

SmartROC D65 T4F

Operation



Atlas Copco



Reference



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



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2 General

2.1 Foreword

This instruction manual is part of the complete delivery of the drill rig. It provides information on the design and operation of the drill rig and contains advice and the measures necessary to keep the rig operational. This instruction manual is no replacement for thorough training on the drill rig.

This instruction manual should be read in advance by all persons who are to operate or repair the drill rig or carry out maintenance on it.

See separate instructions for documentation on the rock drill/rotation unit, the diesel engine and certain other components.

For other questions refer to the local Atlas Copco company office. Addresses and telephone numbers are in the Maintenance instructions.

2.2 Application

The drilling equipment is designed mainly for drilling blast holes in e.g. quarries and open-cast mines. All other uses are considered inappropriate.

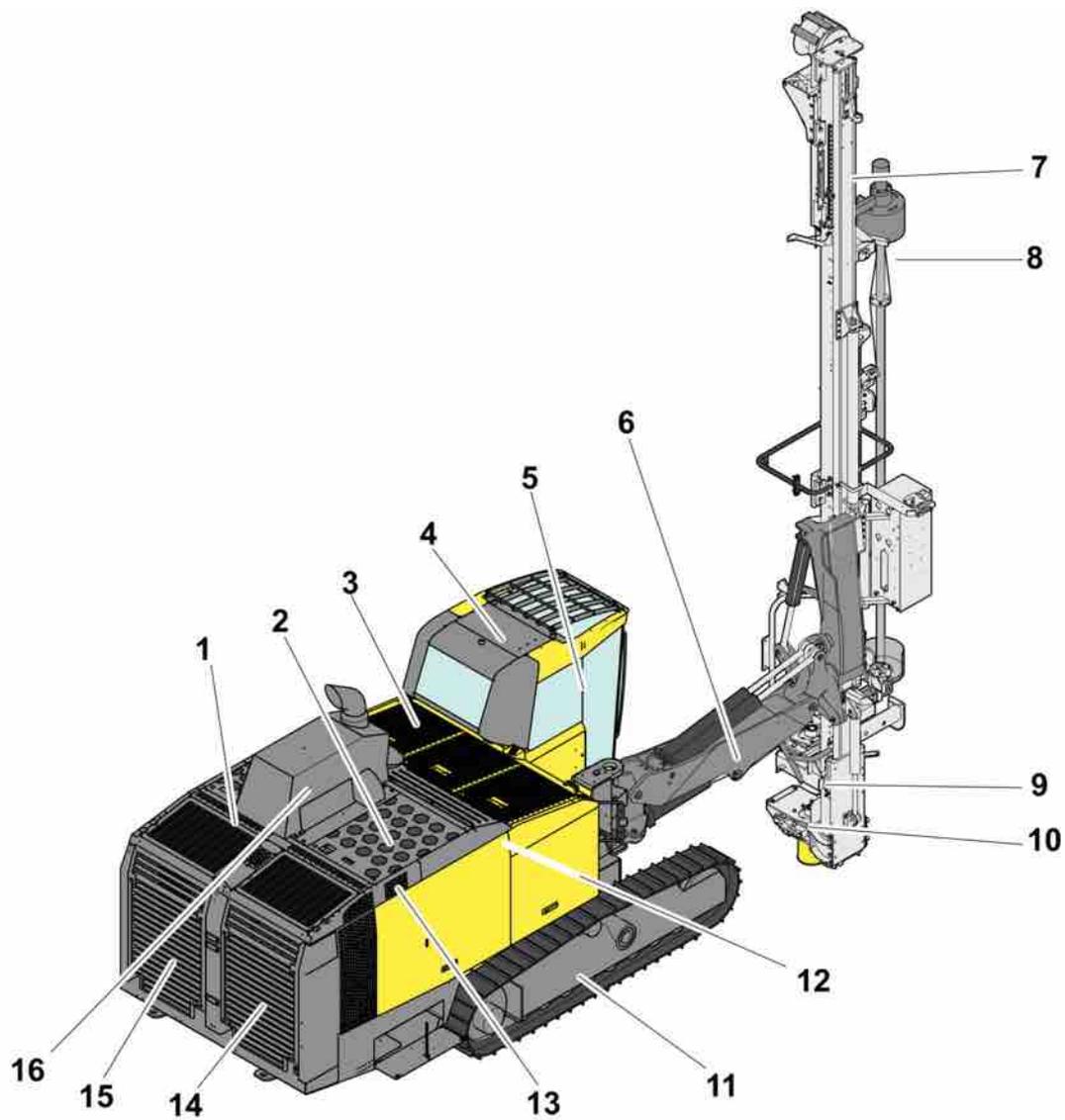
Examples of inappropriate use:

- Lifting and transporting loads and people
- Supporting objects
- Scaling rock

The manufacturer is not liable for damage caused by inappropriate use.

- It is essential the operator has read and comprehends the operator, maintenance and overhauling instruction as well as the maintenance schedules.
- The drilling equipment must only be used, maintained and repaired by personnel well conversant with the equipment and the dangers involved.
- It is essential that personnel observe general and local safety, health and traffic regulations.
- The manufacturer is not liable to damage caused by any arbitrary changes made to the drilling equipment.
- There must be no work in, on or in the vicinity of the machine when there is a risk of lightning.

2.3 Principal components



Principal components

| Position | Component | Position | Component |
|----------|-------------------------------|----------|-------------------------------------|
| 1 | Compressor | 9 | Bit Breaker |
| 2 | Diesel engine | 10 | Rod guide |
| 3 | Electric cabinet | 11 | Track frames |
| 4 | Operator's cabin | 12 | Hydraulic pumps |
| 5 | Operator's panel for drilling | 13 | Dust collector |
| 6 | Boom | 14 | Radiator |
| 7 | Feeder | 15 | Compressor and hydraulic oil cooler |
| 8 | Rod handling system | 16 | Exhaust purifier |

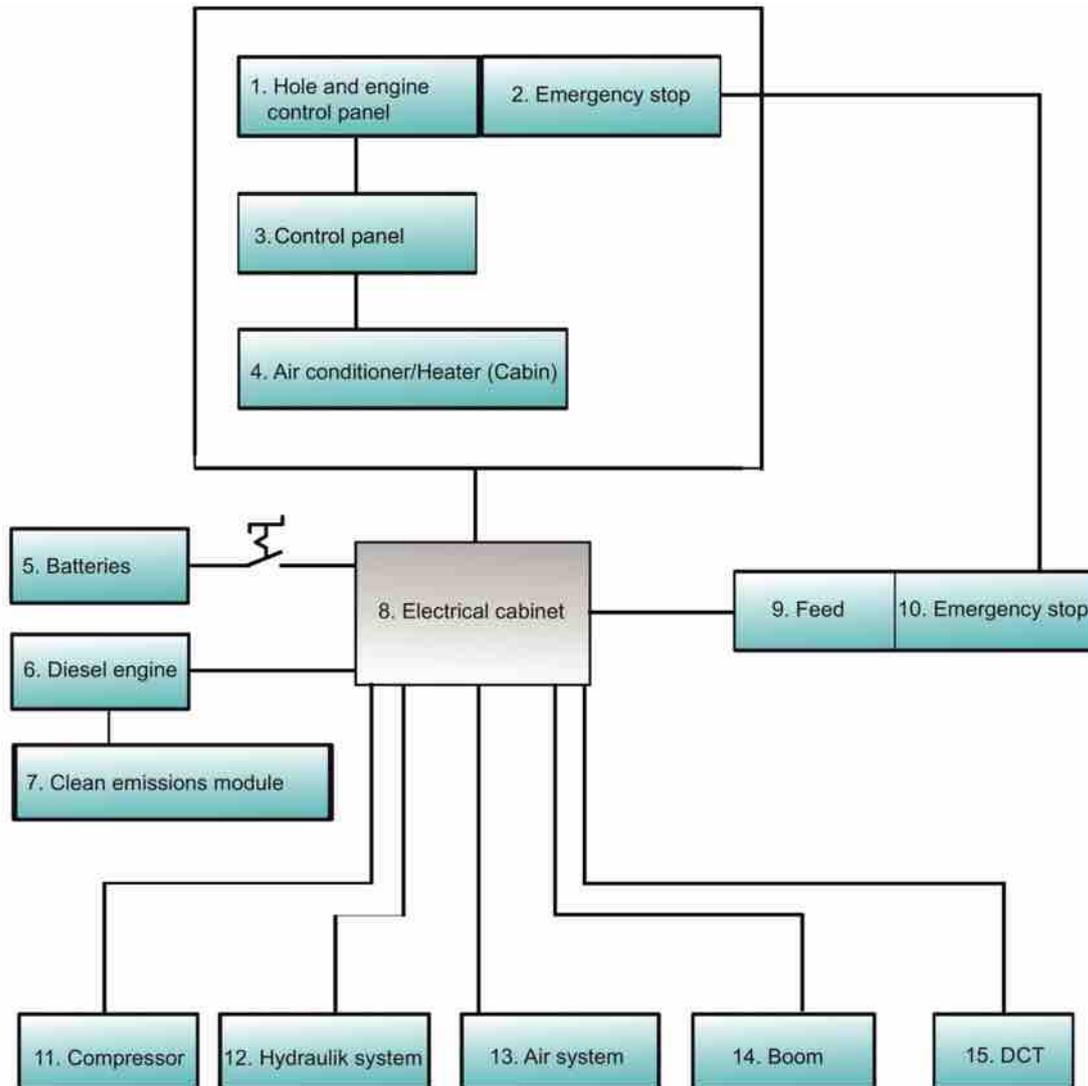
Table 1: Principal components

2.4 General system description

2.4.1 General description of the drill rig

This drill rig is a fully diesel-hydraulic drill rig designed for surface drilling applications such as in quarries and on construction sites.

The drill rig consists of the following main components: (See illustration under General Description)



General Description

| | |
|---|--|
| 1 | Control panel for diesel engine and directional instrument |
| 2 | Emergency stop |
| 3 | Operator's panel |
| 4 | Air conditioning/Heating (Drill rigs with cabin) |
| 5 | Batteries |
| 6 | Diesel engine |

| | |
|----|-------------------------|
| 7 | Emissions cleaning unit |
| 8 | Electric cabinet |
| 9 | Feeder |
| 10 | Emergency stop |
| 11 | Compressor |
| 12 | Hydraulic systems |
| 13 | Air system |
| 14 | Boom |
| 15 | Dust collector DCT |

2.4.2 Wagon frame with track frames

The diesel engine, chassis, dust collector, hydraulic system, air system and boom system are mounted on the wagon frame.

The wagon frame comprises a frame with the operator's cabin/platform mounted on the left. Controls for tramping and drilling are installed in the operator's cabin/platform.

The track frames are carried on journals in the wagon frame. When tramping on uneven ground the drill rig is balanced by means of two compensating cylinders.

Each track frame has its own service brake. The brakes are operated by two separate control systems.

The bodywork covers the diesel engine, the compressor, the various lubrication tanks, the valves and the hydraulic hoses. Inspection covers allow easy access to the various machine components. The covers are secured in the open position by means of gas springs.

The dust collector is mounted at the back of the rig on the right-hand side.

2.4.3 Power pack

This hydraulic drill rig is powered by a turbocharged, water-cooled diesel engine.

The diesel engine is equipped with a monitoring system that includes automatic shut-down functions.

The drill rig is driven by two traction motors with gears. The traction motors with gears are mounted in the track frames.

The hydraulic pumps and the compressor are driven by a diesel engine.

2.4.4 Exhaust filtering (Tier 4 Final)

Regeneration is a process that burns the soot from the diesel engine's particle filter, which cleans the exhaust emissions. In most cases regeneration is started completely automatically and without affecting the rig's performance. Regeneration can be run in two different modes depending on the speed of the diesel engine and calculated soot level in the particle filter.

In addition to the particulate filter, this rig is equipped with a system that injects DEF (Diesel Exhaust Fluid) into the machine's exhaust system. By means of a chemical reaction, this fluid dramatically reduces the amount of harmful nitrogen oxides (NOx gases) the rig releases into the atmosphere.

2.4.5 Boom system

The boom system consists of boom body, boom head, feed holder and associated hydraulic cylinders. The boom system is controlled by directional valves for positioning the feed with the rock drill at different distances and directions.

2.4.6 Dust collector

The hydraulically driven dust collector features automatic cleaning and consists of a filter unit, pre-separator, suction fan and suction hose.

2.4.7 Electrical system

The 24 V electrical system is supplied with current by an alternator and two batteries.

The electrical system consists of the starter, work lights, electric controls, electric control system, electro-hydraulic circuits and safety devices.

The electrical control system includes control modules, I/O modules, application modules, switches, resistors and diodes.

The emergency stop buttons/cables are connected in series with the diesel engine cut-out system. As soon as an emergency stop button/cable is activated, the diesel engine will be stopped immediately. Reset the emergency stop buttons before restarting the engine. The engine cannot be started while one of the emergency stops is still activated.

For further details, see separate wiring diagram.

For details of the diesel engine, see separate diesel engine instructions.

2.4.8 Hydraulic system

The hydraulic system consists of six hydraulic pumps, oil cooler, hydraulic oil reservoir, valves, hoses, etc.

The six hydraulic pumps provide hydraulic pressure as follows:

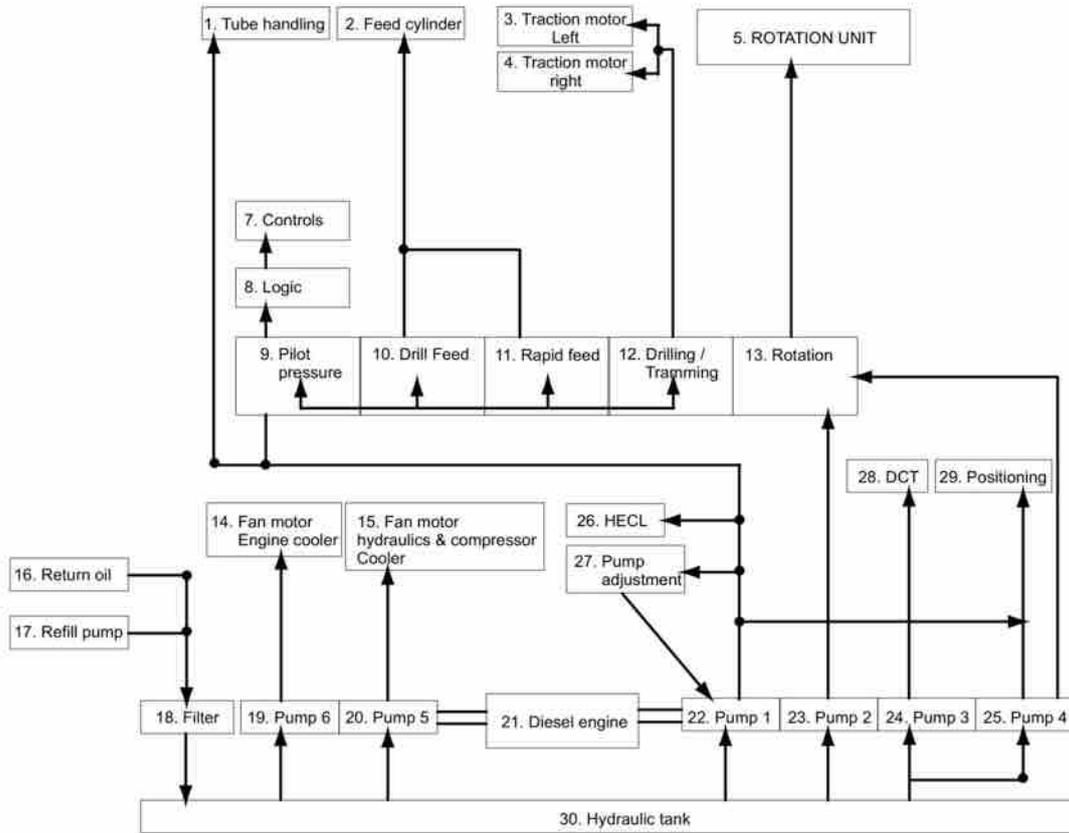
| Pump no. | Description |
|----------|---|
| 1 | Drill feed, rapid feed, traction motors, rod handling and cylinder positioning. |
| 2 | Rotation unit |
| 3 | Dust collector |
| 4 | Cylinder positioning, rotation unit |
| 5 | Cooler motor for compressor and hydraulic oil |
| 6 | Cooler motor, diesel engine coolant |

Table 2: Hydraulic pumps

The hydraulic oil reservoir is located on the left-hand side of the drill rig.

The coolers are located at the rear of the wagon.

(For further details, see separate hydraulic system drawing.)



Hydraulic system functions

| | |
|----|----------------------------|
| 1 | Rod handling |
| 2 | Feed cylinder |
| 3 | Traction motor, left |
| 4 | Traction motor, right |
| 5 | Rotation unit |
| 7 | Controls |
| 8 | Logic valves |
| 9 | Pilot pressure |
| 10 | Drill feed |
| 11 | Rapid feed |
| 12 | Drilling/tramming |
| 13 | Rotation |
| 14 | Fan motor, engine radiator |
| 15 | Fan motor, oil cooler |
| 16 | Return oil |
| 17 | Filler pump |
| 18 | Filter |

| | |
|----|----------------|
| 19 | Pump 6 |
| 20 | Pump 5 |
| 21 | Diesel engine |
| 22 | Pump 1 |
| 23 | Pump 2 |
| 24 | Pump 3 |
| 25 | Pump 4 |
| 26 | Hydraulic tank |

2.4.9 Air system

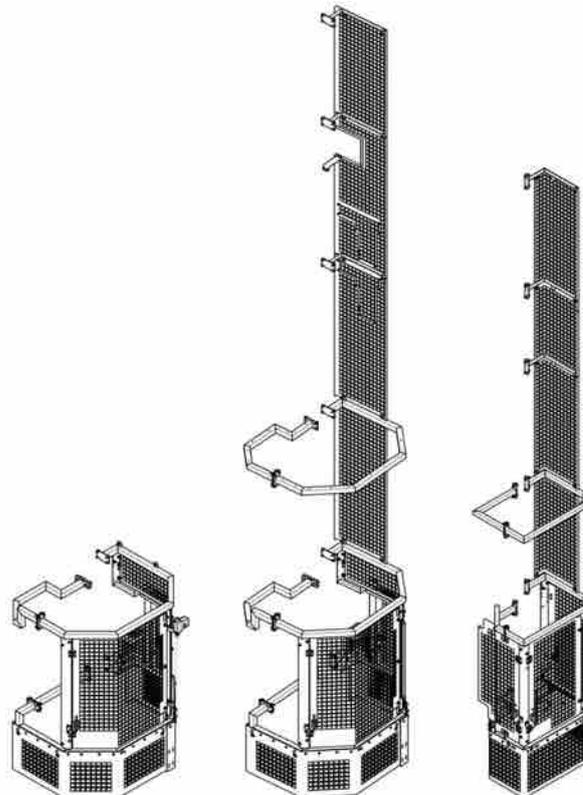
The air system consists of the compressor with oil separator, hoses and valves.

The compressor is driven directly by the diesel engine

The compressor element is lubricated by an air-oil mixture. The mixture is separated in the oil separator.

The system supplies air to the down-the-hole rock drill and its lubricating system HECL and to the dust collector for cleaning the filter.

2.5 Protection of Moving Parts



Protection of moving parts is a steel structure fitted on the feeder. The protection provides increased safety when the machine is operating.



NOTE: *The protection does not affect drilling and must be closed during operation.*

3 Technical data

3.1 SmartROC D65 (Tier 4)

3.1.1 Weight (with drill strings)

| Description | Data | |
|------------------|--------------------------------|-----------|
| SmartROC D65/D60 | Weight Long Feed Tier 4 Final | 27 000 kg |
| | Weight Short Feed Tier 4 Final | 25 700 kg |
| | Weight Long Feed Tier 3 | 26 600 kg |
| | Weight Short Feed Tier 3 | 25 300 kg |



NOTE: With wide body kit + 700 kg

NOTE: With RC kit + 1200 kg

3.1.2 Performance

| Description | Data | |
|---|--|-------------|
| Diesel engine Caterpillar C15 | power output at 1800 rpm SmartROC D65 - 402 kW SmartROC D60 - 354 kW | |
| Temperature range in operation | -25 to +50°/55°C | |
| Tramming speed, max. | 3.2 km/h | |
| Tractive force | 138 kN | |
| Ground clearance | 405 mm | |
| Max. hydraulic pressure | 250 bar | |
| Track oscillation (Forward/rearward) | 10° /10° | |
| Noise level (inside cabin) | <85 dB(A) | |
| Noise level (outside cabin) | Idling speed | 115.5 dB(A) |
| | Full engine speed | 115 dB(A) |
| | Drilling | 127 dB(A) |
| Vibration in operator's seat during drilling (weighted average) | 0.18 m/s ² | |

3.1.3 Electrical system

| Description | | Data |
|-------------|----------|-----------------|
| Voltage | | 24 V |
| Battery | Capacity | 2 * 12 V/230 Ah |
| Work lights | Front | 4 * 70W |
| | Rear | 2 * 70W |
| | Roof | 1 * 70W |
| | Feeder | 2 * 70W |

3.1.4 Air system

| Description | | Data |
|-------------------|-----------------------------|---------|
| Compressor XRX 10 | Max. air pressure | 30 bar |
| | Free air delivery at 30 bar | 470 l/s |

3.1.5 Capacities

| Description | | Data |
|-----------------------|-------------------------|--------|
| Hydraulic systems | Hydraulic oil reservoir | 380 L |
| | Hydraulic system, total | 515 L |
| Fuel tank | | 1050 L |
| Traction gear | | 3 L |
| Compressor oil | | 63 L |
| Lubricating oil tank | | 20 L |
| Diesel engine oil | | 42 L |
| Engine cooling system | | 68 L |

3.1.6 Air conditioning unit

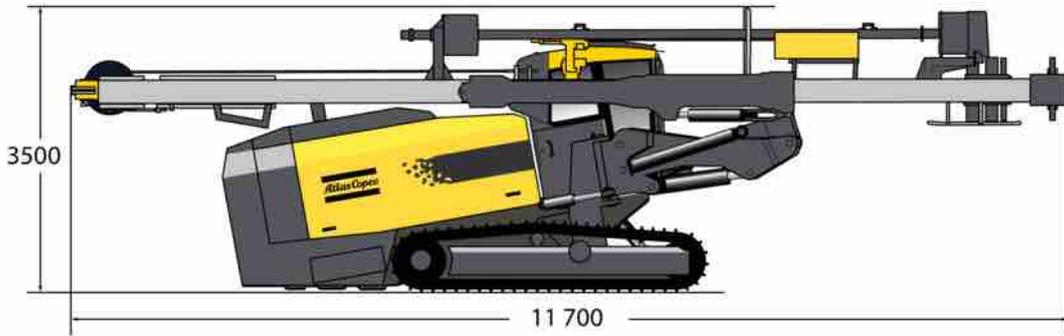
| Description | | Data |
|-------------|-------------------|-------|
| Red Dot | Refrigerant, type | R134A |

3.1.7 Miscellaneous

| Description | | Data |
|-------------------|--------------|----------|
| Fire extinguisher | A-B-C powder | 2 * 6 kg |

3.2 Dimensions

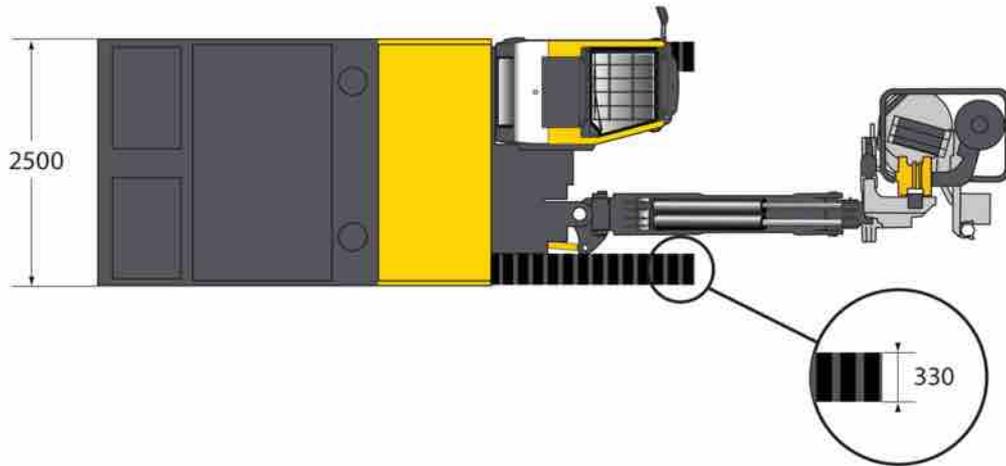
3.2.1 Dimensions SmartROC D65 Long feed (Tier 4)



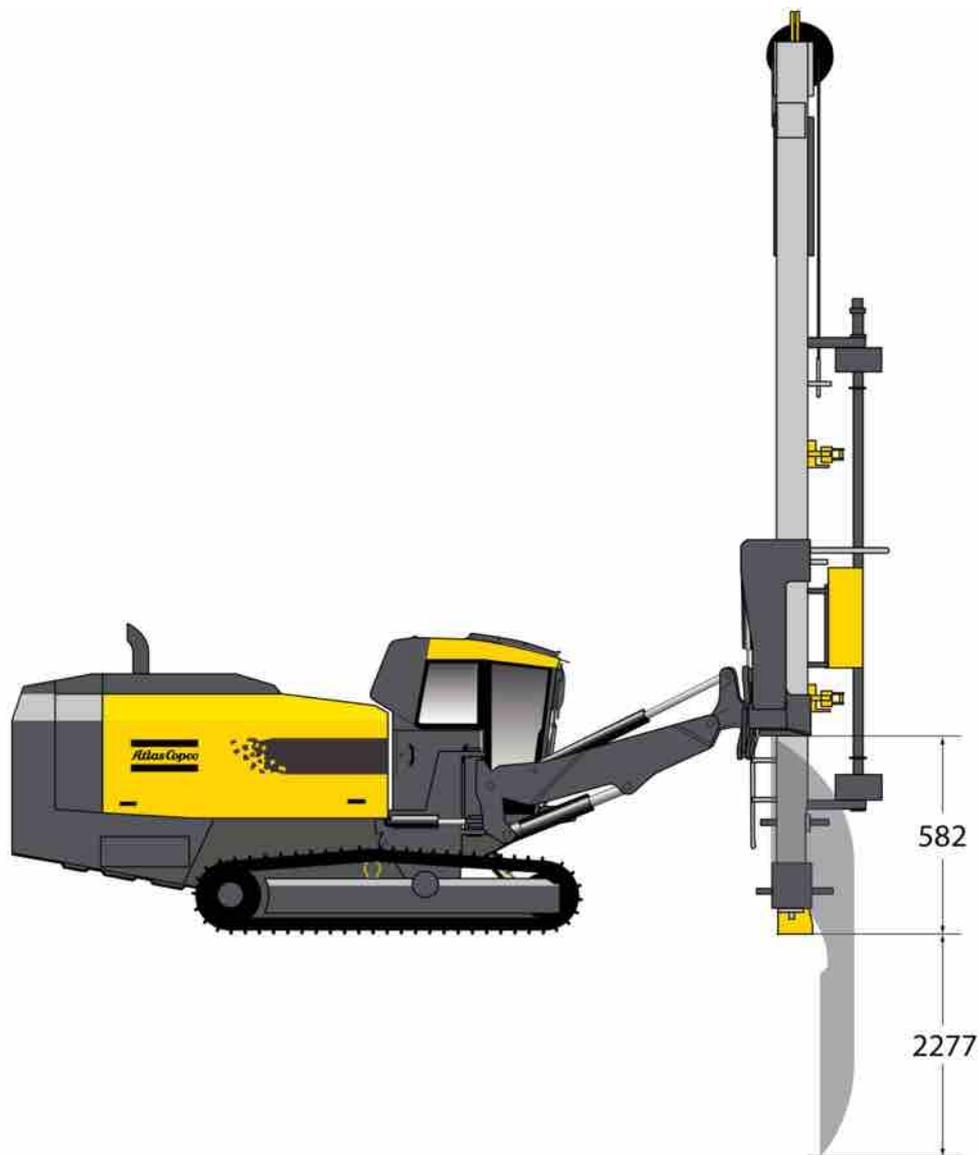
Transport dimensions



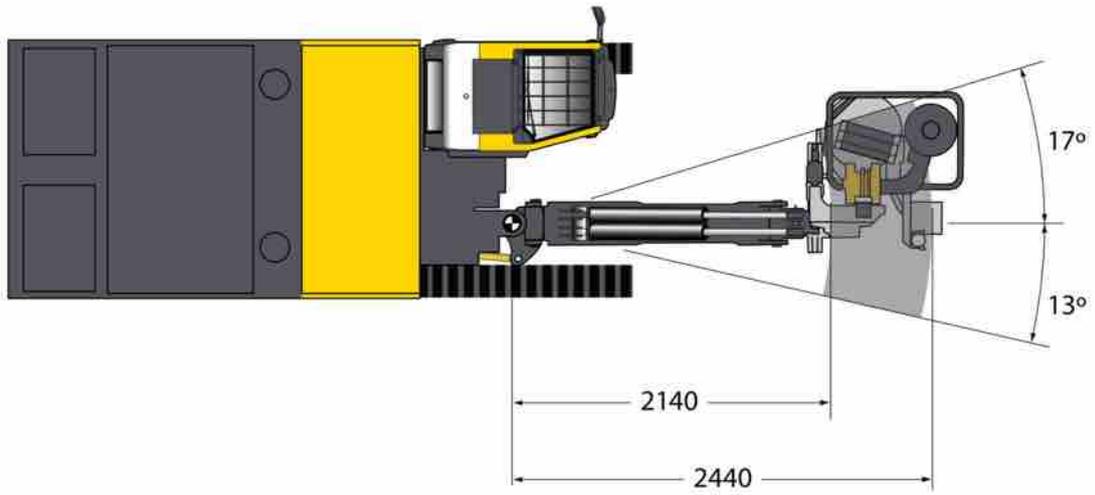
Measured from the side



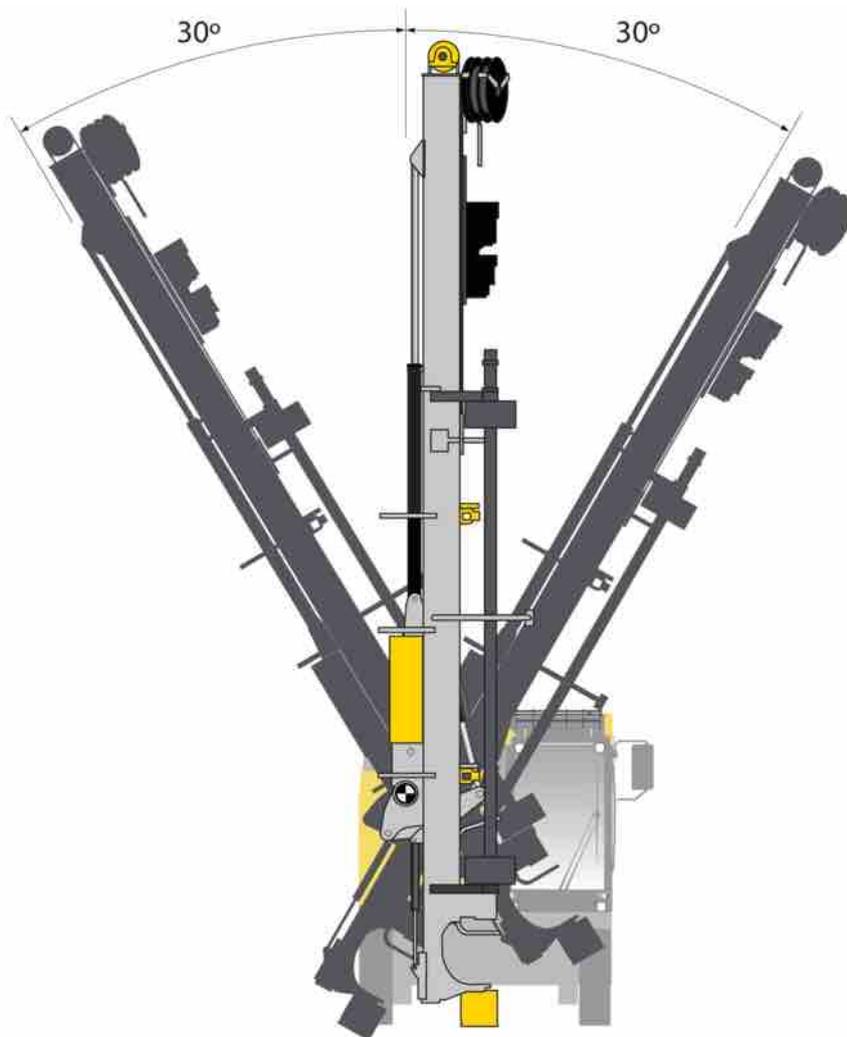
Measured from above



Coverage area from the side

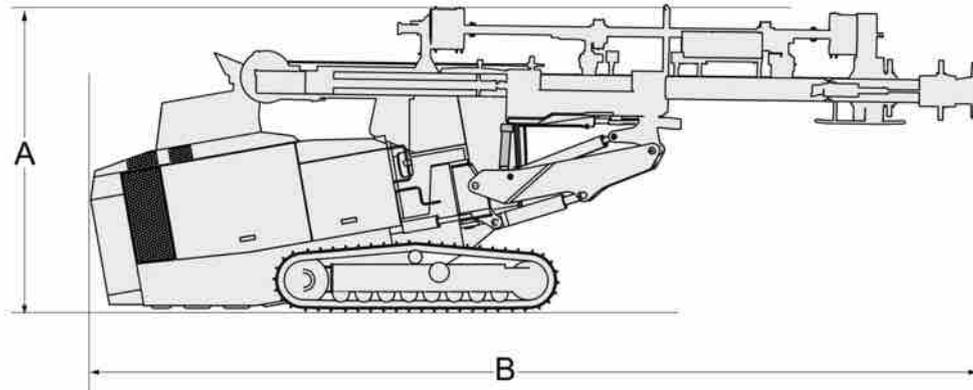


Coverage area from above



Feeder angles of inclination

3.2.2 Dimensions SmartROC D65 Short feed (Tier 4)

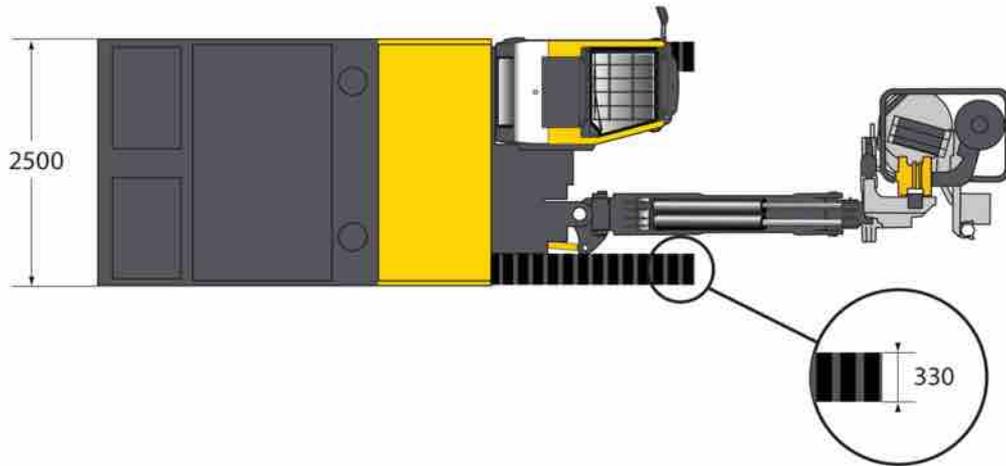


Transport dimensions

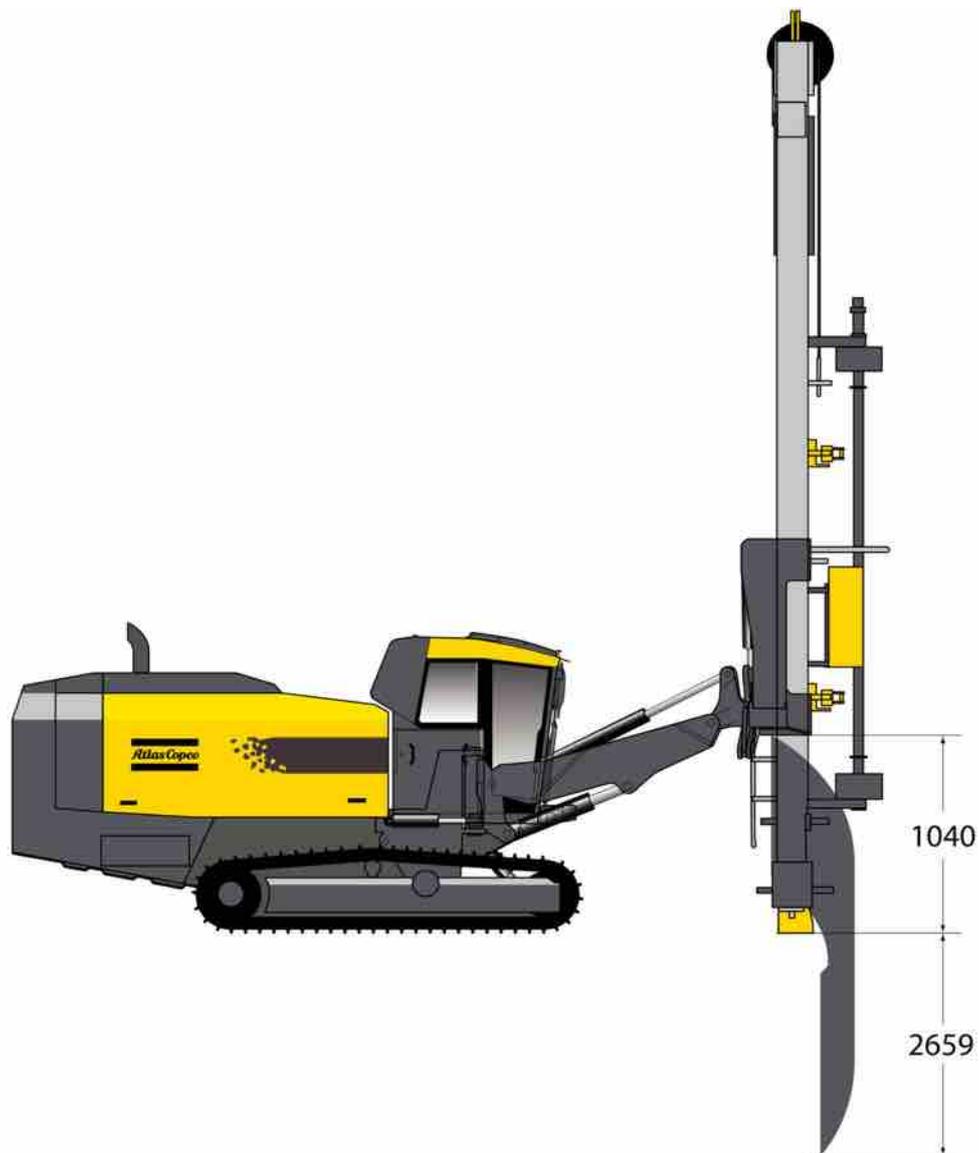
| | |
|---|------|
| A | 3.4 |
| B | 10.7 |



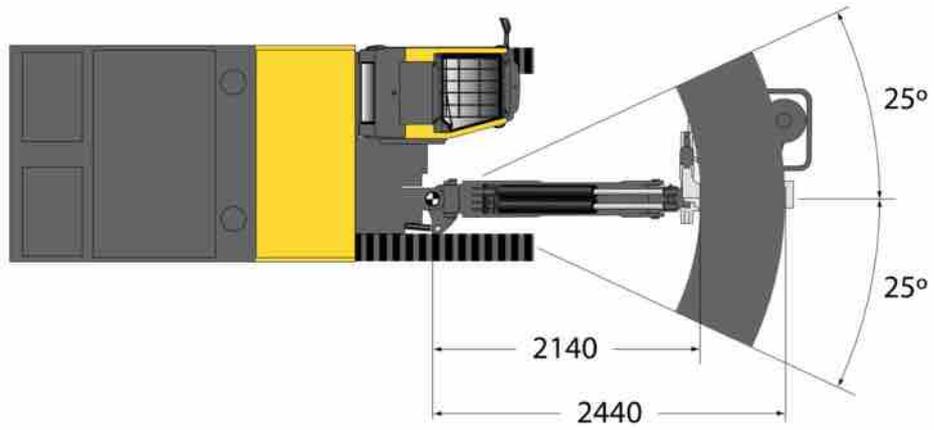
Measured from the side



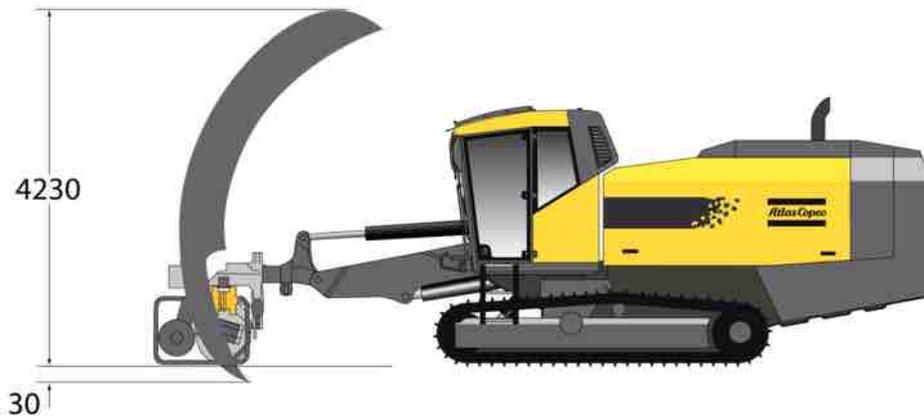
Measured from above



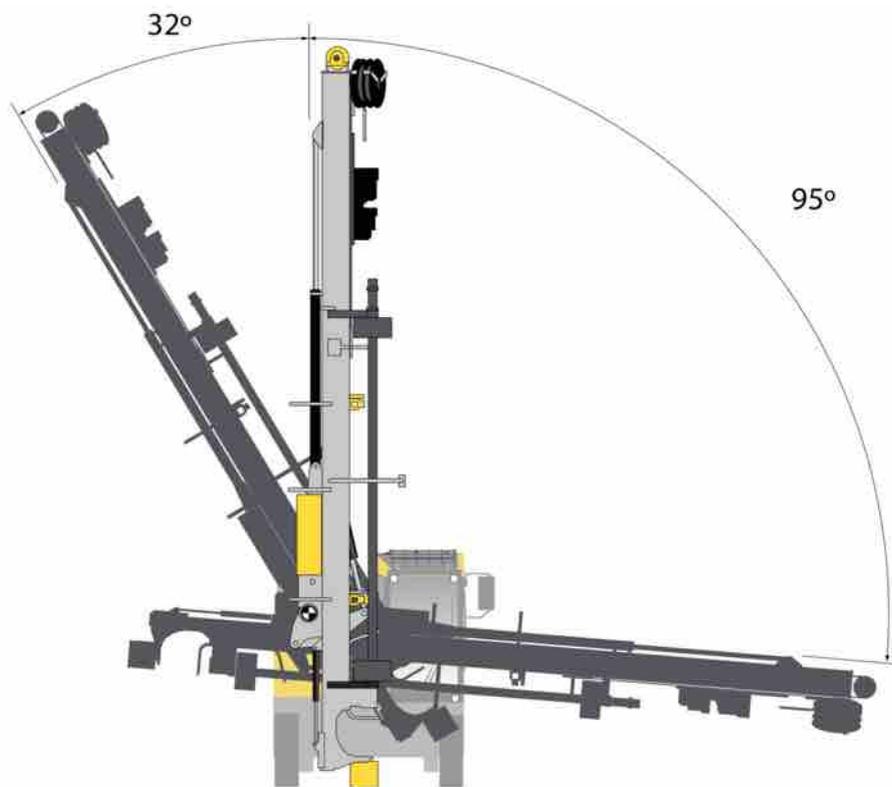
Coverage area from the side



Coverage area from above



Coverage area for bottom-hole drilling (extra equipment for short feeder)



Feeder angles of inclination with extra equipment for bottom-hole drilling (only for short feeder)

4 Daily checks

4.1 Foreword

This chapter provides instructions for daily inspection and maintenance to be carried out by the operator before each shift.

Regarding weekly inspections and other maintenance tasks, see separate instructions "**Maintenance schedules**".

4.2 Extra safety check

4.2.1 Safety

DANGER

Serious injury or death

Danger of moving parts

- ▶ Risk of serious personal injury
- ▶ Set all levers and switches in neutral position before preparing start-up
- ▶ Perform the extra safety check without the engine running

DANGER

Serious injury or death

The side hatches on the drill rig are not dimensioned for extra weight

- ▶ Risk of serious personal injury
- ▶ Standing, sitting or leaning on the side hatches can result in serious injury
- ▶ The side hatches must be closed when work is carried out on top of the rig

WARNING

Serious injury

Very high exhaust temperatures

- ▶ May cause serious personal injury and damage to property
- ▶ Always check that the rig is positioned so that fire or other damage cannot occur when regeneration is in progress

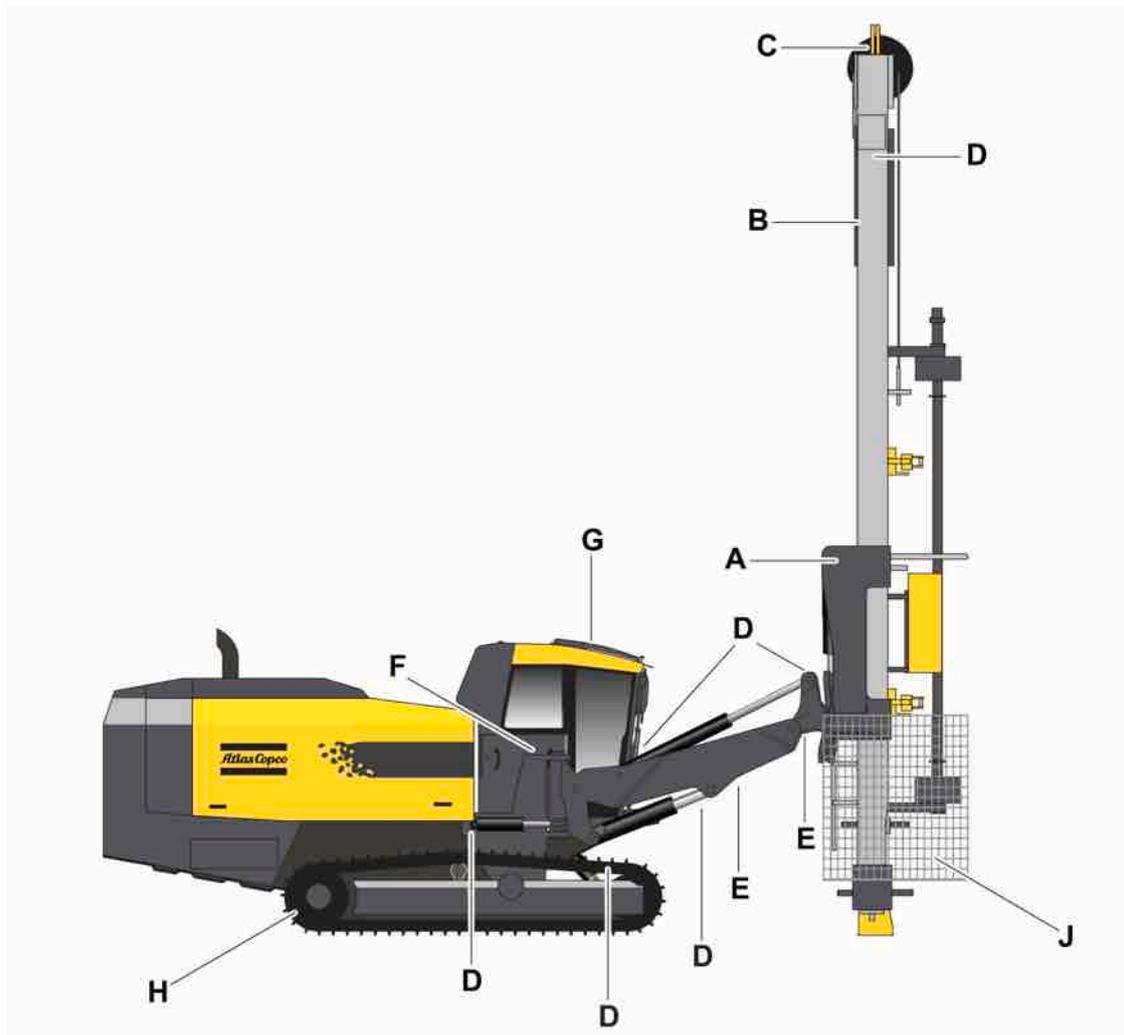
Visual check

Before each shift starts an extra and thorough visual safety check should be carried out in order to detect:

- Damage that could give rise to structural weakness or cracks.
- Wear that could have the same consequences.
- Cracks or fractures in materials or welded joints.

If the drill rig has been subjected to abnormally high stresses, vital load-bearing components may have been damaged. From a safety viewpoint, it is therefore especially important to check the following points (see illustration: Check points).

4.2.2 Checklist



Checklist

| | |
|---|--------------------------------|
| A | Feed holder with brackets |
| B | Feed chain with attachments |
| C | Hose drum with cradle |
| D | Cylinder brackets |
| E | Boom/boom head |
| F | Boom support with pivot |
| G | Operator's cabin with brackets |

Checklist

| | |
|---|---|
| H | Track frames with attachments |
| J | Protection of moving parts with attachments |

4.3 Before starting

4.3.1 Safety

 WARNING**Serious injury**

Danger of moving parts

- ▶ Can cause serious personal injury
- ▶ Set all levers and switches in NEUTRAL position before start-up preparations
- ▶ Carry out the procedures with the engine switched off

 WARNING**Serious injury**

Dangerous compressed air

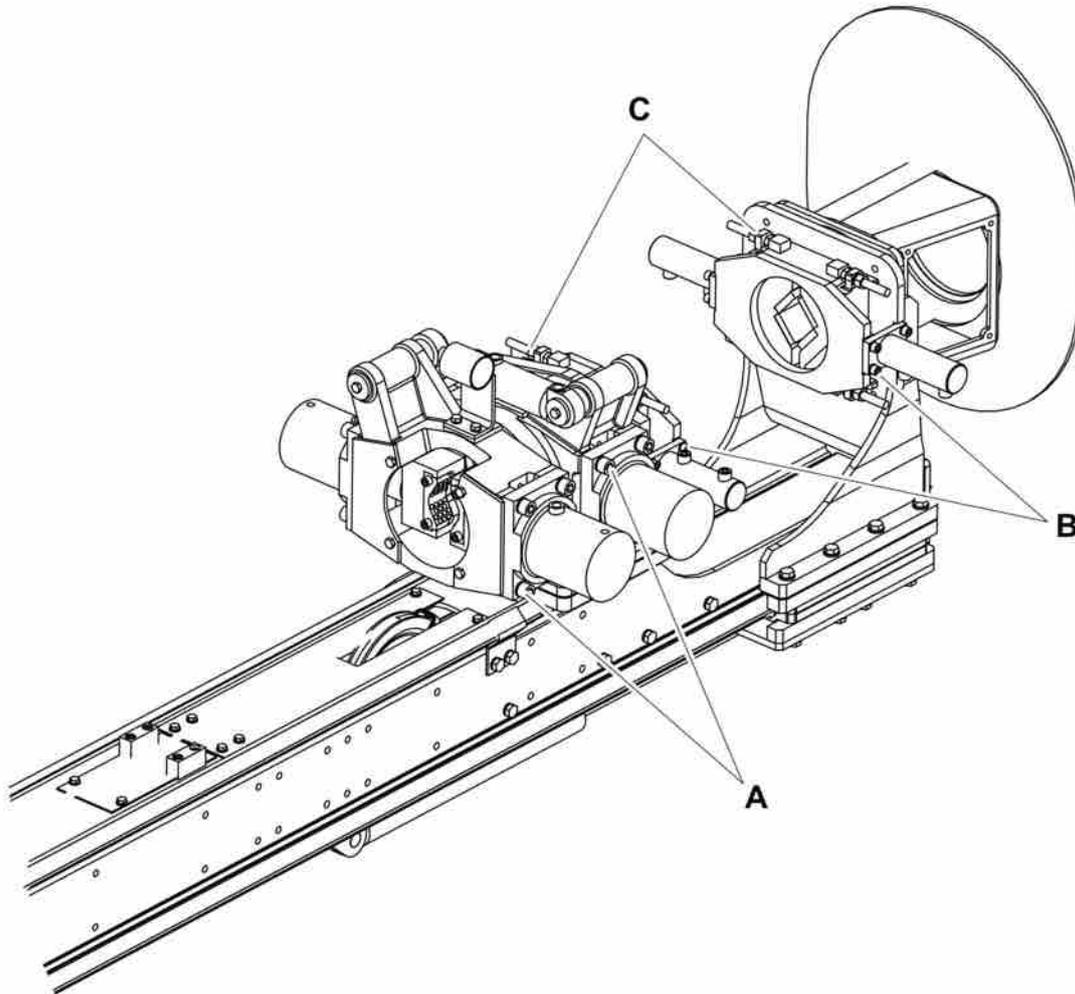
- ▶ Can cause serious injury
- ▶ Release the pressure in the tank before removing the filler plug

 WARNING**Serious injury**

Very high exhaust temperatures

- ▶ May cause serious personal injury and damage to property
- ▶ Always check that the rig is positioned so that fire or other damage cannot occur when regeneration is in progress

4.3.2 Breakout table/Rod guide



Breakout table/Rod guide

| Check point | Control object | Action |
|-------------|--|-------------------------------------|
| - | Grease nipples | Fill grease into the grease nipples |
| A | Cylinder bracket, breakout table | Check the torque, 600 Nm |
| B | Cylinder bracket, pipe guide | Check the torque, 120 Nm |
| C | Lock nut for adjusting screw, pipe guide | Check the torque, 185 Nm |

Table 3: Breakout table/Rod guide



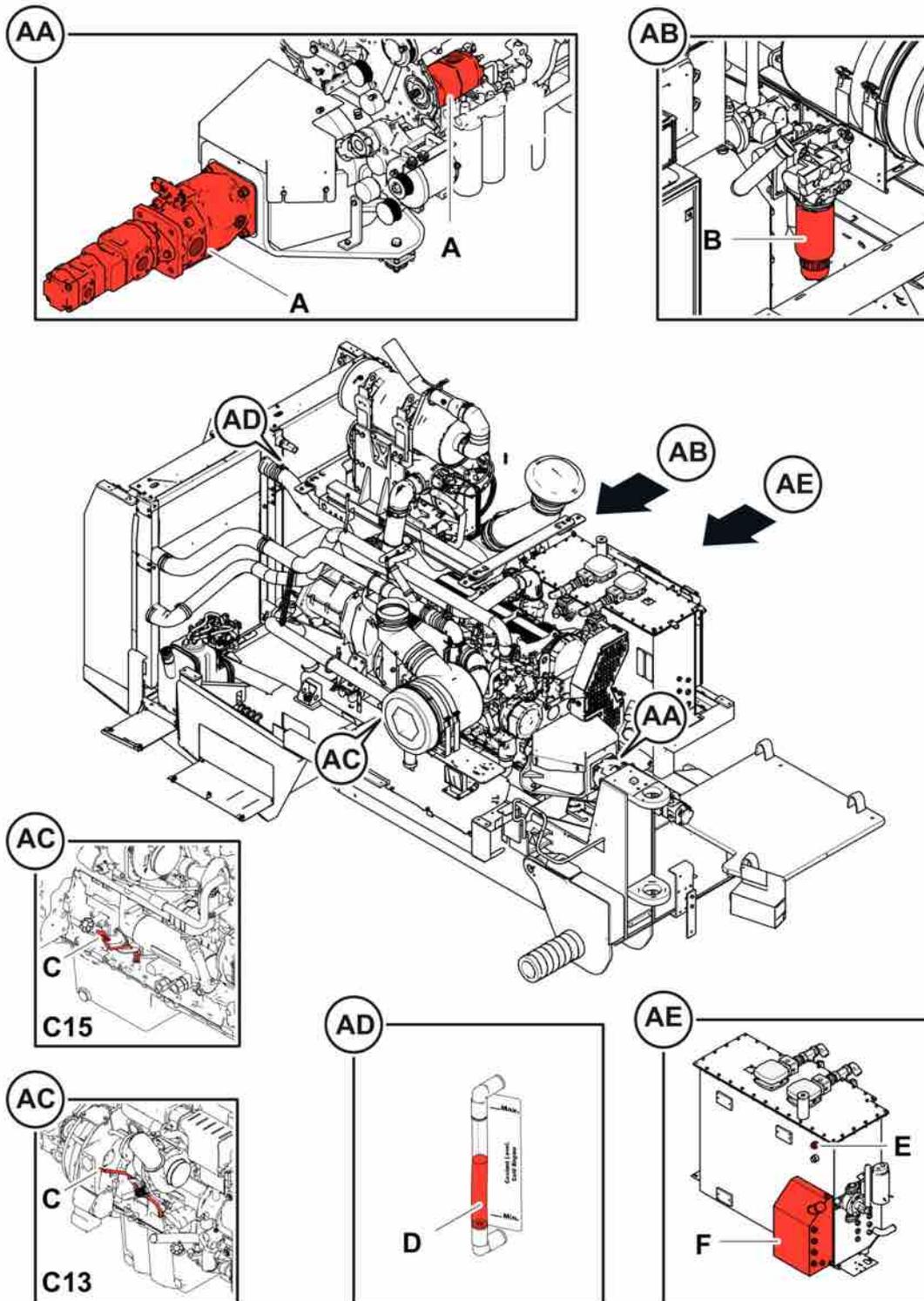
NOTE: If central lubrication is installed then the function and connections must be checked.

4.3.3 Drill rig.

| Check point | Inspection | Instructions |
|-------------|--------------|---|
| Drill rig. | Visual check | Check for any signs of leaks, damage, breakage or cracks. |

Table 4: Drill rig.

4.3.4 Engine Package



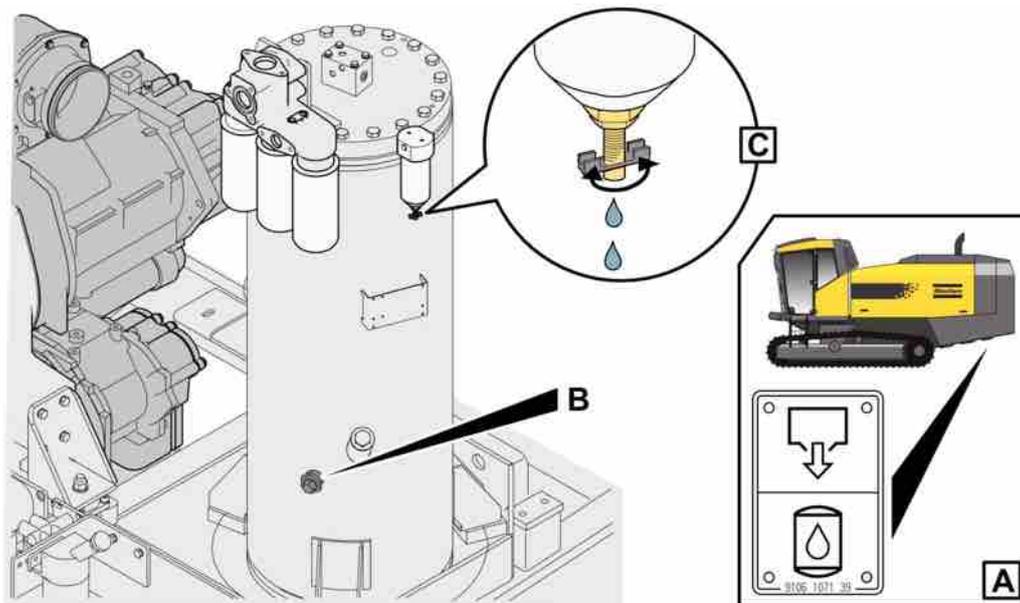
Engine Package

| Check point | Control object | Action |
|-------------|-------------------|--|
| - | Engine/Compressor | Check for leakage around the engine and compressor |
| A | Hydraulic pumps | Check for signs of leakage |
| B | Fuel prefilter | Drain off water |

| Check point | Control object | Action |
|-------------|--|---|
| C | Oil level in diesel engine | The oil must be between the two marks on the dipstick |
| D | Coolant | Check level |
| E | Hydraulic oil | Check level |
| F | Lubricating oil HECL/ECL/ECG | Check level |
| - | Grease for central lubrication (extra equipment) | Check level |
| - | Grease for thread lubrication (extra equipment) | Check level |

Table 5: Engine Package

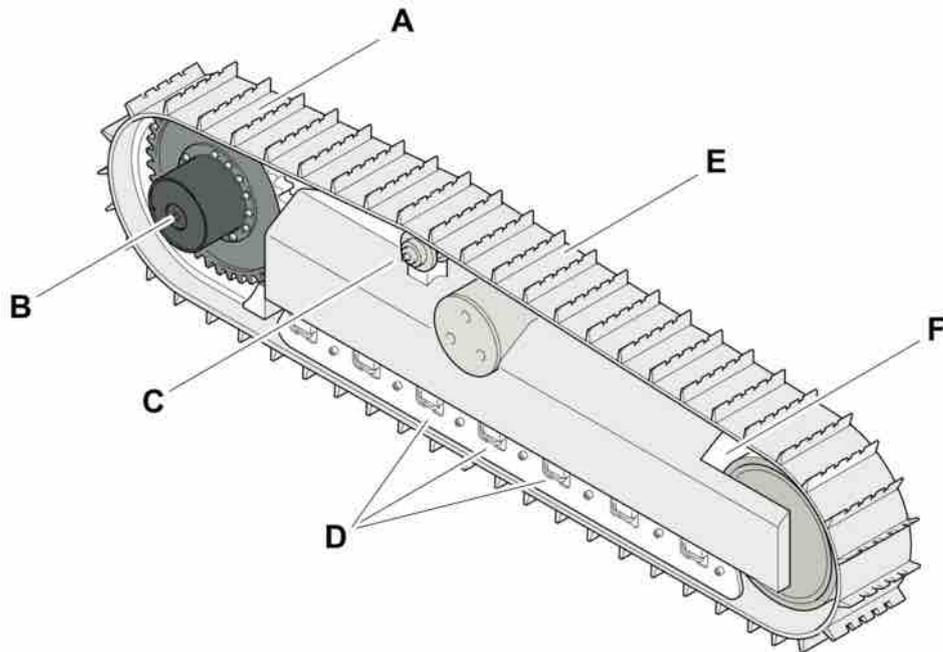
4.3.5 Compressor tank



| Check point | Control object | Action |
|-------------|----------------------------------|---|
| A | Tank, draining | Open drain plug (A). Drain the water. The drill rig must have been standing still for one hour before the water can be drained. |
| B | Tank, oil level | Check the oil level. The gauge must be in the green zone. The drill rig must be level and must have been standing still for 10 minutes before checking. |
| C | Water separator filter, draining | Open the drain valve. Drain the water. Close the drain valve. |

Table 6: Compressor tank

4.3.6 Track frames

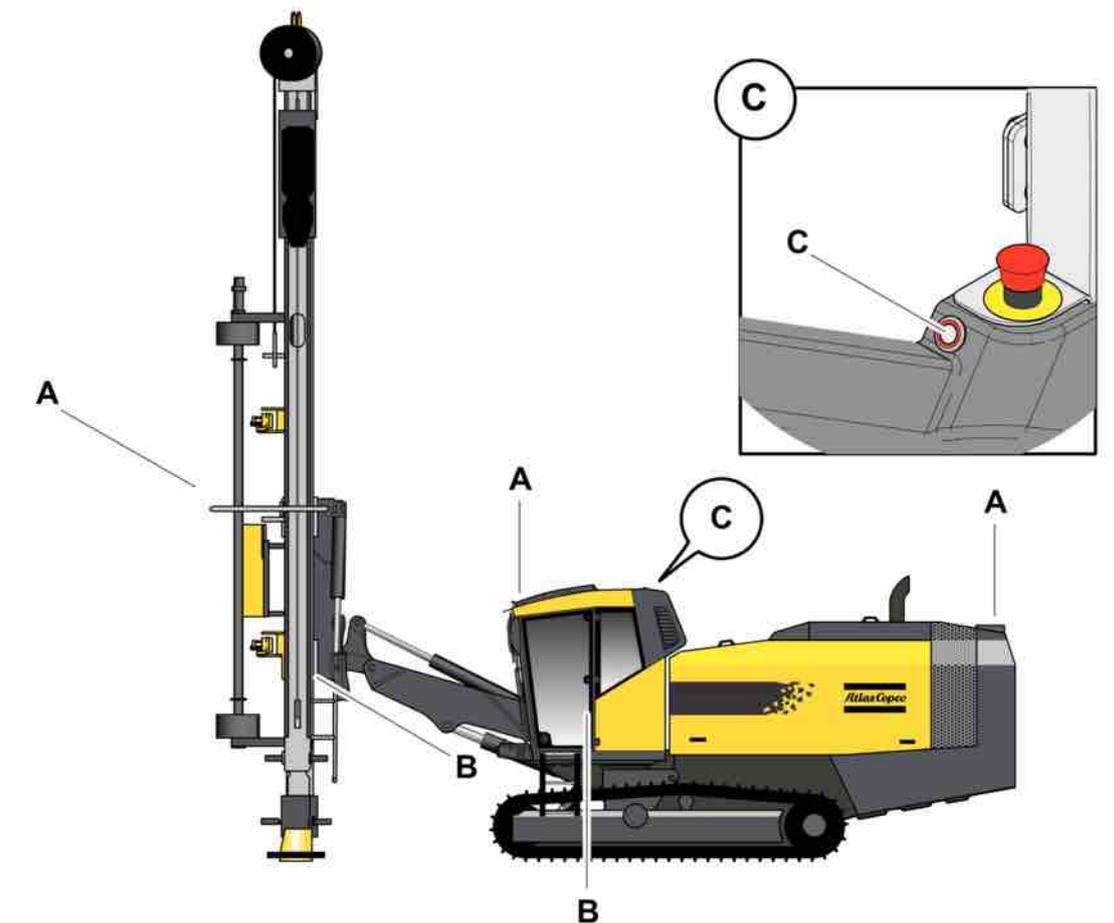


Track frames

| Check point | Control object | Action |
|-------------|-----------------|---|
| A | Traction motors | Check for signs of leakage. |
| B | Traction gears | Check for signs of leakage. |
| C | Limberoller | Check for signs of leakage. |
| D | Track roller | Check for signs of leakage. |
| E | Crawler tracks | Check the tension, visual inspection. |
| F | Front wheel | Check that springs and dampeners move freely. Clean if necessary. |
| - | Bolted joints | Check for loose screws and nuts. |

Table 7: Track frames

4.3.7 Electrical system



Electrical system

| Check point | Control object | Action |
|-------------|-----------------------------|--|
| A | Work lights | Front, rear and on feeder. Function |
| B, C | Emergency stop buttons/Wire | Attachment. Check each emergency stop button individually. The engine must stop. Before you check the next emergency stop button the previous button must be reset before restarting. There is an additional emergency stop reset button in the cabin (c) that must be depressed in order to reset the system. If the engine is hot, there is a risk of damaging the DEF injector by activating each respective emergency stop button. In this case, the engine must be restarted immediately after each emergency stop button is depressed. |

Table 8: Electrical system

4.4 Functionality test after start

4.4.1 Checks



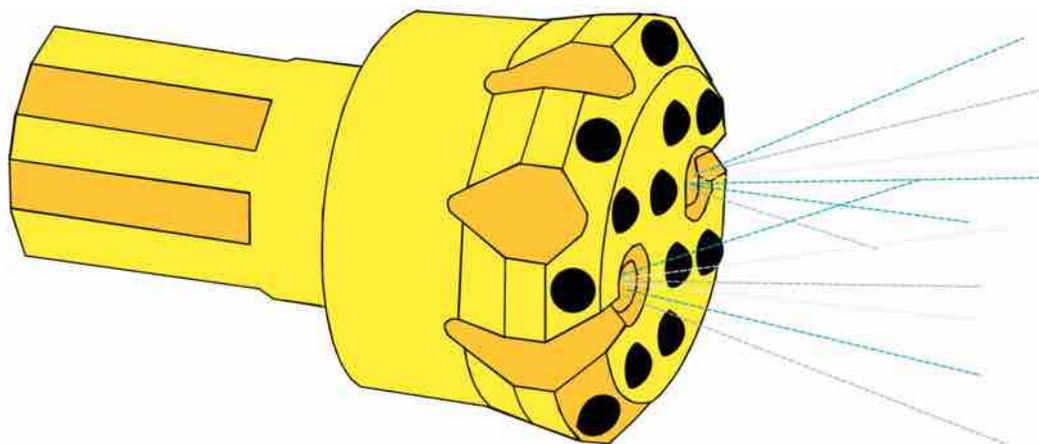
NOTE: The emergency stop buttons and wires must be checked before each shift and after tramping.

| Check point | Inspection | Instructions |
|--|--------------|---|
| Emergency stop buttons (all) and the emergency stop wire on the feed beam. | Function | <p>Check each emergency stop button individually. The diesel engine must stop!</p> <p>Between testing each emergency stop, the previous stop must be reset before restarting the rig. For the location of the stops, see "Safety"</p> |
| Display for engine and directional instruments | Visual check | <p>Check that none of the fault indicator symbols is on. If a fault is indicated in the status bar, stop the unit and rectify the fault.</p> |

Table 9: Checks.

