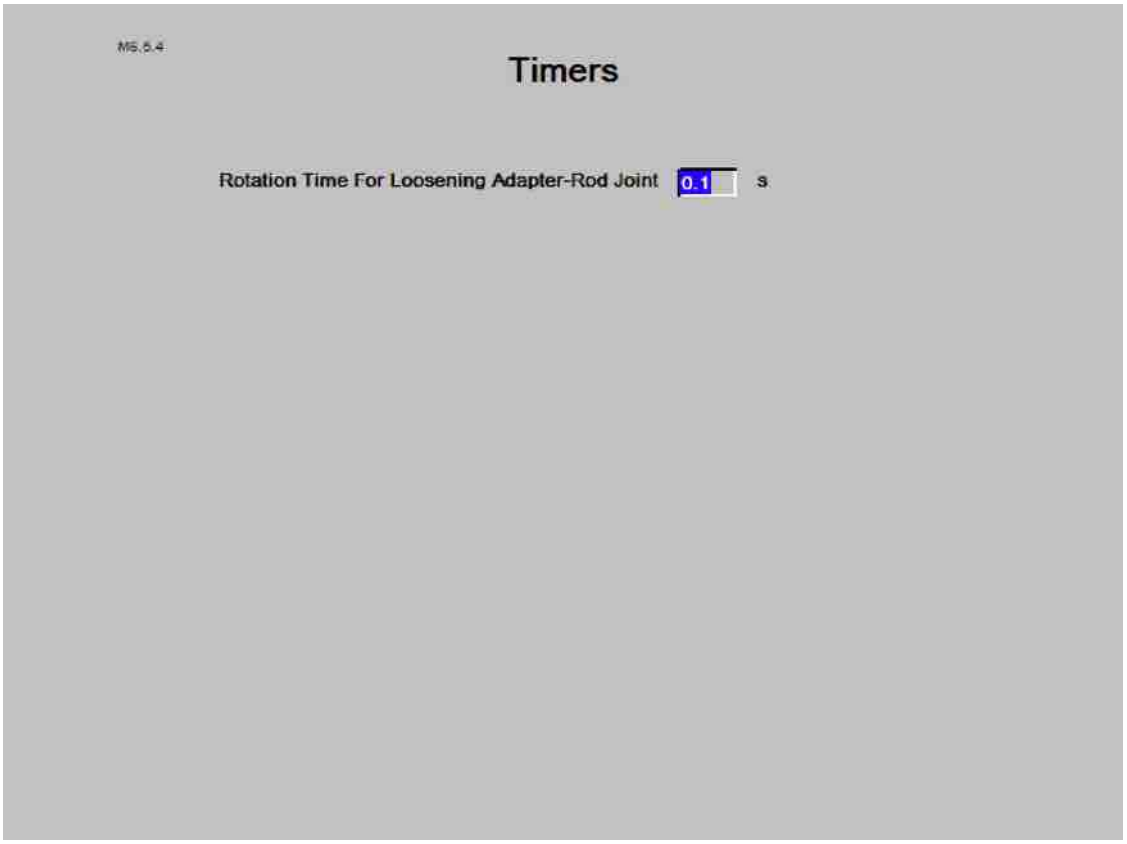
RHS - Auto RHS parameters - Rotation



Rotation

- **Max. Rotation Pressure Threading, Adapter-Rod (Y155)**
- **Max. Rotation Pressure Threading, Rod-Rod (Y155)**
- **Threshold Value For Threading Completed, Adapter-Rod**
- **Threshold Value For Threading Completed, Rod-Rod**
- **Max. Allowed Rotation Pressure, Unthreading(B101)**

RHS - Auto RHS parameters - Times



Timers

- Rotation Time For Loosening Adapter-Rod Joint

6 Hydraulic systems

6.1 Environmental considerations when handling oil

NOTICE

Environmental effect

Think of the environment!

- Leaking hydraulic connections and lubrication grease are environmentally hazardous
- Changing oils, replacing hydraulic hoses and different types of filter can be environmentally hazardous
- Always collect used oil, oil spillage, waste with oil content and lubrication grease residue and spillage. Treat in accordance with local regulations in force.
- Use biodegradable hydraulic fluids and lubrication oils for Atlas Copco products wherever possible. Contact your local Atlas Copco office for further information

6.2 General

WARNING

Serious injury

Danger of burn injuries

- The hydraulic oil may reach a temperature of 80 °C

CAUTION

Risk of injury

Hazardous hydraulic oil pressure

- Risk of personal injury
- Working on the hydraulic system can involve a high risk of danger. Ensure the system is depressurised before starting work
- The hydraulic system may also be pressurised for a short time after the motor has been switched off

! ***NOTE:*** *The pressure in the hydraulic hoses may vary depending on the operating mode selected.*

⚠ CAUTION

Risk of injury

Hazardous hydraulic oil and water pressure

- Can cause personal injury
- Never replace high pressure hoses with hoses of lower quality than the originals or with hoses fitted with removable couplings

The hydraulic system is sensitive to impurities. The environment in which a drill rig normally operates is usually unsuitable for repairing hydraulic components. Work on the hydraulic system on-site should therefore be limited to absolute necessities, i.e. only changing components. When changing valves, the unit in question must be well strapped and supported. Components should then be repaired in a suitable environment.

Observe the following points to avoid breakdowns and interruptions in operation due to fouled hydraulic oil:

- Keep the drill rig clean. Hose it down at regular intervals, preferably with an added grease solvent.
- Before opening any connection, clean the area round it thoroughly.
- Use clean tools and work with clean hands.
- Always plug hydraulic connections immediately after they have been detached.
- Use clean protective plugs.
- Hydraulic components, such as hoses, valves, motors, must always be kept with suitable protective plugs fitted.
- Spare parts for hydraulic components must always be kept in sealed plastic bags.
- Change filter cartridges as soon as the filters indicate clogging.

6.3 Repairing hydraulic components

Repairing and/or reconditioning hydraulic components should be carried out by expert personnel and in a suitable place. The following alternatives are possible:

- Suitable premises for hydraulic repairs to be arranged at the workplace. Repairs to be carried out by your own specially trained personnel, the manufacturer's technicians or Atlas Copco personnel.
- Components to be sent to the manufacturer's local agent for repair.
- Component repairs are carried out by Atlas Copco. Overhauling instructions are available for the most important and most complicated hydraulic components.

6.4 Replacement of hydraulic hoses

The high system pressure with safety valves set to 280 bar, together with the vibration and other mechanical strain, puts high demands on the hydraulic hoses. All hydraulic hoses are fitted with pressed couplings and should therefore be purchased ready-made from Atlas Copco. Hose dimensions and qualities are specified in the spare parts lists for the drill rig.

6.5 Hydraulic workshops

Workshops used for the repair of hydraulic components must:

- Be separate from activities which generate dust and particles, such as welding, grinding, the transportation of vehicles, etc.
- Have their own suitable washing equipment which is required for repairing the components.
- Have the necessary tools, both standard and special, that are only used in the hydraulic workshop.
- Have a ventilation system that does not admit dust into the premises.
- Have well-trained mechanics.

6.6 Filter

6.6.1 Return oil filter

General

The return oil filter cleans the oil before it returns to the tank.

There are two return oil filters connected in parallel. A return oil filter consists of a tube containing two filter inserts. The tubes are mounted inside the hydraulic oil reservoir.

The filter inserts should be replaced according to the maintenance schedule but if the return filter's pressure gauge on the operator display indicates "Clogged filter" (red zone on the scale), all return oil filters must be changed immediately.

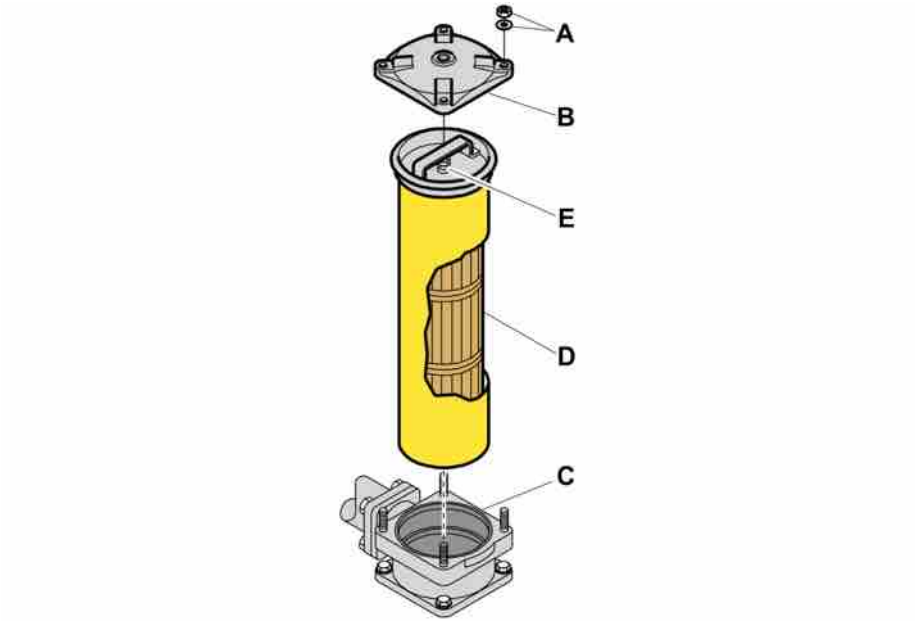
Symbol for clogged filter

***NOTE:** The filter cartridges cannot be cleaned but must be replaced when they are clogged.*

Changing the return oil filter

The filter inserts can be dismantled by removing the cover and lifting them up.

1. Clean on and around the filter cap and unscrew the nuts (A).



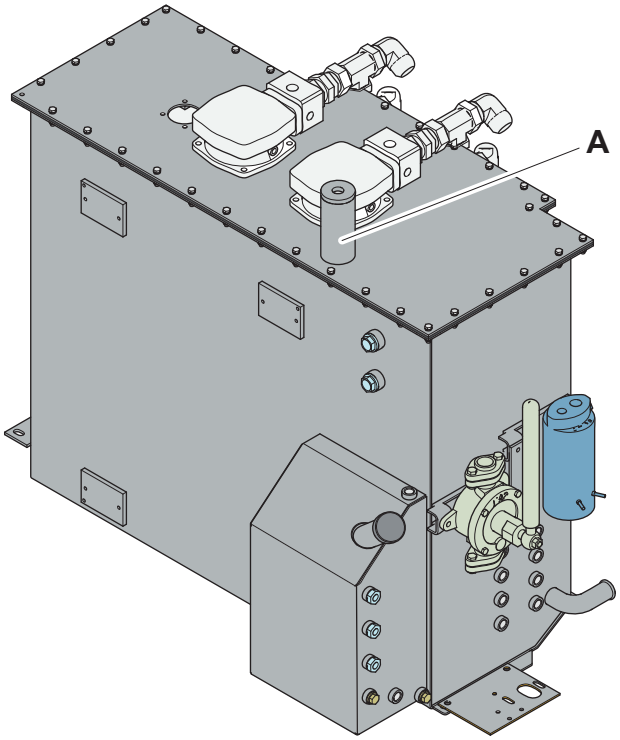
Changing filter

2. Lift off the cap (B) and replace the O-ring (C) if it is damaged.
3. Lift up the whole filter canister by the handle.
4. Detach the overflow valve (E) by pressing down and turning the handle anticlockwise.
5. Take out the filter cartridges (D) and replace with new ones.
6. Refit the overflow valve and filter canister and screw on the cap.

6.6.2 Breather filter

General

There is a breather filter (A) fitted on the hydraulic oil reservoir. The purpose of the breather filter is to equalise the pressure differences in the tank that would otherwise arise when the level in the tank changes if, for example, a jack is lowered.



Breather filter

The breather filter must be replaced as set forth in the maintenance schedule and also if it is severely fouled.

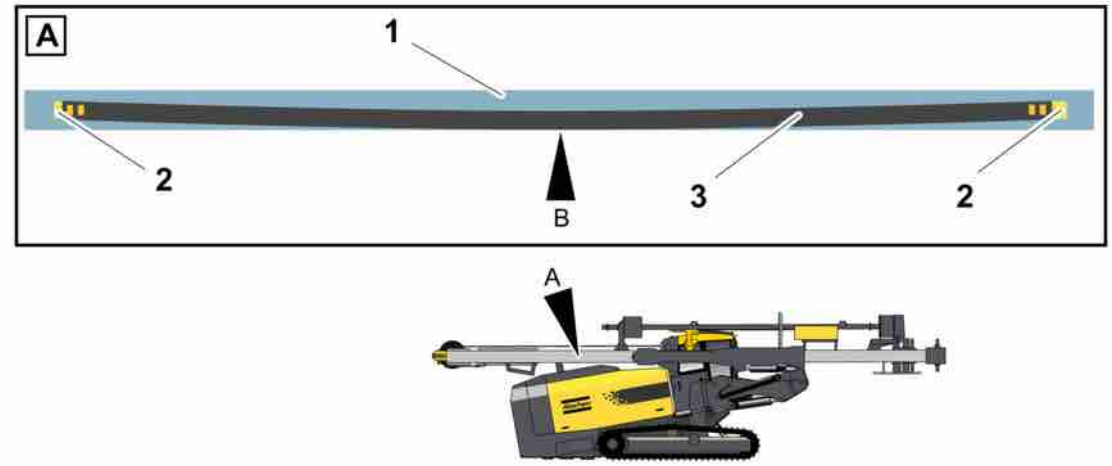
> ***NOTE:*** *If the breather filter becomes covered in oil it will be ruined. This can happen if the tank is overfilled. The filter must then be changed.*

Changing the breather filter

1. Wash clean on and around the filter (A).
2. Unscrew the old filter.
3. Fit a new filter.
4. Tighten the filter by hand.

7 Feeder

7.1 Feeder chain tension



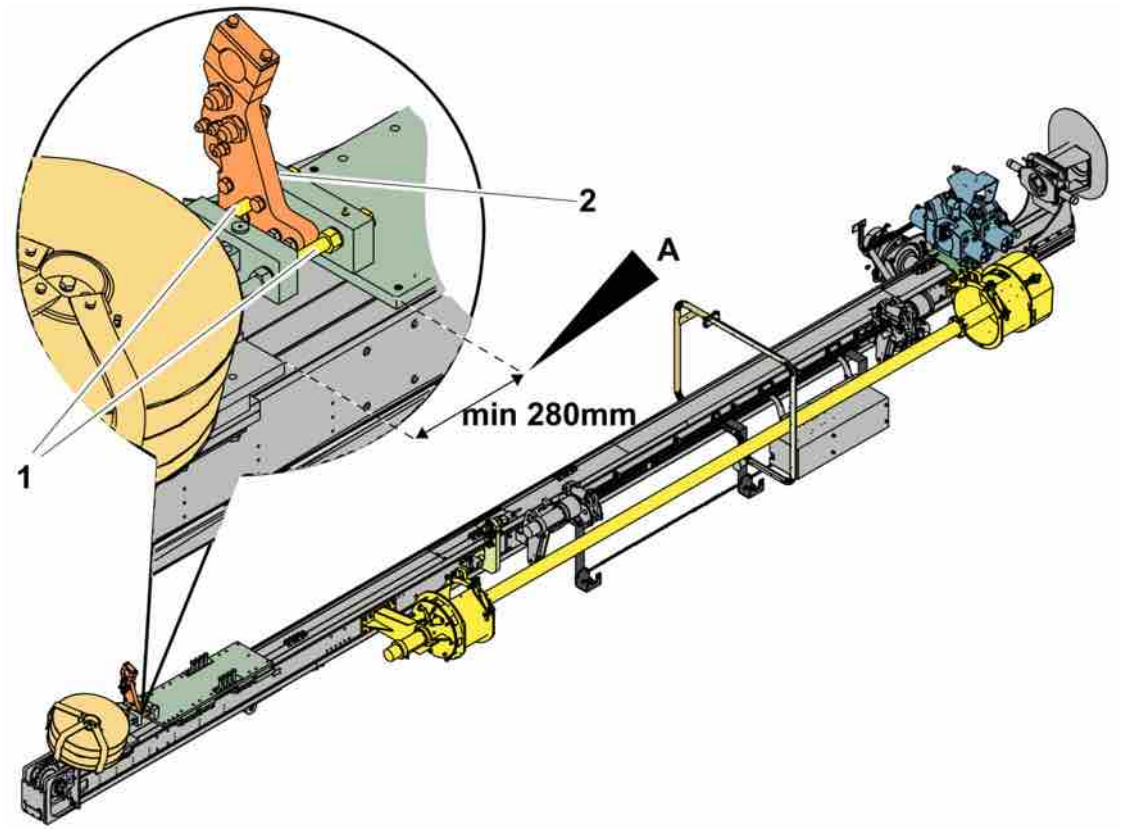
Correct feeder chain tension

1	Feed beam
2	Gear
3	Chain

It is important to ensure that the feeder chain has the correct tension. A poorly tensioned chain leads to increased wear on both the chain and associated components.

When the feeder chain is correctly tensioned it should come into contact with the inner edge of the lower prism on the feed beam at point (B) when the feeder is aligned in a horizontal position, e.g. tramming position.

7.1.1 Feeder chain tension



tension, feeder chain

Tighten or loosen the feeder chain with the bolts (1).

If it is necessary to change the tension of the feeder chain, lubricate the bolts (1) via the grease nipples (2) before starting to adjust. A small amount of grease should also be applied directly to the threads at the same time.

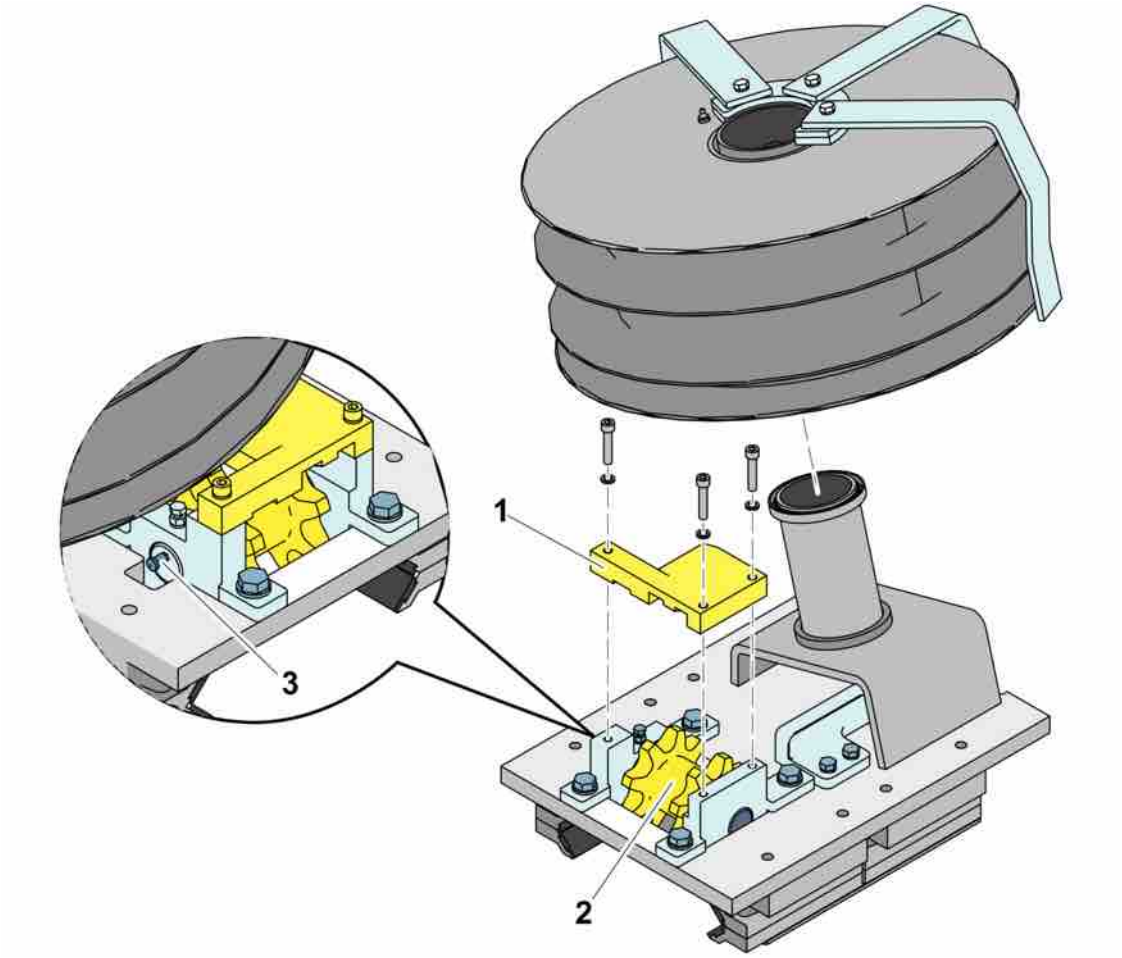
The distance (A) must be at least 280 mm.

7.2 Tension of hoses on the hose drum

1. Move the rotation unit halfway down on the feeder.
2. Fit a chain pulley block between the hose drum cradle and the top of the feeder.
3. Remove the cover plate on the hose drum cradle that holds the chain in place on the sprocket wheel.
4. Lift up the chain from the sprocket wheel using a crowbar or similar.
5. Pull the hose drum cradle along the feeder with the chain pulley block until the hoses are tensioned.
6. Remove the crowbar, refit the cover plate and remove the chain pulley block.

7.3 Climbing chain

7.3.1 Lubricating the sprocket wheel and checking the climbing chain cover.



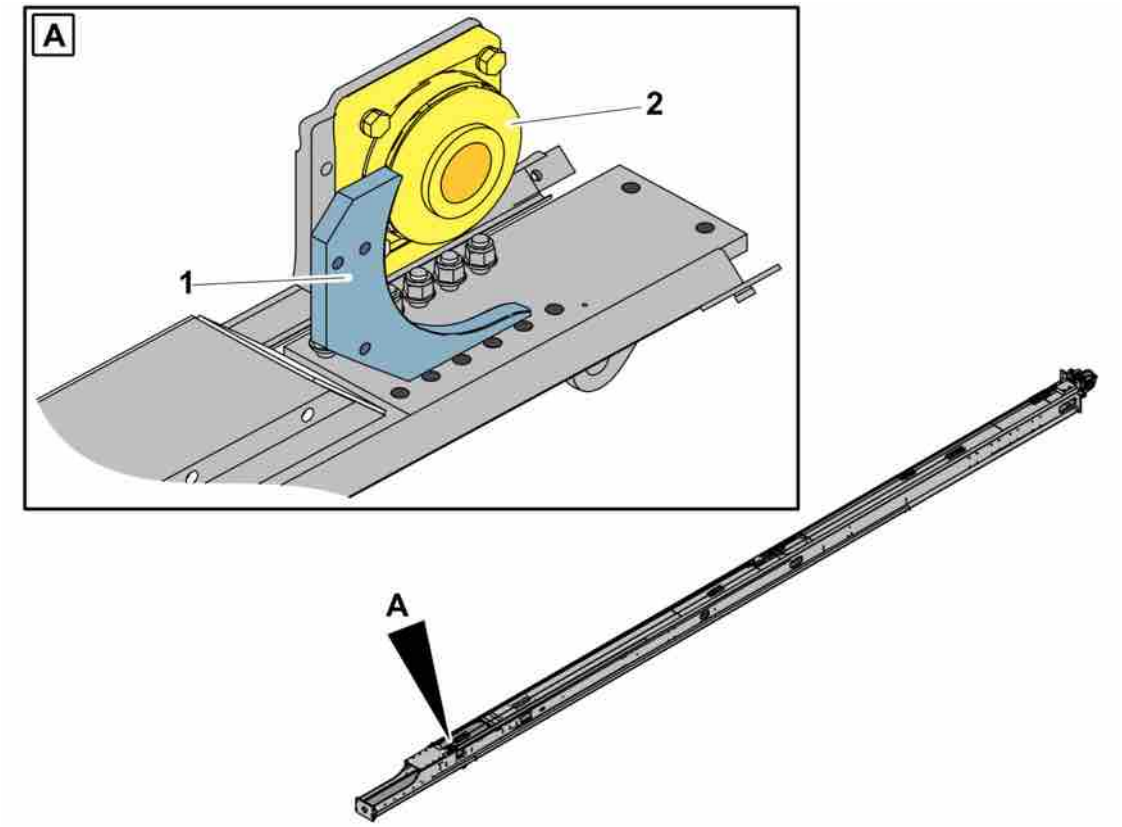
Climbing chain, sprocket wheel and climbing chain cover

The climbing chain's gear (2) is lubricated by means of filling 2 to 3 pump strokes of grease in the grease nipple (3) on the gear's shaft.

If the climbing chain cover (1) is worn then it must be replaced.

After a while the chain links will start to chafe against the jack chain cover. When this takes place, replace the jack chain cover.

7.4 Bearing unit and checking the chain guide



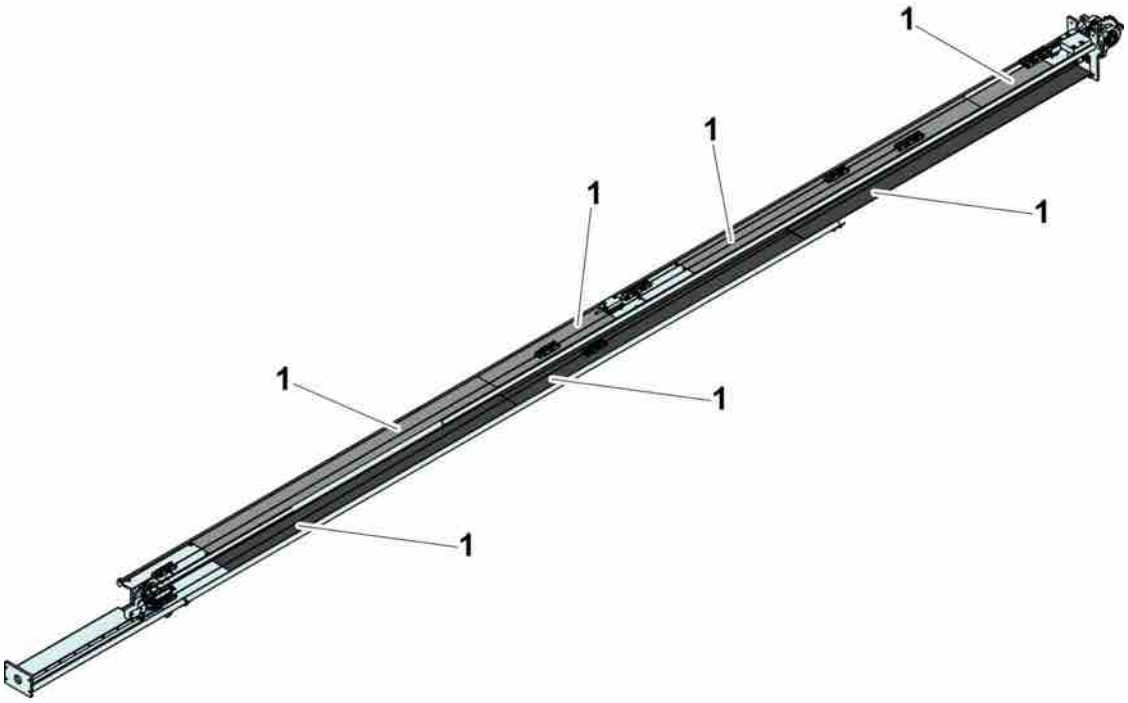
Bearing unit (2) and chain guide (1)

7.4.1 Replacing the bearing unit (chain feed)

After 5000 engine hours the bearing unit (2) should be replaced with a new unit.

