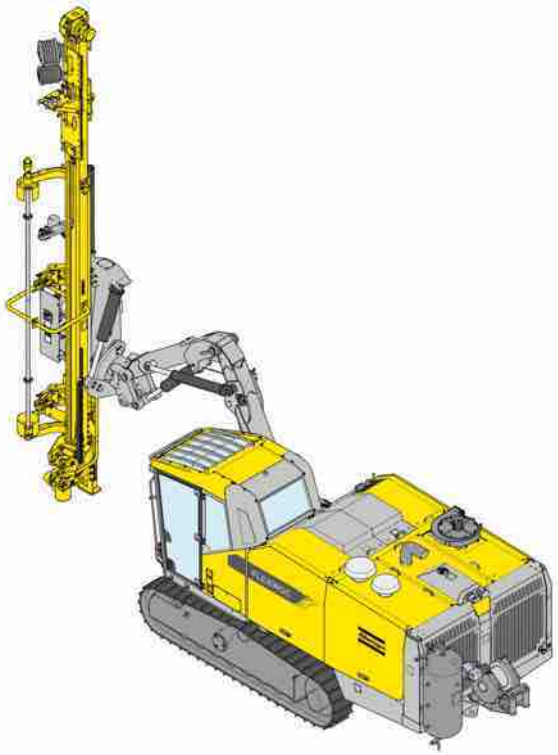
Atlas Copco Rock Drills

SmartROC T45-11
Operation



Original instructions

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Atlas Copco

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1 Introduction

1.1 Safety First

Always read the information in the Safety document before starting to use the product or starting maintenance work.

1.2 The Purpose of this Publication

The Operation manual is intended to:

- Give an overall description of methods, required calculations, and settings
- Give an overall description of machine features
- Instruct the operator in applicable controls, handling, and operation
- Instruct the operator in operator maintenance and troubleshooting

1.3 Target Group

The information in this publication is intended for everyone involved in the application, operation, and maintenance of the machine and related equipment. All readers are expected to possess basic competence regarding mining methods, construction methods, and the machines used for that kind of operation.

Atlas Copco is not liable for any damage, injuries, or deaths caused by users who misunderstand the published information and/or use it incorrectly.

2 Product Description

The SmartROC T45-11 has the following features and characteristics:

- Track-driven blasthole drill
- Equipped with a top hammer rock drill
- Powered by a diesel engine
- Automatic rod-handling system
- Computer-based rig control system

2.1 Intended Use of the Product

The rock drill rig and related equipment are designed for drilling holes in opencast mines, in quarries, and on construction sites.

It is designed solely for this purpose.

2.2 Non-intended Use of the Product

Any use not described in the section, Intended Use of the Product, are forbidden.

Examples of non-intended and forbidden use:

- Lifting or transporting loads or people
- Supporting objects
- Scaling rock
- Cleaning stopes and drill locations using the feed
- Using the boom to help the machine move up inclines

The list is not exhaustive.

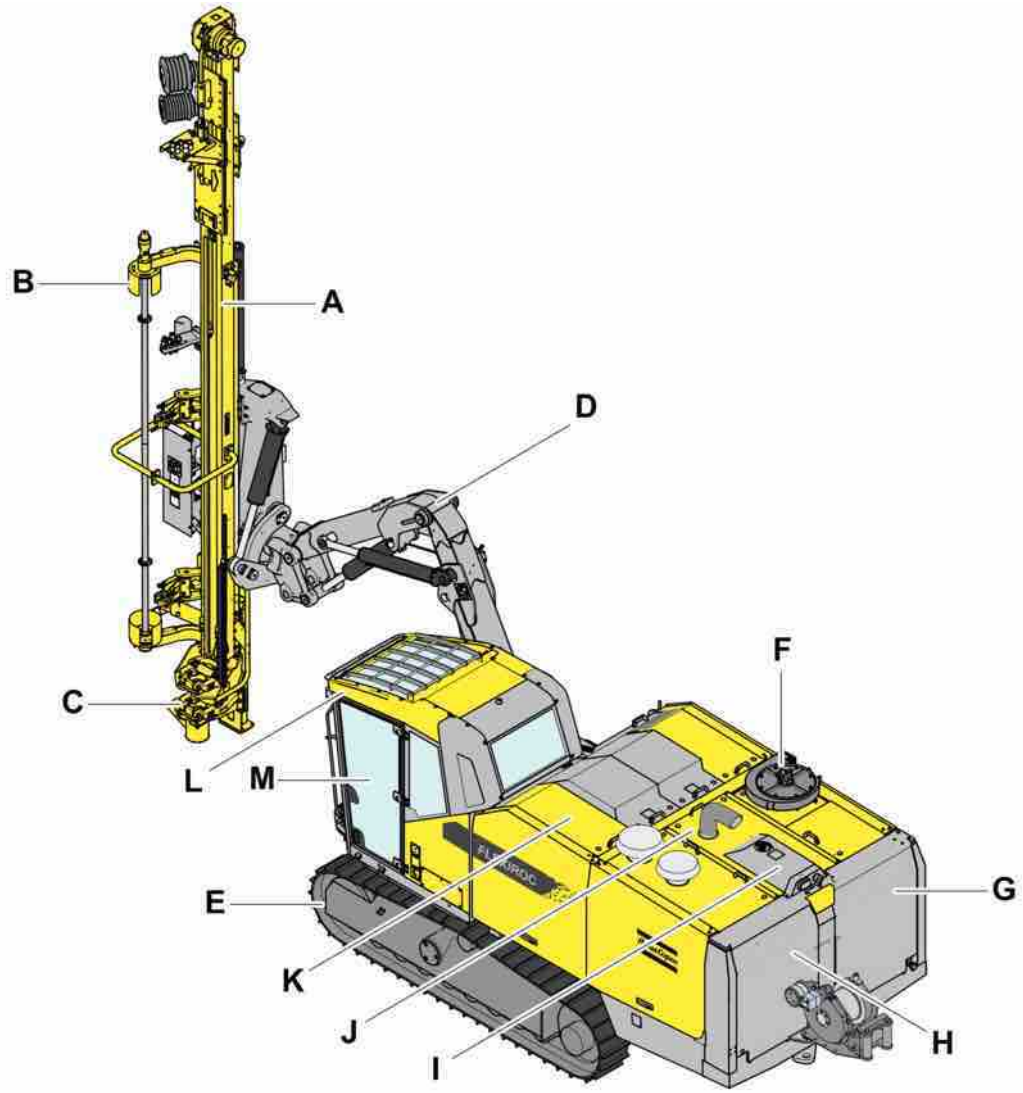
WARNING

Non-Intended Use

Using the machine for tasks other than what is described in the instructions can cause serious injury or death.

- ▶ The instructions must be followed in all applications and tasks when using the machine.
- ▶ Read the instructions before using the machine, and become familiar with the permitted tasks and machine capabilities.

2.3 Main Components

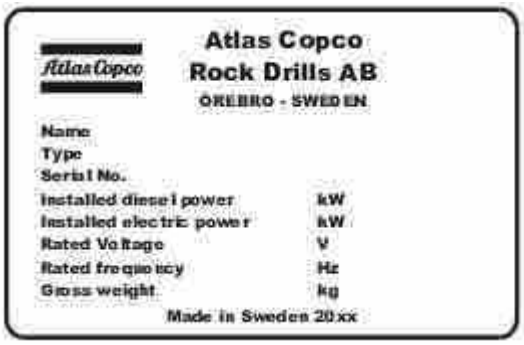


Main Components

A	Feed
B	Rod Handling System (RHS)
C	Drill support
D	Boom
E	Crawler tracks
F	Dust Collector (DCT)
G	Intercooler and radiator
H	Compressor and hydraulic oil cooler
I	Compressor
J	Diesel engine
K	Hydraulic pumps

L	Operator's cabin
M	Operator's panel

2.4 Data Plate

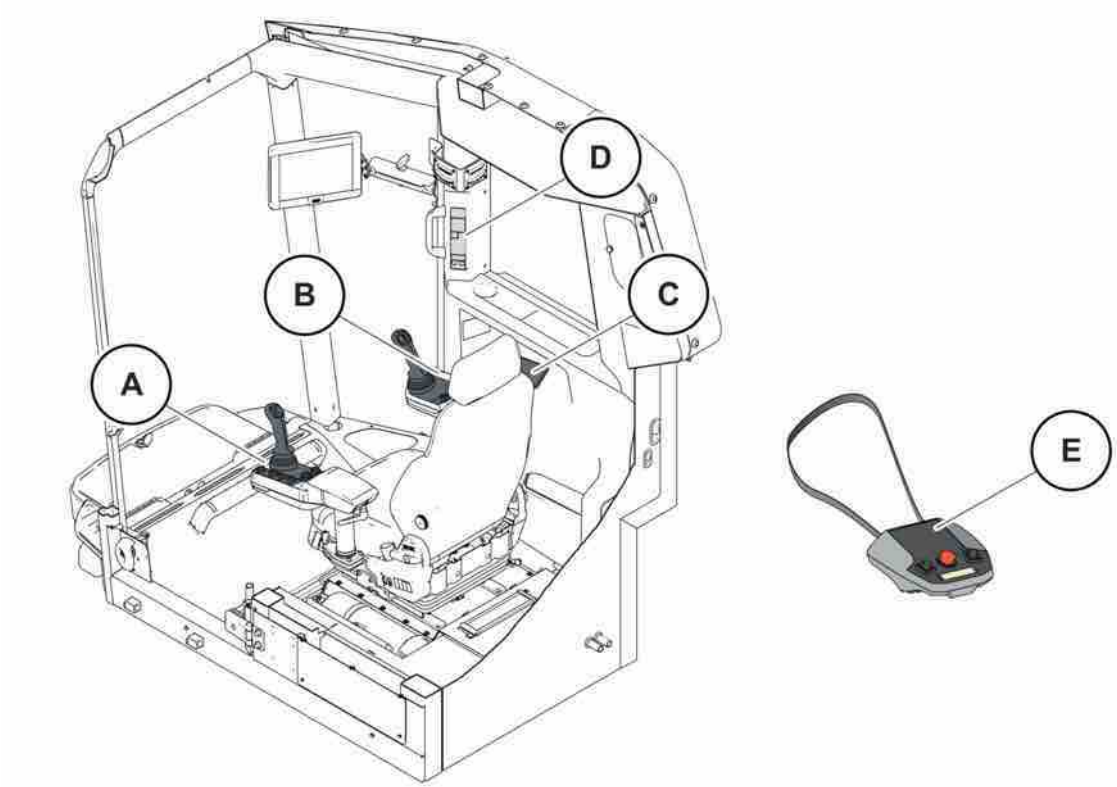


Data Plate

The data plate contains the serial number (product identification number) for each individual machine, and is required when:

- Contacting Atlas Copco for support
- Ordering components or kits
- Creating records
- Maintaining records

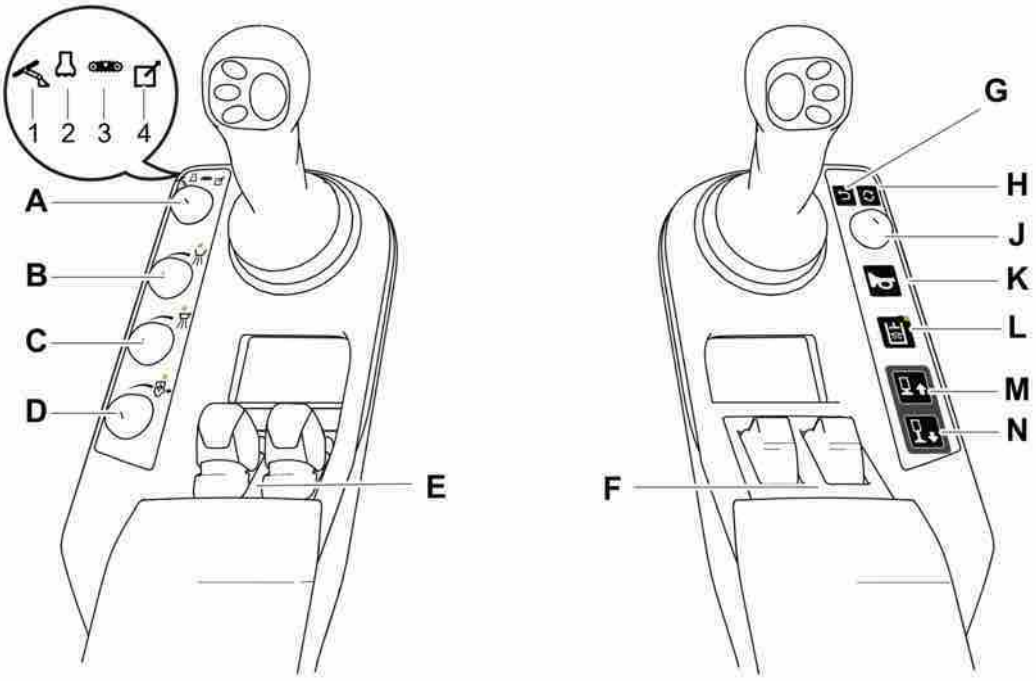
3 Controls and Instruments



Overview

A	Left lever
B	Right lever
C	Right control panel
D	Operator's environment control panel
E	Winch control unit

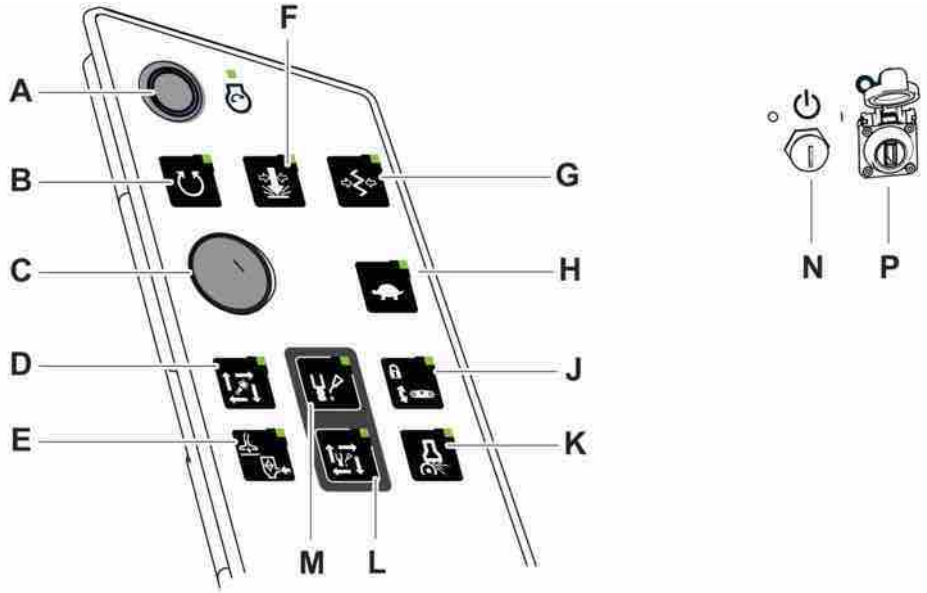
3.1 Operating Controls



Operating Panel

A	Mode selector 1. Positioning mode 2. Drill mode 3. Tram mode 4. Winch mode/Remote control mode
B	Flush air
C	Water mist
D	Dust Collector (DCT)
E	Tramming levers
F	Track oscillation levers
G	Display - Escape button
H	Display - Toggle button
J	Display - Navigation knob
K	Signal Horn
L	Preheating (hydraulic oil)
M	Jack in
N	Jack out

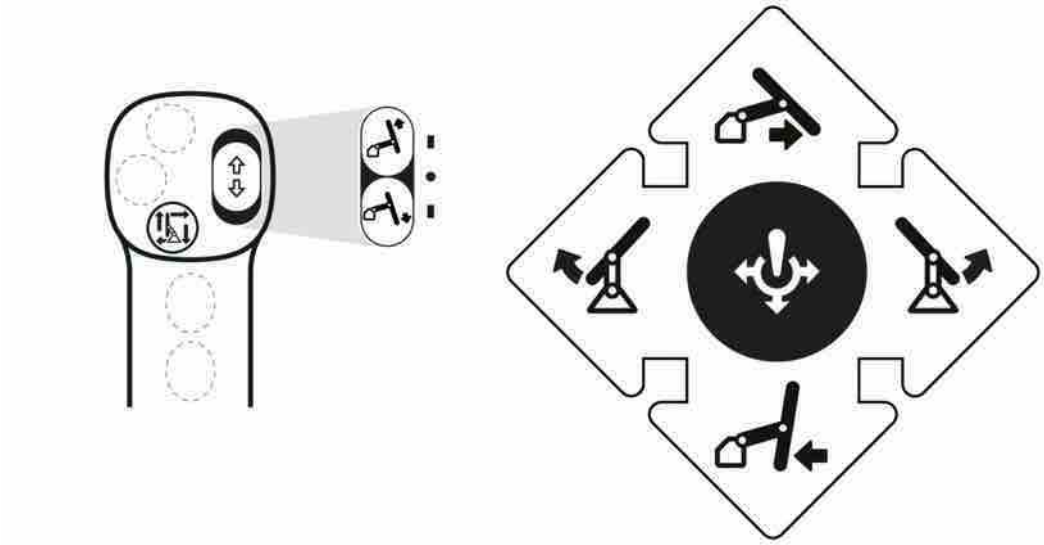
3.2 Right Control Panel



Right Control Panel

A	Diesel engine start/stop button
B	Rotation control
C	Value adjustment for buttons B, F, G, and H
D	Automatic rod handling
E	Dust collector
F	Percussion control
G	Feed control
H	Tramming low speed/high speed
J	Track oscillation lock
K	Activation of compressor and/or hydraulics for grinding
L	Automatic thread lubrication
M	Thread lubrication
N	Ignition key/CAN system start
P	USB port

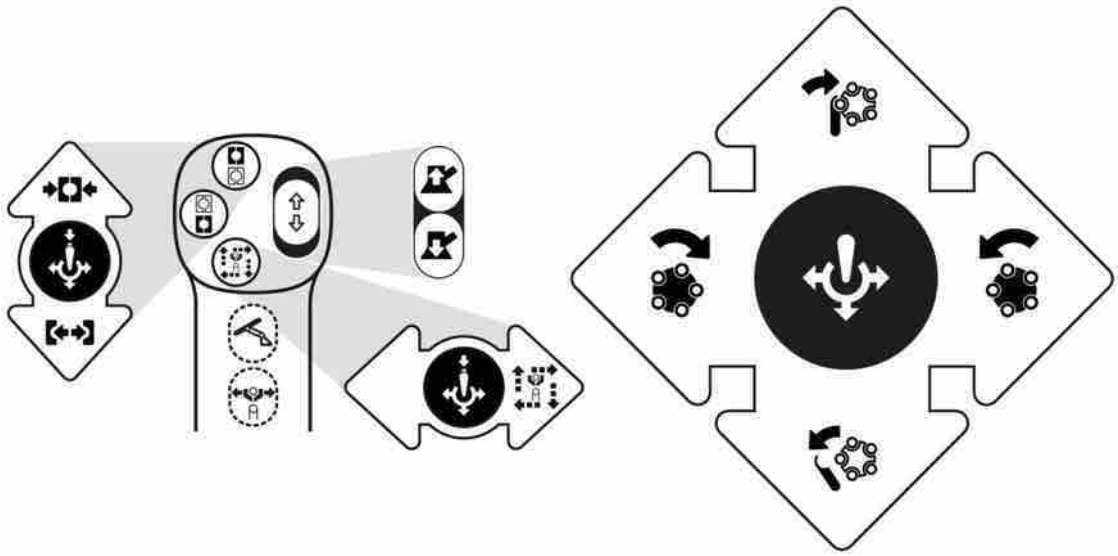
3.3 Left Lever in Tram Mode/Positioning Mode



Left Lever in Tram Mode/Positioning Mode

	Feed tilt forward
	Feed tilt backward
	Feed swing left
	Feed swing right
	Feed extension up
	Feed extension down
	Semi-auto positioning