4.5 Function test while drilling

4.5.1 Down-the-hole rock drill (DTH)



The down-the-hole rock drill's drill bit

| Check point | Inspection | Instructions |
|--------------------------------|------------|--|
| Down-the-hole rock drill (DTH) | Function | <p>Lubrication oil should seep out of the drill bit. Place a plank in front of the drill bit and activate air flushing. The plank should become oily after a short time.</p> |

Table 10: Down-the-hole rock drill.

4.5.2 Display



Display.

| Check point | Inspection | Instructions |
|-------------|--------------|--|
| Display | Visual check | Check that no fault indicator symbols are shown. If a fault indicator shows in the status field, stop the drill rig and rectify the fault. |

Table 11: Display.

4.5.3 Dust collector (DCT)

| Check point | Inspection | Instructions |
|----------------------|-------------------------------------|--|
| Dust collector (DCT) | Suction ability and filter cleaning | In case of dust formation: Check the filter in the filter holder and suction hose and also the drill-steel support's drill gasket. |

Table 12: Dust collector (DCT).

4.5.4 Drill rig

| Check point | Inspection | Instructions |
|-------------|--------------|---|
| Drill rig | Visual check | Look for any signs of leaks. -Hydraulic systems -Fuel system -Cooling system |

| Check point | Inspection | Instructions |
|-------------|------------|--------------|
| | | -Compressor |

Table 13: Drill rig.

4.6 Cleaning the rig

4.6.1 Rinsing

The rig must be flushed with water at least once a day since it is important to remove drill cuttings, mud and dirt. The feeder, front part of the boom and crawler tracks are particularly important to keep clean.

5 Controls

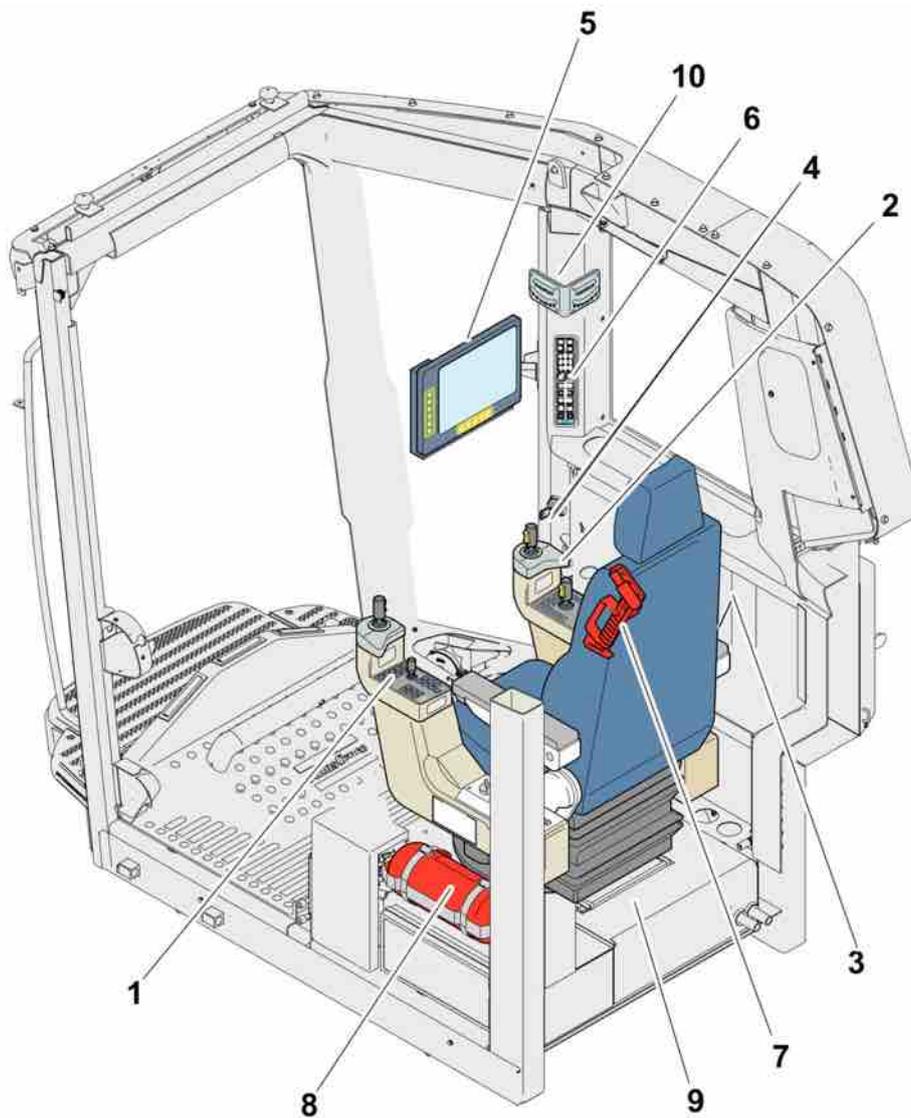
5.1 Control

5.1.1 General

The controls and gauges for operating the drill rig are located inside the operator's cabin.

The equipment for filling up with fuel, hydraulic oil and compressor oil is located close to the appropriate tanks.

5.1.2 Cabin

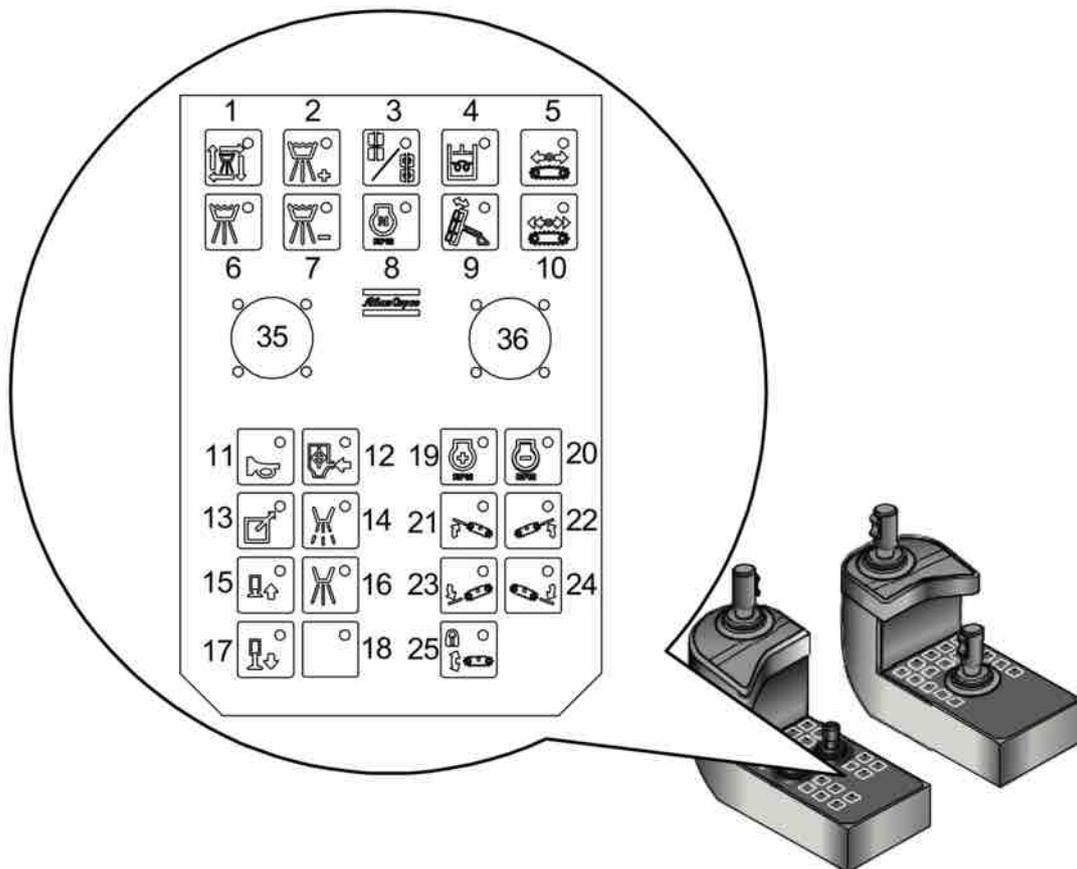


Cabin

| | |
|---|---------------------|
| 1 | Left control panel |
| 2 | Right control panel |

| | |
|----|--|
| 3 | Tramming levers |
| 4 | Ignition key |
| 5 | Display |
| 6 | Operator's panel for operator's cabin |
| 7 | Hammer for emergencies |
| 8 | Fire extinguisher |
| 9 | Heater unit/Air conditioning (located in roof) |
| 10 | Gradient meter |

5.1.3 Left control panel

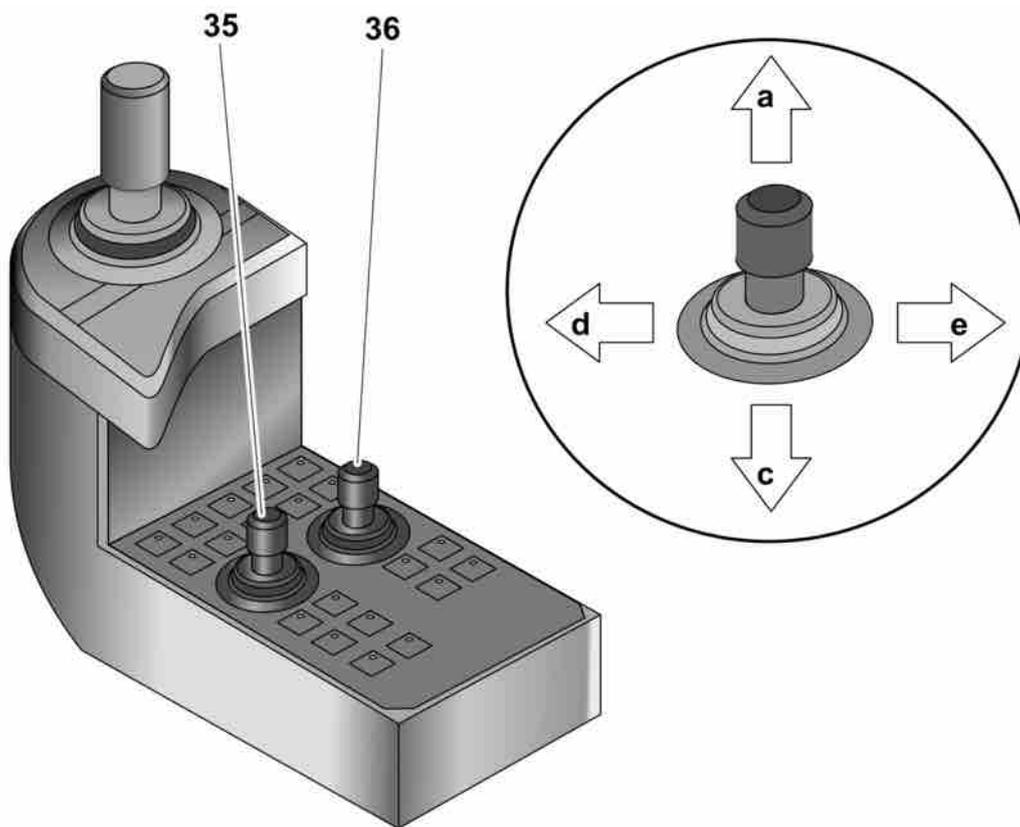


Left control panel

| | |
|---|---|
| 1 | Watermist system, auto |
| 2 | Watermist system, increase of the water amount in auto mode |
| 3 | Function switching for lever 36, breaker jaws/drill-steel support |
| 4 | Heating of hydraulic oil |
| 5 | Tramming Low Speed |

| | |
|----|---|
| 6 | Watermist system, max. |
| 7 | Watermist system, decrease of the water amount in auto mode |
| 8 | Idling speed (1100 rpm) |
| 9 | Not activated |
| 10 | Tramming High Speed |
| 11 | Signal Horn |
| 12 | DCT ON/OFF |
| 13 | Not used |
| 14 | Reduced flushing air |
| 15 | Jack in (with a double press of the button the jack automatically retracts all the way) |
| 16 | Full flushing air |
| 17 | Jack out |
| 18 | Not activated |
| 19 | Rev up diesel engine (between 1500-1800 rpm) |
| 20 | Rev down diesel engine (between 1500-1800 rpm) |
| 21 | Left track oscillation (forward) |
| 22 | Right Track Oscillation (Forward) |
| 23 | Left track oscillation (reverse) |
| 24 | Right track oscillation (reverse) |
| 25 | Track Oscillation Lock |
| 35 | Rod handling |
| 36 | Suction hood/Drill-steel support/Break table |

Levers for rod handling (RHS) and suction hood/drill-steel support/break table



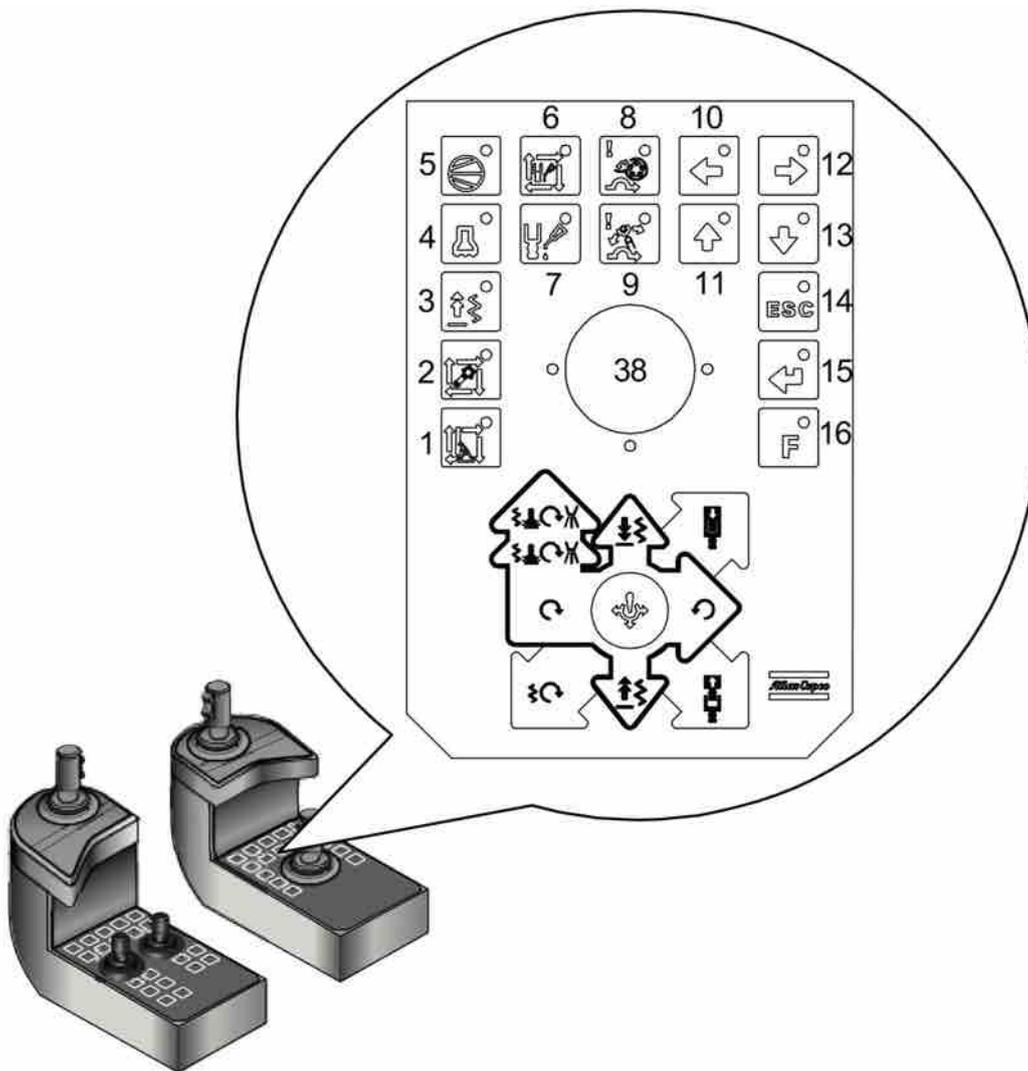
Levers for rod handling and suction hood (left control panel).

| | | |
|----|---|---|
| 35 | | Lever for Rod handling |
| | a | Rod to carousel |
| | b | Neutral (lever in centre position) |
| | c | Rod to drill centre |
| | d | Carousel rotation (Clockwise) |
| | e | Carousel rotation (Anticlockwise) |
| | | Push button on top of lever |
| | | Depressed: Open gripper |
| | | Not depressed: Closed gripper |
| 36 | | Suction hood/Drill-steel support, button 3 activated |
| | a | Upper drill-steel support (closed) |
| | b | Neutral (lever in centre position) |

| | | |
|----|---|------------------------------------|
| | c | Upper drill-steel support (open) |
| | d | Suction hood - Down |
| | e | Suction hood - Up |
| | Movement with depressed top button | |
| | a | Lower drill-steel support (closed) |
| | b | Neutral (lever in centre position) |
| | c | Lower drill-steel support (open) |
| | d | Not used |
| | e | Not used |
| 36 | Break table , button 3 not activated | |
| | a | Upper break table (Close) |
| | b | Neutral (lever in centre position) |
| | c | Upper break table (Open) |
| | d | Suction hood - Down |
| | e | Suction hood - Up |
| | Movement with depressed top button | |
| | a | Lower break table (Close) |
| | b | Neutral (lever in centre position) |
| | c | Lower break table (Open) |
| | d | Not used |
| | e | Semi-automatic breaking |

Table 14: Levers for rod handling and suction hood.

5.1.4 Right control panel

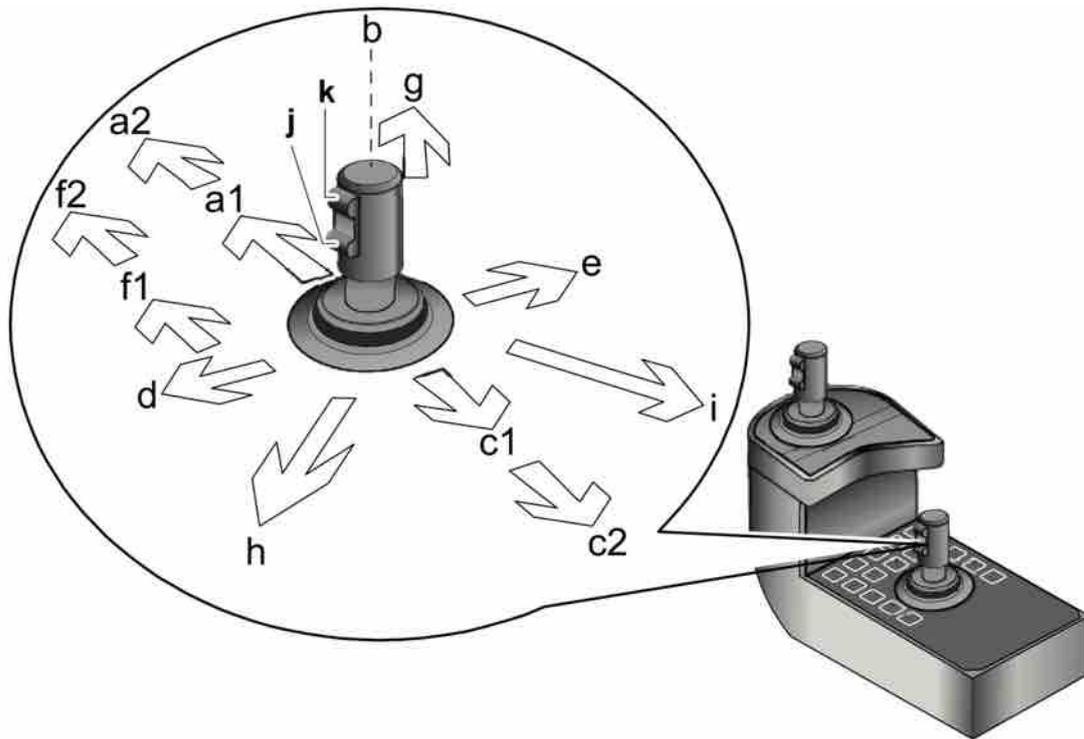


Right control panel

| | |
|-------|---|
| 1 | Semi-automatic boom positioning (option) |
| 2 | Automatic rod handling/Automatic collaring (Option) |
| 3 | Rapid Feed Stop (Software stop for break table activated) |
| 4 | Drilling position |
| 5 | Compressor loading |
| 6 | Automatic thread lubrication (Option) |
| 7 | Thread lubrication (Option) |
| 8 | Emergency operation of carousel gate |
| 9 | Emergency operation of gripper claws with lever 35 |
| 10-13 | Arrow keys for tramming cursor on display |

| | |
|----|--|
| 14 | Escape (Exit menu on display) |
| 15 | Enter (Confirm selection) |
| 16 | Browse button (Browse between menus F1 - F5) |
| 38 | Drill Lever |

Drill lever functions



Drill lever (38) functions

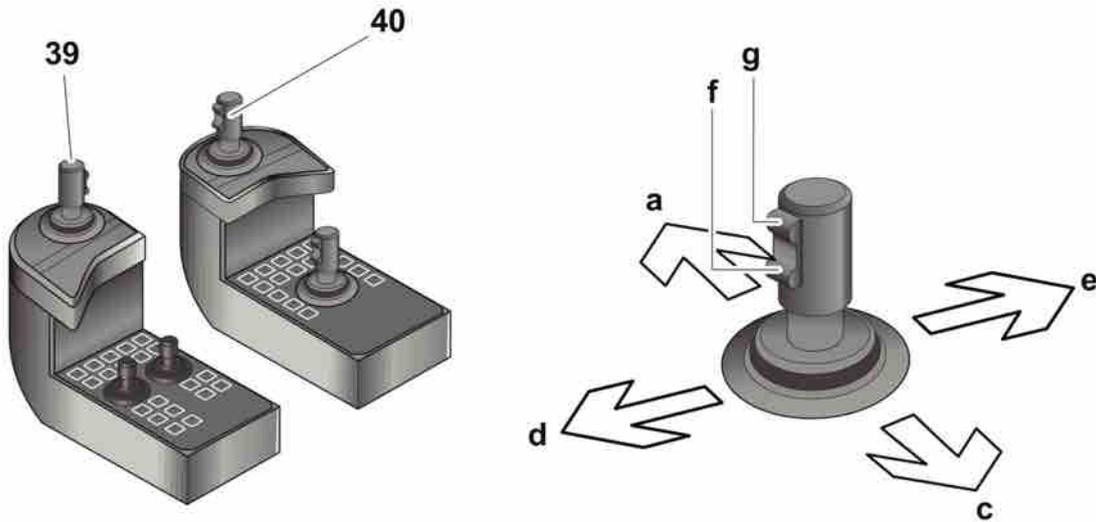
| | |
|----|------------------------------------|
| a1 | Drill feed |
| a2 | Rapid feed down |
| b | Neutral |
| c1 | Drill feed |
| c2 | Rapid feed up |
| d | Rotation |
| e | Counter clock wise rotation |
| f1 | Reduced auto-drilling |
| f2 | Full auto-drilling |
| g | Threading |
| h | Rotation/Flushing air/Feed/Reverse |
| i | Unthreading |
| j | Interrupt drilling |

k

locking collaring

! *NOTE: For a more detailed description, see "Maintenance instructions".*
NOTE: To change between reduced drilling and full drilling move the lever to F2

5.1.5 Boom and feed handling levers

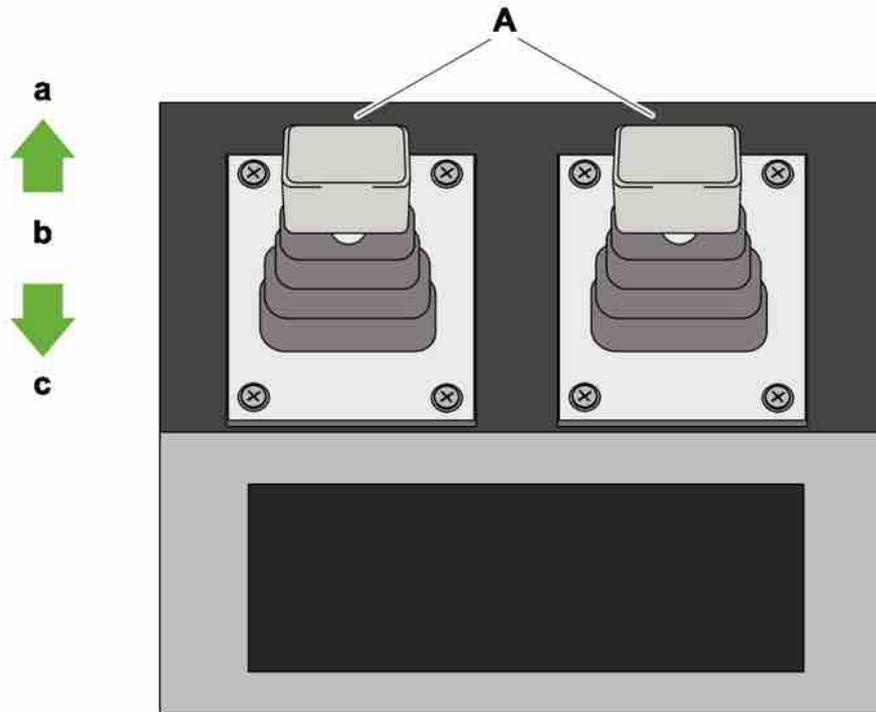


Boom and feeder control levers.

| | | |
|----|---|--|
| 39 | | Lever for Boom positioning |
| | a | Boom lowering |
| | b | Neutral |
| | c | Boom lift |
| | d | Boom swing (left) |
| | e | Boom swing (right) |
| | f | Boom extension (Out) (does not apply to Smart ROC D65) |
| | g | Boom extension (In) (does not apply to Smart ROC D65) |
| 40 | | Lever for Feeder positioning |
| | a | Feed tilt (spike forward) |
| | b | Neutral |
| | c | Feed tilt (spike rearward) |
| | d | Feed swing (left) |
| | e | Feed swing (right) |
| | f | Feed extension (down) |

g Feed extension (up)

5.1.6 Trimming levers



Trimming levers

| | |
|---|---------|
| a | Forward |
| b | Neutral |
| c | Reverse |

! ***NOTE:** If one crawler track is operated while the other is stationary the tracks are subjected to unnecessary stresses. This should therefore be avoided.*

5.1.7 Display



Display.

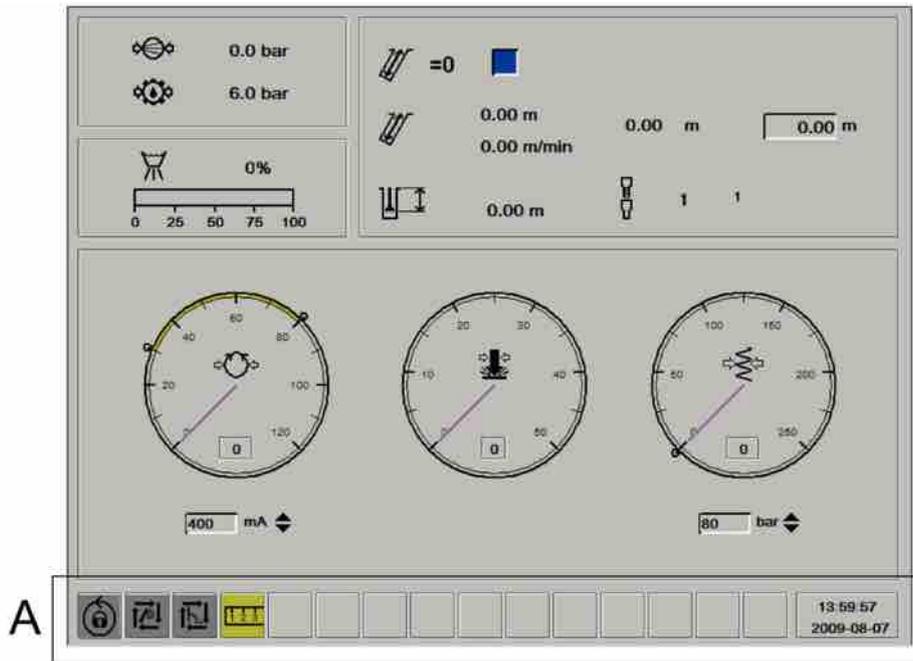
| Button | Description | Function |
|--------|---------------|---|
| ESC | Escape | Move one step to the right in the menu structure. |
| A | Left arrow | Move the cursor to the left of the display screen. |
| B | Arrow up | Move the cursor up on the display screen. |
| C | Arrow down | Move the cursor down on the display screen. |
| D | Right arrow | Move the cursor to the right of the display screen. |
| E | Enter | Confirm selected icon, cursor position and accept a value. |
| F1 | Shortcut menu | See drilling system |
| F2 | Shortcut menu | See drilling system |
| F3 | Shortcut menu | See drilling system |
| F4 | Shortcut menu | See drilling system |
| Fn | Function | To obtain shortcut menu F5 press Fn and then F1. (Fn is activated for 3 seconds after the button is depressed.) |

| Button | Description | Function |
|--------|-------------|----------|
| F6-F8 | | Not used |

Table 15: Button functions, Display.

5.1.8 Status bar icons

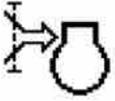
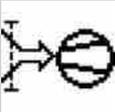
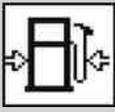
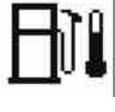
In the lower section of the display window in menus F1 to F5, is a "status bar". This bar displays different types of symbols to illustrate the events on the drill rig.

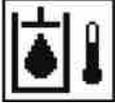
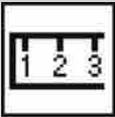
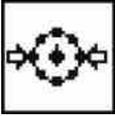
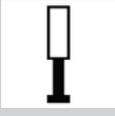
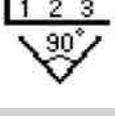


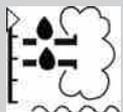
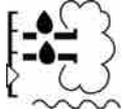
A: Status bar

The following is a list of the symbols and their meaning.

| | | |
|--|--------------------------|--|
| | Yellow/Red warning/fault | General warning - fault symbol. Always in combination with print-out in event log. |
| | Red fault | Emergency stop activated. The icon is activated when any one of the emergency stops has been activated. The diesel engine is switched off automatically. |
| | Red fault | Hydraulic oil level low. The diesel engine turns off automatically if a fault occurs. |
| | Yellow/Red warning/fault | Engine coolant level low. The diesel engine turns off automatically if a fault occurs. |

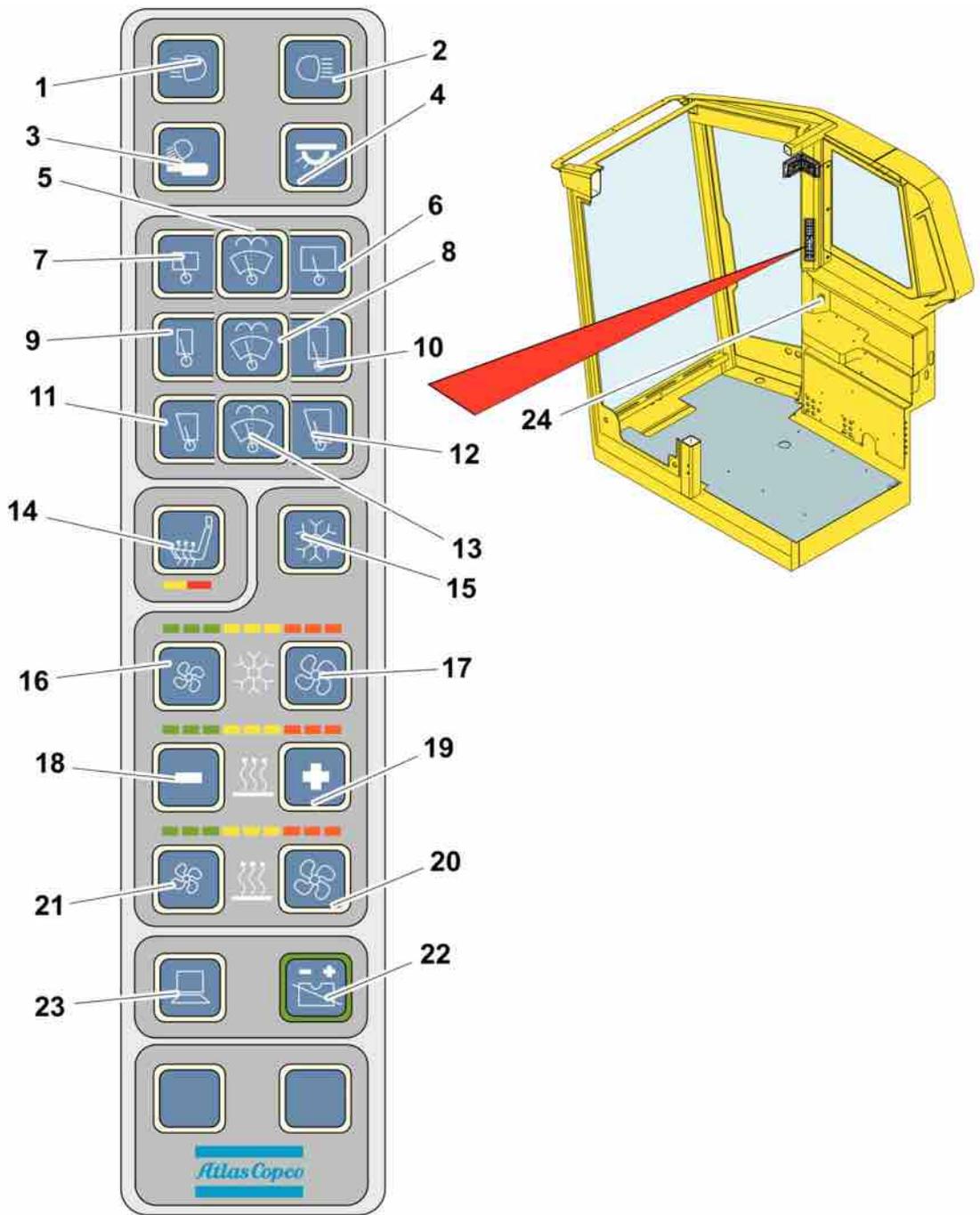
| | | |
|---|--------------------------|---|
|  | Yellow/Red warning/fault | High compressor temperature. The diesel engine turns off automatically if a fault occurs. |
|  | Yellow warning | Clogged air filter, diesel engine. |
|  | Yellow warning | Clogged air filter, compressor. |
|  | Yellow warning | Clogged hydraulic oil filter. |
|  | Yellow/Red warning/fault | Diesel engine temperature high. The diesel engine turns off automatically if a fault occurs. |
|  | Yellow warning | Warning from one of the sensors connected to the ECM. See engine status menu for more info. |
|  | Yellow warning | The diesel engine has gone down to reduced power. |
|  | Yellow warning | Unknown fault from ECM, see SPN and FMI codes in engine status menu. |
|  | Yellow/Red warning/fault | High or low fuel pressure. The diesel engine turns off automatically if a fault occurs. |
|  | Yellow/Red warning/fault | Low oil pressure in diesel engine. The diesel engine turns off automatically if a fault occurs. |
|  | Yellow warning | High charge air temperature. |
|  | Yellow/Red warning/fault | High fuel temperature. The diesel engine turns off automatically if a fault occurs. |
|  | Yellow warning | High engine speed. |

| | | |
|---|--------------------------|---|
|  | Yellow/Red warning/fault | High or low hydraulic oil temperature. The diesel engine turns off automatically if a fault occurs. |
|  | Yellow warning | Length sensor not calibrated. This icon is displayed when the control system starts and stops when the rock drill cradle has been calibrated. |
|  | Red fault | Low HECL pressure. Drilling is switched off automatically. |
|  | Yellow warning | Jack down. |
|  | Yellow warning | Low fuel level. The icon is activated when the fuel level drops below 80 litres. |
|  | Yellow warning | Contact with remote control broken. |
|  | Yellow warning | Time for engine service. |
|  | Yellow warning | Time for rock drill service. |
|  | Yellow warning | Erroneous positioning data obtained from angle sensor. |
|  | Yellow warning | Lever fault: Erroneous values from lever/levers. See event log for more information. |
|  | Yellow warning | File transfer initiated. Goes out automatically when saving is finished. Do not remove the USB memory stick while the symbol is displayed! |
|  | Green info | The MWD log is saved on a card. Do not remove the USB memory when the symbol is illuminated! |

| | | |
|---|-----------------|--|
|  | Yellow warning | Time to regrind drill bit. |
|  | Yellow warning | Quality log has been corrupted because the operator has added one more hole than the maximum allowed. Create a new correct drill plan to clear the warning symbol. |
|  | Grey/Green Info | Green=no locking. This symbol is always displayed when the drilling system is unlocked! Grey=locked rotation |
|  | Green info | Locked collaring. |
|  | Green info | Auto-drilling locked. This icon is green while the function is activated. |
|  | Green info | Indicates that the DEF (Diesel Exhaust Fluid) level is > 80% |
|  | Green info | Indicates that the DEF (Diesel Exhaust Fluid) level is < 80% |
|  | Green info | Indicates that the DEF (Diesel Exhaust Fluid) level is < 60% |
|  | Green info | Indicates that the DEF (Diesel Exhaust Fluid) level is < 40% |
|  | Green info | Indicates that the DEF (Diesel Exhaust Fluid) level is < 20% |
|  | Grey/Green info | Option Green=the automatic rod handling system is activated. Grey=Inactive or option not activated. |
|  | Green/Grey info | Option Green=the automatic positioning system is active. Grey=Inactive or option not activated. |

| | | |
|--|-----------------|--|
| | Grey/Green info | Option Green=Laser receiver has received a hit on the laser plane. Grey=No hit or option not activated. |
| | Red fault | Oil stop valve pressure - Indicates that the pressure is too low. Engine stopped automatically. |
| | Yellow warning | High exhaust gas temperature (HEST) - Illuminated when regeneration has been started. |
| | Yellow warning | High soot level in the particle filter (DPF) - Shown when the soot level is > 90% |
| | Yellow warning | Automatic regeneration blocked - Used when there is a risk of personal injury or damage to property. |
| | Yellow warning | Illuminated when the DES system (Delayed Engine Shutdown) is activated. |
| | Yellow warning | Self-holding of drilling lever stops - Illuminates when the soot level reaches 100%. If this occurs, switch off the engine and contact authorised service personnel. |

5.1.9 Operator's panel for operator's cabin



| | |
|---|--|
| 1 | Work lights cabin, front |
| 2 | Work lights rig, rear |
| 3 | Work lights feeder |
| 4 | Lighting engine compartment |
| 5 | Windscreen washer, upper |
| 6 | Windscreen wiper, upper increases speed in steps. |

| | |
|----|---|
| 7 | Windscreen wiper, upper reduces speed in steps. Switch off by depressing and holding the button for 2 seconds. |
| 8 | Front windscreen washers |
| 9 | Windscreen wiper, front reduces speed in steps. Switch off by depressing and holding the button for 2 seconds. |
| 10 | Windscreen wiper, front increases speed in steps. |
| 11 | Windscreen wiper, right reduces speed in steps. Switch off by depressing and holding the button for 2 seconds. |
| 12 | Windscreen wiper, right increases speed in steps. |
| 13 | Windscreen washer, right |
| 14 | Seat heating in two steps |
| 15 | Air condition |
| 16 | Fan, air conditioning reduces speed in steps. |
| 17 | Fan, air conditioning increases speed in steps. |
| 18 | Temperature reduces the temperature. |
| 19 | Temperature increases the temperature. |
| 20 | Fan, heater increases the speed in steps. |
| 21 | Fan, heater reduces the speed in steps. |
| 22 | Not used |
| 23 | CANBUS Off/On |
| 24 | Ignition switch |

5.1.10 Hammer for emergencies



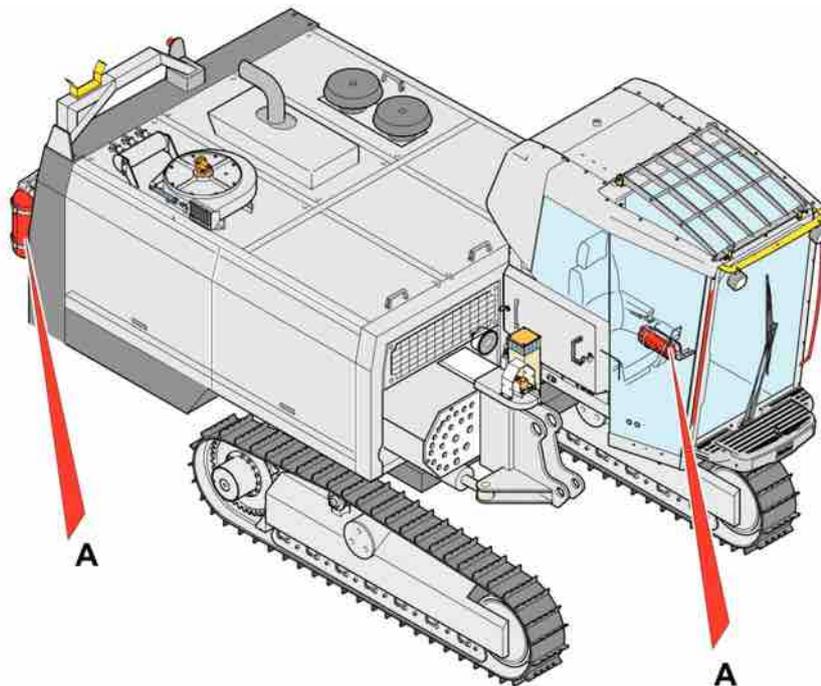
Emergency hammer with belt cutter

If the cabin door is blocked, use the hammer to break a window so that you can get out. On the lower part is a belt cutter to cut off the seat belt if this cannot be released in the usual manner.



NOTE: If the cabin is equipped with safety glass, break the glass in the rear window to get out.

5.1.11 Fire extinguisher



The drill rig is equipped with two fire extinguishers (A-B-C powder).

The fire extinguishers (A) are fitted down to the left under the operator's seat in the cabin, and at the rear of the rig on the right-hand side.

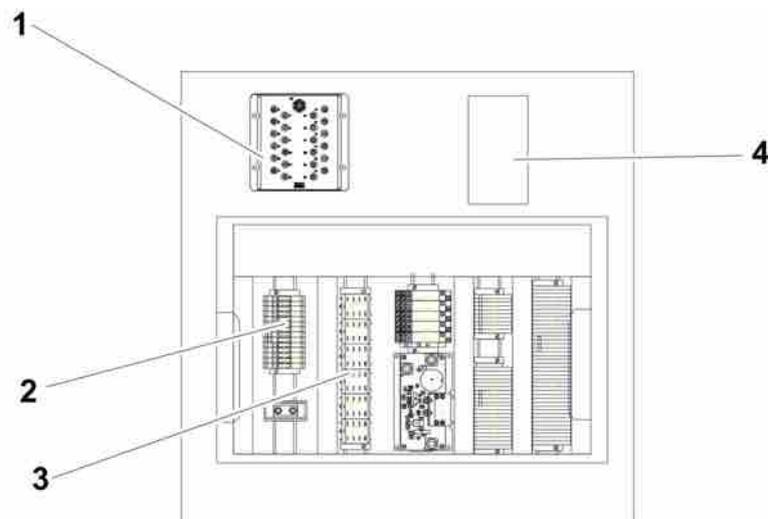
Class A-B-C fires can be put out.



NOTE: The fire extinguishers that are supplied with the drill rig must be considered only as "delivery fire extinguishers". The fire extinguishers must be replaced locally if they are not approved in accordance with local regulations.

5.2 Other controls

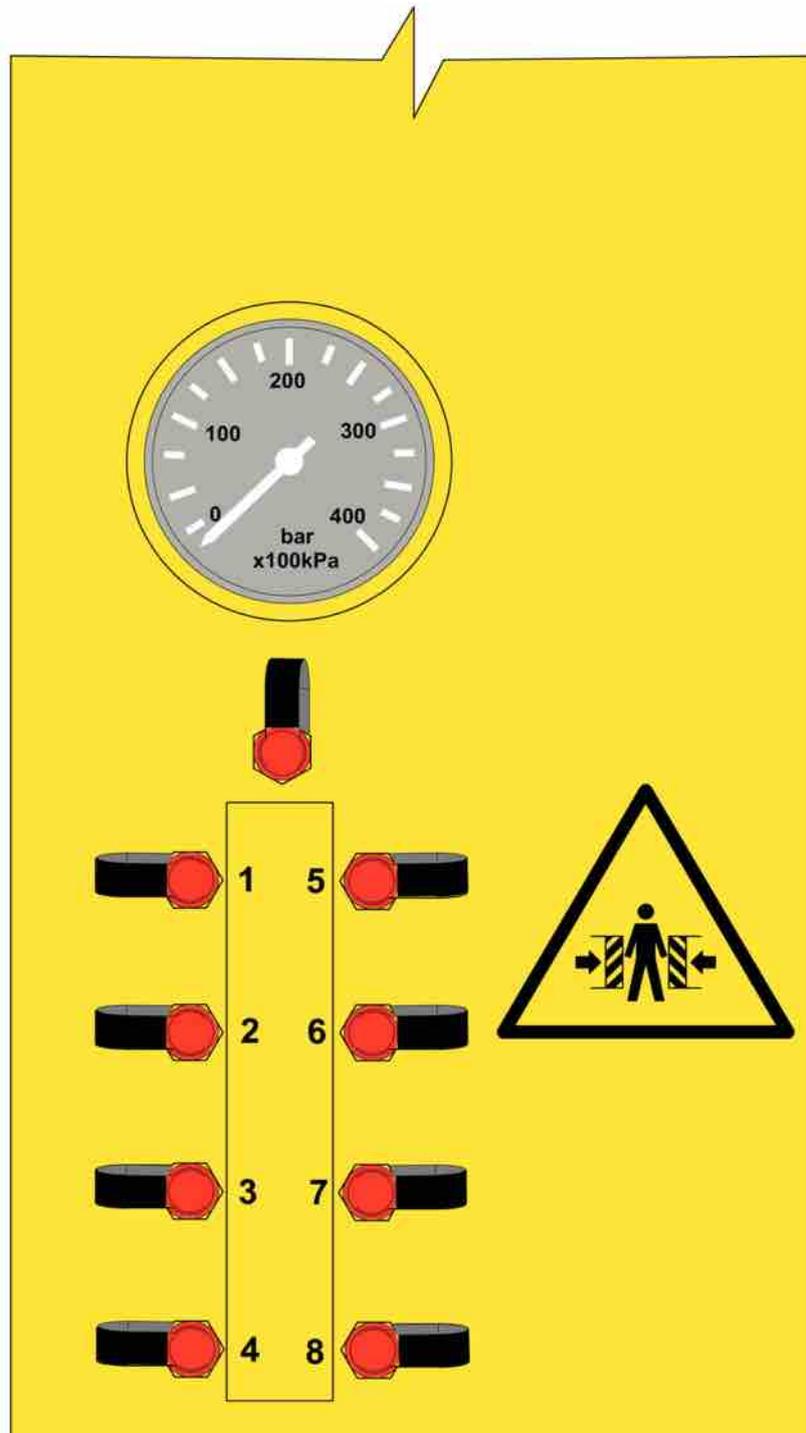
5.2.1 Electrical cabinet



Electric cabinet.

| | |
|---|-------------|
| 1 | I/O module |
| 2 | Fuses |
| 3 | Relays |
| 4 | CAN Gateway |

5.2.2 Test connections for the hydraulic circuits



Test connections

Test instrument for checking the hydraulic circuits.

Connect the test instrument to the different outlets (see table below).

| | |
|---|---|
| 1 | Hydraulic pump 1: drill feed, rapid feed, rod handling, positioning |
| 2 | Hydraulic pump 2: Rotation |
| 3 | Hydraulic pump 3: DCT |

| | |
|---|---|
| 4 | Hydraulic pump 4: Positioning |
| 5 | Hydraulic pump 5: Radiator - hydraulics, compressor and diesel engine |
| 6 | Hydraulic pump 6: Radiator - diesel engine |
| 7 | Pilot pressure |
| 8 | Not used |

Table 16: Test connections

6 Operating

6.1 Before starting

6.1.1 To be checked before each start.

⚠ WARNING

Serious injury
 Danger of moving parts

- ▶ Can cause serious personal injury
- ▶ Set all levers and switches in NEUTRAL position before start-up preparations
- ▶ Carry out the procedures with the engine switched off

⚠ WARNING

Serious injury
 Dangerous compressed air

- ▶ Can cause serious injury
- ▶ Release the pressure in the tank before removing the filler plug

6.1.2 Checks

! *NOTE: For further instructions, see "Maintenance instructions"*

| Check point | Inspection | Instructions |
|---------------|------------|---|
| Hydraulic oil | Oil level | The recommended oil level is half way up the upper sight glass. Make sure the drill rig is in the transport position before checking. Top up as necessary. |
| Lubrication | Oil level | Top up as necessary. |

! *NOTE: Make sure the tank is always at least 1/4 full with oil.*

| Check point | Inspection | Instructions |
|-----------------|----------------|--|
| Engine oil | Oil level | Top up as necessary. |
| Compressor oil | Oil level | Before checking the level, make sure the drill rig is standing level with the engine turned off for at least 10 minutes. Top up as necessary. |
| Water separator | Fuel prefilter | Drain off the water (a). |
| Drill rig. | Visual check | Look for any signs of leaks, damage, breakage or cracks. |

Table 17: Checks before starting.

6.2 Functionality test after start

6.2.1 Checks



NOTE: The emergency stop buttons and wires must be checked before each shift and after tramming.

| Check point | Inspection | Instructions |
|--|--------------|---|
| Emergency stop buttons (all) and the emergency stop wire on the feed beam. | Function | Check each emergency stop button individually. The engine must stop! Between testing each emergency stop, the previous stop must be reset before restarting the rig. For the location of the stops, see "Safety" |
| Display for engine and directional instruments | Visual check | Check that none of the fault indicator symbols is on. If a fault is indicated in the status bar, stop the unit and rectify the fault. |

Table 18: Checks.

6.3 Function test while drilling

6.3.1 Checks

| Check point | Inspection | Instructions |
|-----------------------------|--------------|------------------|
| Hydraulic hoses to the unit | Visual check | Check for leaks. |

| Check point | Inspection | Instructions |
|--|-------------------------------------|--|
| Dust collector (DCT) | Suction ability and filter cleaning | In case of dust formation: Check the filter in the filter holder and suction hose and also the drill-steel support's drill gasket. |
| The drill rig | Visual check | Look for any signs of leaks. |
| Return oil filter | Operator's display in cabin | Inspect for any signs of a leak. If the pressure in the return oil filter exceeds the set value, a symbol will be shown on the operator's display. |
| Display for engine and directional instruments | Visual check | Check that none of the fault indicator symbols is on. If a fault is indicated in the status bar, stop the unit and rectify the fault. |

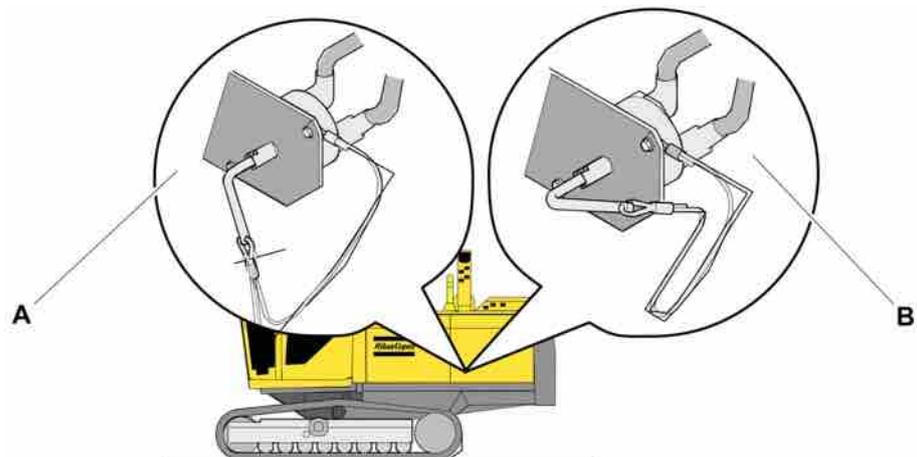
Table 19: Checks.

6.4 Diesel engine starting

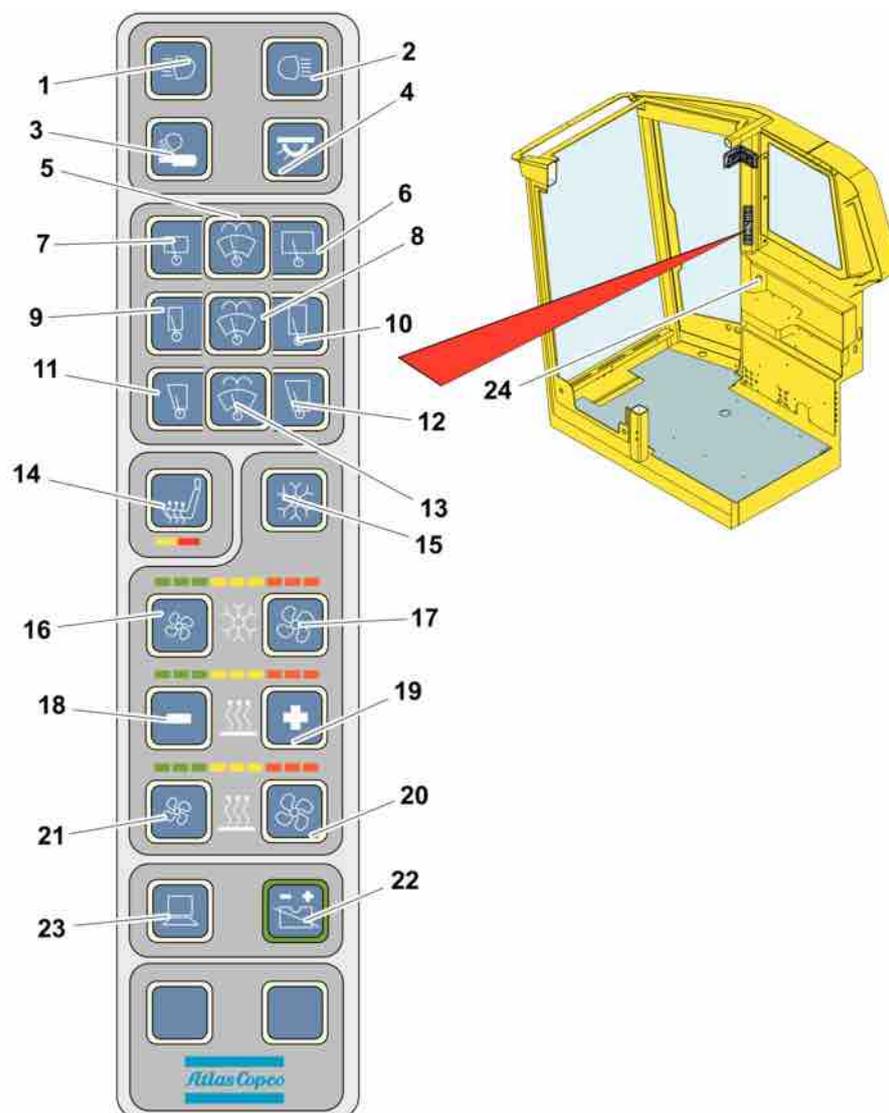


NOTE: Observe the display while at work.

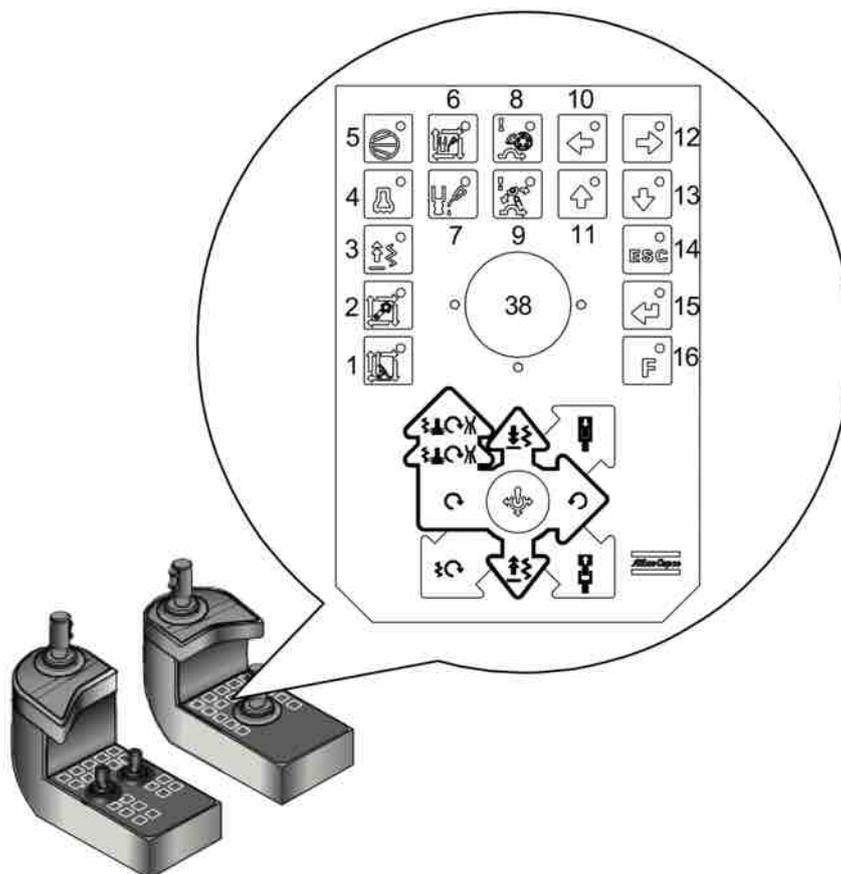
1. Set **Battery main switch** (S300) to position ON (1a) (Clockwise).



2. Activate the drill rig's control system by pressing the **CANBUS** button (23), wait until the startup screen appears on the display, which takes about 1 minute.



3. Activate **Direct selection menu F5** by pressing the **F (16)** button on the right of the control panel.



Right control panel

4. **Ignition key** to position for ignition on.

Wait for approx. 10 seconds so that the CANBUS system makes contact with the engine's ECM. When the voltage at the battery symbol in the shortcut menu F5 shows more than 0.0V then contact has been made.

Press in and turn the **Ignition key** to **start** position.

Engine starts



NOTE: Note

NOTE: Should the engine fail to start, stop trying after 20 seconds and wait one minute before trying again.

5. Release the **Ignition key** the key is spring-loaded and returns to the operating position.

If starting is unsuccessful, check to see which symbols are shown on the display and rectify the fault.

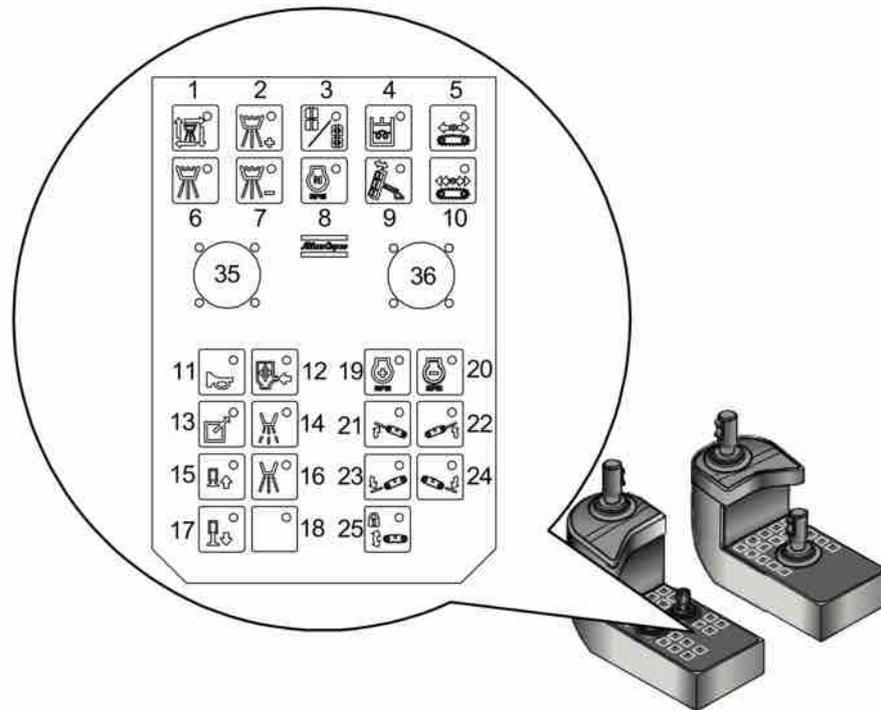
6. Check the hydraulic oil temperature. If the hydraulic oil temperature is below 20 °C (68 °F), drilling and high speed tramping will not work.

6.5 Stopping the diesel engine



NOTE: If the engine is hot, run it at idling speed for a couple of minutes before switching off.

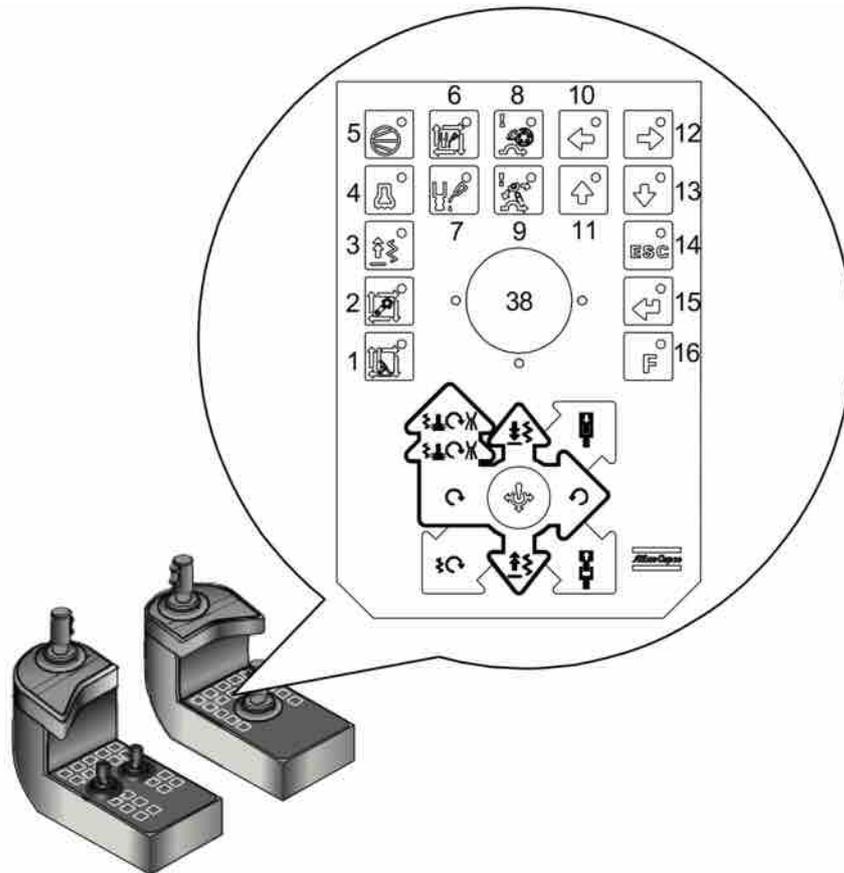
1. Set the drill rig in **Tramming** position with button (5) on the left-hand control panel.



Left control panel.

2. Set the **Compressor** to position OFF. Button (5) on the right-hand control panel should not be illuminated.
- 3.

Activate idle rpm with button (8) on the left-hand control panel.



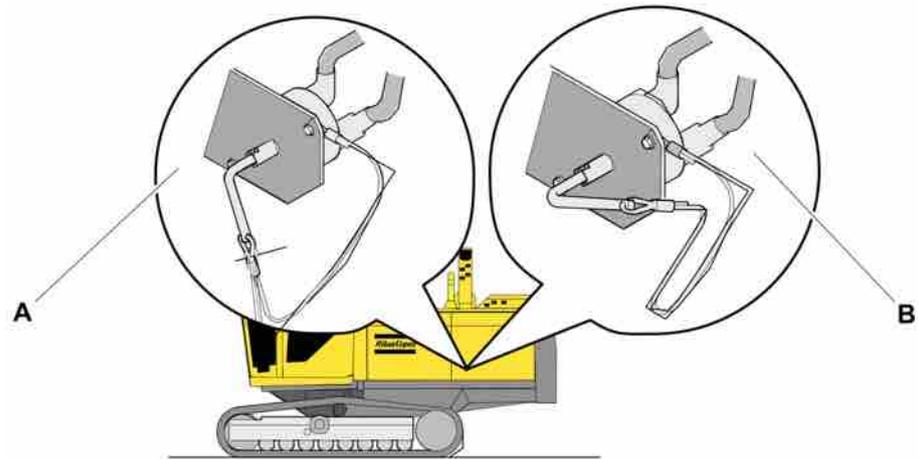
Right operator's panel.

4. **Ignition key** to position OFF (0). The engine may run at idling speed for a few minutes. See section Delayed shutdown (DES) for information.
5. When the engine has stopped, wait 2 minutes before you switch off the battery's main power contactor. The DEF system requires this time to drain all hoses of fluid. The DEF system may be damaged if fluid remains in the hoses after switching off.
6. Put the **Battery main switch** in position OFF (1b) (see figure: Battery main switch).



NOTE: Note

NOTE: Always set the main power contactor to OFF (1b) once the diesel engine has stopped after finishing work or for long-term storage!



Main power contactor.

6.6 Delayed Engine Shutdown - (DES)

6.6.1 Description

The purpose of DES is so that the DEF injection system should be able to cool down before the engine stops. If the engine stops when the injector is hot then it may be damaged.

When the ignition key is turned to OFF (0) the engine may continue to run at idling speed for a few minutes. The DES time varies between 1-7 minutes, depending on how hot the injector is.

CAUTION

Risk of injury

Always switch off the engine correctly. See section Stopping the diesel engine for further information.

- ▶ Do not use the emergency stop to bypass the delayed shutdown period.
- ▶ Using the emergency stop system to bypass the delayed shutdown period risks damaging the DEF injector.