Check the chain guide (1) for wear every 500 engine hours. If it is damaged or too worn then it should also be replaced with a new one.

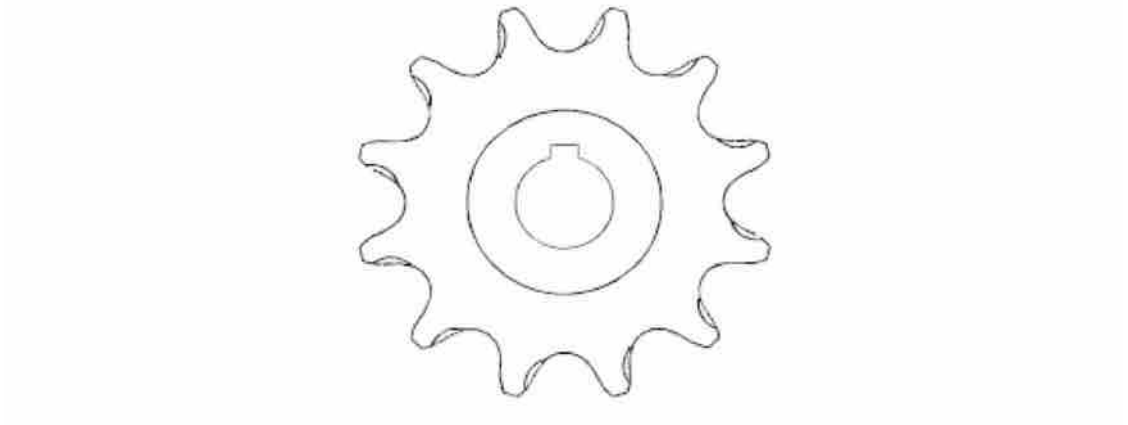
7.5 Protective plates



Chain feed, protective plates

The feed beam is equipped with black protective plastic plates (1). These are designed to stop the chain and beam causing damage to each other. They must be replaced when they become worn.

7.6 Checking for wear on the sprockets



A worn sprocket

Check whether there is any unevenness or if it jams when the chain engages and disengages from the gears.

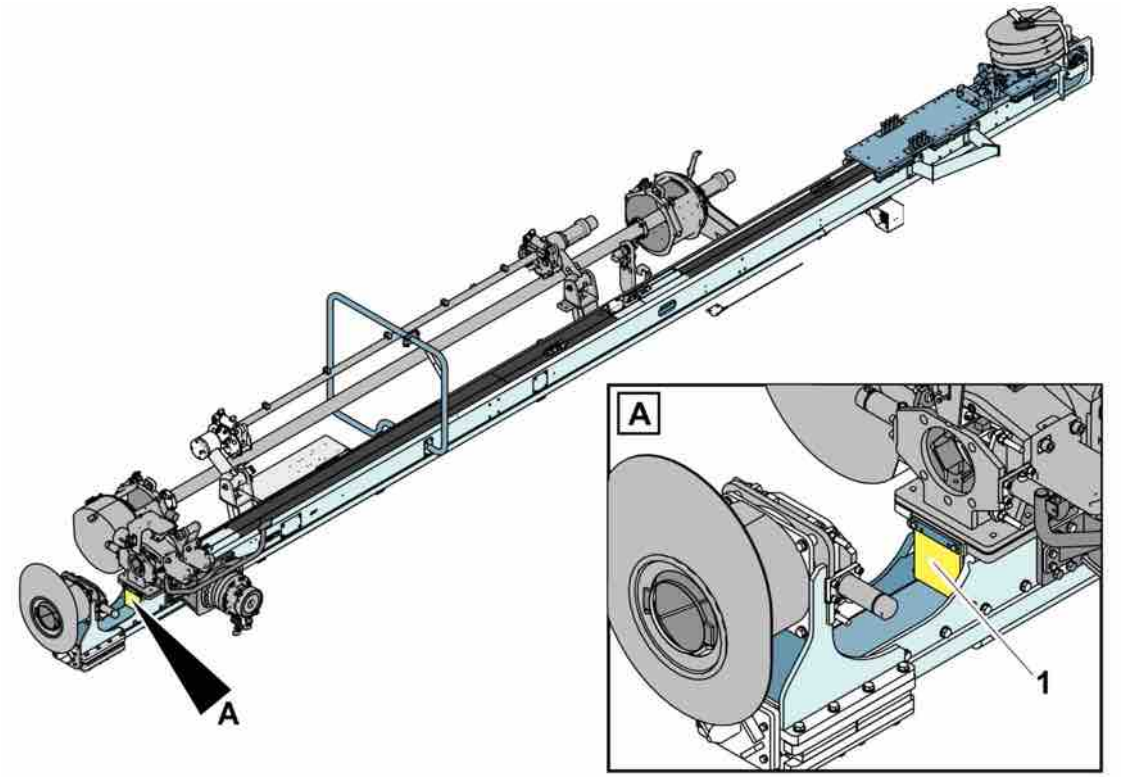
Inspect the teeth for reduced area and bent tips. If the teeth are too worn then the sprocket wheels should be replaced. (See figure: A worn sprocket).

Do not run a new chain on worn gears. It will lead to the new chain wearing out very quickly.

Do not run a worn chain on new gears since this will lead to the new gears wearing out quickly.

As a general rule, replace the gears every third chain replacement.

7.7 Sealing disc

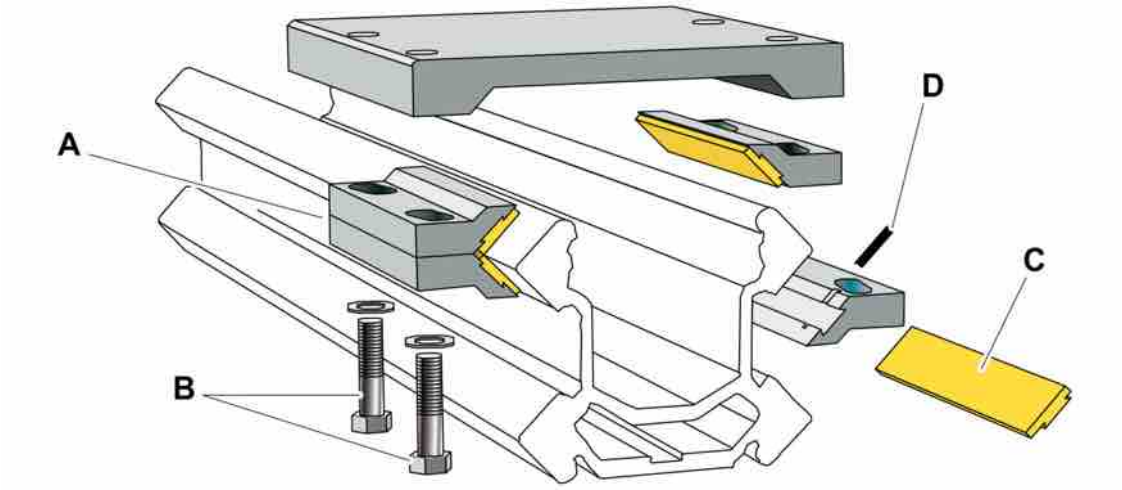


Sealing disc (1)

Cuttings accumulate over time behind the sealing disc (1). There is risk that the cuttings may damage the chain and gears. Bend the cutting disc down in order to clean out dirt collected behind it.

7.8 Replacing the slide pieces in the holder

Each holder has replaceable slide pieces. The slide piece (C) is kept in place by three keys (D). The slide pieces must be replaced at regular intervals so that the steel in the holder does not wear against the beam. Replace if there is less than 1 mm of wear allowance on the slide piece. It is a good idea to change all the slide pieces at the same time, even if some of them are slightly thicker.



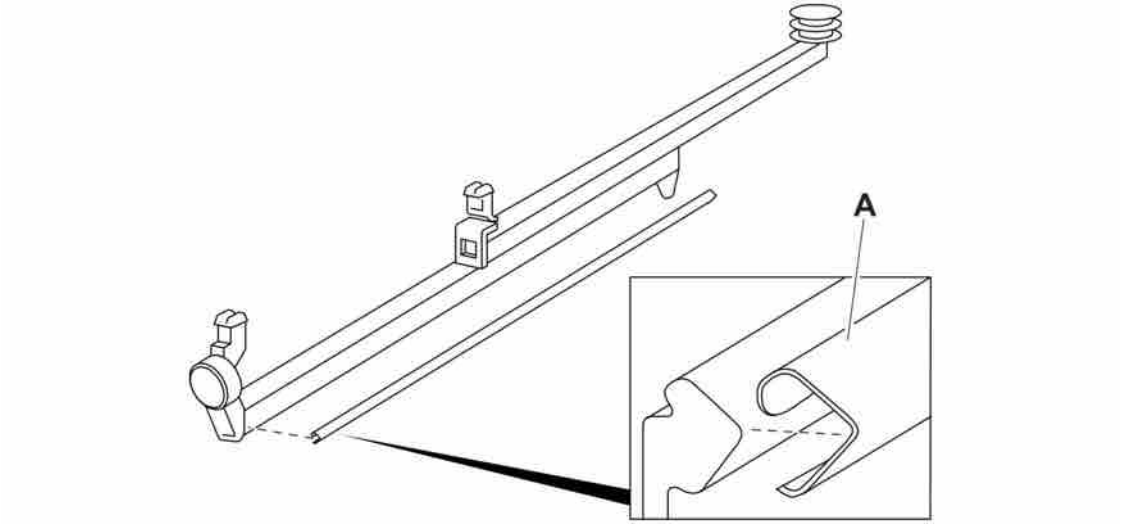
Replacing slide pieces

1. Prise off the slide pieces (C) from the holder using a screwdriver and remove the keys (D).
2. Slide a new slide piece into the holder track and fit the new keys.
3. Makes sure that the holders are refitted to the cradle correctly and that they are adjusted so that the total lateral play is 2-3 mm.

7.9 Replacement of Slide Bars

> ***NOTE:*** *Always replace the slide pieces when replacing slide rails!*

Slide rails should be replaced if they are worn or severely scratched.



Replacement of Slide Bars

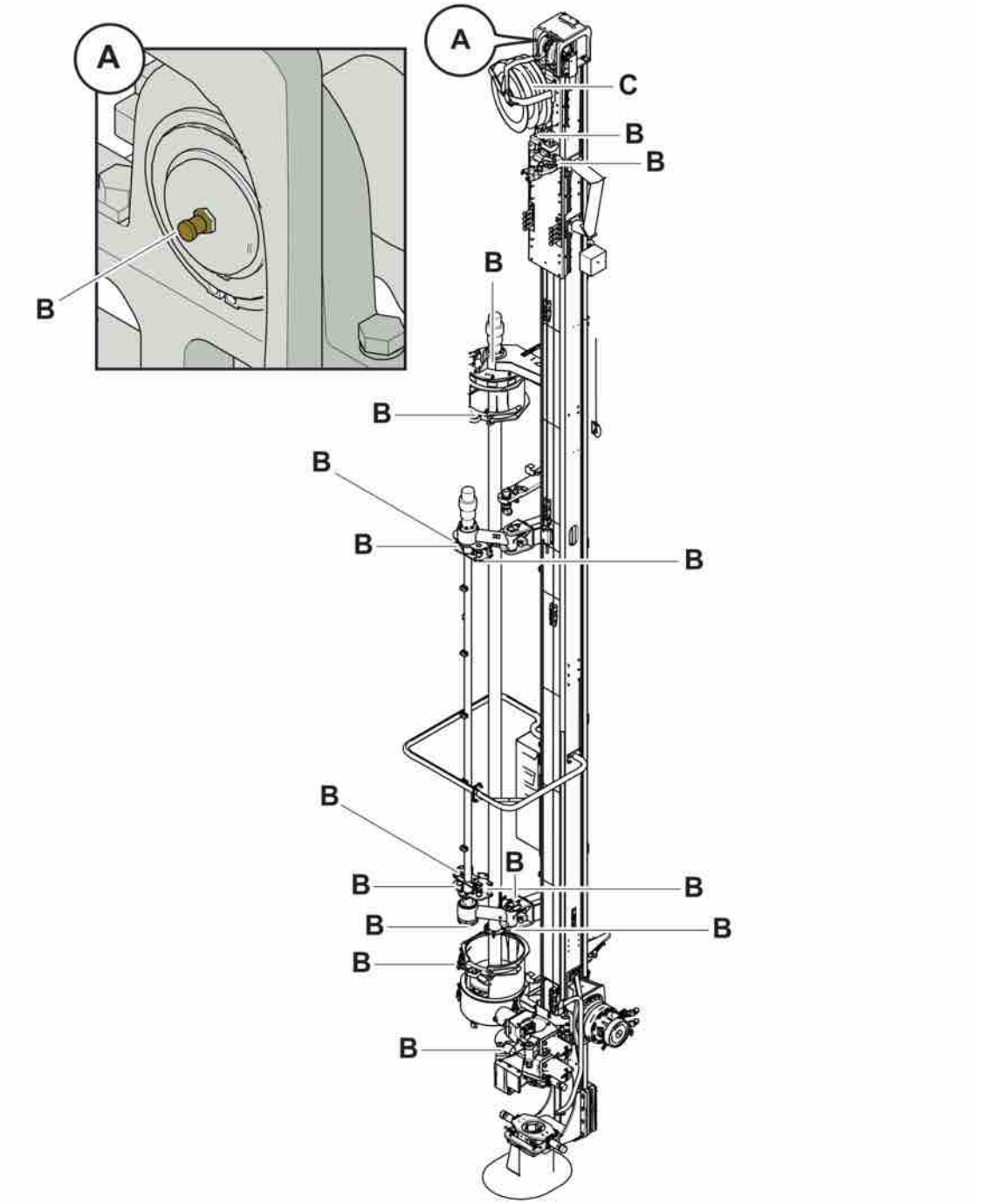
The slide rails are divided up to facilitate replacement.

Before replacing the front slide rails, run the rock drill/rotation unit to its rear end position.

Before replacing the rear slide rails, run the rock drill/rotation unit to its front end position.

1. Remove the cradle for the rock drill, intermediate drill-steel support and the hose drum from the beam.
2. Remove the old slide rails A by prising the lower edges of the bars outwards using a screwdriver.
3. Clean the beam surfaces thoroughly.
4. Fit the new slide rails. The larger edge on the slide rail must be facing upwards. The rails should be pressed in place by hand.
5. Refit the rock drill cradles, intermediate drill-steel support and hose drum. Adjust the holders on the cradles as described in the instructions.

7.10 Lubricating the feeder



The feeder requires lubrication at certain intervals. A number of red grease nipples (A) are located in different positions on the feeder. (B).

In order to reduce the wear of hoses over the drum the hoses (C) must be lubricated with grease regularly.

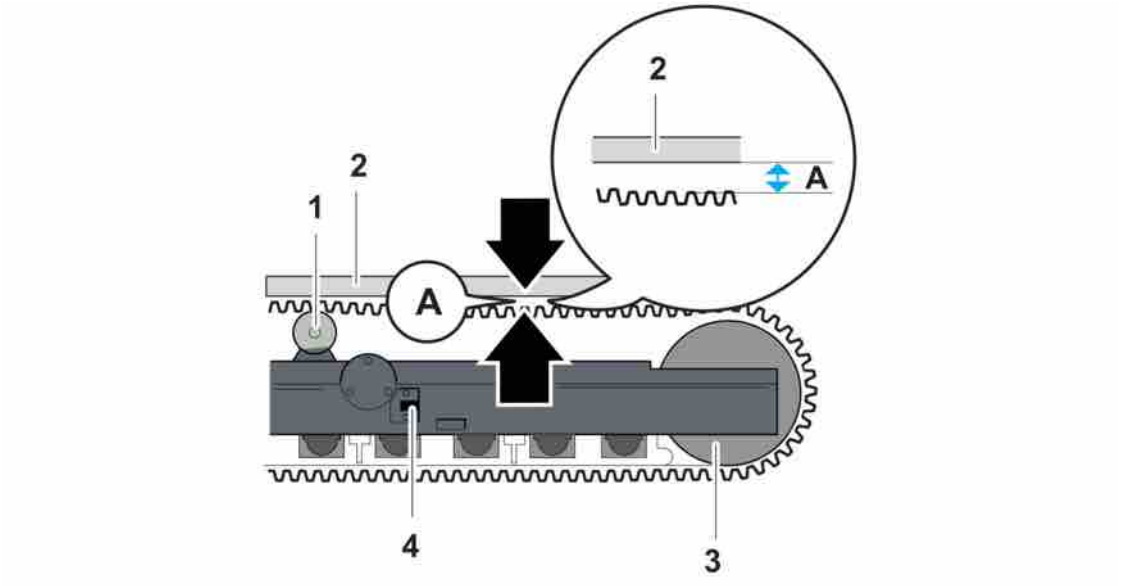
8 Track frames

8.1 Stretching the crawler tracks

> ***NOTE:*** *The clearance (A, see illustration: Crawler track) between the straightedge and the crawler track should be between 20 and 30 mm (0.8 and 1.2").*

> ***NOTE:*** *The grease nipple should not be filled with grease during normal inspection.*

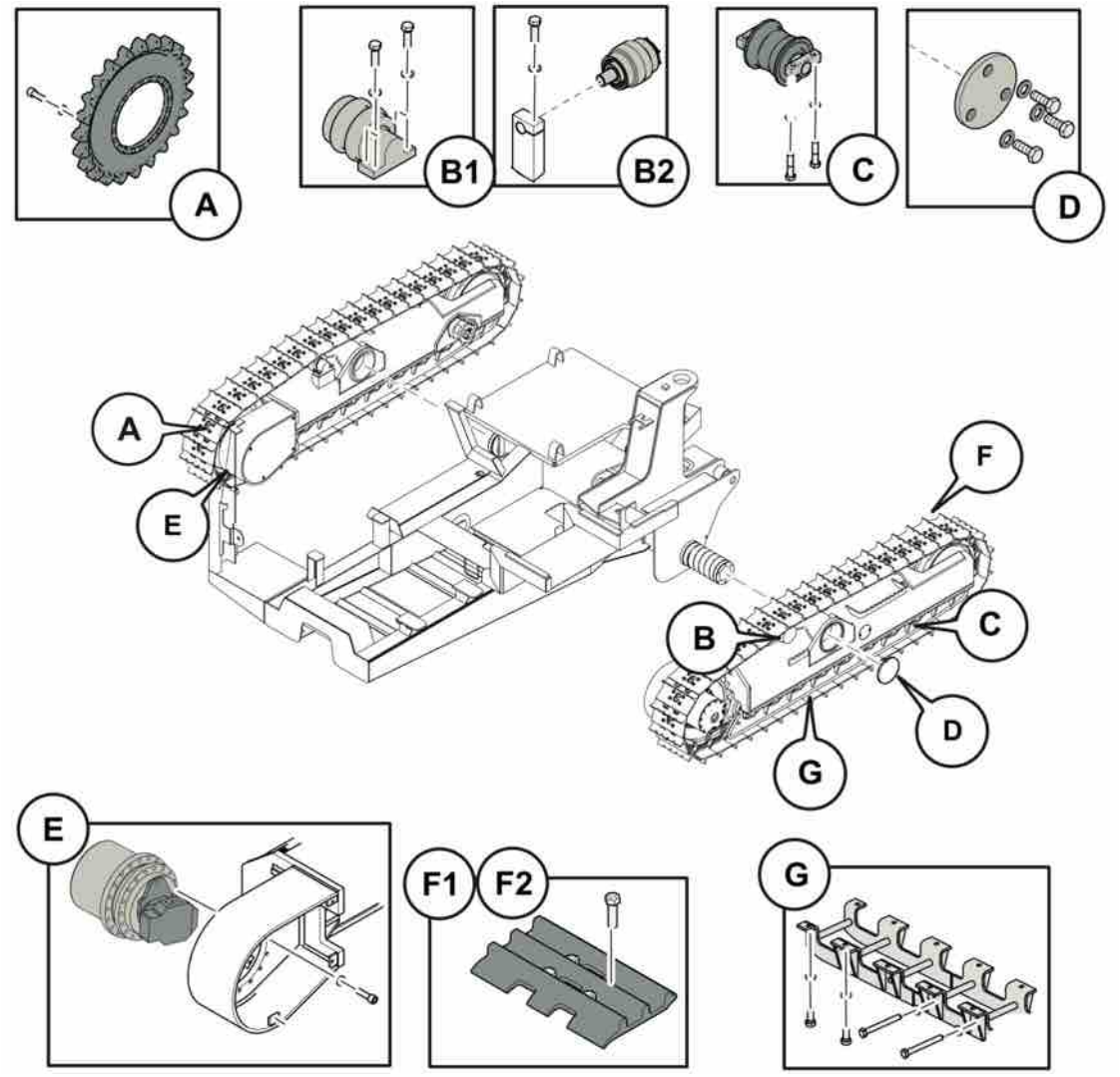
Track tension is checked between the front wheel (3) and limberoller (1) when the drill rig is parked on a level surface with the tracks under normal load.



Crawler tracks

1. Place a straightedge (2, see illustration: Crawler track) on top of each track.
2. Pack with grease via the nipple (4) to tension the track.
3. If necessary, grease can be removed from the tension cylinder by unscrewing the nipple (4).

8.2 Check torques



Tightening torques for track frames

	Size	Torque in Nm	Quantity/track frames	Comments
A	M16	295	20	
B1	M12	86	4	T45, C50, D50, D55, T50SF, C65SF
B2	M16	210	1	T50LF, D60, D65, C65LF
C	M16	210	32	
D	M12	90	3	
E	M16	295	18	
F1	9/16" UNF	260 ± 10	176	T45, C50, D50, D55, T50SF, C65SF

	Size	Torque in Nm	Quantity/track frames	Comments
F2	M16	370 ± 20	176	T50LF, D60, D65, C65LF
G	M16	210	28	
G	M16	210	10	

Table 13: Tightening torques for track frames

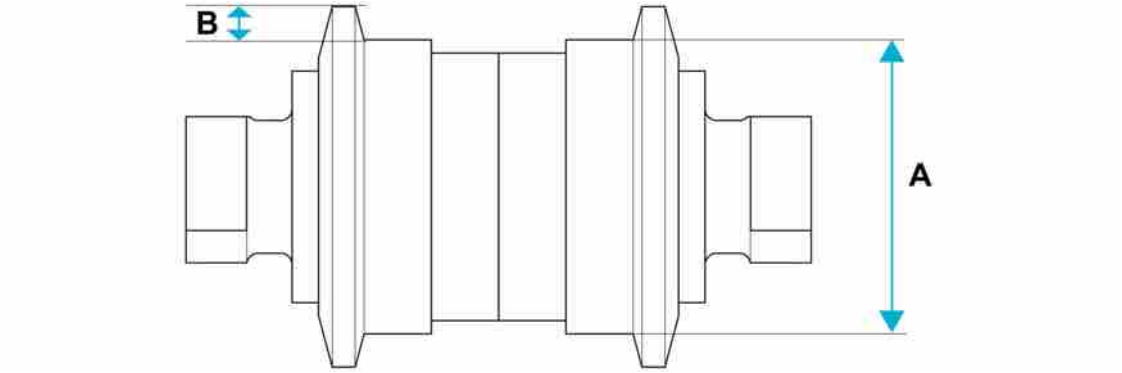
8.3 Check for wear

8.3.1 Procedures

- Components on the track frames that show wear of 100% must be replaced by new components.
- Regular and accurate measuring is required in order to establish the extent of the wear and when replacement is necessary.
- The components must be thoroughly cleaned for measuring.
- Measuring must take place at several points. The degree of wear is determined by the maximum value, not the average value.

8.3.2 Check for wear on the track rollers

Check the wear by measuring the dimensions (A) and (B).

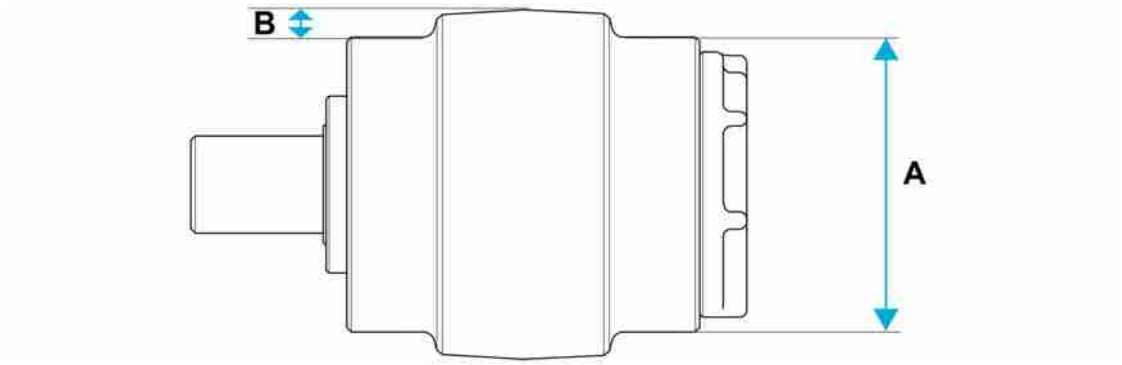


Track roller

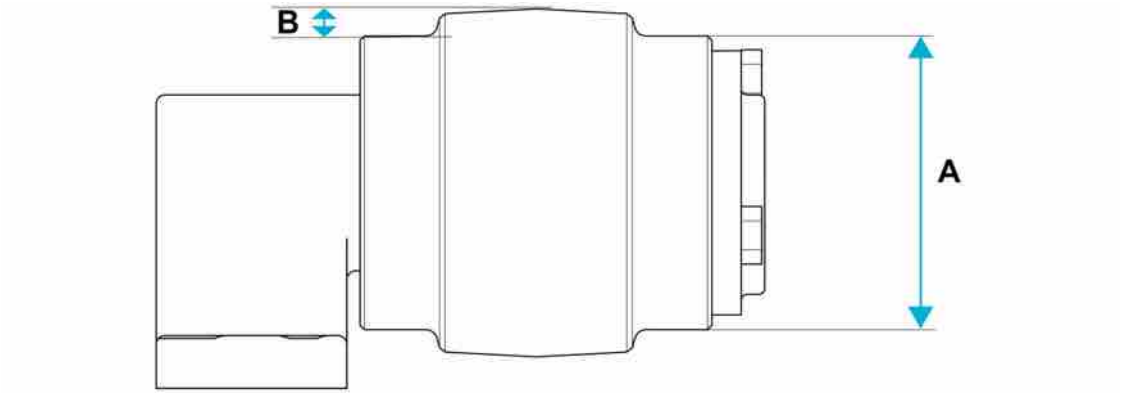
	Wear	New track roller	25%	50%	75%	100%
A	mm	155.0	152,4	149,5	146,0	142,0
B	mm	17.5	18,8	20.3	22.0	24.0

8.3.3 Check for wear on the limberoller

Check the wear by measuring the dimensions (A) and (B) on the limberoller.