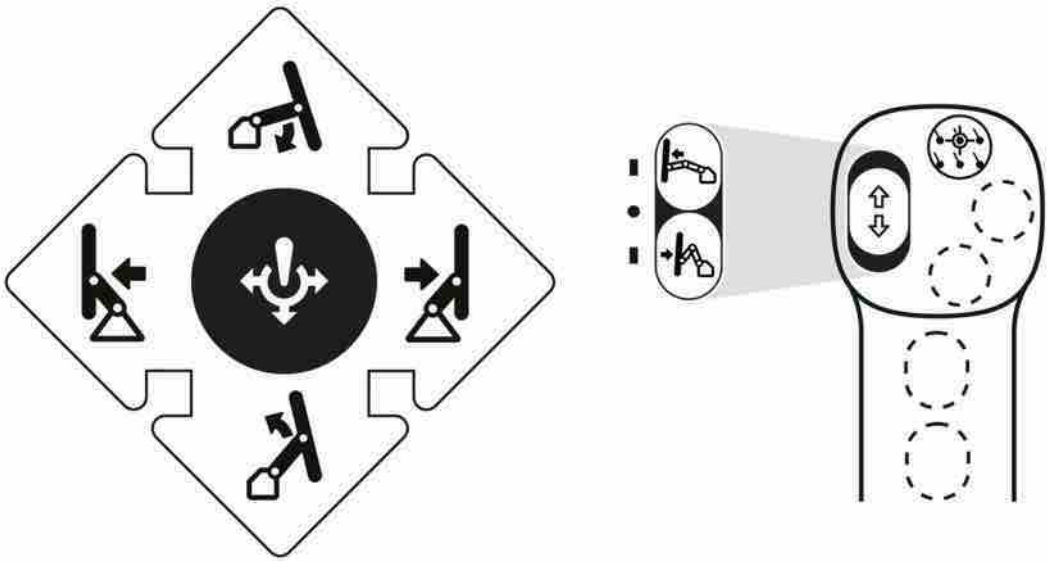
3.4 Left Lever in Drill Mode



Left Lever in Drill Mode

	Rod to carousel
	Rod to drill center/Hard grip (when rod is in drill center)
	Rotate carousel (clockwise)
	Rotate carousel (counterclockwise)
	Upper drill steel support
	Lower drill steel support
	Close drill steel support - press and hold button for drill steel support
	Open drill steel support - press and hold button for drill steel support
	Suction hood - Up
	Suction hood - Down
	Press and hold button - both levers work as during positioning mode
	Press and hold button - Open gripper
	N/A

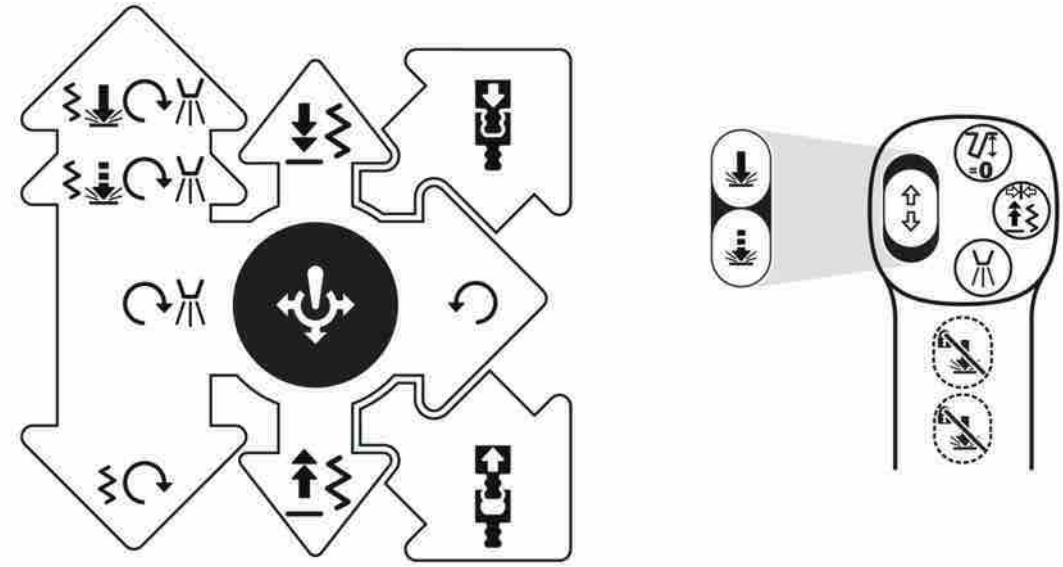
3.5 Right Lever in Tram Mode/Positioning Mode



Right Lever in Tram Mode/Positioning Mode

	Boom lowering
	Boom lift
	Boom swing left
	Boom swing right
	Boom extension out
	Boom extension in
	Confirm suggested hole - HNS system

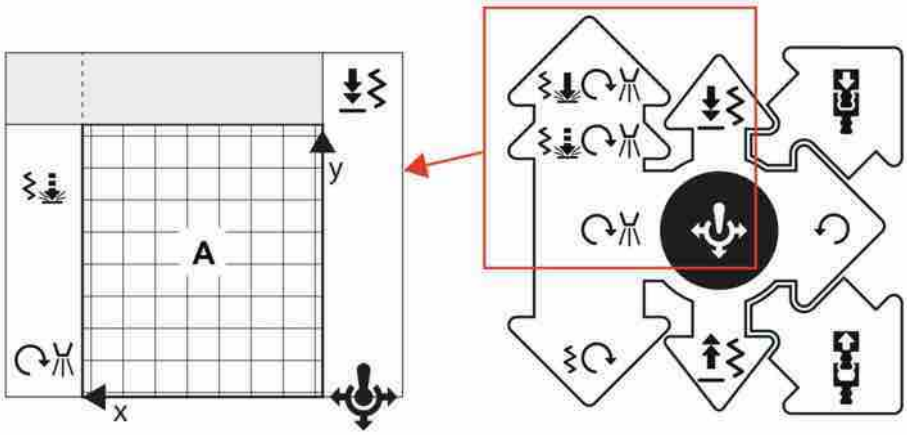
3.6 Right Lever in Drill Mode



Right Lever in Drill Mode

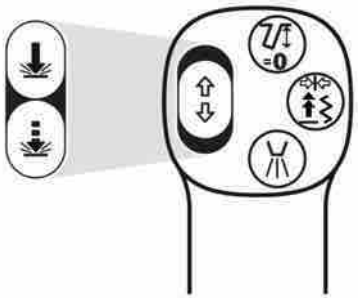
	Rapid-feed forward
	Rapid-feed backward
	Rotation (counterclockwise) and flush air
	Rotation (clockwise)
	Reduced auto-drilling
	Full auto-drilling
	Threading
	Unthreading
	High percussion
	Low percussion
	Resetting of depth meter
	Retraction
	Manual flush air

	Drill stop



Proportional Function for Right Lever in Drill Mode

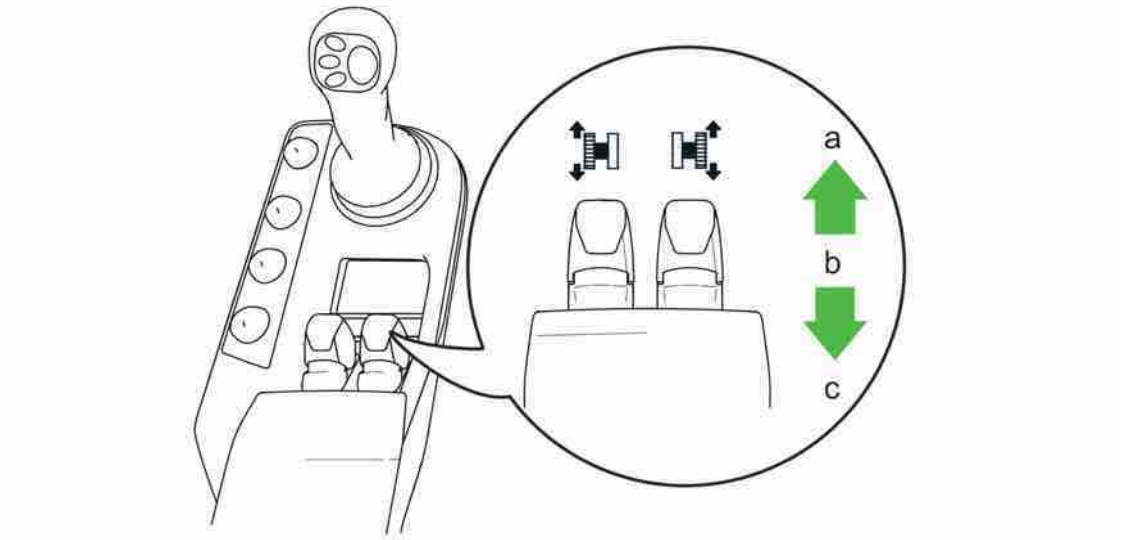
x	Rotation
y	Feed
A	Sector A has a proportional function for rotation and feed.



High Percussion and Low Percussion during Collaring and Full-drilling

	Deactivates drilling during collaring (low percussion, low rotation, low feed). Does not deactivate flush air. Activates collaring during full-drilling (low percussion, low rotation, low flush air, low feed).
	Activates full-drilling during collaring (high percussion, high rotation, high flush air, low feed). Deactivates drilling during full-drilling (percussion, rotation, feed). Does not deactivate flush air.