Dialogue box for switching off the engine



DES Dialogue box

The DES function is activated automatically each time the engine is shut down. When the DES function shall be activated a dialogue box is shown in the control system. This dialogue box cannot be hidden using the ESC key as long as engine status is **On**. When the engine has been switched off the box can be hidden with ESC.

If it is necessary to bypass the DES function then this can take place by selecting **Force engine shutdown**. The engine will switch off immediately. This is not a recommended option and should only be used when absolutely necessary. Repeatedly bypassing delayed shutdown (DES) of the engine may damage the DEF injector. Each time delayed shutdown is bypassed this is registered in the event log in the rig's control system.

Testing the emergency stop system on a rig equipped with DES

The emergency stop system should be tested prior to each shift by activating each respective emergency stop button. If engine is hot, there is a risk of damaging the DEF injector. In this case, the engine must be restarted immediately after each emergency stop button is depressed.

6.7 Low DEF levels

When the DEF (Diesel Exhaust Fluid) levels become too low a warning symbol, or a combination of warning symbols, is shown at four levels. At the last level, the DEF tank is empty and the engine is switched off automatically.

| Warning level | Symbols | Message on the display |
|-----------------|---|------------------------|
| Initial warning |  | - |
| 1 |   | DEF level low |
| 2 |   | DEF level critical |
| 3 |    | DEF tank empty |

Table 20: Low DEF levels

6.8 Regeneration

⚠ WARNING

Serious injury

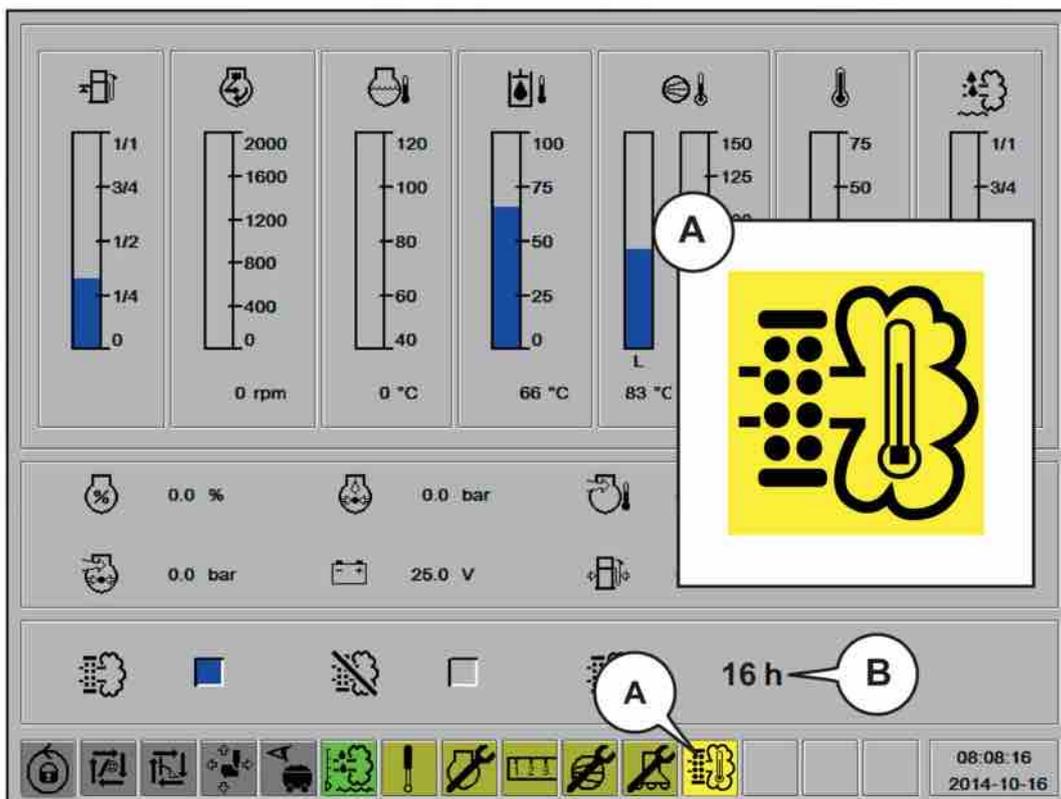
Very high exhaust temperatures

- ▶ May cause serious personal injury and damage to property
- ▶ Always check that the rig is positioned so that fire or other damage cannot occur when regeneration is in progress

6.8.1 General

Regeneration is a process that burns the soot from the diesel engine's particle filter. In most cases regeneration is started completely automatically and without affecting the rig's performance. Regeneration can be run in two different modes depending on the speed of the diesel engine and calculated soot level in the particle filter.

6.8.2 Automatic regeneration



When automatic regeneration is started the symbol **high exhaust temperature (A)** is shown in the display.

Time remaining until automatic regeneration

Number of hours remaining until the next automatic regeneration is shown in the display **(B)**.

! ***NOTE:** The number of hours indicated until the next automatic regeneration (B) is only an approximation. The regeneration process can be started several hours before or after the time shown.*

When automatic regeneration is started the symbol **high exhaust temperature (A)** is shown in the display.

Low speed regeneration

Low speed regeneration (LSR) is allowed to start automatically when the engine speed is between 1200 - 1400 rpm. Other conditions are that the coolant temperature must exceed +40 °C and the particulate filter's soot content has reached 80-100%.

High speed regeneration

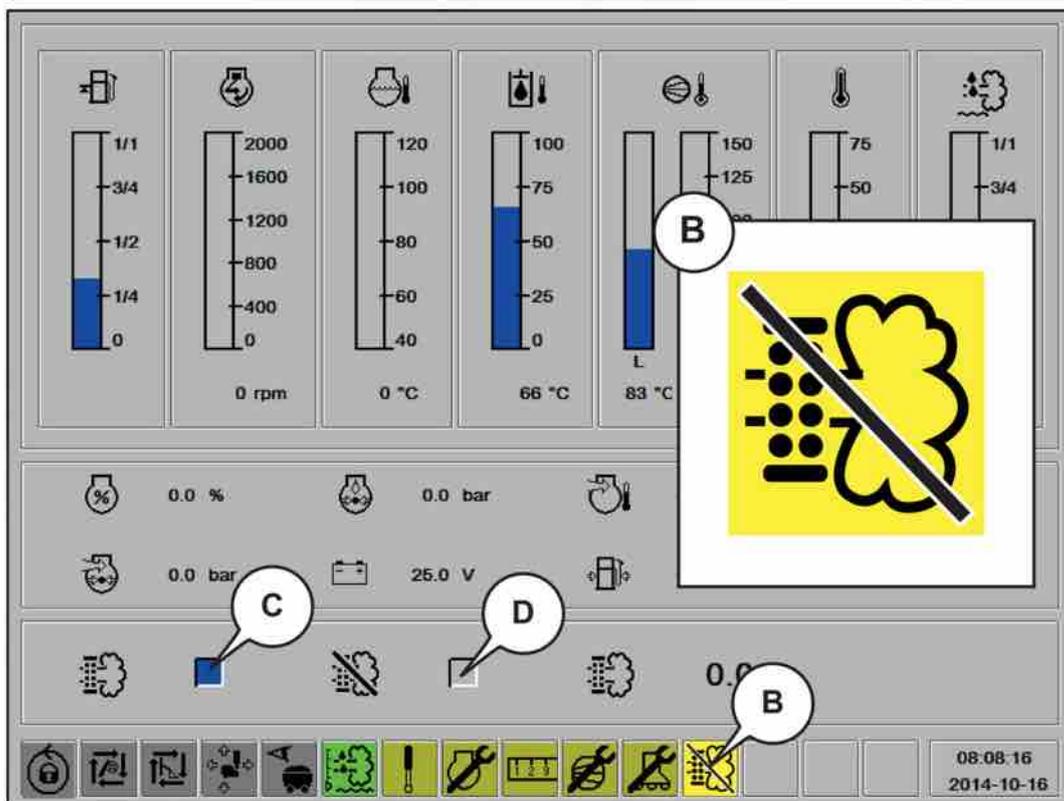
High speed regeneration (HSR) is allowed to start automatically when the engine speed is between 1200 - 1800 rpm. Other conditions are that the coolant temperature must exceed +40 °C and the particulate filter's soot content has reached 80-100%.

! **NOTE:** There may be a certain amount of delay in starting the automatic regeneration. General conditions such as fuel consumption, charge pressure and exhaust temperature control whether it is started or not. Automatic regeneration is not permitted to start when the soot level has reached 100%

6.8.3 Blocked regeneration

Automatic regeneration can be blocked if for some reason it is not suitable to permit it to start, for example:

- When the exhaust extractor is installed on the rig during repairs.
- When personnel must be on the upper parts of the rig with the diesel engine running.
- When there is vegetation or other combustible materials in the immediate vicinity of the exhaust.

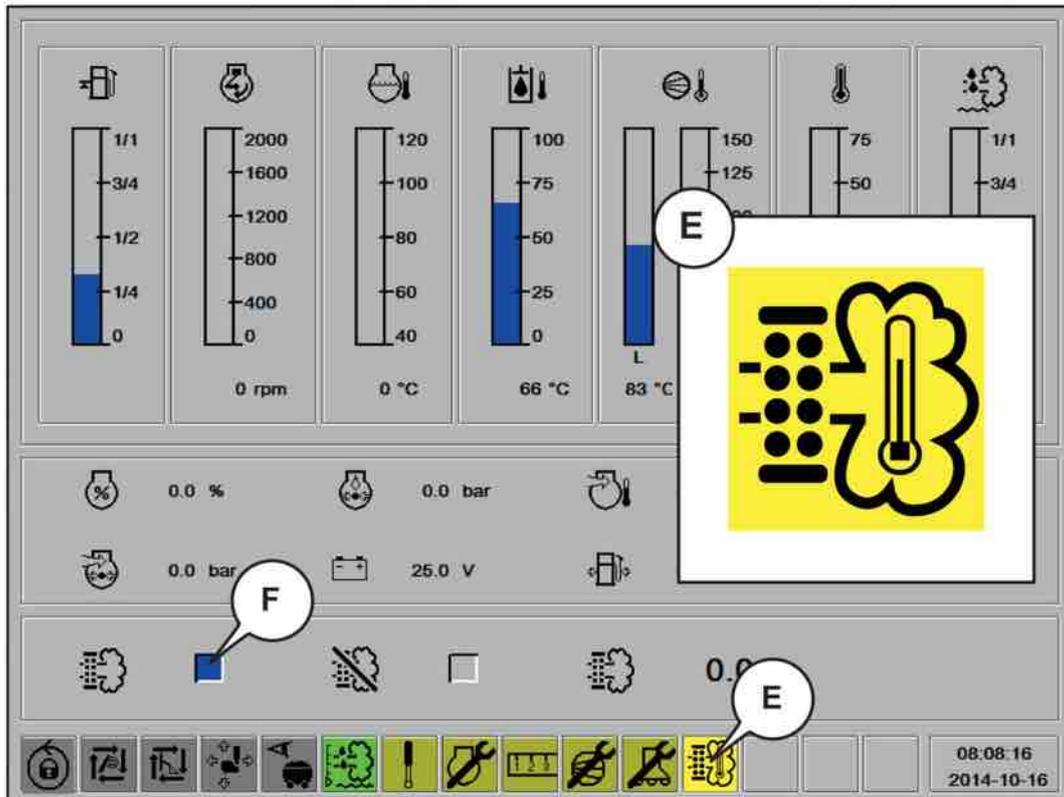


To block the automatic regeneration mark (D) in the display and hold the enter button pressed for 5 seconds and then **Automatic regeneration blocked (B)** is displayed.

Return to automatic regeneration by starting and completing a **forced regeneration**, alternatively by restarting the drill rig.

! **NOTE:** Automatic regeneration can only be blocked when the diesel engine is started. Blocking is automatically reset when the ignition is switched off/on.

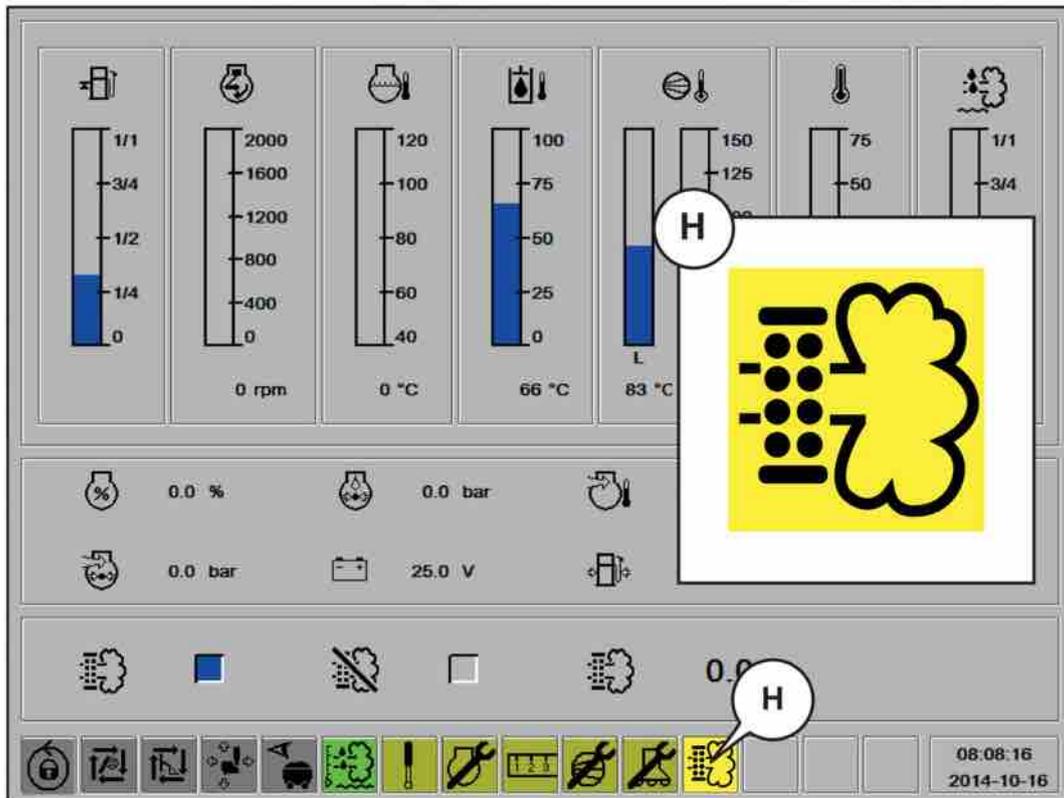
6.8.4 Forced regeneration



Forced regeneration can be started between 1100-1800 rpm. The conditions are the same as for automatic, except that it is permitted to start at a soot level between 15-100%.

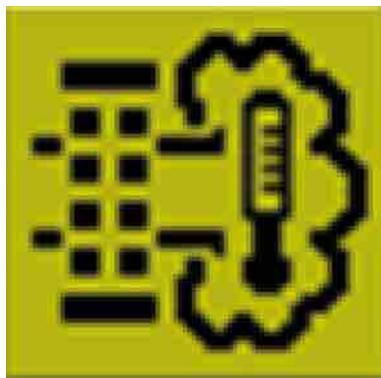
- For forced regeneration the symbol (F) in menu F1 in the display is marked and the enter button is pressed for 5 seconds.
- That forced regeneration has started is shown with the symbol **high exhaust temperature (E)**.
- Return to automatic regeneration by performing one of the following options:
 - restart the drill rig
 - complete forced regeneration.

6.8.5 Warning of high soot content in the particulate filter.



Warning symbol for **high soot level in the particle filter (H)** is shown when the soot level is > 90%.

- If **blocking of automatic regeneration** is activated when the warning is shown, return to automatic regeneration by performing one of the following options:
 - restart the drill rig
 - run forced regeneration
- Automatic regeneration should be prioritised when the warning (H) is shown. If automatic regeneration does not start, the warning symbol (H) will remain visible and not be replaced with the symbol for high exhaust temperature. Drilling should be stopped and the compressor unloaded. This will make conditions more favourable for the automatic regeneration to start.

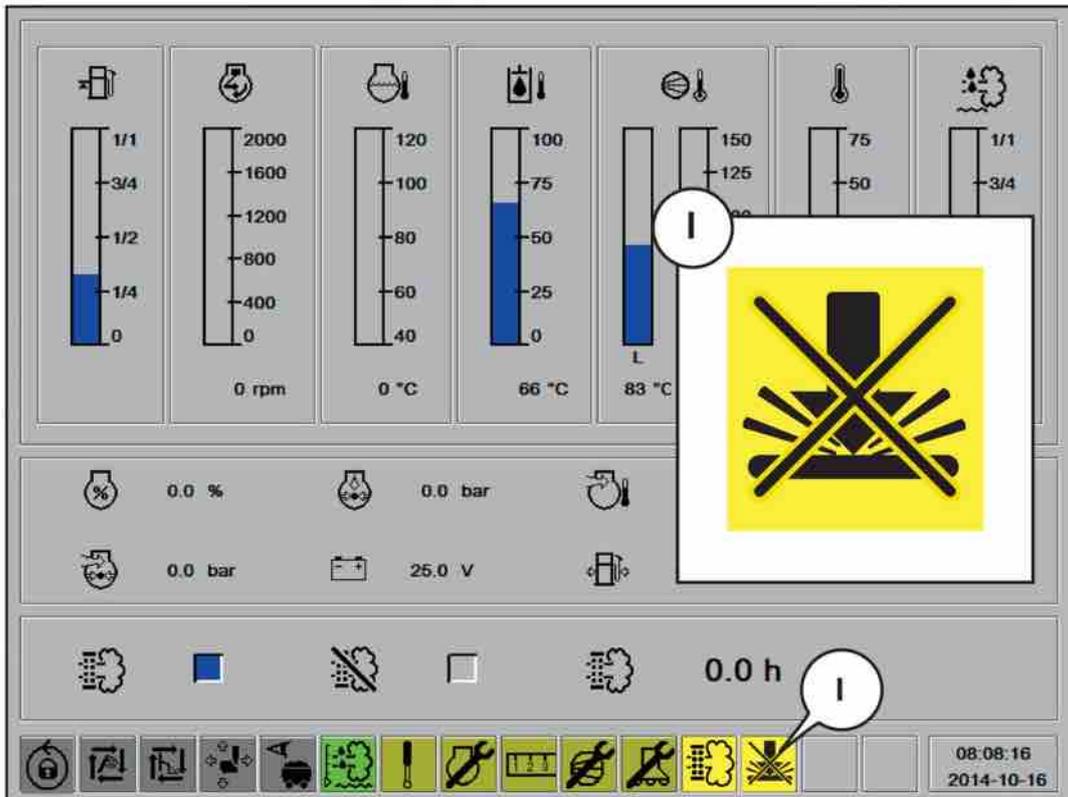


Symbol of High exhaust temperature - approx. 600 °C



NOTE: If it is inappropriate to run a regeneration because of increased fire risk, move the drill rig to a more suitable location before the blocking is deactivated.

6.8.6 Warning of 100% soot content



Warning symbol for **100% soot content in the particulate filter (I)**.

- If the soot content exceeds **100%** then self-holding of the drilling lever ceases in order to alert the operator. If this occurs, switch off the drill rig and contact authorised service personnel.

6.8.7 Warning symbols for regeneration

| Warning level | Symbols | Message on the display |
|-----------------|---|--|
| Initial warning |  | - |
| 1 |  | DPF soot level high, start regeneration |
| 2 |  | DPF soot level critical, contact auth. service personnel |
| 3 |  | DPF soot level critical, contact auth. service personnel |

Table 21: warning symbols for regeneration

6.9 Tramming

6.9.1 Safety

WARNING

Serious injury

Risk of dumping/sliding

- ▶ May cause severe personal injury and damage to property
- ▶ Always check the prevailing ground conditions where the rig shall be operated
- ▶ Keep the track oscillation locks open during tramming
- ▶ Inclination angles for Downward/Upward/Lateral CANNOT be combined with each other
- ▶ Do not exceed the inclination angles, See technical data
- ▶ Note the gradient meters' values
- ▶ Close the cabin door and always use the safety belt
- ▶ Always ensure that unauthorised personnel are outside the working area

WARNING

Serious injury

Danger of high-voltage cables

- ▶ May cause serious personal injury and damage to property
- ▶ Keep away from high-voltage cables

CAUTION

Risk of injury

Note that worn track shoes reduce the friction with the ground considerably and consequently increase the risk of sliding

NOTICE

Risk of damage to the crawler track transmission

Tramming for a long period means that transmission fluid temperature increases and when the temperature exceeds 60 °C there is a risk of transmission damage.

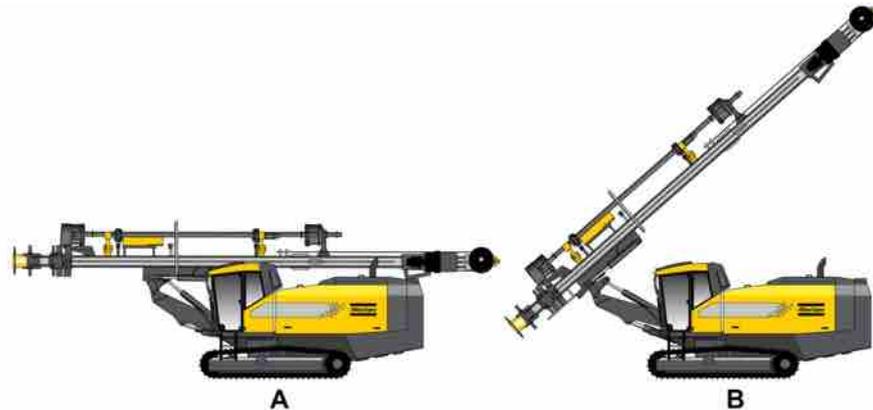
- ▶ When tramming over long tramming distances, check the transmission temperature at regular intervals and allow it to cool down.

6.9.2 Operation



NOTE: The gradient meter shows the chassis frame inclination and not the actual ground inclination.

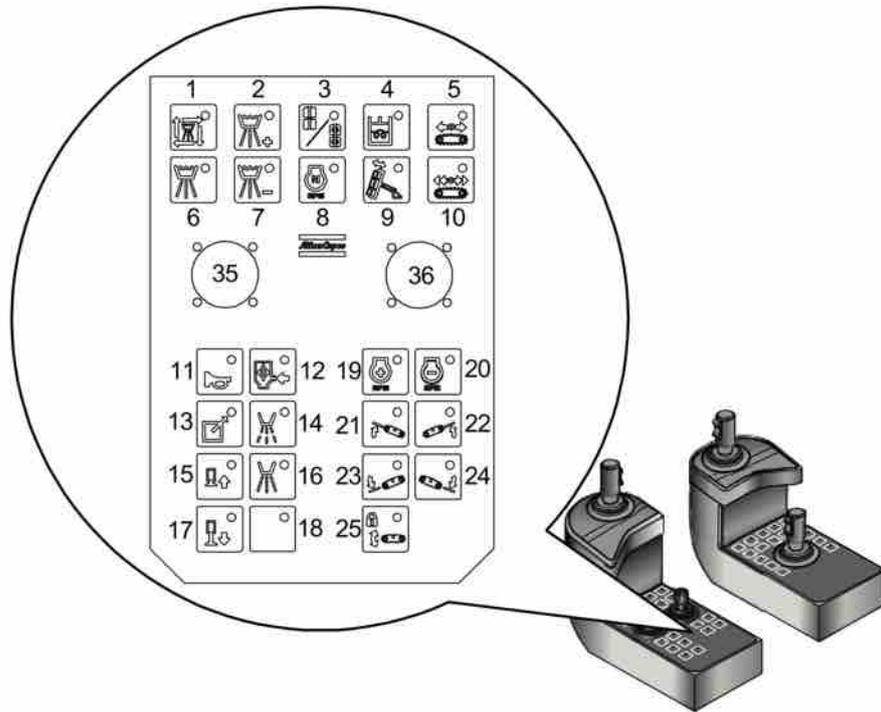
1. Use the boom and feeder positioning control levers alternately to place the feeder onto the feeder support. Make sure the boom and feeder are pointing straight ahead.



Positions for tramping.

| | |
|---|--|
| A | Normal position for tramping with feeder located on the feeder support |
| B | Only for tramping between boreholes if ground inclination allows |

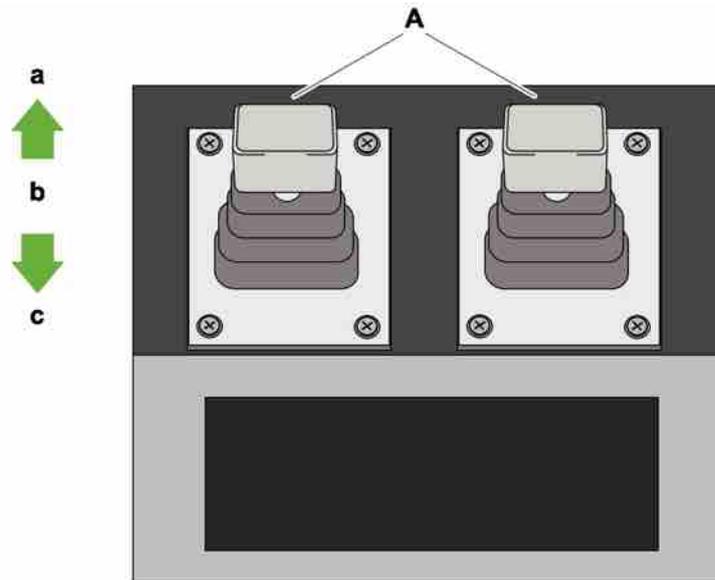
2. **Raise the hydraulic jack** (15). A double press UP will fully retract the jack
3. Put the **track oscillation cylinders** to OPEN position. The diode on button (21) should not be on.
4. Activate **TRAMMING** (low speed/high speed) to a suitable position depending on the character of the terrain. Button (5) or (6).



Left control panel.

! **NOTE:** Adapt the speed to the prevailing terrain.
NOTE: Low speed tramming provides the highest traction and vice versa.

5. Operate the levers for the **Crawler track** (A) to move the drill rig in the desired direction.



Crawler track levers

! **NOTE:** When the drill rig reverses, a horn sounds and a warning lamp comes on.

! **NOTE:** If one crawler track is operated while the other is stationary the tracks are subjected to unnecessary stresses. This should therefore be avoided.

6. Use the buttons for track oscillation (17, 18, 19, 20 and 21) to position the rig as horizontal as possible.
7. Use the boom system to optimise the stability of the drill rig (See chapter: General principles of tramming).

6.10 Checking after tramming

All emergency stop wires and all emergency stops must be checked after tramming.

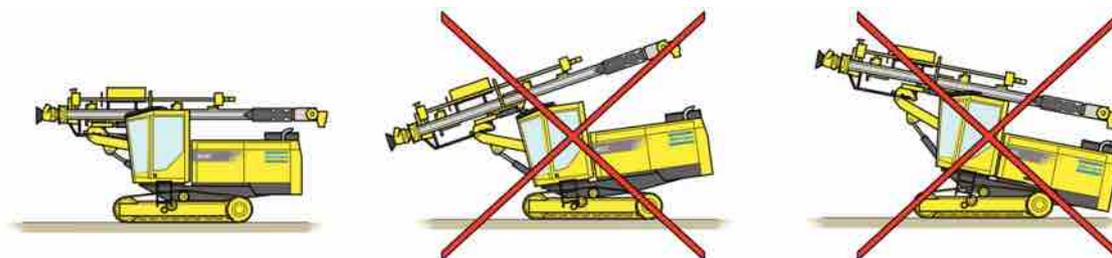
6.11 Tramming - General principles

6.11.1 Tramming, general

Direct the boom system straight ahead **before** opening the track oscillation lock.

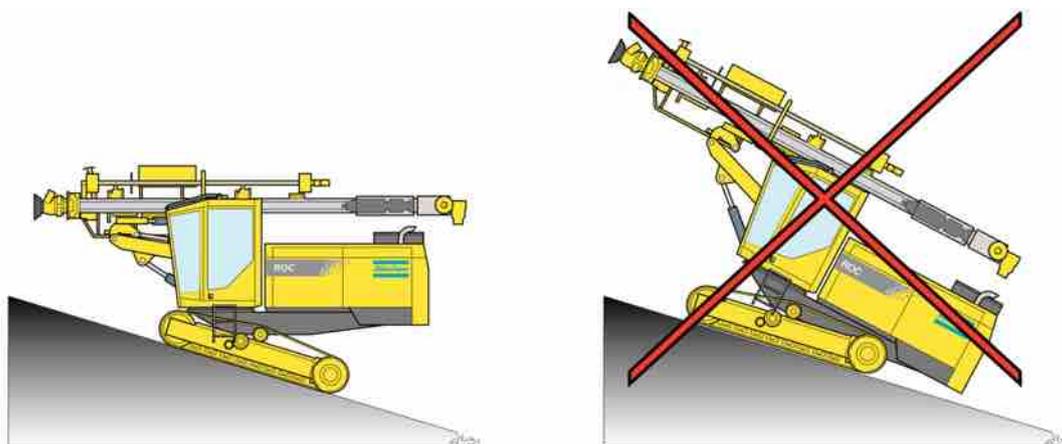
While tramming, the track oscillation lock must be open so that the caterpillar tracks can move freely whenever there is a change in terrain. Use track oscillation to keep the chassis frame as horizontal as possible.

Adapt the speed to the terrain. Always check the terrain where the drill rig will be manoeuvred.



Left: Correct position for general tramming. Centre and right: Wrong position.

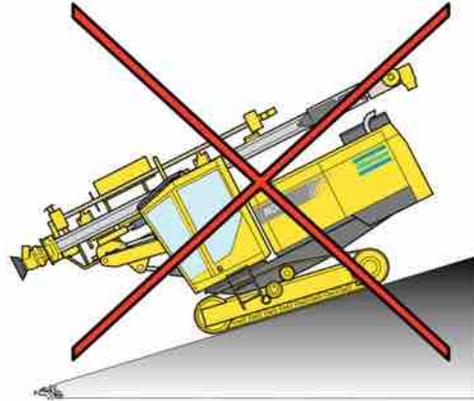
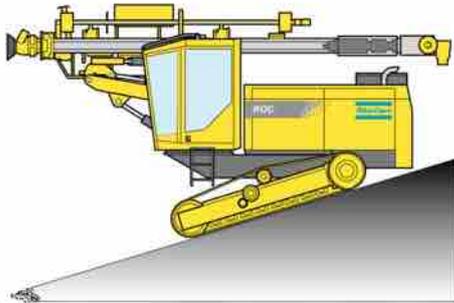
6.11.2 Tramming, uphill



Left: Correct position for tramming uphill. Right: Wrong position.

6.11.3 Tramming, downhill

The boom and rock drill/rotation unit must be as far back as possible.



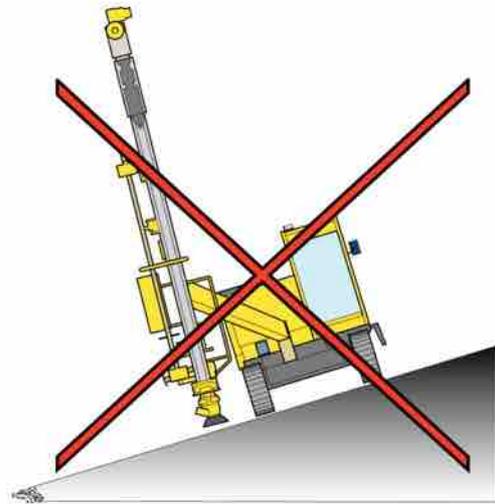
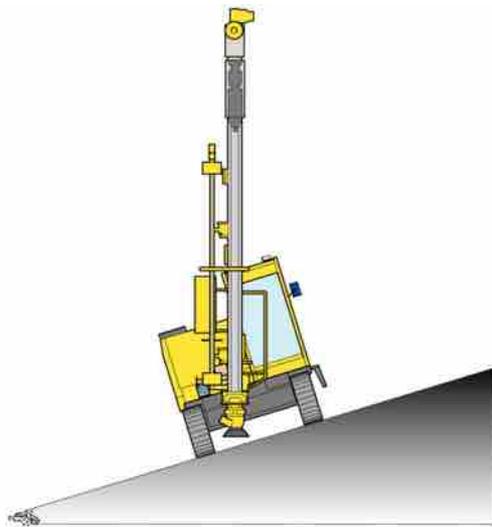
Left: Correct position for tramming downhill. Right: Wrong position.

6.11.4 Tramming on transverse inclines

Use the boom system as a counterweight when traversing inclines.

NOTICE! The risk of slipping is greatest when tramming on a transverse incline.

NOTICE! Always observe ground conditions.



Left: Correct position for traversing inclines. Right: Wrong position.

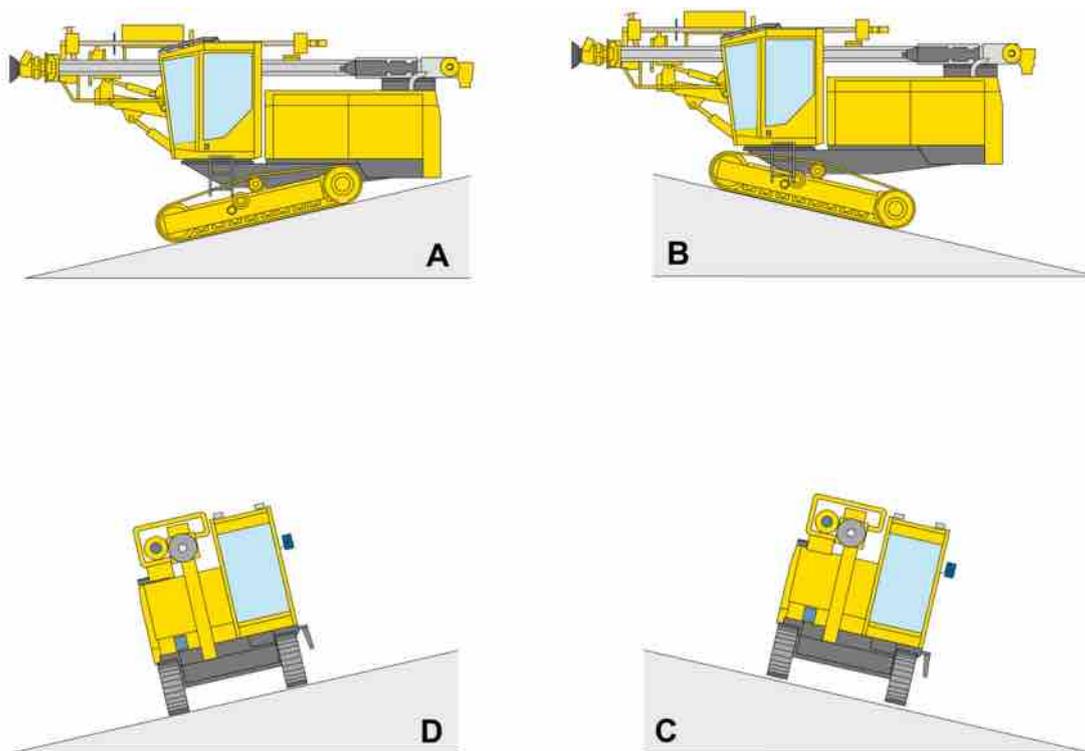
6.12 Maximum permitted angles of inclination during tramming and setting-up for drilling

The angles refer to the ground inclination and not the inclination of the rig.

Track oscillation must always be open during tramming and track oscillation must always be locked during setting-up for drilling.

- ! **NOTE:** RC in the tables stands for rig with the additional equipment RC - Reverse Circulation.
- NOTE:** W in the tables stands for rig with the additional equipment extra wide track frame.
- NOTE:** LF - Long Feed. SF - Short Feed.
- NOTE:** FR - FlexiROC. SR - SmartROC.

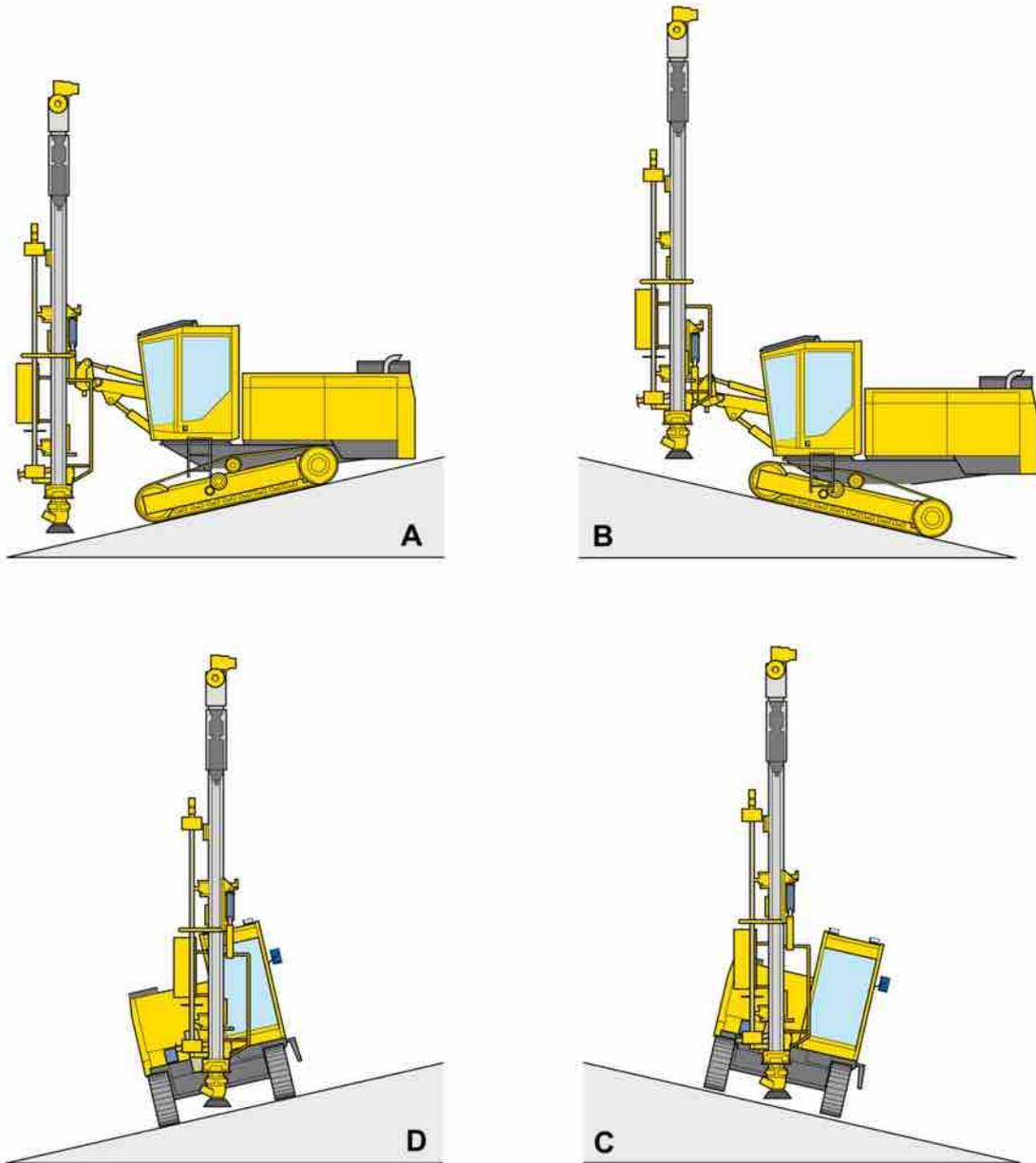
6.12.1 Tramming with the feeder in tramming position



| Illustration reference | Direction | Max. angle of inclination | | | | |
|------------------------|-----------|------------------------------|-------------------|----------------------|---------------------|--------------------------|
| | | FR D50/D55 SF - SR D60/65 SF | FR/SR D60/ D65 LF | FR/SR D60/ D65 RC LF | FR/SR D60/ D65 W LF | FR/SR D60/ D65 W + RC LF |
| A | Forward | 20 | 20 | 20 | 20 | 20 |
| B | Backward | 20 | 20 | 20 | 20 | 20 |
| C | Left | 20 | 20 | 20 | 20 | 20 |
| D | Right | 20 | 17 | 18 | 20 | 20 |

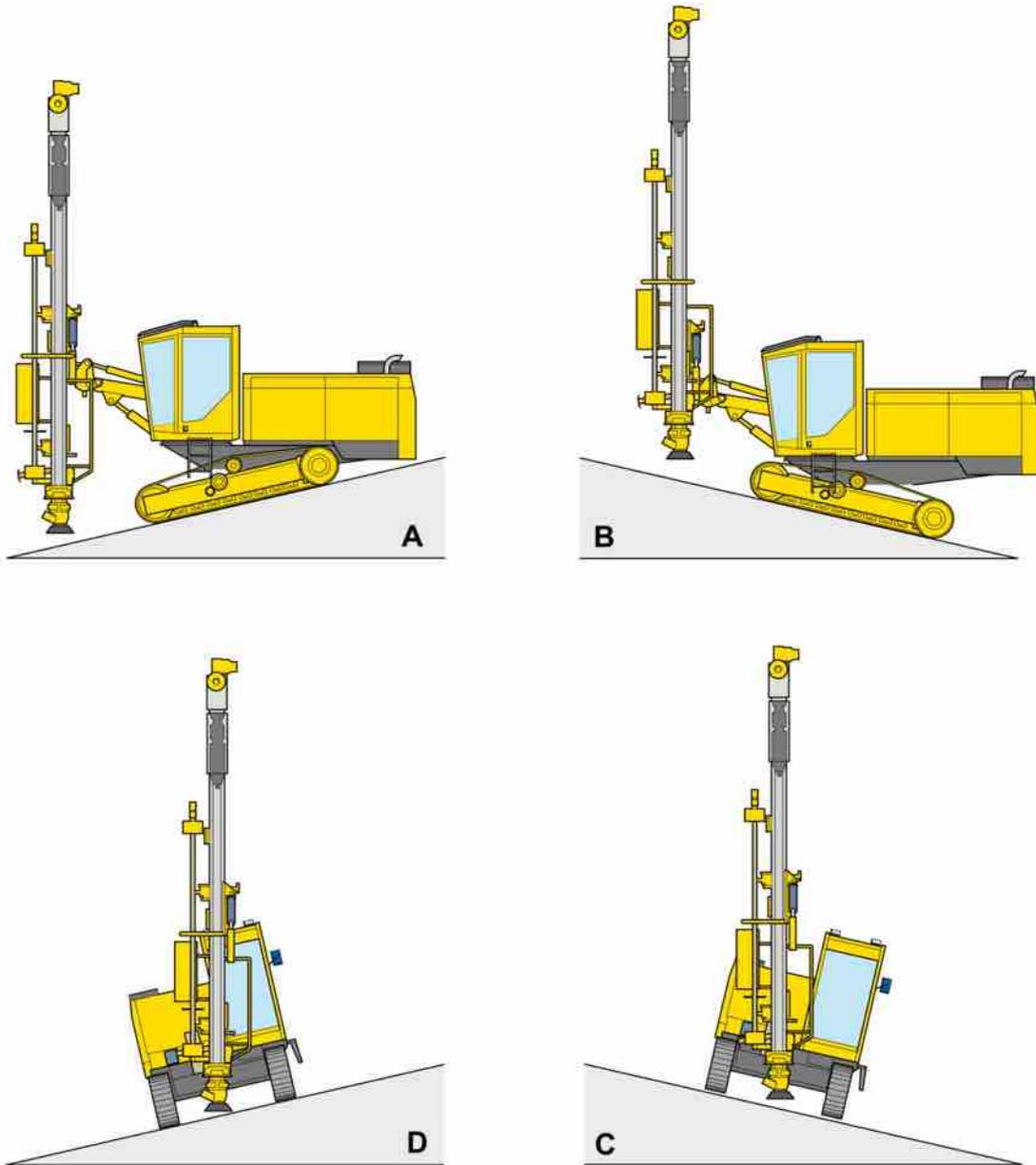
6.12.2 Tramming with the feeder in vertical position and centred between the track frames

Tramming with the feeder in vertical position must only take place between holes. When tramming with the feeder in vertical position the feeder must always be centred between the track frames with the feed front as close to the ground as possible.



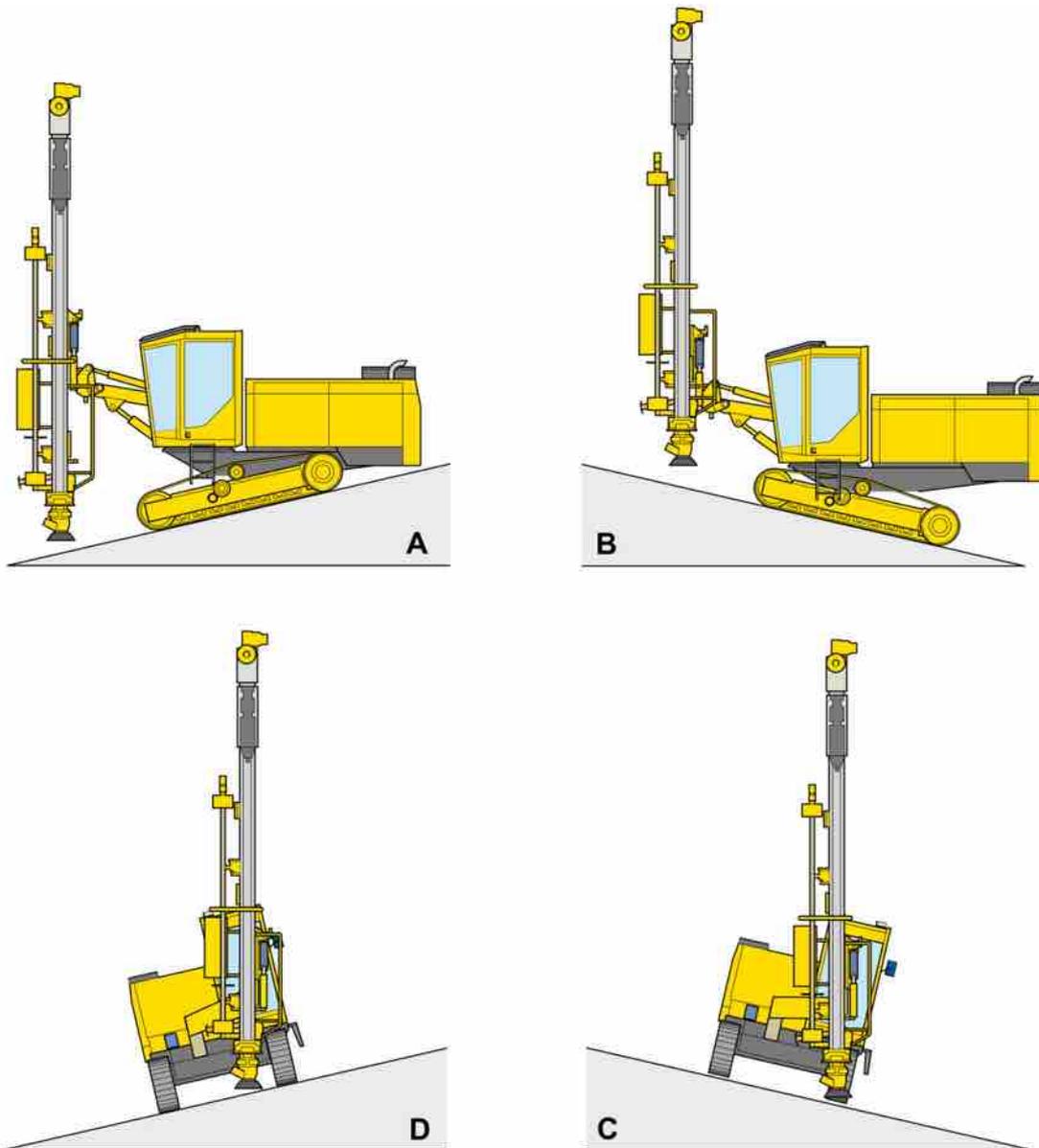
| Illustration reference | Direction | Max. angle of inclination | | | | |
|------------------------|-----------|------------------------------|------------------|---------------------|--------------------|-------------------------|
| | | FR D50/D55 SF - SR D60/65 SF | FR/SR D60/D65 LF | FR/SR D60/D65 RC LF | FR/SR D60/D65 W LF | FR/SR D60/D65 W + RC LF |
| A | Forward | 20 | 19 | 13 | 18 | 18 |
| B | Backward | 20 | 20 | 20 | 20 | 20 |
| C | Left | 20 | 20 | 20 | 20 | 20 |
| D | Right | 20 | 20 | 13 | 20 | 20 |

6.12.3 Setting-up for drilling with the feeder in vertical position and centred between the track frames



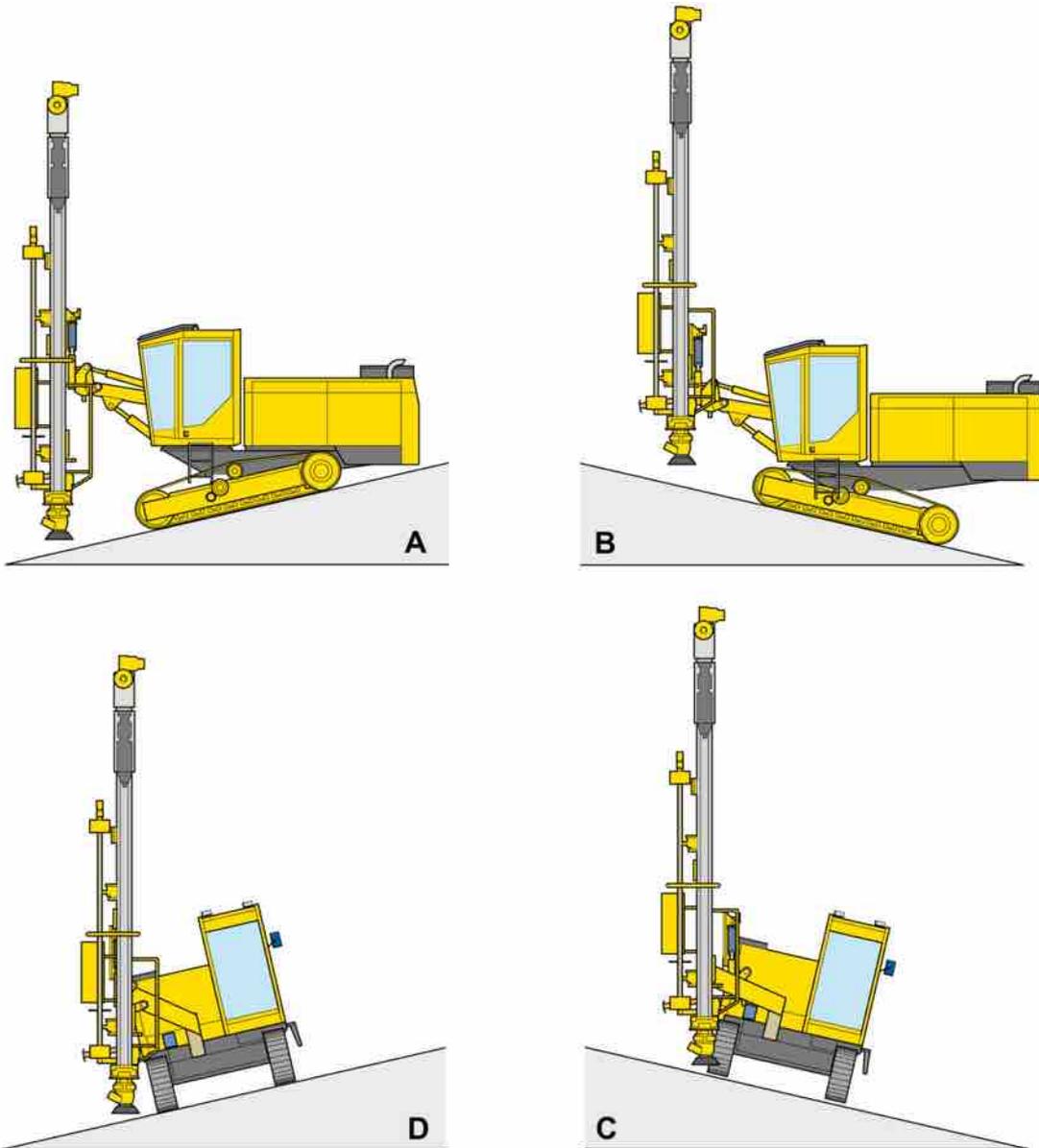
| Illustration reference | Direction | Max. angle of inclination | | | | |
|------------------------|-----------|------------------------------|------------------|---------------------|--------------------|-------------------------|
| | | FR D50/D55 SF - SR D60/65 SF | FR/SR D60/D65 LF | FR/SR D60/D65 RC LF | FR/SR D60/D65 W LF | FR/SR D60/D65 W + RC LF |
| A | Forward | 20 | 19 | 13 | 18 | 18 |
| B | Backward | 20 | 20 | 20 | 20 | 20 |
| C | Left | 20 | 20 | 20 | 20 | 20 |
| D | Right | 20 | 20 | 20 | 20 | 20 |

6.12.4 Setting-up for drilling with the feeder in vertical position and the boom swung max to left



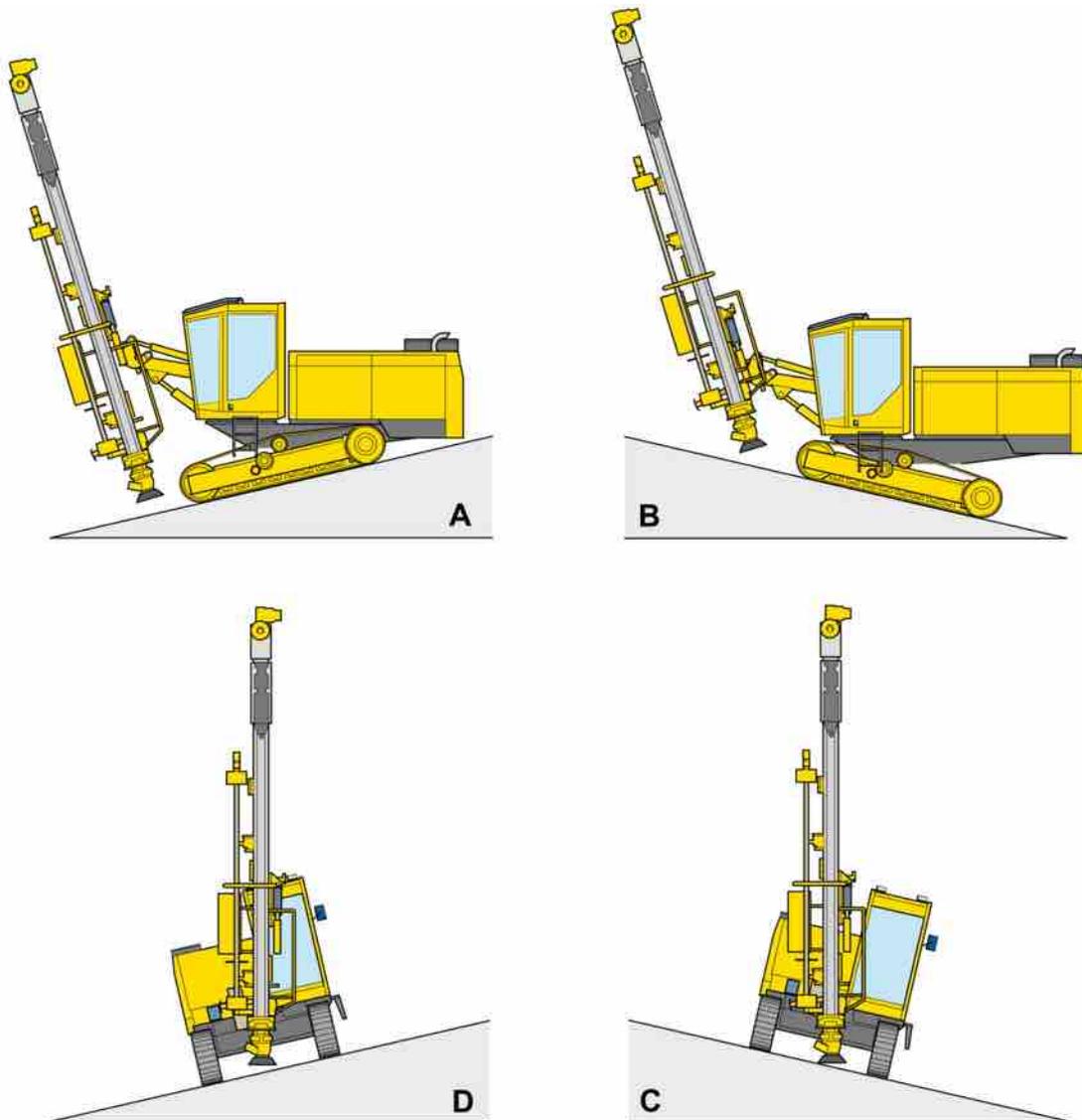
| Illustration reference | Direction | Max. angle of inclination | | | | |
|------------------------|-----------|------------------------------|------------------|---------------------|--------------------|-------------------------|
| | | FR D50/D55 SF - SR D60/65 SF | FR/SR D60/D65 LF | FR/SR D60/D65 RC LF | FR/SR D60/D65 W LF | FR/SR D60/D65 W + RC LF |
| A | Forward | 20 | 19 | 18 | 20 | 20 |
| B | Backward | 20 | 20 | 20 | 20 | 20 |
| C | Left | 16 | 17 | 17 | 20 | 20 |
| D | Right | 20 | 20 | 20 | 20 | 20 |

6.12.5 Setting-up for drilling with the feeder in vertical position and the boom swung max to right



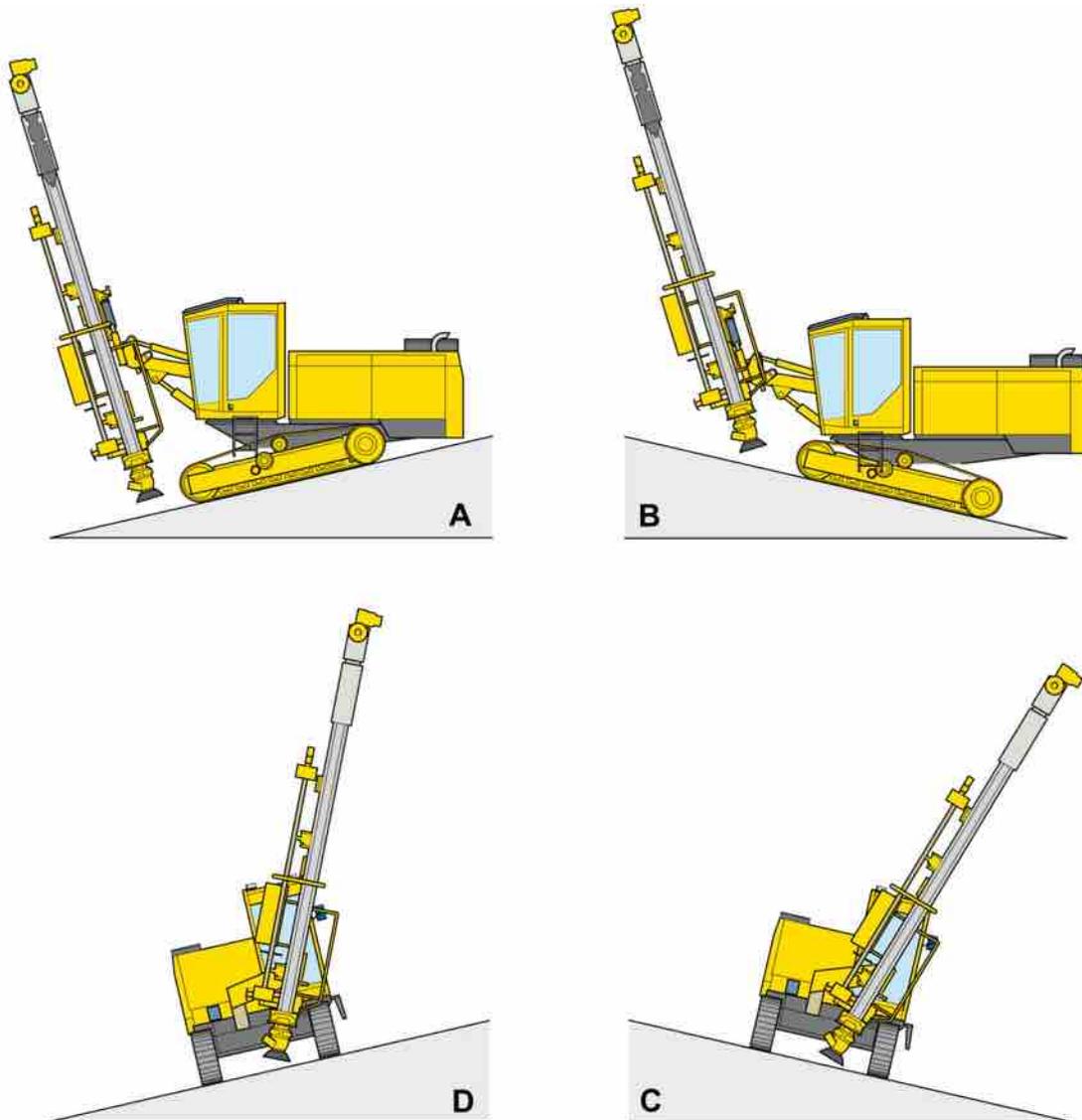
| Illustration reference | Direction | Max. angle of inclination | | | | |
|------------------------|-----------|------------------------------|-------------------|----------------------|---------------------|--------------------------|
| | | FR D50/D55 SF - SR D60/65 SF | FR/SR D60/ D65 LF | FR/SR D60/ D65 RC LF | FR/SR D60/ D65 W LF | FR/SR D60/ D65 W + RC LF |
| A | Forward | 20 | 18 | 17 | 19 | 20 |
| B | Backward | 20 | 20 | 20 | 20 | 20 |
| C | Left | 20 | 20 | 20 | 20 | 20 |
| D | Right | 14 | 16 | 20 | 20 | 20 |

6.12.6 Setting-up for drilling with the feeder top in extreme position forwards, the feeder laterally vertical and centred between the track frames



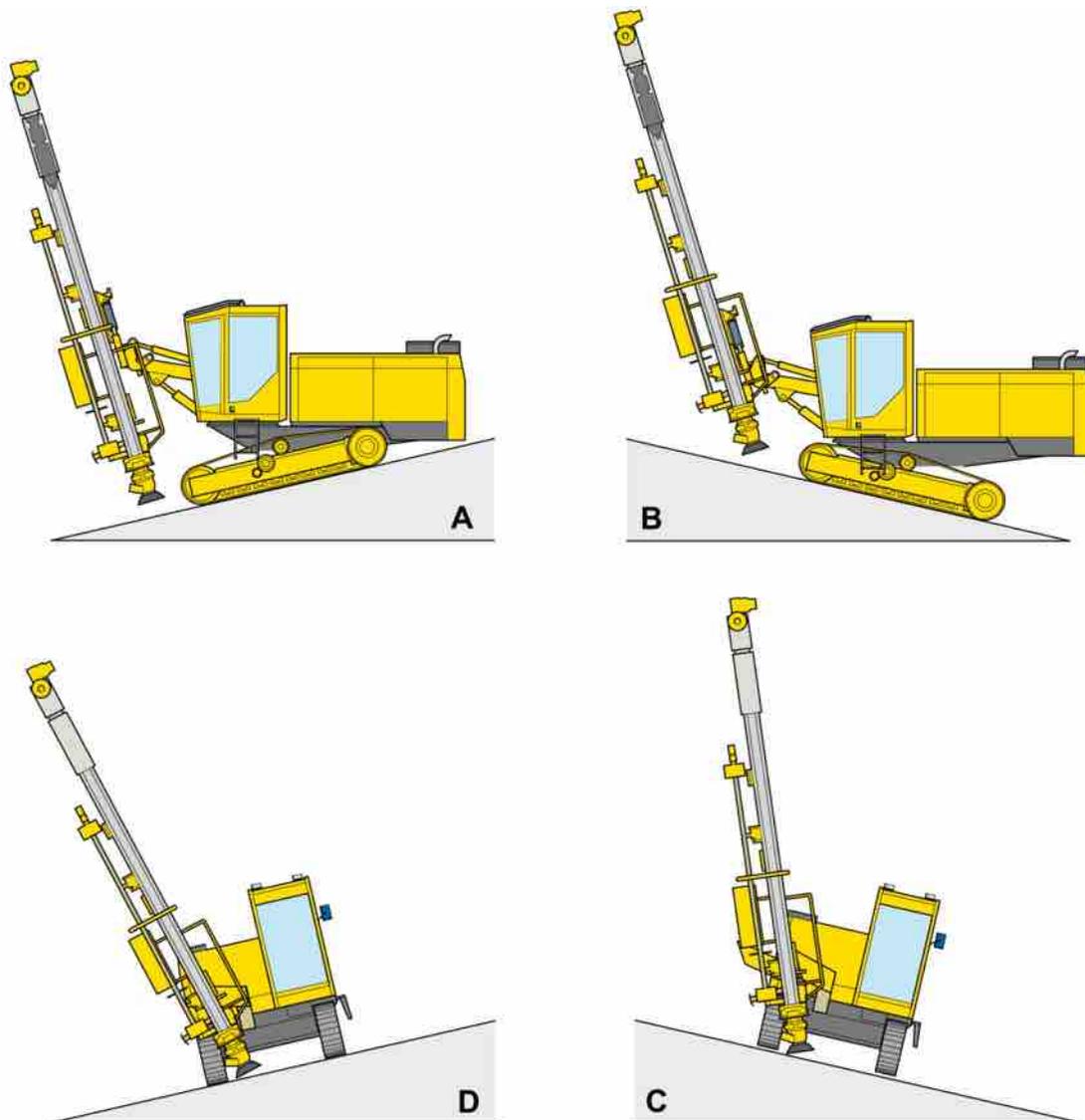
| Illustration reference | Direction | Max. angle of inclination | | | | |
|------------------------|-----------|------------------------------|------------------|---------------------|--------------------|-------------------------|
| | | FR D50/D55 SF - SR D60/65 SF | FR/SR D60/D65 LF | FR/SR D60/D65 RC LF | FR/SR D60/D65 W LF | FR/SR D60/D65 W + RC LF |
| A | Forward | 20 | 13 | 7 | 13 | 13 |
| B | Backward | 20 | 20 | 20 | 20 | 20 |
| C | Left | 20 | 20 | 20 | 20 | 20 |
| D | Right | 20 | 20 | 20 | 20 | 20 |

6.12.7 Setting-up for drilling with the feeder top in extreme position forwards and to the left, and with the boom swung maximum to the left



| Illustration reference | Direction | Max. angle of inclination | | | | |
|------------------------|-----------|------------------------------|------------------|---------------------|--------------------|-------------------------|
| | | FR D50/D55 SF - SR D60/65 SF | FR/SR D60/D65 LF | FR/SR D60/D65 RC LF | FR/SR D60/D65 W LF | FR/SR D60/D65 W + RC LF |
| A | Forward | 20 | 19 | 14 | 20 | 20 |
| B | Backward | 20 | 20 | 20 | 20 | 20 |
| C | Left | 9 | 12 | 9 | 20 | 20 |
| D | Right | 20 | 20 | 20 | 20 | 20 |

6.12.8 Setting-up for drilling with the feeder top in extreme position forwards and to the right, and with the boom swung maximum to the right



| Illustration reference | Direction | Max. angle of inclination | | | | |
|------------------------|-----------|------------------------------|------------------|---------------------|--------------------|-------------------------|
| | | FR D50/D55 SF - SR D60/65 SF | FR/SR D60/D65 LF | FR/SR D60/D65 RC LF | FR/SR D60/D65 W LF | FR/SR D60/D65 W + RC LF |
| A | Forward | 20 | 16 | 10 | 17 | 17 |
| B | Backward | 20 | 20 | 20 | 20 | 20 |
| C | Left | 20 | 20 | 20 | 20 | 20 |
| D | Right | 9 | 9 | 11 | 16 | 20 |

7 Before drilling

7.1 Safety

WARNING

Serious injury

May cause severe personal injury

- ▶ Ensure that unauthorised personnel are not within the working area
- ▶ Do not approach the area surrounding rod/pipe gripper or carousel
- ▶ Always use lifting assistance when loading the carousel
- ▶ Two persons are required to load the carousel
- ▶ Do not approach the area surrounding rod/pipe when the drill-steel support is closed during loading
- ▶ Sensitive levers
- ▶ Inadvertent lever movements can cause serious personal injury
- ▶ Do not rest items on the control panels.
- ▶ Follow the instructions carefully

Two people are required for filling drill pipes/rods. These people should be trained and well conversant with the equipment. Follow the instructions for filling the carousel to avoid personal injury and damage to property.