Limberoller T45, C50, D55, T50SF, C65SF

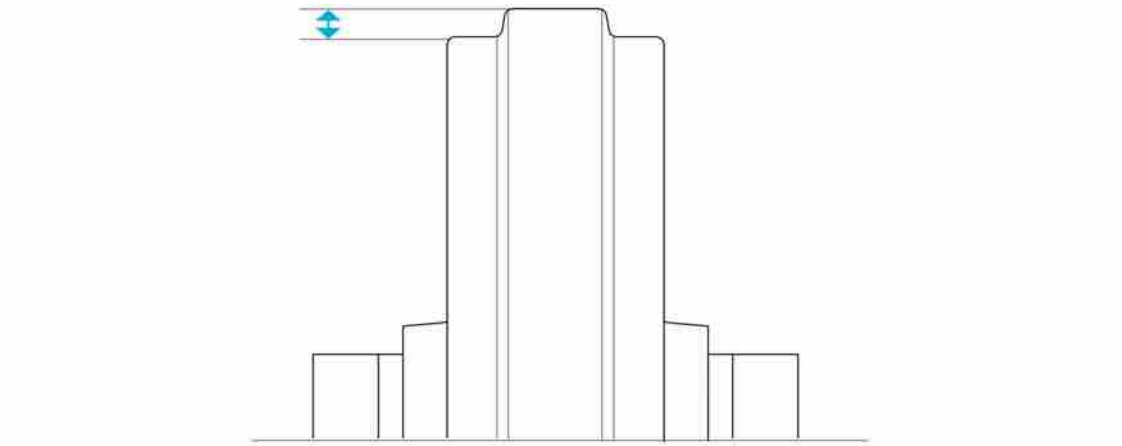


Limberoller T50LF, D60, D65, C65LF

	Wear	New limber-oller	25%	50%	75%	100%
A	mm	100.0	98,5	96,7	94,6	92,0
B	mm	7,5	8.2	9.1	10,2	11.5

8.3.4 Check for wear on the front wheel

Check the wear by measuring the distance between the top and bottom of the front wheel.

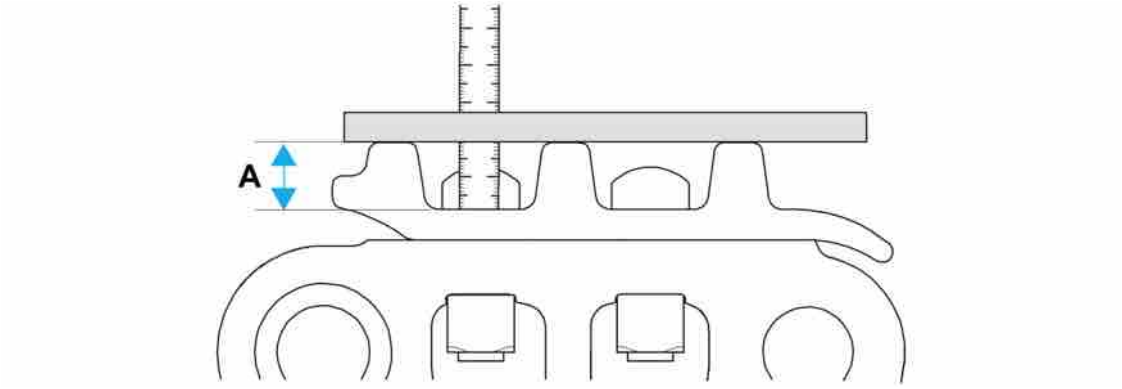


Front wheel

Wear	New front wheel	25%	50%	75%	100%
mm	17.5	19.1	20.9	23.0	25.5

8.3.5 Check for wear on the track shoe

Check the wear on the track shoe by measuring the distance (A) between the top and bottom of the track shoe.



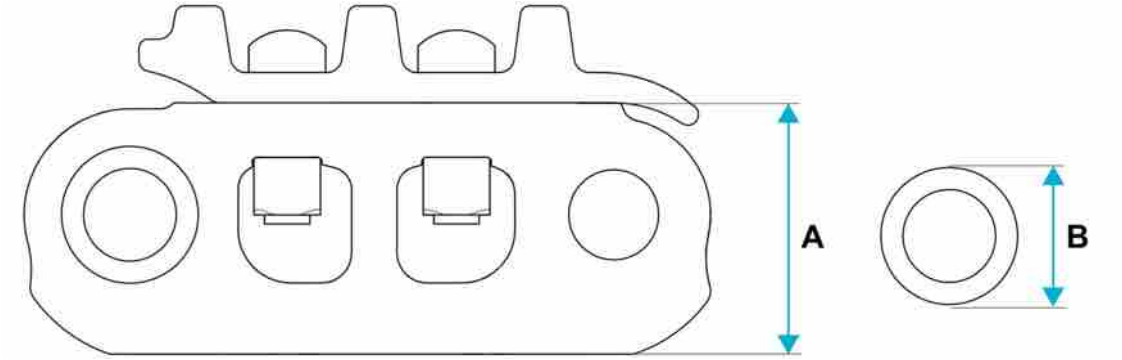
Track shoe

Wear	New track shoe	25%	50%	75%	100%
mm	25.0	20,4	15,7	10.9	6.0

Table 14: Triple grouser

8.3.6 Check for wear on the link and bushing

Check the wear by measuring the dimensions (A) and (B) on the link and bushing.

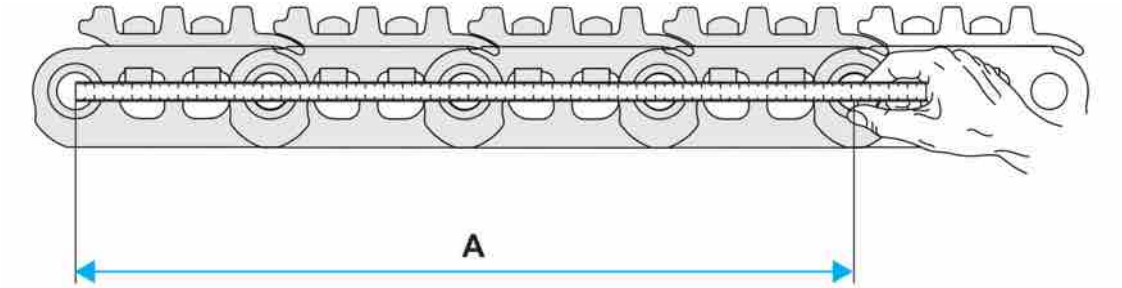


Link and bushing

	Wear	New link/ bushing	25%	50%	75%	100%
A	mm	89.0	87,6	86,0	84,2	82.0
B	mm	50,7	49,8	48,7	47,4	45,9

8.3.7 Check for wear on the chain

Check the wear on the chain by measuring the distance between the centre point in the first pin to the centre point in the fifth pin.

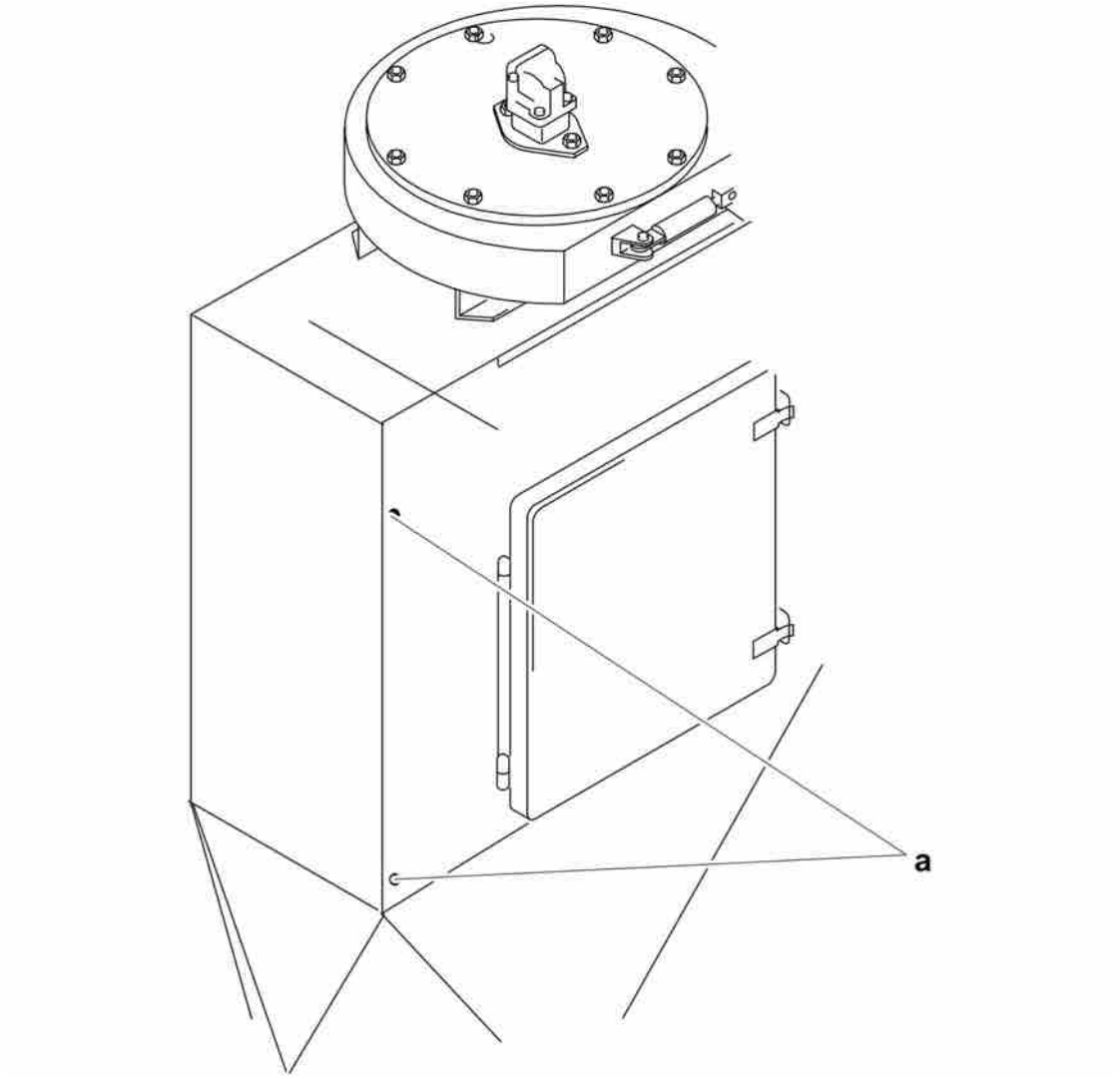


Track shoe

Wear	New chain	25%	50%	75%	100%
mm	686,0	688,5	691,4	694,8	698,7

9 Dust collector (DCT)

9.1 Filter test, dust collector (DCT)



Measurement points for dust collector filter

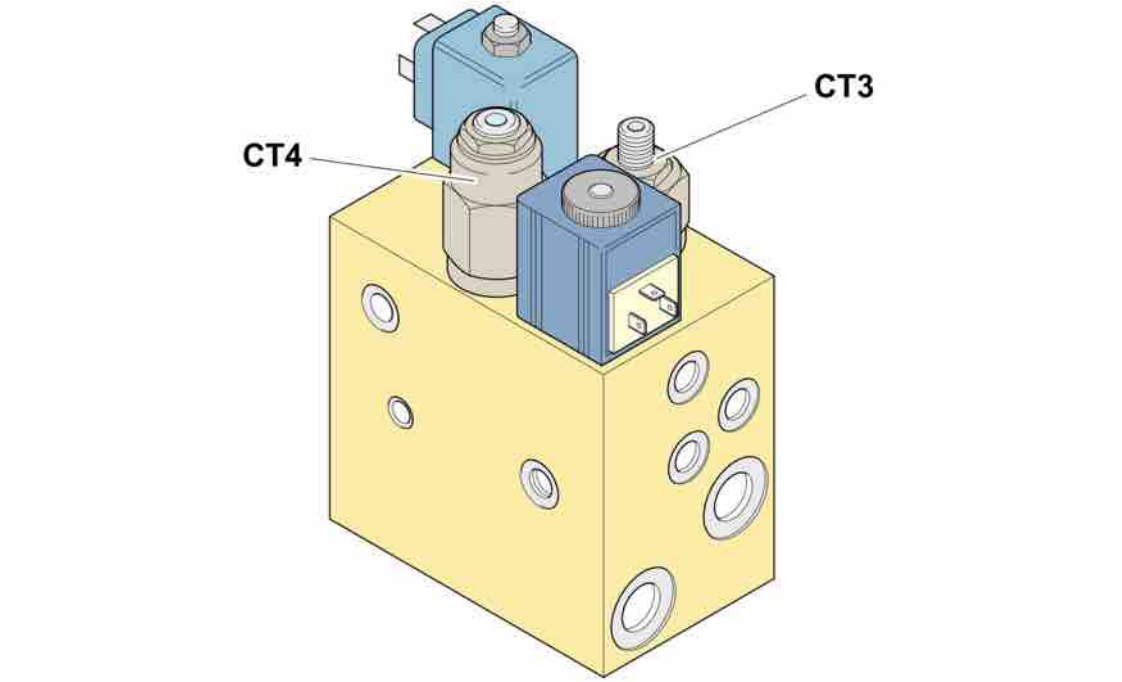
For checking filters in dust collector. Unscrew plugs (a) and apply a differential pressure gauge to the two holes.

Measure the pressure drop while air flushing is activated. If the drop is greater than an 800 mm (wg) column of water, all the filters should be replaced.

! ***NOTE:*** *If pump 3 does not maintain preset pressure it may be due to the dust collector filter being clogged.*

NOTE: *If the dust collector is operated with a deficient filter then the fan wings are worn.*

9.2 Adjust the suction capacity



Valve plate

The DCT's fan wheel is driven by P3.

Sometimes it is necessary to adjust the DCT's suction capacity. This is performed by adjusting the pressure for pump 3 on the valve block. The valve block is fitted on the DCT.

The pressure is adjusted with set screw CT3 and the fan wheel's brake time is adjusted with CT4.

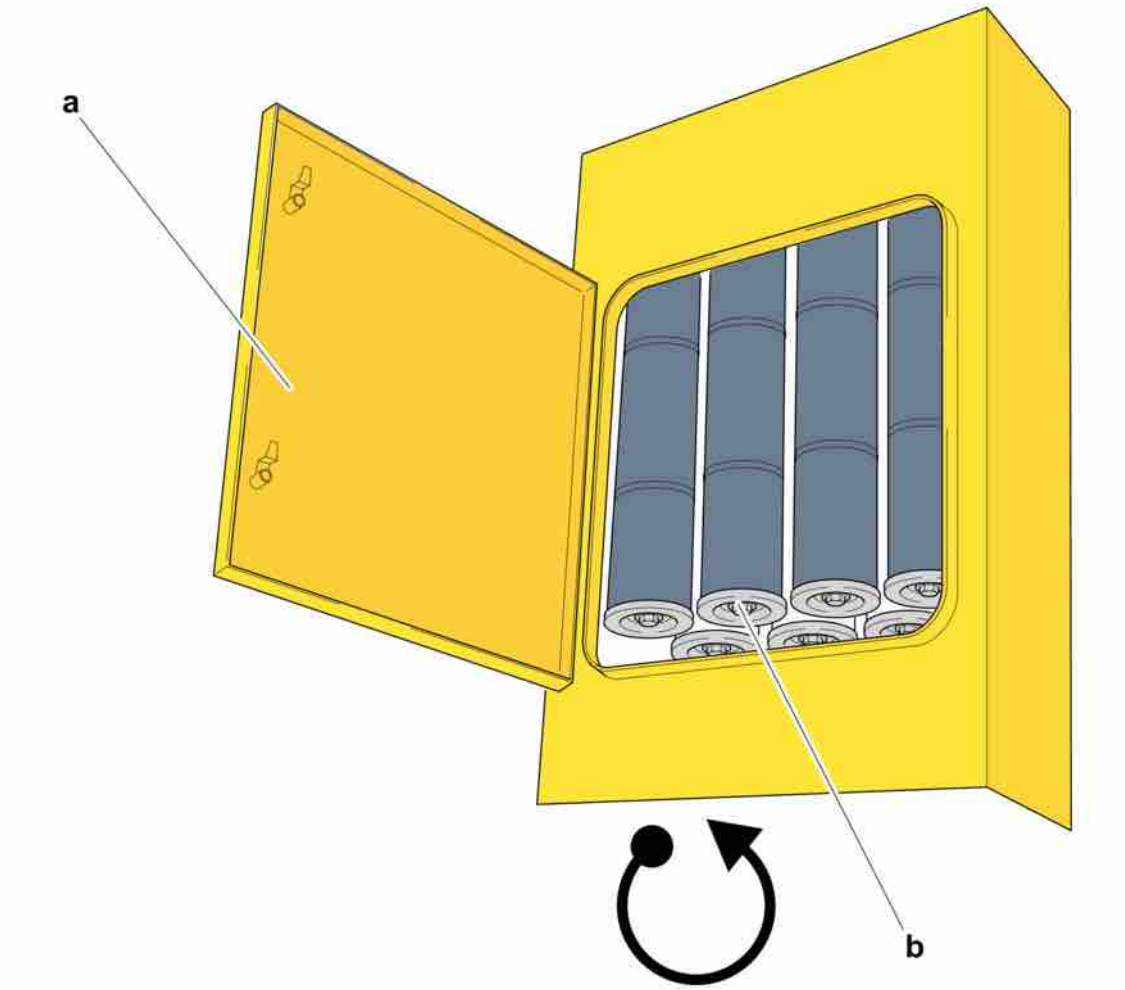
You should aim for a distribution of 70% (pre-separator) - 30% (DCT). Brake time should be 8 - 10 seconds. Factory setting 140 bar.

9.3 Dust collector (DCT) filter change

The dust collector filter is located inside the dust collector. Open the door (a) and change all the filters.

Use a ring spanner to unscrew the filters. Screw the nuts on the bottom of the filters anti-clockwise.

Recommended tightening torque when fitting the new filters is 18-20 Nm.



Dust collector

10 Radiator

10.1 Environmental issues when handling coolant

NOTICE

Environmental effect

Think of the environment!

- Chemicals, e.g. flushing additives, other additives and coolants, can be environmentally hazardous.
- Treat in accordance with local regulations in force for both handling and waste disposal.

10.2 Coolant

WARNING

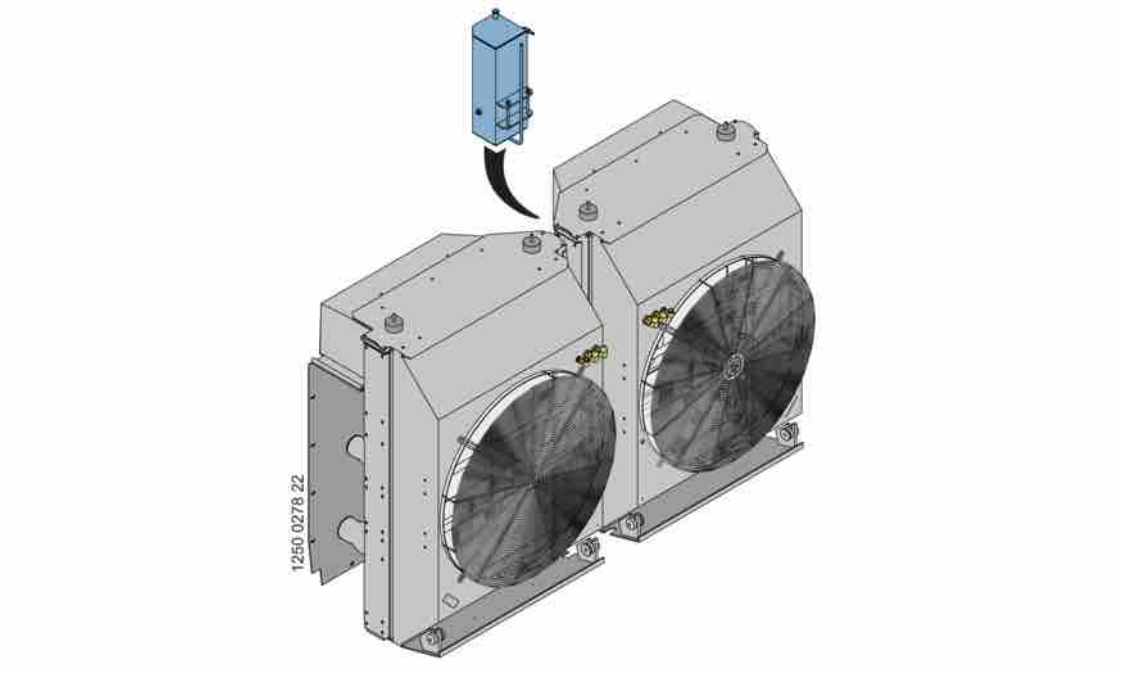
Serious injury

Danger of scalding and pressure

- Can cause serious personal injury
- Release the pressure in the radiator before removing the radiator cap

The drill rig has two radiators. The left-hand radiator is for the compressor oil and hydraulic oil. The right-hand radiator is for the engine's coolant.

Checking and filling coolant takes place in a separate expansion tank. Only CAT ELC coolant may be used.



Radiator and expansion tank

11 Diesel engine

11.1 Safety

WARNING

Serious injury

Danger of rotating parts

- Hot engine and components
- Very high exhaust temperatures
- Can cause serious personal injury
- Maintenance work on the drill rig must only be carried out when the engine is switched off

11.2 Environmental issues when handling oil

NOTICE

Environmental effect

Think of the environment!

- Leaking hydraulic connections and lubrication grease are environmentally hazardous.
- Changing oils, replacing hydraulic hoses and different types of filter can be environmentally hazardous.
- Always collect oil residue, oil spillage, waste with oil content, and lubrication grease residue and spillage. Treat in accordance with local regulations in force.
- Use biodegradable hydraulic fluids and lubrication oils for Atlas Copco products wherever possible. Contact your local Atlas Copco office for further information.

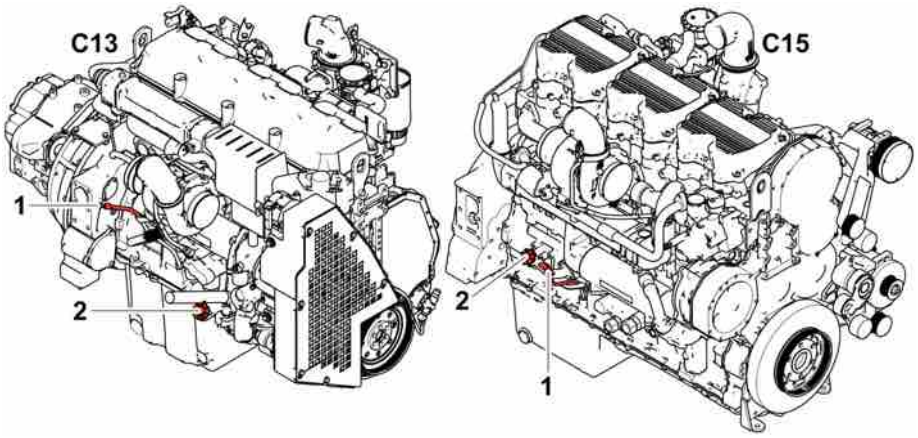
11.3 Oil for the diesel motor

NOTE: *See also the separate operating instructions for the diesel motor, for details of diesel motor maintenance.*

NOTE: *Top up (2) if the oil level is below or level with the lower mark on the dipstick.*

! ***NOTE:*** *See the chapter Oils and fuel for oil grade.*

1. Check that the oil level is between the upper and lower marks on the dipstick (1).



Diesel engine

1.	Dipstick
2.	Filling up

2. Top up (2) if the oil level is below or level with the lower mark on the oil dipstick (see the table "Recommended oils and lubricants").

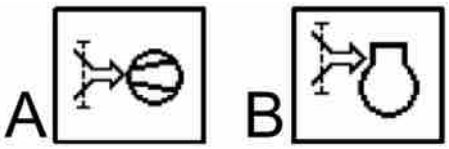
11.4 Maintenance of components

11.4.1 Air filter for engine and compressor, service intervals

The air filters consist of filter housing with cover, filter cartridge, safety cartridge, indicator and evacuation valve. Cleaning is carried out in two stages. The first stage comprises a cyclone and the second stage a normal filter. Both cleaning stages take place in the filter housing.

A filter's performance will improve right up until it becomes clogged. For this reason the filter cartridge should not be replaced at regular intervals, but only when it starts to become clogged. The filter cartridges must never be cleaned as this impairs filtration and also risks damaging the filter element.

There is an indicator fitted onto the filter housing to advise when the filter cartridge is clogged. It is connected to the HEC display in the cabin, or the LCD display on the left-hand side of the rig for cabinless rigs. A yellow warning symbol is visible on the status bar at the bottom of the display if a filter starts clogging. The indicator must be checked every 1000th engine hour.



Warning symbols on the rig's HEC display

A	Warning symbol for compressor air filter
B	Warning symbol for engine air filter

The discharge from the first stage of the cleaning flows through a single evacuation valve. This should preferably be checked once each shift.

The filter housing also contains a safety cartridge which must be replaced every third time the filter cartridge is replaced.

If maintenance and replacement at fixed intervals is necessary for any reason, which is not normally recommended, then the following guidelines apply.

Hours	0	500	1000	1500	2000
Replacing the filter cartridge and cleaning the filter housing	New	X	X	X	X
Replacing the safety cartridge	New	-	-	Changing	-
Indicator test	-		X		X

Table 15: Intervals for filter maintenance

11.4.2 Air filter for engine and compressor, maintenance

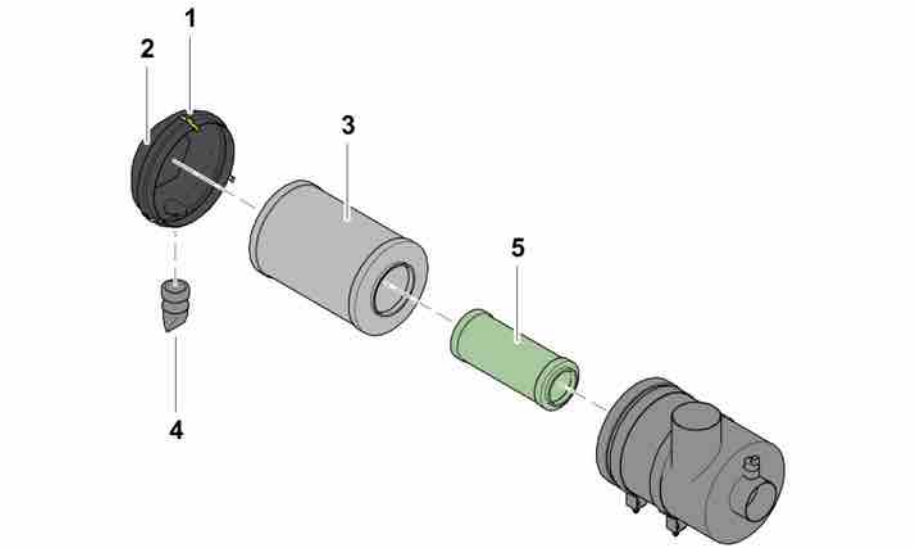
NOTE: *Never clean the filter cartridges.*

NOTE: *When an evacuation valve is damaged, replace it.*

NOTE: *If the warning symbol for clogged air filter remains visible, the safety cartridge must also be replaced.*

Replacing the filter cartridge

1. Undo clamps (1) and remove the cover (2).



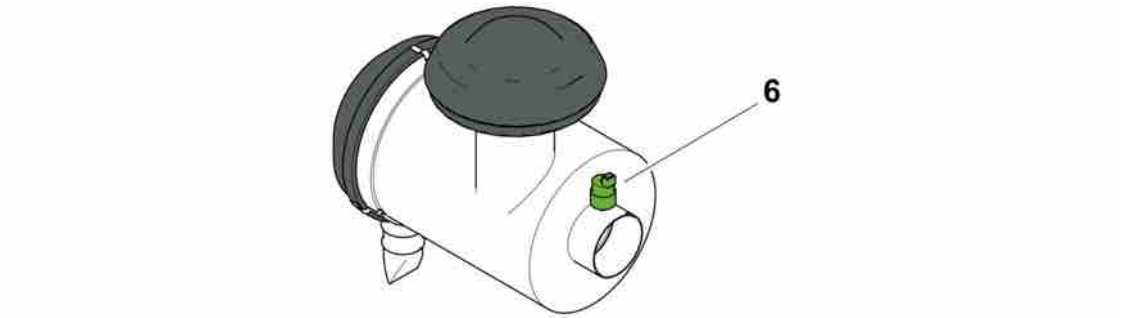
Air filter

2. Remove the main cartridge (3).
3. Clean inside the filter housing and lid with a clean, dry rag.

> ! ***NOTE:*** *NOTE! If the safety cartridge has also been removed for changing, the filter housing air outlet must be completely covered with adhesive tape before cleaning the filter housing.*

4. Check that the evacuation valve (4) is not damaged. Change it if necessary.
5. Remove any adhesive tape there may be on filter housing air outlet.
6. Install a new main cartridge and a new safety cartridge if required.
7. Refit the cover and fasten the clamps.