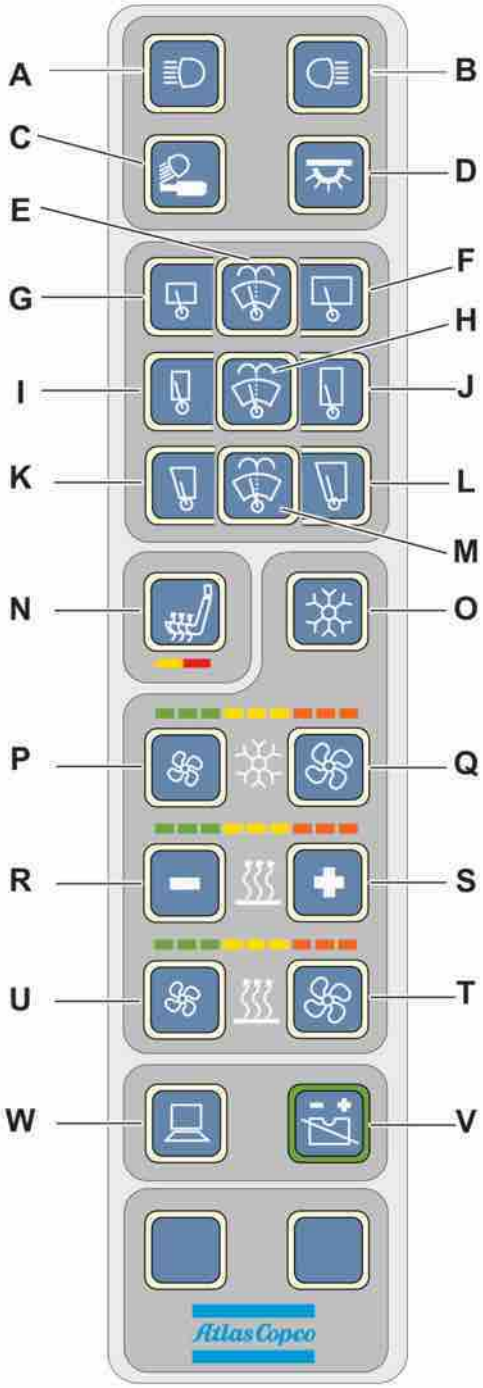
3.7 Tramming Levers



Tramming Controls

a	Forward
b	Neutral
c	Reverse

3.8 Operator's Environment Control Panel

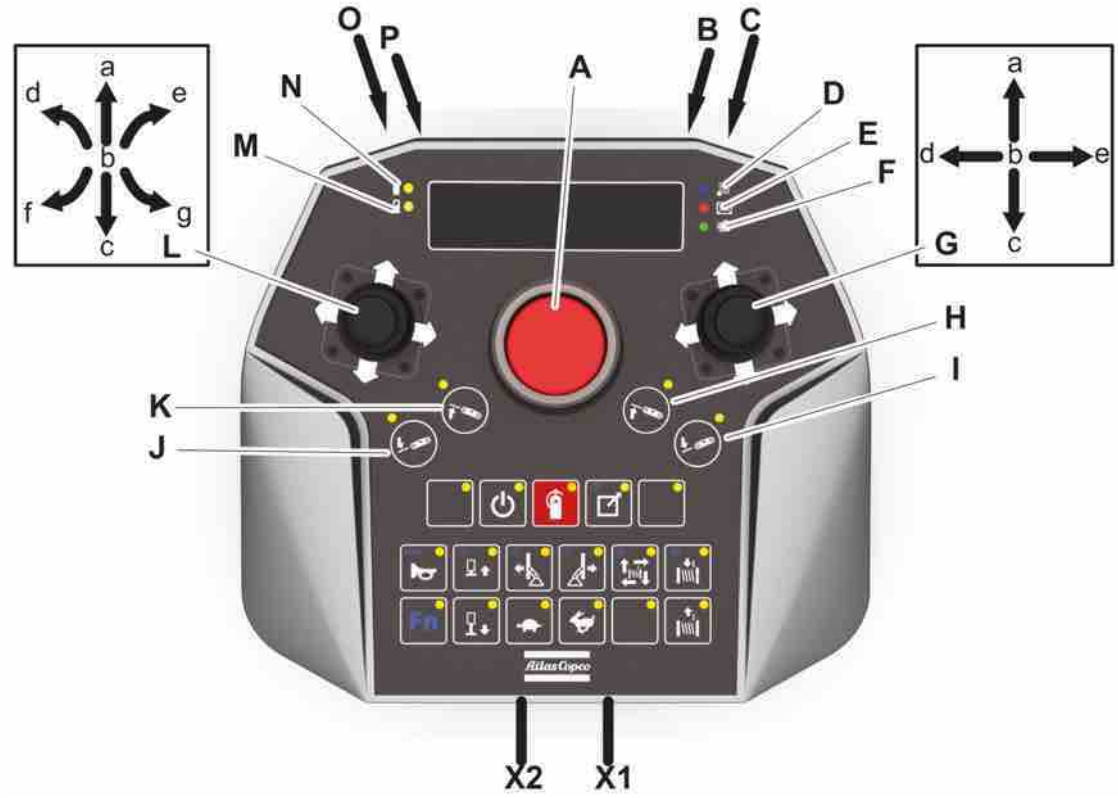


Panel for Operator's Cabin

A	Front cabin working lights
B	Rear cabin working lights
C	Feed working lights
D	Engine compartment light
E	Upper windshield washers
F	Upper windshield wiper (each press increases speed)

G	Upper windshield wiper (each press reduces speed) - switch off by pressing and holding the button for 2 seconds
H	Front windshield washer
I	Front windshield wiper (each press reduces speed) - switch off by pressing and holding the button for 2 seconds
J	Front windshield wiper (each press increases speed)
K	Right windshield wiper (each press reduces speed) - switch off by pressing and holding the button for 2 seconds
L	Right windshield wiper (each press increases speed)
M	Right windshield washer
N	N/A
O	Air conditioner
P	Air conditioning fan (each press reduces speed)
Q	Air conditioning fan (each press increases speed)
R	Temperature (each press reduces temperature)
S	Temperature (each press increases temperature)
T	Heater fan (each press increases speed)
U	Heater fan (each press reduces speed)
V	N/A
W	N/A

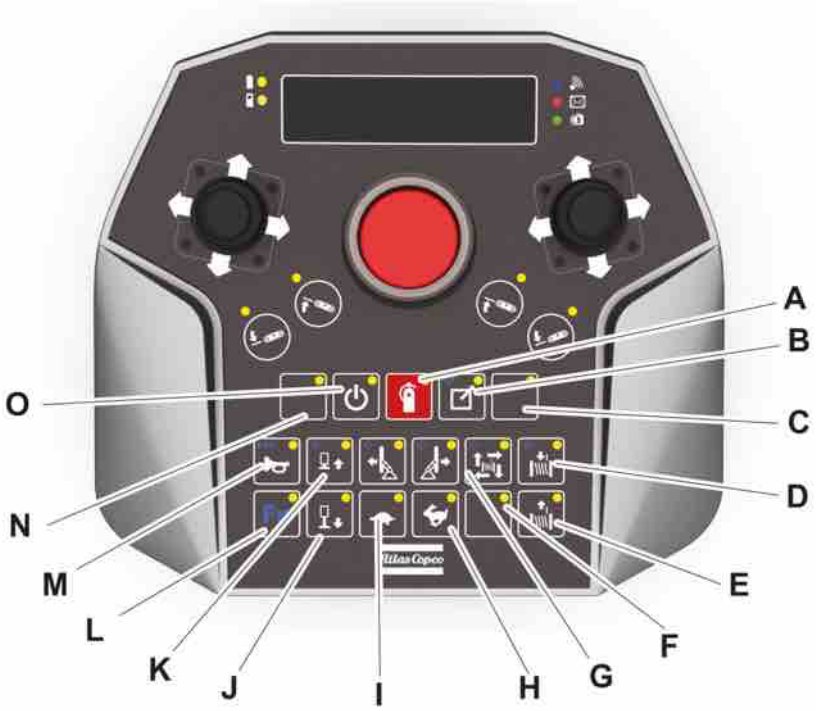
3.9 Winch Control Unit



Winch Control Unit

A	Emergency stop
B	Front button, track oscillation up
C	Front button, track oscillation down
D	LED - indicates radio contact between winch control unit and receiver unit
E	LED - indicates error message
F	LED - grip sensor
G	Boom swing, boom lift
H	Track oscillation, right crawler track (up)
I	Track oscillation, right crawler track (down)
J	Track oscillation left crawler track (down)
K	Track oscillation, left crawler track (up)
L	Tramming lever
M	LED - indicates low battery
N	LED - indicates fully charged battery
O	Front button, increasing winch power
P	Front button, decreasing winch power

X1	Cable socket for cable operation without radio contact
X2	Cable socket for winch control unit, battery charging cable



Winch Control Unit Touch Buttons

A	N/A
B	Cabin/Remote control unit, LED illuminates during winch operation
C	N/A
D	Winch in
E	Winch out
F	N/A
G	Activate winch
H	High speed tramming
I	Low speed tramming
J	Hydraulic jack out
K	Hydraulic jack in
L	Function key
M	Signal horn
N	N/A
O	Winch control unit Off/On

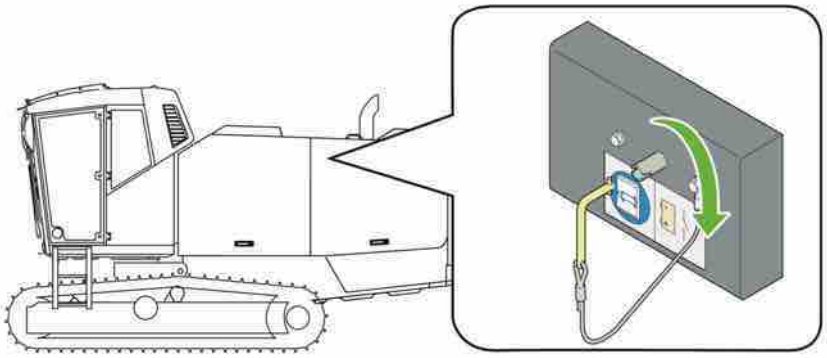
4 Operation

4.1 Startup and Shutdown

4.1.1 Turning On Battery Power

Condition ✓ Daily maintenance has been carried out.

1. Turn the battery isolation switch a quarter of a turn clockwise until the handle stops.



4.1.2 Turning Off Battery Power

The battery isolation switch must be turned off once the diesel engine has stopped, after finishing work, or for long-term storage.

Condition ✓ The diesel engine is switched off.