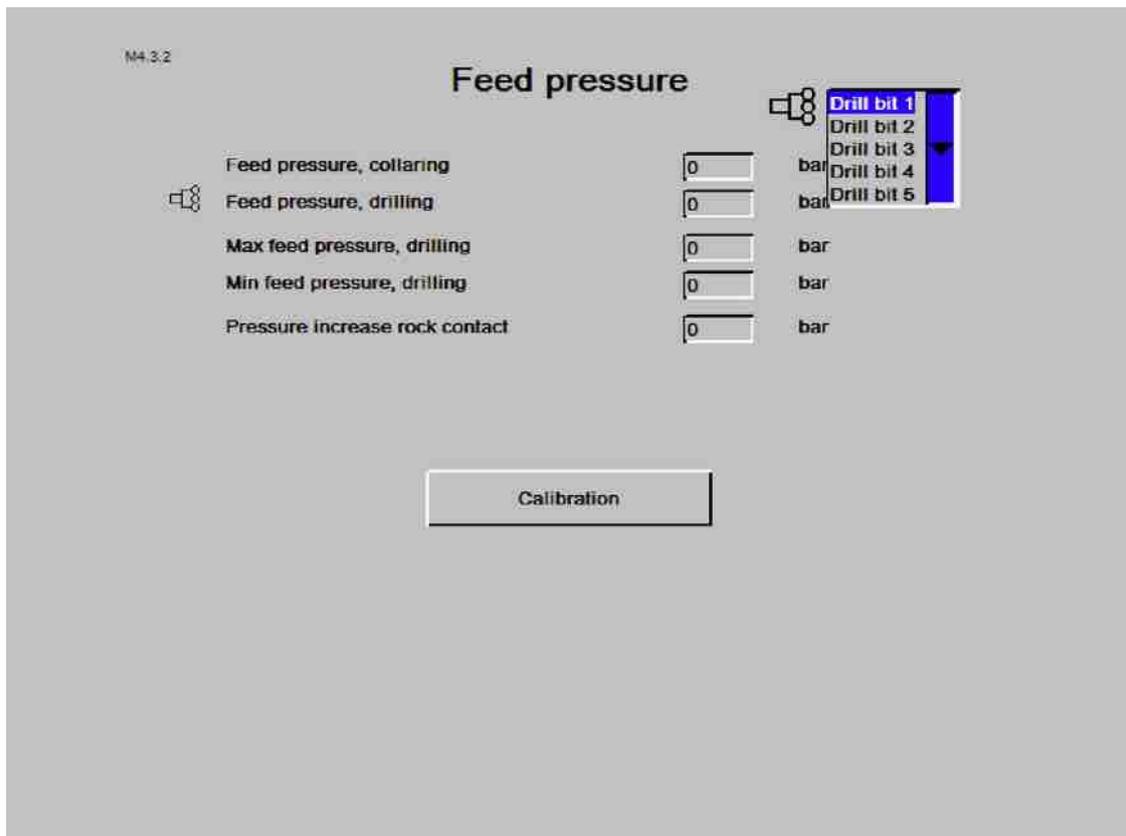
7.2 Calibration of the rotation unit

For all the drilling functions to work, the system will need to know the position of the cradle. This means that the cradle position must always be calibrated before drilling.

This must be done routinely whenever the drilling system is started. An information lamp in the status bar will illuminate if this has not been done.

- Calibrate the cradle by running it so it is positioned above the upper calibration sensor on the feeder.
- Then lower the cradle to the drill-steel support, it will move at reduced speed in this case until its side plate reaches the calibration sensor. The information box in the status bar will then close and full drill lever function will be activated.

7.3 Setting feed pressure



Examples of settings of Feed pressure.

- **Change setting of Drill bit:** Press Enter to display a drop-down menu. Then use the arrow keys up/down (on the display screen) and select the desired setting, confirm with Enter. E.g. as follows:
 - Different type of drill bit
 - Different operator settings
 - Different feed pressures can be changed so that they suit various local conditions.

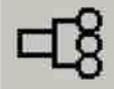
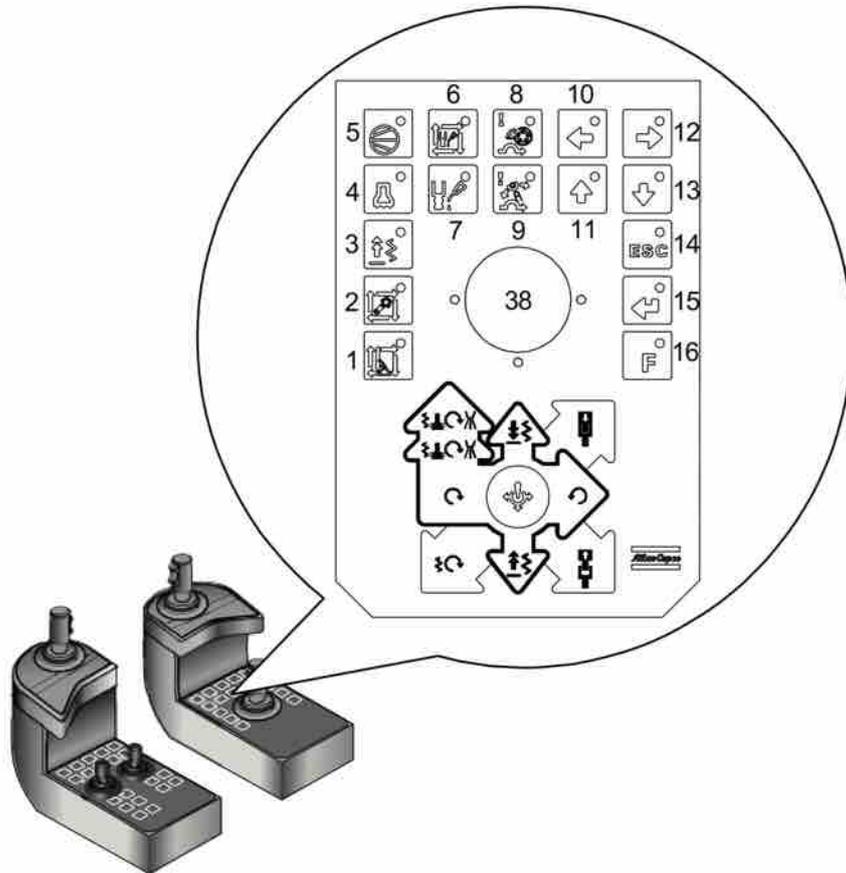
| Symbol | Explanation |
|---|---|
|  | Drill bit. This symbol is next to various parameters and indicates that they are drill bit specific. The symbol can also be found together with a list of options from which the desired type of drill bit can be selected. |

Table 22: Symbols

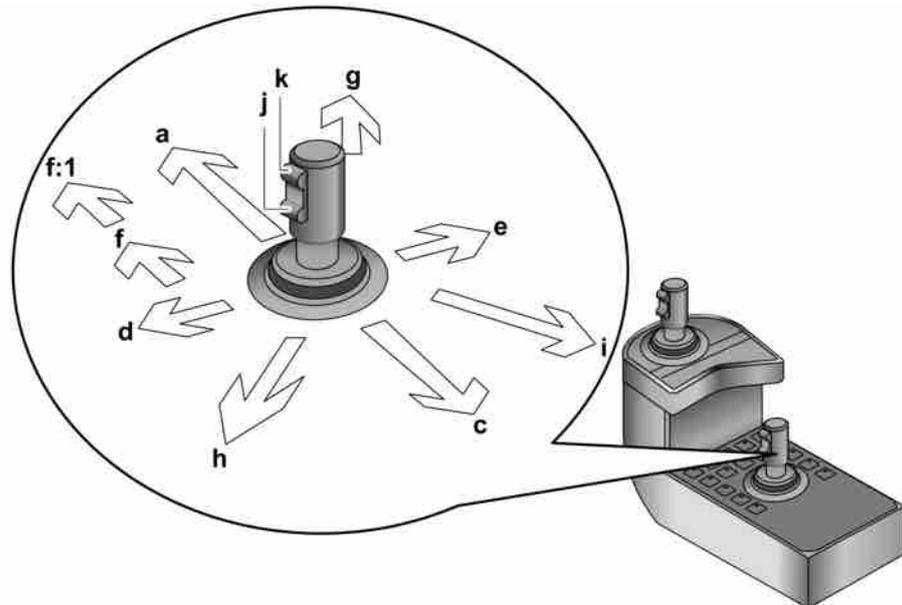
7.4 Loading the rod carousel

1. Activate drilling with button (4)



Right operator's panel.

2. Move the rotation unit to its top position on the feeder by moving drill lever (38) to position (c).

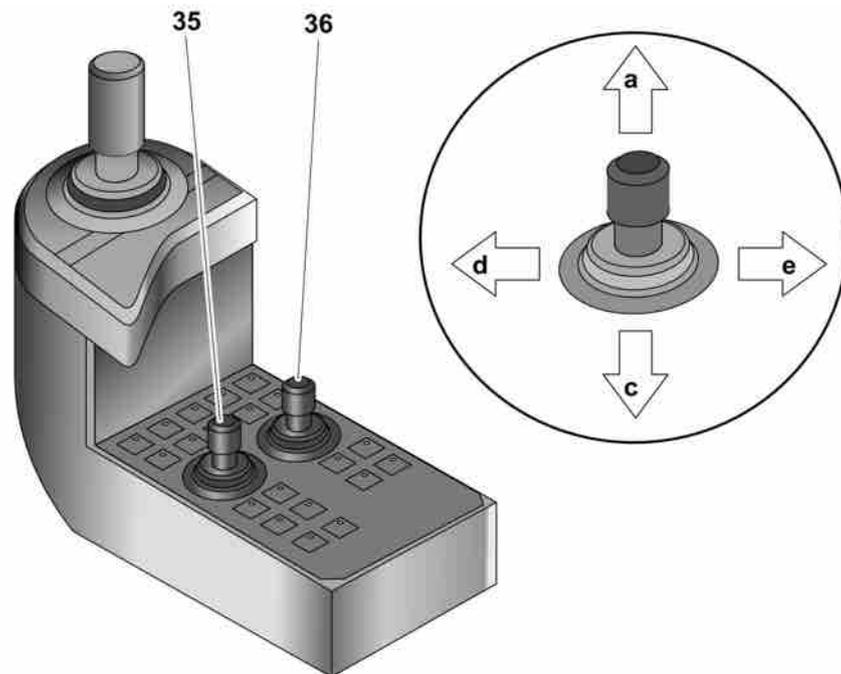


Drilling lever

3. Position the feed beam to the position for filling the drill steel.



Feeder position for filling drill steels.



Boom and feeder positioning levers.

4. Move the arms out from the carousel by moving the rod handling lever (35) to position (c).
5. Rotate the carousel anticlockwise by moving the rod handling lever (35) to rotation anticlockwise (e) repeatedly until the carousel has reached its end position.
6. Activate the rapid feed stops to obtain the correct stops. Button 32, right control panel.
7. Operate the rotation unit down to its lower position. Drill lever position (a)
8. Open both drill-steel supports. Lever 36, position (c) and then press the top button and move the lever to position (c) again
9. Insert the first drill pipe through the drill-steel supports (use suitable lifting equipment). Then close the drill-steel supports so they grip the drill pipe, Lever 36, position (a). Then press the top button and move the lever to position (a) again.
When the drill-steel supports are closed the pipe may move suddenly. Make sure that no-one is in the vicinity of the pipe.
10. Thread together the rotation unit and drill pipe. Drill lever position (g).
11. Open both drill-steel supports. Lever 36, position (c) and then press the top button and move the lever to position (c) again

12. Operate the rotation unit up with the drill pipe, drill lever position (c), until the pipe stops with the thread inside the upper drill-steel support. Close the drill-steel supports.
 13. Open the rod handling grippers and move out the rod handling arms so they grip the pipe. Lever 35 position (c).
 14. Release the lever to the neutral position. The grippers now adopt loose grip.
 15. Operate the rotation unit up to the position for inserting to carousel.
 16. Activate hard grip. Rod handling lever, position (c).
 17. Following which, activate unthreading. Drill lever in position (i).
 18. When the rotation unit is unthreaded from the drill pipe, the pipe is moved into the carousel. Lever 35, position (a)
- Repeat this procedure until the carousel contains the required number of pipes.

7.5 Setting up for drilling



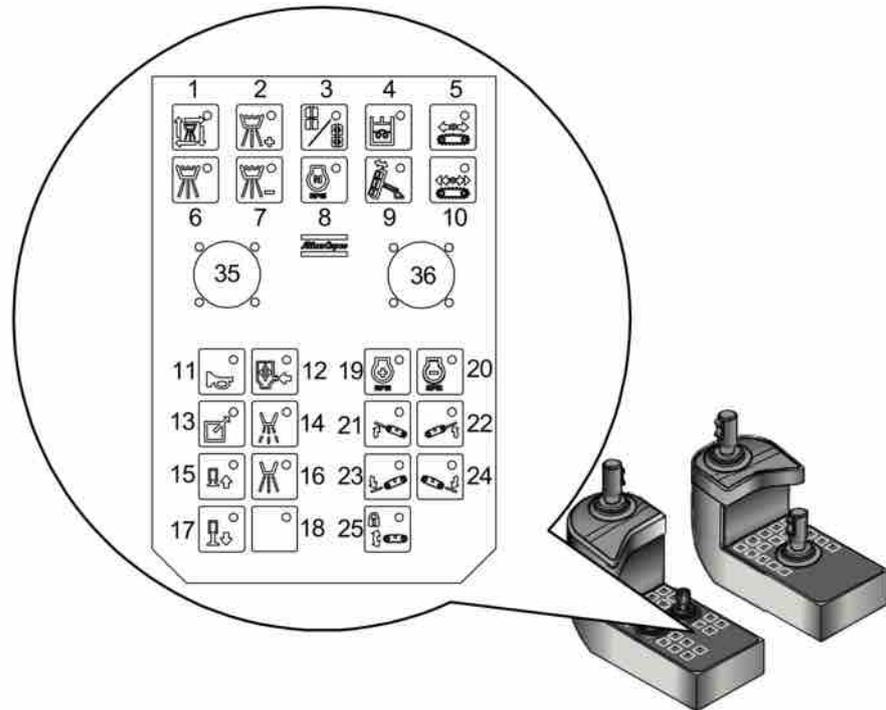
WARNING

Serious injury

Risk of dumping

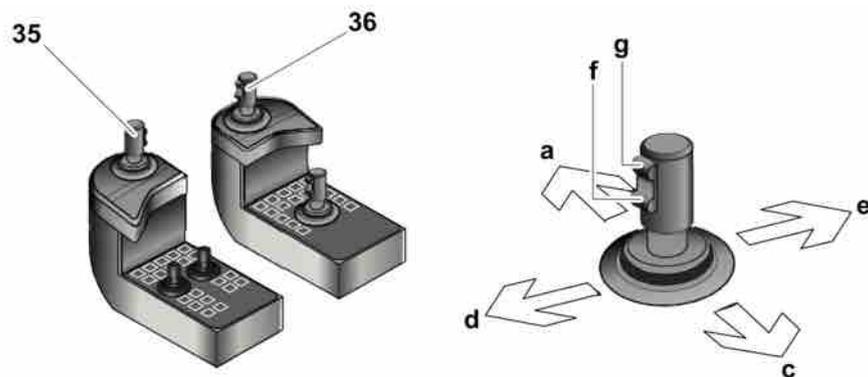
- ▶ May cause severe personal injury and damage to property
- ▶ Keep the track oscillation cylinders locked
- ▶ Do not lower the hydraulic jack too much, the rear sections of the track frames must stand firmly against the ground
- ▶ The angles for Downward/Upward/Lateral, specified in Technical data, must NOT be combined
- ▶ Do not exceed the inclination angles, see Technical data
- ▶ Note the gradient meters' values
- ▶ Ensure that unauthorised personnel are not within the working area

1. Set up the drill rig horizontally using the buttons **Track oscillation (left, right)** (21-24).



Left control panel.

2. Lower the **jack** (option) firmly on the ground without lifting the drill rig. Button (17).
3. Lock the track oscillation cylinders. Button (25).



Boom and feeder positioning.

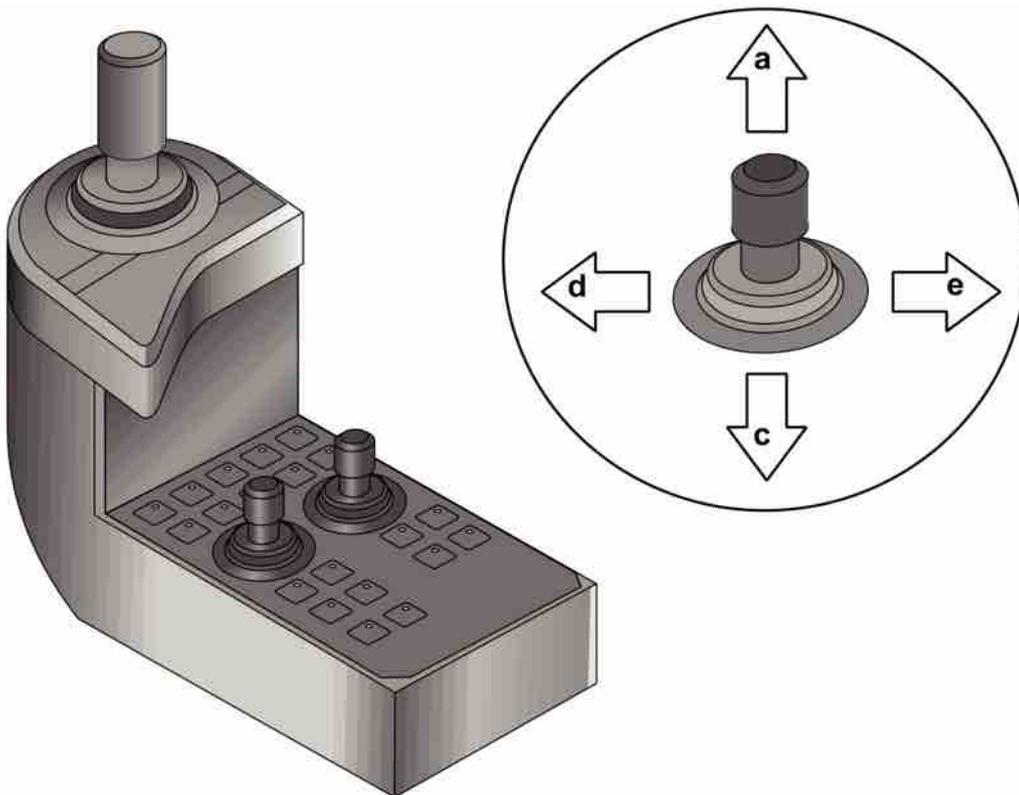
4. Position the feeder with the levers for boom and feeder positioning correctly positioned for drilling. Lever (35) and (36).
5. Set the feed spike firmly on the ground using the feed extension. Lever (35) button in position (g).

8 Drilling

8.1 Start of drilling

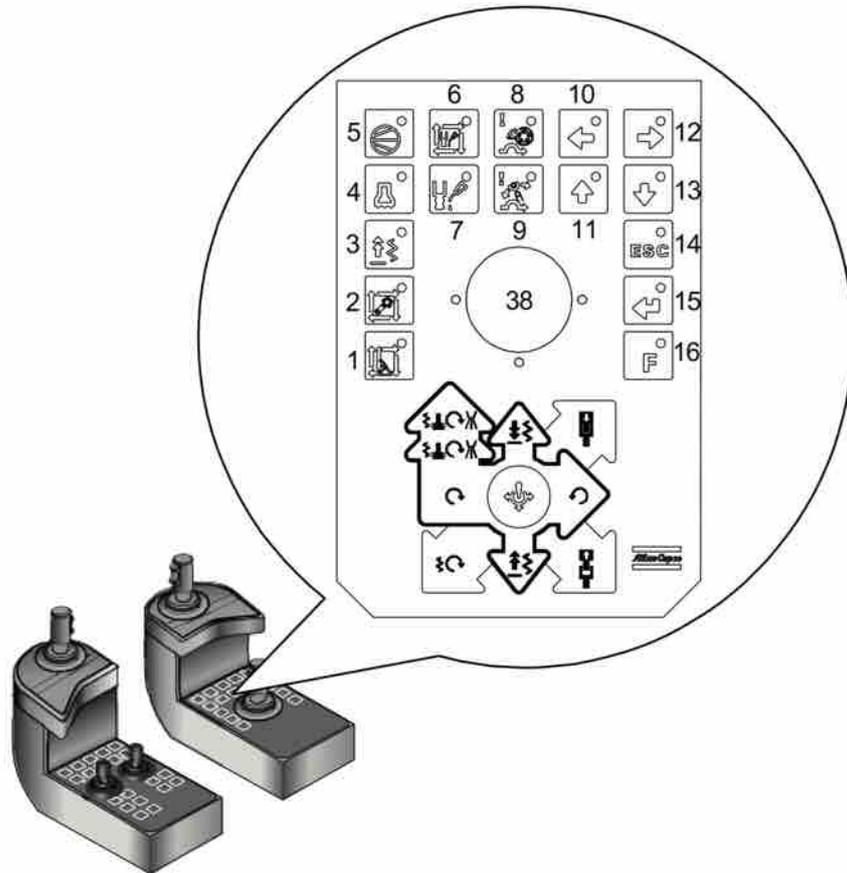
8.1.1 Collaring

Make sure: the rotation unit is at its highest position, there is a drill rod coupled to the rock drill, and there is a drill bit mounted on the drill rod.

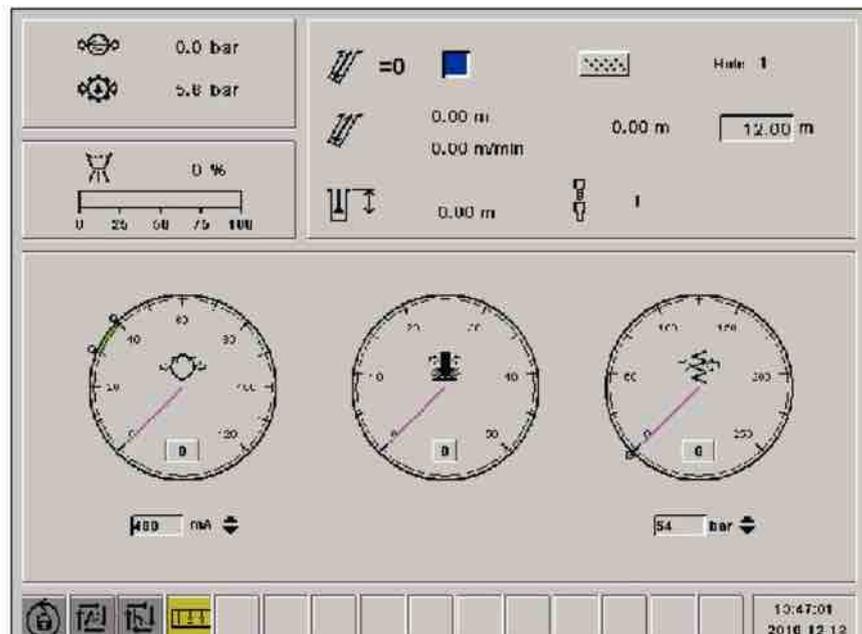


Levers on left control panel.

1. Make sure that the engine speed is at least 1300 rpm.
2. Charge the compressor, button (5). Set the rig in drilling position. Button (4).

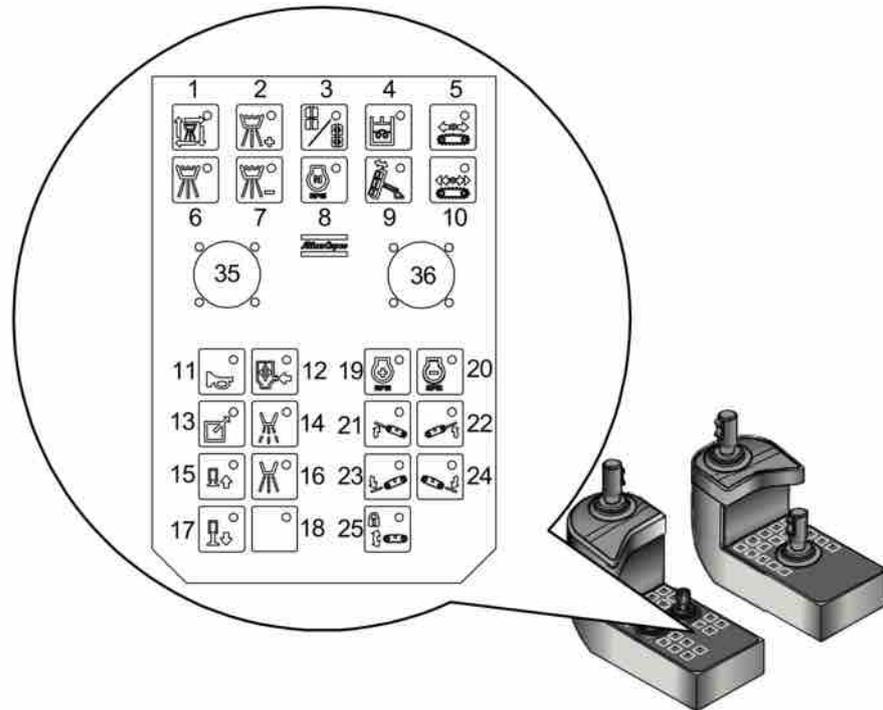


3. Lower the drill bit toward the rock.
4. Set the desired drill depth in the F1 menu (B) and reset the depth meter (A).

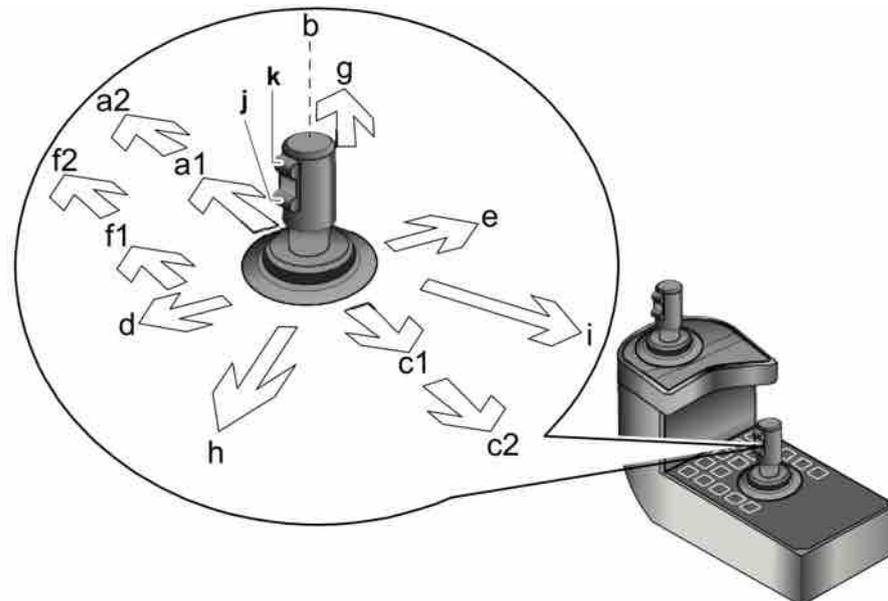


F1 menu

5. Lower the suction hood to the ground. Lever (36) position (d).



6. Make sure that the lower drill-steel support is closed. Move lever (36) forward with button depressed.
7. Activate the dust collector. Button (12).



Drill Lever

8. Activate rotation. Drill lever position (d).
9. Activate collaring. Drill lever from position (d) to position (f). The feed is proportional to the lever in positions (d) and (f). Alternatively activate auto RHS (button 2 on the right-hand control panel) (option) for automatic collaring.

To lock collaring, hold button (k) depressed for 2 seconds during collaring with lever (36) in position (f1).

At this stage the drill lever can be released to neutral (if collaring is unsuccessful the control lever must be moved back and the collaring process restarted).



NOTE: Notice! Use the lever proportionally forward, until the drill bit has entered into solid rock before locking collaring.

10. Full drilling can be activated after reaching homogenous rock or once the drill bit has entered far enough into the rock.
11. Activate full drilling, drill lever position (f2), and hold the lever there for two seconds. When this happens, the green information box will be activated in the status bar on the display (see figure: menu F1).



NOTE: To check that crushed rock is flushed up properly from the hole, the suction hood should be raised now and then.



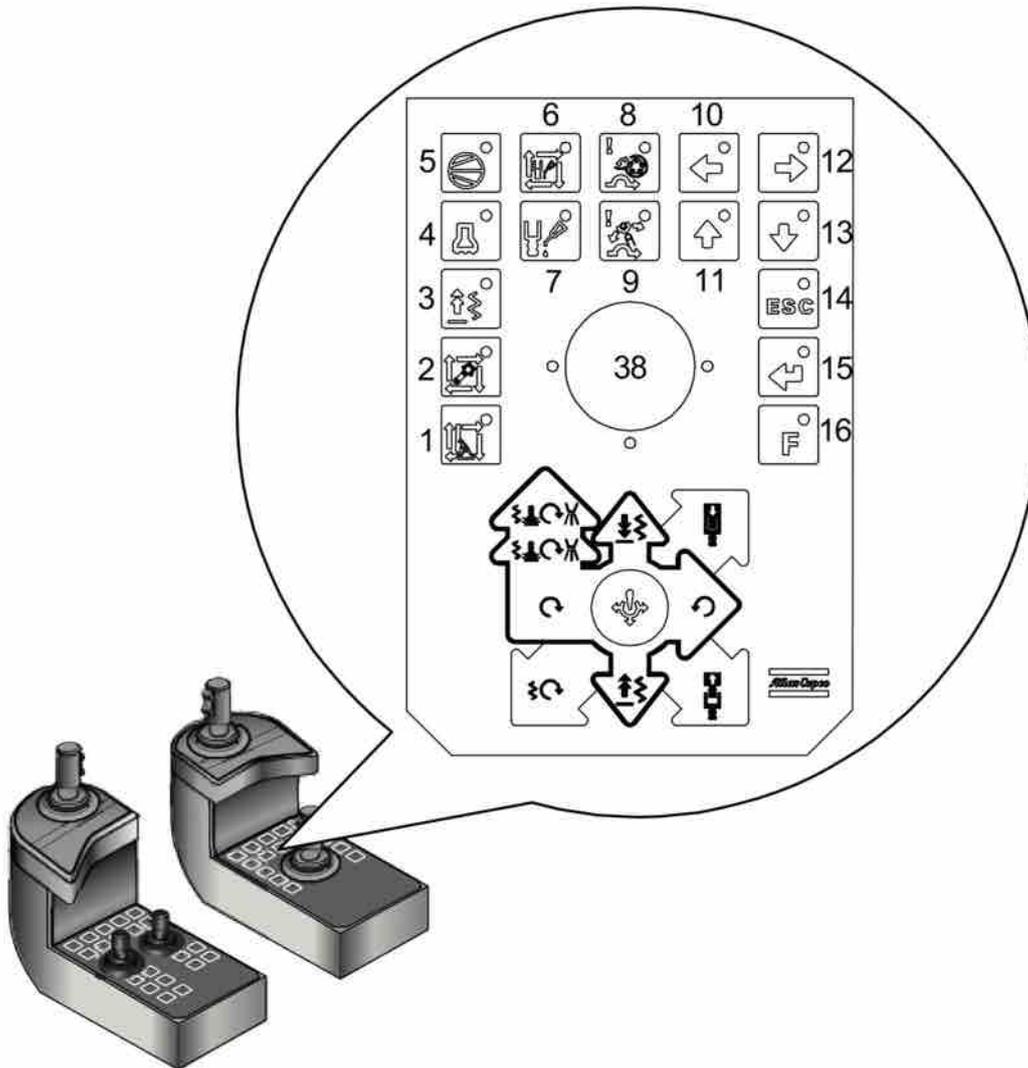
NOTE: Notice! If water flushes out of the hole, turn off the dust collector. Button (8).



NOTE: Moving the drilling lever to position (f2) switches between reduced and full drilling.

8.1.2 One hole automatics (OHA)

The OHA function enables the rig to drill automatically to a desired depth and then extract the rods from the hole. OHA is activated by pressing **button 2**.



OHA is activated with button 2

Start and stop of OHA

Starting up OHA

The OHA function can only be used if the rig is in drilling position. There are two ways of starting the function.

1. Start the drilling process by carrying out a manual collaring. When the locked drilling has begun, press the OHA button to shift to automatic.
2. Start drilling by pressing the OHA button. The auto-sequence starts with an **initial collaring** before increasing to full drilling speed.

When the OHA function is active, a green indicator light will be seen in the status bar at the bottom of the display.



OHA symbol

Stopping OHA

The auto-sequence can be stopped by pressing any of the drill lever buttons or the OHA button itself.

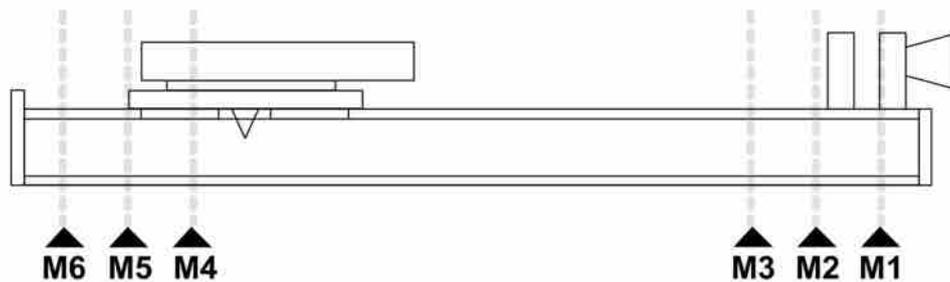
Restart of OHA

If OHA is stopped during drilling, it can be restarted with the OHA button. The OHA sequence will continue from the position it was in when stopped. If the auto-sequence is stopped when a drilling rod is loaded or retracted, the operator must manually ensure that both threaded elements are together, that the RHS arms are in the carousel and that the break-out claws are open before OHA can be restarted.

If the function is stopped during the drilling phase, OHA can be restarted in two ways:

1. Resume locked drilling manually and then press the OHA button.
2. Restart drilling by pressing the OHA button. The auto-sequence process is restarted by initiating a low air flow. The cradle then moves 5 cm back and the drill begins to rotate. The rig begins a locked collaring for a certain time, depending on the time set under **Min collaring time**. When the locked collaring is complete, full drilling will be resumed.

Initial collaring



Cradle positions

Initial collaring is a stage within the OHA function and is performed with the first rod when a new hole is started.

During initial collaring the rig will perform the following steps sequentially:

1. If the cradle is currently at position M5, it will be retracted to this point. This guarantees that the drill bit does not come into contact with the surface when calibrated at idling feed speed.
2. Forward feed of the cradle will start without rotation and air.
3. The cradle will move down 5 cm and the idle feed pressure is then read-in by the system.
4. Once the cradle passes position M5 the lower drill steel support will close.
5. Forward feed continues without rotation and air. When the drill makes contact with the rock, the rig detects this as an increase in feed pressure over the idling feed speed which was calibrated in step 3. The feed pressure can be set via the menu **Drilling, Parameters, Feed pressure, Pressure increase rock contact**.
6. When rock contact is detected the cradle is moved backward 5 cm in order to let out air flow.
7. Low air flow is started, rotation is switched off for a preset time. This period can be modified with F2, **Settings 1, Rotation delay time auto collaring**.

Rotation delay time, auto collaring s

Rotation delay time

- After 2 seconds, collaring begins for a preset extent. This extent can be specified under **Initial collar length**, in menu **Drilling, Parameters, Others**.

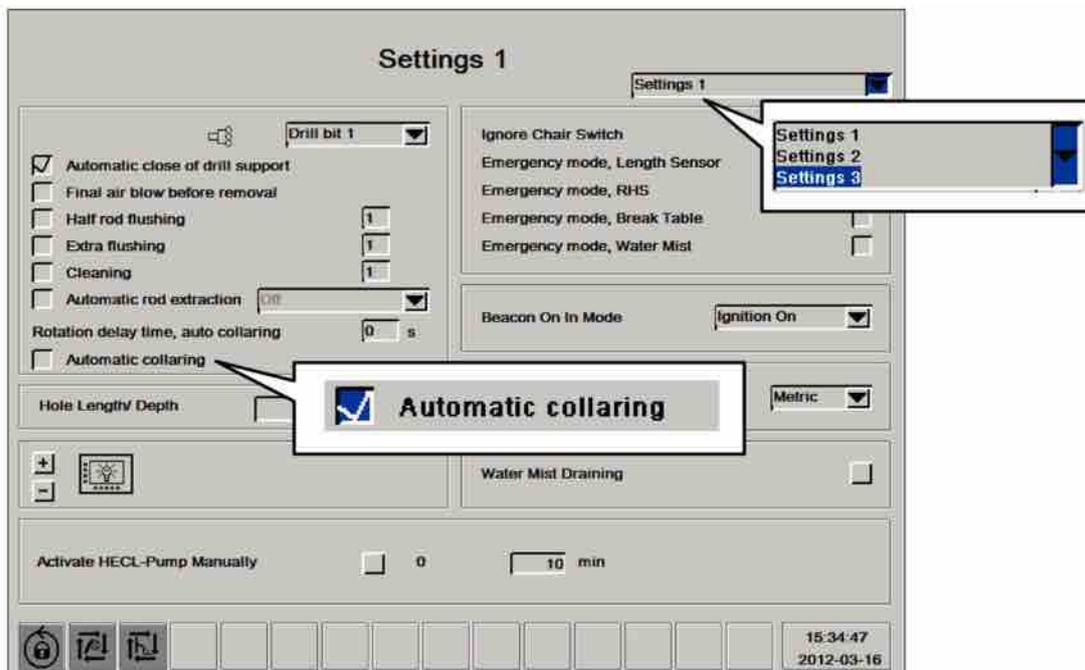
Drill out when position M1 or the desired hole length/depth is reached

When position M1 is reached during the OHA process, the rig will perform the following steps:

- The drill feed will stop.
- The cradle moves back to position M2.
- Rotation and air flushing continue until the air pressure has fallen to the value set according to **Air pressure, drill out**, in menu **Drilling, Parameters, Others**. If this pressure is not reached within 5 seconds, rotation and air flushing are turned off and the RHS sequence continues.
- If **Extra flushing** has been selected with F2, rotation is turned off and air flushing continues for a preset time which can be set via **Extra flushing, Time**. The Water mist function is not switched on during extra flushing.

Automatic collaring - hole build.

Automatic collaring is an extension of the **initial collaring** function. When Automatic collaring is selected, the rig drills forwards then backs up a set distance with the first rod in order to build the hole. Both **initial collaring** and **automatic collaring** are accessed via F2.



Menu F2 - Settings 1

The sequence which is followed during Automatic collaring is the same as for **initial collaring** until the drill tip makes contact with the rock. Then the first part of the hole is created in three steps. Each step can be repeated a certain number of times. The parameter menu for **Automatic collaring** is reached via F2, **Settings 3, Automatic collaring**.

Automatic collaring Collar step 1

| | |
|--|-------------------------------------|
| Collar length | 3.00 m |
| Forward distance | 0.50 m |
| Number of cycles per collar step | 2 ⇒ 1.00 m |
| Increase of length for each cycle | 0.50 m |
| Move backward to M4+offset | <input type="checkbox"/> |
| Backward distance (if not M4+offset is selected) | 0.50 m |
| Air at forward feed | Air flow, reduced |
| Air at backward feed | Off |
| Rotation on at backward feed | <input checked="" type="checkbox"/> |
| Water mist on at forward feed | <input type="checkbox"/> |
| Water mist on at backward feed | <input type="checkbox"/> |
| Water mist pump speed | 50 % |
| Air on rock contact detect level | 1.0 bar |
| Air on time after rock contact | 2.0 s |

Menu 2 - Settings 3 - Automatic collaring Settings 3 , Automatic collaring.

Collar length and collaring step

- **Collar length:** The length of collar calculated from the contact point with the rock. As automatic collaring is only performed by the first drilling rod, this distance which is given as the collar length is limited to the rod length. The parameter menu for **collar length** is reached via F2, **Settings 3, Collar length**.
- **Collaring step:** Automatic collaring has three steps, each with its own parameters. The operator selects each step in turn and inputs the desired values. When the automatic collaring sequence is started, the rig will begin by using the values in collaring step 1, progressing on to collaring steps 2 and 3.

Drill forward and backward.

- **Forward distance:** Each collaring step starts by moving the drill bit forward this length. Forward distance is measured from the rock contact point in collaring step 1 or from the point that the previous step ended for collaring step 2 or 3. The parameter menu is reached via F2, **Settings 3, Forward distance**.
- **Number of cycles per step:** This is the number of times that the drill bit moves forward and backs up in the hole during each collaring step. The parameter menu is reached via F2, **Settings 3, Number of cycles per collar step**.
- **Increase of length for each cycle:** This figure indicates the extra depth added to the collar with each forward movement of the drill bit during a collaring step. It can be set to a value of 0. The parameter menu is reached via F2, **Settings 3, Increase of length for each cycle**.
- **Final length:** The figure shown to the right of the arrow on the **Automatic collaring** display is the final length (from rock contact point) for the collaring step selected. If the Collar length is not reached when collaring step 3 is complete, the last part of the collar is drilled as usual without cycles. If the Collar length is reached before collaring step 3, the system stops the process. It only carries out the measures necessary to achieve the required collar length.
- **Move back to M4 offset:** If **Move backwards to M4 + offset** has been selected, the cradle reverses to position M4 + M4 offset between each forward cycle. Position M4 is above ground level.

- **Distance back: Backward distance (if not M4 + offset is selected)** is used if **Move backwards to M4 + offset** has not been selected. After each forward cycle, the drill is moved back by the distance which the operator specifies here.

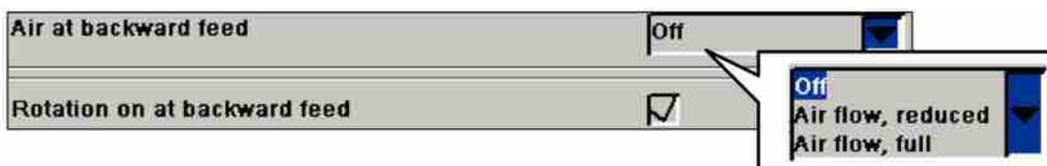
Air when tramping forward



Air flow

- **Air flow, reduced** Reduced air flow is on during each forward feed.
- **Air flow, full** Full air flow is on during each forward feed.
- **Reduced air flow at rock contact** If this choice is activated, the air flow is switched off during the forward movement of the drill bit. When the feed pressure measured exceeds the calibrated idling feed pressure plus pressure for **Air on rock contact detect level**, reduced air is switched on. For example if the calibrated idling feed pressure is 50 bar and **Air on rock contact detect level** is 13 bar, reduced air is switched on when the total pressure exceeds 63 bar. The feed pressure measured can be given in the **Air on rock contact detect level** field. When rock contact is lost, the air flow always continues for a certain time. This time is set using **Air on time after rock contact**. This function helps avoid sudden short shocks which can lead to blockages in the hole. The air is always switched on when the drill steel is less than 0.3 m from the drilled hole base, to protect against shocks.
- **Full air flow at rock contact:** Same function as **Reduced air flow at rock contact** except that the entire air flow is used when rock contact is made and the measured feed pressure exceeds the calibrated idling feed pressure.

Air and rotation when moving backward



Air and rotation when moving backward

- **Off:** No air flow on backward feed.
- **Air flow, reduced:** Reduced air flow is on at backward feed.
- **Air flow, full:** Full air flow is on at backward feed.
- **Rotation on at backward feed:** This function rotates the drill bit during backward feed.

Water mist



Water mist option

- **Water mist on at forward feed:** When the drill bit moves forward, water mist is activated.

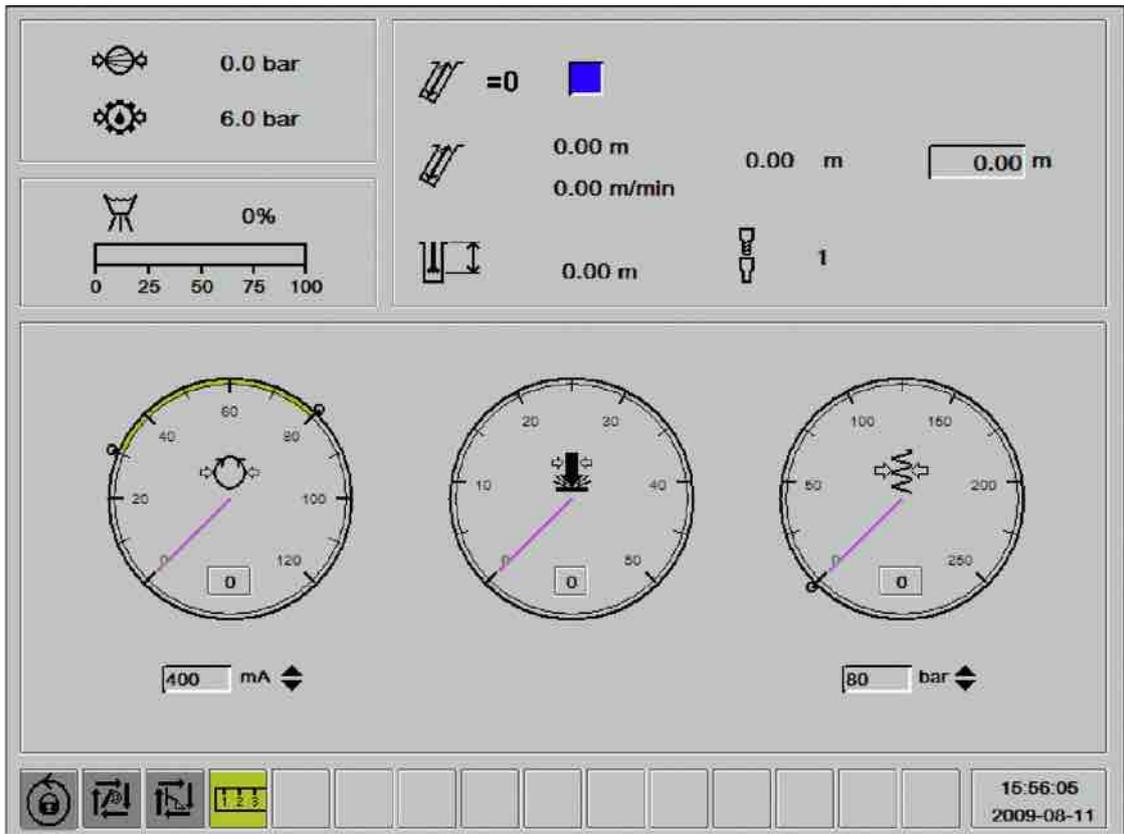
- **Water mist on at backward feed:** When the drill bit moves backward, water mist is activated. Air on backward feed must also be activated for the water mist to work on backward feed.
- **Water mist pump speed:** The speed of the water mist pump (0-100%). This parameter is only valid if water mist is selected.

8.1.3 Direct selection menus



In order to read or change values in the various menus for drilling, the operator must activate the correct menu. The direct selection menus F1-F4 can be activated using the direct selection buttons (F1 - F4). Direct selection menu F5 is activated by pressing the **Fn** button and then the right-hand button **F1**. (Fn is activated for 3 seconds after each press of the button.) Below is a description of the five direct selection menus.

8.1.4 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 |
|--------|--------------------------|---|
| | Air pressure | Shows the current pressure in the pressure tank (Bar) |
| | Water mist | Shows current flow to water mist system (%) |
| | Lubrication oil pressure | Shows the current lubrication oil pressure to the drill hammer (Bar) |
| | 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. |

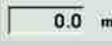
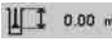
| Symbol | Name | Explanation |
|---|---|---|
|  | Shortcut, drill plan | This can be used for direct access to the drill plan. |
|  | Current hole length Penetration rate | The value at the top shows the current hole length (m) and the bottom value the penetration rate (m/min). During autodrilling, 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. |
|  | 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. |
|  | Drill bit position | Shows the position of the drill bit in metres |
|  | Rod indication | Shows the number of drill steel in the hole |

Table 23: Explanation of the symbols in direct selection menu F1.

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

Adjustable parameter boxes are located under the pressure gauges for rotation and feed pressure.

The feed pressure is set in this box. These values can be found in the **Drilling-Parameters** menu and are marked with a drill bit to the left.

- **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)

8.1.5 Direct selection menu F2.

The screenshot displays the 'Settings 1' menu with the following options:

- Drill bit 1** (dropdown menu)
- Automatic close of drill support**
- Final air blow before removal**
- Half rod flushing** (value: 1)
- Extra flushing** (value: 1)
- Cleaning** (value: 1)
- Automatic rod extraction** (value: Off)
- Ignore Chair Switch**
- Emergency mode, Length Sensor**
- Emergency mode, RHS**
- Emergency mode, Break Table**
- Emergency mode, Vessel Pressure Sensor B456**
- Emergency mode, Water Mist**
- Beacon On In Mode** (value: Ignition On)
- Hole Length/ Depth** (value: Hole Length)
- Units of Measurement** (value: Metric)
- Water Mist Draining** (checkbox)
- Activate HECL-Pump Manually** (checkbox) with a timer set to 10 min.

At the bottom, there are several icons and a status bar showing the time 10:25:42 and date 2011-01-19.

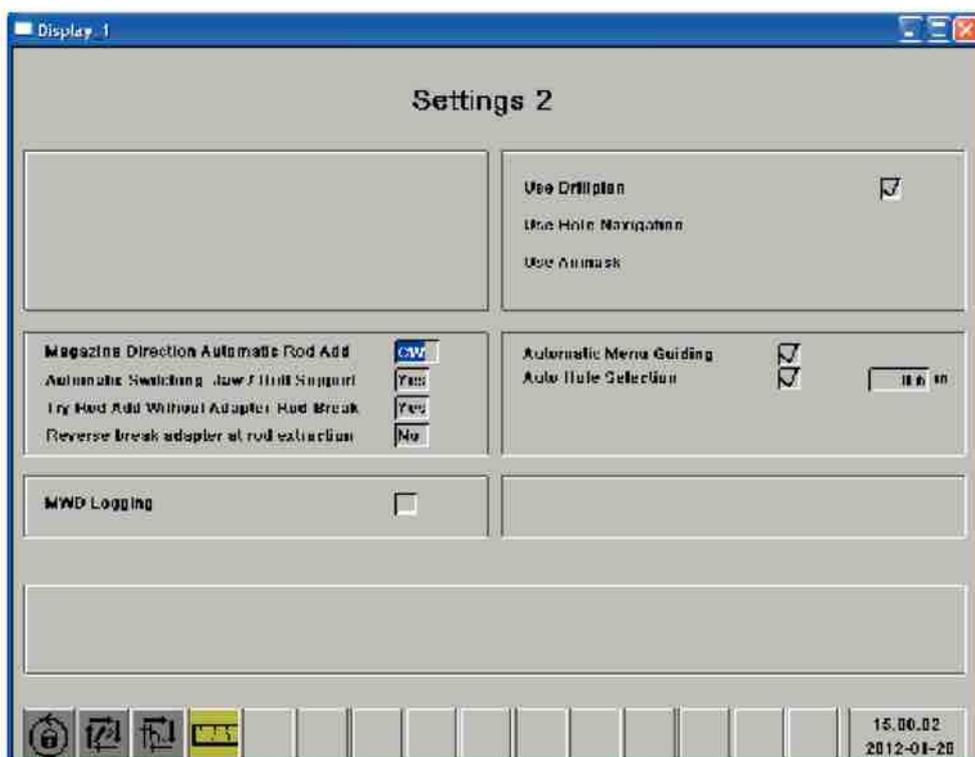
Direct selection menu F2. **Settings 1**

Quick Settings

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

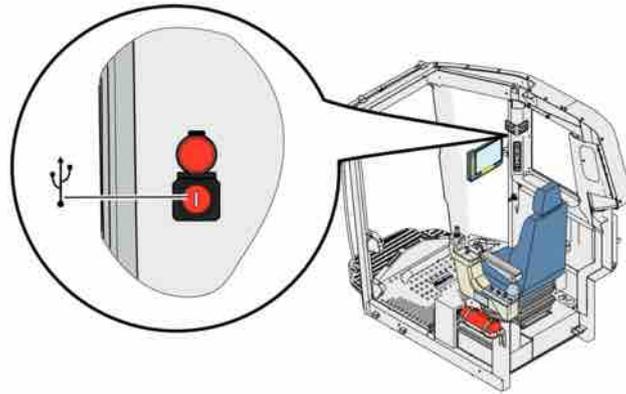
- **Automatic close of drill support:** Automatic close of drill support can be set here so that the function can be disengaged for single-rod drilling.
- **Final air blow before removal:** Activates extra flushing when the hole is finished.
- **Half rod flushing:** Activates extra flushing when a half rod length is drilled.
- **Extra flushing:** Activates extra flushing before auto drilling.
- **Cleaning:** Before auto drilling, extra flushing and feed up and down for one drill pipe length are activated.
- **Automatic rod extraction:** Select from three functions. **Off** = Normal extraction. **Rotation** = Extraction with rotation on. **Rotation and air** = Extraction with both rotation and air on.
- **Hole Length/Depth:** Selection of method of measurement.
- **Activate HECL-Pump Manually:** The HECL pump can be activated manually from here and will remain active during an adjustable period of 1-90 minutes, after which the pump must be reactivated for additional time.
- **Ignore Chair Switch**
Activated when the positioning levers need to be used when the operator is not seated, for example, to get a better view through the rear window.
- **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. The emergency mode buttons on the right-hand panel can also be used.
- **Emergency mode, Break Table:** Enables manual operation of the break table using lever (36).
- Emergency mode, Vessel Pressure Sensor B456
- **Emergency mode, Water Mist:** The water pump can be operated even with a warning of level too low.
- **Beacon on in mode:** Selects whether the warning beacon should be on in **Ignition On, Trammig Mode** or **Trammig**.
- **Units of Measurement:** Select Metric/Imperial units
- **Water mist draining:** The watermist system is drained, but not the tank.



Direct selection menu F2 Settings 2

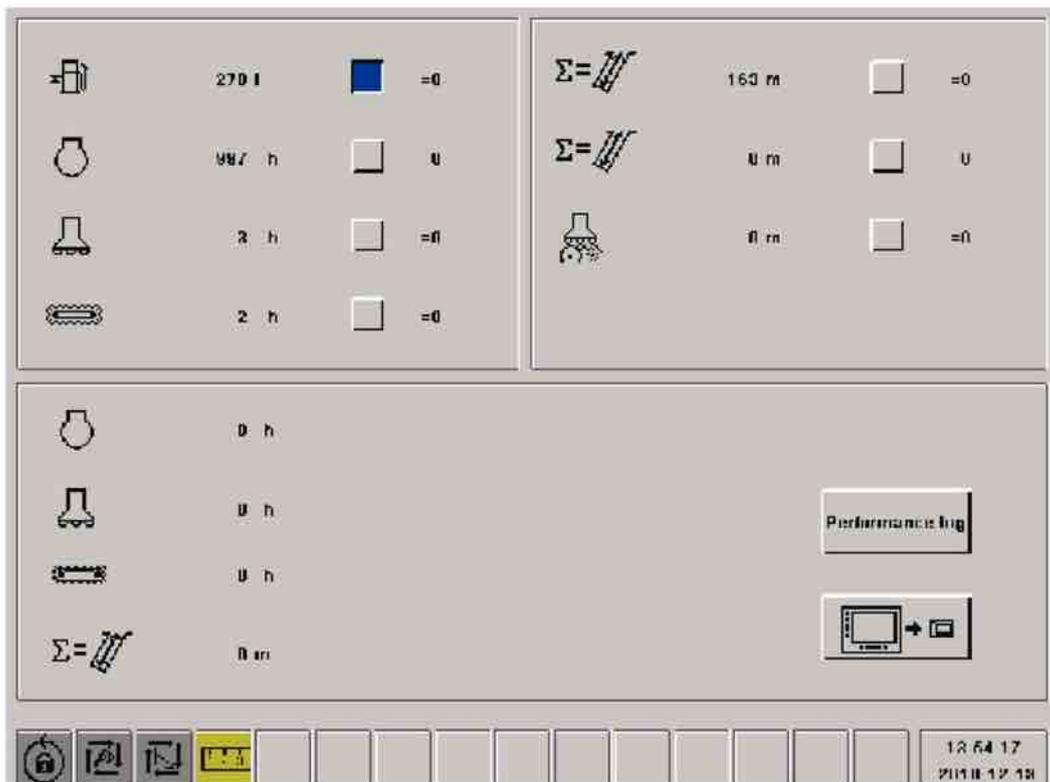
- **Magazine Direction Automatic Rod Add:** Selects **CW** or **CCW**.
- **Automatic Switching: Jaw/Drill Support** This means that during drilling the button is active and controls the drill-steel supports, but when semi-automatic breaking is performed the button is deactivated and the lever then controls the breaker jaws, the button is activated when the drilling starts again.
- **Try Rod Add Without Adapter-Rod-Break** To save time the system attempts to thread the adapter apart from the tube by simply closing the lower jaw pair. If this is not possible then breaking will take place automatically.
- **Reverse break adapter at rod extraction** In order to facilitate loosening the joint between adapter and rod the break table performs backward breaking for extraction.
- **Auto hole selection** When a drill plan is used and this function is activated the system will suggest the next closest hole by selecting the hole in the fine navigation menu. The operator approves the selection by pressing Enter.
- **MWD logging** (Option): Activates the MWD function. MWD presents a range of values from drilling in the ROC Manager. Requires a USB memory stick to be inserted in the socket on the right post at the display.



USB socket

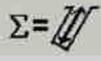
- **Use Drillplan:** Used if import of drill plan from ROC Manager is executed.
- **Use Hole Navigation:** Used if the rig is specified with GPS (option).
- **Use Anmask:** Used if the rig is specified with GPS (option) and if import of drilling data from Anmask is required.
- **Automatic Menu Guiding:** Used if automatic changing of navigation menus is required.
- **Local coord drillplan:** Used if the system shall be used with local coordinates.

8.1.6 Direct selection menu F3.



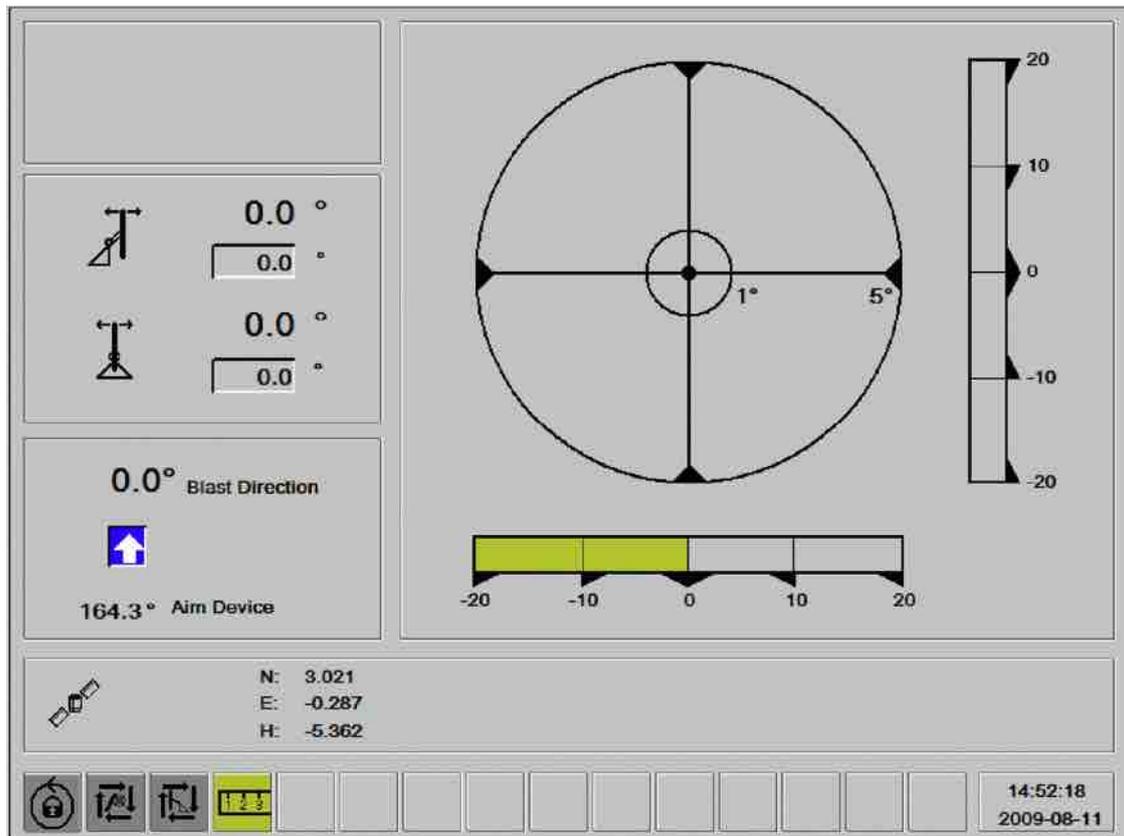
Direct selection menu F3.

Symbol description for direct selection menu F3

| Symbol | Name | Explanation |
|---|---------------------|---|
|  | Diesel consumption | Counter for diesel consumption. |
|  | 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 |
|  | Save | Save to USB memory stick for printing on PC |
|  | Grinding interval | Resettable counter for grinding interval |

- **View performance log:**

8.1.7 Direct selection menu F4.



Direct selection menu F4.

- **Angle position:** Upper value on left shows current tilt of feeder. Under this value is an adjustable field where the desired tilt angle can be set.
- **Angle position:** The bottom value shows the current swing position of the feeder. Under this value is an adjustable field where the desired side 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 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.

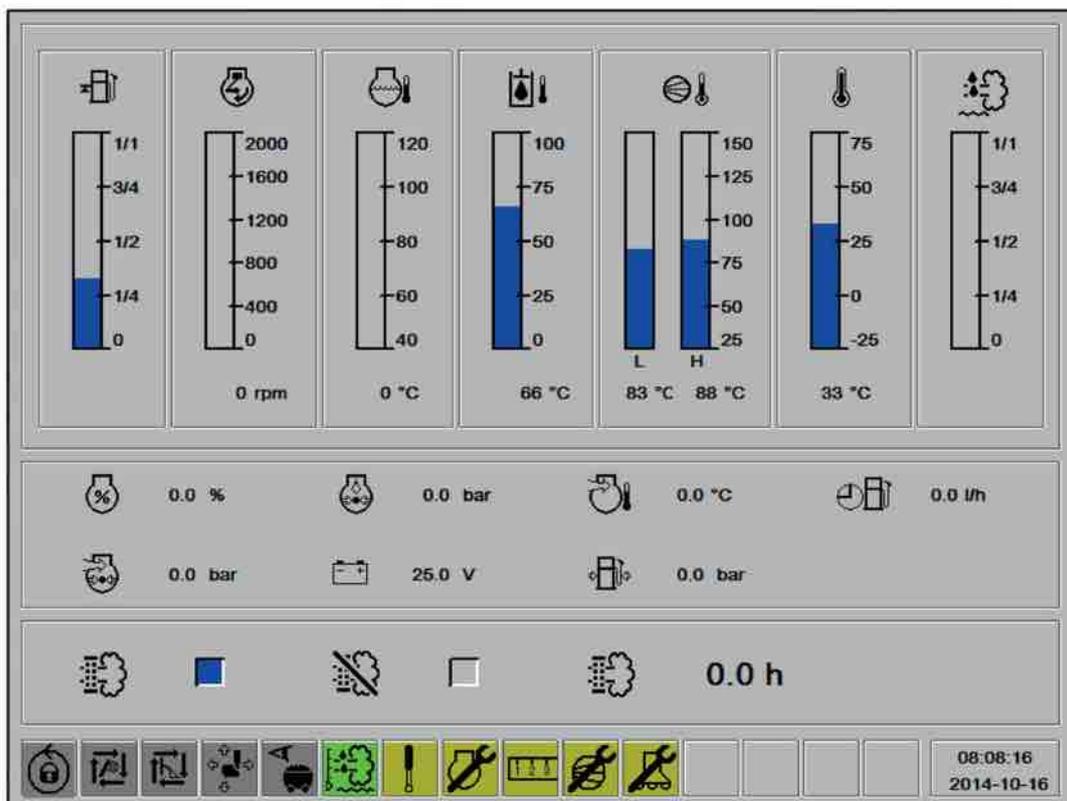
The end of the needle reaching the centre of the graphic image means the feeder position is at the desired value.

This setting can also be made using "Automatic feeder positioning" (option).



NOTE: Read more about direct selection menu F4 in the chapter "Angle instruments"

8.1.8 Direct selection menu F5



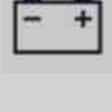
Direct selection menu F5

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 |
|  | Coolant temperature | Displays temperature of coolant |
|  | Hydraulic Oil Temp | Displays the temperature of the hydraulic oil |

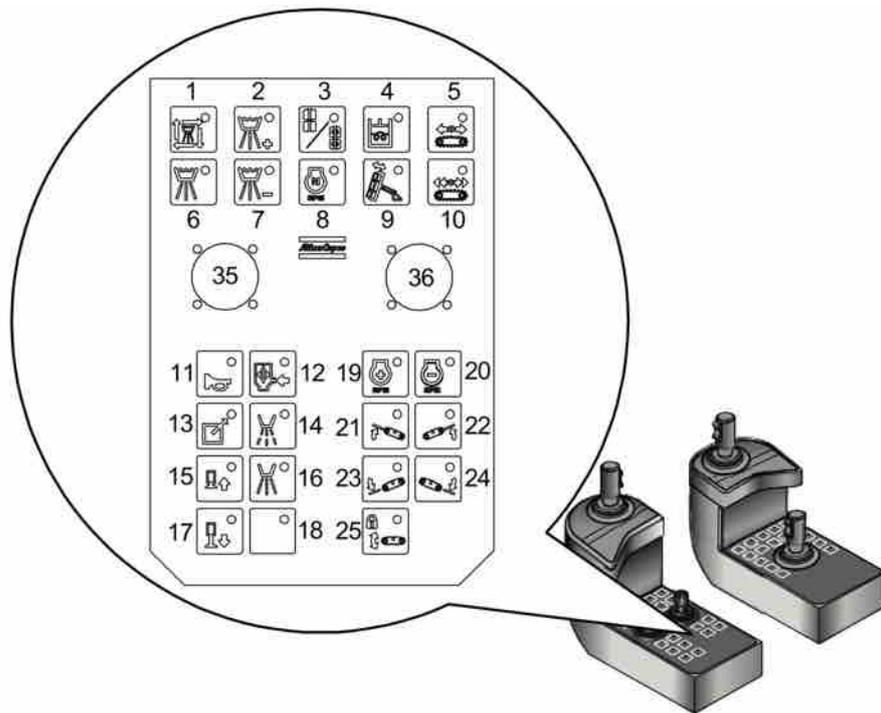
| Symbol | Name | Explanation |
|---|------------------------|---|
|  | Compressor temperature | Reads and displays the current compressor temperature. If the compressor attains a high air temperature (120 °C), the diesel engine will be switched off automatically and an information box will be shown 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. |
|  | Fuel pressure | Displays the operating fuel pressure to the injectors |
|  | Forced regeneration | Start forced regeneration |

| Symbol | Name | Explanation |
|---|------------------------------------|---|
|  | Block regeneration | Block automatic regeneration |
|  | Max. time left before regeneration | Shows maximum time remaining until automatic regeneration of the diesel engine's particulate filter |

8.2 Adding drill rods

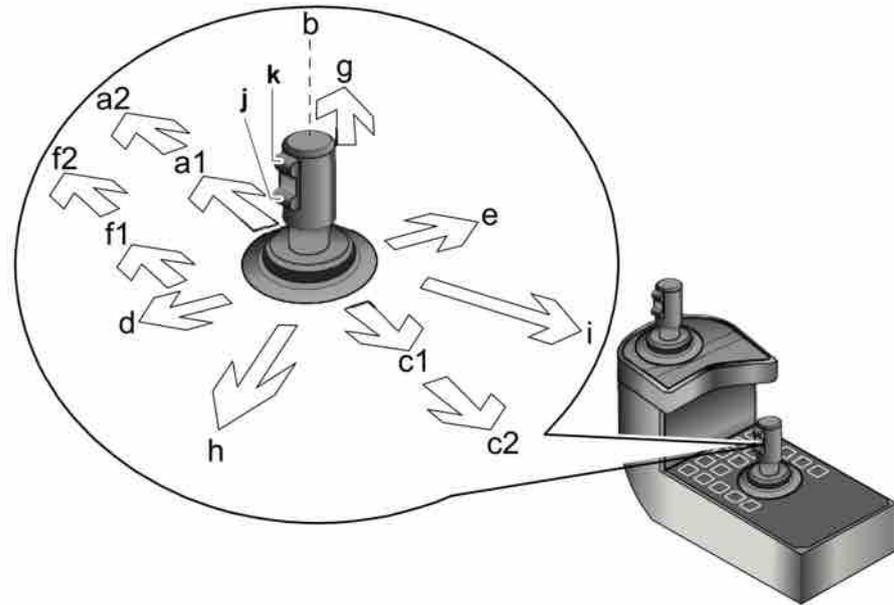
8.2.1 Unthreading of the rotation unit from the drill pipe and extraction:

1. Break the joint using semi-automatic breaking. Make sure the button (3) on the left-hand control panel is deactivated.