Checking the indicator



To ensure filter clogging is detected, the function of the indicator (6) must be checked regularly. This is done by gradually blocking the air intake with a piece of wood or similar. The indicator should then signal and the warning symbol should be visible, or the warning light should illuminate. If the warning does not indicate, start by checking the cable connections. If there are no problems with the connections, then the indicator is faulty and must be replaced.

> ! ***NOTE:*** *The indicator is not included in the filter housing, but is ordered separately.*

Take care to use a whole and clean piece of wood so that dirt or other particles do not enter the filter housing.

11.4.3 Fuel system

Fuel quality

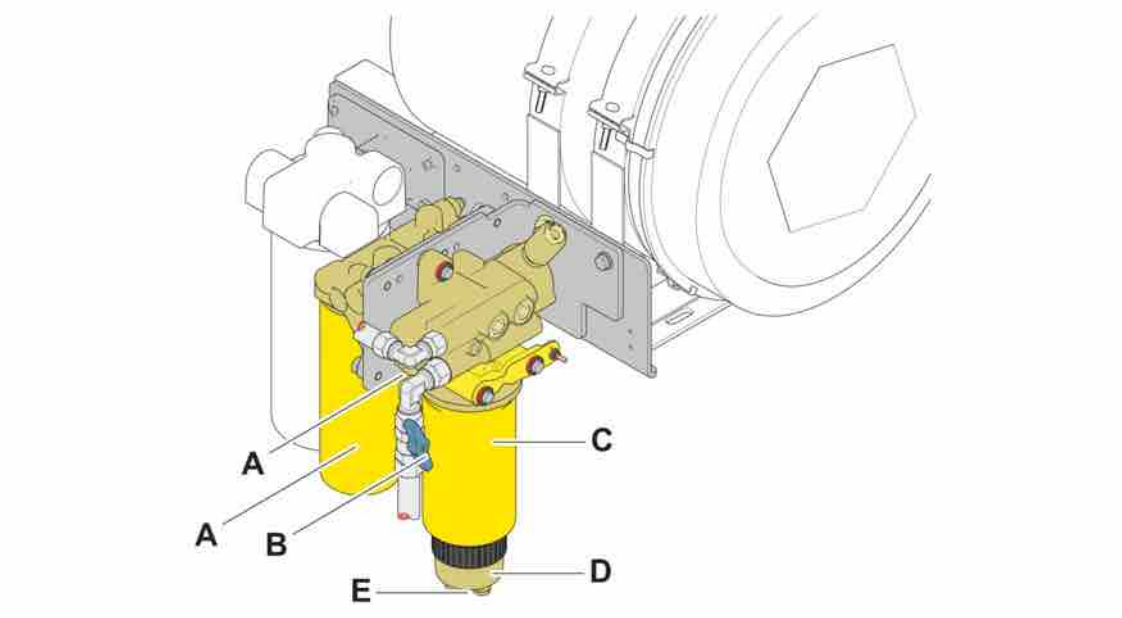
See the chapter Oils and fuel.

Filter

There are two types of fuel filter for the diesel engine, a primary filter and two secondary filters.

The diesel engine fuel filter must be changed and not cleaned.

Primary and secondary filters



Primary and secondary filters

Drainage

- Drain the water from the primary filter container daily by closing the fuel cock (B) and opening the drain cock (E).

Replacing the primary filter

- Remove the filter bowl (D) and clean with pure diesel fuel.
- Remove the fuel filter (C) and then clean the sealing surface on the base of the filter. Make sure all the remnants of the gasket have been removed.
- Apply pure diesel oil to the new fuel filter gasket.
- Screw on the new fuel filter on the base of the filter until the gasket makes contact with the filter base. Use the twist marks to aid tightening. Tighten the filter a further three quarters of a turn by hand. Do not tighten the filter too hard.
- Screw the clean filter bowl (D) back in place.

Replacing the secondary filter

- Close the fuel cock for the primary filter (B).
- Slacken off the secondary filters (A) using a suitable tool and remove them.
- Collect any residual fuel.
- Clean the filter holders seal surfaces of dirt.
- Apply a thin layer of oil to the new fuel filter rubber seals.

! ***NOTE:*** *The primary filter/water separator can be filled with fuel in advance so that the engine does not run unevenly or stop due to air bubbles. Do not fill the secondary fuel filter with fuel before installation. The fuel would not then be filtered and could be contaminated. Contaminated fuel increases the wear on the components of the fuel system.*

Filter for DEF tank

Changing the DEF tank filter:

- See separate instructions from diesel engine.

11.4.4 Environmental issues when handling fuel

NOTICE

Environmental effect

Think of the environment!

- Fuel spill is a hazard to the environment and a fire hazard.
- Always collect fuel residue and spillage. Treat in accordance with local regulations in force.

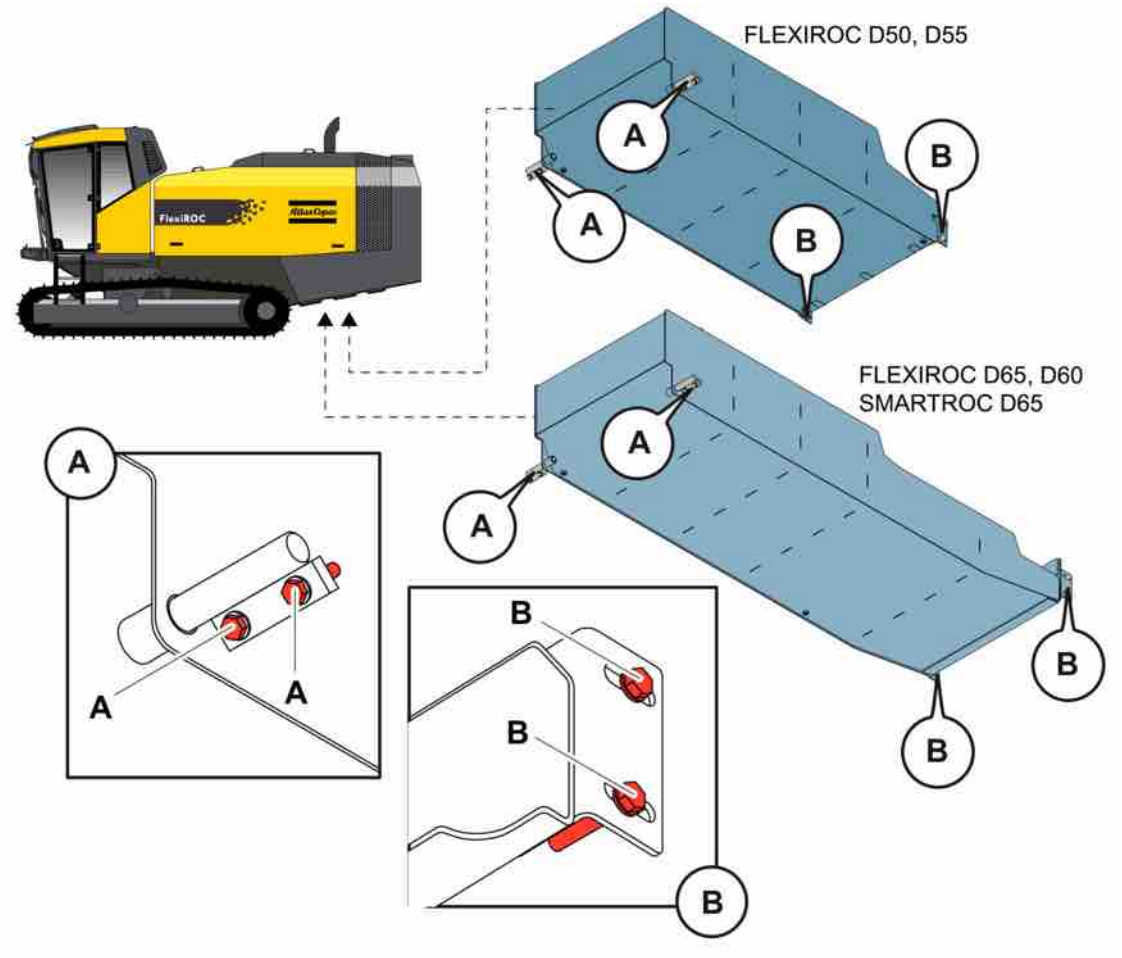
11.4.5 Fuel tank brackets

WARNING

Serious injury

Never remove the protective plate from the underneath of the drill rig without first checking that ALL fuel tank retaining bolts (front and rear) are tightened to 73 Nm and that the tank is secured in the rear bracket.

- When performing maintenance on a rig, be aware that you will be working under a suspended load. Before starting work, the machine must be supported with appropriate jack stands.



Fuel tank brackets

Check that the front fuel tank retaining bolts (A) are tightened to the correct torque of 73 Nm every 500 engine hours.

All fuel tank retaining bolts (A + B) and mountings must be checked before performing any maintenance under the rig.

11.4.6 Draining the fuel tank

Always fill the fuel tank with clean diesel oil and fuel of the correct grade for the temperature.

1. Undo the front protective plate on the underside of the drill rig.
2. Undo the bottom plug by holding the nut with a 22 mm ring spanner and unscrewing with an 8 mm Allen key. Allow the water to drain.
3. Use track oscillation to tilt the drill rig in order to drain the tank completely.
4. Tighten the plug so the diesel oil cannot leak out.

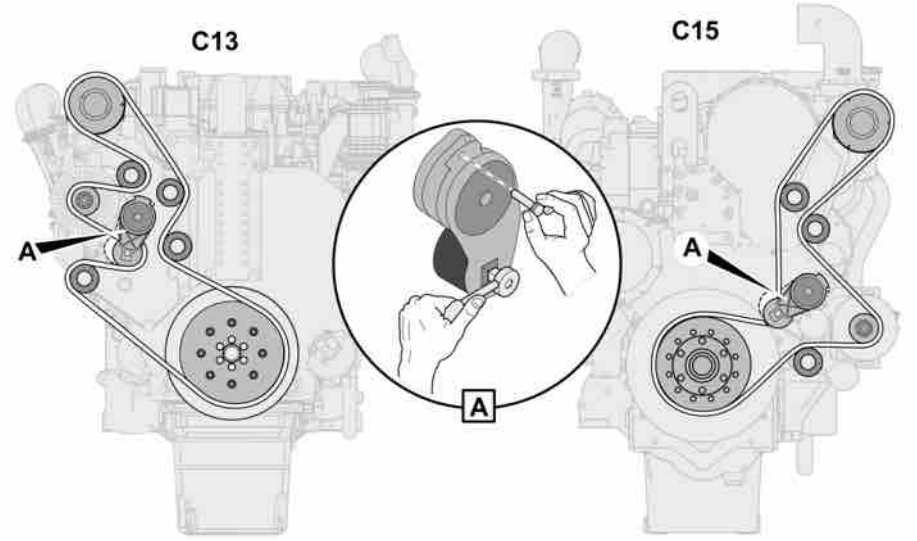
11.4.7 Drive belt

Replacing the multi-belt

Make sure the engine is switched off.

1. Remove the belt cover.

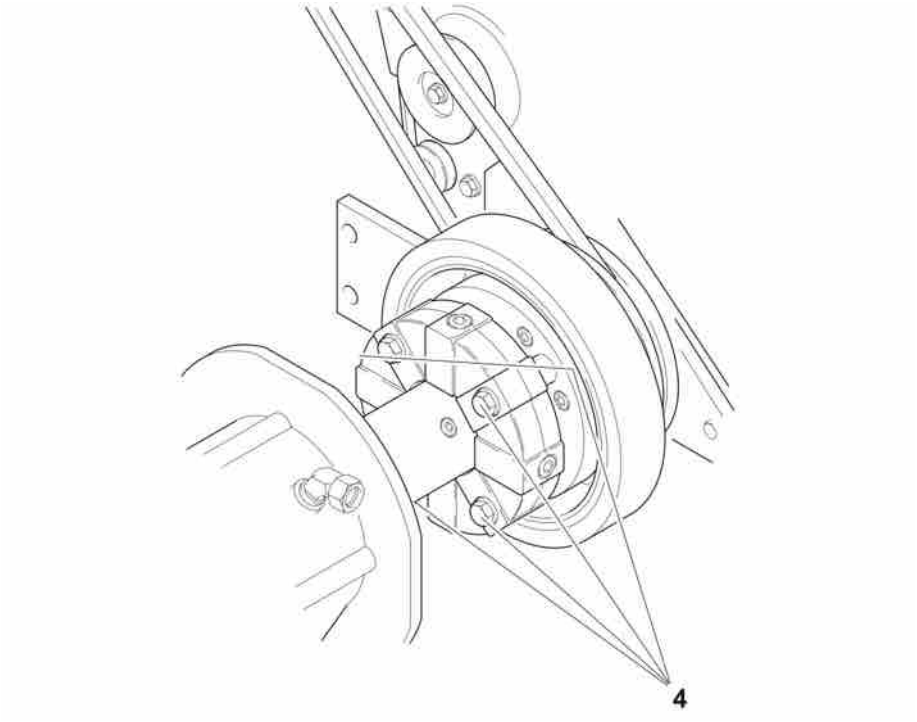
2. Ease up on the belt tension by turning the tensioning wheel (A).



Belt tension

> ***NOTE:*** *See the chapter Technical data for the correct engine alternative.*

3. Secure the tensioner wheel in the position where the belt is slack using a pin (A).
4. Undo and pull out the four bolts (4) in the shaft coupling until there is play.



Undo the bolts

5. Replace the belt by inserting it through the clearance between the coupling rubber and the shaft flange.
6. Screw back the coupling rubber and tighten the bolts (185Nm).

7. The belt is tensioned automatically when the lock-out assembly is removed from the tensioning wheel.
8. Refit the belt cover.

11.4.8 For further instructions, see separate instructions for the diesel engine.

12 Compressor and air system

12.1 Safety

WARNING

Serious injury

High system pressures and temperatures

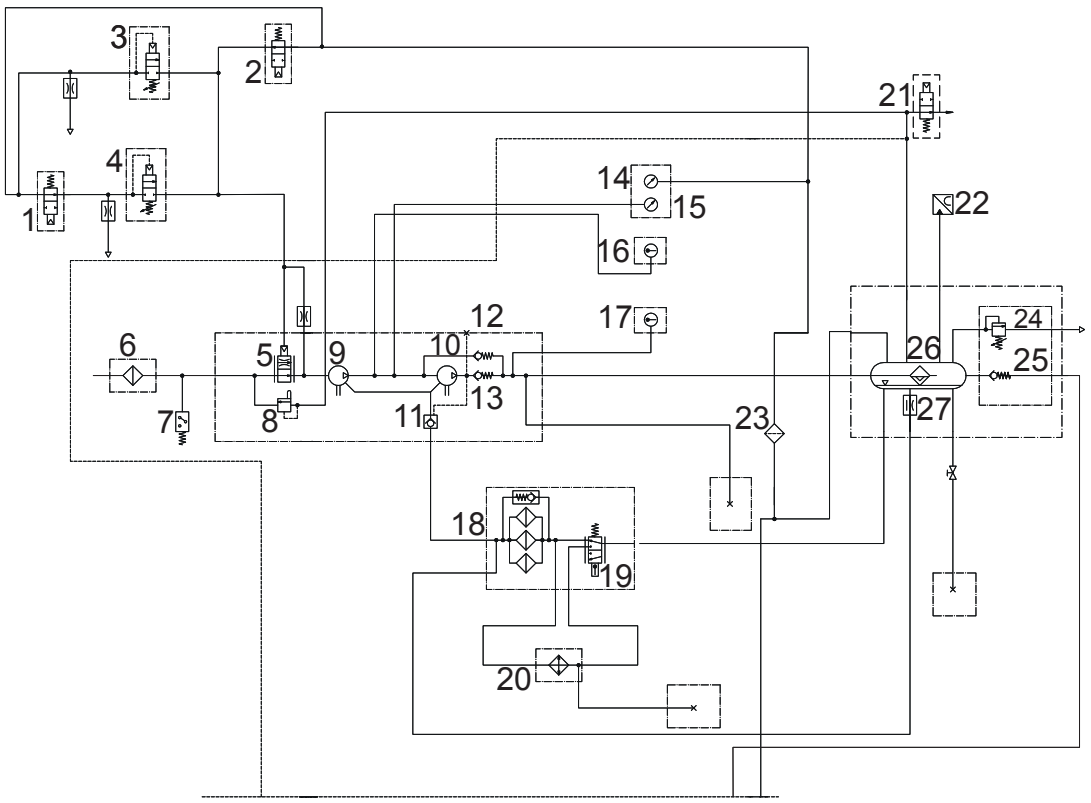
- Can cause personal injury
- Never perform maintenance work while the drill rig is operating
- Make sure that the hydraulic, water and air systems are depressurised and that the electrical system is de-energised before starting work on the rig.
- The use of incorrect or used oil, or mixing oils, may involve a risk of fire or explosion in the compressor system.
- Risk of fire if the intervals for changing compressor oil are not observed

The compressor may emit pressure up to 35 bar. The compressor oil must cool down before work on the compressor is started. The oil can reach temperatures of 130°C during operation. When replacing air hoses, use only Atlas Copco original hoses, or consult Atlas Copco. In the event of a suspected leakage you must absolutely not use your hands to detect/search for the leakage. Such a procedure could lead to immediate fatality.

Hoses must be considered as consumable items. For this reason, all hoses between compressor and pressure tank must be replaced at a maximum interval of 5 years.

12.2 Compressor description

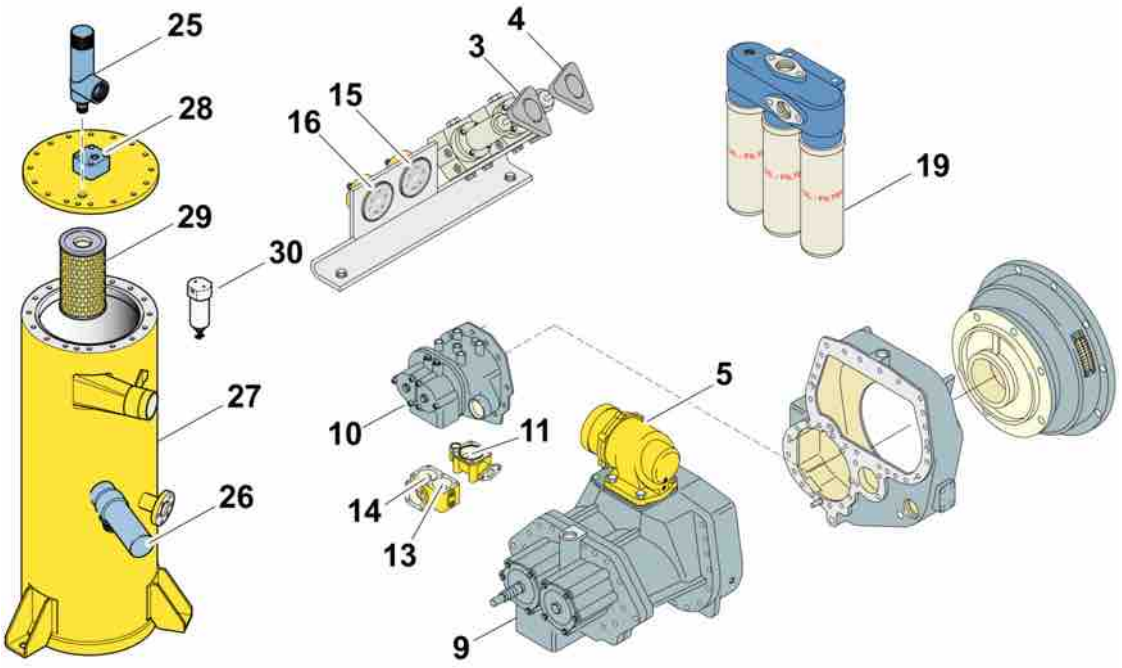
The rig is equipped with a two-stage screw compressor which is driven by the diesel engine. The compressed air from the compressor flows to an air receiver which also functions as an oil separator. The majority of the oil is removed in the air receiver by means of centrifugal force. The remainder is separated in an oil separator element in the air receiver. The separated oil is collected in the lower part of the air receiver, which functions as an oil tank.



Diagram, compressor system

1	Loading valve Y210B
2	Loading valve Y210A
3	Control valve, high percussion pressure
4	Control valve, low percussion pressure
5	Intake valve
6	Air filter
7	Filter indicator
8	Drain valve
9	Compressor, low pressure stage
10	Compressor, high pressure stage
11	Oil stop valve
12	Pressure Relief Valves
13	Check valve
14	Pressure gauge, tank pressure
15	Pressure gauge, intermediate stage pressure
16	Temperature sensor, low pressure stage
17	Temperature sensor, high pressure stage
18	Oil filter

19	Thermostat
20	Radiator
21	Pressure relief valve (extra equipment)
22	Pressure tank sensor, B456
23	Water separator filter
24	Safety valve
25	Minimum pressure valve
26	Air receiver
27	Restriction

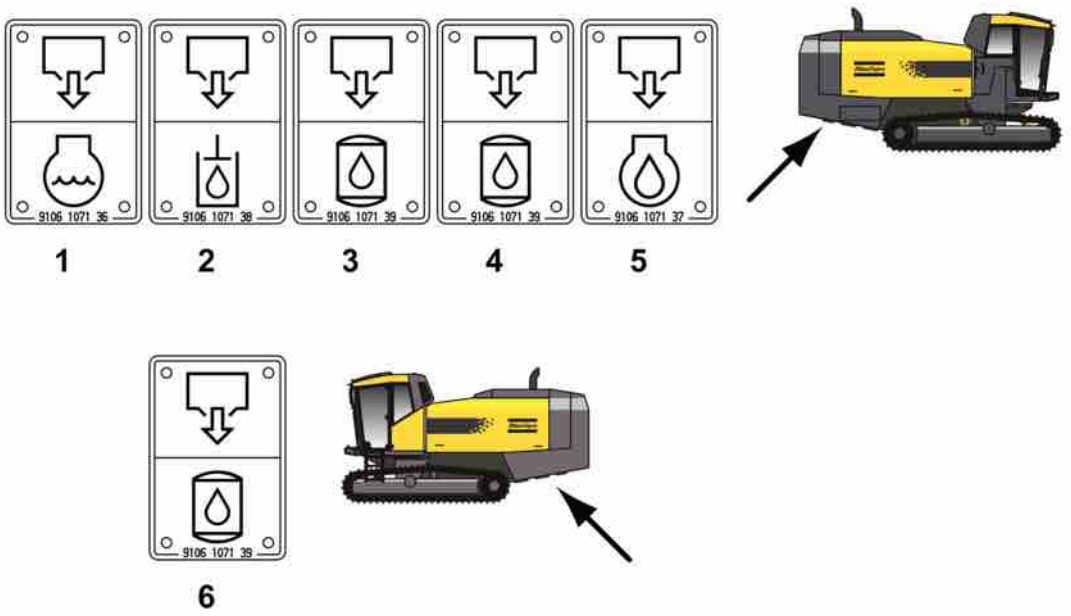


Compressor parts

3	Control valve, high percussion pressure
4	Control valve, low percussion pressure
5	Intake valve
9	Compressor, low pressure stage
10	Compressor, high pressure stage
11	Oil stop valve
13	Pressure Relief Valves
14	Check valve
15	Pressure gauge, tank pressure
16	Pressure gauge, intermediate stage pressure
19	Oil filter

25	Safety valve
26	Minimum pressure valve
27	Air receiver
28	Restriction
29	Oil separator element
30	Water separator filter

12.3 Maintenance



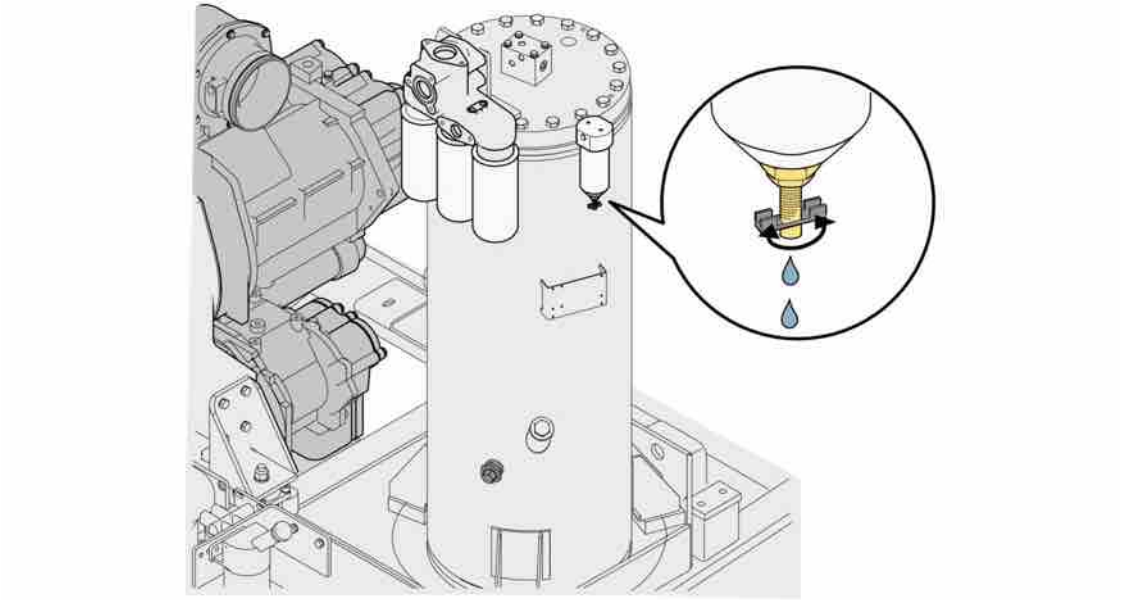
Right and left-hand draining points

1	Engine radiator
2	Hydraulic oil cooler
3	Compressor cooler
4	Compressor element
5	Engine oil
6	Compressor tank

12.3.1 Draining the condensate in the pressure tank

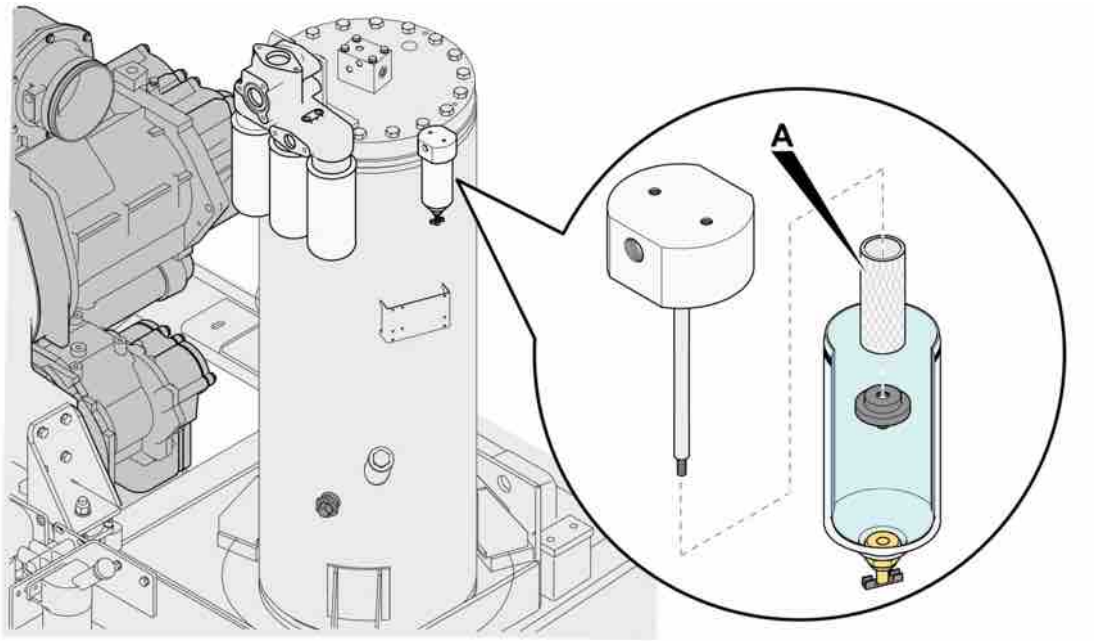
The pressure tank must be drained of condensate daily, preferably before the start of the work shift. The rig must have been switched off for at least 1 hour. Draining is performed from the cock (6) at the draining point on the left-hand side of the rig.