1. Wait 2 minutes after the diesel engine has been switched off.

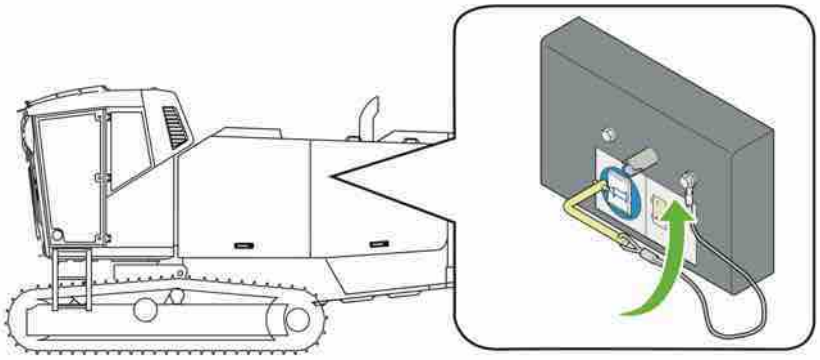
NOTICE

Fluid remaining in Hoses after Shutdown

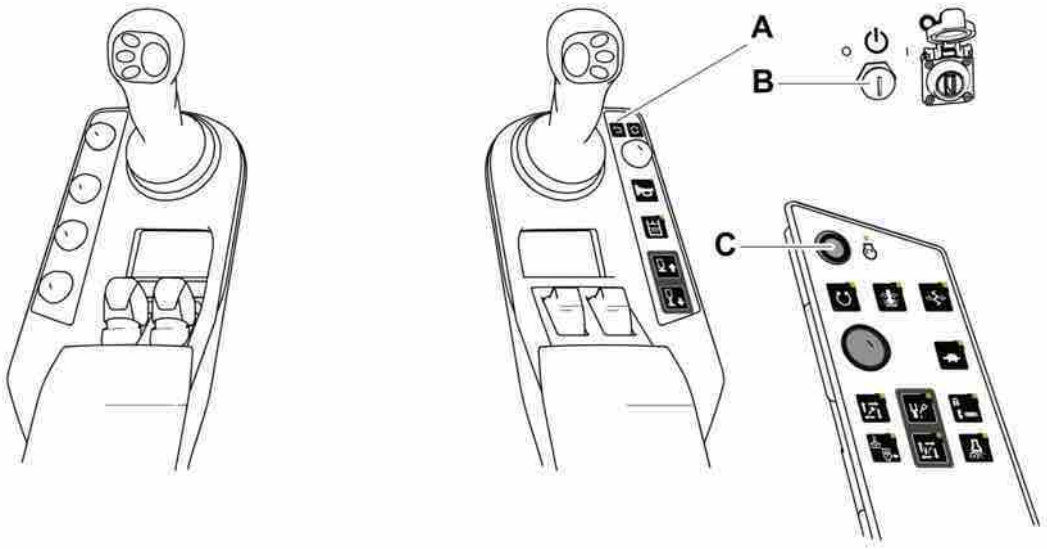
Risk of damage to Diesel Exhaust Fluid (DEF) system.

▶ Always wait 2 minutes after the engine has shutdown before turning off the battery isolation switch.

2. Turn the battery isolation switch a quarter of a turn counterclockwise until the handle stops.



4.1.3 Starting the Diesel Engine



! ***NOTE:*** *Monitor the display during operation of the machine.*

Condition
✓ The battery isolation switch is set to ON.
✓ No emergency stop is activated.

1. Turn the ignition key (B) to the ignition position to activate the control system. Wait about one minute.
2. Press the Reset button in the cabin.

➔ A green circle around the start button (C) shows that the ignition is switched on.

! ***NOTE:*** *If the green circle flashes, the system is not ready for the engine to start. Wait until the green circle is lit steady. If it continues to flash, check which symbols are shown on the display and correct the error.*

3. Press the escape button (A) to reset start-up messages.
4. Press and hold the start button (C) for the diesel engine. Release the button when the diesel engine starts.

! ***NOTE:*** *If the engine fails to start, stop trying after 20 seconds and wait one minute before trying again.*

5. Check the hydraulic oil temperature. If the hydraulic oil temperature is below 20ºC (68ºF), drilling does not work.

4.1.4 Warming Up the System

When working in a cold climate, it is important to:

- Use the preheating function
- Use ISO VG 32 hydraulic oil
- Open the recirculation valve when starting

These functions prevent preheating and the heating is stopped automatically:

- Drilling
- Rotation
- Tramming

Activating Cylinder Functions during Preheating

It is recommended to activate the cylinder functions in cold climate.

Condition ✓ Preheating is active.

1. Position the boom and feeder. Start rod handling and track oscillation to activate cylinder functions.
   ➔ Activation of cylinder functions warms the oil in the system.
2. Run rotation for one minute.
   ➔ Cold oil in the rotation circuit is changed. Rotation prevents preheating and the heating is stopped. Preheating starts automatically after rotation.
3. Heat the oil until the temperature of the hydraulic oil is above 21°.

Automatic Preheating

Automatic preheating is activated from the control system menu **Settings**, **Rig**. The activation is set to zero when the control system is restarted and needs reactivation.

Automatic preheating warms the hydraulic oil when the oil temperature falls below 20º, **min. temperature for heating** in a situation which allows preheating. The preheating continues until **max. temperature for heating** is reached. After drilling, rotation, and tramming preheating starts automatically.

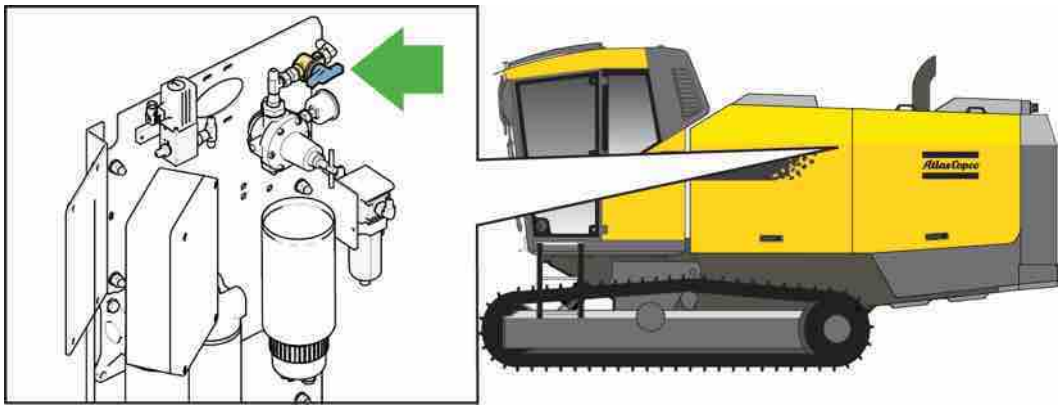
Manual Preheating

Manual preheating is activated on the panel located by the right-hand lever.

Manual preheating is applied when the hydraulic oil temperature is below **min. temperature for heating**. The mode selector must be in tram mode, drill mode, or positioning mode.

The preheating turns off during drilling and high speed tramming, and needs to be reactivated if required. After rotation and low speed tramming the preheating turns on automatically.

Re-Circulation Valve for Preheating



Re-Circulation valve for preheating

There is a re-circulation valve under the front hatch on the left-hand side of the rig. When the temperature is below 0° the rig must be started with the re-circulation valve open. When the rig has reached operating temperature the re-circulation valve must be closed.

The re-circulation valve must be closed in order for drilling to work.

4.1.5 Particle Filter Regeneration

Regeneration cleanses the particle filter of the exhaust system. In normal conditions, regeneration starts automatically and does not affect the performance of the machine.

WARNING

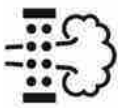
Very High Exhaust Temperatures

Can cause serious personal injury and damage to property.

- Park the machine in the open air during regeneration.
- Never cover the particle filter.
- Never let flammable materials come in contact with the particle filter.

When regeneration is in progress, the symbol High Exhaust Temperature is shown as a warning in the menu status bar.

Symbol Indicating that Forced Regeneration is Required



When the symbol for forced regeneration is shown in the menu status bar, a forced regeneration must be started.

The remaining hours until the next automatic regeneration is shown in menu **Engine**. This symbol appears when the counter showing hours to next regeneration indicates zero and a forced regeneration is required.

If automatic regeneration is blocked when the warning is shown, the machine must be moved to a safe place before activating the forced regeneration.

To make conditions more favourable for the regeneration to start, idling mode is recommended.

Time Remaining until next Automatic Regeneration

The remaining hours until the next automatic regeneration is shown in menu **Engine**. The number of hours indicated is an approximation. The regeneration process can be started several hours before the time shown.

Blocked Automatic Regeneration

Automatic regeneration can be blocked temporarily, for example:

- Exhaust venting equipment is fitted on the rig in connection with repairs.
- Personnel need to be on the superstructure of the rig with the diesel engine started.
- Vegetation or other flammable materials are near the exhaust gases.

Automatic regeneration can only be blocked when the diesel engine is started. Blocked regeneration is automatically reset when the ignition is switched off/on.

Automatic regeneration is blocked in menu **Engine**.

Forced Regeneration

Forced regeneration can only be started when there is less than eight hours remaining until next automatic generation.

A forced regeneration can be started for two reasons:

- The warning symbol is shown in the menu status bar. When this symbol is shown in the menu, forced regeneration must be started.
- The machine will soon be working in a location that is not safe for regeneration, requiring a forced regeneration to be performed directly.

4.1.6 Delayed Engine Shutdown

When the engine is switched off, it may continue to run at idling speed for a few minutes. The delayed engine shutdown (DES) time varies between 1 and 7 minutes.

DES is intended to enable the diesel exhaust fluid (DEF) injection system to cool down before the engine stops. This reduces the risk of damage to the DEF injector.

Testing Emergency Stops on Machines Equipped with DEF injection system

The emergency stop system should be tested prior to each shift by activating each emergency stop button. If the engine is hot, there is a risk of damaging the DEF injector. In such cases, the engine must be restarted immediately after each emergency stop button has been pressed.

Dialogue Box for Delayed Engine Shutdown

NOTICE

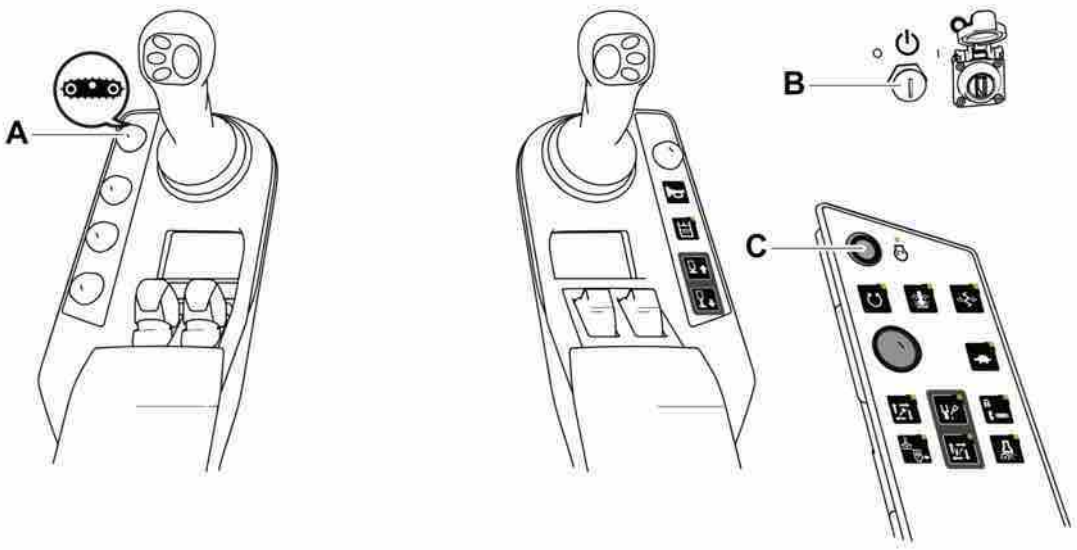
Increased Wear

Risk of damage to diesel exhaust fluid injector.