Move lever (36) with depressed top button to the right for semi-automatic breaking.

2. Activate unthreading, drill lever (i).



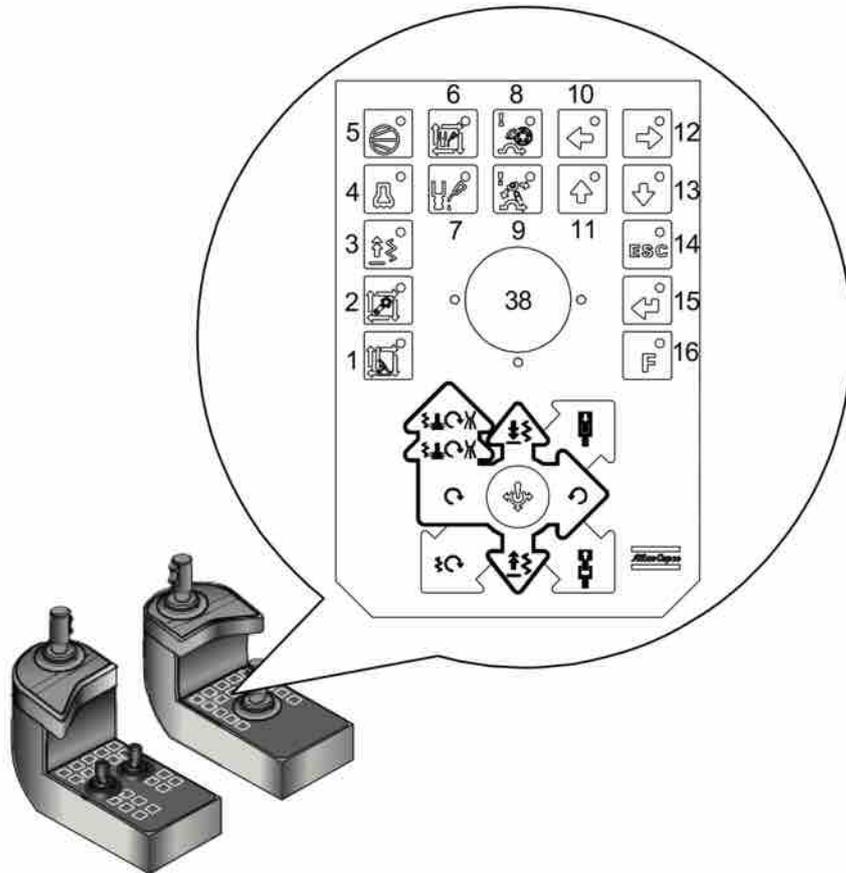
Drill lever functions.

The rotation unit is unthreaded from the drill rod when the shank adapter is free from the sleeve.

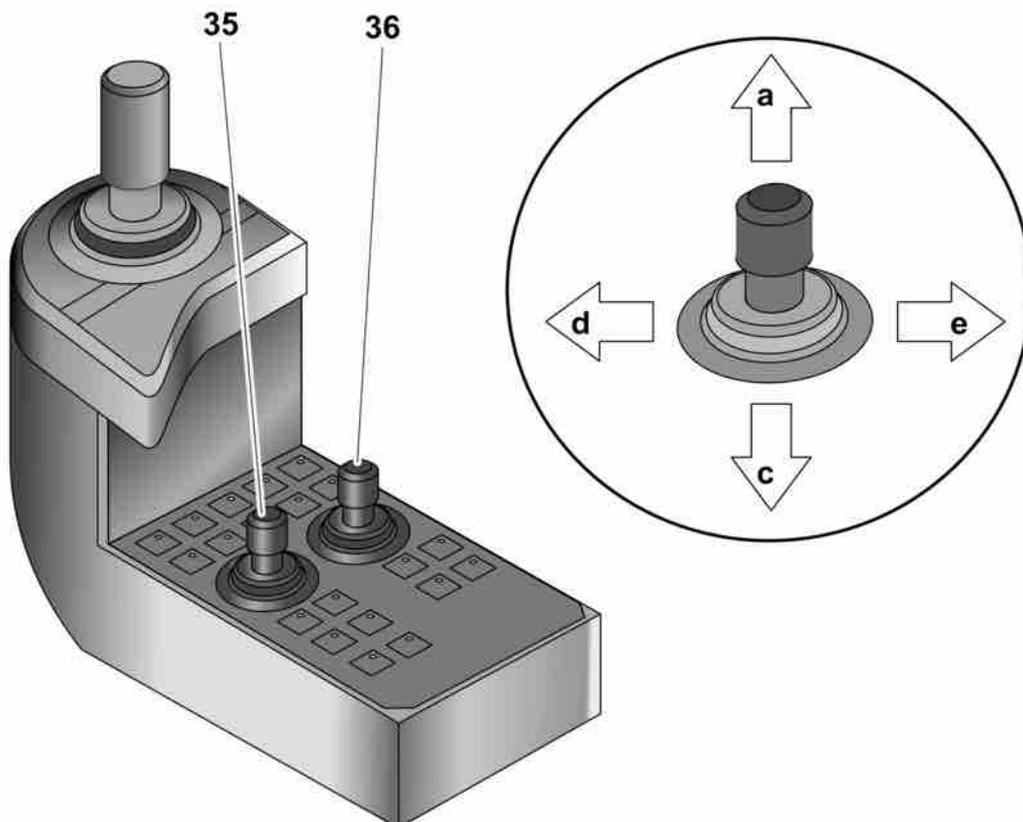
1. Move the drill lever to neutral.
2. Activate rapid feed up, drill lever position (c).
3. The cradle stops automatically above the carousel so that a new drill rod can be added.
4. Move the drill lever to neutral.



NOTE: The drill rod retraction function must be deactivated, the diode on the button must not be on.



8.2.2 Threading a new drill pipe

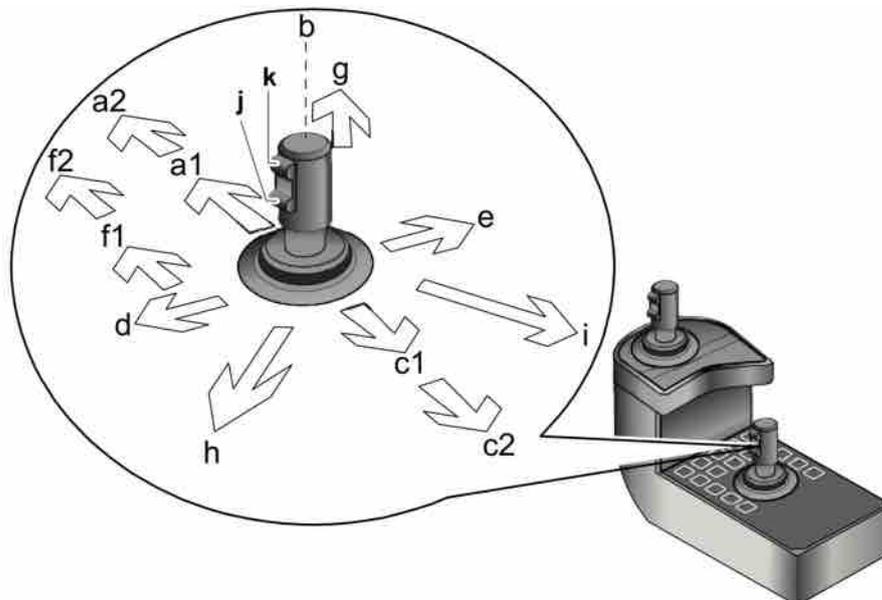


RHS levers and Suction hood/drill-steel support/break table.

1. Move the drill pipe to drill centre. Lever (35) position (c)



NOTE: If there is no new drill pipe in the RHS grippers then the carousel must first be rotated.



Drill lever functions.

2. Move the rod handling lever (35) to (b) neutral.
3. Activate threading, drill lever (g).
The rotation unit is threaded onto the new drill pipe and the new drill pipe is threaded onto the drill string.
4. Move the drill lever to neutral.
5. Rotate the carousel, lever (35) to position (d) or (e).
6. Move the rod handling arms to the carousel by depressing the button on the rod handling lever (35) and keep it held in while moving the lever to position (a). Release the button and the lever.
7. Open the lower break table by depressing the top button on lever (35) and moving it to position (c).

8.3 Changing drill bit

WARNING

Serious injury

Moving parts

- ▶ Risk of personal injury, clothing can be trapped
- ▶ Stop rock drill rotation when changing bits



NOTE: *Never start percussion with the drill bit free without any resistance.*

1. Operate the feeder until the spike is approx. 10 cm from the rock.
2. Make sure that the rotation lever is in neutral.
3. Move the drill bit forward until it is pressed against the rock.
4. Switch on high percussion pressure for several seconds.
5. Switch off the percussion when the chuck has loosened.
6. Unscrew the old drill bit by hand and replace with a new one.

8.4 Action in case of drilling problems

For information regarding **Down-the-hole rock drills (DTH)** see "**Instructions for COP 44/54/64/**".

9 Angle instruments

9.1 Angle, depth and laser instrument

Depending on the equipment level chosen, the drill rig can be equipped with one of the following alternatives:

- Angle instrument with aim device (standard equipment).
- GPS compass (option).
- Laser plane instrument (option).

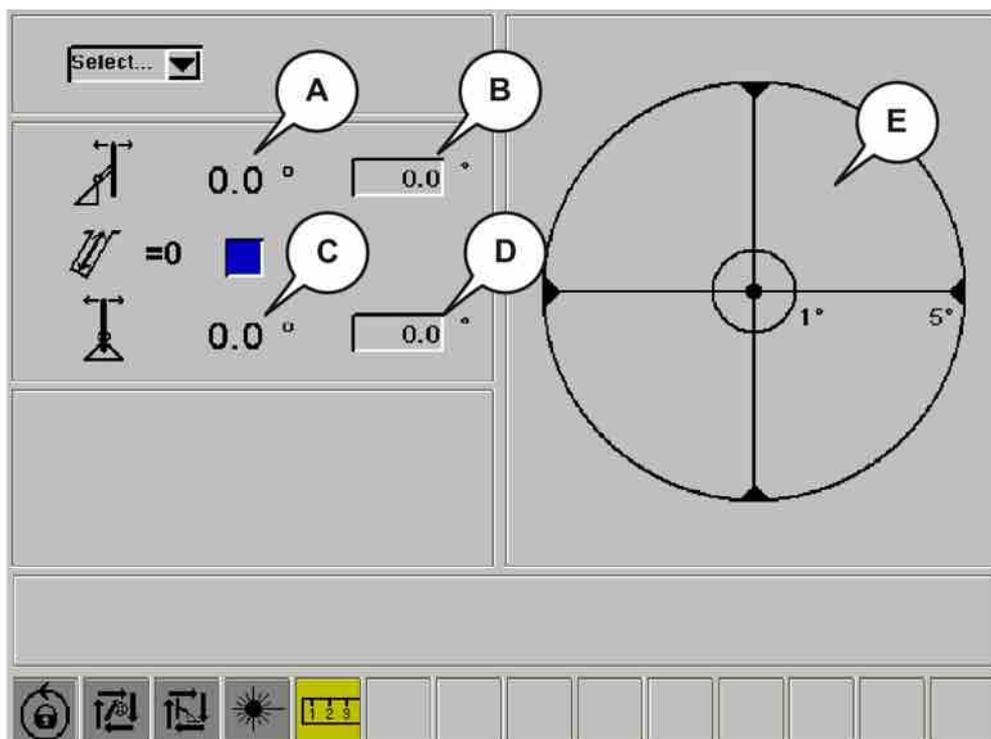
In all cases, the system consists of a number of sensors in the cabin and boom - feed system. The sensors are connected to the I/O unit and the LCD display through CAN BUS communication. The system is presented and operated from the cabin's LCD display.

9.1.1 Angle instrument with sight

This drill rig is equipped with an electronic angle indication system consisting of an angle sensor on the boom and feeder, aim device and graphic presentation on an LCD display. The aim device makes it possible to drill parallel holes by selecting a reference point before the first hole is drilled. This reference point is then maintained throughout the entire round or as long as the direction of movement is the same. By turning the aim device back to the same reference point the entire time regardless of how the rig travels, the instrument calculates how the feed inclination must be changed to maintain the same direction of movement. The angle sensor on the boom mounting allows the instrument to compensate for the turning of the boom the same way as when the aim device is turned.

9.1.2 Angle instrument menu

The angle instrument is accessed by pressing the F4 button in the left-hand edge of the display. These four buttons always provide direct access to the respective functions, i.e. you do not need to use the ESC key to go back to the main menu to select them.



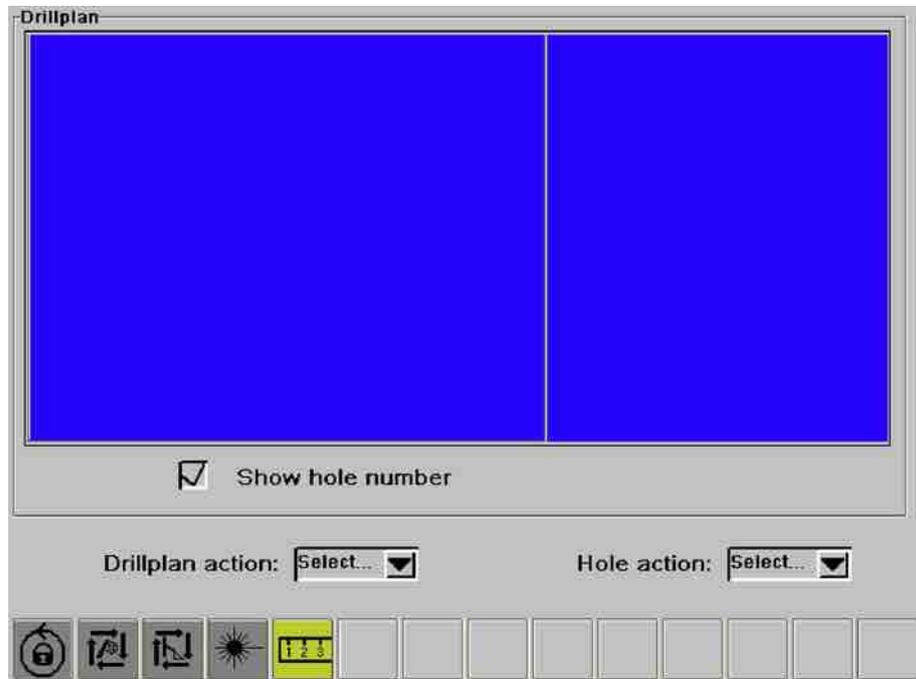
Direct selection menu - F4.

Shown in the angle instrument display are four numbers, two each for the tilt-incline and two each for the side gradient plus a graphic image of the deviation from desired value.

1. **Actual inclination front/back:** Shows the actual inclination of the feeder. When the feeder is positioned perfectly, the desired value and the actual value are the same.
2. **Desired inclination forward/backward:** Set the desired inclination angle in relation to the reference point (aim device). Select and activate the box by scrolling with the arrow keys until the box turns blue and then press Enter to open it. Move the cursor in the box to the relevant decimal. Set the desired hole inclination with the arrow keys and then press Enter to confirm.
3. **Actual inclination left/right:** Shows the actual inclination of the feeder. When the feeder is positioned perfectly, the desired value and the actual value are the same.
4. **Desired inclination left/right:** Set the desired inclination angle in relation to the reference point (aim device). Highlight the box by moving with the arrow keys until it turns blue and then press the enter key to open it. Move the cursor in the box to the relevant decimal. Set the desired hole inclination with the arrow keys and then press the enter key to confirm.
5. **Reset:** Resetting the drilled length instrument. Before the start of each hole, the drill bit should be positioned against the ground. Change menu by pressing F1, then the cursor will automatically be in the reset box of the F1 menu. Press Enter. The actual drilled length should then show 0. The display will continue to show the menu for drill pressure settings F1.
6. **Graphic:** The graphic shows deviation from the desired inclination via a line drawn in the direction of the deviation. The feeder spike must be positioned in the opposite direction of the line to reduce the deviation. When the feeder is set with the desired amount of inclination, only a dot is shown in the centre of the graphic.

! *NOTE: Remember that the desired angle values should always be specified in relation to the setting of the sight. If the sight is not to be used, it should be set straight ahead and the desired values adjusted to 0.*

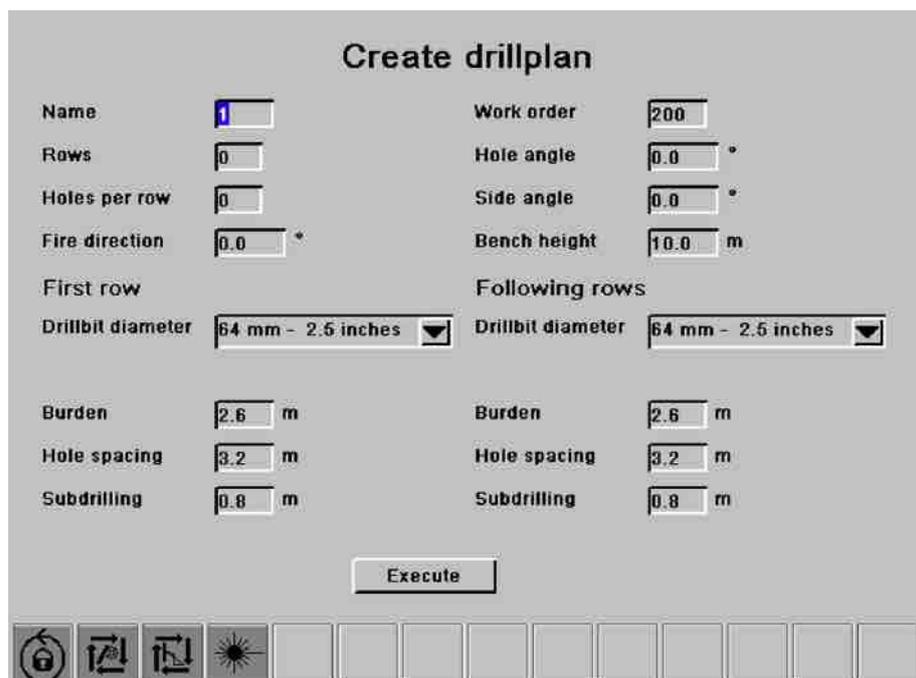
7. **Drill plan:** Mark **Drill Plan Handling...** in the combo box and confirm with Enter.



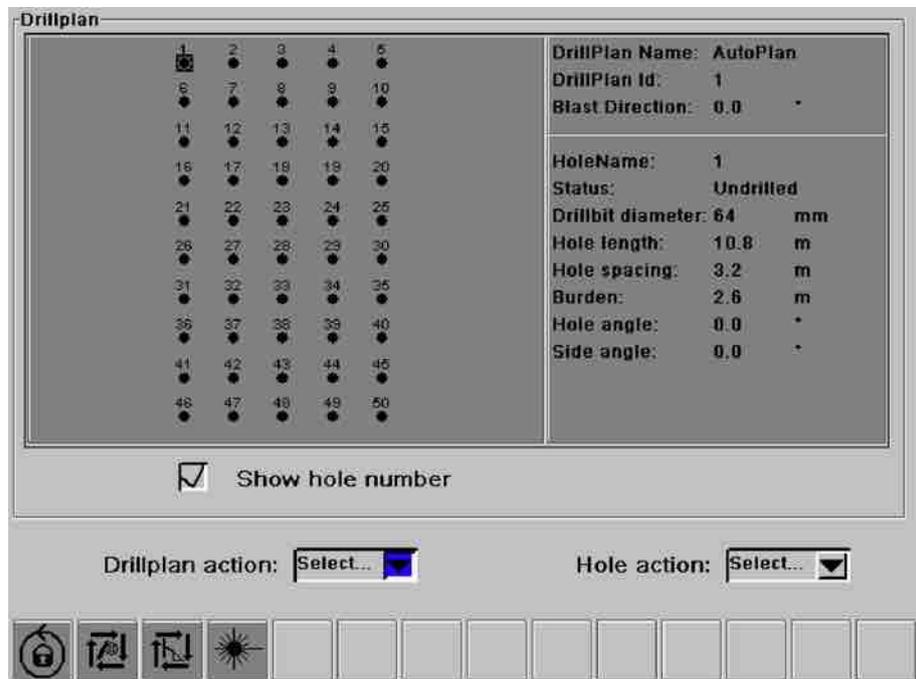
8. Use the arrow key to move to **Drillplan action:**.
9. Press enter to see the whole menu.
10. Select the function with enter.

Load is used to import a drill plan from ROC Manager.

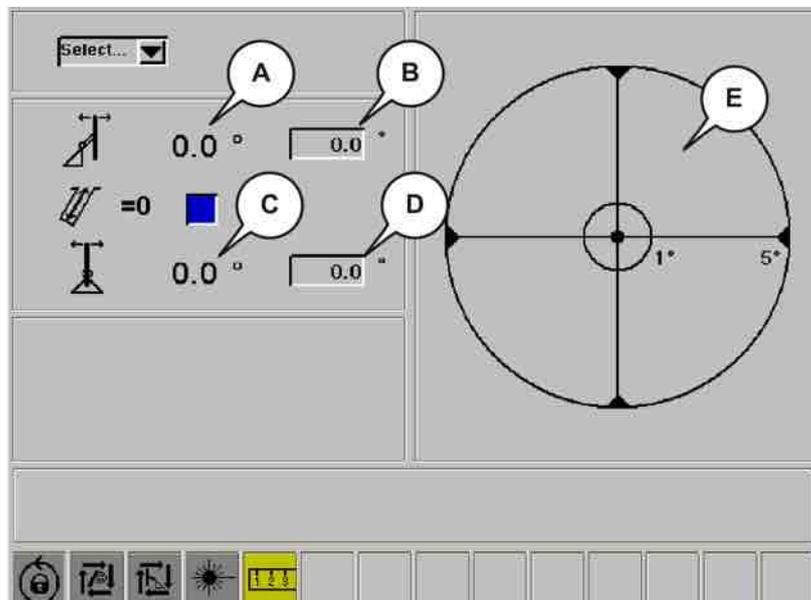
Create is used if a drill plan shall be made in the rig.



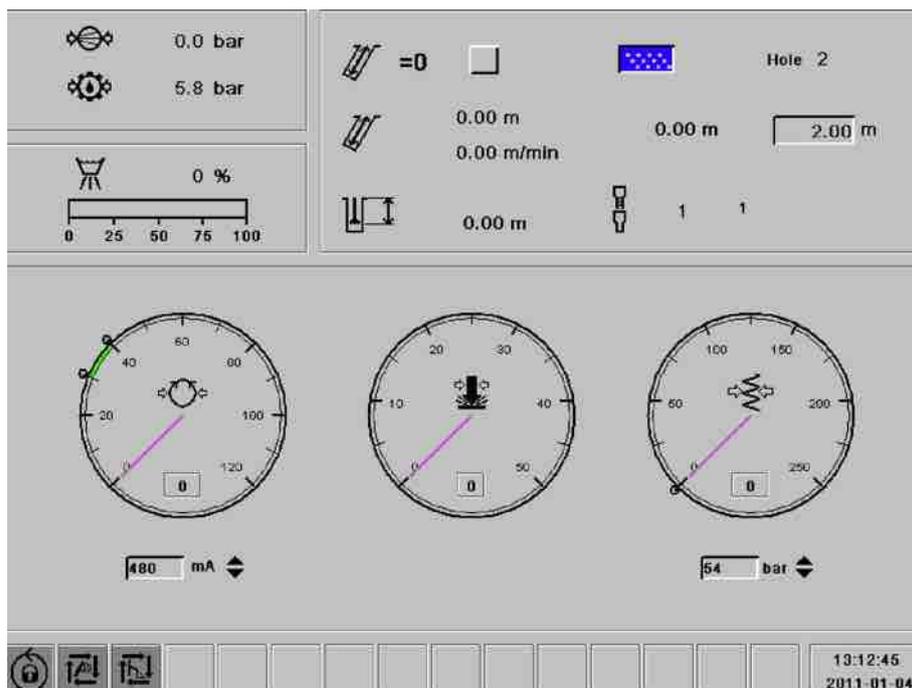
11. Move the cursor and make the desired settings by moving the cursor with the arrow keys, at the desired setting, press Enter. Select the value using the arrow keys and confirm with Enter. Once the desired settings have been made, move the cursor to **Execute** and confirm with Enter.



12. The selected settings are now displayed to the right and the drill plan to the left of the menu.
13. Now use the arrow keys to highlight the whole upper part of the menu and confirm with enter. You can then select a hole using the arrow keys and pressing enter.



14. The set angles will automatically be included in the menu. Use the boom positioning lever or autofeed-button (button 34 on right drill lever) (option) to set the angles.
15. Select menu F1.



16. Reset the length sensor by moving the cursor with the arrow keys, confirm with enter and change the value to 0.00 m with the arrow keys and press enter.
17. Ready to start drilling!
18. When HNS is used you can reach the menu for fine navigation via a shortcut on menu F1.



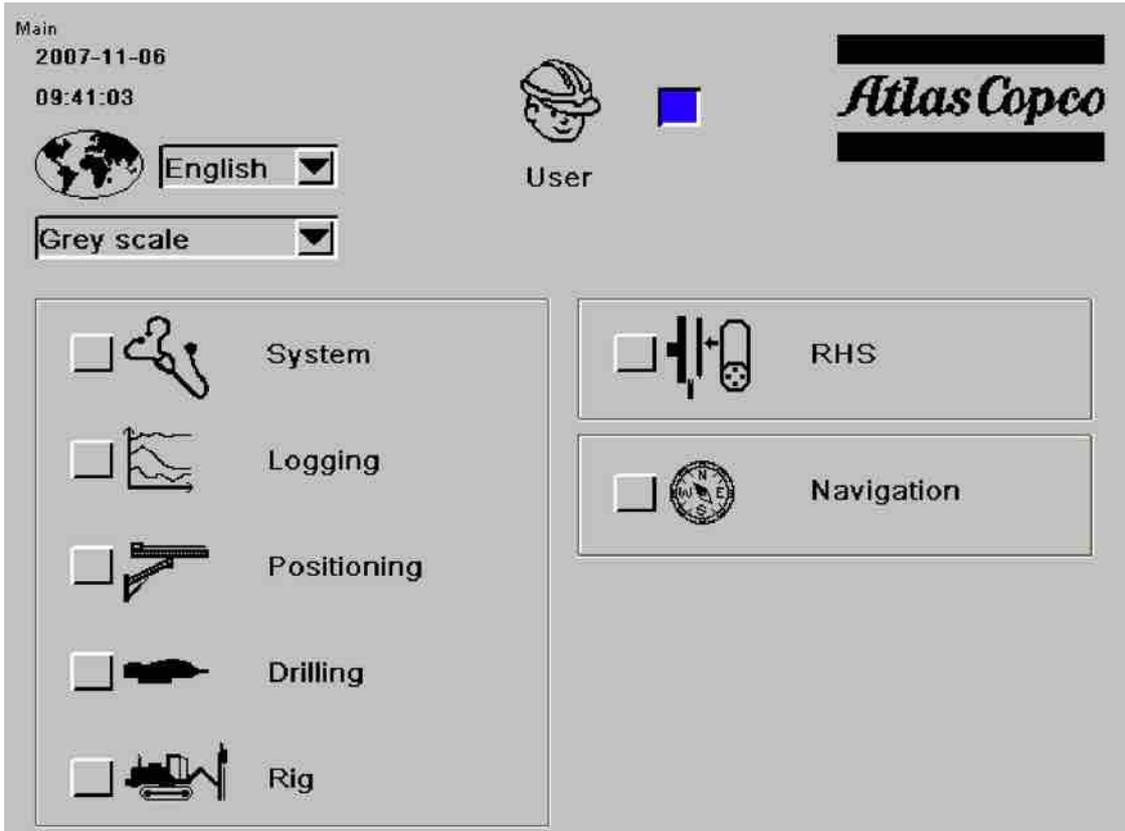
Shortcut to menu for fine navigation

19. To select a new hole, select direct selection menu F4. Highlight **Drill Plan Handling...** using the arrow keys and confirm with Enter. Select the new hole see step 11

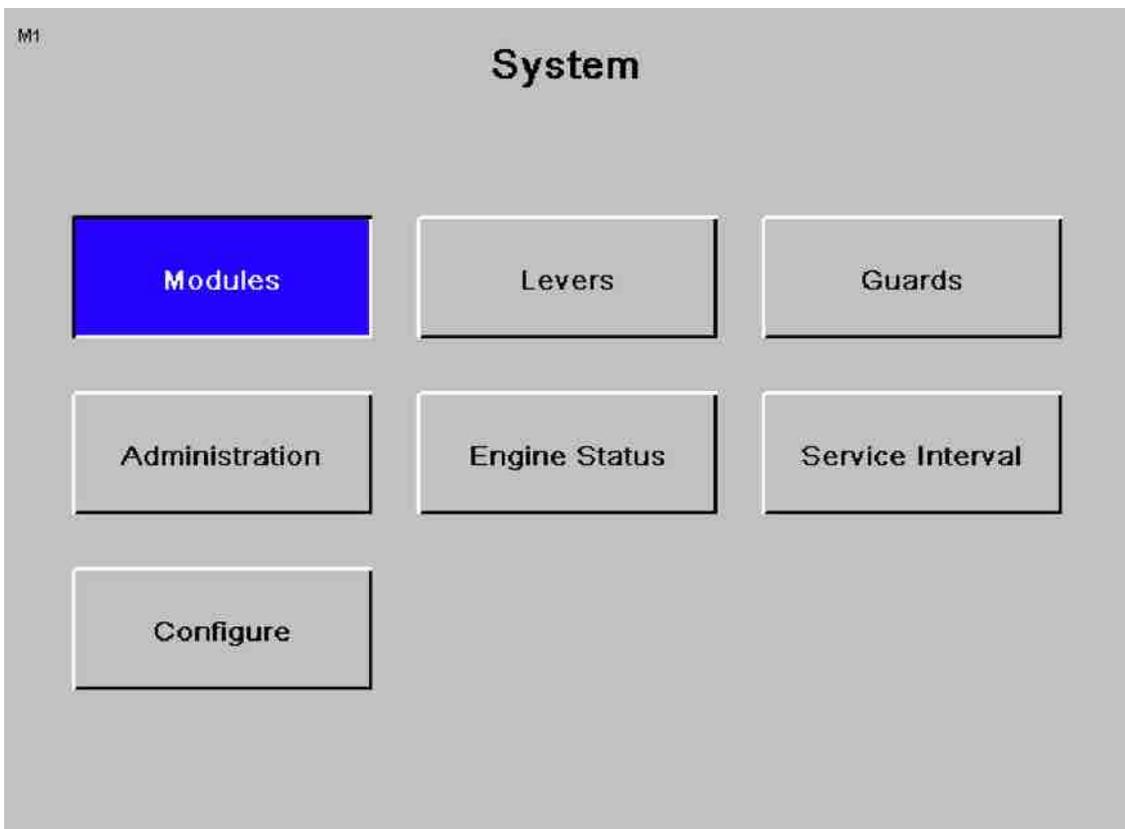
9.1.3 GPS compass (option)

When the drill rig is equipped with an electronic angle indication system, which consists of angle sensor on the boom and feeder, aim device, GPS compass and graphic presentation on an LCD display, the aim device is set making it possible to drill parallel holes by selecting a reference point before the first hole is drilled. This reference point is then maintained throughout the entire round or as long as the bearing is the same. The bearing is then kept to the same reference point automatically, regardless of how the drill rig travels, without the need for changing the aim device. The instrument calculates how feeder inclination must be changed to maintain the same bearing.

To activate the GPS compass:



Select **System**



Select **Configure**

M1.7

Configure

| | |
|----------------------------------|--------------------------|
| Engine Type | CAT C7 |
| Boom Type | B12 Fold |
| Feeder Type | BMH 6000 |
| Drill Machine Type | COP 1838HE |
| Rod Handling Type | RHS-51 |
| Length Sensor Type | Incr. Puls Sensor |
| Sensor type: Compr. temp | Linear |
| Sensor type: Ambient temp | Linear |
| Aim Devie Type | Analog |
| HNS GPS receiver | — |

Rig Options

Select **Rig Options** and confirm with Enter.

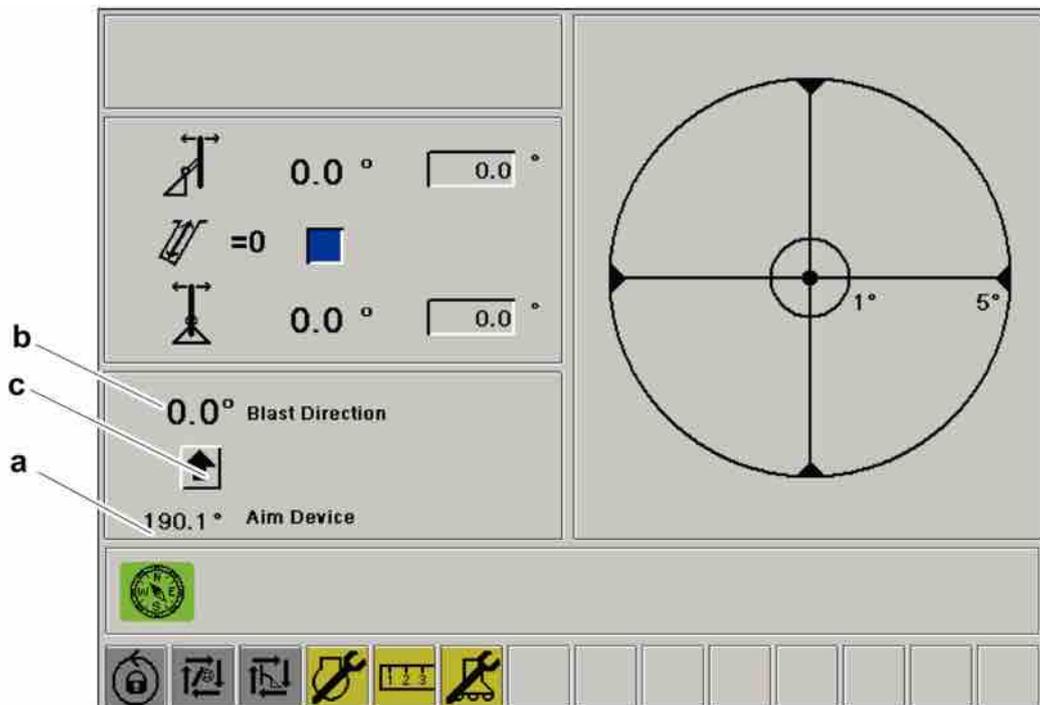
M1.7.1

Rig Options

| | |
|---------------------------------|--|
| Remote Ctrl./Winch | No |
| Extractor | Yes |
| Laser Plane | No |
| Angle Indication | Yes |
| Hole Navigation | No |
| Electr. Compass | Yes <input checked="" type="checkbox"/> |
| Automatic Positioning | Yes |
| Automatic Rod Handling | Yes |
| HECL | No |
| Maintenance Logging | No |
| MWD Logging | No |
| ECL Collector | Yes |
| Water Mist | No |
| ECG Pump | Yes |
| Thread Greasing Brush | No |
| Silence Kit | No |
| Intelligent Fan Control | No |
| Vibration Measure Module | No |

Electr. Compass is ticked or unticked. Then follow the instructions that appear on the screen.

The direct selection menu F4 contains the settings for the GPS compass.



| | |
|---|--|
| a | Shows the aim device's compass direction |
| b | Shows the compass direction selected for locking |
| c | Moves the aim device's compass direction, to the locked value, b |

Table 24: Menu F4

- Turn the aim device to the required direction.
- Access menu F4. The compass direction which was set appears in front of **Aim device**.
- Lock the value by selecting the arrow (c) using the arrow keys on the display.
- The value selected for locking now appears in front of **Blast dir.**

| Symbol | Explanation |
|--------|--|
| | Green info/ Yellow warning |
| | Green = GPS compass active. Yellow = problem with e.g. GPS reception. |

Table 25: Symbols

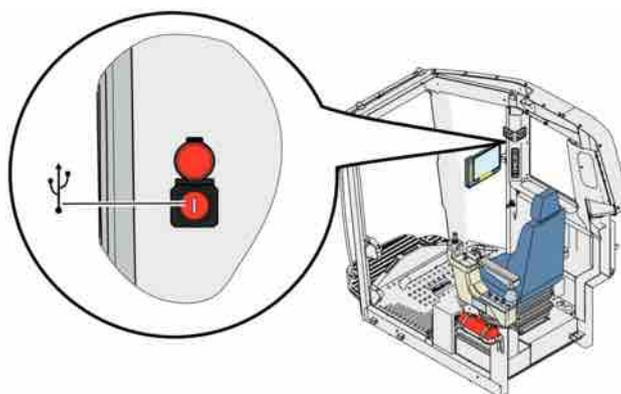
! ***NOTE:** After starting up the rig's electrical system it may take several minutes before the symbol becomes green. This is because the antennas have to establish contact with the satellites.*

If the symbol does not become green then this may be due to several causes, e.g.:

- No satellites available
- The antennas are covered by snow
- Open circuit in cable between the antennas and the electronic unit

If the symbol remains green, deactivate the GPS compass in the F4 menu and use the aim device in the traditional way.

9.1.4 Drill Plan



USB socket

A USB memory stick with the drill plan made in ROC Manager is inserted into the rig's USB socket on the right post at the display.

Drillplan

| | | | | |
|----|----|----|----|----|
| 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 |
| 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 |
| 26 | 27 | 28 | 29 | 30 |
| 31 | 32 | 33 | 34 | 35 |
| 36 | 37 | 38 | 39 | 40 |
| 41 | 42 | 43 | 44 | 45 |
| 46 | 47 | 48 | 49 | 50 |

DrillPlan Name: AutoPlan
DrillPlan Id: 1
Blast Direction: 0.0 °

HoleName: 1
Status: Undrilled
Drillbit diameter: 64 mm
Hole length: 10.8 m
Hole spacing: 3.2 m
Burden: 2.6 m
Hole angle: 0.0 °
Side angle: 0.0 °

Show hole number

Drillplan action: Select... Hole action: Select...

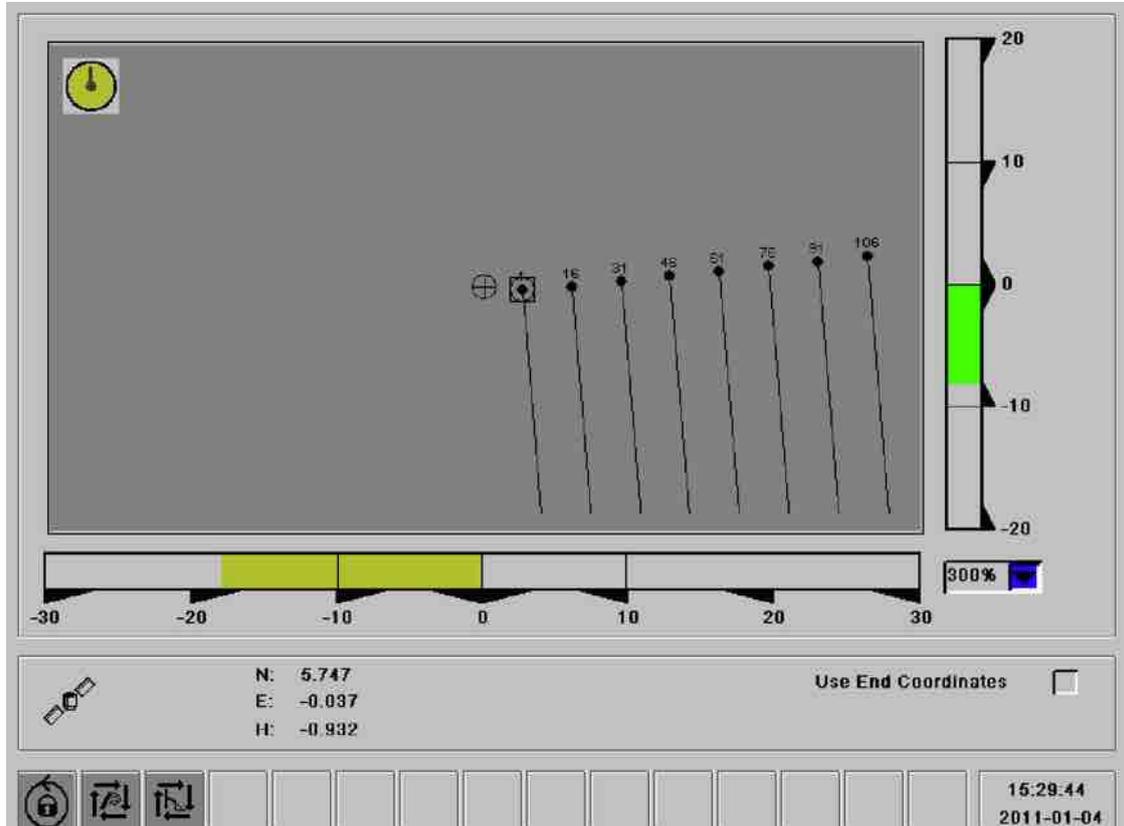
Drill Plan

- In the combo box **Drillplan action:** select **Load**, confirm with Enter.
- Select drill plan and confirm with Enter. When **Load Ok** is shown on the display screen, acknowledge this with the ESC key twice.
- Move the cursor up to the drill plan using the ESC and arrow keys.
- **DrillPlan Name:** Name of drill plan
- **DrillPlan Id:** Drill plan's ID.
- **Blast Direction:** The blast direction that is selected in ROC Manager.
- **HoleName:** Number of hole.
- **Status:** Shows whether the hole is undrilled, drilled manually or in Auto mode.
- **Drillbit diameter:** Diameter of hole from start coordinate to final plane.
- **Hole length:** Depth of hole. (Selected in ROC Manager)

125

No: 713944459.6 en

- **Hole spacing:** Distance between holes. (Selected in ROC Manager)
- **Burden:** Distance between rows in the drill plan. (Selected in ROC Manager)
- **Hole angle:** Angle of hole. (Selected in ROC Manager)
- **Side angle:** Side angle of hole. (Selected in ROC Manager)
- **Level:** The level selected in ROC Manager.



Menu for fine navigation

1. The aim device shows the drill bit's current position.
2. The system suggests the next hole by marking it with a circle.
3. Press enter to confirm the selection. The selected hole is now marked by a square.
4. The bars under and to the right now function as navigation help. When the drill bit is in the correct position they should be at 0.
5. When the drill bit has the correct position, go to the F1 menu and reset the depth meter.
6. Everything is now ready to start drilling.
7. Repeat the procedure for the next hole.

Select hole

When holes are selected a rough navigation menu appears automatically and this shows the direction in which the rig should be repositioned. Green line marks tramping direction, red line indicates north.

Set up the rig in accordance with the rules described in "Preparations for drilling".

Set the feeder angles and make sure that the bars are green with the semi-autopositioning button in combination with the boom levers. The drill bit then has the correct coordinates.

To return to F4, press ESC twice and the selected angles from ROC Manager are presented together with bars on the side with drill bit location in relation to the selected coordinates for the hole in question.

Reset the depth meter in the normal way. Now hole length is presented for the selected final plan in the local coordinate system. Start drilling in the normal way. The rig will stop drilling when the correct final plan is attained.

After drilling one hole, select the next one and repeat as above.

If further holes need to be added:

- Position the drill bit in the intended location for the hole.
- Move the cursor to the combo box **Hole action** and select **Add**, confirm with Enter.
- Confirm with **Execute** if other factors for the hole correspond.

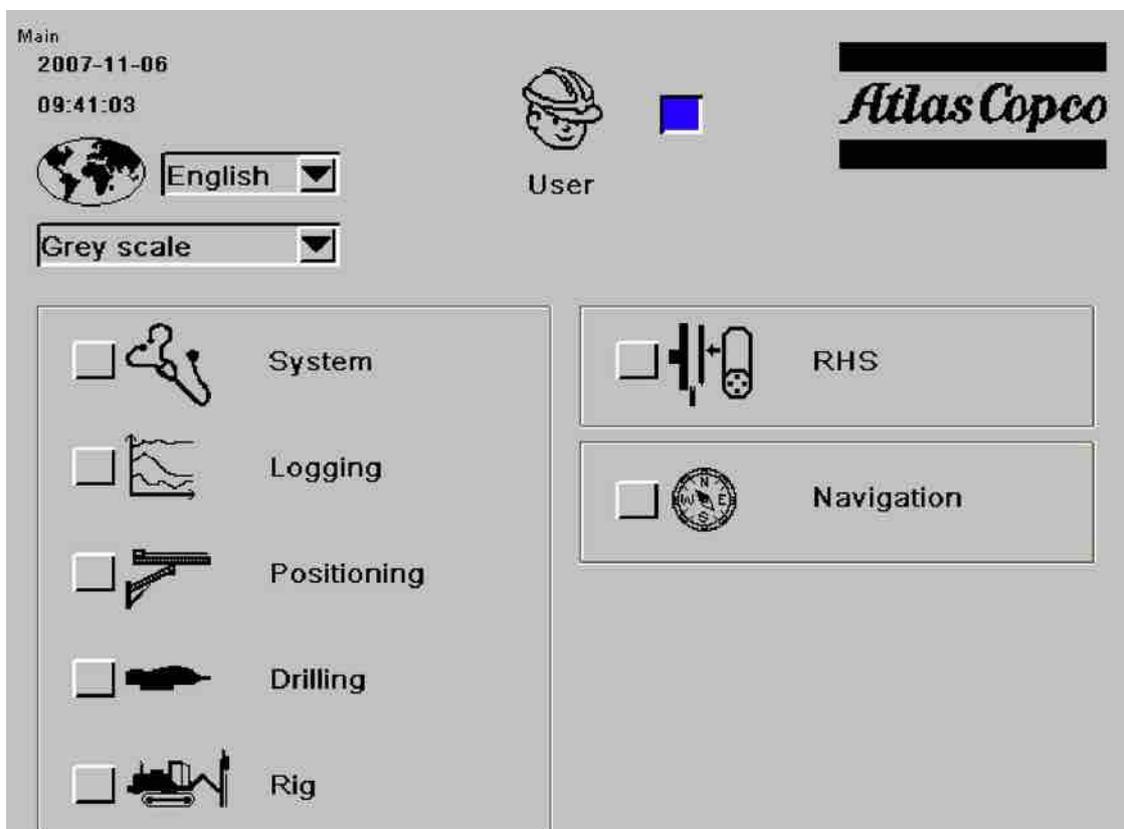
! ***NOTE:** When the drill plan has been drilled everything must be saved for retrieval in the event of changes to the original.*

- Select **Save** in the combo box entitled **Drillplan action:** and confirm with Enter.

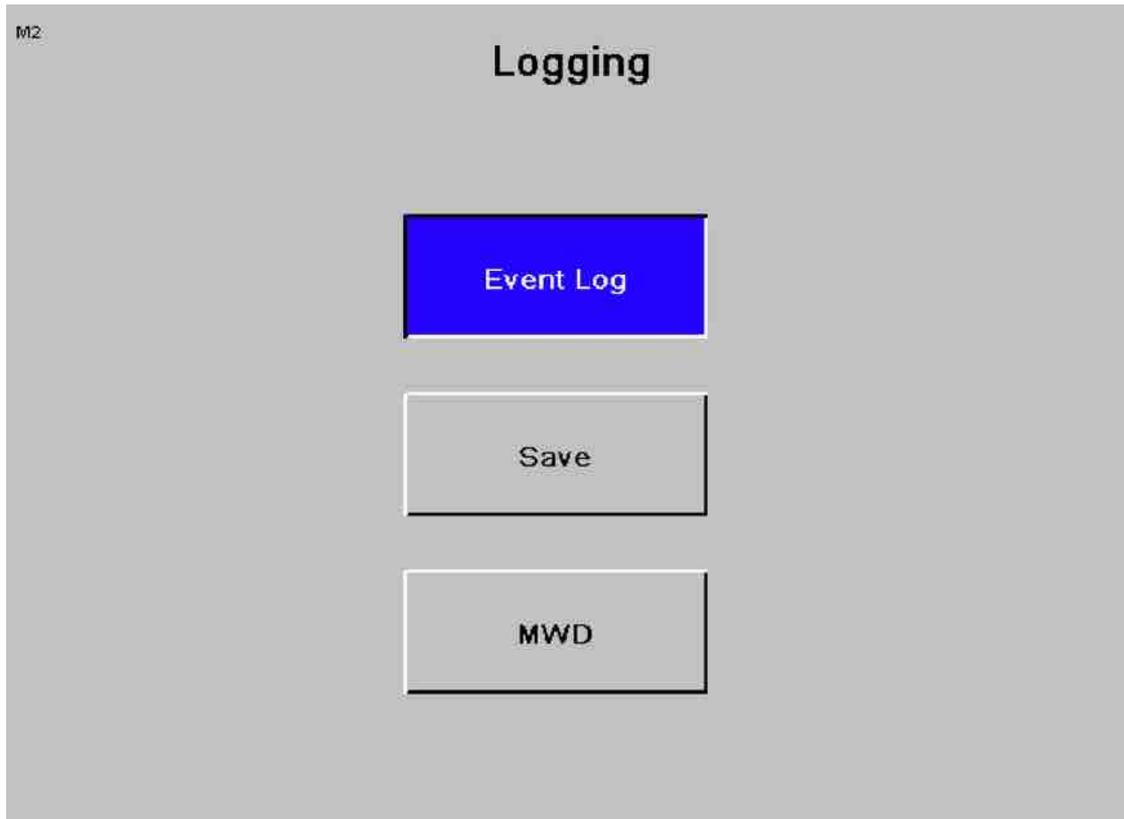
! ***NOTE:** Notice! If there is no USB stick in the USB socket then nothing is saved.*

Quality log

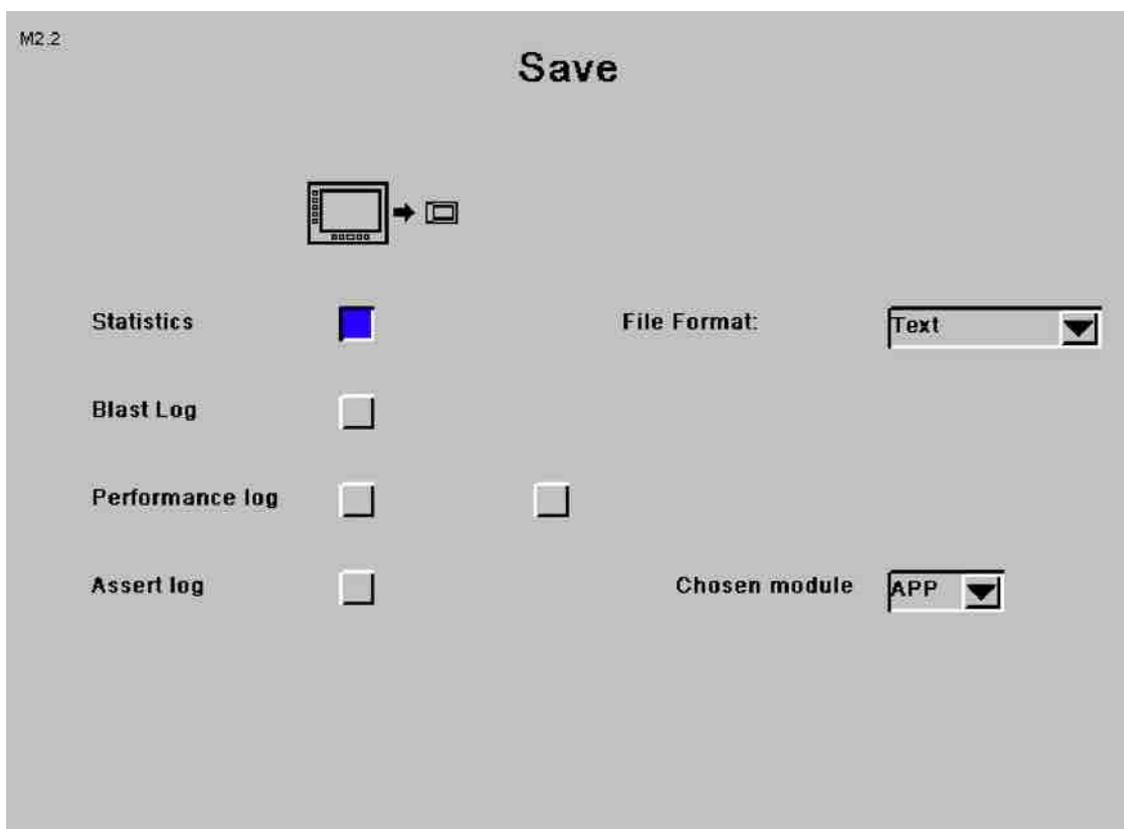
In addition, save a quality log for retrieval with all facts on the completed drill plan.



- Select **Logging**



- Select **Save**



- Select **Blast Log**, confirm with Enter.
- Remove the USB stick and import the information in ROC Manager in accordance with the instructions for ROC Manager.

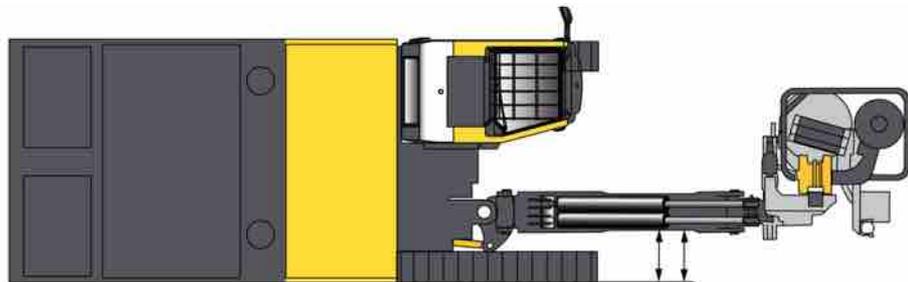
9.1.5 Calibration

1. Adjust the feeder to exactly 90° as illustrated. Use a spirit level.



Feeder at 90°

2. Adjust the boom so that it is parallel with the rig.



Boom parallel with rig

3. Operate the cradle up to mechanical stop.
4. Adjust the aim device in the cabin to straight ahead (see the arrow on the aim device) i.e. 90° towards the windscreen and parallel with the boom.

After completing all these preparations, the following menu should be used, located under:
-Positioning-Sensors.

M3.1.1

Calibration

| Sensor | Raw value | Value | Calibrate | Offset | Coefficient |
|------------|-----------|----------|-------------------------------------|-------------------------------------|------------------------------------|
| Feed Swing | 0 | 0.00 * | <input checked="" type="checkbox"/> | <input type="text" value="0.00 *"/> | <input type="text" value="0.001"/> |
| Feed Dump | 0 | 0.00 * | <input type="checkbox"/> | <input type="text" value="0.00 *"/> | <input type="text" value="0.001"/> |
| Boom Swing | 2045 | -0.04 * | <input type="checkbox"/> | <input type="text" value="0.00 *"/> | <input type="text" value="0.088"/> |
| Aim Device | 0 | -169.9 * | <input type="checkbox"/> | <input type="text" value="0.0 *"/> | <input type="text" value="0.332"/> |

Calibration.

! ***NOTE:** In order to make these settings, you must log in using the service code.*

Access under the heading **Sensors** to calibrate the sensors for **Feed swing**, **Feed dump**, **Boom swing** and **Aim device**. The K-value, i.e. the inclination of the curve, is a fixed value and must not be adjusted or changed.

■ Fixed K-values are for:

- **Feed swing** -0.001

However, the offset value should be changed so that the system will be able to reproduce the correct information value in the different menu screens. I.e. in this case where all the angles are zero, the value to the right of the offset box should also be zero when calibration is complete.

- **Feed dump** -0.001
- **Boom swing** 0.088
- **Aim device** -0.001

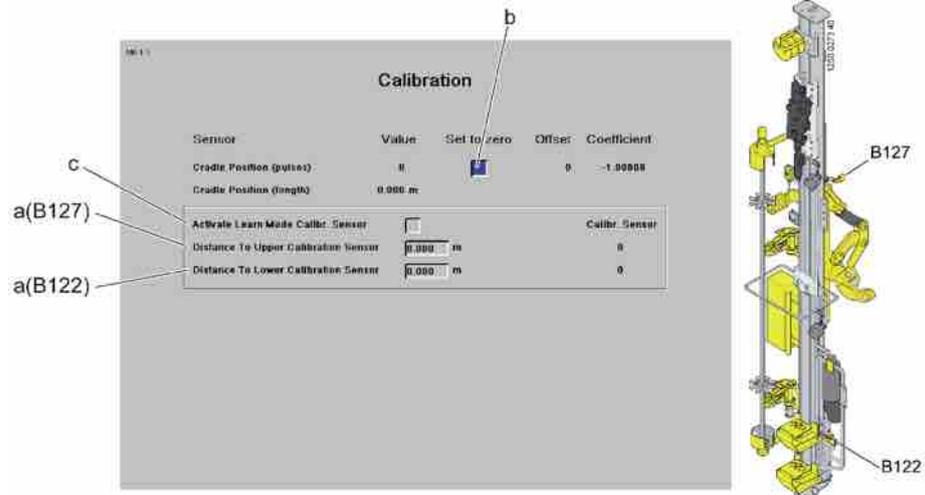
■ **Calibrate:**

- Move the cursor to the correct box for calibration using the arrow keys and confirm with enter.
- Set to zero by pressing Enter on the box under the **Calibrate** heading.
- Use ESC to go back in the system.

! ***NOTE:** Once calibration is complete, make sure the new settings are saved to a USB memory stick where all the other parameters are saved, otherwise the old settings will remain on the USB memory stick if the software is ever reloaded.*

Length sensor calibration

1. Operate the cradle up to mechanical stop.
2. Go to the menu, Settings/Logging in/Length sensor calibration on the display for engine and directional instruments.



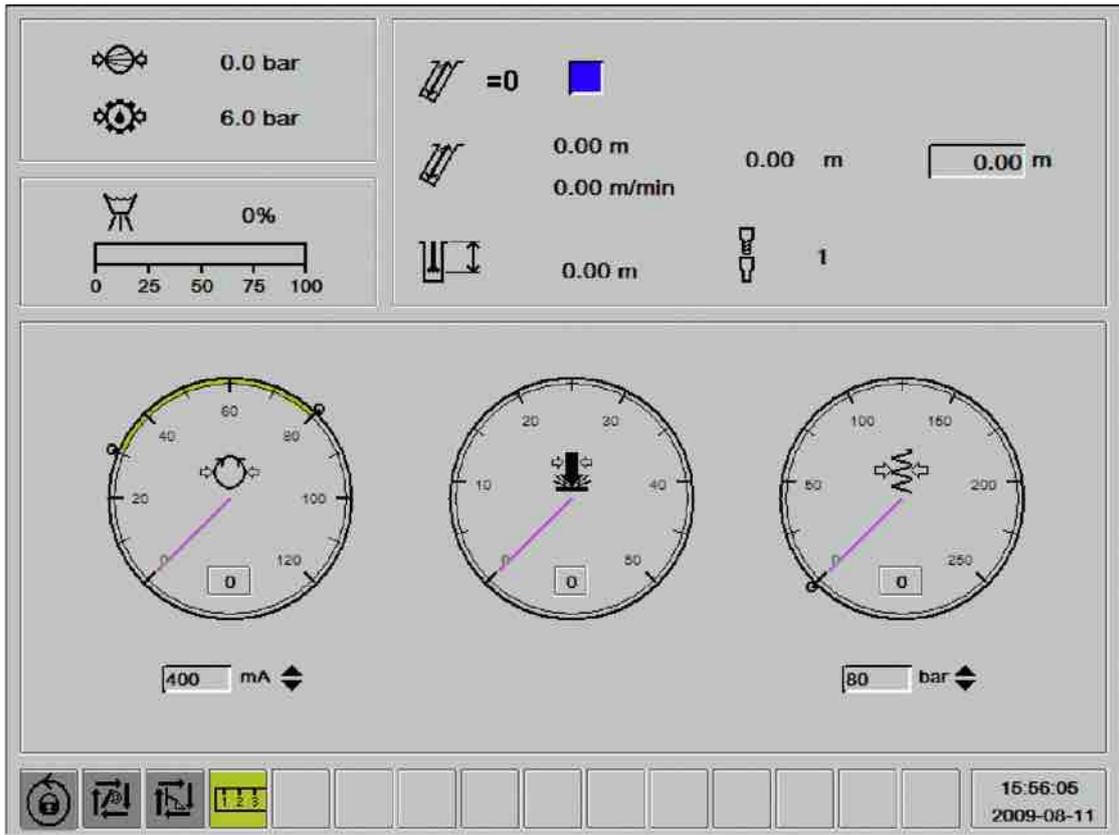
3. Reset cradle position (b) to zero and select "Activate Learn Mode Calibr. Sensor" (c).
4. Activate drill feed and operate the cradle so that it passes both sensor B127 and sensor B122.
5. The distances will automatically appear in the boxes (a).
6. Calibration finished, exit with ESC.

9.1.6 Depth measuring system

To keep control of the drill length, drill metres and penetration rate, there is a drill length sensor available. The drill length sensor is mounted on the side of the feed beam and is connected to the display via an I/O module together with the other components in the system. The drill length instrument can be configured to show either the actual drilled length, hole length measurement, or the vertical depth, vertical depth measurement. In the latter case, the instrument will take into account the inclination of the hole and the displayed value will consequently be less than the actual drilled length.

9.1.7 Depth measurement menu

The length instrument is accessed by pressing button F1 in the left-hand edge of the display. This provides direct access to the drilled length instrument menu.

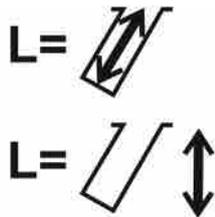


Direct selection menu - F1.

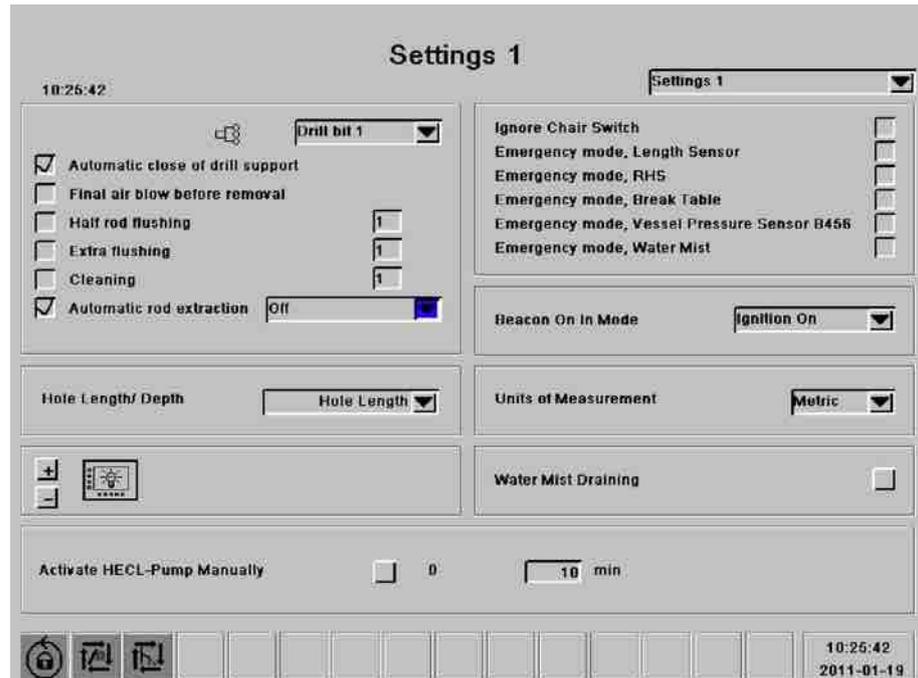
The method of depth indication can be chosen from direct selection menu F2.

The following functions are accessible from the F2 direct selection menu.

1. Indication of selected measurement method:

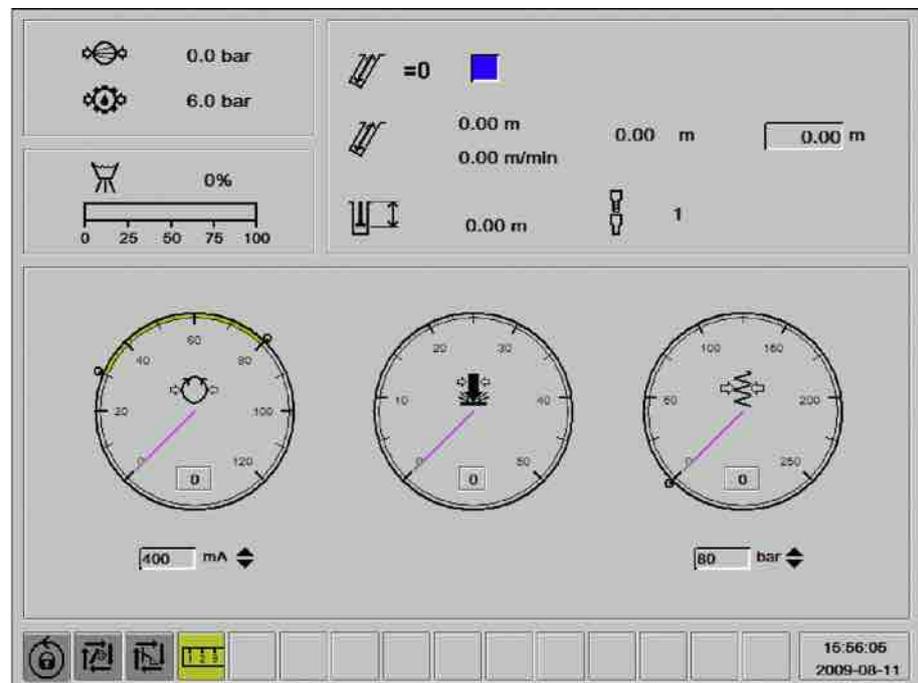


Upper figure: Hole length measurement. Lower figure: Vertical depth measurement.