12.3.2 Draining the water separator filter



The water must be drained on a daily basis, preferably before the work shift. Drain by opening the cock under the water separator filter.

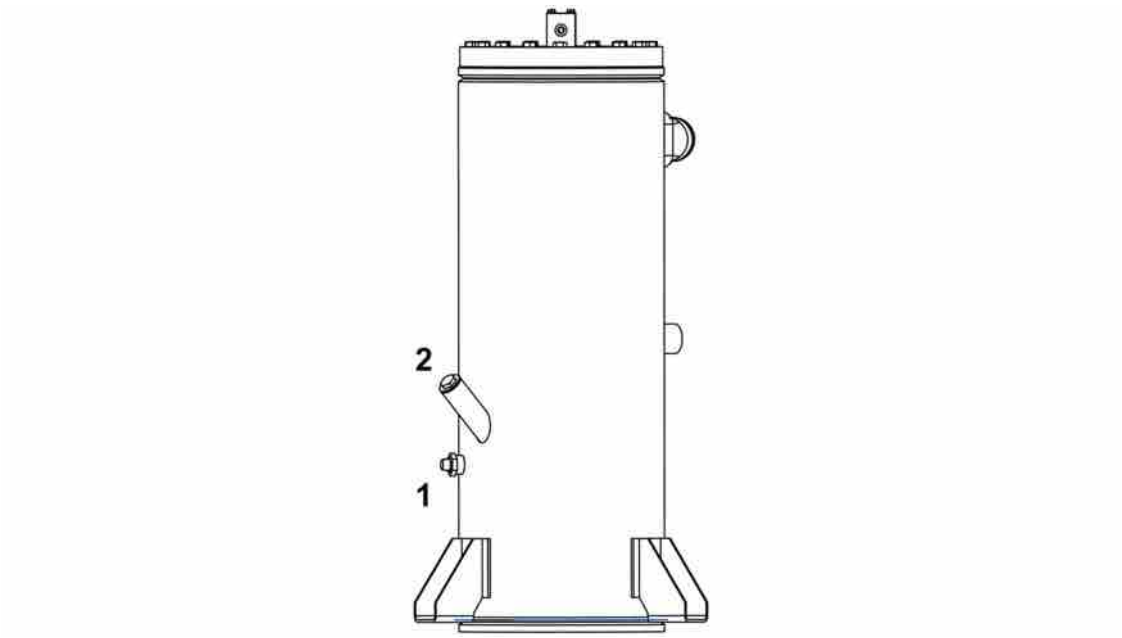
12.3.3 Replacing the filter element in the water separator filter



The filter element (A) must be replaced in accordance with the interval in the maintenance schedule.

12.3.4 Checking the oil level

Check the oil level daily.



1. Make sure the rig is standing level.
2. Switch off the rig and allow the oil level to settle for at least 5 minutes.
3. Check the compressor oil level. The indicator on the gauge (1) must be in the green zone.
4. Fill with oil at (2), if required.

! ***NOTE:*** *Never fill with too much oil. Overfilling results in high oil consumption.*

NOTE: *Take care to use the correct oil grade". See "Recommended oils and lubricants".*

12.3.5 Changing oil and oil filter

The intervals for oil change are determined by oil grade and operating temperature. The prescribed interval (see maintenance schedules) is based on up to a certain oil temperature and normal operating conditions (see oil temperature under the heading "Safety" in the chapter "Compressors and air system" in the maintenance instructions). Oil should be changed more frequently when working in high ambient temperatures or very dusty or damp conditions.

1. Run the compressor to operating temperature. Switch of the engine and wait until the pressure has eased through the automatic outlet valve. Unscrew the oil filler plug one turn. This uncovers a ventilation hole which releases pressure from the system.
2. Drain the oil through the removed drain plugs for compressor tank, compressor cooler and compressor element. Collect the oil in a receptacle. Screw out the plug on the filter housing to speed up the draining. Tighten the plugs after draining.
3. Remove the oil filters, for example by means of a special tool. Collect the oil in a receptacle.
4. Clean the filter seat on the filter housing using oil, and make sure that no dirt falls down into the system. Lubricate the gasket on the new filters. Screw the filters in place until the gasket makes contact with the seat. Then screw a further half turn.

5. Fill the air receiver until the oil level reaches the filler pipe. The indicator on the gauge (1) must be in the upper section of the green zone. Make sure that no dirt falls down into the system. Fit and tighten the filler plug once again.
6. Operate the unit without any load for several minutes in order to circulate the oil and force out any air in the oil system.
7. Stop the compressor. Allow the oil to settle for several minutes. Check that the system is depressurised. Unscrew the filler plug (2) and fill with oil until the indicator on the oil level gauge (1) is once again in the green zone. Fit and tighten the filler plug once again.

! ***NOTE:*** *If the oil has been destroyed due to the use of incorrect oil or excessive temperature, or overextended operating time following the latest change, then the system must be flushed clean before new oil is filled. See "Changing to new type of oil" for the method.*

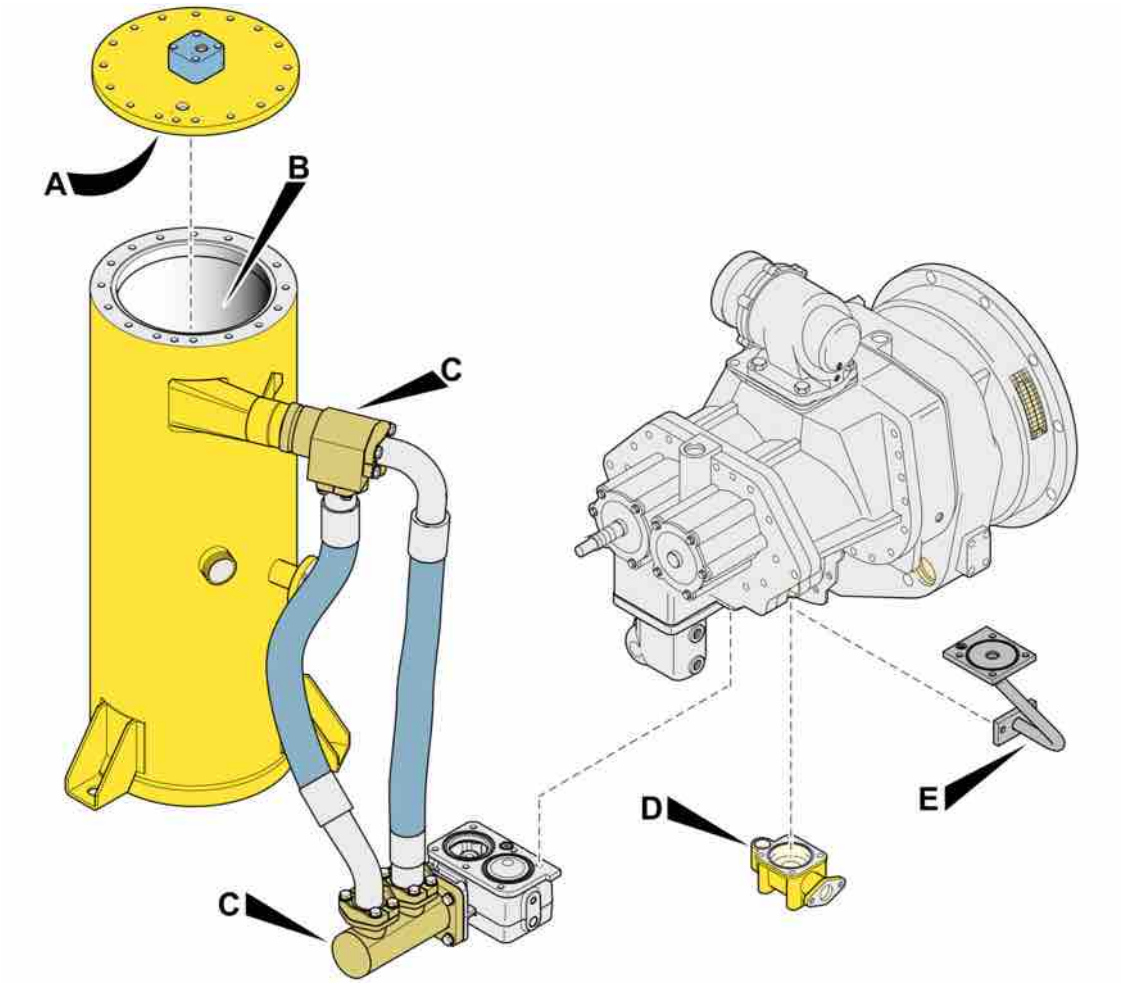
NOTE: *Never fill with too much oil. Overfilling results in high oil consumption. Take care to use the correct oil grade". See "Recommended oils and lubricants".*

12.3.6 Changing to new type of oil

To avoid problems when changing to a new type of oil (see table below), a special procedure for compressor oil flushing must be followed. The table is only applicable if the replaced oil has not passed its expiration date. Old oil is best detected by using an analysis program for oil samples, SOS (Scheduled Oil Sampling). Indications that the oil is old are that it smells strongly, that there are contaminants such as sediments inside the oil reservoir and the stop valve, or that the oil has a brownish colour.

	Paroil M	Paroil S	Paroil Sxtreme
Paroil M	drainage*	flushing	flushing
Paroil S	drainage**	drainage*	drainage
Paroil Sxtreme	drainage**	drainage	drainage*

* When changing to the same oil within the interval between changes, drainage is sufficient. ** Change not recommended



A	Underside of reservoir cover plate
B	Inside of reservoir
C	Hose connections
D	Oil stop valve
E	Pipe

Procedure for compressor flushing

1. First of all, the system must be drained thoroughly when the oil is hot so that as little oil as possible is left in the system, especially in inaccessible areas. If possible the oil system must also be pressure washed so that the remaining oil will be blown out. See step 1 and 2 under the heading "Change of oil and oil filter" for detailed description.
2. Remove the oil filters (a).
3. Open the cover plate on the air receiver and remove the oil separator element.
4. Check the inside of the oil reservoir. If sediments are detected, the parts (A-E) must be thoroughly cleaned before the process is completed. Contact Atlas Copco's service department.
5. Insert a new oil separator element, screw on the new oil filter and close the valve in accordance with the instructions under the heading "Changing oil and oil filter".

6. Fill the oil reservoir with the minimum amount of oil permissible and run the compressor unloaded in light mode for 30 minutes.
7. Drain the system thoroughly when the oil is hot so that as little oil as possible is left in the system, especially in inaccessible areas. If possible the oil system must also be pressure washed so that the remaining oil will be blown out.
8. Fill the system to full level.
9. Run the compressor unloaded in light mode for 15 minutes and check for leaks.
10. Check the oil level and fill if necessary.
11. Collect all surplus lubricant and discard it in accordance with regulations for handling waste lubricants. See the chapter "Oils and fuel" in the maintenance instructions.

12.3.7 Cleaning the oil cooler

Keep the compressor oil cooler clean using compressed air in order to maintain efficient cooling.

12.3.8 Test pressurising the safety valve

1. Disconnect the cables for the flushing air valves Y115 and Y116:
2. Load the compressor (S180 in the cabin).
3. Activate high percussion (S446 in the cabin).
4. Note the current pressure on the pressure gauge 15.
5. Adjust the regulator for high pressure until the safety valve is triggered. The pressure must then not have exceeded maximum triggering pressure in accordance with the table below.

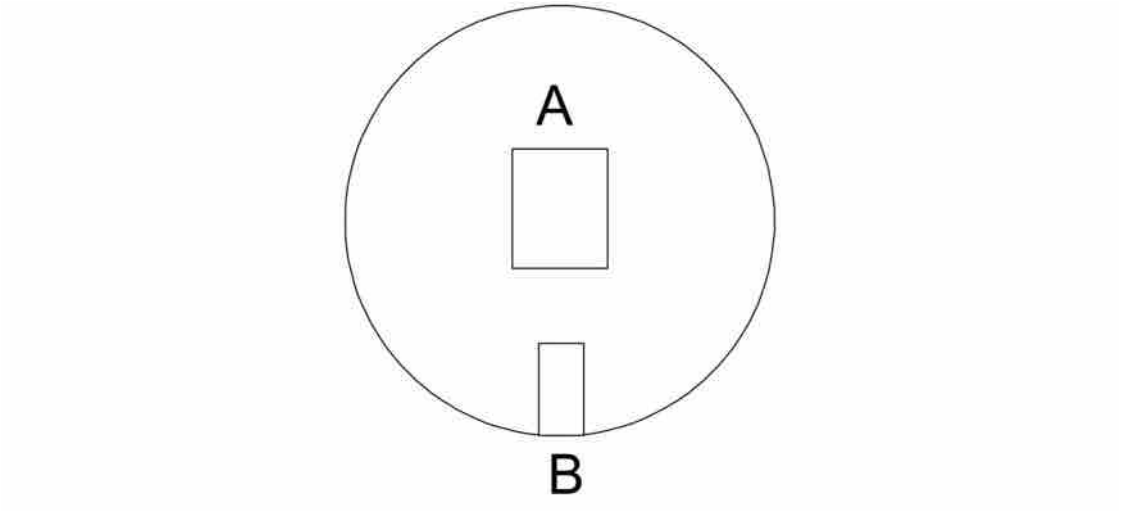
Rig model	Maximum triggering pressure
FlexiROC D50	32 bar
FlexiROC D55	35 bar
FlexiROC D60	32 bar
SmartROC and FlexiROC D65	35 bar

6. Adjust the regulator for high pressure so that the pressure returns to the previous value.
7. Reconnect the cables for the flushing air valves Y115 and Y116:

! ***NOTE:*** *The regulator must not be adjusted during drilling.*

NOTE: *Under no circumstances may the set pressure of the safety valve be changed to a pressure other than that stamped on the valve.*

12.3.9 Checking the pressure sensor B456



Pressure tank's top side

A	Valve plate
B	Pressure sensor B456

Check that the tank pressure shown on the display corresponds with the tank pressure shown on the pressure gauge at the regulators. The difference must be no greater than 0.1 bar.

12.3.10 Checking the start protection

If tank pressure exceeds 1.5 bar then the engine cannot be started.

1. Switch off the engine without unloading the compressor.
2. Try to start the engine again immediately while the pressure exceeds 1.5 bar. The engine cannot be started.

12.3.11 Checking the minimum charge pressure

If tank pressure is less than 4 bar then the compressor cannot be loaded.

1. Set the drill rig in Tramming position with button (5) on the left-hand operator's panel.
2. Set engine speed to 1500 rpm.
3. Load the compressor with button (5) on the right-hand operator's panel.
4. Check that the compressor does not load until the tank pressure reaches 4 bar.

12.4 Control system

12.4.1 System description

The control system consists of:

- Control valve for low percussion pressure
- Control valve for high percussion pressure
- Loading valve (solenoid valve) Y210A

- Loading valve (solenoid valve) Y210B
- Flushing air valve Y115
- Flushing air valve Y116

When the compressor is unloaded the loading valves Y210A and Y210B are 0-activated (open). When the compressor is loaded (button (5) on the right-hand control panel) the solenoid valve Y210A will be activated (closed) and lead the air over the low pressure regulator (4) provided that the pressure is above 4 bar.

When low percussion is activated (S38 moved halfway forward) the low flushing air valve (Y116) will be activated and release air to the hammer. On the low flushing air valve it is possible to adjust the air flow to the down-the-hole drill to a moderate flow for collaring.

When high percussion is activated (S38 moved fully forward) Y210 B will also be activated (closed). This results in the air being directed over the high-pressure regulator (3). Now the high flushing air valve will also open (Y115) which results in full pressure and full air flow to the hammer.

12.4.2 Setting the percussion pressure

Setting the percussion pressure is carried out by setting the tank pressure during disengaged percussion.

Recommended tank pressure is 32 bar for high percussion pressure and 20 bar for low percussion pressure

1. Make sure the percussion is switched off.
2. Load the compressor. (Button (5) on the right-hand control panel.)
3. Adjust both control valves (3, 4) alternately until the recommended high percussion pressure is obtained on pressure gauge (15).
4. Adjust the control valve for low percussion pressure (4) until the recommended low percussion pressure is obtained on pressure gauge (15).

! ***NOTE:*** *The adjustment must not be made during drilling.*

NOTE: *Percussion pressure is affected by many factors such as rock properties, size of and wear on the down-the-hole rock drill, the drill bit, drill feed pressure, down-the-hole rock drill air consumption etc.*

13 Oil and fuel

13.1 Environmental issues when handling fuel

NOTICE

Environmental effect

Think of the environment!

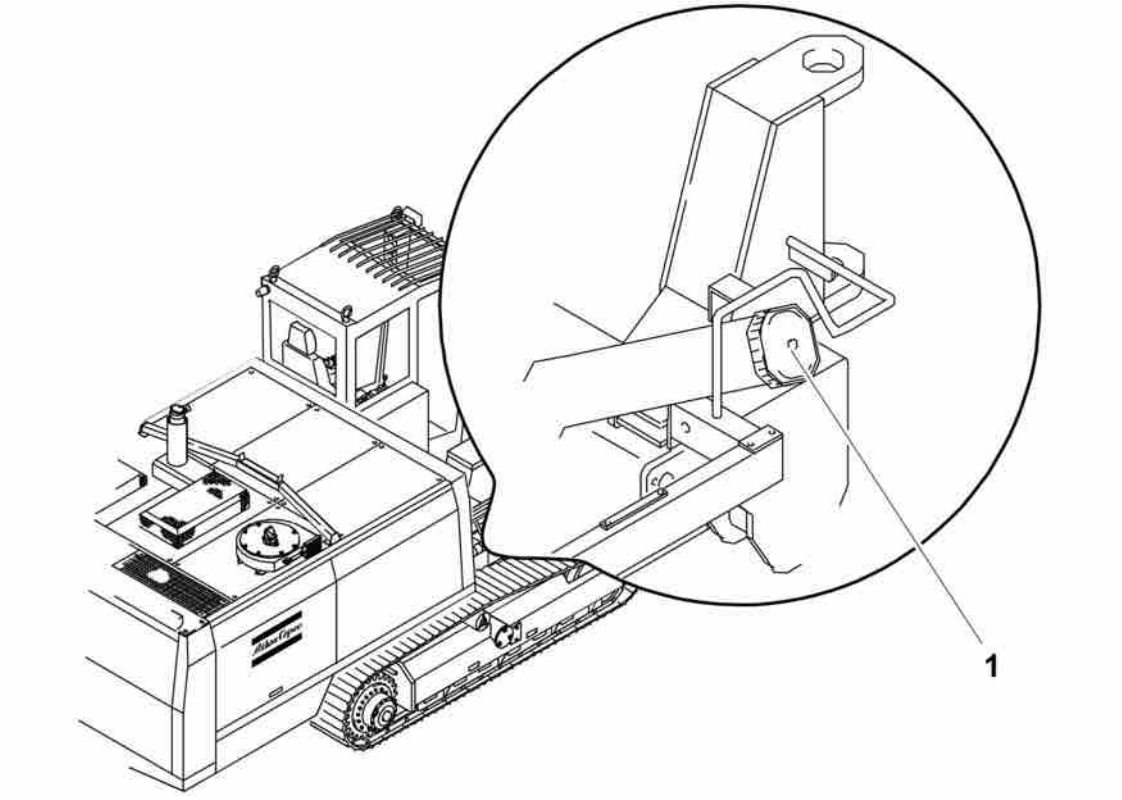
- Fuel spillage is environmentally hazardous and a health risk.
- Always collect fuel residue and spillage. Treat in accordance with local regulations in force.

13.2 Filling fuel

Switch off the engine before topping up the fuel. Do not handle fuel in the vicinity of hot surfaces, sparks or naked flames.

Cleanliness is important when filling with fuel. Ensure that the tank and tank cover are clean. Fuel should not be added if there is a risk that it is contaminated, for example in windy or wet weather, or when there is dust in the air.

Fuel which is stored must not have contact with the air, but should be stored in a closed vessel. The vessel must be approved for its purpose and shall be clean.



Filling fuel

1	Location of fuel filler orifice

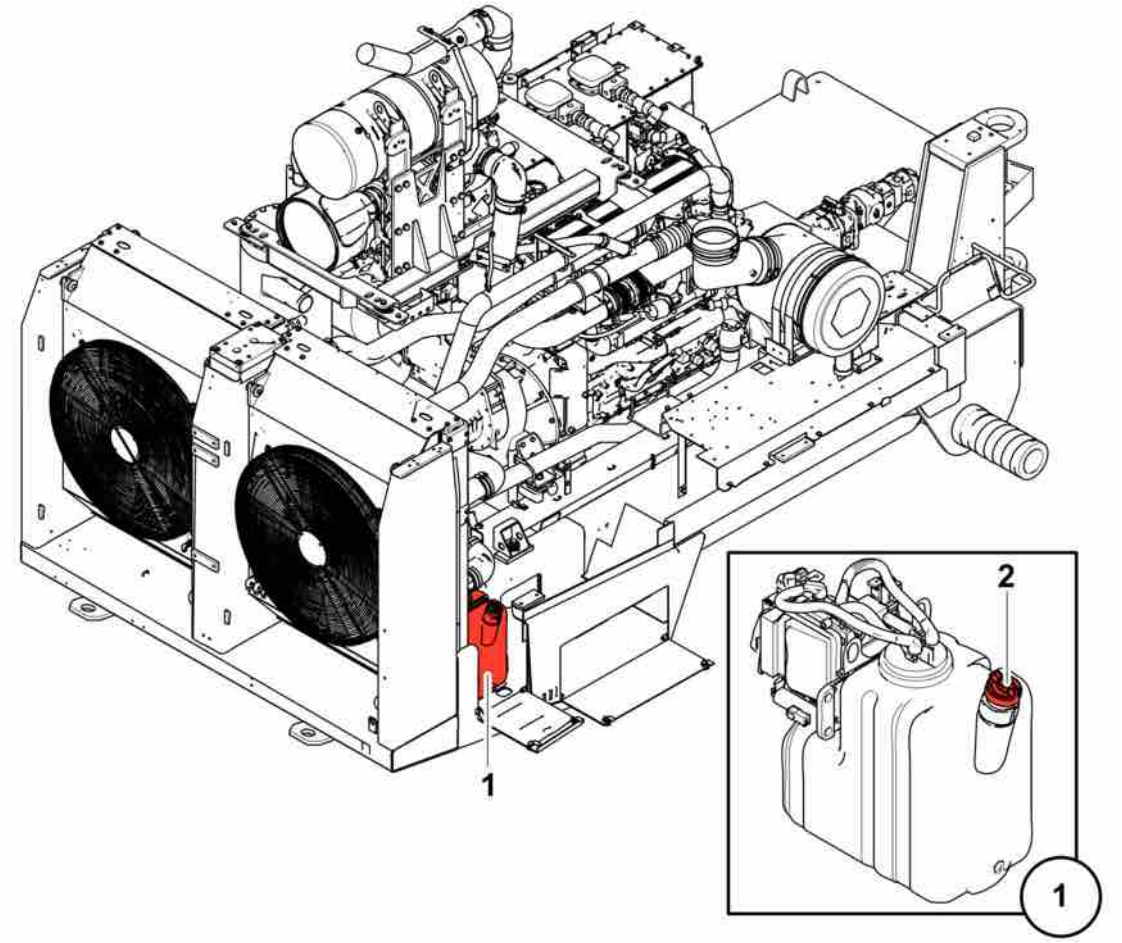
NB! Use Ultra Low Sulphur Diesel (ULSD). It must not have more than 15ppm Diesel Fluid Sulphur.

13.3 DEF (Diesel Exhaust Fluid)

DEF fluid must meet the requirements specified in ISO 22241-1. Read the CAT manual for more information about DEF.

When the DEF tank is almost empty, a series of warnings will be shown on the rig's display. When the tank is empty, the engine is switched off.

13.3.1 Filling DEF (Diesel Exhaust Fluid)



DEF (Diesel Exhaust Fluid) tank (1)

The DEF tank (1) is topped up at each refuelling.

(2) DEF filler location. Do not overfill the tank. In cold climates DEF freezes and needs space so that the fluid can expand in the tank.

Do not use a contaminated container or funnel when filling the DEF tank.

13.3.2 Storing DEF (Diesel Exhaust Fluid)

DEF (Diesel Exhaust Fluid) degrades over time and no longer meets the requirements for the DEF system. DEF (Diesel Exhaust Fluid) degrades even faster in hot temperatures. Read the CAT manual for more information about DEF.

13.4 Environmental considerations when handling oil

NOTICE

Environmental effect

Think of the environment!

- Leaking hydraulic connections and lubrication grease are environmentally hazardous.
- Changing oils, replacing hydraulic hoses and different types of filter can be environmentally hazardous.
- Always collect oil residue, oil spillage, waste with oil content, and lubrication grease residue and spillage. Treat in accordance with local regulations in force.
- Always use biodegradable hydraulic fluids and lubrication oils for Atlas Copco products wherever possible. Contact your local Atlas Copco office for further information.