- ▶ Do not bypass the delayed engine shutdown period.

When there is a requirement for the engine to run at idling speed, a dialogue box is shown in the control system. It is always recommended to wait until the engine is turned off automatically. If **Force engine shutdown** is selected, DES is bypassed and the engine is switched off immediately. Repeatedly bypassing DES of the engine damages the DEF injector. Each bypass of DES is recorded in the event log in the rig control system and the diesel engine ECM.

4.1.7 Stopping the Diesel Engine



1. Set the mode selector (A) in tram mode .
2. Run the engine at idling speed for 2 minutes.
3. Press the stop button (C) to switch off the diesel engine.

NOTICE

Increased Wear

Risk of damage to diesel exhaust fluid injector.

- ▶ Do not bypass the delayed engine shutdown period.

➔ The engine may continue to run at idling speed for a 1-7 minutes.

4. Turn the ignition key (B) to "OFF" position after the engine has stopped.

5. Wait 2 minutes before turning off the battery isolation switch.

NOTICE

Fluid remaining in Hoses after Shutdown

Risk of damage to Diesel Exhaust Fluid (DEF) system.

- Always wait 2 minutes after the engine has shutdown before turning off the battery isolation switch.

4.1.8 Activating the Winch Control Unit

WARNING

Unintentional Maneuvering

Can cause serious injury and damage to property.

- Always have an overview of the drill rig and the winch control unit.
- Never operate the winch control unit from the drill rig when the winch is being used.
- Always deactivate the winch control unit when not in use.

1. Set the mode selector on the operation panel in the remote mode .
2. Press and hold the ON button on the winch control unit until the indication lights flash once.
3. Press the button for cabin/remote control unit on the winch control unit.
   ➔ The indicator light comes on when the winch control unit and the receiver unit on the drill rig have radio contact.

4.1.9 Deactivating the Winch Control Unit

WARNING

Unintentional Maneuvering

Can cause serious injury and damage to property.

- Always have an overview of the drill rig and the winch control unit.
- Never operate the winch control unit from the drill rig when the winch is being used.
- Always deactivate the winch control unit when not in use.

1. Press the button for cabin/remote control unit on the winch control unit.
   ➔ The indicator light goes off.
2. Press the OFF button to switch off the winch control unit.

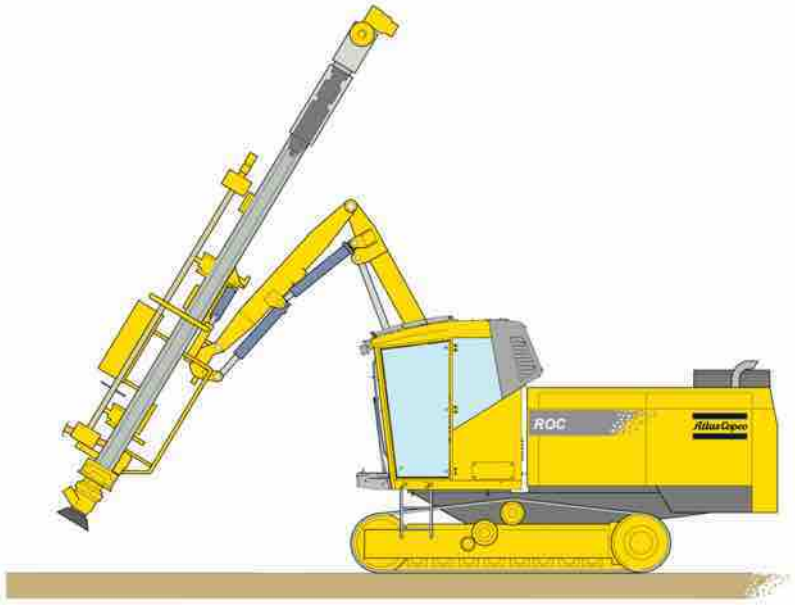
3. Set the mode selector on the operation panel to drill mode, tram mode, or positioning mode to activate desired functions.

4.2 Tramming

4.2.1 Preparations Before Tramming

1. Perform a walk-around inspection of the machine.
2. Start the diesel engine.
3. Set the boom and feed to the correct position for tramming.

Correct Position for Tramming



Correct Position for Tramming

- Direct the boom system straight ahead, and contract the boom and position the feed against the outer boom before opening the track oscillation lock.

4.2.2 Basic Tramming

WARNING

Tipping Risk

The tipping over of a machine can cause serious injury or death.

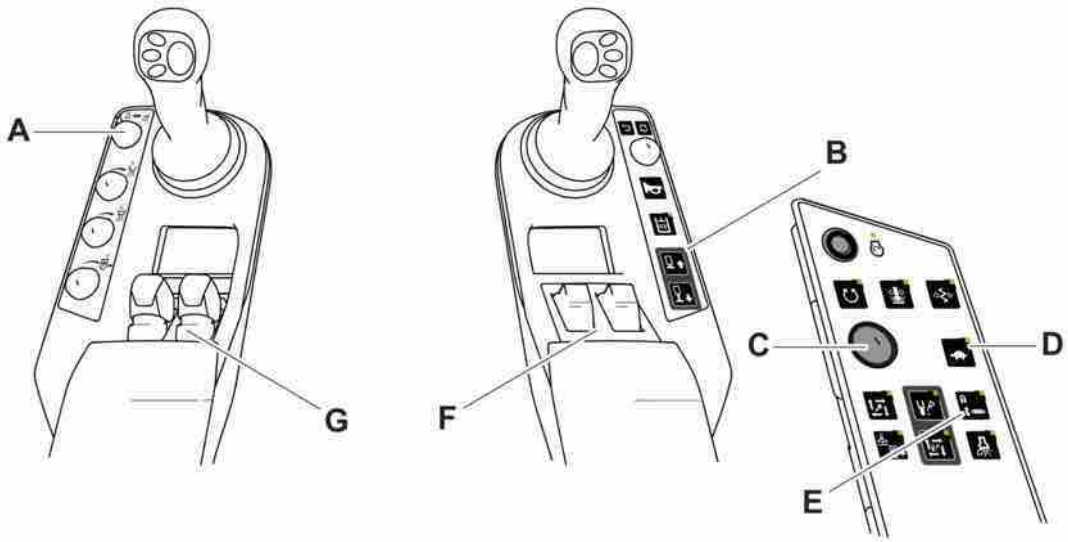
- Always wear a seat belt when operating the machine.
- Always check the ground conditions where the machine will be operated.
- Never exceed the maximum allowed inclination angles for the machine.
- Never combine inclination angles for downward/upward/lateral tramming.
- Adapt the speed to the terrain.

WARNING

High Voltage

High-voltage cables can cause serious injury and damage to property.

- Keep away from high-voltage cables.



Condition
✓ The diesel engine is started.
✓ The boom and feed are set in the correct position for tramming.
✓ No person is present in the machine's direction of tramming.

1. Set the mode selector (A) to tram mode .
2. Raise the hydraulic jack (B).
3. Unlock track oscillation (E).
   ➔ The LED goes off when track oscillation is unlocked.
4. Use track oscillation (F) to correct the position of the rig to as horizontal as possible.
5. Select high speed or low speed (D) depending on terrain characteristics.

➔ The LED comes on when low speed is selected.

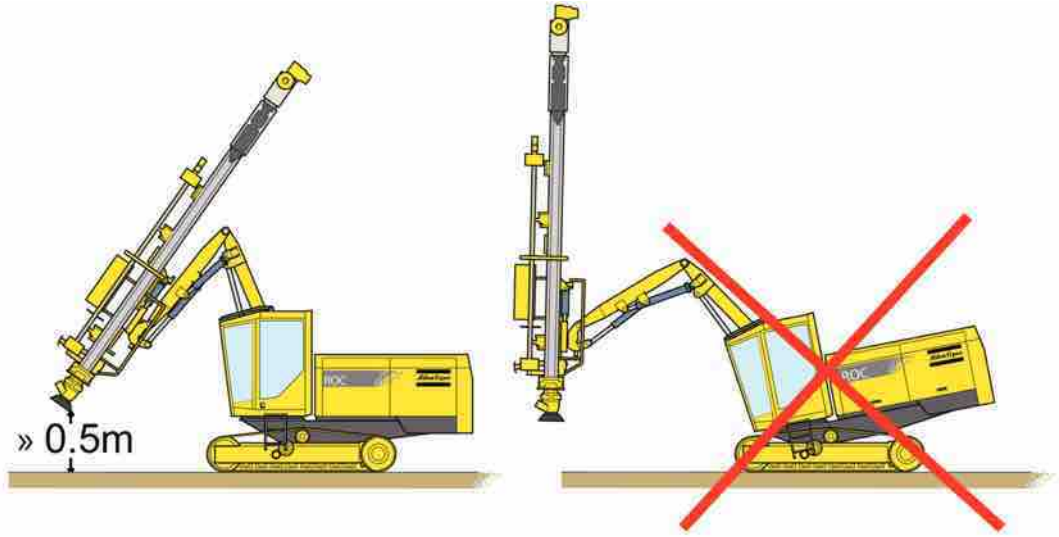
> ! ***NOTE:*** *The maximum speed for tramming (high speed/low speed) can only be adjusted with the knob (C), when tramming levers are activated.*

6. Operate the tramming levers (G) to move the drill rig in the desired direction.

> **NOTICE**
>
> **Unnecessary stresses**
>
> Can cause damage to crawler tracks
>
> ▶ Never operate one crawler track when the other crawler track is stationary.