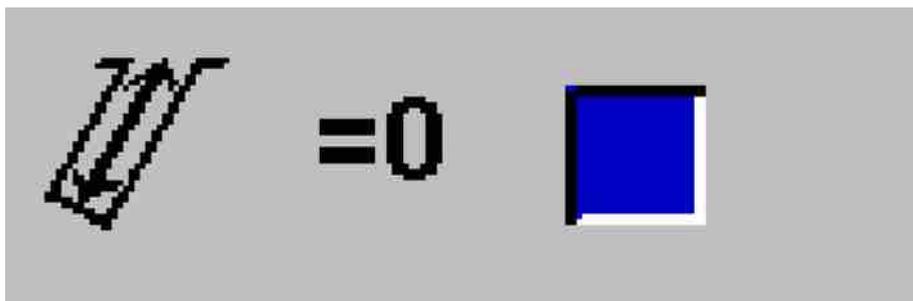
Direct selection menu - F2.

The measurement method can be selected in the F2 shortcut menu "Parameters". Use the arrow keys to select the **Hole Length/ Depth** button. Press Enter to switch between the two alternatives. Confirm with Enter. Select the relevant menu with direct selection buttons F1-F4.



Direct selection menu - F1.

2. **Resetting the hole length counter:** Before starting each hole, the drill bit must be placed on the ground. Activate the F1 or F4 menu by pressing F1 or F4 and the cursor will be placed automatically in the reset box of menu F1 or F4. Press enter. The current hole length will then show 0. The display will continue to show the selected menu.



Resetting the hole length counter

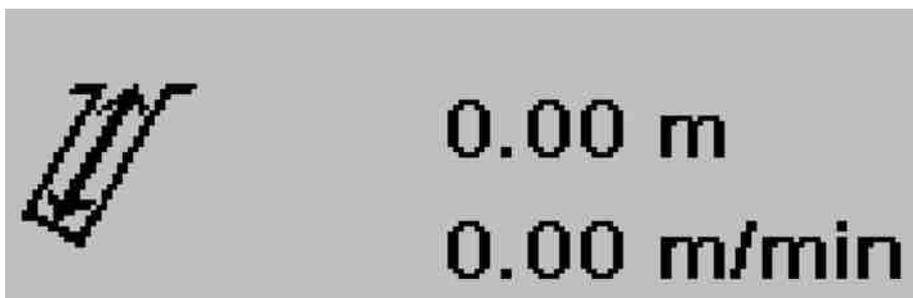
3. **Desired hole length when using automatic drill stop:** Select the field by stepping through with the arrow keys until the field is highlighted blue. Press enter to open the active field, move the cursor in the field to the relevant decimal. Set the desired drill length with the arrow keys and press enter to confirm. Once the counter has been zeroed and the drilling has started, it will stop automatically when the set value has been reached.



Desired hole length

Current drilled length: Shows the drilled length of the hole in progress after the counter has been reset in accordance with (4).

4. **Current hole depth/Penetration rate:** The upper value represents the attained drill length in the current hole since the counter was zeroed and the lower value represents the penetration rate during current drilling. During rod adding, the average penetration rate of the latest rod is shown. After resetting the counter, the average penetration rate for the previous hole is shown.



Current hole length/Penetration rate.

9.1.8 Laser plane instrument (option)

Additional to the drill length instrument, there is also the possibility of using a laser plane as a reference level instead of the local ground level with the help of a laser beacon and a receiver on the rig. This requires the distance between the drill bit and the laser receiver being specified when the instrument is installed (see section "Calibration"). Once the laser receiver on the rock drill cradle has passed the laser plane, the displayed drill length will be relative to the laser plane instead of ground level. The displayed drill length will then "jump" to the pre-programmed value and then continue measuring from there. The laser beacon must be placed in such a way that there is a free line of sight between the beacon and the receiver on the rig.

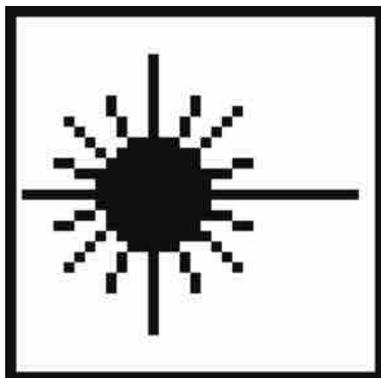
The rig has also the possibility of using several laser planes. The distance to the reference plane, which is the top laser plane, is then set in the box for distance to reference laser plane.

9.1.9 Laser menu

The laser plane function is activated in Direct selection menu - F2 and the function is indicated in the display's status bar.

Direct selection menu - F2.

1. **Activation of Laser plane:** Highlight the field by scrolling with the arrow keys until the button turns blue and then press Enter to open the active field, choose On/Off and confirm the selection with Enter.

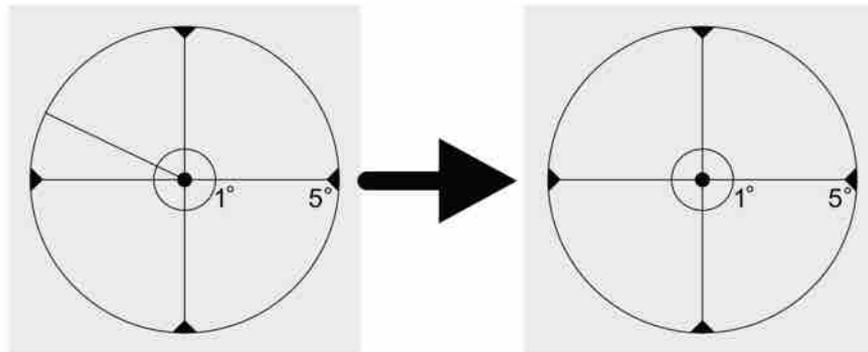


Laser plane indication

2. **Laser plane function indication:** The indicator is lit in the status field of the display when the function is active. Once the laser receiver has registered the laser plane, the indicator will change colour from grey to green and the drilled length value will then be calculated from the laser plane level.

9.1.10 Operation

1. Move the drill rig to the drill site and set it in the desired position.
2. Select a reference point and turn the sight so that the arrow points towards the reference point. The reference point should be as far away as possible (at least 2 km) if it does not lie in direct line with the row of holes in order to minimise angle error. If the reference point lies in line with the row of holes, it can be as close as 10 m from the last hole of the row without any angle errors arising.
3. Set the desired hole inclination front/back or left/right.
4. Position the feed beam so that the red line in the graphic is reduced to a red dot in the centre. Once this has occurred, the desired angle value is the same as the actual value.



Positioning using the angle instrument.

5. Press the feeder spike against the ground by using the feed extension.
6. Set the desired hole length / vertical depth in the hole length instrument's menu if automatic drill stop is to be used.
7. Place the drill bit on the ground and reset the length measurement with F1 or F4. This reset should be done even if the laser plane function is used.
8. Drill until the preset depth has been reached and drilling stops automatically or drill until the desired drilled length is shown in the drilled length menu and switch off drilling manually.
9. Pull up the drill rod and move the drill rig to the next hole or turn the boom to the next hole if it has sufficient reach.
10. If the rig is moved, the aim device should be turned until it is aligned with the reference point. The instrument will then take the rig's new position into consideration to make the next hole parallel to the previous one. If additional holes can be drilled without changing the set-up, the aim device does not have to be adjusted.
11. Repeat steps 4-10.

10 Options

10.1 Fire suppression system

10.1.1 Semi automatic fire suppression system

Safety

CAUTION

Risk of injury

On delivery of a new rig from the factory, the semi-automatic fire fighting system is disconnected due to transport restrictions. It must be reconnected before the rig is put in use.

DANGER

Serious injury or death

The fire fighting system's fuel gas cylinders must not be removed by unauthorised service personnel. The cylinders are pressurised at 145 bar, which can be lethal if handled incorrectly.

DANGER

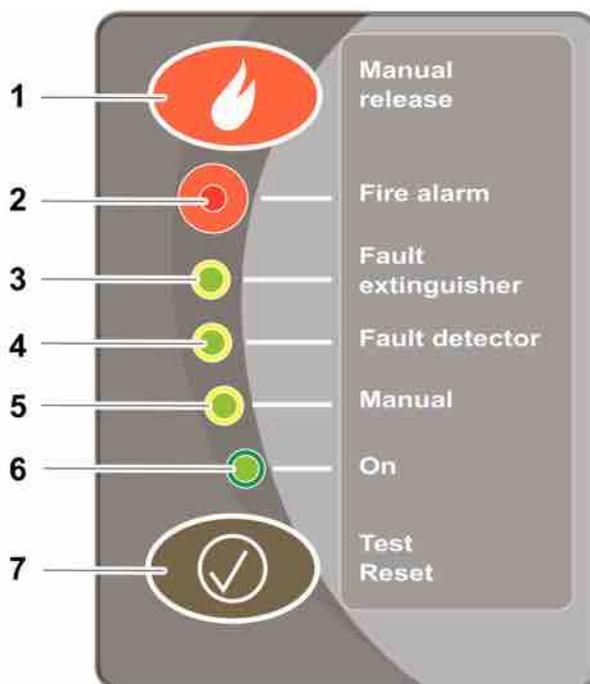
Serious injury or death

The fire fighting system's gas generators contain a small charge and can cause serious injury. They must not be handled by unauthorised personnel. A gas generator must not be disposed of in normal waste but shall be handled as hazardous goods and sent for destruction.

System description

The semi-automatic fire fighting system comprises an extinguishing system and a fire alarm. The system has a combined manual/automatic activation. When the machine is in operation with enabled blocking, the system must be activated manually in case of a fire alarm, either with the push button on the operator's panel in the cabin or the mechanical device outside the machine.

When the machine is not in operation with deactivated blocking, the system will trigger automatically when the fire alarm starts.



Operator's panel - Semi-automatic fire fighting system

| | |
|----|---|
| 1) | Triggering push button: Hold in for 1 second. |
| 2) | Flashing light: Fire alarm. |
| 3) | Yellow diode on: Fault in trigger loop, gas generator activated, cable break. |
| 4) | Yellow diode on: Fault in detector loop, terminal resistor missing, cable break. |
| 5) | Yellow diode on: Manual mode - System blocked/semi-automatic. |
| 6) | Green diode on: System engaged. Green diode off: Fault in power supply - Battery fault, cable break. |
| 7) | Button for alarm test and reset: Hold in for at least 1 second. The diodes light up in sequence and conclude with an alarm test of the signal and lamp. |

In case of fire (Semi-automatic fire fighting system)

1. Stop the machine's engine.
2. Trigger the extinguishing system, either electrically with the operator's panel in the cabin or manually on the outside of the machine.
3. Move quickly to a safe distance.

 DANGER**Serious injury or death**

A fire can re-ignite. Do not return to the machine until you are sure the fire is completely extinguished.

10.1.2 Manual fire suppression system

Safety

 DANGER**Serious injury or death**

The fire fighting system's fuel gas cylinders must not be removed by unauthorised service personnel. The cylinders are pressurised at 145 bar, which can be lethal if handled incorrectly.

 DANGER**Serious injury or death**

The fire fighting system's gas generators contain a small charge and can cause serious injury. They must not be handled by unauthorised personnel. A gas generator must not be disposed of in normal waste but shall be handled as hazardous goods and sent for destruction.

System description

The manual fire fighting system comprises an extinguishing system only. In case of fire, trigger manually with the device outside the machine.

In case of fire (Manual fire fighting system)

1. Stop the machine's engine.
2. Trigger the extinguishing system with the device outside the machine.
3. Move quickly to a safe distance.

10.1.3 After a fire

The alarm on a semi-automatic system will cease once the fire has been extinguished and the detectors are cool.

With a manual system, you must perform a visual check from a safe distance to establish whether the fire is extinguished.

**CAUTION****Risk of injury**

Due to the risk of re-igniting, be prepared with a fire extinguisher before returning to the machine

Open the ventilation hatches to exhaust the smoke and gas. **Avoid breathing in the fire gases.** Get in touch with a qualified Atlas Copco service engineer as soon as possible.

Do not restart the machine until a qualified service engineer has established the cause of the fire and any faults have been rectified.

10.2 Rig Remote Access (RRA)

10.2.1 General

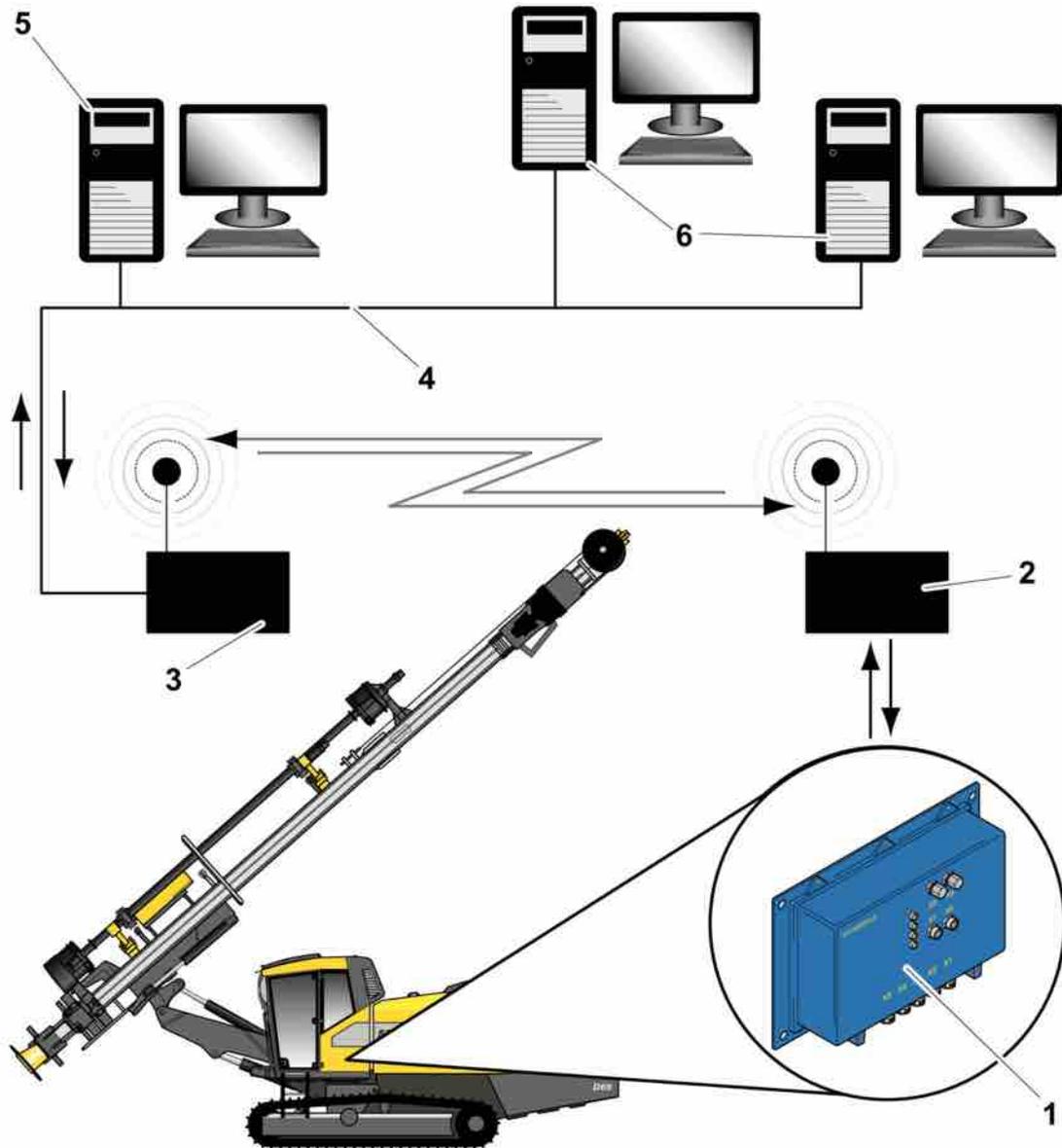
RRA is a package of communication options which make the rig accessible via the user's data network.

If RRA is installed, the operator does not need to load drill plans via a USB memory. The log files are saved to the rig CCI where the planning department can retrieve information via wireless transmission. The latest plans are always accessible from the rig.

From the office computer, one can:

- View the rig statistics - e.g. percussion hours
- Upload saved log files.
- Obtain information on rig guards and alarms.

The rig cannot be remote controlled nor any changes made to the rig menu via the RRA system.



Overview of a typical RRA system.

| | |
|----|--|
| 1) | CCI (Common Communication Interface on drill rig) |
| 2) | Rig wireless access point (WLAN module on drill rig) |
| 3) | WLAN Router (Wireless Local Area Network) |
| 4) | Internal Ethernet network |
| 5) | PC installed with RRA server software. |
| 6) | PCs installed with RRA client software. |

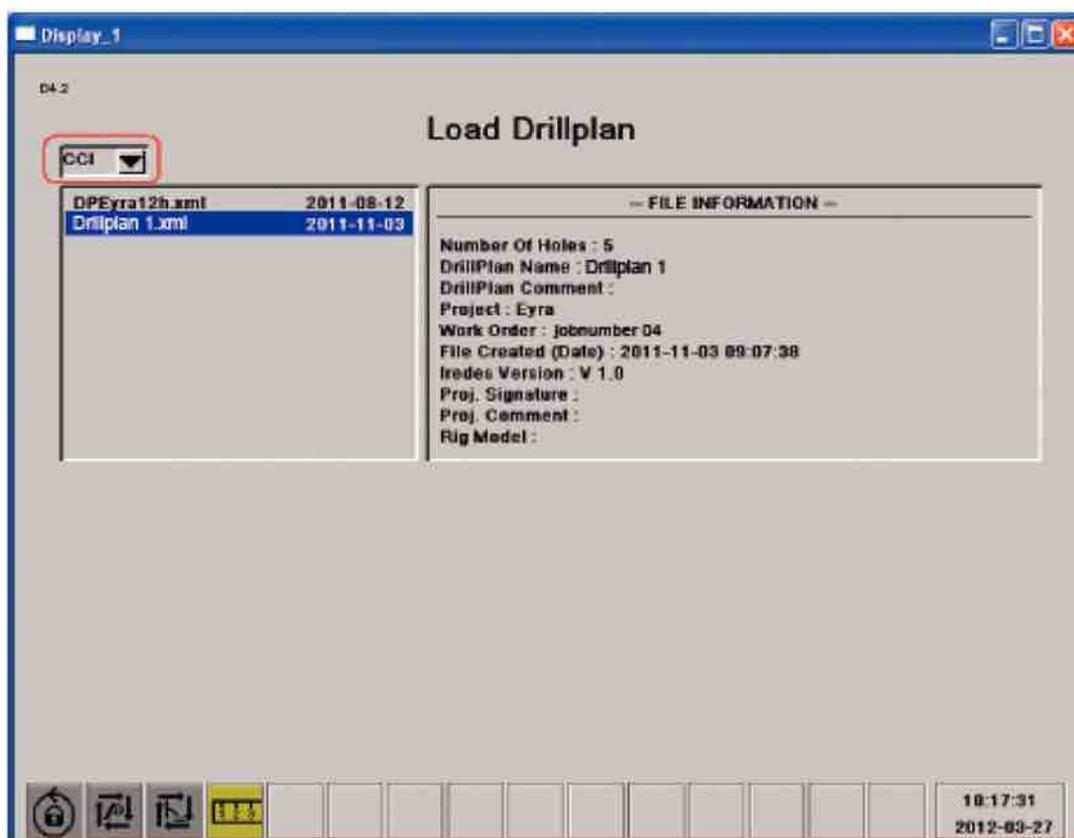
10.2.2 Transmission of a drill plan to the rig via RRA

Before files (e.g. a drill plan) can be transferred to and from a rig via RRA, the RRA system must be installed as shown in the diagram above.

To transfer a drill plan from an RRA client computer to a rig, copy the required file to the folder **To Machine**. This folder is on the RRA server computer and should be visible to all RRA client computers on the same Ethernet network. Each rig connected to the RRA system has its own unique **To Machine** folder. The plan is stored in this folder on the RRA server until the rig is accessible online. At this point, the RRA server copies the drill plan to the rig CCI which contains a hard disk.

The operator can then load the drill plan from the rig CCI module in almost the same way as loading a drill plan from a USB memory.

To load a drill plan, press **F4**, then in **Drill Plan Handling** select **Drillplan action**. Select **Load**. In **Load Drillplan** you can choose between **CCI** or **Disp**. In this case, you should choose **CCI**. It is now possible to choose between all drill plans on the drill rig's CCI hard disk.

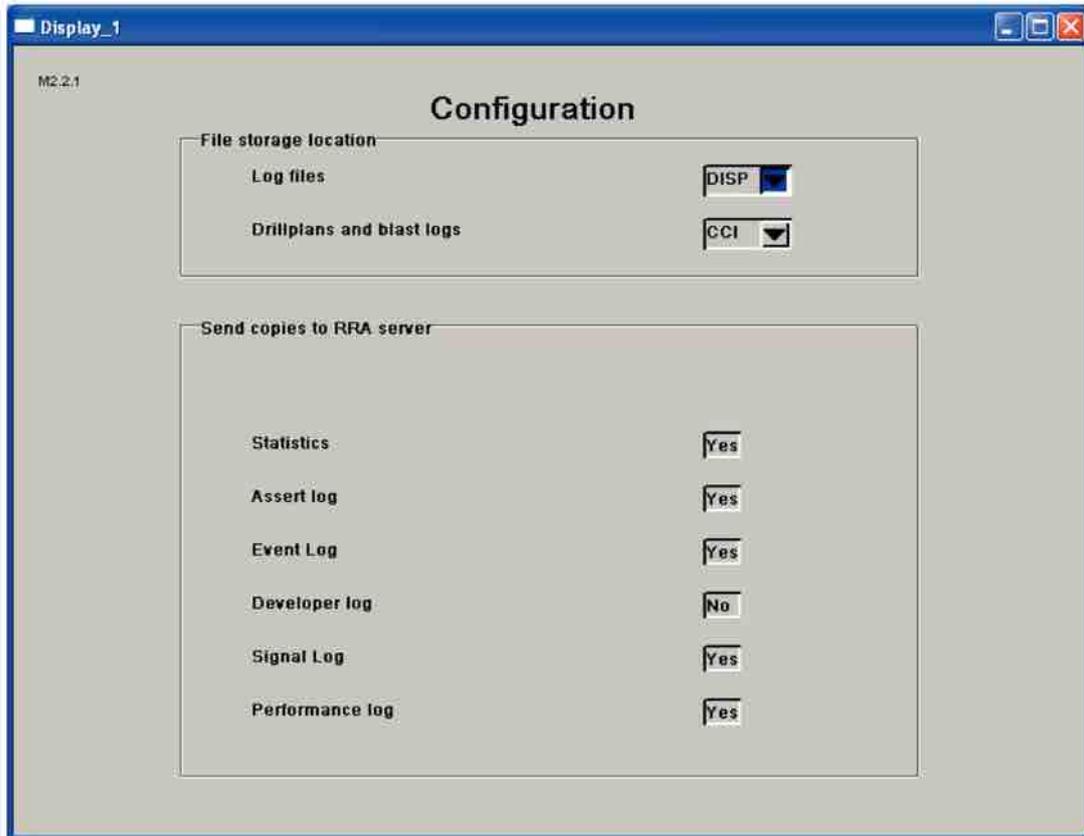


Choose either CCI or Disp

10.2.3 Transmission of data files from the rig to a PC via RRA

The PC must be on the same network as the rig and have RRA client software installed. There must also be an RRA server on the same network.

The operator can choose to save files on the rig CCI in **Configuration**. When the rig CCI is able to contact the RRA server, these files are downloaded from the rig CCI to the relevant **From Machine** folder on the RRA server. The **From Machine** folder should be visible for an RRA client on the same network.



Configuration options

10.3 HNS

10.3.1 General

The rig must be equipped with the HNS option. If it is available in the rig then the system can be activated or deactivated under the **System** menu.

Main
2007-11-06
09:41:03

 English

 User



Grey scale

| | | | |
|---|-------------|--|------------|
| <input type="checkbox"/>  | System | <input type="checkbox"/>  | RHS |
| <input type="checkbox"/>  | Logging | <input type="checkbox"/>  | Navigation |
| <input type="checkbox"/>  | Positioning | | |
| <input type="checkbox"/>  | Drilling | | |
| <input type="checkbox"/>  | Rig | | |

M1

System

| | | |
|----------------|---------------|------------------|
| Modules | Levers | Guards |
| Administration | Engine Status | Service Interval |
| Configure | | |

Select **Configure**.

M1.7

Configure

| | |
|----------------------------------|-------------------|
| Engine Type | CAT C7 |
| Boom Type | B12 Fold |
| Feeder Type | BMH 6000 |
| Drill Machine Type | COP 1838HE |
| Rod Handling Type | RHS-51 |
| Length Sensor Type | Incr. Puls Sensor |
| Sensor type: Compr. temp | Linear |
| Sensor type: Ambient temp | Linear |
| Aim Devie Type | Analog |
| HNS GPS receiver | — |

Rig Options

Select Rig Options

M1.7.1

Rig Options

| | |
|---------------------------------|---|
| Remote Ctrl./Winch | No |
| Extractor | Yes |
| Laser Plane | Yes |
| Angle Indication | Yes |
| Hole Navigation | Yes <input checked="" type="checkbox"/> |
| Electr. Compass | No |
| Automatic Positioning | Yes |
| Automatic Rod Handling | Yes |
| HECL | No |
| Maintenance Logging | No |
| MWD Logging | Yes |
| ECL Collector | Yes |
| Water Mist | Yes |
| ECG Pump | Yes |
| Thread Greasing Brush | No |
| Silence Kit | No |
| Intelligent Fan Control | No |
| Vibration Measure Module | No |

Hole navigation is ticked or unticked. Then follow the instructions that appear on the screen.

Menus F1, F2 and F4 will be changed depending on this option.

F2

When **Hole Navigation** is selected, F2 **Settings 2** will appear as follows:

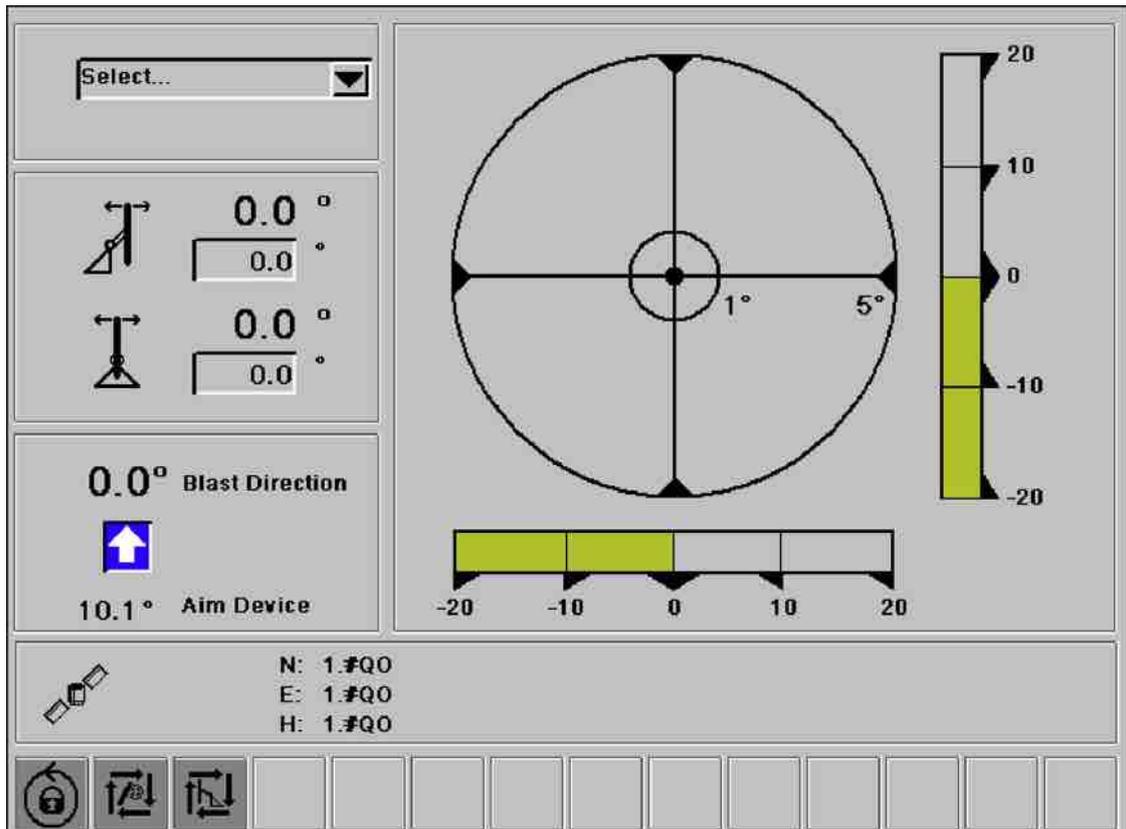
The screenshot shows a software interface titled "Settings 2" with a timestamp of 13:53:13. The interface is divided into several sections:

- Top Right Section:** Contains three checkboxes: "Use Drillplan" (checked), "Use Hole Navigation" (checked), and "Use Anmask" (unchecked).
- Middle Left Section:** Contains four settings:
 - "Magazine Direction Automatic Rod Add" with a dropdown menu set to "CCW".
 - "Automatic Switching: Jaw / Drill Support" with a dropdown menu set to "Yes".
 - "Try Rod Add Without Adapter-Rod-Break" with a dropdown menu set to "No".
 - "Reverse break adapter at rod extraction" with a dropdown menu set to "No".
- Middle Right Section:** Contains two checkboxes: "Automatic Menu Guiding" (unchecked) and "Auto Hole Selection" (checked). A text input field next to "Auto Hole Selection" contains the value "0.5 m".
- Bottom Left Section:** Contains one checkbox: "MWD Logging" (checked).
- Bottom Bar:** A row of icons including a padlock, a gear, a document, and a yellow icon with "1 2 3". To the right of the icons is a timestamp "13:53:13" and a date "2010-12-13".

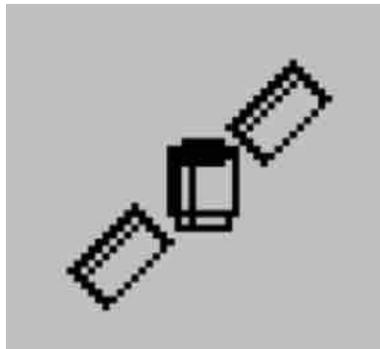
F2 Settings 2 with Hole navigation selected

Use drillplan can be used here.

F4



F4 with drill plan selected



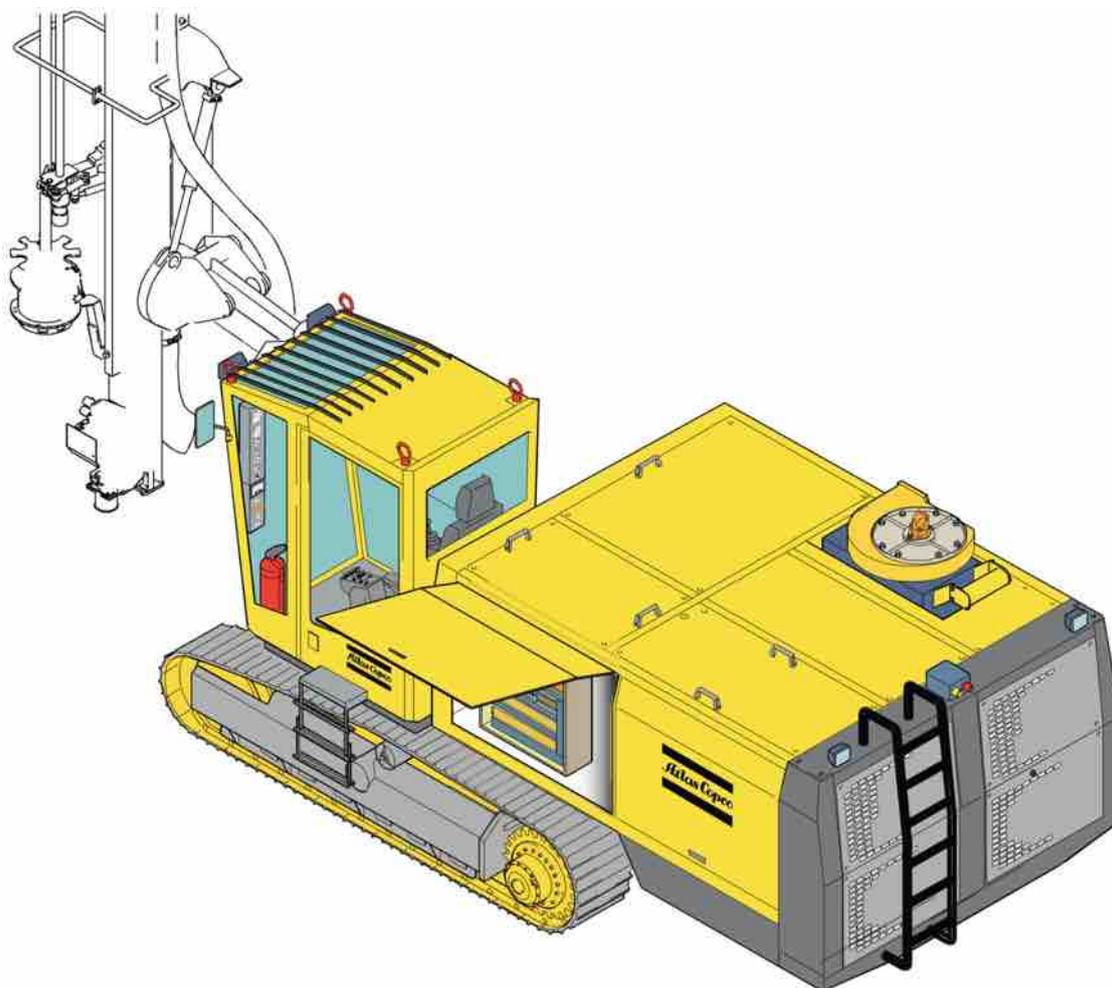
Satellite symbol

Satellite symbol : Shows the status of the satellite contact.

- Grey: System not OK, a second warning is probably also shown in the status bar.
- Yellow: System OK, but inadequate contact with satellite. This means that full accuracy will not be attained.
- Green: System OK.

10.4 Lincoln Quicklub

10.4.1 System description



System description

QUICKLUB progressive central lubrication system

- Can serve up to 300 lubrication points depending on the length of hose.
- Automatically lubricates all connected lubrication points
- Works through lubrication cycles (interval time, propagation time and load time)
- Pumps grease up to NLGI 2 4 at temperatures between -25 degrees C and +70 degrees C.
- Can be used down to -40 degrees C if special low temperature grease is used.
- The pump delivers grease through one or more distribution blocks to all connected lubrication points.

The progressive lubricant distributor

- Reliably distributes lubricant in the predetermined amounts.
- Delivers lubricant to the connected lubrication points in a reliable manner.
- By mounting the three pump elements, the pump can serve three separate lubrication circuits.
- Each lubrication circuit is equipped with a safety valve that holds the pressure within permissible values.

- If there is a block in one of the lubrication circuits, lubricant will leak from the respective safety valve.

10.4.2 Central lubrication pump QUICKLUB 203 CS-.../....

Pump type

203 CS - ZS

Pump for standard vehicle (control via ignition lock) Pump with adjustable interval time.

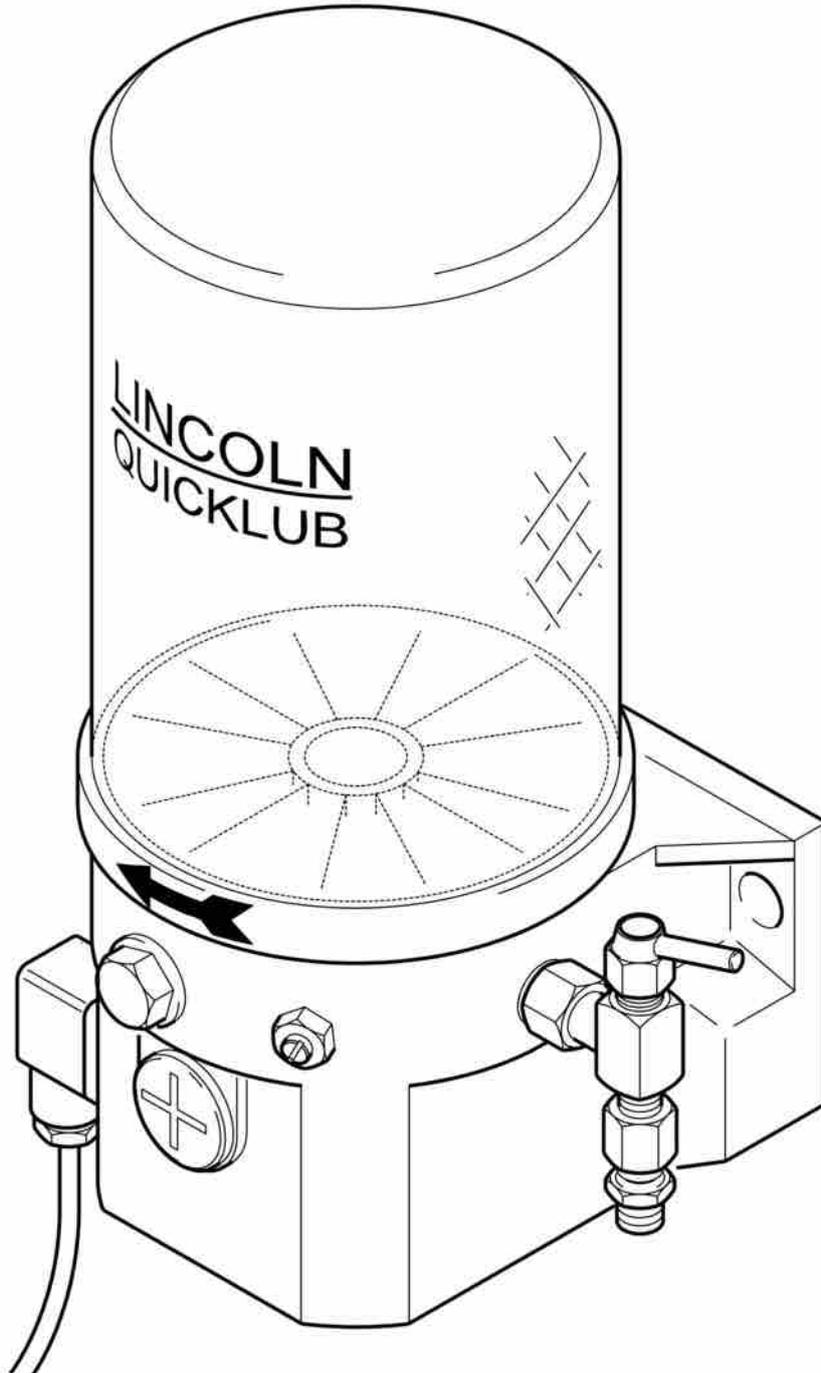


Fig. 2 Central lubrication pump with two-litre reservoir

Central lubrication pump QUICKLUB 203 CS

QUICKLUB 203 CS is a compact multi-line pump consisting of reservoir with agitator, pump housing with built-in motor, timer, pump element, safety valve and filler nipple.

- Can serve up to three pump elements.
- Works through lubrication cycles (interval time, propagation time and load time).

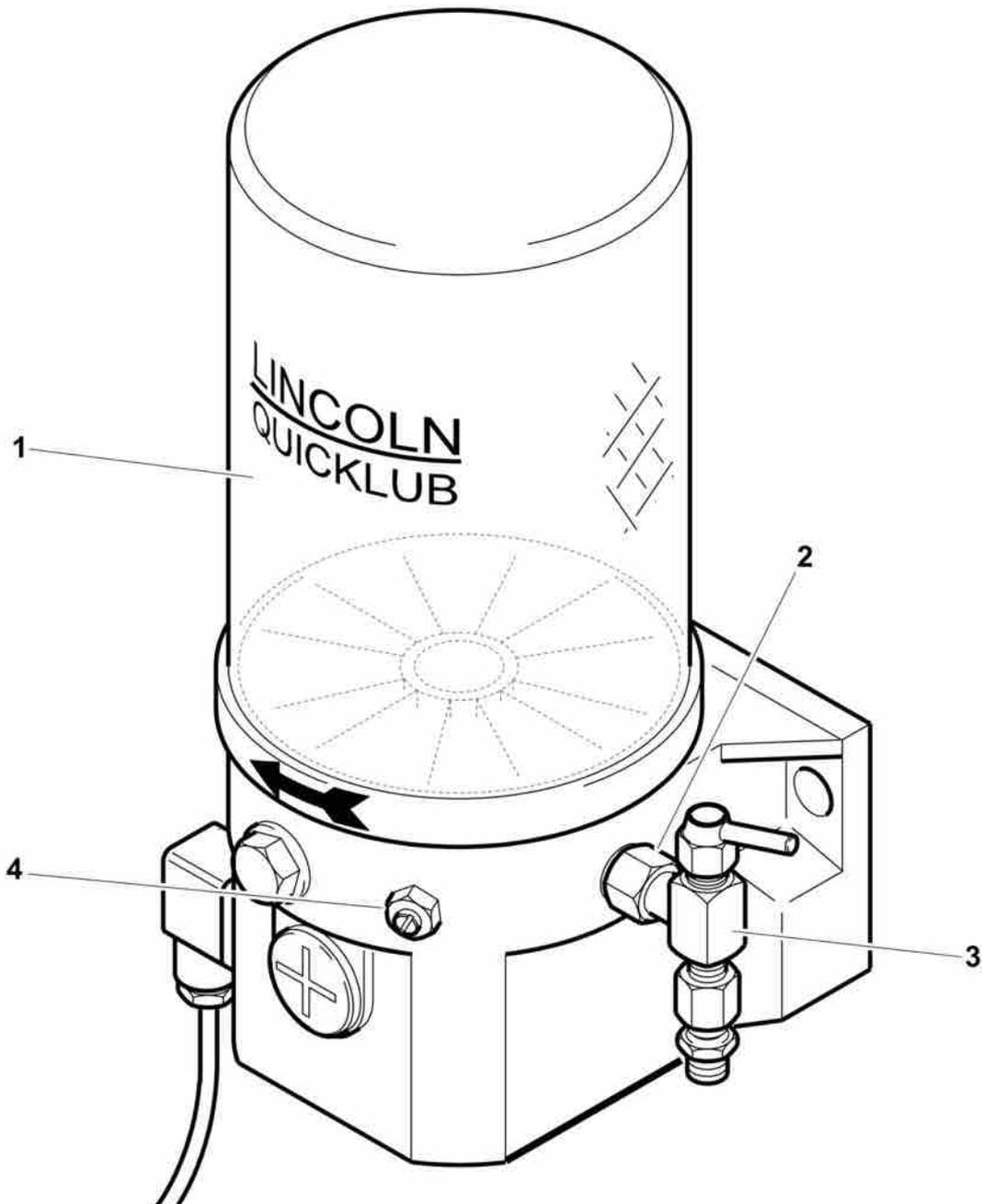


Fig. 3 Pump

| | |
|---|---------------|
| 1 | Reservoir |
| 2 | Pump element |
| 3 | Safety valve |
| 4 | Filler nipple |

Function of the pump element

- Electric motor runs the eccentric, see fig. 5 and 6
- This occurs while the pump is running, see fig. 5
- Piston 2 draws in lubricant from the reservoir.
- The piston delivers lubricant via the distributor to the connected lubrication points, see fig. 6.

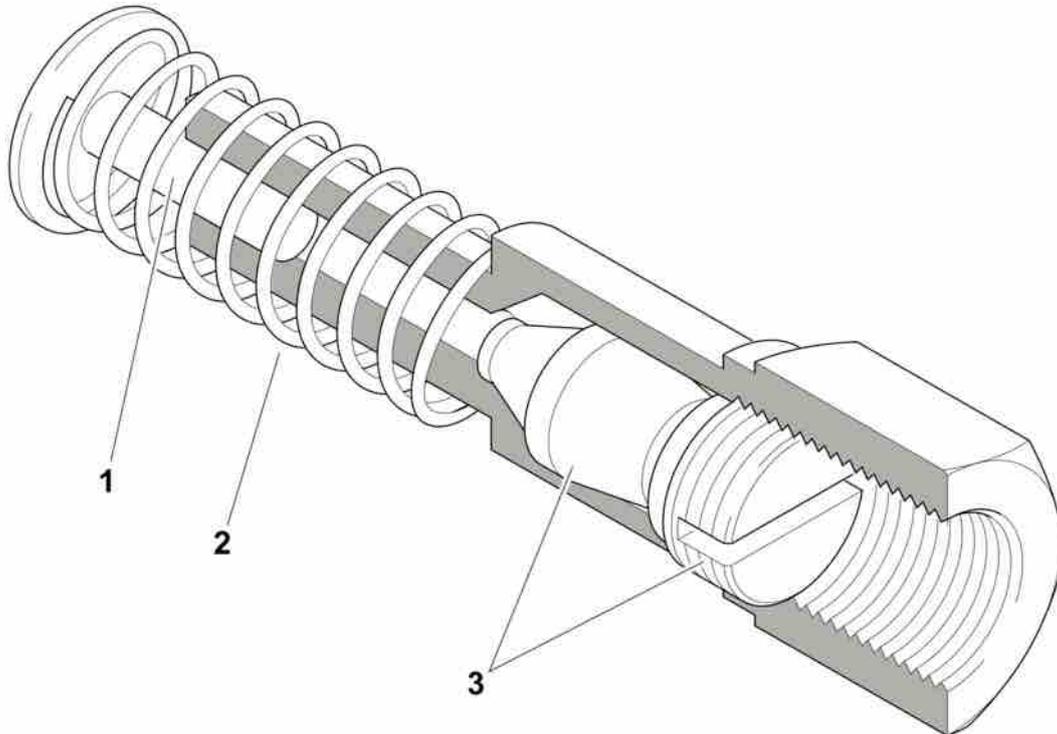


Fig. 4 - Pump element

| | |
|---|---------------|
| 1 | Piston |
| 2 | Return spring |
| 3 | Check valve |

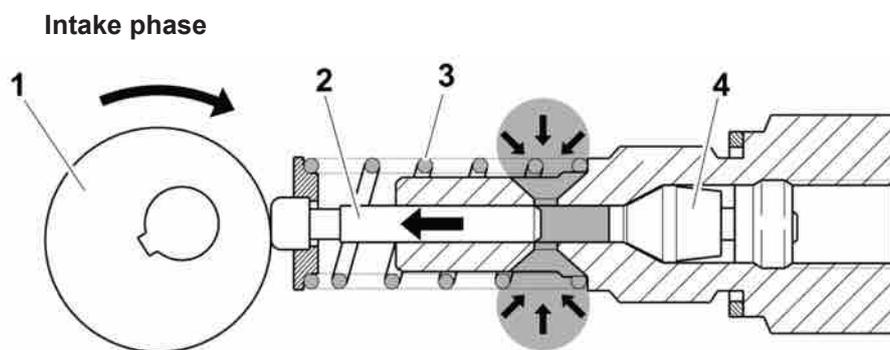


Fig. 5 - The pump element draws in lubricant

| | |
|---|---------------|
| 1 | Eccentric |
| 2 | Piston |
| 3 | Return spring |
| 4 | Check valve |

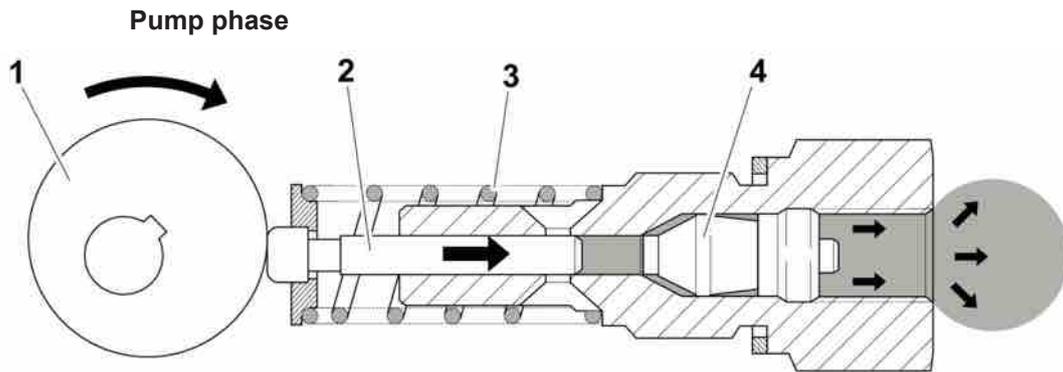


Fig. 6 - The pump element distributes lubricant.

| | |
|---|---------------|
| 1 | Eccentric |
| 2 | Piston |
| 3 | Return spring |
| 4 | Check valve |

Check valve

- Ensures that the pump element functions as it should.
- Prevents lubricant from returning to the pump housing or the reservoir.

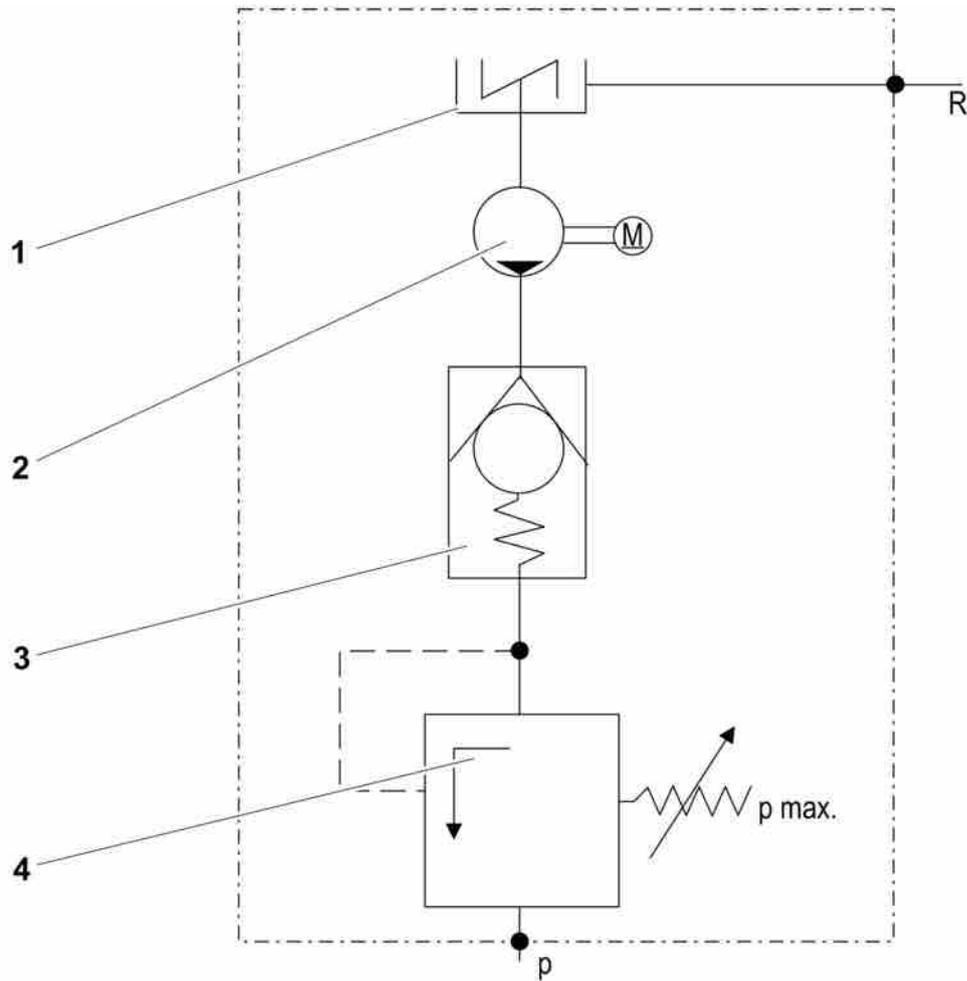


Fig. 7 - Hydraulic diagram for the pump

| | |
|---|-------------------------|
| 1 | Reservoir with agitator |
| 2 | Pump |
| 3 | Check valve |
| 4 | Safety valve |
| R | Return line |
| P | Pressure line |

Function of the safety valve

- The safety valve:
 - Limits pressure in the system.
 - Opens at a pressure of 350 bar.
- Lubricant leaking from the safety valve is an indication of a blockage in the system.

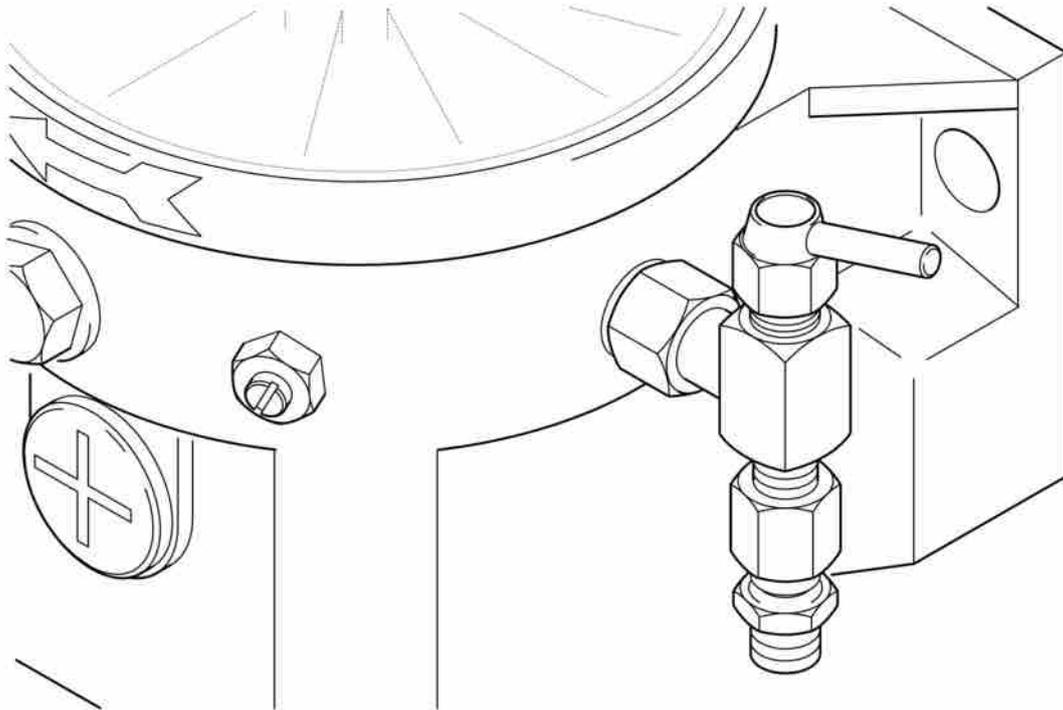


Fig. 8 - Safety valve

Filling the pump

- Fill lubricant up to the "MAX" mark on the reservoir using the filler nipple. Select a lubricant up to NLGI 2.

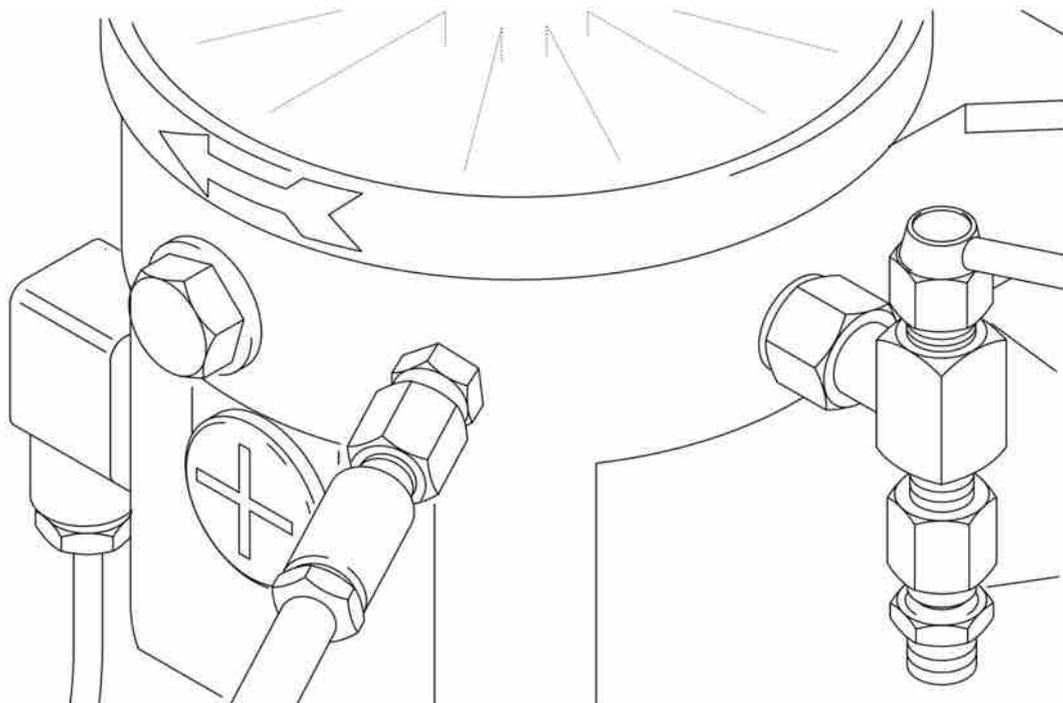


Fig. 9 - Filling the pump

Return connection

- "Excess" lubricant after dosage to the primary distributor must be led back to the pump through the return connection (Fig. 10).

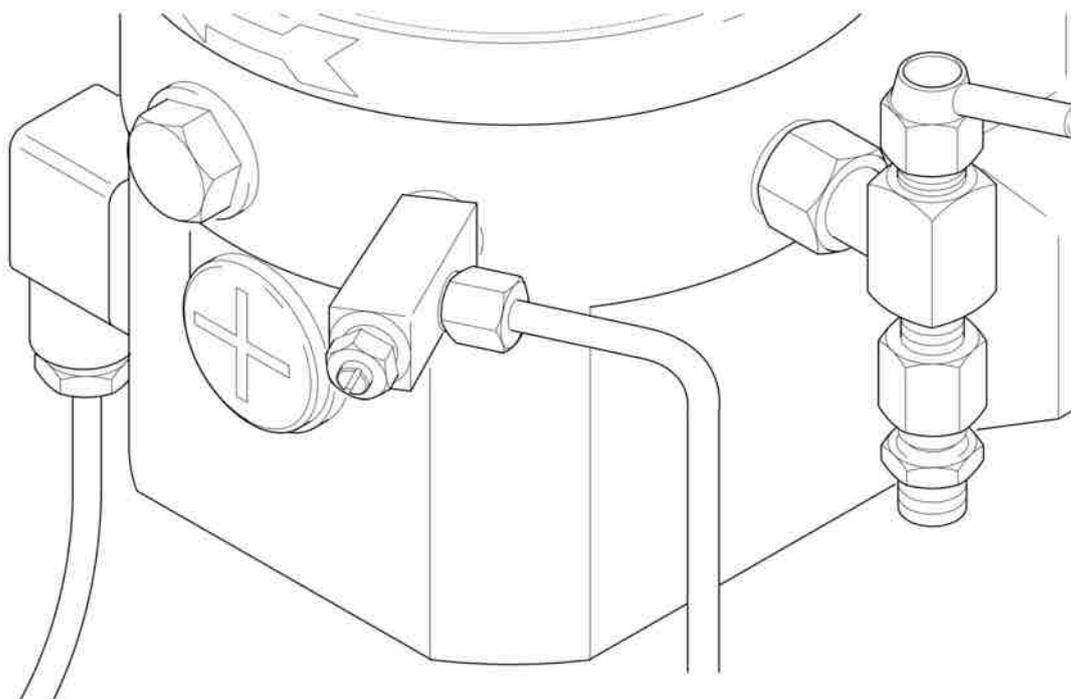


Fig. 10 - Return connection with filler nipple

10.4.3 Safety instructions

Suitable usage

- Use pump 203 only to provide lubricant to the central lubrication system. The pump is designed for intermittent usage.

General safety instructions

- LINCOLN-QUICKLUB central lubricating system:
 - Mounted for reliable usage
- Incorrect usage can result in bearing damage caused by too little or too much lubricant.
- No modifications or changes to the installed system may be made by unauthorised personnel. All modifications must be preceded by consultation with the manufacturer or a representative thereof.

Directions for preventing accidents

- Adhere to the instructions for avoiding accidents that apply to the country in which the pump is used.

Usage, Maintenance and Repair

- Repairs must only be carried out by authorised personnel who are well acquainted with the instructions.
- LINCOLN-QUICKLUB central lubrication pump may only be in operation with the safety valve installed.
- LINCOLN-QUICKLUB central lubrication pump must be regularly filled with clean lubricant.
- LINCOLN-QUICKLUB central lubrication system works automatically. Regular checks must be performed, however, (about every other week) to ensure that the lubricant reaches all lubrication points.
- A defective circuit board must be packed in a suitable manner and returned to the factory or local representative.
- Used or dirty lubricant must be disposed of in a legal manner.

- The manufacturer of the lubricating system does not accept responsibility for:
 - Damage caused by lubricant not intended for pumping or that can only be pumped under certain conditions in a central lubrication system
 - Damage caused by faulty lubrication and insufficient pump filling.
 - Damage caused by the use of contaminated lubricant.
 - Damaged caused by faulty disposal of used or contaminated lubricant.

10.4.4 Timer 236438624 with adjustable interval time

Power Supply

- The timer receives power through the ignition lock (contact 15) and ground (contact -31)
- The vehicle operating time and the lubrication system interval time are started and stopped via the ignition switch
- The system will retain the time settings after turning off the ignition.

10.4.5 Interval time - propagation time

Setting time interval

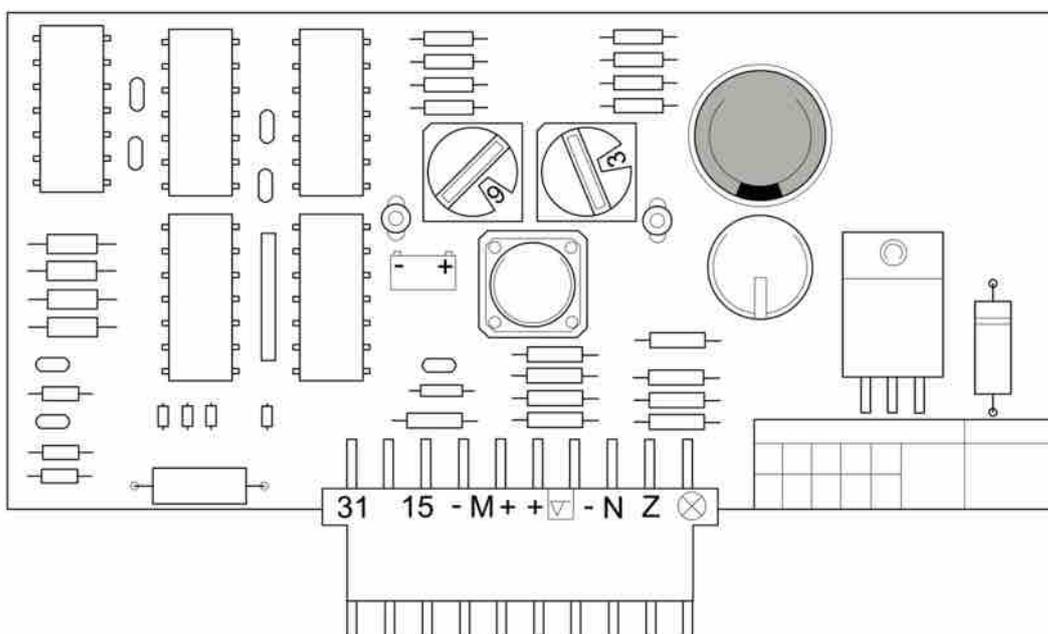
| Range | Interval |
|-------|---------------|
| Hours | 1 to 15 hours |

Table 26: Interval time

| Range | Interval |
|---------|-----------------|
| Minutes | 2 to 30 minutes |

Table 27: Propagation time

Adjusting interval time/propagation time



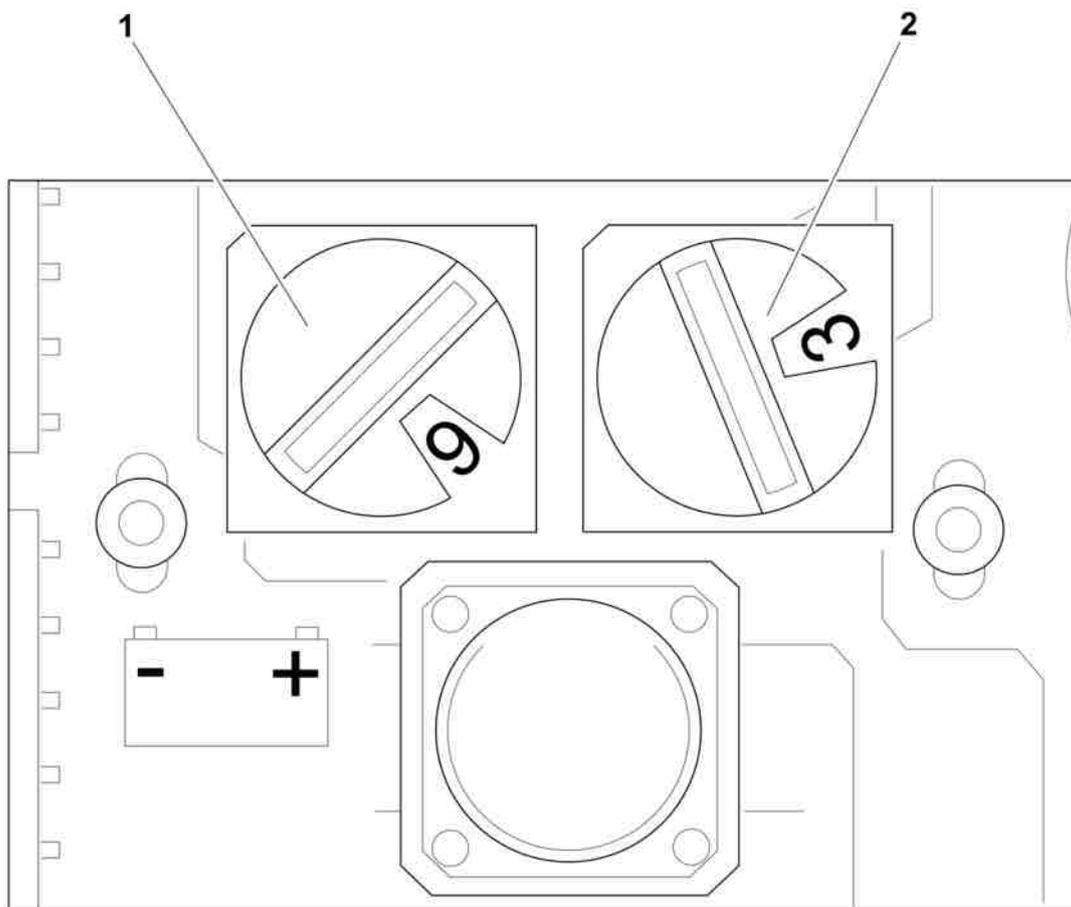
Interval time can be adjusted in 15 steps with the **blue rotary switch**

Propagation time can be adjusted in 15 steps with the **red rotary switch**.

Adjusting interval time/propagation time table

| | | | | | | | | | |
|-----------------|----|----|----|----|----|----|---|---|---|
| Switch position | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Hours | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Switch position | A | B | C | D | E | F | | | |
| Hours | 10 | 11 | 12 | 13 | 14 | 15 | | | |

Rotary switch for interval time



1 Blue rotary switch

2 Red rotary switch

10.4.6 Test/extra lubrication

- There is a built-in test function to test the timer and system.
- Switch on the ignition.
- Hold the push button on the timer depressed for 2 seconds.
- A short interval time begins and then the propagation time starts.

Diode with engine symbol illuminates.

- If battery voltage is connected (contact +15), the diode with the battery symbol will illuminate.