13.5 Compressor oil

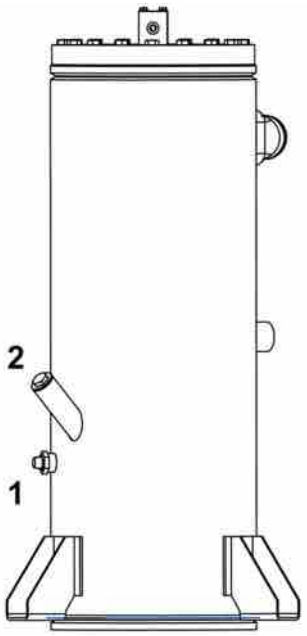
WARNING

Serious injury

Danger of rotating parts

- Hot engine and components
- Can cause serious personal injury
- Maintenance work on the drill rig must only be carried out when the engine is not running

Check the oil level daily.



1. Make sure the rig is standing level.

2. Switch off the rig and allow the oil level to settle for at least 5 minutes.
3. Check the compressor oil level. The indicator on the gauge (1) must be in the green zone.
4. Fill with oil at (2), if required.

! ***NOTE:*** *Never fill with too much oil. Overfilling results in high oil consumption.*

13.6 Oil sampling

An oil sample gives a good indication of how well the hydraulic system has been maintained.

13.7 Hydraulic oil

⚠ CAUTION

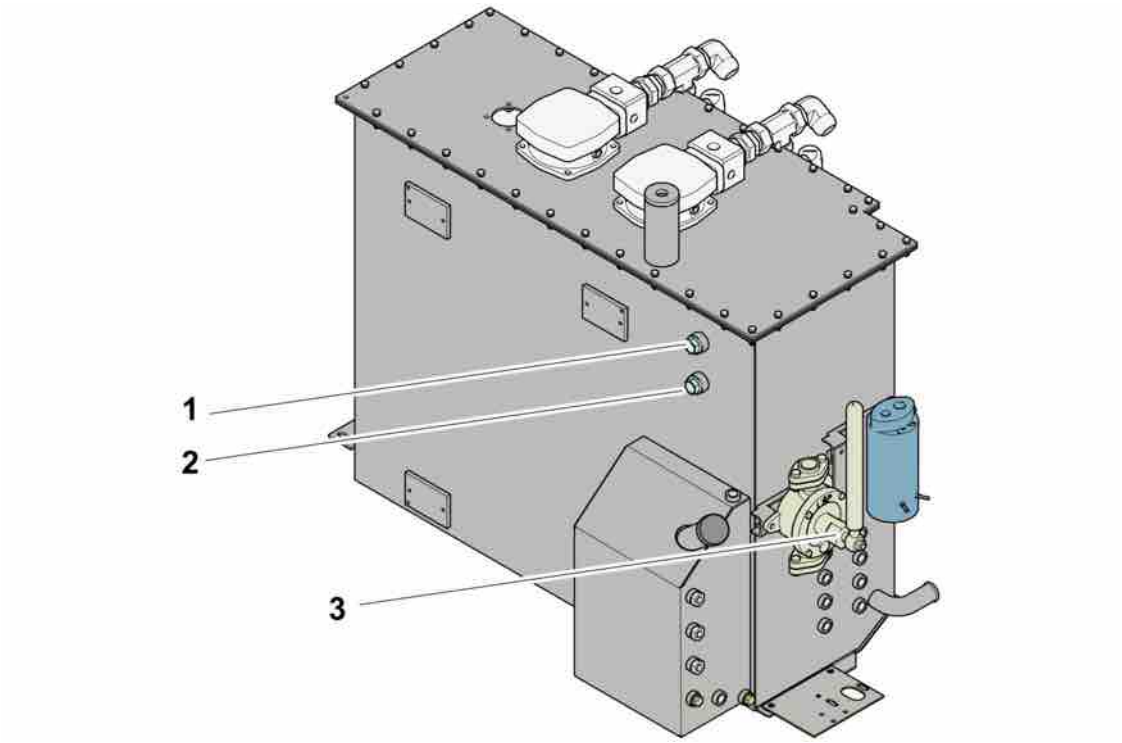
Risk of injury

Protect your eyes from hydraulic oil

! ***NOTE:*** *Do not fill up with too much hydraulic oil as it might then clog the ventilation filter.*

The hydraulic oil level can be read in the sight glass on the front of the hydraulic oil reservoir. The lower sight glass (2) should be full and the upper sight glass (1) should be half full.

- Check the hydraulic oil level (1 and 2)
- Fill with the hand pump (3) if necessary (see the chapter "Recommended oils and lubricants")

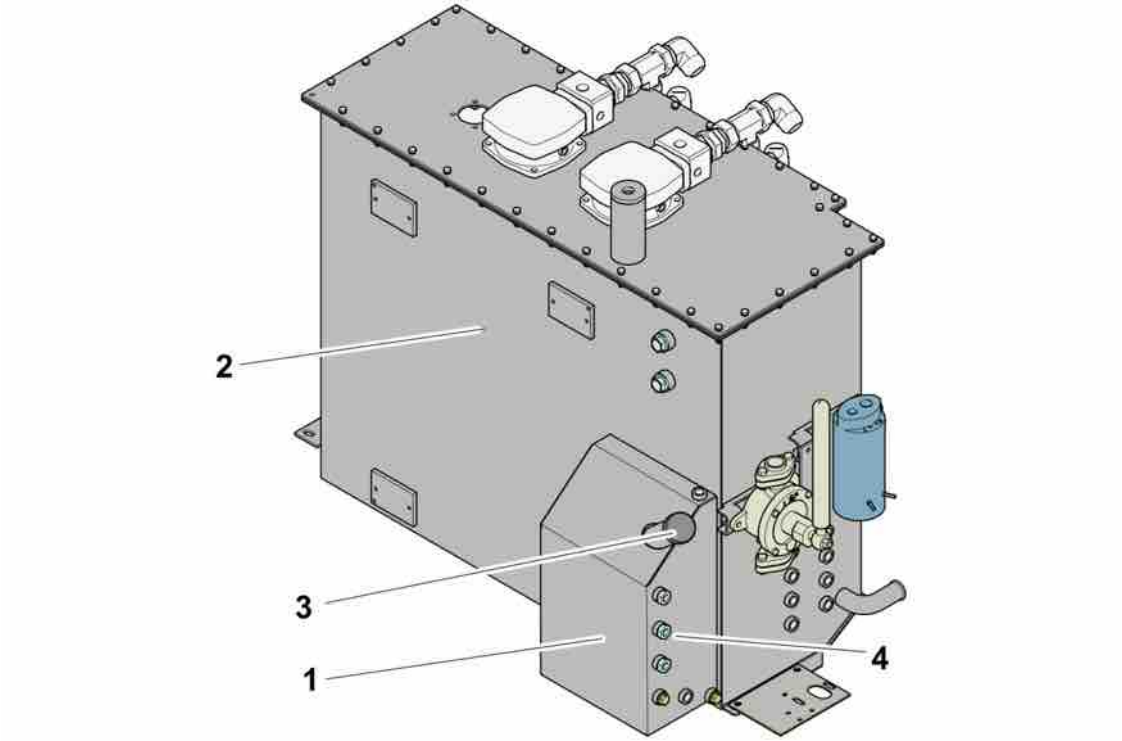


Hydraulic oil reservoir

13.8 Lubrication

The lubricating oil tank (1) is fitted on the hydraulic oil tank (2).

The lubricating oil level can be read in the sight glass (4). In the event of a low level there is also a warning on the display for engine and directional instruments.



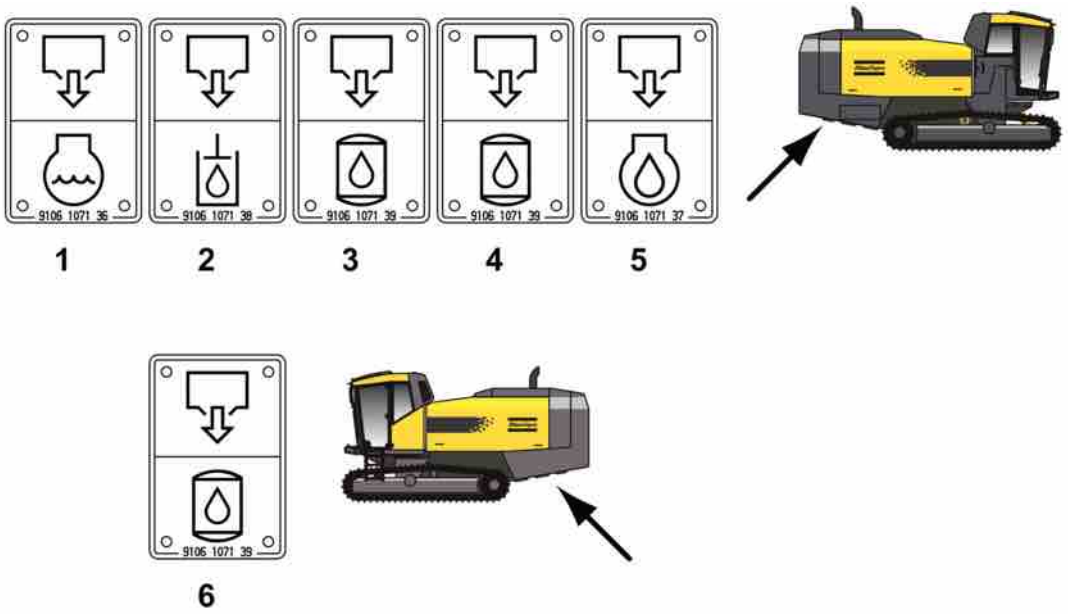
Fill (3) if necessary (see the chapter "Recommended oils and lubricants").

NOTE: *Always use a funnel with strainer when refilling.*

NOTE: *If the lubricating system is fully drained of oil then the system must be bled. See the maintenance instructions for the drill system.*

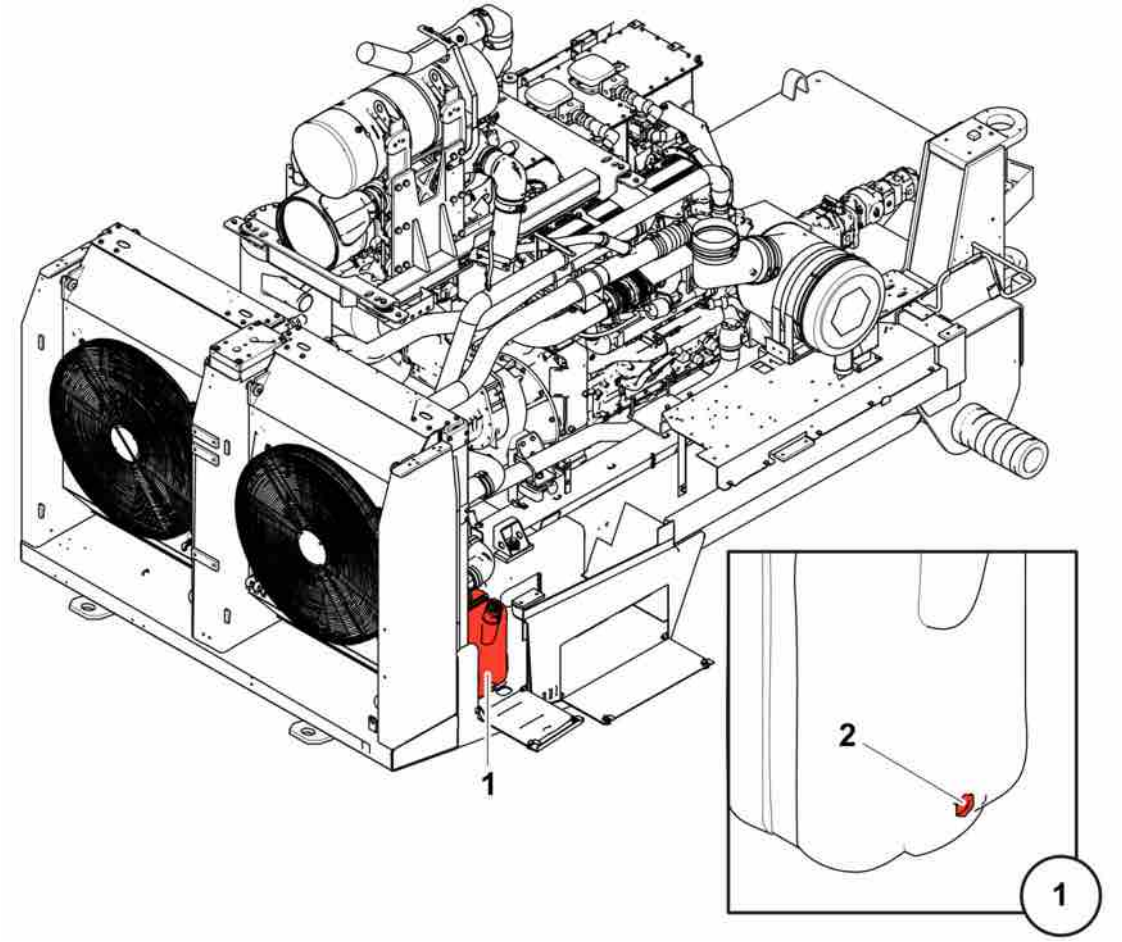
13.9 For engine oil and fuel, see chapter "Diesel engine".

13.10 Draining the fluids



1	Engine radiator
2	Hydraulic oil cooler
3	Compressor cooler
4	Compressor element
5	Engine oil
6	Compressor tank

13.10.1 Draining DEF (Diesel Exhaust Fluid)



DEF tank drain plug (2)

Drain the DEF fluid by unscrewing the DEF tank (1) drain plug (2).

13.11 Recommended oils and lubricants

13.11.1 Engine oil

Ambient temperature °C	Atlas Copco Fluids
-30 to 0	Engine 200
> 0	Engine 100

Table 16: Ambient temperature °C

13.11.2 Hydraulic oil

Use mineral based or synthetic (polyalphaolefin or diester) hydraulic oil with good rust, wear, oxidising and foam inhibitive properties and good air and water separation ability. Select an oil with viscosity grade (VG) and viscosity index (VI) specified in the "Ambient temperature" table. Oil with high viscosity index is less temperature dependent.

! ***NOTE:*** *Surplus oil should be disposed of in an environment-friendly manner as prescribed by the authorities.*

Ambient temperature. 25-50 (°C) St.	Viscosity grade VG (ISO 3448)	Viscosity index VI
+ 25 to +50	ISO VG 68	Min. 150
0 to +25	ISO VG 46	Min. 150
-30 to 0	ISO VG 32	Min. 150

Table 17: Ambient temperature °C

> ***NOTE:*** *When operating in extremely low temperatures, installation of an extra heater is recommended.*

13.11.3 Lubricating oil tank (ECL) (ECG) (HECL)

Atlas Copco recommends the use of Atlas Copco COP OIL which has been specially developed for our hydraulic rock drills and DTH hammers.

COP OIL is an environmentally friendly, degradable oil which can be used in ambient temperatures between -25 °C and +50 °C.

If COP OIL is not available then the oil should have the following properties:

- Use an oil with good lubricating properties intended for compressed air tools.
- Depending on ambient temperature, the oil should have the following viscosity grades if the viscosity index (VI) is about 100:

Ambient temperature °C	Viscosity grade (ISO 3448)
-30 till +-0	VG 32 - 68
-10 till +20	VG 68 - 100
+10 till +50	VG 100 - 150

- The oil must have additives that prevent foam formation.

ASTM D 2783	Min. 250 kg
ASTM D 4172 (40 kg)	Max. 0.5 mm

- The oil must have good adhesion capacity.
- The oil must have additives that prevent foam formation.

13.11.4 Grease nipples and CLS

	Working temperature °C
Universal grease NLGI 2 Lithium/molybdenum additives	Max. 100 °C
Synthetic sodium or calcium grease	Max. 140 °C

Table 18: Grease nipples and CLS

13.11.5 Rotation unit

Grease: lithium complex, mineral oil based EP grease. NLGI 2, Viscosity 300-600 cSt at 40 °C. Mechanically stable. Intended for use in vibration applications (Shell: Limona LX2).

! ***NOTE:*** *Do not use other types of grease, as some of them are not miscible.*

13.11.6 Traction gears, carrier rollers

Use mineral-based transmission oil with EP additive to ISO VG class 220. Meets ACMA specification for R & O EP oils. Classified as ISO-L-CKC according to ISO 6743/6 and SS-ISO/TR 3498.

13.11.7 Oil recommendations for two-stage compressor

Atlas Copco recommends only using Atlas Copco PAROIL for the two-stage compressors. Use of another oil is at customer's own risk

The type of PAROIL should correspond to the table below. If the ambient temperature permits, then PAROIL S XTREME should be used in the first instance.

Ambient temperature	Oil
Below +30 °C	PAROIL S
Above -10 °C	PAROIL S EXTREME

Never mix oils of different brands.

13.11.8 Coolant

Never mix propylene with ethylene glycol. Use only ready-mixed coolant that meets ASTM with DG210.

14 Options

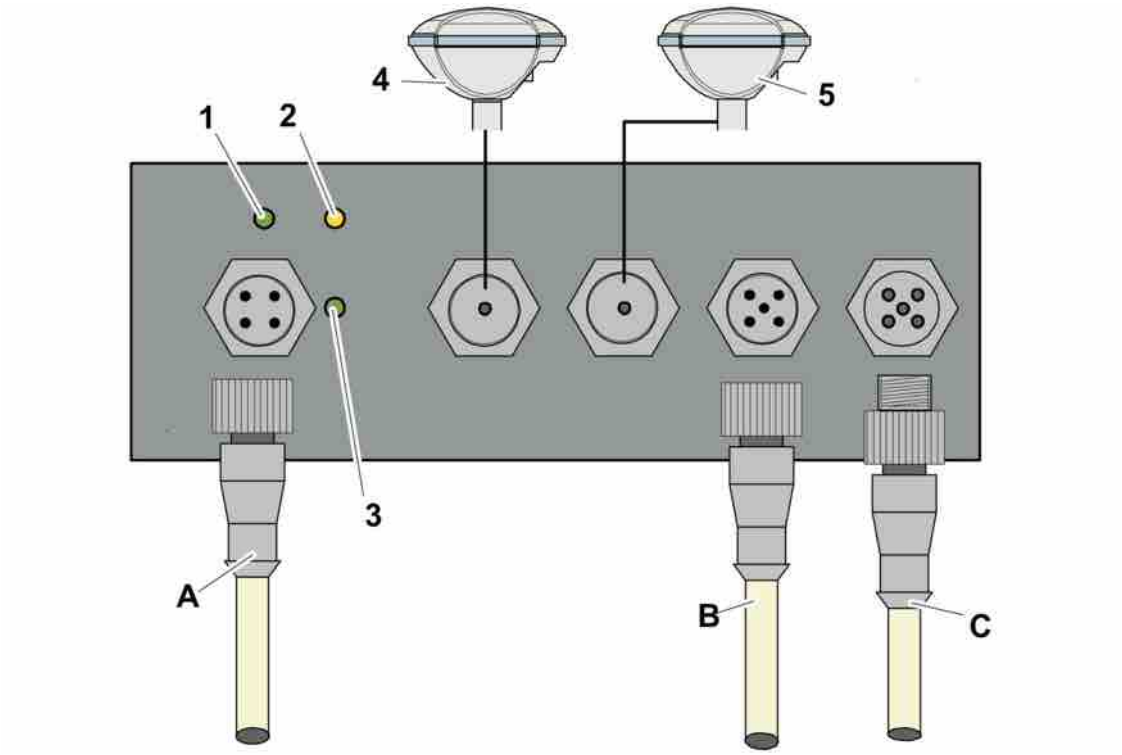
14.1 GPS

14.1.1 General

The GPS system consists of two antennas and one receiver. The antennas are fitted at a distance of 0.5 metres apart. There must not be any permanent fixture between the antennas and the horizon, apart from the drill rig's feeder.

14.1.2 General data

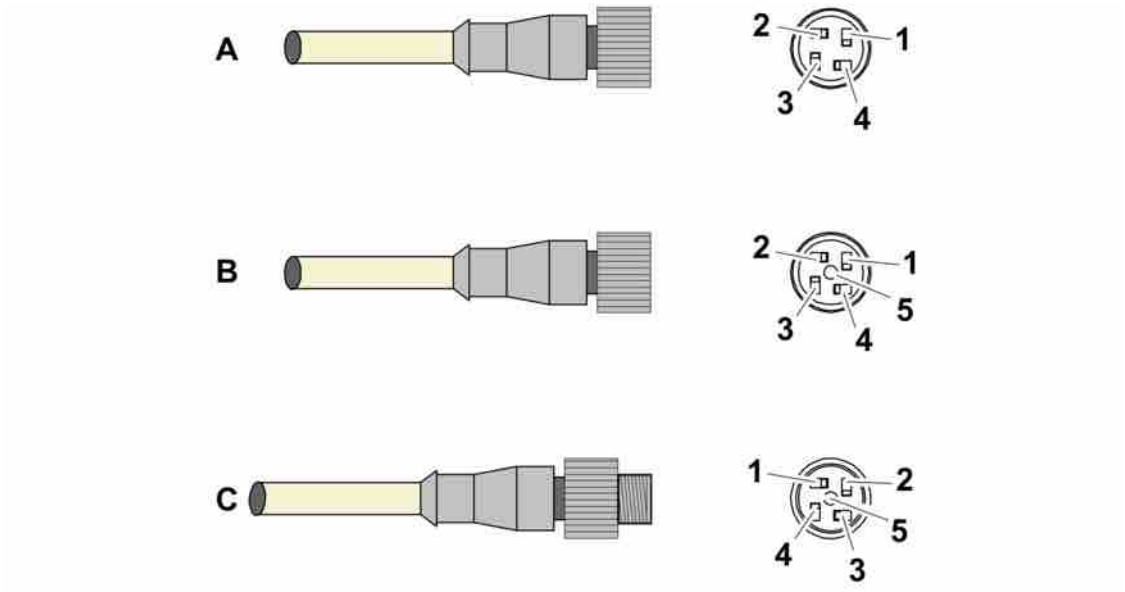
Voltage	24V DC
Current usage	0,2 A
Operating temperature	+70°C - -30°C
Enclosure class	IP65
Precision	<0.3° rms
Start-up time	<60 s
CAN test report form	CAN Open



GPS compass

A	**Voltage cable**

B	**CAN BUS cable**
C	**CAN BUS cable**
1	**PWR:** Green lamp that indicates that the supply voltage is OK.
2	**GPS lock** : Yellow lamp that indicates that the satellite reception is OK.
3	**HDG** : Green lamp that indicates that the drill rig's direction data has been sent onward to the CAN BUS.
4	**Primary antenna**
5	**Secondary antenna**



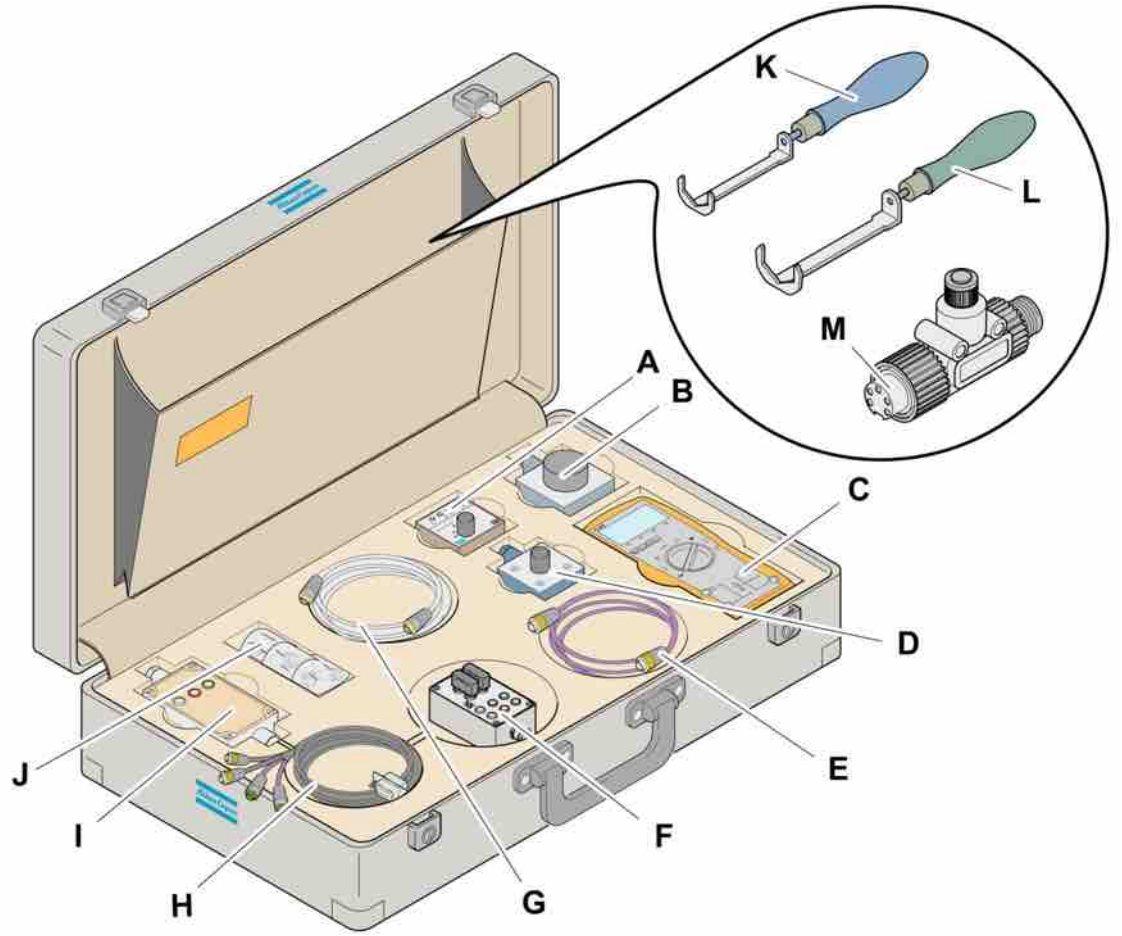
GPS cables

Wire	Conductor 1	Conductor 2	Conductor 3	Conductor 4	Conductor 5
A	**brown** 24V	**white** GND	**blue** Tx data	**black** Rx data	**-**
B	-	**white** 24V	**blue** GND	**black** CAN HI	**grey** CAN LO
C	-	**white** 24V	**blue** GND	**black** CAN HI	**grey** CAN LO

NOTE: ** The voltage cable's 24V conductor (1) has a 1 A fuse connected.*

14.2 Service equipment

14.2.1 Service tool bag RCS



Service bag

A	CAN tester
B	Resolver tester
C	Multimeter
D	Encoder tester
E	CAN Open cable
F	I/O tester
G	Signal cable
H	Test cables
I	Test box
J	Connectors
K	Torque tools
L	Torque tools
M	Contact

The service bag is used for fault finding on rigs equipped with Atlas Copco RCS (Rig Control System).