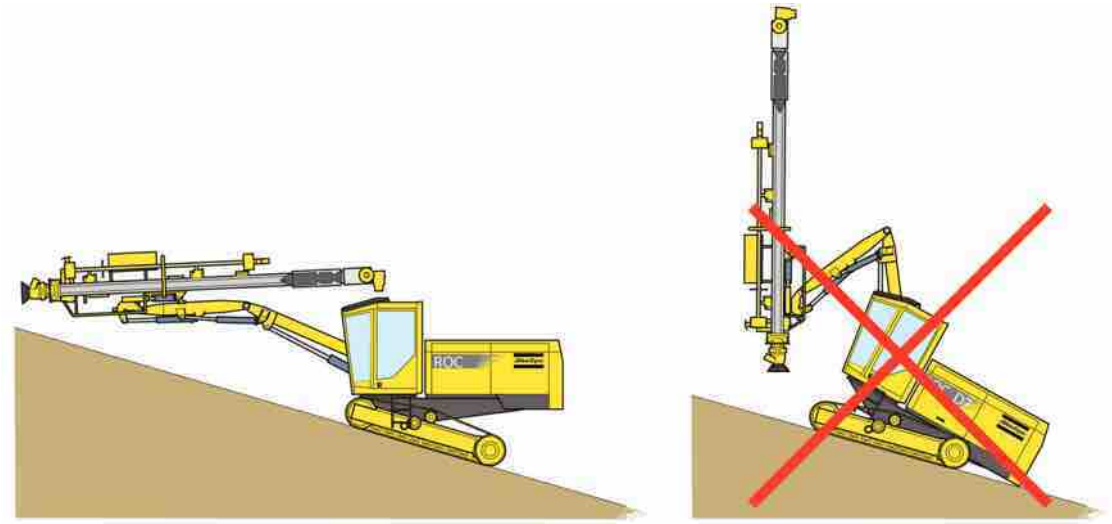
7. Use the boom system to optimize the stability of the drill rig.

4.2.3 Tramming on Level Ground



Correct and Incorrect Position when Tramming on Level Ground

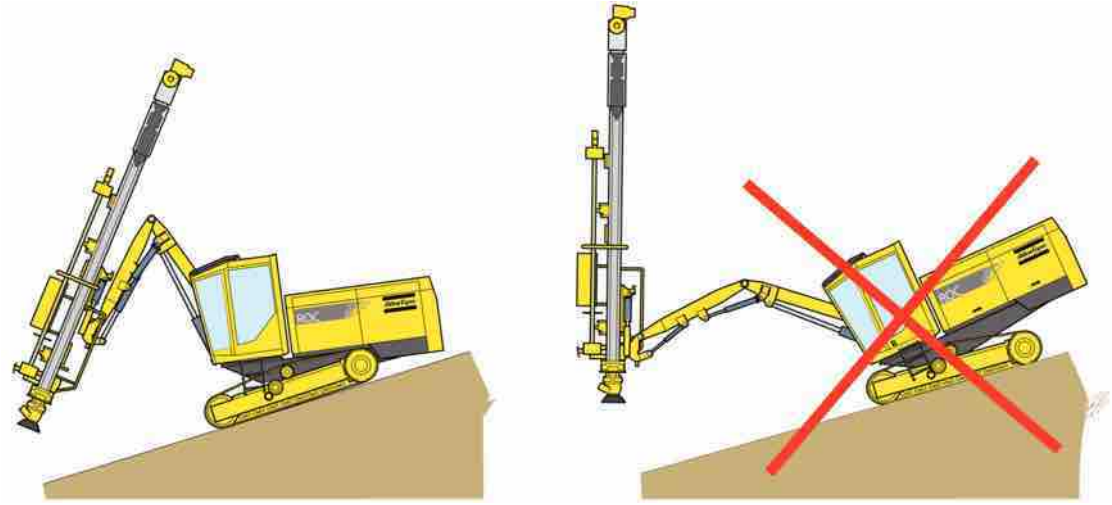
4.2.4 Tramming Uphill



Correct and Incorrect Position for Tramming Uphill

- Extend the boom system and use it as a counterweight when tramming uphill.

4.2.5 Tramming Downhill



Correct and Incorrect Position for Tramming Downhill

- Retract the boom system maximally towards the drill rig.

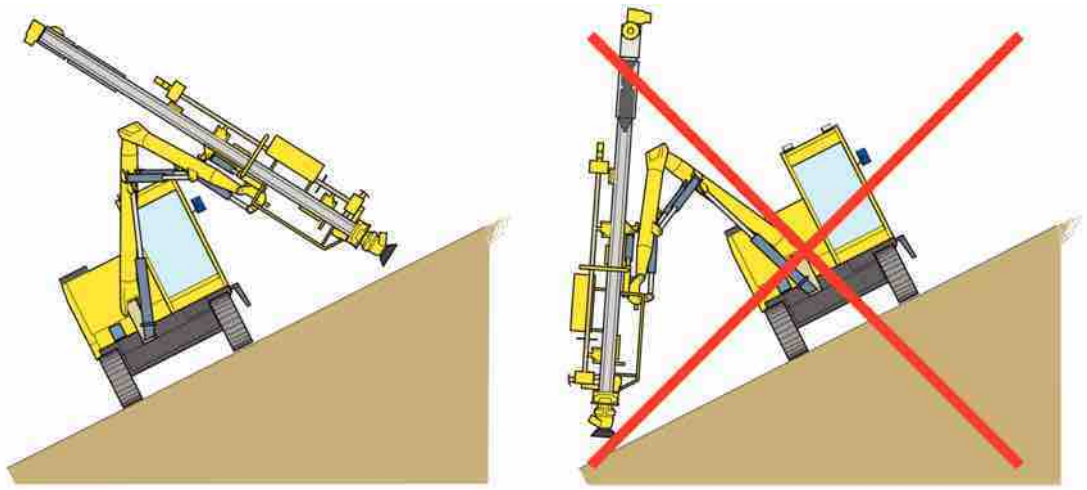
4.2.6 Tramming on Sideway Slopes

WARNING

Increased Risk of Slipping

Can cause serious injury or death

- Be aware of that the risk of slipping is highest when tramming on a sideway slope.
- Always observe ground conditions.



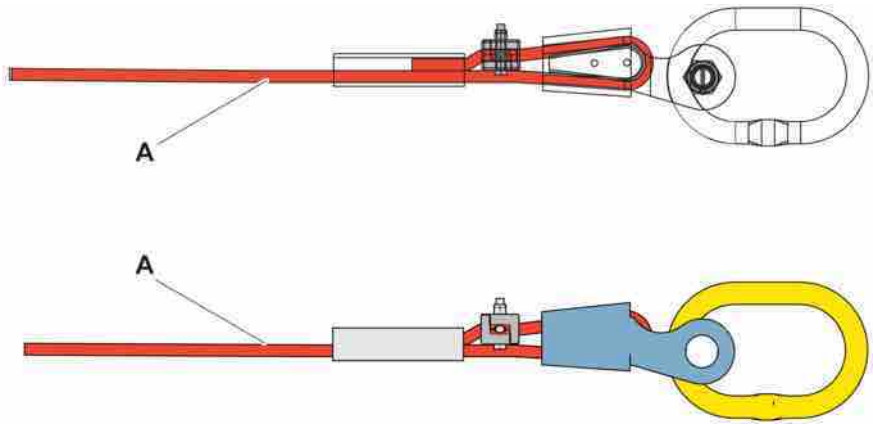
Correct and Incorrect Position for Tramming on Sideway Slopes

- Use the boom system as a counterweight when tramming on sideway slopes.

4.2.7 Checking before Using the Winch

The following must be checked before each use of the winch.

- Check that the cable (A) is attached correctly in the connector sleeve and eye. The cable must run in line with the eye on the connector sleeve.



- Check that the cable has not sustained any damage.
- Check that there are at least 4 turns remaining on the drum. The winch must never be used with fewer than 4 turns remaining on the drum.

4.2.8 Using the Winch when Tramming

WARNING

Tipping Risk

The tipping over of a machine can cause serious injury or death.

- Never exceed the maximum allowed inclination angles for the machine.
- Never combine inclination angles for downward/upward/lateral tramming.
- Never operate the drill rig from the down side.
- Keep the winch cable continuously taut.

WARNING

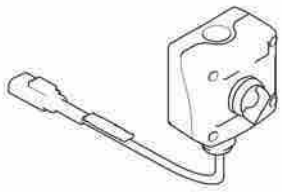
Unintentional Maneuvering

Can cause serious injury and damage to property.

- Always have an overview of the drill rig and the winch control unit.
- Never operate the winch control unit from the drill rig when the winch is being used.
- Always deactivate the winch control unit when not in use.

Condition ✓ Checks before using the winch have been performed.

1. Check that the track oscillation is unlocked.
2. Check that the boom system is in transport position.
3. Put the winch disengagement switch in the unlocked position to disengage the winch drum.



4. Pull out the cable and attach the eyelet to the anchorage point.

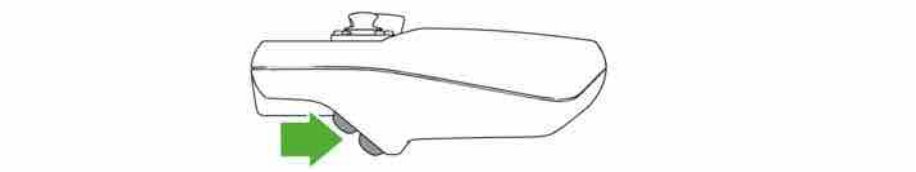
WARNING

Tipping Risk

The tipping over of a machine can cause serious injury or death.

- The anchorage point must be firm and secure. Pay attention to local regulations.
- Never use a damaged cable or hook.
- The safety hook must not be able to slide or detach from the anchorage point.

5. Put the winch disengagement switch in the locked position.
6. Set the winch pressure regulator to the desired pressure with the finger switches on the winch control unit.



7. Activate the winch circuit on the winch control unit.
8. Activate winch power-in manually to ensure that the locking mechanism engages fully with the drum before putting a load on the winch.
9. Reverse up/tram down the incline using the tramming levers. Make sure that the cable is kept taut constantly.
10. Adjust the pressure for the winch motor to achieve sufficient traction.

4.2.9 Checking after Tramming

All emergency stops must be checked for proper function after tramming.

4.3 Positioning

4.3.1 System Settings

Setting Desired Feed Angle with the Aiming Device

When vertical holes are drilled, the aiming device is not in use and the desired angle settings must be adjusted to zero.

When inclined holes are drilled, the aiming device should be used to ensure that all the holes are drilled with correct angles in the same direction.

1. Adjust the aiming device as parallel as possible to the direction of the blast.
   a. If step 1 can’t be followed, set up the feed using a spirit level or similar and continue with step 3.
2. Position the feed to the correct side and tilt angles, looking at the actual angles in the **Angle Indication** menu.
3. Align the aiming device with a reference point as far ahead as possible.
   ➔ The actual tilt angle and side angle will change.
4. Set the desired angles to the same values as the actual angles. These values are different from the adjusted angles in step 2.
   ➔ The graphic image for angle deviations should now display a dot.
5. Turn the aiming device to the same reference point before positioning the feed for the next hole to drill. Adjust the feed until the graphic display shows a dot and it's parallel with the first hole.