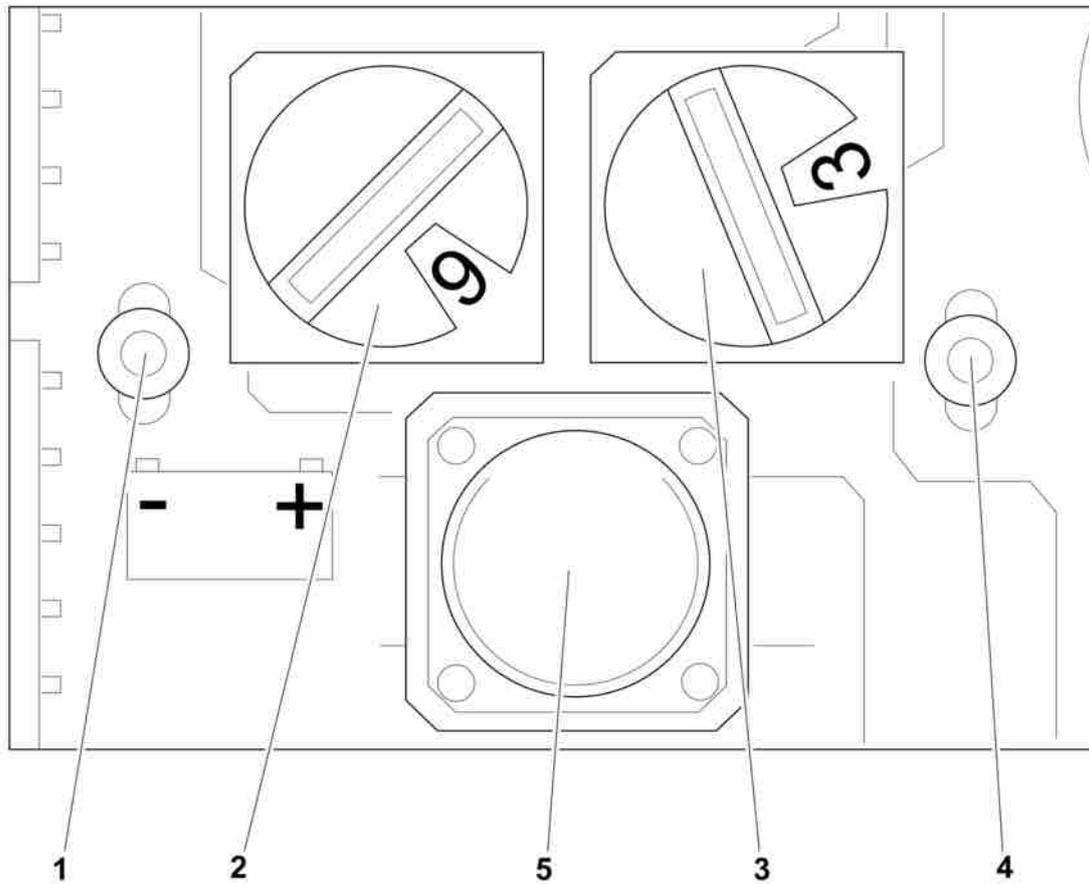


Fig. 14 - Timer LEDs and rotary switches

| | |
|---|--|
| 1 | Battery diode |
| 2 | Rotary switch for pause time |
| 3 | Rotary switch for running time |
| 4 | Engine diode |
| 5 | Push button for test/extra lubrication |

10.4.7 Timer terminal

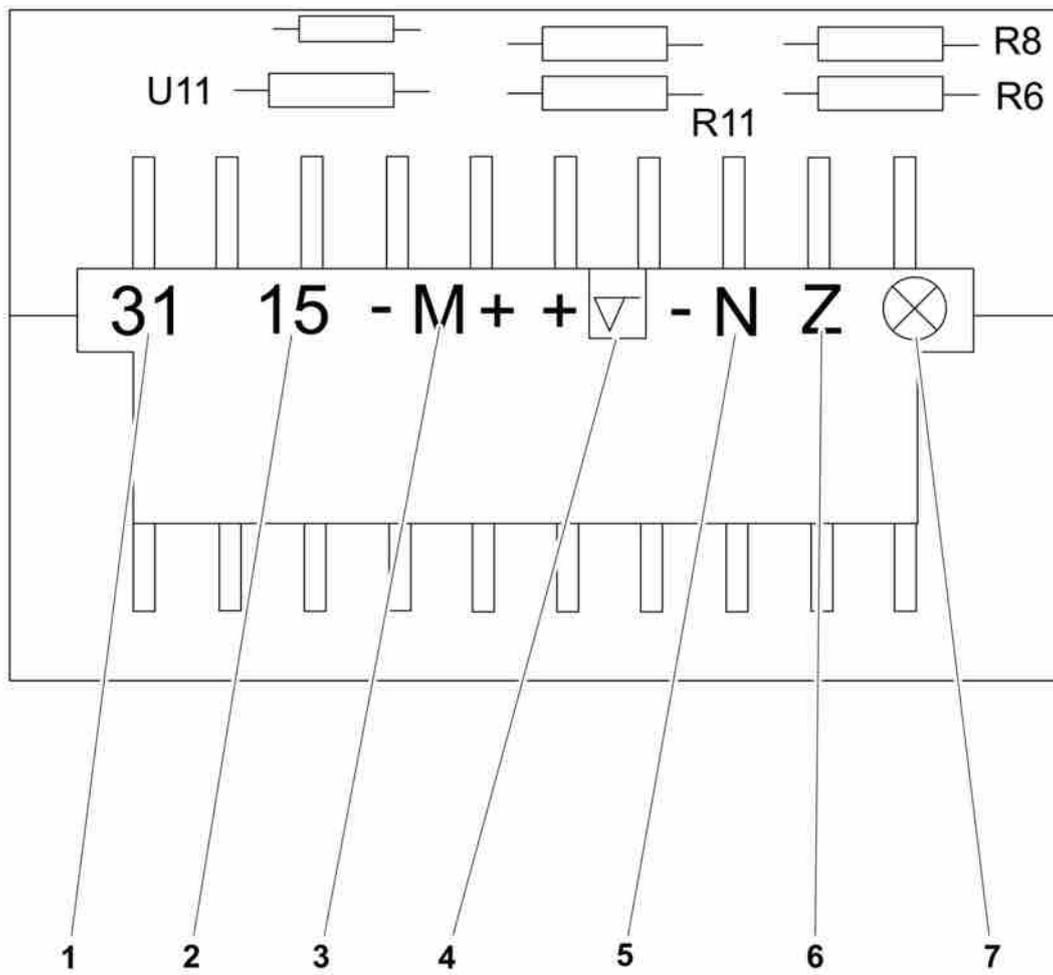


Fig. 15 Timer terminal

| | |
|---|----------------------|
| 1 | Ground |
| 2 | Ignition lock |
| 3 | Engine |
| 4 | Low level indication |
| 5 | Level indication |
| 6 | Extra lubrication |
| 7 | Lamp in push button |

Circuit diagram

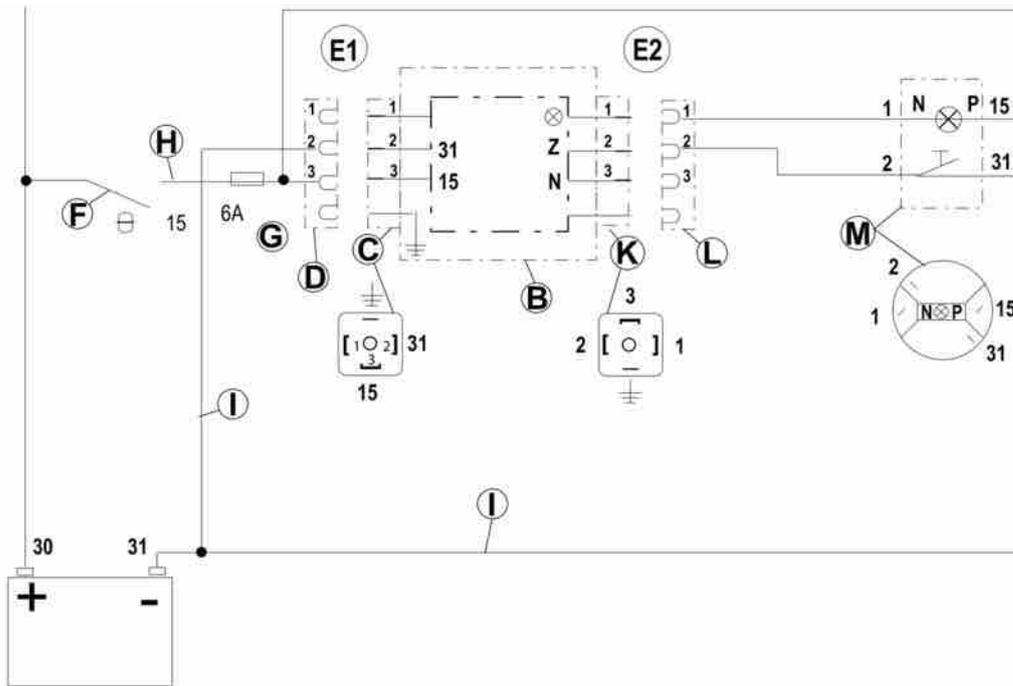


Fig. 16 - versions E1 and E2

| | |
|----|--------------------------------|
| A | Timer |
| B | Pump housing |
| C | Terminal |
| D | Cable contact |
| E1 | Pump without extra push button |
| E2 | Pump with extra push button |
| F | Ignition lock |
| G | Fuse |
| H | Cable, black |
| I | Cable, brown |
| K | Terminal 2 |
| L | Cable contact |
| M | Push button with lamp |

! **NOTE:** If pump model 103CS... E2 is replaced with pump model 203 CS...E2, the cable to the lamp in the push button must be converted from negative to positive.

10.4.8 Progressive lubricant distributor, type SSV

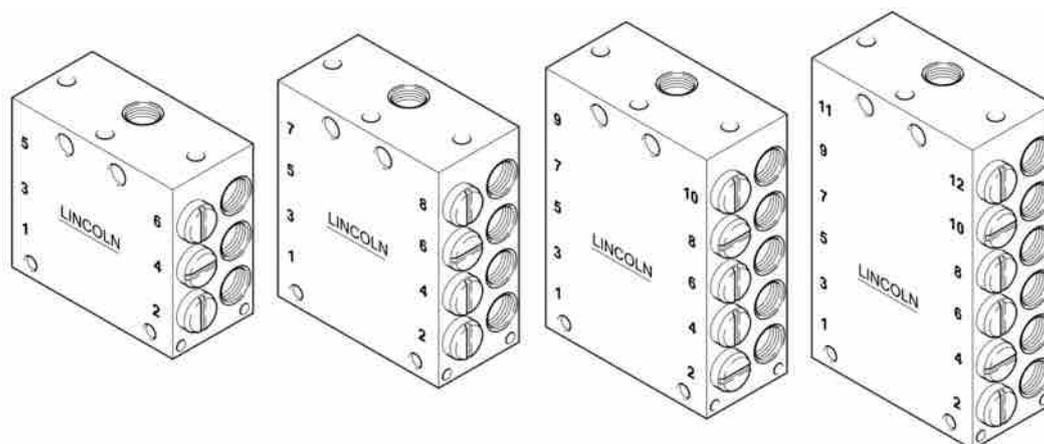


Fig. 17 - Progressive lubricant distributor with 6, 8, 10 and 12 outputs

What is a progressive lubricant distributor

The word "progressive" comes from the special way this type of lubricant distributor works, e.g. it is the lubricant that is pressurised and then drives the pistons inside the distributor. The pistons move in a predetermined manner and this pattern of movement is repeated over and over again. Each piston must complete its movement before the next piston can move, regardless of whether the flow of lubricant is constant or irregular. The pistons are dependent on one another and it is technically impossible for a connected lubrication point to be skipped.

Progressive lubricant distributor, type SSV

- Have pistons as the only moving part, i.e. no springs, balls or gaskets that can break
- Reliably distributes lubricant to the connected lubrication points
- Gives 0.2 cm³ lubricant per output and piston stroke
- Can be plugged to obtain double, triple, etc. the amount per output (see "Plugging the outlet")
- Can have 6 to 22 outputs
- Makes it possible to connect several lubrication points to one lubrication area.

Flow in the distributor

- The following 5 illustrations show what happens inside the distributor step by step.



NOTE: For purposes of simplification, lubricant distribution to outputs 2, 7, 5, 3 and 1 are shown. The other outputs receive their amounts in order, but are not shown here.

Step 1

- Lubricant enters the distributor and then follows the direction of the arrow to the right-hand end of piston A
- The pressure of the lubricant presses piston A to the left. The lubricant in front of the left-hand end of the piston is pressed out through output 2.

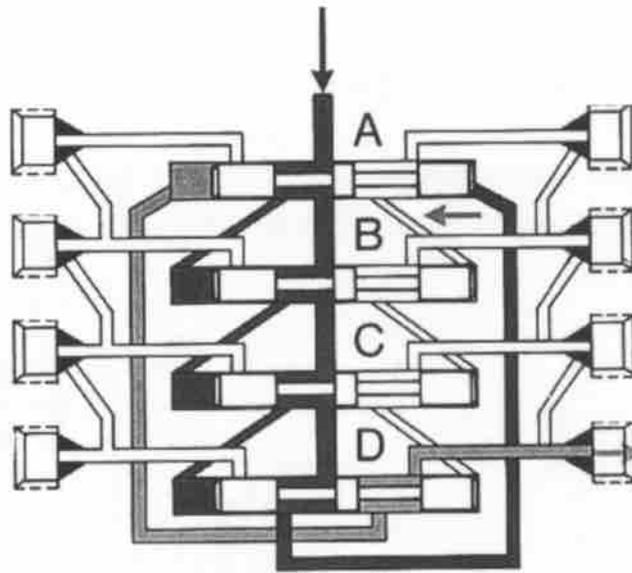


Fig. 18 - Step 1, D=output 2

Step 2

- When piston A has reached its left end position, a channel opens to the right-hand end of piston B.
- The lubricant moves in the direction of the arrow and moves piston B to the left. The lubricant in front of the left-hand end is pressed out through output 7.

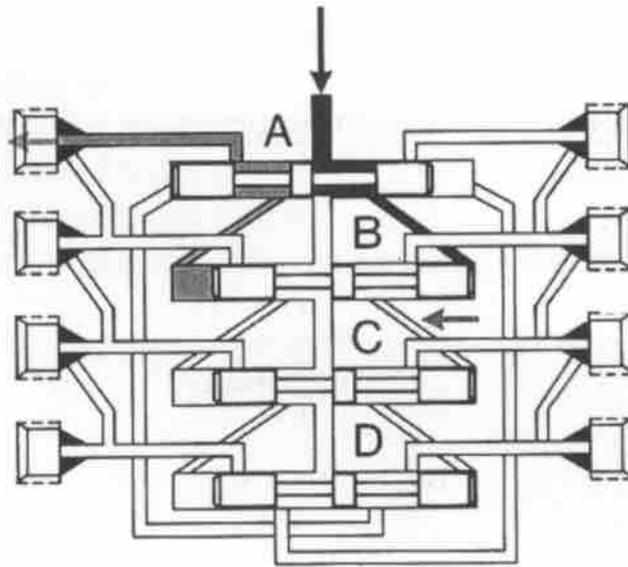


Fig. 19 - Step 2, A=output 7

Step 3

- When piston B has reached its left end position, a channel opens to the right-hand end of piston C
- The lubricant moves in the direction of the arrow and moves piston C to the left. The lubricant in front of the left-hand end is pressed out through output 5.

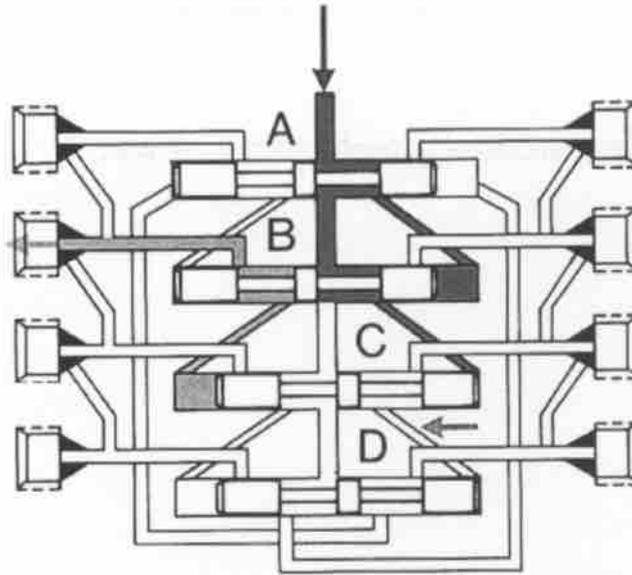


Fig. 20 - Step 3 B=output 5

Step 4

- The channel to the right-hand end of piston D is now open.
- The lubricant presses piston D to the left. The lubricant in front of the left-hand end of the piston is pressed out through output 3.

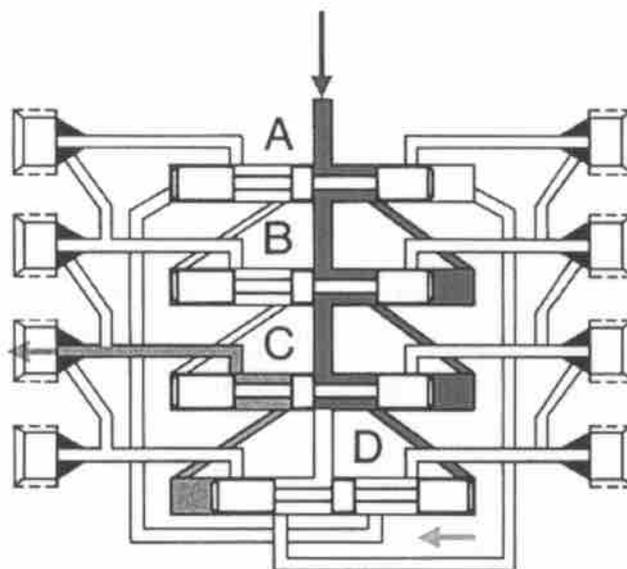


Fig. 21 - Step 4, D=output 1

Step 5

- Piston D opens the channel to the left-hand side of piston A.
- The lubricant presses the piston to the right. The lubricant in front of the piston is pressed out through output 1.
- Pistons B to D are then moved in order from left to right.
- A complete lubrication cycle has now been completed and will begin again.

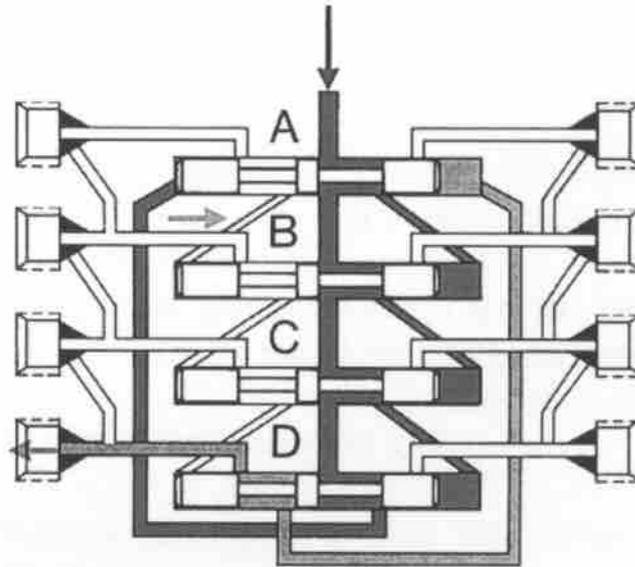


Fig. 22 - Step 5, D=output 1

When lubricant flow has been interrupted

- The pistons stop
- No lubricant reaches the lubrication points
- When the flow starts again, the pistons begin to move from the exact spot they stopped.

Functionality check

- The primary distributor (Fig. 23) and secondary distributors are connected with main lines (G). The pump is connected to the primary distributor.
- If a piston in any of the blocks gets jammed or if an output is blocked, the lubricant distributor will stop.
- Thanks to the design of the system, a blockage in the primary distributor will propagate and the entire lubrication system will stop (all pistons in all distributors stand still).
- The simple design also ensures that a blocked lubrication point is never forgotten.
- Since the pump is still pumping out lubricant and the distributors have stopped, the lubricant must go somewhere. Pressure in the system increases and the block becomes apparent when lubricant leaks from the safety valve (Fig. 25).

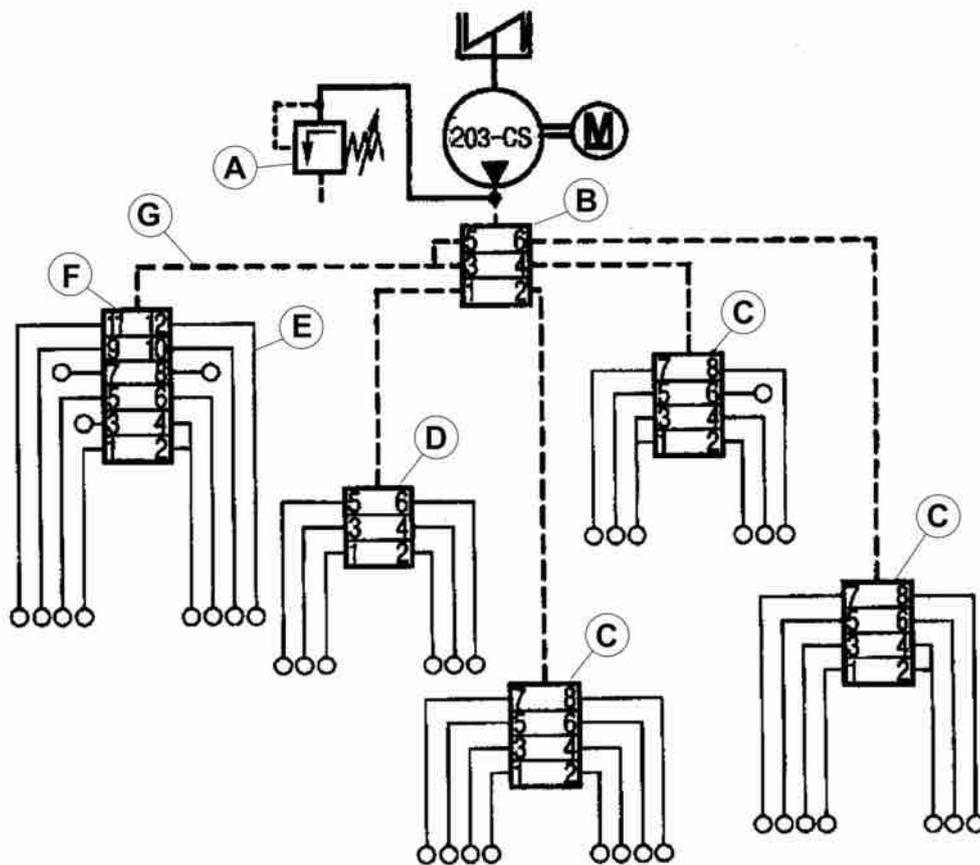


Fig. 22 - Example of lubrication system

| | |
|---|------------------------------|
| A | Safety valve |
| B | Primary distributor SSV 6 |
| C | Secondary distributor SSV 8 |
| D | Secondary distributor SSV 6 |
| E | Secondary hose |
| F | Secondary distributor SSV 12 |
| G | Primary hose |

- Lubricant distributors can be equipped with an indicator pin. The pin is secured in the end of a piston and follows its movements.
- When the system is blocked, the pin also stops.

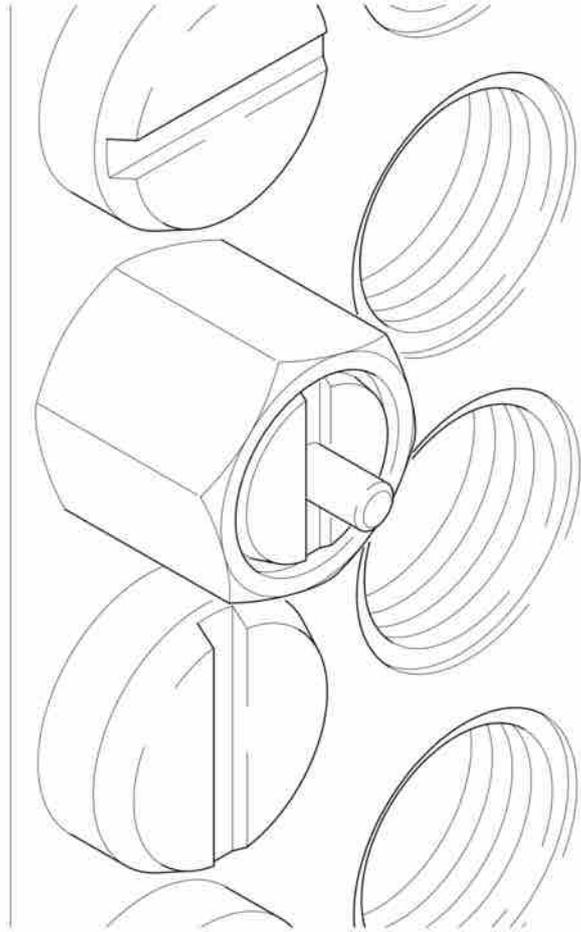


Fig. 24 - Indicator pin

- The pump's safety valve is used to check the entire lubrication system. If the pump is working and lubricant leaks from the valve, there is a stop in the system.

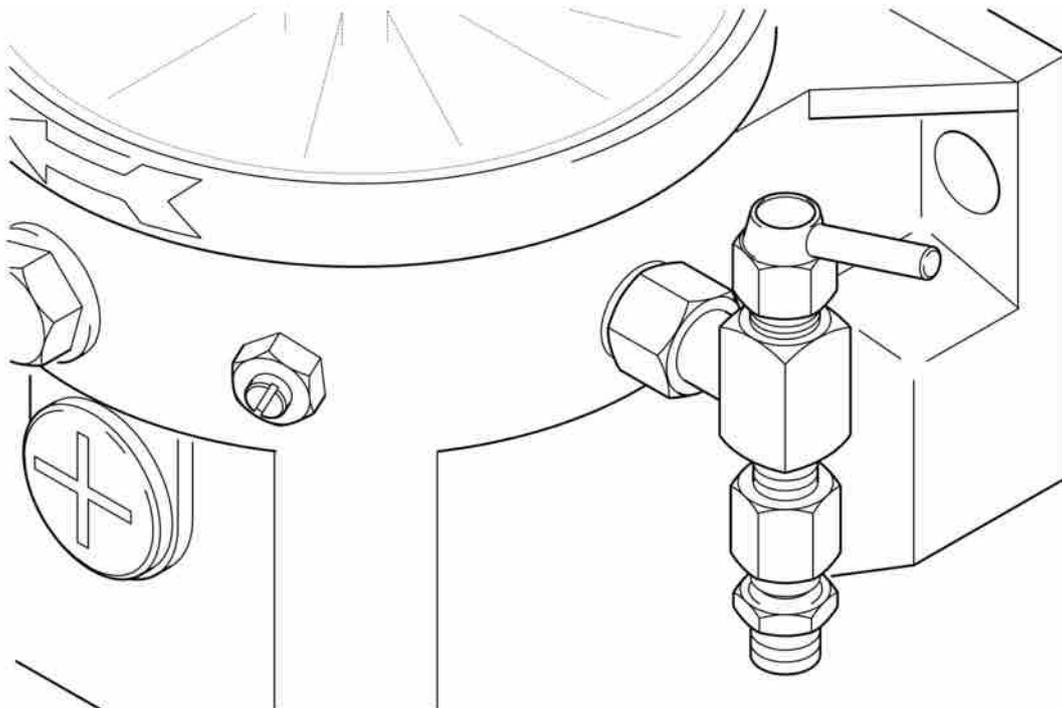


Fig. 25 - Safety valve

10.4.9 Plugging the outlet

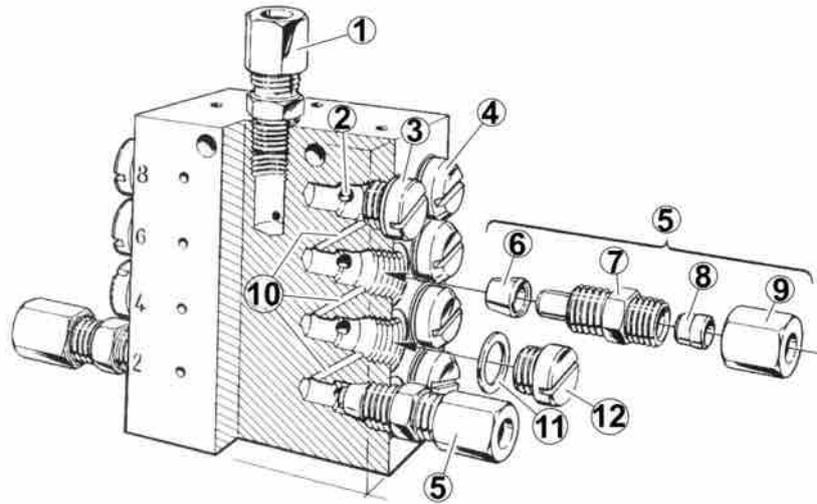


Fig. 26 - Outlet couplings and plugs

| | |
|----|---------------------|
| 1 | Inlet coupling |
| 2 | Channel from piston |
| 3 | Plug, screwed in |
| 4 | Plug, for piston |
| 5 | Check valve, kit |
| 6 | Brass cone |
| 7 | Valve body |
| 8 | Ferrule |
| 9 | Union nut |
| 10 | Connection channel |
| 11 | Copper washer |
| 12 | Plug |

- The amount of lubricant can be increased by plugging outputs.
- Set a complete outlet coupling in each output that is to be used. See Fig. 26 and 27.
- The plug (4) that sits at the piston is recognisable by its bevelled edge. It must **never** be unscrewed.
- **Never** replace plug (12) with plug (4).



NOTE: The valve body (7) must be used together with the brass cone (6).

- The brass cone (6) closes the connection channel (10) and must **never** be used together with plug (12).

! **NOTE:** For distributors SSV 6 to SSV 12, you must never use plugs in outputs 1 and/or 2. For distributors SSV 14 to SSV 22, you must never use plugs in the outputs with the highest number. Should one of these outputs be plugged, the entire distributor will become blocked.

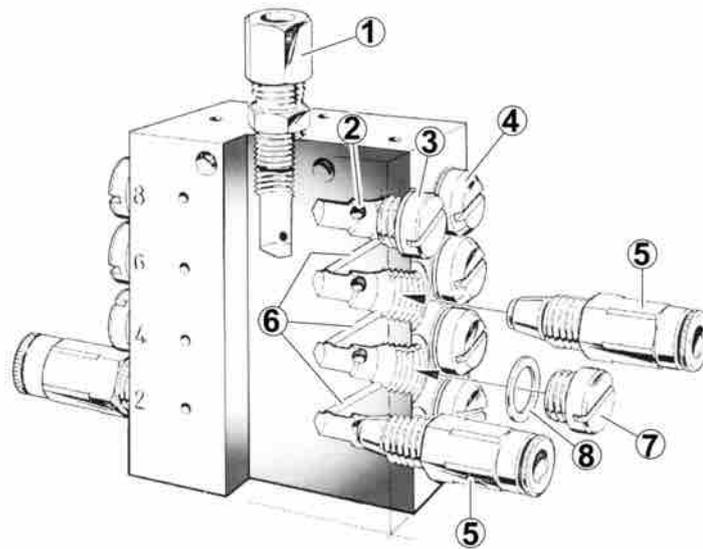


Fig. 27 - Outlet couplings and plugs

| | |
|---|---------------------|
| 1 | Inlet coupling |
| 2 | Channel from piston |
| 3 | Plug, screwed in |
| 4 | Plug for piston |
| 5 | Valve body |
| 6 | Connection channel |
| 7 | Plug |
| 8 | Copper washer |

Single amount of lubricant

- The single amount of lubricant is the amount that comes from one output with one piston stroke. The amount is 0.2 cm^3

Outputs linked in series

- If any of the lubrication points require more lubricant, one or more outputs can be plugged.
- In Fig. 28, output 10 is plugged. The amount of lubricant that should have come out here goes through the connection channel and out through output 8.
- Total amount in output 8:
 - output 8's "own" amount
 - plus the amount from output 10
- outputs that are above the output from which lubricant comes out, etc. See Fig 28 outputs 1, 3 and 5

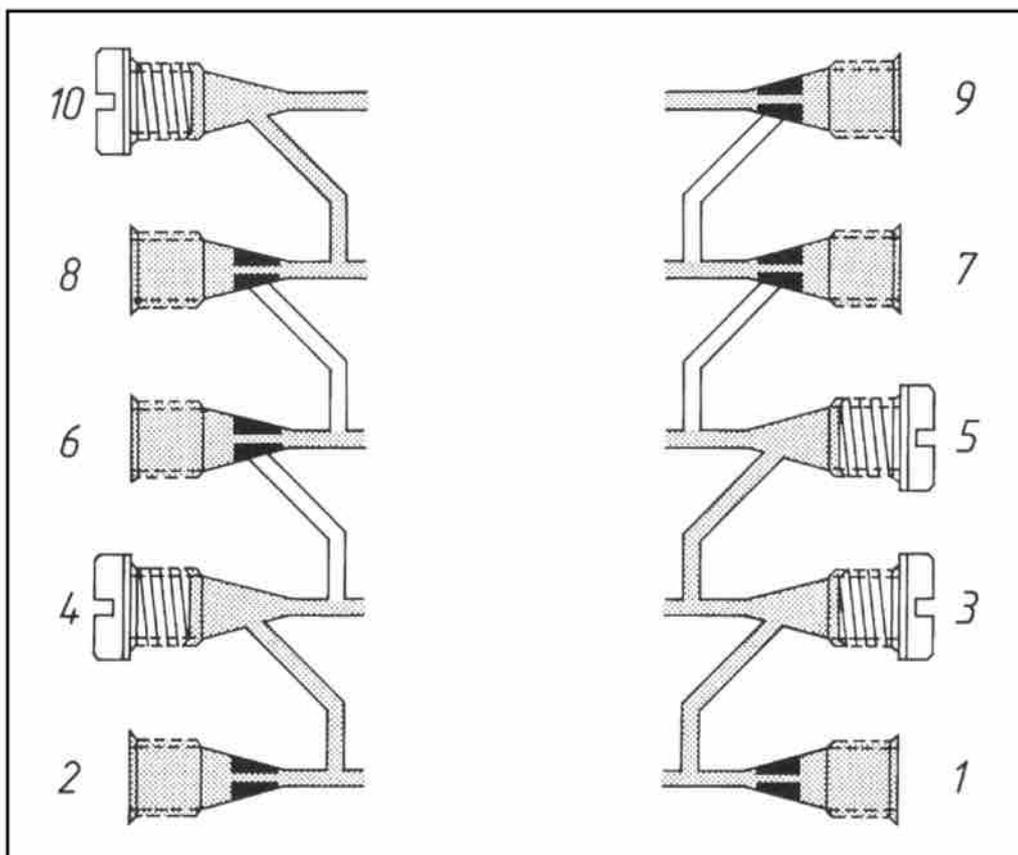


Fig. 28 - Single, double and triple amount of lubricant for distributor SSV 10.

10.4.10 Technical data

Pump QUICKLUB 203 CS-ZS

| Description | Data |
|-----------------------|--------------------------------|
| Operating temperature | -25 °C to 70 °C |
| Number of outputs | 1, 2 or 3 |
| Reservoir size | 2 L |
| Filling up | Via filler nipple or cartridge |
| Lubricant | Grease up to NLGI2 |

Motor

| Description | Data |
|--------------------------|--|
| Motor | DC motor geared down (radio interference suppressed) |
| Voltage | 12V DC or 24V DC |
| Max. current consumption | 12V 6.5A |

| Description | Data |
|-------------------------------------|-----------------------------|
| | 24V 3A |
| Engine speed | 17rpm |
| Protective class | IP54 |
| Output transistor | 5A short-circuit protection |
| Protected from faulty polarisation: | counter-voltage polarised |
| Temperature range | -30 °C to 85 °C |

Pump element

| Description | Data |
|------------------------------|----------------------------------|
| Piston diameter, standard K6 | 6 mm |
| Amount of lubrication* | approx. 2.8 cm ³ /min |



NOTE: * The amount of lubrication is based on NLGI 2 grease at a temperature of +20 °C, counterpressure 100 bar and a voltage of 12/24 V. At other temperatures and pressures the amount of lubrication will be slightly different. The design of the lubrication system is based on the above.

| Description | Data |
|------------------------|--------------------------------|
| Piston diameter, K5 | 7 mm |
| Amount of lubrication | approx. 4 cm ³ /min |
| Max. working pressure | 350 bar |
| Connection thread | G 1/4" |
| Suitable hose diameter | 6 mm |

Electronic timer in pump model E1 or E2 QUICKLUB 203CS-ZS, ZS/ADR



NOTE: This electronic timer is polarised.

| Description | Data |
|------------------|------------|
| Nominal voltage | 12/24 V DC |
| Working voltage | 12 V |
| | 9 V - 15V |
| | max. 18V |
| | 24 V |
| | 18 V - 30V |
| Protective class | IP66 |

| Description | Data |
|-------------------------------|--------------------------|
| Ripple in relation to voltage | 5% acc. as per DIN 41755 |

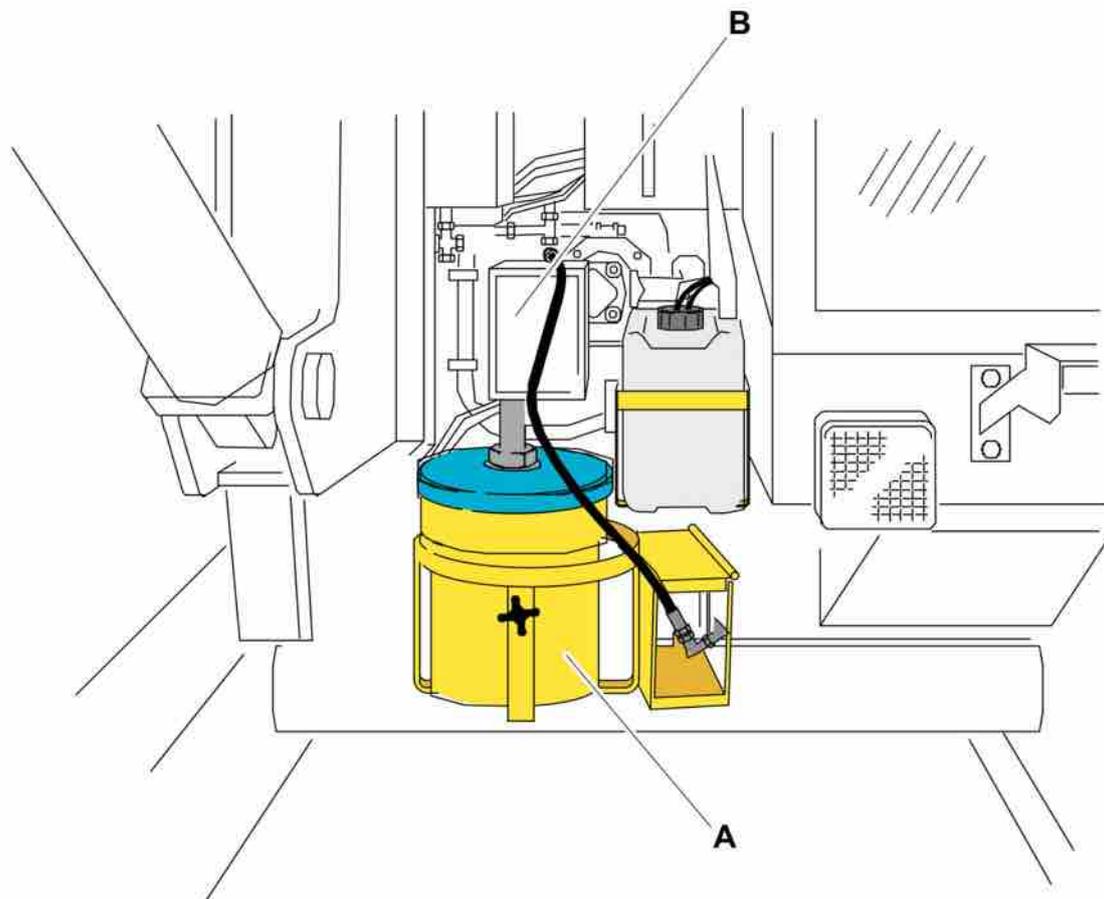
10.5 Thread lubrication

10.5.1 General

Function

Drill pipe threads are lubricated by means of spraying grease on them through a nozzle which is located on the upper breakout table.

The grease comes from a compressed air powered pump (B) which is located in a grease container (A) on the front of the chassis frame. Grease is pumped from the grease container to the nozzle where it is sprayed on the thread using compressed air from a separate air line to the nozzle.



Thread lubrication system.

| | |
|---|-------------|
| A | Grease tank |
| B | Pump |

Operation and adjustment

The direction of the nozzle must be adjusted so that the grease reaches the male thread when a pipe is in breakout position.

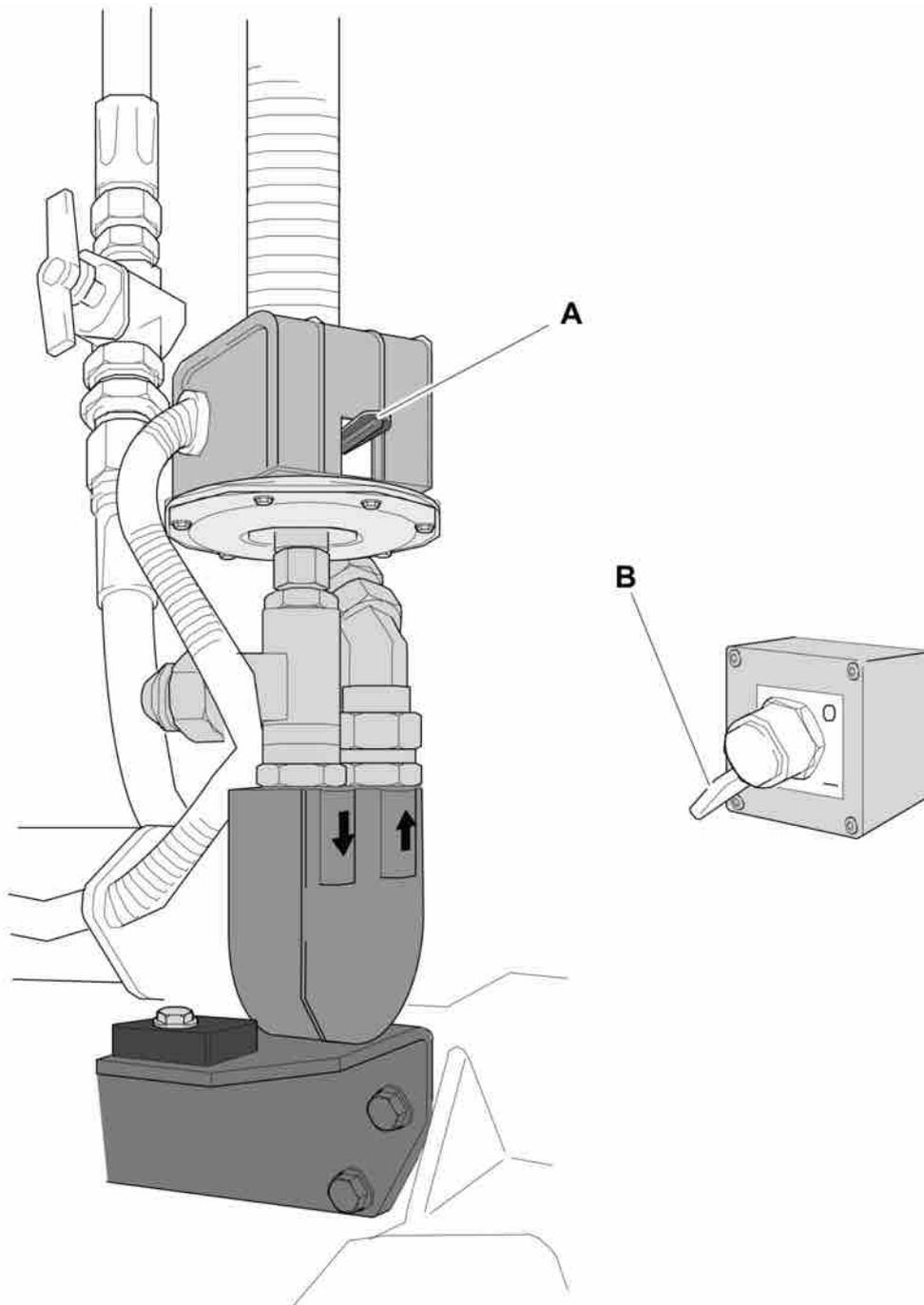
The threads must be greased during both drilling and retraction.

During drilling: Move circuit breaker S449 on the rod handling panel forwards before a new pipe is joined on.

During retraction: Move circuit breaker S449 on the rod handling panel forwards before the adapter on the rotation unit is threaded onto the pipe in breakout position.

10.6 Electric filler pump

10.6.1 Electric pump for filling fuel



Electric filler pump

The pump is used to fill fuel.

1. Make sure that the hose and the filter are clean.
2. Connect the attached hose to the fuel source.
3. Move switch (B) to position 1.
4. Activate switch (A) to start filling.

The electric filler pump will stop automatically when the drill rig fuel tank is full. It will also stop if the source of fuel runs out.

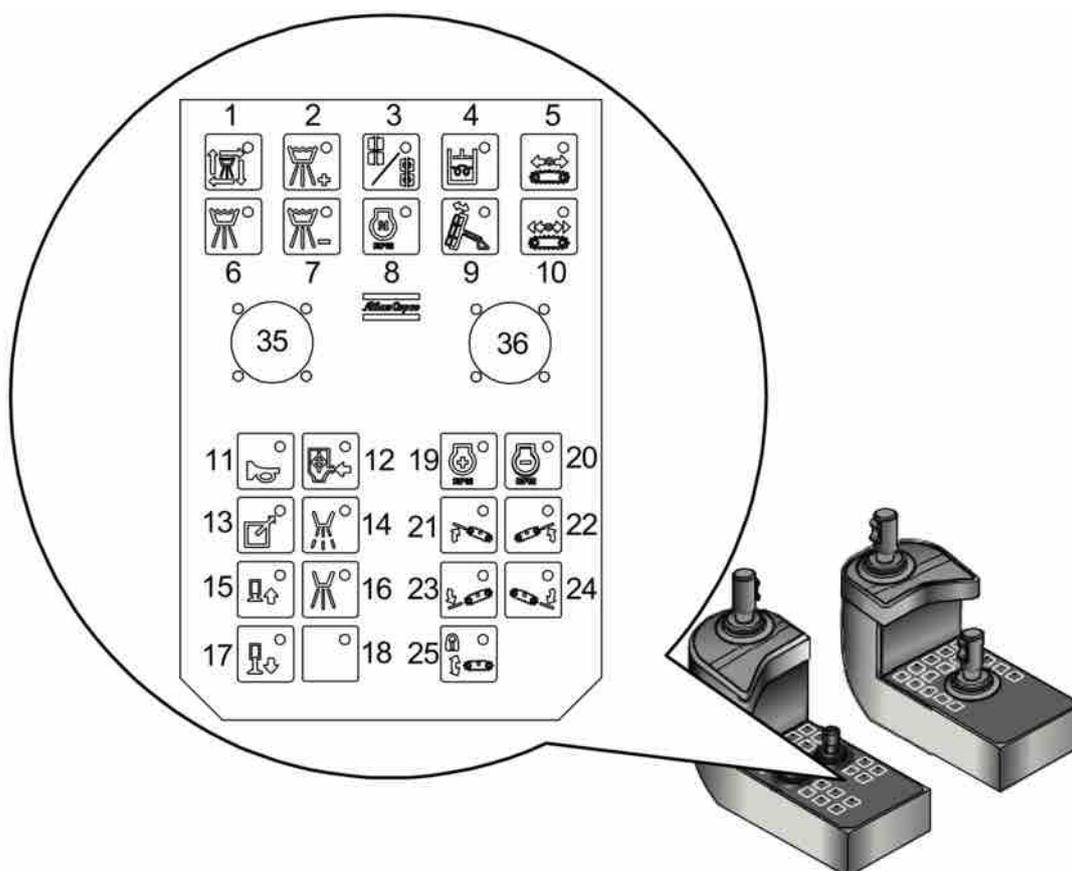
10.7 Water mist system

10.7.1 Water mist system

Operation

For the watermist system to be activated requires that the flushing air is activated.

- The water tank must be filled with pure water and possibly dust binding additive through the filler valve on top of the tank (A).
- The tank can be drained through the valve on the bottom of the tank (B).
- Buttons 1, 2, 6 and 7 on the left-hand control panel control the water mist:



Left control panel

- Button (1) varies between OFF and a reduced amount of water. The amount can then be increased with button (2) and decreased with button (7).
- Button (6) gives the full amount of water.

To prevent clogging suction hoses and filters, the dust collector should be switched off if the dust is damp or if water is being flushed out of the hole.

If there is a risk of freezing, the tank should be emptied and the system flushed with anti-freeze before leaving the rig overnight or for the weekend. Flushing is performed from Direct selection menu F2.

The filter (C) should be regularly dismantled and cleaned.

10.8 Service Winch

⚠ WARNING

Serious injury

Using the winch often involves working with a suspended load.

- ▶ Work on suspended loads may cause serious personal injury.
- ▶ Make sure that the winch cable and attaching devices are free from defects.

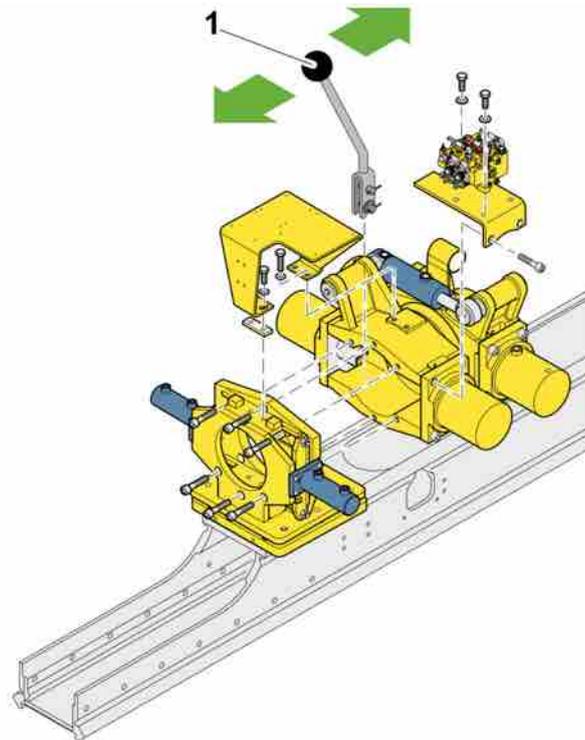
⚠ WARNING

Risk of damage to winch arm

If the winch is used when the feed beam is placed outside the vertical position, the winch arm may break and cause injury or death.

- ▶ The winch may only be used when the feed beam is placed vertically at 90°.

10.8.1 General instructions



Service winch control lever

1

Control lever - service winch

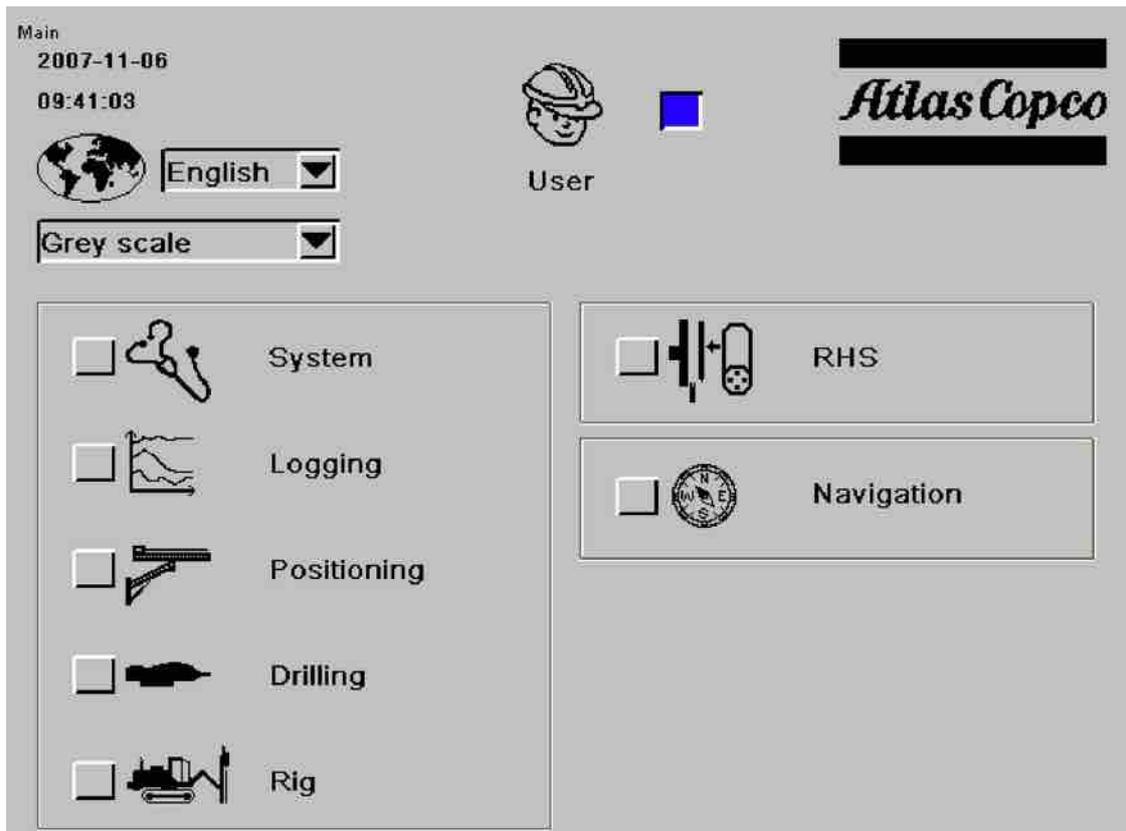
To use the service winch, place the rig in drilling position (drilling mode). Pull the control lever (1) up in order to lift, and then down to lower.

The maximum load must not exceed 10 kN.

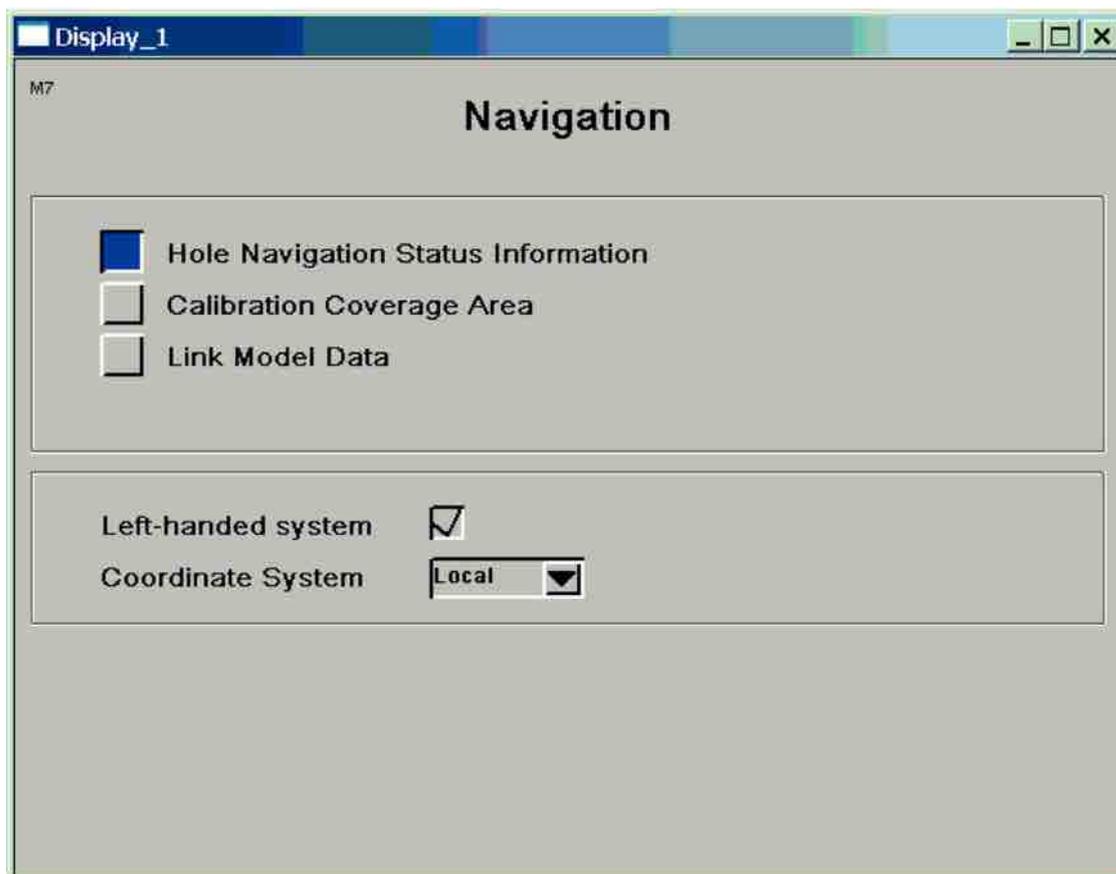
10.9 Navigation

10.9.1 Menus

Navigation menu



Select **Navigation**



The following can be selected in the Navigation menu:

- **Hole Navigation Status Information:** Information on the HNS system.
- **Calibration Coverage Area:** Calibration of the boom system's coverage area.
- **Link Model Data:** Information on direction measurements.
- **Left-handed system:** Normally ticked.
- **Coordinate System:** Specifies the type of coordinate system in use, normally it is local.

Hole Navigation Status Information - Trimble system

M7.1

Hole Navigation Status Information

| | Trimble SPS850 | Trimble SPS550 |
|---------------------|----------------|----------------|
| Date : | 0 | 0 |
| UTC Time : | 0.00 | 0.00 |
| Sat in Use : | 0 | 0 |
| DOP : | 0.00 | 0.00 |
| Quality Indicator : | 0 | 0 |
| Northing : | 0.000 m | |
| Easting : | 0.000 m | |
| Height : | 0.000 m | |
| Yaw : | | 0.00 ° |
| Tilt : | | 0.00 ° |
| Range : | | 0.000 m |

| | | | | |
|-------|----------------|-------|----------------|---------|
| COM3: | Trimble SPS850 | 18400 | /none/1/8/none | Failure |
| COM2: | Trimble SPS550 | 18400 | /none/1/8/none | Failure |

| | | | |
|--------------------|----------|-----------------|----------|
| Bit Pos Northing : | 1.757 m | Rig Heading : | 171.64 ° |
| Bit Pos Easting : | 0.196 m | Calc Baseline : | 9.427 m |
| Bit Pos Height : | -5.548 m | | |

Hole Navigation Status Information - Rigs equipped with Trimble system.

The **Hole Navigation Status Information** menu contains information on the system and can be useful for fault finding. When the **yellow lamp Hole Navigation Warning** is illuminated in the status bar, this menu has to be activated in order to obtain more detailed information on the cause.

- **Date:** Current date that **Moving Base** and **Rover** are sending (month:day:year).
- **UTC Time:** Current **UTC** time that **Moving Base** and **Rover** are sending (hours:minutes:seconds:hundredths of a second).
- **Sat in Use:** Number of satellites that **Moving Base** and **Rover** have contact with.
- **DOP:** **DOP-Moving Base** number for **Rover**.
- **Quality Indicator:** Quality indicator for **Moving Base** and **Rover**. When the system is OK it shows 3 3.
- **Northing:** Northerly coordinate in metres for **Moving Base**.
- **Easting:** Easterly coordinate in metres for **Moving Base**.
- **Height:** Elliptic height in metres for **Moving Base**.
- **Yaw:** Side angle for **Rover** Antenna in degrees, positive clockwise, northerly direction is zero.
- **Tilt:** Height angle for **Rover** Antenna in degrees.
- **Range:** Distance (**Baseline**) to **Rover** Antenna in metres.
- **GPS Serial Com:** Communication parameters and status for serial communication between **CCI** and **Moving Base**.
- **Bit Pos Northing:** Northerly coordinate in metres for Drill bit.
- **Bit Pos Easting:** Easterly coordinate in metres for Drill bit.
- **Bit Pos Height:** Elliptic height in metres for Drill bit.
- **Rig Heading:** Rig compass direction in degrees, positive direction clockwise, northerly direction is zero.

- **Calc Baseline:** Calculated baseline / (distance) between **Moving Base** and **Rover** Antenna in metres.

Hole Navigation Status Information - Leica system

M7.1

Hole Navigation Status Information

| | Leica Powerbox | | Leica Powerbox | |
|-------------------|----------------|-------|----------------|---------|
| Date | : | 0 | | 0 |
| UTC Time | : | 0.00 | | 0.00 |
| Sat in Use | : | 0 | | 0 |
| DOP | : | 0.00 | | 0.00 |
| Quality Indicator | : | 0 | | 0 |
| Northing | : | 0.000 | m | |
| Easting | : | 0.000 | m | |
| Height | : | 0.000 | m | |
| Yaw | : | | | 0.00 ° |
| Tilt | : | | | 0.00 ° |
| Range | : | | | 0.000 m |

COM1: Leica Powerbox /none/1/8/none Failure

| | | | | | | | |
|------------------|---|--------|---|---------------|---|--------|---|
| Bit Pos Northing | : | 1.757 | m | Rig Heading | : | 171.64 | ° |
| Bit Pos Easting | : | 0.196 | m | Calc Baseline | : | 9.427 | m |
| Bit Pos Height | : | -5.548 | m | | | | |

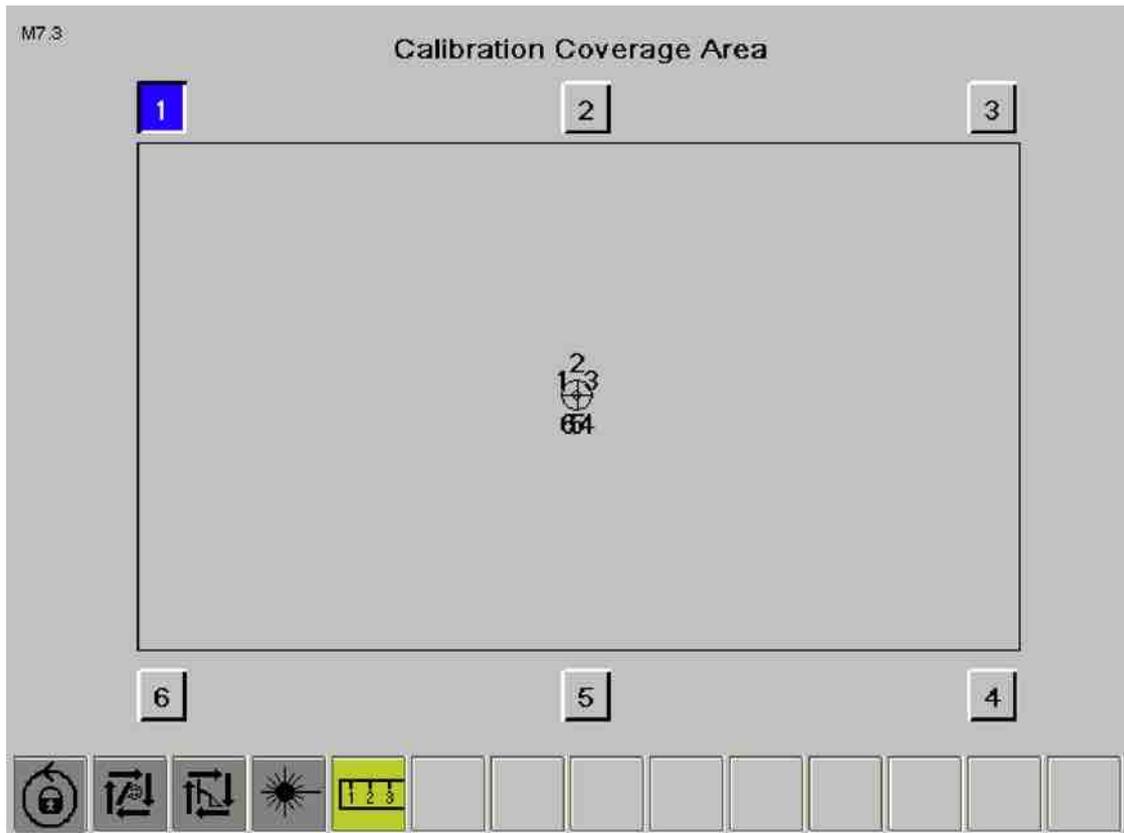
Hole Navigation Status Information - Rigs equipped with Leica system.

The **Hole Navigation Status Information** menu contains information on the system and can be useful for fault finding. When the **yellow lamp Hole Navigation Warning** is illuminated in the status bar, this menu has to be activated in order to obtain more detailed information on the cause.

- **Date:** Current date that **Master GPS receiver** and **Slave GPS receiver** are sending (month:day:year).
- **UTC Time:** Current **UTC** time that **Master GPS receiver** and **Slave GPS receiver** are sending (hours: minutes:seconds:hundredths of a second).
- **Sat in Use:** Number of satellites that **Master GPS receiver** and **Slave GPS receiver** have contact with.
- **DOP:** **DOP-Master GPS receiver** number for **Slave GPS receiver**.
- **Quality Indicator:** Quality indicator for **Master GPS receiver** and **Slave GPS receiver**. When the system is OK it shows 255.
- **Northing:** Northerly coordinate in metres for **Master GPS receiver**.
- **Easting:** Easterly coordinate in metres for **Master GPS receiver**.
- **Height:** Elliptic height in metres for **Master GPS receiver**.
- **Yaw:** Side angle for **Slave GPS receiver** Antenna in degrees, positive clockwise, northerly direction is zero.
- **Tilt:** Height angle for **Master GPS receiver** Antenna in degrees.
- **Range:** Distance (**Baseline**) to **Master GPS receiver** Antenna in metres.
- **GPS Serial Com:** Communication parameters and status for serial communication between **CCI** and **Master GPS Receiver**

- **Bit Pos Northing:** Northerly coordinate in metres for Drill bit.
- **Bit Pos Easting:** Easterly coordinate in metres for Drill bit.
- **Bit Pos Height:** Elliptic height in metres for Drill bit.
- **Rig Heading:** Rig compass direction in degrees, positive direction clockwise, northerly direction is zero.
- **Calc Baseline:** Calculated baseline / (distance) between **Master GPS receiver** and **Slave GPS receiver** Antenna in metres.

Calibrating the coverage area



Calibration Coverage Area

The rig must be level before calibration begins.

Start by parking the rig on a level surface. Then use the track oscillation and level the rig using the spirit level in the cabin.

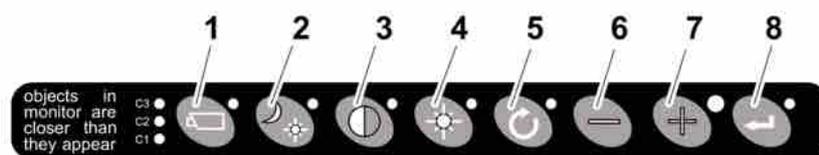
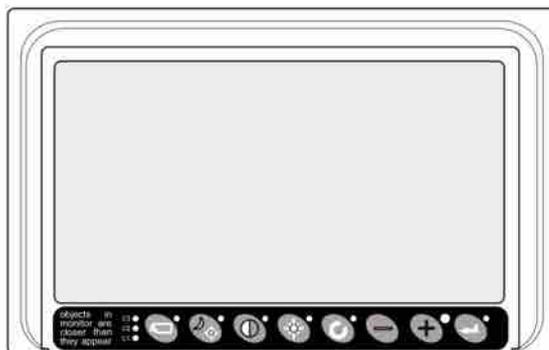
Then lock the track oscillation. Activate drilling position.

- Position the boom system max left and as far forward as possible with vertical feed and feed extension max up. Then press Box 1.
- Position the boom system straight forward and as far forward as possible with vertical feed and feed extension max up. Then press Box 2.
- Position the boom system max right and as far forward as possible with vertical feed and feed extension max up. Then press Box 3.
- Position the boom system max right and as close to the rig as possible with vertical feed and feed extension max up. Then press Box 4.
- Position the boom system straight forward and as close to the rig as possible with vertical feed and feed extension max up. Then press Box 5.
- Position the boom system max left and as close to the rig as possible with vertical feed and feed extension max up. Then press Box 6.