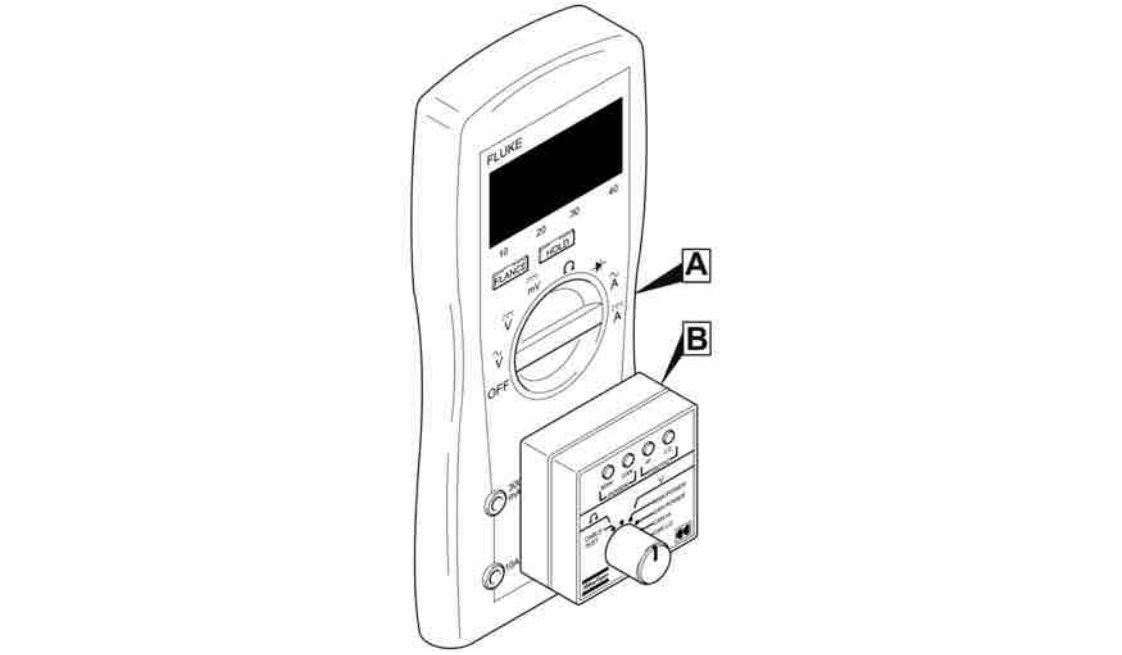
14.2.2 Checking the power supply and the CAN network

General

The power supply for the module, the CAN power supply and CAN communication can be measured and checked using the CAN tester.

> ***NOTE:*** *Always use the torque tools to tighten cable connections.*

- MAIN POWER lights if power is being supplied to the module.
- CAN POWER comes on if there is a voltage present to the CAN network.
- CAN HI and CAN LO flash while communication is in progress on the CAN network.



CAN tester

A	Multimeter
B	CAN tester

Pin	Function
1	Screen / Shield
2	CAN +
3	CAN -
4	CAN HI
5	CAN LO

Table 19: Pin configuration, CAN inputs and outputs, I/O modules

Pin	Function
1	NC / not connected
2	CAN +
3	CAN -
4	CAN HI
5	CAN LO

Table 20: Pin configuration, CAN inputs and outputs, other modules

Mount the tester on the multimeter. Make certain the pins are positioned correctly as indicated by the colour coding. The red pin goes to V/Ohm on the multimeter. Set the multimeter range to DC Volt.

CAN measurement

Connect the tester's 5-pin connectors to the CAN network requiring measurement:

- Decoder: contact X3 or X4.
- Display, application and master modules: connector X2, X3 or X4.
- I/O modules: contact X1 or X19.
- Resolver modules: contact X3 or X4.

Normal state

- Supply voltage (MAIN POWER) 24-28 V (shines green).
- CAN power supply (CAN POWER) 20-24V (shines green).
- CAN communication (CAN HI), about 2.5V (flashes green).
- CAN communication (CAN LO), about 2.3 V (flashes green).

Fault indication

- CAN HI glows red constantly for short circuit to ground.
- CAN HI glows green constantly for voltage above 3.5 V.
- CAN LO glows green constantly for short circuit to ground.
- CAN LO glows red constantly for voltage above 3.5 V.
- If neither CAN HI nor CAN LO is lit, then there is no communication even though power is being supplied to CAN.
- If any light is flashing red, then CAN communication is at the wrong level or is inverted.

Supply voltage

Connect the tester's 5-pin connector to the module's power supply:

- I/O modules: contact X25. 7-pin contact. Use enclosed T-cross.
- Other modules: connector X1. 4-pin connectors.

The power supply (MAIN POWER) must be 24-28V (lights green).

CAN cable test

! ***NOTE:*** *System is to be shut down.*

1. Mount the tester on the multimeter. Make sure the pins are positioned correctly according to the colour markings. Red pin to V/Ohm on the multimeter. Set the multimeter measuring range to ohms.
2. Connect the tester's 5-pin connectors to the CAN network requiring measurement:

   Decoder: contact X3 or X4.

   Display, application and master modules: connector X2, X3 or X4.

   I/O modules: contact X1 or X19.

   Resolver modules: contact X3 or X4.
3. Select CABLE TEST on the CAN tester. The multimeter should read about 60-65 Ohms if the cable is intact.

Fault indication

- If the multimeter reads 120 Ohm, the end plug is missing or there is a break in a cable.

! ***NOTE:*** *Because of the internal resistance in the tester, the multimeter reads about 100 kOhm if the cables are not connected or if there is an open circuit in one of the cables.*

14.2.3 I/O module

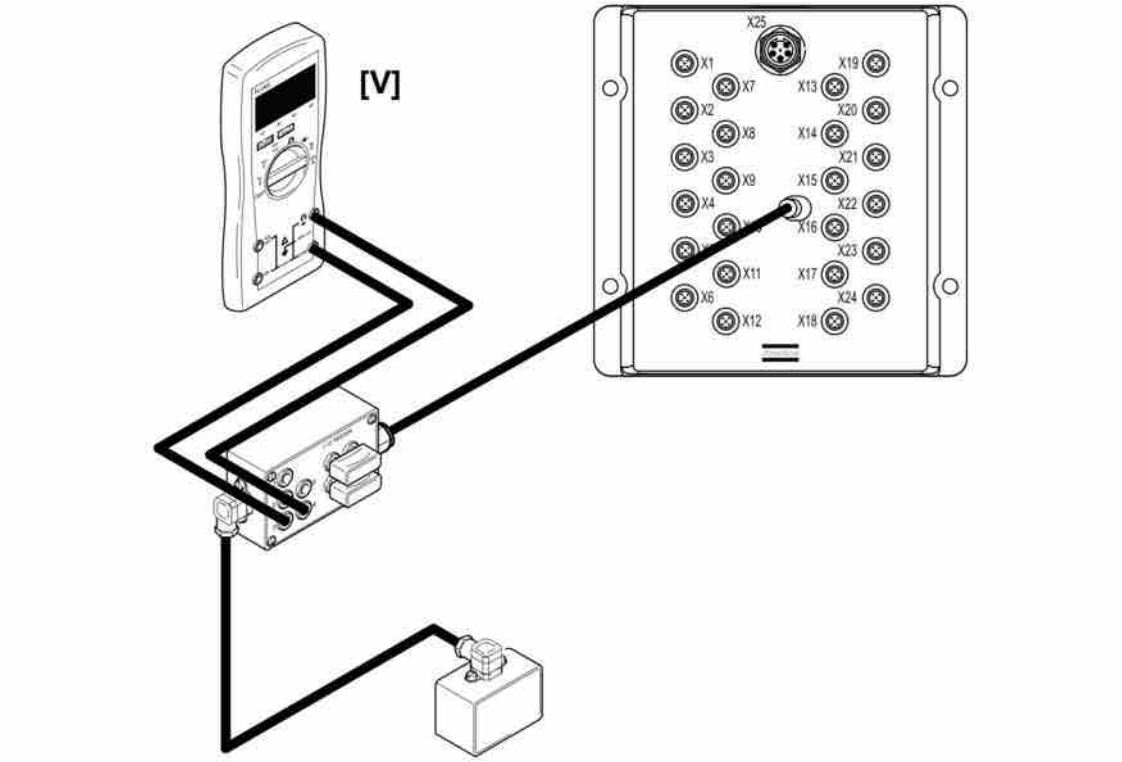
Checking the digital inputs

There are two digital inputs designated A and B at each contact Normally, the signal is 0V for an open contact and +24V for a closed contact.

Pin	Function
1	+24V DC
2	Signal B
3	GND
4	Signal A
5	GND

Table 21: Pin configuration

Measuring voltage/power



Connecting the I/O tester

1. Connect the I/O tester between the I/O module input and the guard as illustrated.
2. Measure the voltage according to the table.

Checking the digital outputs

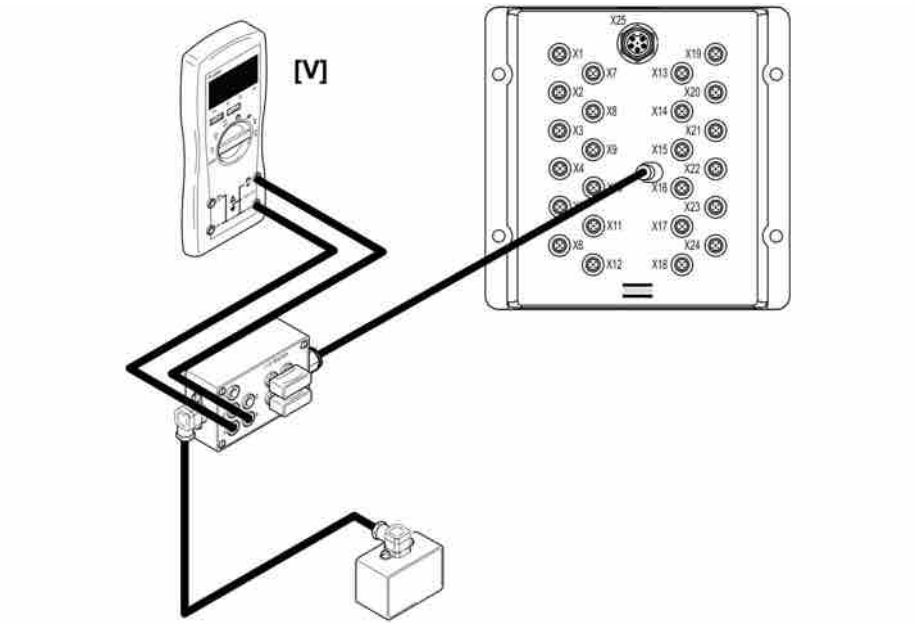
There are two digital outputs designated A and B in each contact.

Pin	Function
1	+24V DC
2	Signal B
3	GND
4	Signal A
5	GND

Table 22: Pin configuration

Measuring voltage/power

1. Connect the 5-position connector on the I/O tester between the output of interest on the I/O module and the valve as illustrated.



Connecting the I/O tester

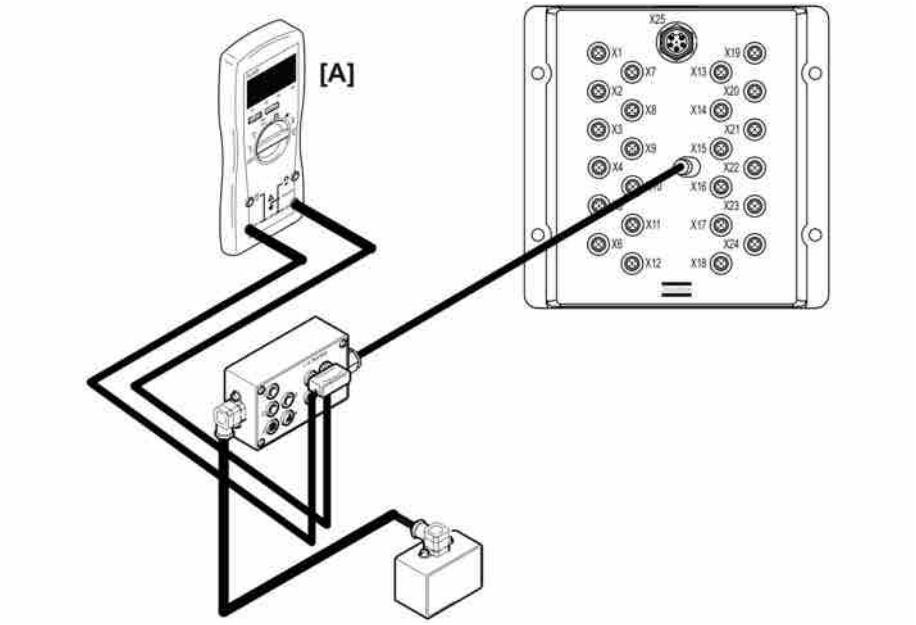
2. Connect the 5-position connector on the I/O tester to an unoccupied 5-position connector in the I/O module.
3. Connect the multimeter between GND and the +A or +B output that is of interest.
4. Activate the function. Normally, the multimeter will read ~ 24V.

Fault indication

- If the valve is not activated, there is an open circuit in the cable running to the valve or in the coil in the valve.

Measuring current

1. Connect the 5-position connector on the I/O tester between the output of interest on the I/O module and the valve as illustrated.



Connecting the I/O tester

2. Connect the multimeter in series with the +A or +B output that is of interest.
3. Activate the function. Normally, the multimeter is to read ~1A.

Fault indication

- If the multimeter reads 0.00A and the solenoid coil diode is lit, there is an open circuit in the coil in the valve.

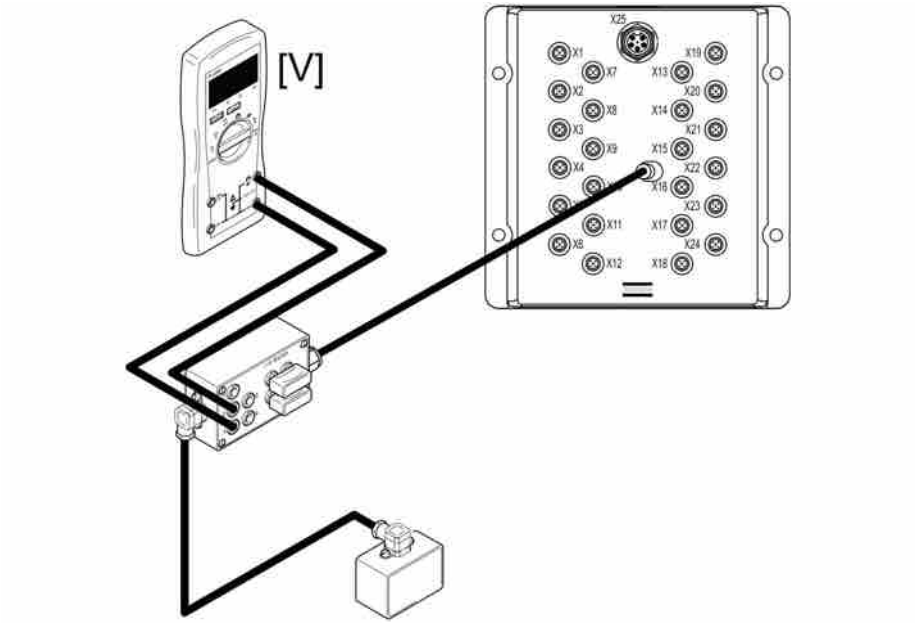
Checking the analogue inputs

Pin	Function
1	+24V DC
2	0-5V
3	GND
4	4-20mA
5	+5V DC

Table 23: Pin configuration

Measuring voltage/power

1. Connect the 5-position connector on the I/O tester between the input of interest on the I/O model and the sensor as illustrated.



Connecting the I/O tester

2. Measure currents according to the table.

Checking the PWM outputs

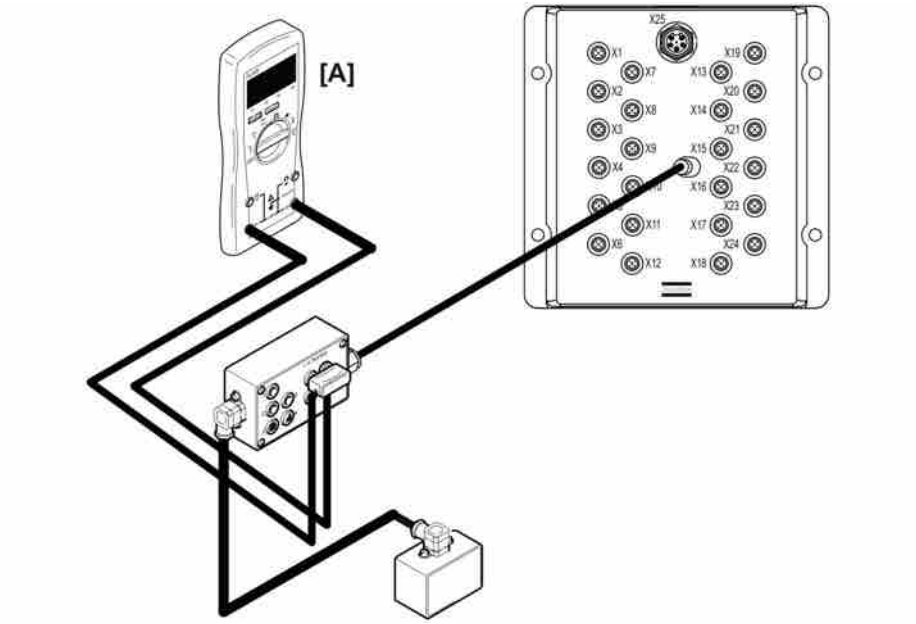
There are two PWM outputs designated A and B in each contact.

Pin	Function
1	
2	out +B
3	out -B
4	out +A
5	Out -A

Table 24: Pin configuration

Measuring current

1. Connect the 5-position connector on the I/O tester between the output of interest on the I/O module and the valve as illustrated.



Connecting the I/O tester

2. Connect the multimeter in series with the +A or +B output that is of interest.
3. Actuate the function and check that the current corresponds with the actuated value on the display.

Encoder inputs (pulse sensor) X12, X18

Each encoder connector has two signals, A and B.

Pin	Function
1	+24V DC
2	B
3	GND
4	A

Pin	Function
5	GND

Table 25: Pin configuration

14.2.4 Resolver module

Checking resolver inputs X6 - X9

Pin configuration:

Pin	Function
1	Ref +
2	Ref -
3	Sine signal
4	Sine GND
5	Cosine signal
6	Cosine GND

Table 26: Pin configuration

1. Connect the resolver tester to the relevant cable. Turn the test sensor slowly and check that the angle shown on the sensor menu changes.

Resolver tester

If the angle changes, the sensor on the boom is faulty.

If the angle does NOT change, the cable on the boom must be checked.

2. Connect the test sensor and test cable directly to the resolver module input. Turn the test sensor slowly and check that the angle on the sensor menu changes.

If the angle changes, the cable on the boom is faulty.

If the angle does NOT change, the resolver module is faulty.

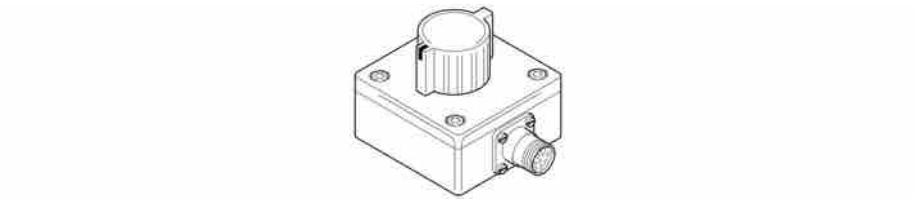
Checking the encoder input (Pulse sensor input) X10

Pin	Function
1	+15V
2	+15V
3	Signal A
4	GND

Pin	Function
5	Signal B
6	GND

Table 27: Pin configuration

1. Connect the encoder tester to the end of the relevant cable. Turn the test sensor slowly and check that the length measurement shown on the sensor menu changes.



Encoder tester

If it changes, the sensor on the boom is faulty.

If it does NOT change, the cable on the boom must be checked.

2. Connect the test sensor with test cable directly to the resolver module input. Turn the test sensor slowly and check that the length measurement shown on the sensor menu changes.

If the measured value changes, the cable on the boom is faulty.

If the measured value does NOT change, the resolver module is faulty.

Checking analogue input channels X11 and X12

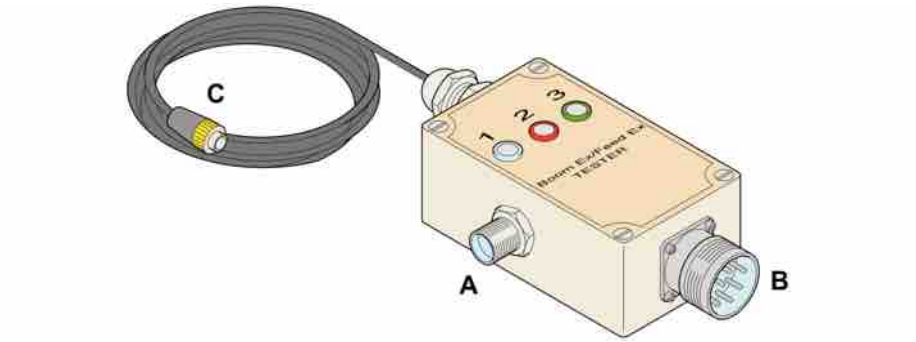
Pin	Function
1	GND
2	+ 4.5V power supply out
3	Signal in
4	(Not used)
5	(Not used)

Table 28: Pin configuration for input channel X11

Pin	Function
1	GND
2	+ 15V power supply out
3	Signal in
4	(Not used)
5	(Not used)

Table 29: Pin configuration for input channel X12

1. Connect the resolver module connector X11 or X12 to test box connector (B).



Test box

2. Connect the multimeter to test box pins 2 and 3.
3. Set the multimeter to DC voltage (=). It should read 4.5V on connector X11 and 15V on connector X12.

   If the multimeter reading is 0V there may be a fault in the signal cable or resolver module. Continue fault finding as follows:

   a. Connect the cable (C) on the test box to resolver module input X11 or X12 and measure between 1 and 2.

   b. Recheck the multimeter reading. If it is 0V, there is a fault on the resolver module input (X11 or X12).

14.2.5 Replacing the module

1. Make certain the module has the correct address plug and that the end plug (if any) is mounted in place.
2. When any of the application module, I/O or resolver module is replaced, the program must be read into the system again.
3. Insert the USB memory stick with the program into the USB port and start the RCS system.
4. When the program has been fully loaded, the following will appear on the display: "Remove card and restart the system!"
5. Switch off the system - remove the USB memory stick and start the system once again.

> ! ***NOTE:*** *Make certain that electric power is present at the rig or that the diesel engine is running before loading the program. Avoid starting the diesel engine while the program is being loaded. Never turn off the system while the program is being loaded.*

14.3 RC - Reverse Circulation

14.3.1 General

Most maintenance work consists of checking leakage and wear, as well as replacing wear parts. All parts that come into contact with cuttings are wear parts. The components that wear the most are the inner tubes and deflectors, the former in particular.

There are also a number of lubrication points.

A general inspection is recommended every week or every 50 engine hours.

Before any component is unscrewed the system should be depressurised. Failure to do so would cause the O-rings to be sucked out from their grooves when the air escapes past them.

For maintenance of the rotation unit, see the separate documentation.

For maintenance of the down-the-hole rock drill, see the supplier's documentation.

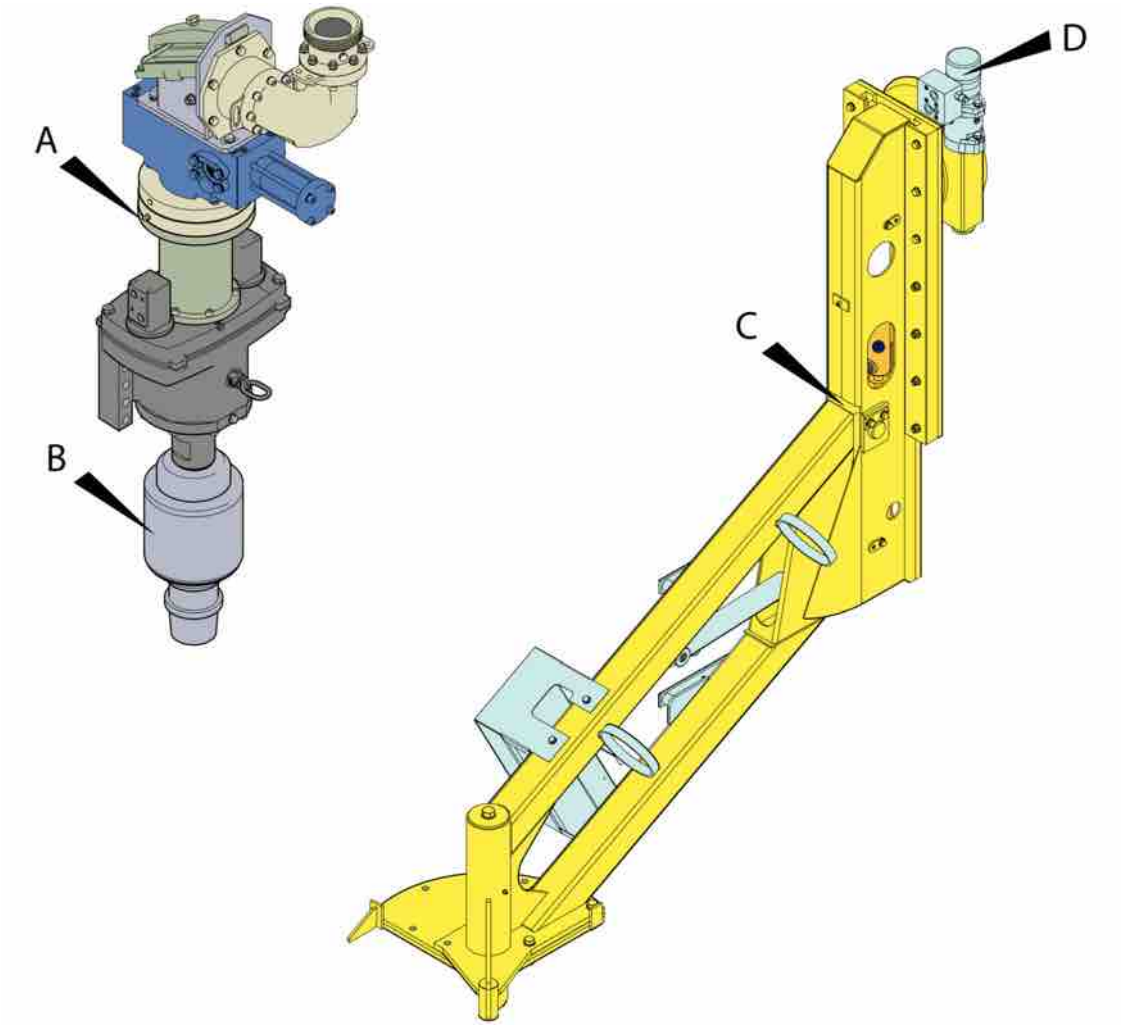
14.3.2 Lubrication

The lubrication points are on the arm, the rotary actuator, the outlet swivel and the air swivel. For the rotary actuator, lubrication is recommended every two months or every 500 engine hours. Other points must be lubricated daily.

CAUTION

Risk of injury

Special tools are required for service: Article number 9495 6730 00 - 6x screws, 12:9 quality when fitting the adapter.



Lubrication points

A	Outlet swivel
B	Air swivel
C	Shaft
D	Rotary actuator

The air swivel should be lubricated carefully. A maximum of a couple of presses with grease in each nipple is sufficient. Too much lubrication can pressurise the seals and lead to heat development which damages seals and bearings.

In addition, lubrication is recommended after cleaning the equipment.

Recommended Lubricants:

- Castrol APX T Grease
- Shell Albida Grease HD 2
- Fuchs Renolite LX- EP2
- BP Energrease LC 2

14.3.3 Maintenance of components

Down-the-hole rock drill

Good lubrication, clean air and regular maintenance are critical factors for the service life of the down-the-hole rock drill.

The most common cause of breakdown is a defective inner tube. The inner tube tends to wear at the lower end first. If it is allowed to become too short or too thin then the pipe's end breaks and jams under the piston during the down stroke, which leads to piston failure and cylinder damage.

Most inner tubes for down-the-hole rock drills have a wear indicator that shows when it is time for replacement. It can be seen and/or felt inside the bottom of the down-the-hole rock drill when the drill bit is removed. Often, this is obvious when it becomes more difficult to obtain the sample through the drill bit.

The service life for the down-the-hole rock drill's inner tube can vary greatly with a probable average life of around 800 m, but in some abrasive rock types the service life can be as low as 300 m.

Drill pipe

The drill pipes wear on the outside and need to be measured if you are worried about size. The diameter is measured at the weld seam because this is the weakest point when it is worn. For a drill pipe of 114.3 mm (4.5") the time for replacement is at a size of 109 mm. A pipe of 101.6 mm (4") needs to be replaced at about 96 mm. Underdimensioned drill pipes could fail which could lead to costly losses.

Drill pipes and inner tubes, as well as inner tubes for adapters, are wear parts. The degree of wear depends largely on rock conditions.

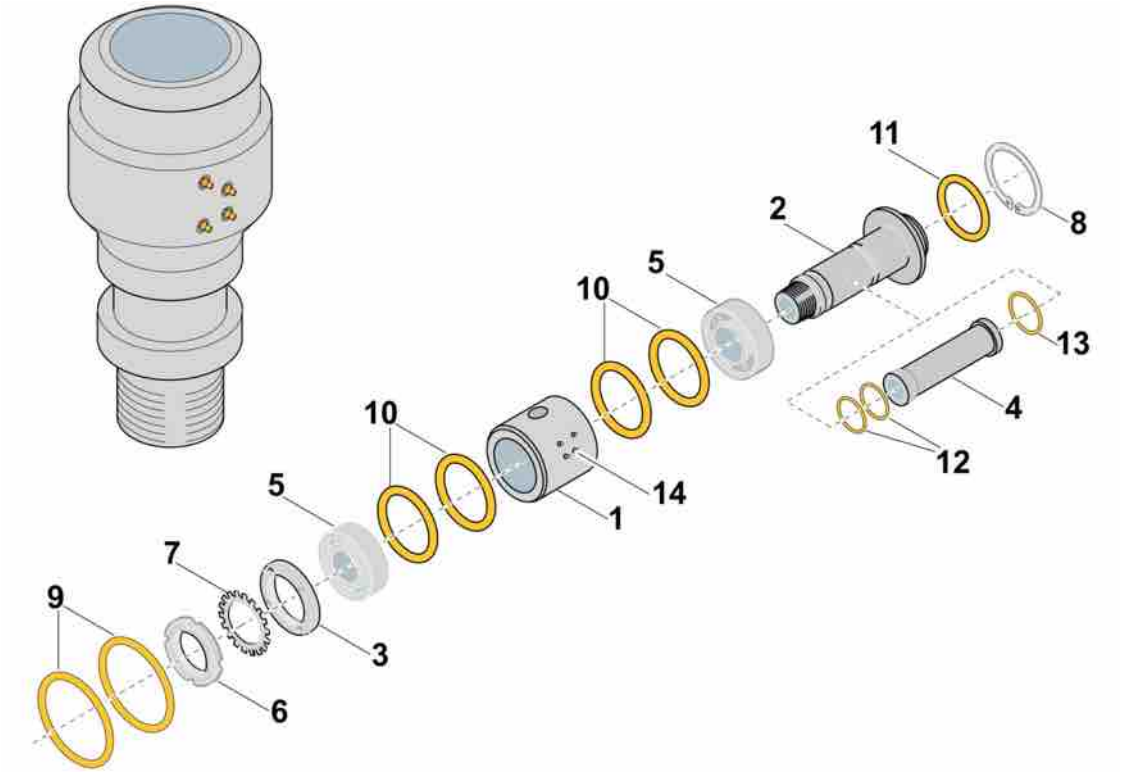
The inner tube on top of the drill pipe is changed by removing the circlip. A damaged inner tube results in considerable loss of pressure and is therefore easy to diagnose.

CAUTION

Risk of injury

A damaged inner tube causes a considerable increase in the wear of other parts. Stop drilling immediately if you suspect a damaged inner tube.

Air swivel



Normal maintenance includes lubrication of seals and bearings via the 4 grease nipples (14) on the shell (1). This must be carried out daily or every 10 engine hours. A maximum of a couple of presses with grease in each nipple. **DO NOT OVER LUBRICATE -** Too much lubrication can pressurise the seals and lead to heat development which damages seals and bearings.

The normal service life of a seal can be up to 2000 hours, and the service life for shaft and bearing may be many times this service life. However, seal replacement is unavoidable.

During dismantling, the lock nut (6), retaining washer (7) and holder washer (3) are removed so that the shell (1) can be removed from the shaft (2). Check the seal's running surfaces on the shaft. If it is very grooved then the shaft is replaced. Check the other parts in terms of wear/damage and replace if necessary. Replace seals and assemble.

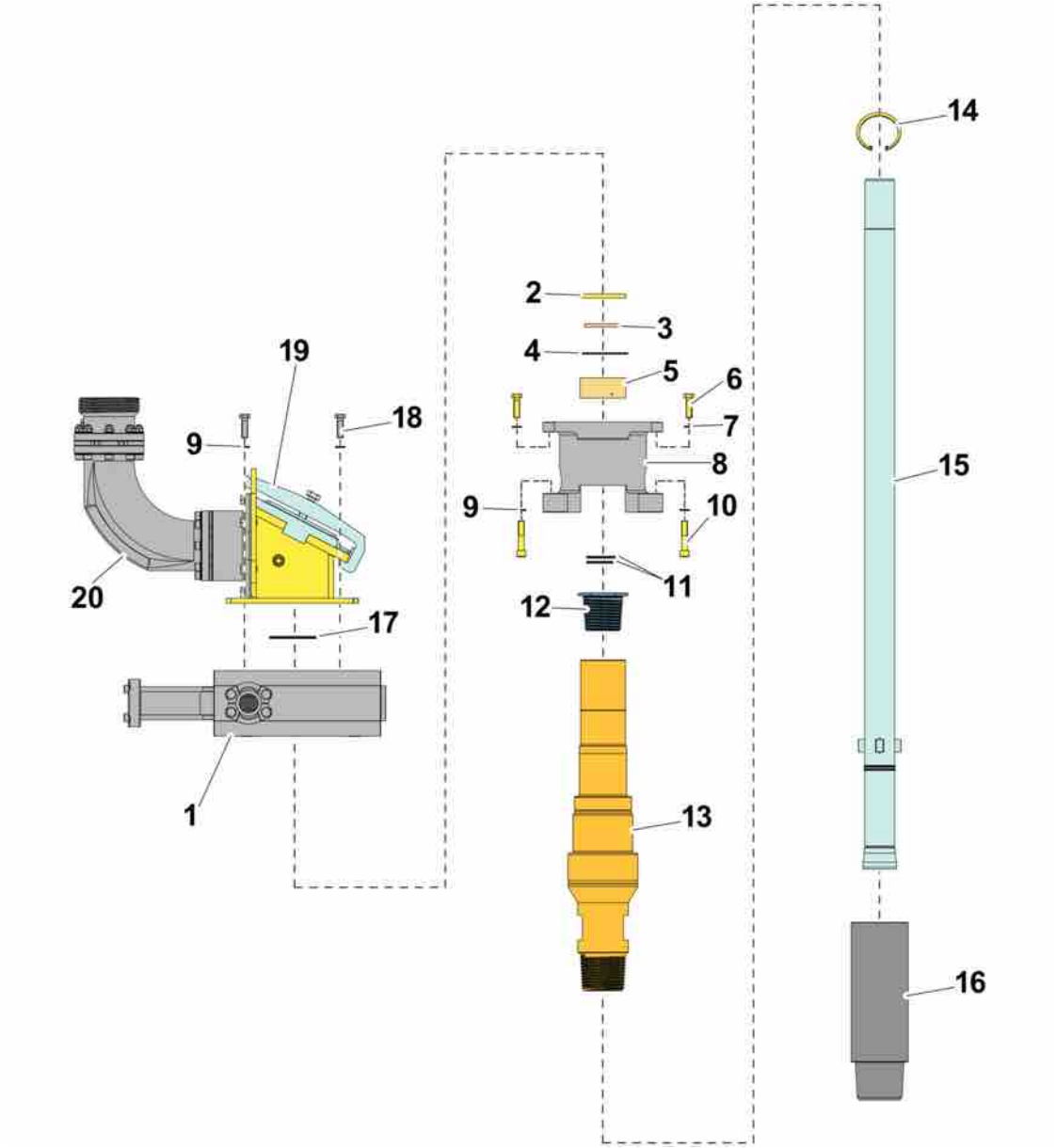
Some consider it necessary to tack weld the air swivel's shaft (2) onto the rotation unit's shaft. If this is done then brazing lugs must be used on both shafts. **The seam between the shafts must not be welded.**

CAUTION

Risk of injury

Tightening must be secure before tack welding.

Outlet swivel (with Metzke Blowdown Valve)



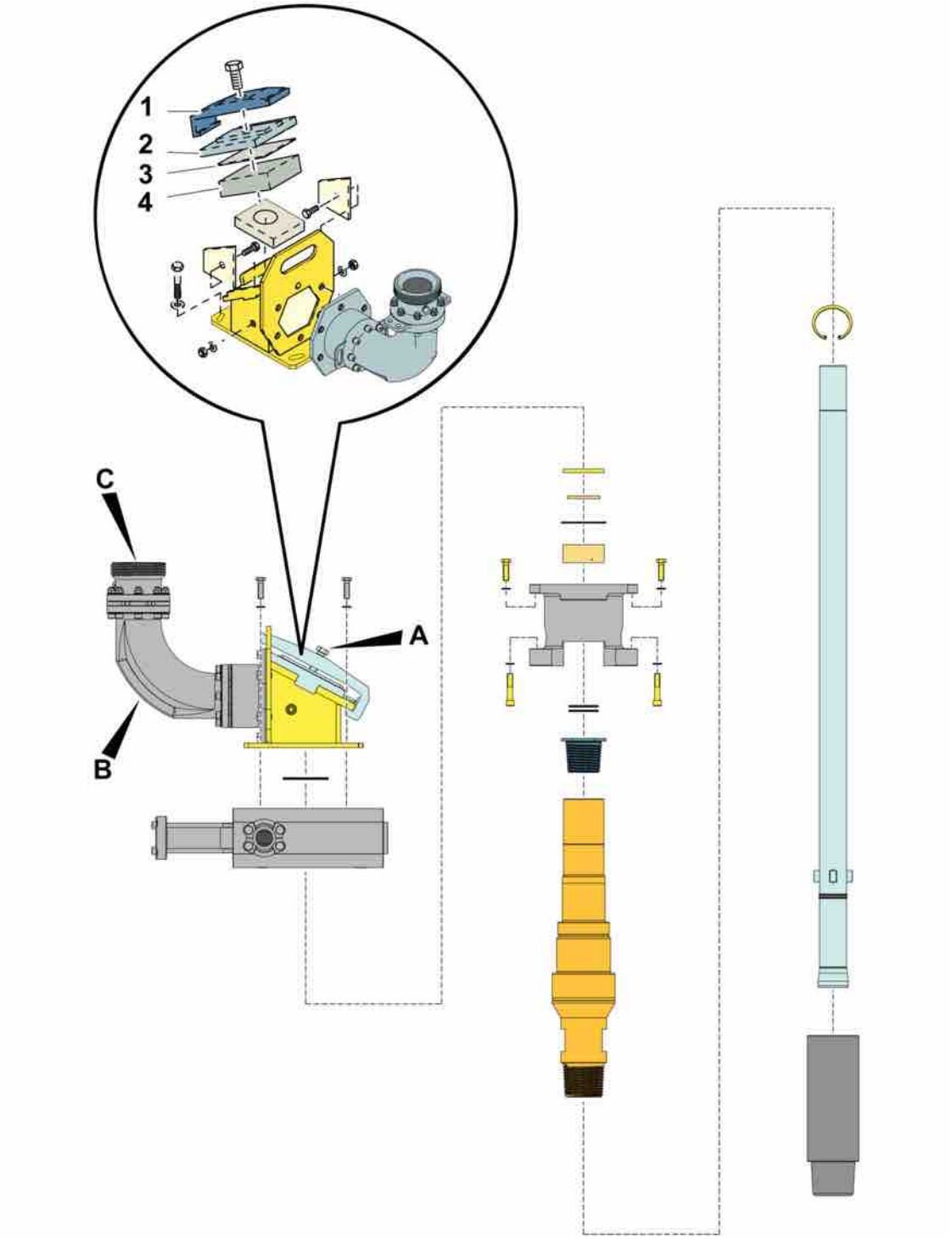
1	Metzke Blowdown Valve
2	Seal
3	Seal
4	O-ring
5	Seal
6	Hex head screw
7	Washer
8	Short adapter housing
9	Washer
10	Socket head cap screw

11	O-ring
12	Spindle adapter
13	Spindle DHR6RC
14	Circlip
15	Inner tube
16	Outer tube
17	O-ring
18	Hex head screw
19	Deflector 1
20	Deflector 2

Seal 5 on the outlet swivel requires regular lubrication. There is a grease nipple for this on the adapter housing (8). **Grease must be applied daily to this seal (5) via the grease nipple.**

Replace the seals when they start leaking. Leaking cutting seals can cause water and dirt penetration in the rotation unit. The sealing sleeve around which the seals rotate may also require replacing if rutted.

Deflectors



The first deflector (A) meets all the force from the sample flow, which can reach speeds of up to 200 m/s, and is therefore exposed to hard wear. The deflector has a heavy ceramic block (4) which is easy to replace by removing the bridge (1) and the cover plate (2). As the service life varies greatly depending on rock conditions this block should be checked every month or every 250 engine hours, until a replacement programme has been established.

The second deflector (B) has a longer service life, but this also depends on rock conditions.

The connection cover plate (C) becomes worn and is normally checked when replacing the sample hose.

Ensure that all screws are at least 8.8 in strength class and that all nuts have Nylock for the reassembly of these components.

Discharge System

The roller for the sample hose, fitted on the feeder, requires no maintenance as it is made of nylon.

The end of the sample hose needs to be replaced on occasion. The hose is often used until it breaks, in which case it must be replaced immediately. The hose must have safety sleeving fitted. When fitting a hose it is important to ensure that the clamps engage in the retaining groove in the collar.

The sample hoses must have hose protection (sleeving) fitted on both ends of the hose in the event of a functional breakdown. The hose protection must be attached with shackles onto the attachment points on the hubs.

DANGER

Serious injury or death

Burst hoses can cause personal injuries.

Cyclone and splitter

The cyclone has replaceable wear plates inside the shell and inlet. These need to be monitored and replaced when they are badly worn.

The cone splitter's knife valves have rope seals. If the sample begins to leak this seal can be tightened until the leak stops. This is performed by tightening the 8 screws holding the seal holder in place. This can be performed several times before the seal needs replacing. Be careful not to tighten too hard as this could cause the knife blade to lock. The rope seals must be replaced as necessary.

About inner tubes

All components from the rotation head shaft down contain an inner tube.

Along with deflectors the inner tubes are the components that wear the most. There are inner tubes in the down-the-hole hammer, the drill pipes, the different adapters, the air swivel as well as the shaft that runs through the rotation unit and rotation head. It is not possible to measure the remaining service life of an inner tube, which often leads to the inner tubes being used until they break. Apart from the tube in the rotation unit, a damaged inner tube causes significant pressure loss and it is therefore easy to diagnose. This may lead to the surrounding components being damaged, and at best lead to continued drilling not being possible.

All inner tubes are replaceable and are removed through the top of the component by removing the component from the drill string, removing the circlip and sliding the tube out.

The inner tube in the rotation head is hardened and is much thicker than other inner tubes so it lasts longer, but visual inspection (with regard to wall thickness) is important when possible (if the swivel is removed or if the seals in the rotation head are replaced).

The cost of a few inner tubes is often made worthwhile by the reduced downtime that the replacement of all tubes can result in when one of them needs to be replaced.

All inner tubes are sealed with O-rings in order to separate the high-pressure air from return air. It is critical that these O-rings are in place and in good condition. When you access them it is prudent to replace any O-rings whether or not they are worn.

14.3.4 Blow adapters

Blowdown adapter

Certain RC machines from Atlas Copco are equipped with a blowdown system from Metzke. It is possible to screw blowdown system loosely on the drill string on RC rigs without one. The blowdown adapter directs the compressed air down through the inner tubes and in this way clears any blockages and forces return air to the outside of the drill pipes. We recommend contacting an Atlas Copco service engineer before making any changes to the rig.

Blow-up adapter

DANGER

Serious injury or death

There are blow-up adapters on the market that direct the compressed air upwards through the deflectors and the sample hose to the cyclone. It is very easy to subject the sample hose to damage, which may also cause injury if anyone is in the vicinity. Due to this you are advised against using blow-up adapters.

14.3.5 Metzke Blowdown Valve

The Metzke Blowdown Valve directs the compressed air down through the inner tube and so clears away any blockages and forces return air to the outside of the drill pipe.

WARNING

Serious injury

The blowdown valve works with air under high pressure. Air under high pressure is extremely dangerous.

- Remove or isolate the air or hydraulic inputs before service or maintenance.
- The valve has internal moving parts that can be dangerous due to pressure forces. Do not position any part of the body or any objects in the valve ports during tramming.

A daily visual inspection should be carried out in order to check for abnormal wear, hydraulic leaks and damaged components. Replace parts when necessary.

The Metzke Blowdown Valve does not have any lubricating points.

The spool sleeve, upper and lower inserts, and seals will wear over time - this is normal. With this in mind, regular inspections must be made through the top of the valve. It is essential that these parts are replaced before being worn. Any further wear will cause considerable damage to other components in the valve.

The hardened inserts have a goods thickness of 6 mm and an original inside diameter (ID) of 50 mm. They should be replaced if the inside diameter exceeds 58-60 mm.

Check for any uneven wear on the inserts as this can indicate that the main air seals are leaking.

It is essential the inner pipes included in components fitted in the system after the blow-down valve are in good condition. Inner pipes in bad condition can impact negatively on test flow and cause extra wear to the blowdown valve.

There is an indicator hole in the cylinder housing. If oil or air starts to leak from this hole, it means the cylinder rod seal is leaking and must be replaced.

CAUTION

Risk of injury

Serious damage or lethal injuries can occur if changes or repairs are performed on this system by unauthorised persons.

- We recommend always getting in touch with a qualified service engineer before performing any work on this system.

14.3.6 Fault finding in the event of air leakage

If the down-the-hole rock drill appears to be obtaining less pressure than expected, or if there are difficulties with sample return, the most likely cause will be missing O-rings or holes in an inner tube.

A circular cover plate is used during fault finding (test sub - check in spare parts list for correct part number) that blocks the flow of compressed air between the inner and outer tubes so that compressed air is contained. Look in the spare parts list for the correct part number.

A drill rod or rotation head is screwed on by hand and the air is switched on. If air is flowing from the centre of the cover plate then this indicates that O-rings are either missing or are in poor condition, or that there is a hole in one of the inner tubes above the cover plate. If the leaking air hisses out then the problem is probably missing O-rings, if the air is blowing out then it is probably a hole in an inner tube.

By using the method of elimination, the adapter can be moved up or down on the drill string in order to determine which component is generating the problem. As each step in the test is taken, one component is removed and checked until you have found which one is defective. The problem must be rectified, i.e. the part must be replaced or repaired, and a test performed to confirm that this was the only problem. It is important not to assume that a particular component is faultless - all must be tested in a logical sequence until the problem is found.

14.3.7 Conversion to normal drilling

If there is a requirement to convert from RC drilling to normal drilling, there are several ways to achieve this, each with a different scope:

- A normal down-the-hole rock drill is used on RC tubes together with an adapter for API threads. A stop plug is also fitted in the inner tubes at the down-the-hole rock drill or at the spar adapter in order to prevent air from flowing out through the inner tubes. This is not an option in the long-term because the increased vibration tends to damage the inner tubes.
- The inner tubes can be removed from the RC tubes. The deflectors and sample hoses can also be removed. If the sample hose is removed then the deflectors must also be removed and vice versa.

- The RC tubes are removed and replaced with normal drill pipes. The air swivel is removed and replaced with an adapter. The deflectors and sample hose can be removed. An adapter is fitted on the rotation head for the air supply to the drill string. This is a longer-term adaptation and is used if normal drilling is to be carried out over several weeks or more.

14.4 Fire suppression system

14.4.1 Daily checks and maintenance

If there is a pressure gauge fitted, then check that the needle on the pressure meter for the containers is within the green zone.

On **semi-automatic fire fighting systems**, check that the LEDs are working as specified in the Operator's Manual. Perform a test - press the green test button (7) for at least 1 second. The diodes come on successively and conclude with an alarm test of signal and lamp.

14.4.2 Annual maintenance

In many countries, insurance companies require proof that a qualified engineer has inspected and approved the fire fighting system annually. We recommend checking with your insurance company to find out if they have any requirements concerning this system.

14.4.3 Electric Welding, Steam Cleaning and High Pressure Cleaning

⚠ CAUTION

Risk of injury

The operator's panel on semi-automatic fire fighting systems must be disabled for the following tasks:

- Electric welding, battery charging and start help. Harmful currents can damage the electronics.
- Steam cleaning. The heat detectors are triggered at 120°C and could be activated by the steam.
- High-pressure washing. Components or cables could be damaged by the jets and trigger the system.

Once the semi-automatic fire fighting system is enabled again, make sure the LEDs and the system work as specified in the Operator's Manual. Perform a test - press the green test button on the operator's panel for at least 1 second. The diodes come on successively and conclude with an alarm test of signal and lamp. A description of the operator's panel can be found in the Operator's Manual

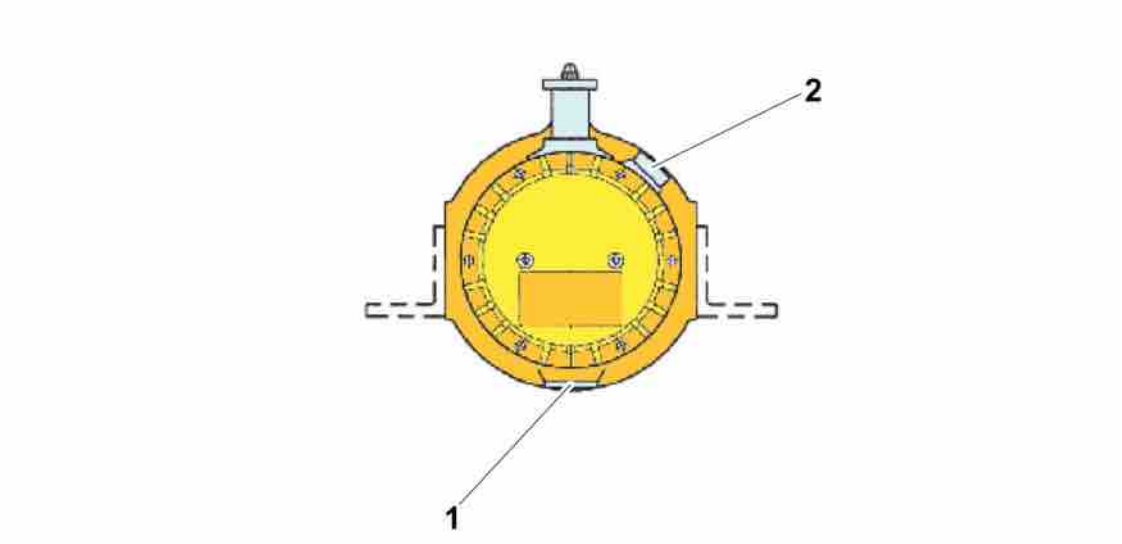
14.5 Service Winch

14.5.1 Cleaning

Always clean the winch after use.

14.5.2 Transmission

Check the oil level regularly. Replace the oil every 8000 engine hours.

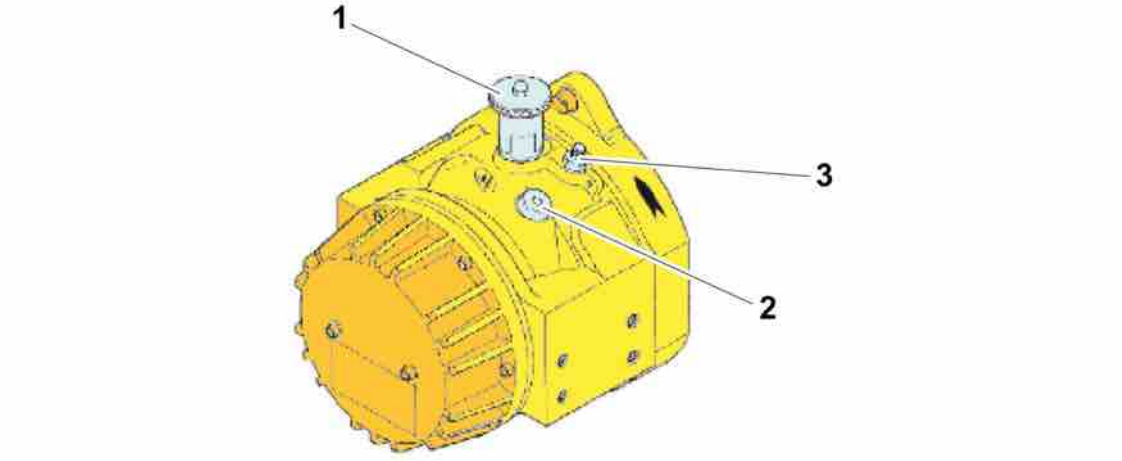


Service winch, oil filling orifice

1	Oil drain plug
2	Oil filling orifice cover plate

The winch gear holds 0.5 L oil. Drain out the old oil by removing the oil drain plug (1). Pour in new oil into the winch transmission via the oil filling orifice cover plate. (2)

14.5.3 Disengagement device



Service Winch

1	Disengagement device
2	Oil filling orifice cover plate
3	Drum brake adjusting screw

Lubricate the disengagement device (1) every 1000th engine hour.

14.5.4 Adjusting - Drum brake

WARNING

Serious injury

Check regularly that the brake is correctly adjusted. When the drum is disengaged there is a risk that the cable may unreel uncontrollably.

Increase braking force

1. Undo the lock nut on the adjusting screw (3).
2. Rotate the brake nipple clockwise one quarter turn (3).
3. Tighten the locking nut.

Decrease braking force

1. Undo the lock nut on the adjusting screw (3).
2. Rotate the brake nipple anticlockwise one quarter turn (3).
3. Tighten the locking nut.

14.5.5 Cable

CAUTION

Risk of injury

Check the cable regularly. Do not use the winch if the cable is damaged.

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