Now the boom system's coverage area can be seen on the screen. This area is used in the fine navigation menu for viewing which holes can be reached from the current position.

10.10 Reverse camera

10.10.1 Description of the display



Display

| Pos. | Function | Description |
|------|---------------------|--|
| 1 | Camera selection | Press the button. The camera's LED flashes in order to show that manual camera selection is active. Use the plus and minus keys to select camera. Press the button again to activate camera selection. |
| 2 | Background lighting | There are three setting modes: <ul style="list-style-type: none"> ■ Automatic control of background lighting (ABC) ■ Day setting ■ Night setting |
| 3 | Contrast setting | Press the button to activate the setting mode. Use the plus and minus keys to select contrast. Press the button again to activate the setting. |
| 4 | Brightness setting | Press the button to activate the setting mode. Use the plus and minus keys to select brightness. Press the button again to activate the setting. |

| Pos. | Function | Description |
|------|-------------------------|---|
| 3+4 | Saturation setting | Press buttons 3 and 4 simultaneously in order to activate the setting mode. Use the plus and minus keys to select saturation. |
| 5 | Alternate/previous menu | Go back to previous menu. |
| 6 | Minus | Go to next menu option or move to the left. |
| 7 | Plus | Go to previous menu option or move to the right. |
| 8 | Enter | Change to Standby, select or activate options in the menus. |

Table 28: Checks

Menus

- Open the Service menu by pressing the buttons (1), (6) and (7) simultaneously.
- Navigate with the buttons:
 - (5) **Alternate/previous menu** Go back to previous menu
 - (6) **Minus** Go to next menu
 - (7) **Plus** Go to previous menu
 - (8) **Enter** Select or activate the desired option

| Menu | Submenu | Description |
|-----------------|---------------------------|---|
| Camera settings | Mirror | Mirrors the image (left/right). |
| | Up and down | Turns the image up and down. |
| | Brightness | Adjusts brightness, can also be done directly with button 4. |
| | Contrast | Adjusts contrast, can also be done directly with button 3. |
| | Saturation | Adjusts saturation, can also be done directly with buttons 3+4. |
| | Change delay | Not used |
| | Horizontal line marking | Shows a reference line on the screen. Shown as horizontal green line. |
| | Line arrangement | Adapts the vertical height of the reference line (0 - 100). |
| | Vertical line arrangement | Shows a reference line on the screen. Shown as vertical green line. |

| Menu | Submenu | Description |
|-----------------|--------------------|--|
| | Line arrangement | Adapts the vertical position of the reference line. Setting between 38 and 63. |
| | Grid | Shows a grid on the screen. |
| | Widescreen mode | Shows the camera image in widescreen. |
| | Camera type | Selection of camera type. Select CCC. |
| | Videostndrd | Only applicable if DVD is connected. |
| Camera marking | 1 | Option to label camera inputs. The name is visible on the display. |
| | 2 | |
| | 3 | |
| | 4 | |
| System settings | Language | Selection of language |
| | Show on screen | <p>The following settings can be made for the screen's display:</p> <ul style="list-style-type: none"> ■ OSD interruption - Sets the time (in seconds) that the OSD (camera number/name top left) is shown on the screen. ■ Location of OSD - Setting the horizontal position for OSD menu text. ■ Changes transparency for: <ul style="list-style-type: none"> ● Camera marking ● System menu ● Indemnity clause ■ OSD help menu - The function activates/deactivates the automatic text messages for the OSD help menus. On activation the help messages are shown automatically in all menus after 10 seconds inactivity. |
| | Keyboard | Keyboard lock - Enables locking of functions. |
| | Power save setting | <ul style="list-style-type: none"> ■ Standby mode - This includes three options: |

| Menu | Submenu | Description |
|------|-------------------------|--|
| | | <ul style="list-style-type: none"> ● MNU = This function is used to access the user menu via the Enter key (8). ● IMM = Immediate standby ● 2S = Standby after a 2-second delay. <ul style="list-style-type: none"> ■ Standby, camera off - The power to the camera is switched off during Standby |
| | CAN-bus | Factory setting |
| | LCD background lighting | <ul style="list-style-type: none"> ■ LCD lighting mode ABC = Activates automatic control of background lighting. ■ ABC level = Indicates the minimum brightness that the ABC can use when the ambient light is weak. ■ LCD background lighting daytime = Manual setting of daytime brightness (50-100%). ■ LCD background lighting night-time = Manual setting of night-time brightness (0-50%). |
| | Scanning | <ul style="list-style-type: none"> ■ Scanning sequence = Selection of cameras from which images are shown in sequence. ■ Scanning interval = Selection of how long a camera image is shown. |
| | Camera changer | Configuration of current camera system. Setting options: <ul style="list-style-type: none"> ■ AV = 1 camera ■ 2C = 1 camera + DVD, or 2 cameras ■ 4C = 3 cameras + DVD |
| | Front camera | Activates front camera functionality |
| | Standard settings | Reset to factory settings. 1 = Supplier's standard settings. There is the option to create 16 sets of settings. |

| Menu | Submenu | Description |
|------|-----------------|---------------------------------|
| | Config ext unit | Not used. |
| Info | Info | Shows current software version. |

10.11 RC - Reverse Circulation

10.11.1 General

RC, or Reverse Circulation, is a method for transporting cuttings and the collection of cutting samples. Unlike conventional drilling, when cuttings are drawn up by flushing air between the drill steel and the borehole wall, the cuttings are drawn up with flushing air in a separate tube inside the drill pipe.

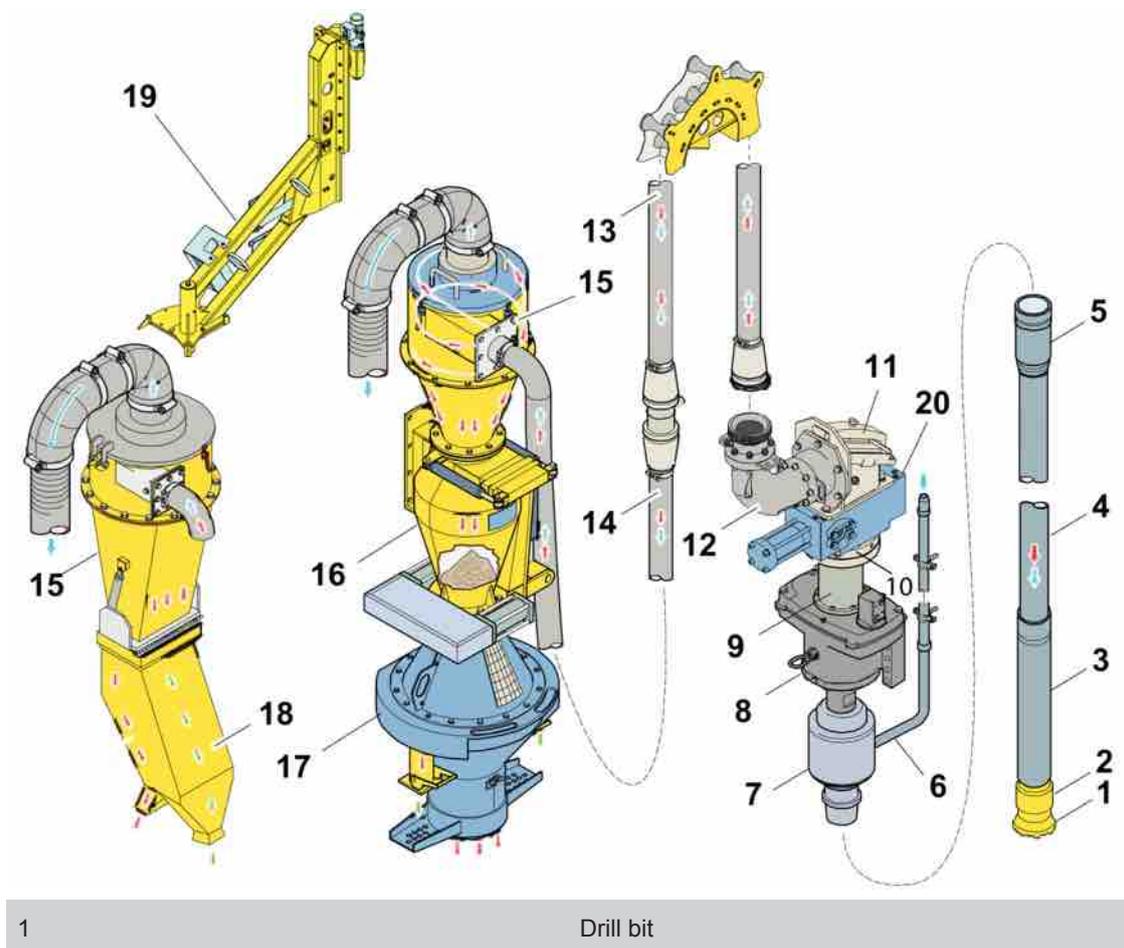
The system covers the entire drill string, i.e. drill bit, down-the-hole rock drill and drill steel, as well as devices for the further transportation and division of cuttings in small samples.

For documentation on the rotation unit, see separate instructions.

For specific documentation on drill pipes and the down-the-hole rock drill, refer to the documentation of the supplier in question.

Atlas Copco assumes no responsibility for the durability of the rig if rig equipment from another supplier is fitted.

10.11.2 Functional description of RC components



| | |
|----|--------------------------------|
| 2 | Seal ring |
| 3 | Down-the-hole rock drill |
| 4 | Drill pipe |
| 5 | Thread adapter |
| 6 | Tube for input compressed air |
| 7 | Air swivel |
| 8 | Rotation unit |
| 9 | Spacer pipe |
| 10 | Outlet swivel |
| 11 | First deflector |
| 12 | Second deflector |
| 13 | Sample hose |
| 14 | Sample hose |
| 15 | Cyclone |
| 16 | Intermediate chamber |
| 17 | Cone splitter |
| 18 | Jones riffle splitter |
| 19 | Arm |
| 20 | Metzke blowdown valve - Option |

Drill bit and seal ring

RC drill bits are similar to conventional drill bits externally. They break the rock in the same way and they are sharpened in the same way.

The main difference is the route of the flushing air and the cuttings. The clean flushing air is led to hole bottom through slits on the outside of the drill bit. On the lower part of the drill bit are two openings where the mixture of cuttings and flushing air each flow into separate channels. The two lower channels merge together into one upper channel about 100 mm into the drill bit.

Since two channels are combined into one, the upper channel can be worn down to become oval. This can lead to rapid wear of the down-the-hole rock drill's inner tube. Drill bits exhibiting such wear should be removed from operation.

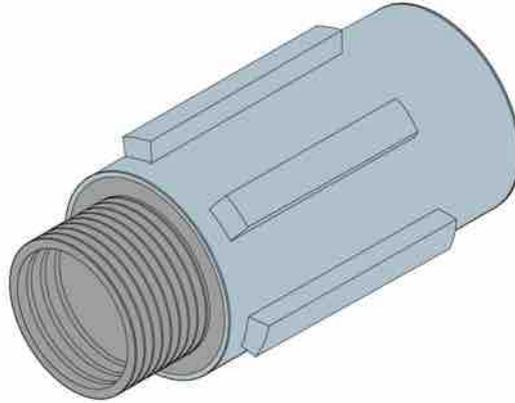
During normal drilling, flushing air and cuttings are routed up between the hole wall and the outside of the drill pipes, but during RC drilling, preferably no cuttings should be routed this way. Instead everything should be routed into the drill bit's two openings. For this reason, there is a seal ring just above the drill bit. The difference in diameter between the seal ring and the drill bit should not be more than 3 mm. If there is much water in the hole, this should not be more than 1-2 mm.

A good seal between the seal ring and the borehole wall is the most important factor for collecting as much of the cuttings as possible.

Down-the-hole rock drill

RC down-the-hole rock drills resemble normal down-the-hole rock drills, but they have a hardened inner tube to guide up cuttings and flushing air. The inner tube is a wear part and in most cases it is easily replaced through the upper part of the down-the-hole rock drill.

Guide



A guide, which is normally slightly smaller than the drill bit, stabilises the down-the-hole rock drill and results in less hole deviation. It is primarily used in horizontal or inclined holes.

The guide is mounted between the lowest drill pipe and the down-the-hole rock drill.

A mounted guide also makes it easier to work loose after jamming.

Drill pipe

Double tubes are used during RC drilling, one inside the other. The compressed air for the down-the-hole rock drill is routed between the inner and the outer tube and then back, together with the cuttings, in the inner tube.

The outer tubes are threaded. The inner tubes are held in place in the outer tubes with circlips. There are three O-rings in the lower end of the inner tube.

Normally, a 6 m long drill pipe with a diameter of 4" or 4-1/2" is used on the outer tube.

Because the RC pipes are heavier than normal drill pipes only 4 tubes may be loaded in the carousel. The maximum number of tubes is then 4+1, that is, 4 tubes in the carousel and 1 tube in the feeder.

Thread adapter

The thread on the air swivel is suitable for the Metzke 4" drill pipe. If another drill pipe is used then a thread adapter is required.

Spar adapter

In order to protect the thread on the air swivel or thread adapter directly above, a short spar adapter is used. It has the same type of thread at both ends.

Air swivel

The air swivel guides in the compressed air between the outer and the inner drill pipe.

Rotation unit

The rotation unit is similar to normal rotation units but has a hollow shaft which in turn has a hardened inner tube for transporting air and cuttings.

Outlet swivel

The shaft that is routed through the rotation unit is the last rotating component. It has its upper end in the outlet swivel.

Blowdown (option)

The 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.

Deflectors

The cuttings exit from the inner tube at high velocity. Before they can be routed further in a hose, they must be slowed down, which is done by two deflectors in the outlet section. Both deflectors turn the cuttings/airflow 90 degrees. The first deflector is coated with a replaceable ceramic plate in order to withstand the wear caused by the cuttings. The second deflector comprises a cast section at an angle of 90 degrees. When this is worn, the whole section should be replaced with a new one.

Sample hoses

The sample hoses are made of 3" ID material handling hose, which is specially designed for this type of work. There are two hoses, the upper removable hose from the second deflector to a holder on the rear of the feed beam, and the lower stationary hose from the holder to the cyclone.

Sample preparation components

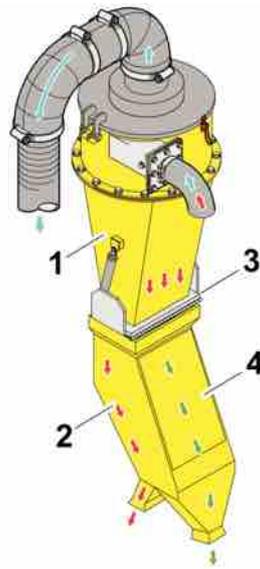
The sampling components consist of a cyclone and a sample splitter. The cyclone and the splitter must always be vertical when they are used, otherwise there may be uneven loading in the division and samples, which is not completely accurate.

There are two types of splitter, the cone splitter with intermediate chamber and the "Jones riffle splitter".

Cyclone

The cyclone is designed to separate cuttings and air, so that the cuttings sample can be collected. A good cyclone normally collects more than 99% of the cuttings sample - the remainder of the mixture of air and dust flows to a dust collector or to the atmosphere.

Jones riffle splitter

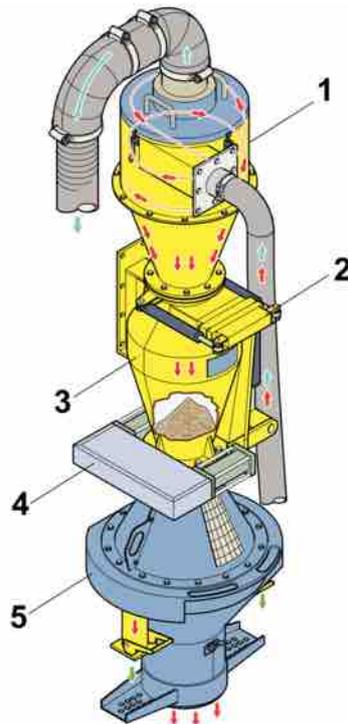


| | |
|---|-----------------------|
| 1 | Cyclone |
| 2 | Jones riffle splitter |
| 3 | Hatch |
| 4 | Inspection hatch |

The "Jones riffle splitter" consists of several levels of splitter which halve the sample at each level until the final sample size is reached, normally 3 or 4 levels, which results in 12.5% or 6.25% of the whole sample. The Jones riffle splitter is easy to use and clean, provided that the cuttings are dry.

The cuttings are collected in the cyclone's lower part during drilling. There is an opening hatch between the cyclone and the Jones riffle splitter. When the hatch is opened a vibrator starts that facilitates emptying.

Cone splitter with intermediate chamber



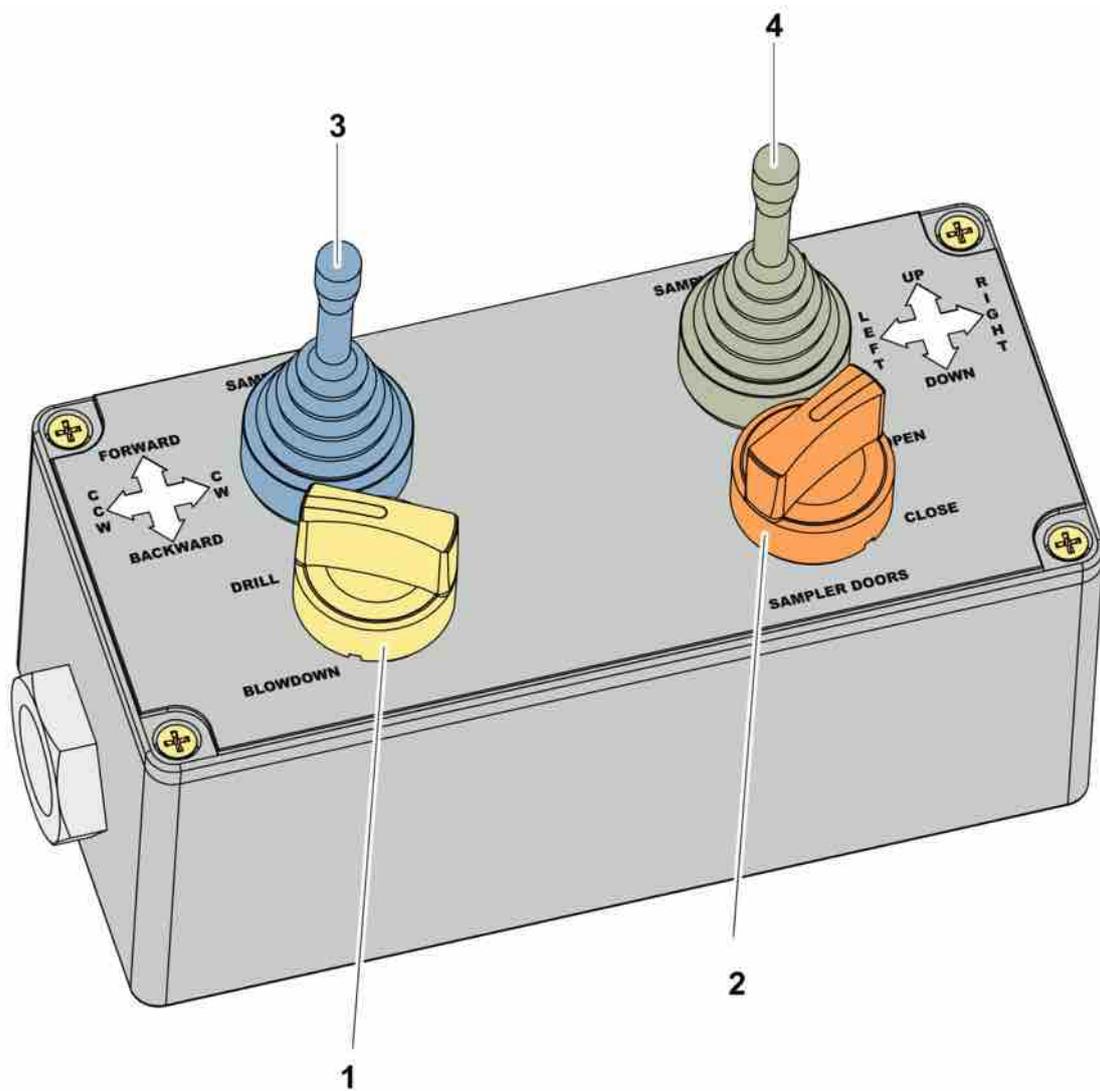
| | |
|---|----------------------|
| 1 | Cyclone |
| 2 | Upper knife valve |
| 3 | Intermediate chamber |
| 4 | Lower knife valve |
| 5 | Cone splitter |

The cone splitter works by means of the whole sample being released down over the top of a cone. At the base of the cone are one or two openings to collect the sample. The size of the openings can be adjusted to collect the percentage required. The cone splitter can provide a more precise division than the Jones riffle splitter, but is more sensitive to set up.

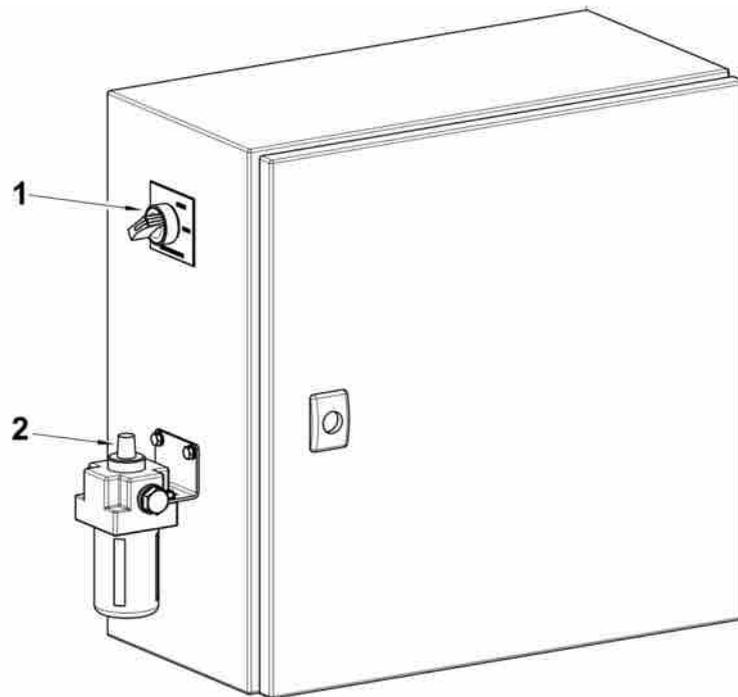
There is an intermediate chamber between the cyclone and the cone splitter in which the cuttings are collected during drilling. The passage between the cyclone and intermediate chamber, and between the intermediate chamber and cone splitter, can be closed with knife valves. When the lower knife valve is opened a vibrator starts that facilitates emptying.

Controls

Control box for Jones riffle splitter

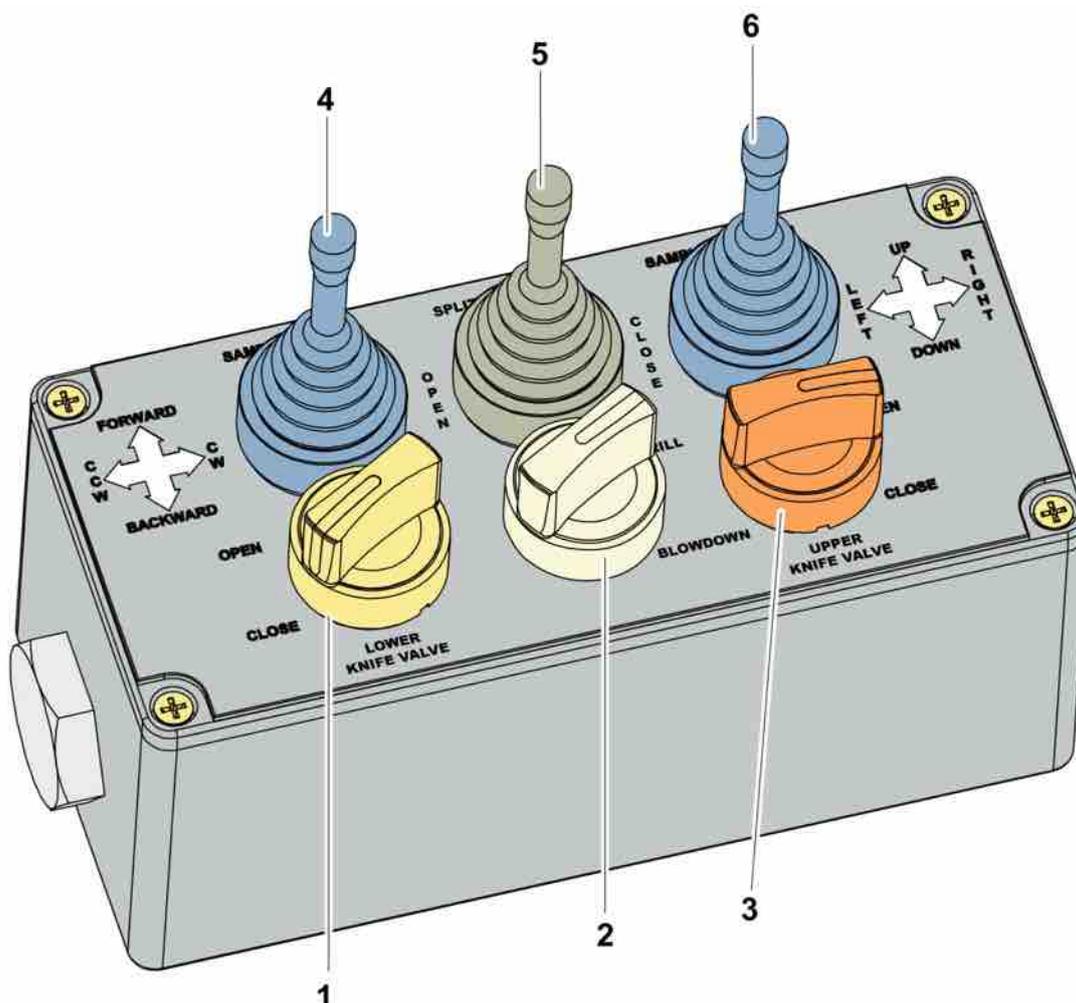


| | |
|---|--|
| 1 | Switch the blowdown valve between drill and blowdown position (option) |
| 2 | Setting the cyclone and splitter position |
| 3 | Setting the cyclone and splitter inclination |
| 4 | Opening/closing the hatch between the cyclone and splitter |

Electric cabinet for Jones riffle splitter

- | | |
|---|--|
| 1 | Opening/closing the hatch between the cyclone and splitter |
| 2 | Pressure regulator |

Control box for cone splitter



| | |
|---|--|
| 1 | Opening/closing the valve between the cyclone and intermediate chamber |
| 2 | Switch the blowdown valve between drill and blowdown position (option) |
| 3 | Opening/closing the valve between the intermediate chamber and cone splitter |
| 4 | Setting the cyclone and splitter inclination |
| 5 | Setting the cyclone and splitter position |
| 6 | Swinging out the cone splitter |

Arm

The arm is locked with 3x M16 bolts, either in drilling position (A) or in tramming position (B).

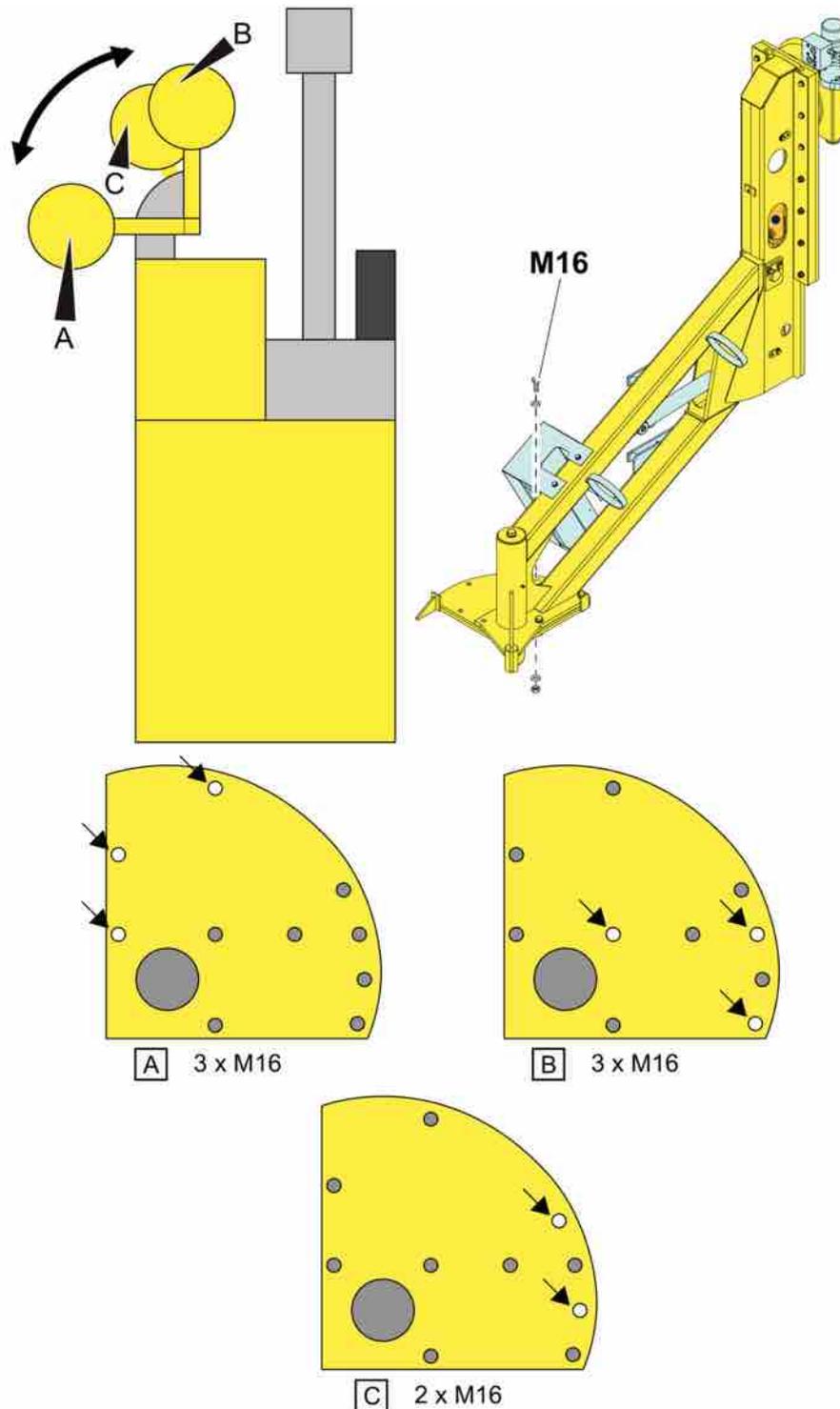
It is also possible to lock the arm in position C (20°). In this case, 2x M16 bolts are required.

⚠ DANGER

Serious injury or death

When tramping or transporting, the arm must be secured in position B. Otherwise there is a great risk of damage to the machine and personal injury.

- ▶ The rig must not be used with the arm unsecured



The RC arm's different positions.

10.11.3 Drilling and sampling

It is assumed that the operator already has knowledge of normal drilling with the rig.

Drilling

Setting up for drilling is carried out in the same way as for normal drilling. It is important that the cyclone and splitter are vertical.

Collaring is performed during normal drilling. During collaring it is appropriate to let the knife valves (cone splitter) or the hatch (Jones riffle splitter) remain open in order to check that the cuttings/air mixture are flowing through the cyclone. When this takes place the lower knife valve/hatch is closed.

Jamming takes place more easily during RC drilling than with conventional drilling. A guide adapter above the down-the-hole rock drill makes it easier to work loose after jamming.

When gripping the drill pipes with the drill-steel support or breakout table, it is important not to do it further away than 300 mm from the thread, otherwise the tube may break.

Sampling with the Jones riffle splitter

The hatch is closed during drilling. When a sample length is fully drilled the feed is switched off. After a few seconds all the cuttings have entered the cyclone. At which point the hatch between the cyclone and splitter is opened, so that the sample can flow out and be collected. While the hatch is opened a vibrator starts in order to facilitate emptying. When the hatch has been closed drilling is resumed by switching on the feed again.

Sampling with the cone splitter

The upper knife valve is open and the lower knife valve is closed during drilling, so that the sample is collected in the intermediate chamber. When a sample length is fully drilled the feed is switched off. After a few seconds all the cuttings have entered the intermediate chamber. At which point the upper knife valve is closed while the lower knife valve is opened, so that the sample can flow through the cone splitter and be collected. While the lower knife valve is opened a vibrator starts in order to facilitate emptying. When the lower knife valve has been closed and the upper opened drilling is resumed by switching on the feed again.

When the cuttings are moist, which makes handling of the sample more difficult, both knife valves can be open during drilling. However, this should be avoided.

10.11.4 Operation of Metzke Blowdown Valve

The blowdown valve consists of one chamber which holds a rectangular piston or spool that slides to and fro to open or close ports to the flows of air and cuttings. A hydraulic cylinder activates the spool.



WARNING

Serious injury

The blowdown valve must not be modified to blow air down the test hose ('blow up'). This can cause high pressure in the test hose, leading to a catastrophic hose failure and possibly serious injury.

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.

Drilling mode

The blowdown valve is open in drilling mode, so that cuttings can pass freely through the main passage in the valve. The air supply in the valve flows directly from the inlet port to the outlet port and then to the air swivel. Air is blocked from entering into the blowdown port.

Drilling mode is selected by setting the switch on the control box to **DRILL** for at least 2 seconds.

CAUTION

Risk of injury

It is essential that the valve is fully open in drilling mode. If the valve is only partially open, it will be subject to serious wear very quickly.

Blowdown mode

The main passage in the valve is closed in blowdown mode and the cuttings blocked. The air outlet port is closed and the blowdown port is now open for the inner tubes. All the air is now directed down the inner tube.

Blowdown mode is selected by setting the switch on the control box to **BLOWDOWN** for at least 2 seconds.

CAUTION

Risk of injury

All the cuttings on their way up in the inner tube must have passed the rotation unit before blowdown is activated.

- ▶ Lift the drill bit from the bottom of the hole and wait for at least 3 seconds before activating blowdown.

10.11.5 Daily maintenance

Cleaning

Cleaning the system should take place at the end of the work shift.

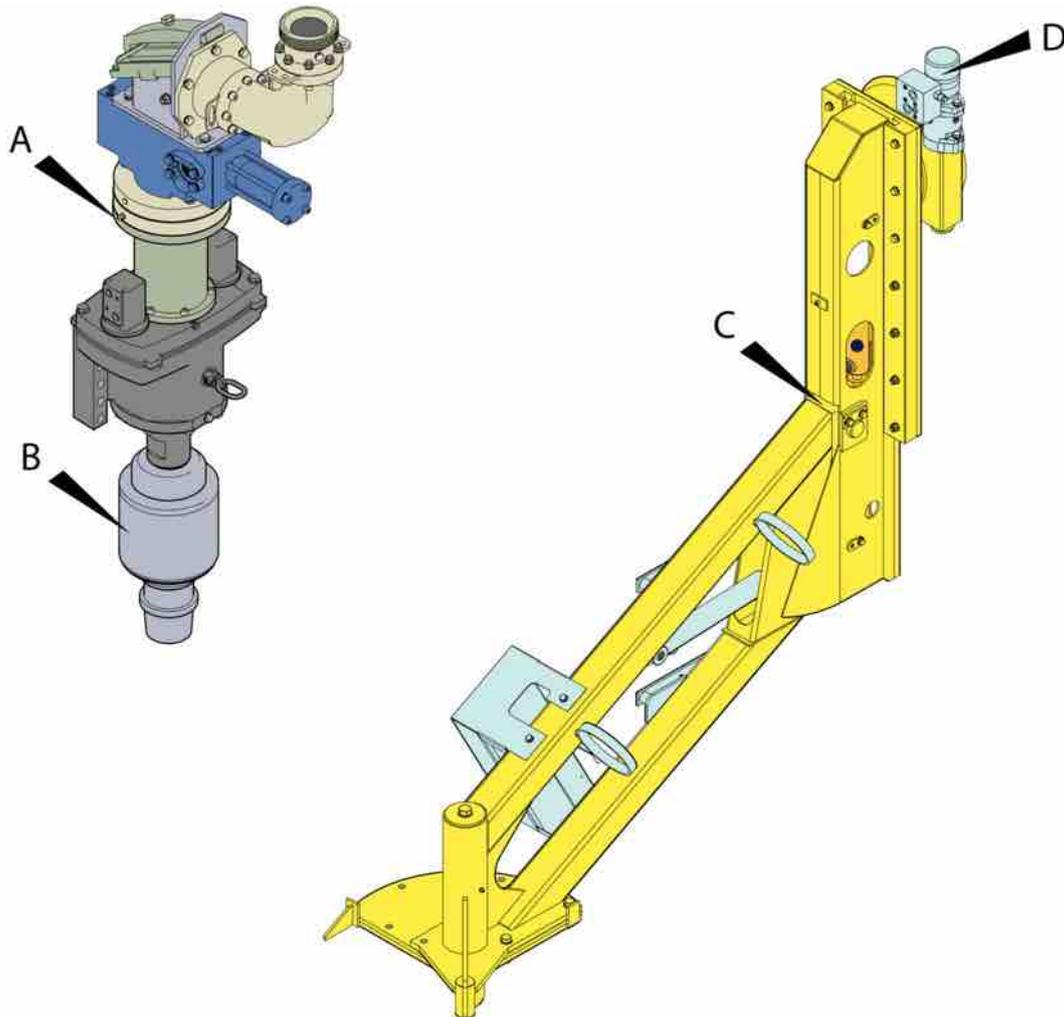
Access can take place in several ways:

- Rotating the cyclone and opening the cover plate.

- Two hatches on the intermediate chamber.
- Jones riffle splitter inspection hatch.
- Swinging the cone splitter out of the way.

Rotary actuators, cylinders and shafts must not be cleaned with high-pressure washing, because any penetrating water may damage the components.

Lubrication

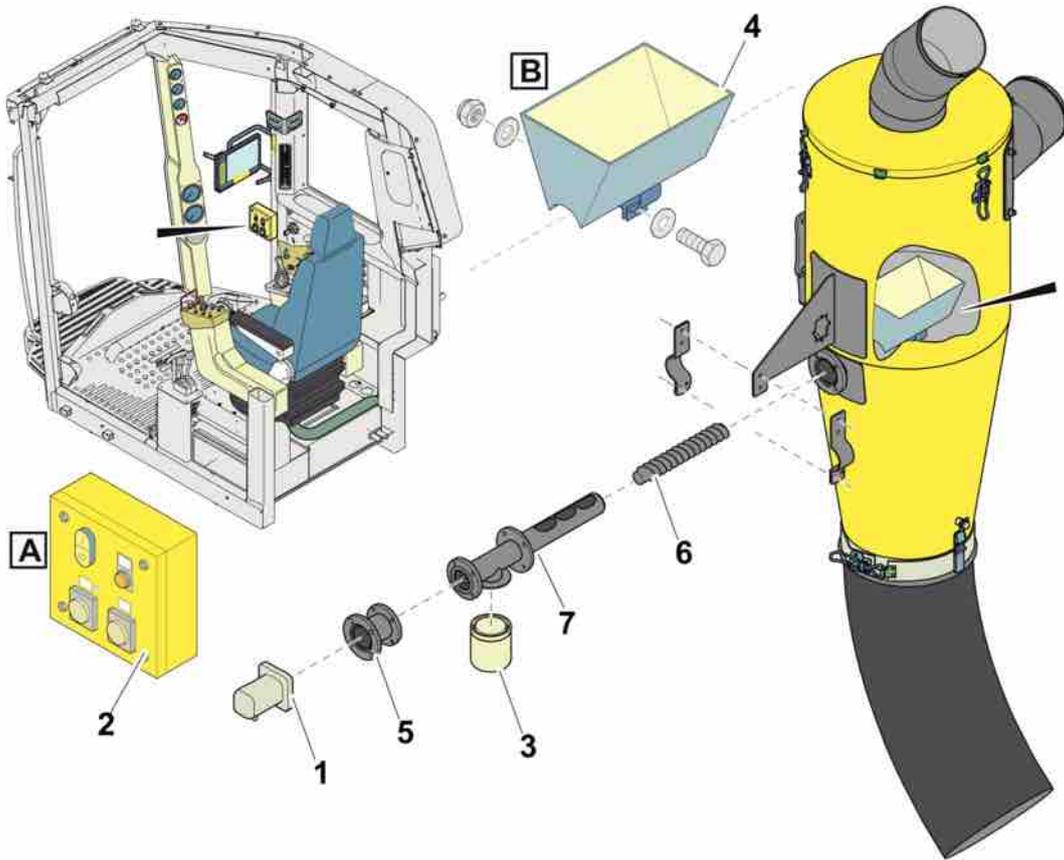


Lubrication points

| | |
|---|---------------|
| A | Outlet swivel |
| B | Air swivel |
| C | Shaft |

10.12 Screw sampler

10.12.1 General

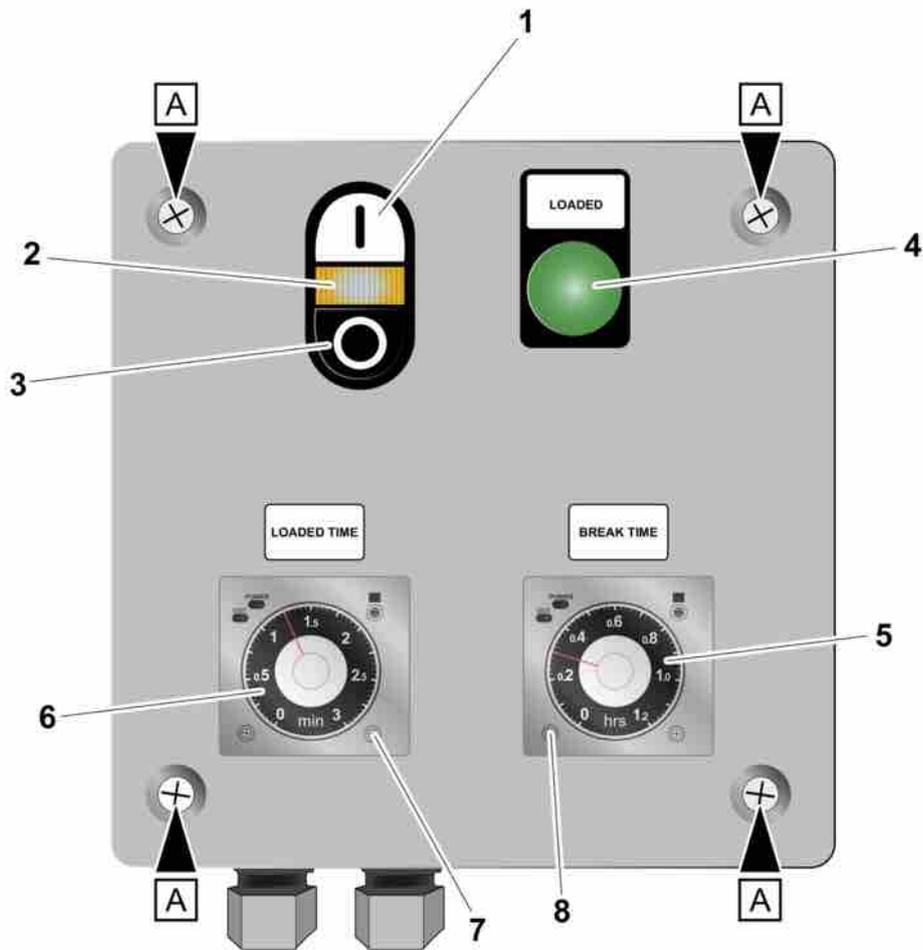


Screw sampler system overview

Screw sampler system overview

| | |
|---|------------------|
| 1 | Hydraulic motor |
| 2 | Control unit |
| 3 | Sample container |
| 4 | Funnel |
| 5 | Spline sleeve |
| 6 | Screw |
| 7 | Pipe |

Sampler control unit



Control unit

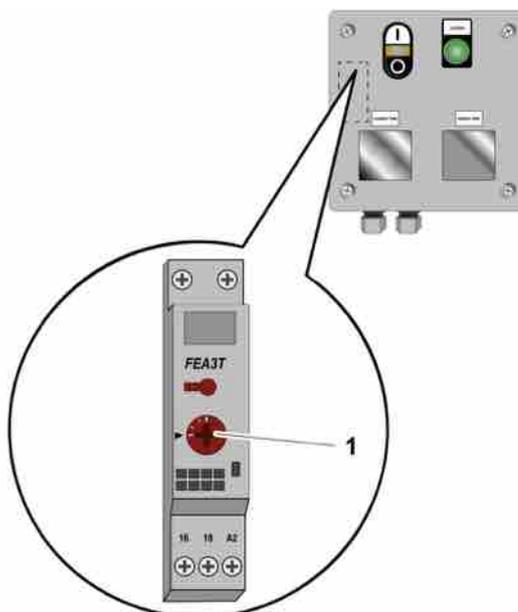
| | |
|---|---|
| 1 | ON button - start sampling. |
| 2 | If the light (2) comes on, sampling is in progress. |
| 3 | OFF button - stop sampling. |
| 4 | If the light (4) comes on, sampling is complete. |
| 5 | Pressure gauge that shows the interval time between each sampling. |
| 6 | Pressure gauge that shows the number of minutes cuttings will be filled in the sample holder. |
| 7 | Screw for adjusting the number of minutes cuttings will be filled in the sample holder. |
| 8 | Screw for adjusting the interval time between each sampling. |

| Image | Description |
|-------|-------------|
|-------|-------------|

10.12.2 Operation

1. The sampler is started and stopped using the ON (1) and OFF (3) buttons.
2. At the start of each new test sequence the sampler is driven backwards for a predetermined time to clear the screw of any remaining cuttings.

- a. The time can be adjusted via a potentiometer on the inside of the control box. Remove the 4 screws holding the front panel in place on the control box (A). The potentiometer is on the left-hand side of the control box. Use a screwdriver to set the desired time. This screw cleaning period should be established before taking the first sample.



Potentiometers

| | |
|---|---|
| 1 | Potentiometer - use a screwdriver to set the desired time of the cleaning procedure |
|---|---|

3. When the screw cleaning procedure is complete, the sampling process starts. To ensure that the desired amount of cuttings is collected in the sample holder, adjust the time with the "Loaded Time" pressure gauge. (6)
4. After taking a sample of cuttings, the process will pause for the amount of time indicated on the "Break-Time" pressure gauge (7). Ensure that this interval is sufficiently long enough to empty and replace the sample holder before the next sampling procedure starts.
5. The sampler continues working until the stop button is pressed.

10.13 Consumables Logging Function

10.13.1 General

Consumables is an option for SmartROC D65 and SmartROC D60. The **Consumables** option helps the driver keep control of the condition of:

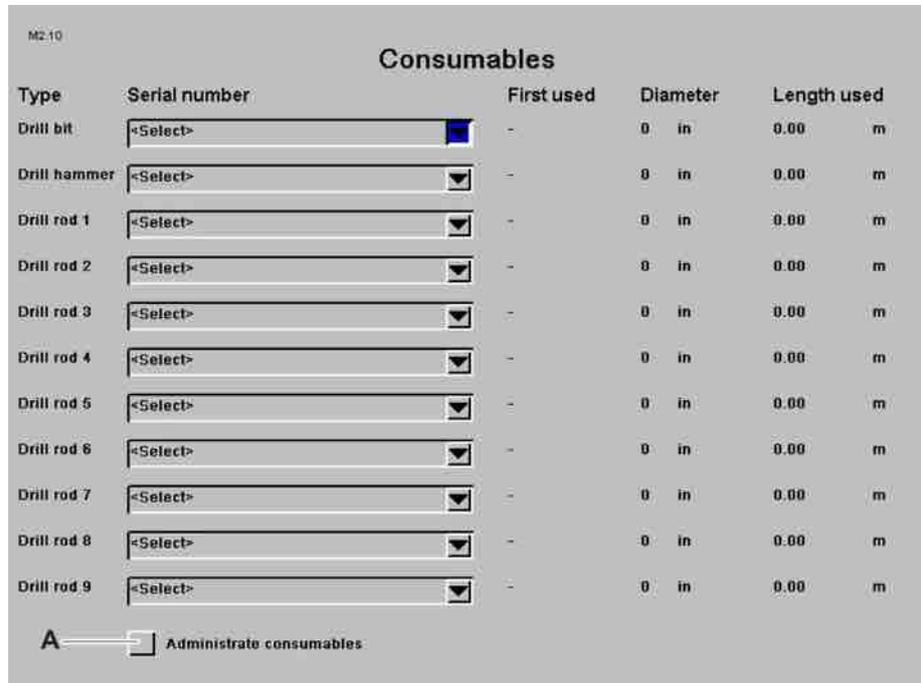
- Drill bit
- Drill hammers
- Drill rods

The operator enters a list of consumables in the machine's RCS. The system keeps track of and displays how many drilled metres each consumable has done. The operator can then evaluate the performance and ensure a more even wear of the consumables.

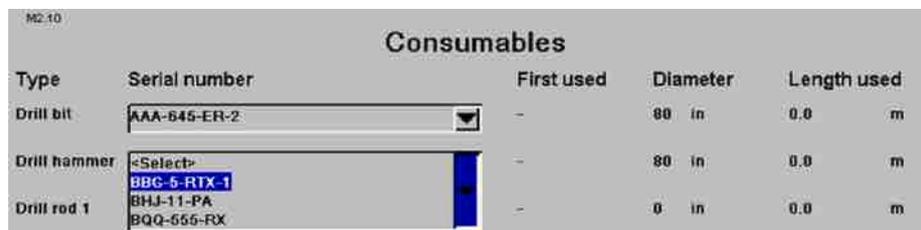
10.13.2 Use of Consumables function

Precondition ✓ Information on all drill bits, drill hammers and drill rods already imported into the system.

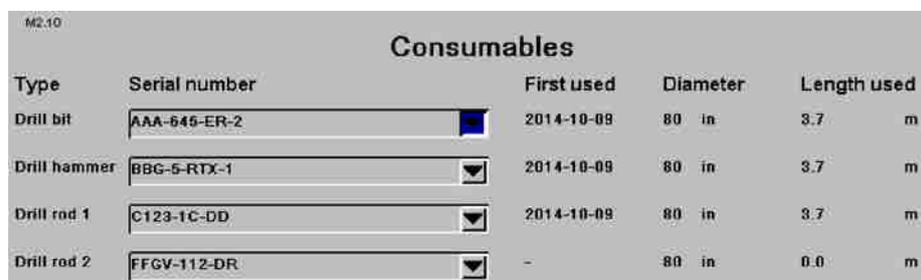
1. Open the **Consumables** menu by selecting **Logging** in the **System** menu and then **Consumables**.



2. Check which drill bit, drill hammer and drill rod are used at present. Change in the list if necessary.



- a. Recalibrate the system if changes have been made to the drill rod position.
3. Start drilling. The **Consumables** function logs how much each drill bit, drill hammer and drill rod have drilled during use. This is updated for every ten centimetres drilled.



10.13.3 Administration of Consumables function

Open the Administrate Consumables menu

1. Select the **Administrate Consumables** menu option as follows:
 - a. In the **System** menu, select **Logging**.
 - b. Select **Consumables**.

The screenshot shows the 'Consumables' menu option. It features a table with columns for Type, Serial number, First used, Diameter, and Length used. The table lists various consumable types like Drill bit, Drill hammer, and Drill rod 1 through 9, each with a '<Select>' dropdown for the serial number. At the bottom, there is a button labeled 'Administrate consumables' with a small icon to its left, marked with a circled 'A'.

| Type | Serial number | First used | Diameter | Length used |
|--------------|---------------|------------|----------|-------------|
| Drill bit | <Select> | - | 0 in | 0.00 m |
| Drill hammer | <Select> | - | 0 in | 0.00 m |
| Drill rod 1 | <Select> | - | 0 in | 0.00 m |
| Drill rod 2 | <Select> | - | 0 in | 0.00 m |
| Drill rod 3 | <Select> | - | 0 in | 0.00 m |
| Drill rod 4 | <Select> | - | 0 in | 0.00 m |
| Drill rod 5 | <Select> | - | 0 in | 0.00 m |
| Drill rod 6 | <Select> | - | 0 in | 0.00 m |
| Drill rod 7 | <Select> | - | 0 in | 0.00 m |
| Drill rod 8 | <Select> | - | 0 in | 0.00 m |
| Drill rod 9 | <Select> | - | 0 in | 0.00 m |

A Administrate consumables

Consumables menu option

- c. Then select **Administrate consumables** (A) at the bottom of the **Consumables** screen.

The screenshot shows the 'Administrate consumables' menu option. It features a form with fields for Serial number and Diameter, and buttons for Add, Remove, Export, and Import. The form is divided into sections for Drill bit, Drill hammer, and Drill rod.

| Type | Serial number | Diameter | Action |
|--------------|----------------------|----------|---------------------------------------|
| Drill bit | <input type="text"/> | 0 in | <input type="button" value="Add"/> |
| Drill hammer | <input type="text"/> | 0 in | <input type="button" value="Add"/> |
| Drill rod | <input type="text"/> | 0 in | <input type="button" value="Add"/> |
| Drill rod | <Select> | | <input type="button" value="Remove"/> |
| Drill hammer | <Select> | | <input type="button" value="Remove"/> |
| Drill rod | <Select> | | <input type="button" value="Remove"/> |

Export consumable status
 Export consumable list
 Import consumable list

Administrate consumables menu option

Add new drill bit, drill hammer or drill rod

1. Open the **Administrate consumables** menu.

The screenshot shows the 'Administrate consumables' interface. It is divided into three main sections:

- Top Section (Add):** Contains three rows for adding items. Each row has a label (Drill bit, Drill hammer, Drill rod), a 'Serial number' input field, a 'Diameter' input field (with '0 in' as a placeholder), and an 'Add' button.
- Middle Section (Remove):** Contains three rows for removing items. Each row has a label (Drill rod, Drill hammer, Drill rod), a dropdown menu (with '<Select>' as a placeholder), and a 'Remove' button.
- Bottom Section (Export/Import):** Contains three checkboxes: 'Export consumable status', 'Export consumable list', and 'Import consumable list'.

2. Enter a new drill bit, drill hammer or drill rod plus the relevant diameter in the top field. Use the keypad on the screen. Then click on **Add**.



NOTE: A new object can only be added if there is room in the system. A warning is shown if there is a problem. A maximum of 10 drill bits, 10 drill hammers and 30 drill rods can be stored in the system.

Remove drill bit, drill hammer or drill rod

1. Open the **Administrate consumables** menu.

M2.10.1

Administrate consumables

Serial number Diameter

Drill bit 0 in

Drill hammer 0 in

Drill rod 0 in

Serial number

Drill rod <Select>

Drill hammer <Select>

Drill rod <Select>

Export consumable status

Export consumable list

Import consumable list

2. Select the serial number of the consumable to be removed in the field **Remove consumables**. Click on **Remove**/ The **Remove consumables** field is in the middle of the **Administrate consumables** menu.

Export Consumable Status

A text file containing all information which the machine has stored on each drill head, drill rod or drill hammer, can be created and saved to a USB memory.

Precondition ✓ A USB memory is placed in the USB port.

1. Open the **Administrate consumables** menu.

M2.10.1

Administrate consumables

Serial number Diameter

Drill bit 0 in

Drill hammer 0 in

Drill rod 0 in

Serial number

Drill rod <Select>

Drill hammer <Select>

Drill rod <Select>

Export consumable status

Export consumable list

Import consumable list

2. Select **Export consumables status**.

- A text file is saved to the USB memory. The text file is called **<timestamp > - CONSUMABLES_STATUS.TXT** and is like the example below:

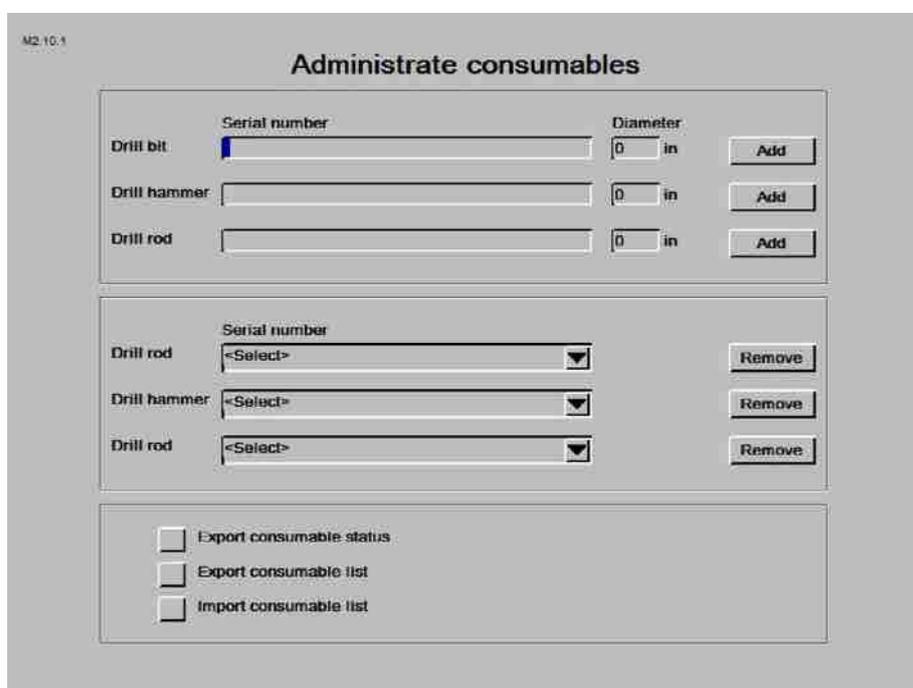
```
#Drill bit
Serial number 1,14,2014-09-12,1.457|
#Drill hammer
Serial number 2,100,2014-09-12,2.190
#Drill rod
ABC-123,123,2014-09-12,2.126
CBA-321,321,2014-09-12,0.523
123-ABC,121,2014-09-12,3.025
```

Export Consumables List

A text file containing the serial number and diameter for each drill head, drill rod and drill hammer can be created and saved to a USB memory.

Precondition ✓ A USB memory is placed in the USB port.

1. Open the **Administratate consumables** menu.



2. Select **Export consumables list**.

- A text file is saved to the USB memory. The text file is called **CONSUMABLES.TXT** and is like the example below:

```
#Drill bit
Serial number 1,14
new one,10
#Drill hammer
Serial number 2,100
#Drill rod
ABC-123,123
CBA-321,321
123-ABC,121
```

Import Consumables List

A text file containing the serial number and diameter for the drill rods, drill hammers and drill bits can be imported directly into the system.

Precondition ✓ A USB memory with a suitable text file is placed in the USB port.

1. Open the **Administrate consumables** menu.

2. Select **Import consumables list**.

→ The system looks on the USB memory for a text file called **CONSUMABLES.TXT**.



NOTE: The text file can be created manually with any text editor or by being exported to the USB memory via the **Export consumables list** function. The file must be called **CONSUMABLES.TXT**.

NOTE: The import process continues as long as there is room for more objects in the system. An object already present in the system will be ignored. After import, a warning appears showing if there were too many objects or duplicates.

Rod Tracker

The Rod tracker function keeps control of the current position of each drill rod in the carousel which is fed into the system. This means that the system can log the correct drill length for each rod as it is used.

Calibrate Rod Tracker

1. Select the **RHS** menu.
2. Select the **Rod tracker** menu. The graphic **Rod tracker** menu is shown.
3. Select **Calibration**.

→ The **Calibrate rod tracker** menu is opened.

4. Select an index position in the carousel for each drill rod which has been added to the system.

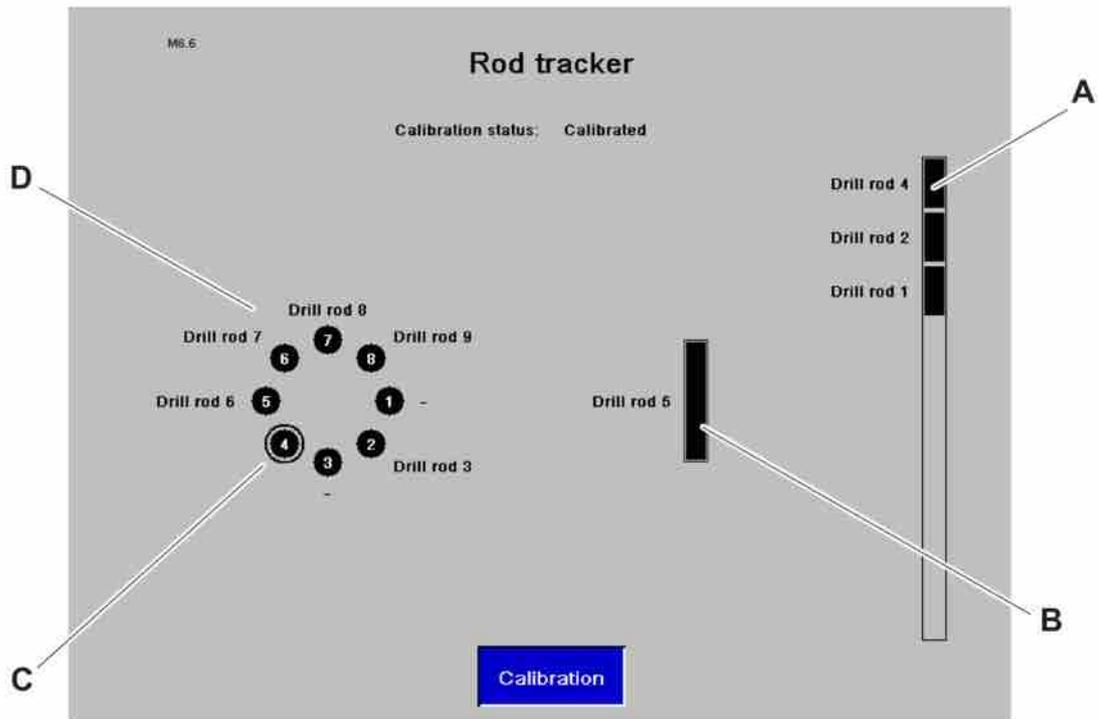


NOTE: Each drill rod can be placed in the carousel and has a carousel slot index. The drill rods can also be in a drill string and have a position index.

- The first place in the carousel is at the drill rod extraction position when the carousel has rotated clockwise to the mechanical stop.
- The first drill rod position is the rod at the bottom of the string.
- The system prevents two drill rods being allocated the same carousel slot index.
- The system ensures that each drill rod is given only one index position in both the carousel and the drill string.
- When the drill rods are placed in a drill string, one of them must have index 1. All subsequent index numbers must be successive. If the drill rods are not in succession in the drill string, calibration will fail.

Rod Tracker Graphical View

There is a menu with a graphic image of the current position of the carousel and drill string. This menu makes it easier to check that the system corresponds to reality.



- A Position of drill rods in drill string
- B Next drill rod to be loaded
- C Drill rod extraction position
- D Carousel loaded with drill rods

Trigger positions for tracking drill rods

The following trigger positions are used by the system to keep control of the drill rods:

- B118 (arm in carousel) moves from position 1 to 0 with the grippers closed. A drill rod is moved from the carousel and is indicated as the next rod for drilling.



NOTE: There must be a drill rod at the carousel slot index from which the arms are moved.

- B120 (arm in drill center) moves from position 1 to 0 with grippers closed.



NOTE: There must be at least one drill rod in the drill string.

- B120 moves from position 1 to 0 with grippers open. The next drill rod to be used is added to the drill string.
- B118 moves from position 1 to 0 with grippers closed. The next drill rod to be used is placed in the carousel.

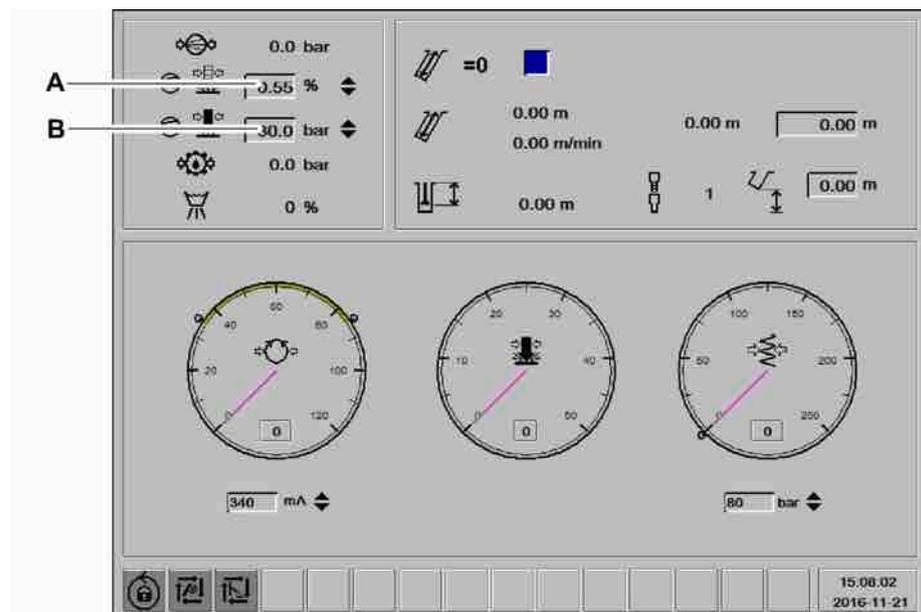
10.14 Fuel saving unit

The fuel saving unit requires minimal monitoring from the machine operator. The following settings are made by the operator:

- Air pressure
- Air flow
- AUX air pressure
- AUX hydraulic pressure

10.14.1 Air pressure and air flow

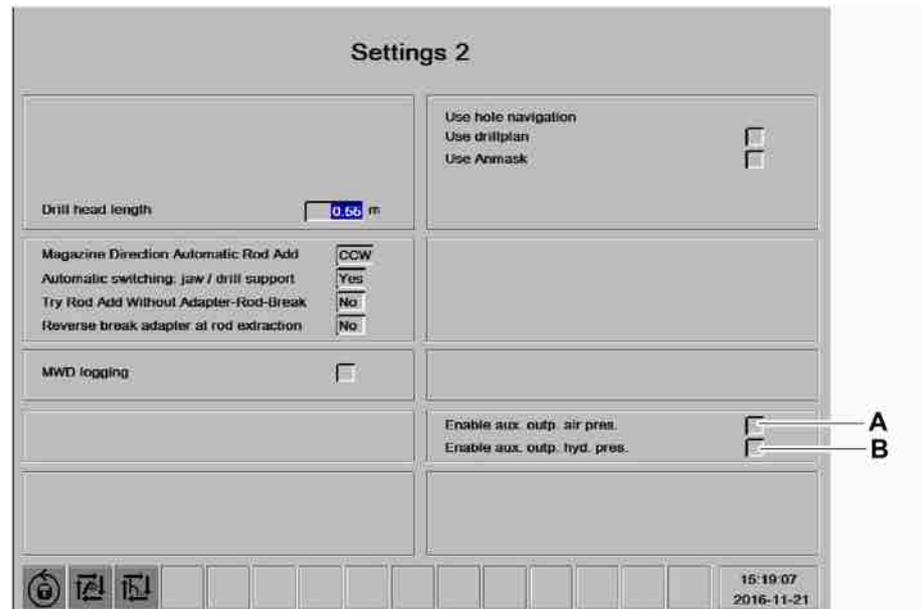
1. Press the **F1** button on the display.



2. Enter the desired low percussion air flow (%) in field (A).
3. Enter the desired full percussion pressure (bar) in field (B).

10.14.2 Activate AUX air pressure and hydraulic pressure

1. Press the **F2** button on the display.
2. Select **Settings 2**.



3. Select **Enable aux. outp. air pres.** (A) to activate AUX air pressure.
4. Select **Enable aux. outp. hyd. pres.** (B) to activate AUX hydraulic pressure.

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