Activating the Laser Plane Instrument

When the drill steel length is replaced or when TAC tube is used, the value for **Dist. laser sensor to drill bit** must be adjusted. If several laser planes are used, the **Dist. to reference laser plane**, must be set. The reference plane is the top laser plane.

1. Activate laser plane by selecting the box and press Enter in menu **Settings**, **System**.
2. Check that the value for **Dist. laser sensor to drill bit** is correct.
   ➔ Once the laser receiver has registered the laser plane, the laser plane symbol  will change color from grey to green in the menu status bar. The drilled length value will be calculated from the laser plane level.

Activating the GPS Compass

If the rig is equipped with a GPS compass, it will be activated on machine start-up.

- Deactivate/activate the function in the **Rig Options** menu.

GPS Reception

After starting up the rig it may take several minutes before the symbol  becomes green. The antennas have to establish contact with the satellites.

If the symbol does not become green this may be due to the following causes:

- No satellites are available.
- The antennas are covered by snow.
- There is an open circuit in the cable between the antennas and the electronic unit.

If there is no GPS reception, the GPS compass can be deactivated in the **Rig Options** menu, and the aiming device used in the traditional way.

Activating the Drill Plan Handling

If the rig is equipped with drill plan handling (**Hole navigation**), this function will be activated on machine start-up.

- Deactivate/activate the function in the **Rig Options** menu.

Calibrating the Coverage Area

The coverage area must be calibrated before starting working with drill plans. The coverage area is used in the **Navigation** menu for viewing which holes can be reached from the current position.

1. Place the rig on a level surface.
2. Set the rig in level position using track oscillation.
3. Lock track oscillation.
4. Go to menu **Settings** / **Navigation** and select **Calibration Coverage Area**.
5. Position the boom system max left and as far forward as possible with vertical feed and feed extension max up. Press Box 1.
6. Position the boom system straight forward and as far forward as possible with vertical feed and feed extension max up. Press Box 2.

7. Position the boom system max right and as far forward as possible with vertical feed and feed extension max up. Press Box 3.
8. Position the boom system max right and as close to the rig as possible with vertical feed and feed extension max up. Press Box 4.
9. Position the boom system straight forward and as close to the rig as possible with vertical feed and feed extension max up. Press Box 5.
10. Position the boom system max left and as close to the rig as possible with vertical feed and feed extension max up. Press Box 6.

Result ➔ The coverage area of the boom system is shown on the display.

Loading Drill Plans

1. Insert a USB memory stick with drill plans into the USB socket.
2. Download drill plans to the rig from the **Drillplan** menu, or from the **Data** menu.

Selecting Drill Plan

Condition ✓ A drill plan is downloaded to the system.

1. Go to the **Angle Indication** menu or to the **Navigation** menu.
2. Select **Drillplan** and press Enter.
3. Select **Load Drillplan** and press Enter.
4. Go to desired drill plan and press Enter.
   ➔ Drill plan loading is finished when the message **Load OK** is shown on the display.

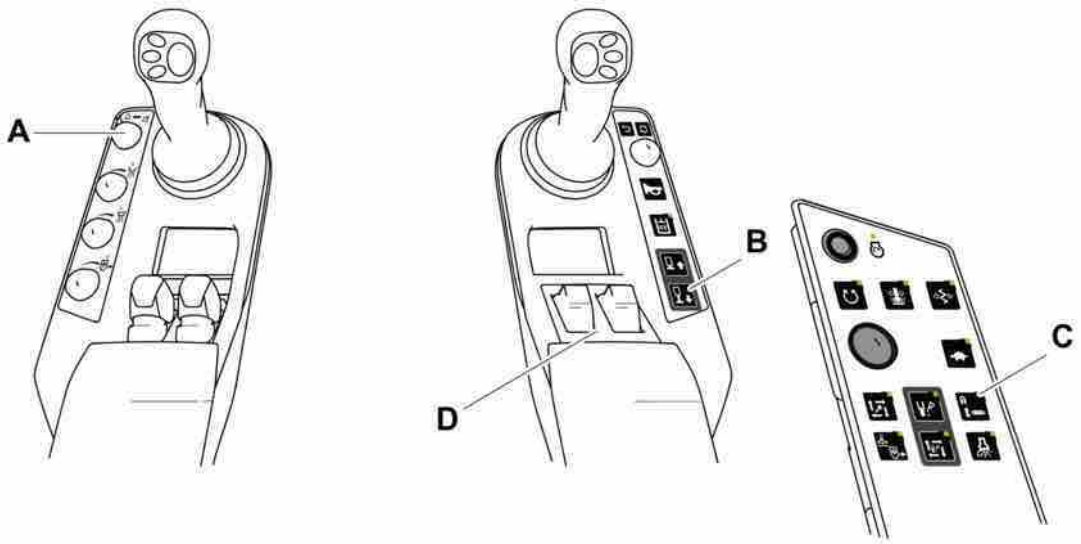
4.3.2 Machine Positioning

WARNING

Tipping Risk

The tipping over of a machine can cause serious injury or death.

- Always wear a seat belt when operating the machine.
- Always check the ground conditions where the machine will be operated.
- Never exceed the maximum allowed inclination angles for the machine.
- Never combine inclination angles for downward/upward/lateral setup.



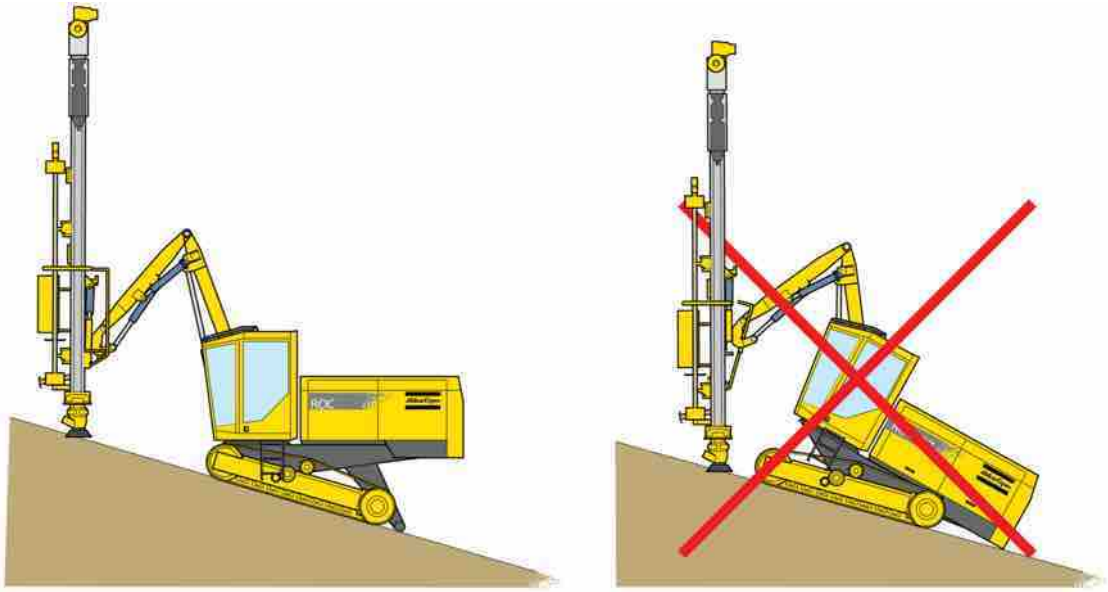
1. Set the mode selector (A) to tram mode .
2. Use track oscillation (D) to correct the position of the rig to as horizontal as possible. The track oscillation (C) is unlocked.
3. Lower the jack (B) steadily against the ground without lifting the track frames from the ground. The rear sections of the track frames must stand firmly on the ground.
4. Lock track oscillation (C).
   ➔ The light comes on when the track oscillation is locked.
5. Position the boom and feed correctly for drilling.
6. Set the feed dowel steadily against the ground with feed extension.

Setup on Level Ground

Correct and Incorrect Setup

Uphill Setup

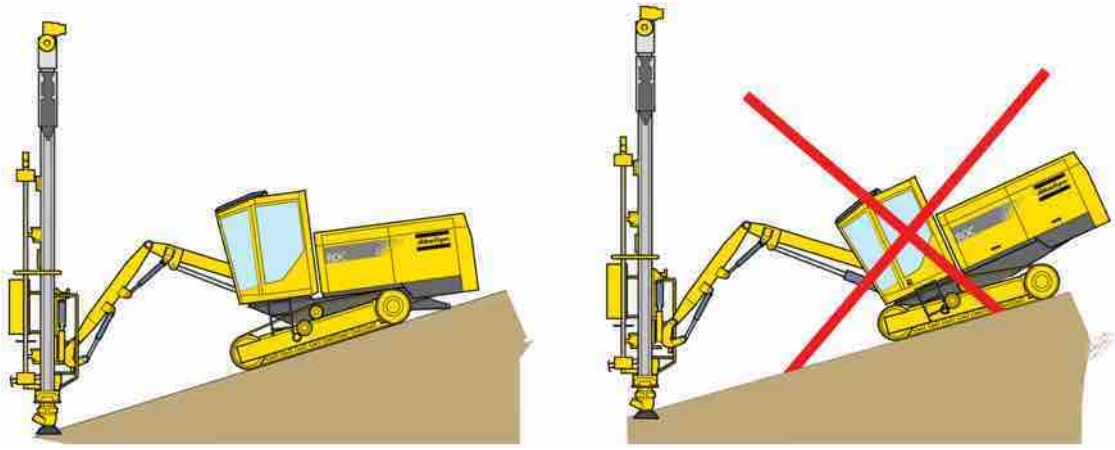
Set the drill rig as close to the horizontal position as possible.



Correct and Incorrect Uphill Setup

Downhill Setup

Set the drill rig as close to the horizontal position as possible.



Correct and Incorrect Downhill Setup

Setup on Sideway Slopes

WARNING

Increased Risk of Slipping

Can cause serious injury or death

- Be aware of that the risk of slipping is highest when setting up the rig on a sideway slope.
- Always observe ground conditions.
- Always use smooth movements during setup.

- Always be very careful when setting up the rig on a sideway slope.

4.3.3 Drill System Positioning

Positioning with GPS Compass

1. Turn the aiming device to the required direction.
2. Go to the **Angle Indication** menu. The compass direction setting is visible in the field.
3. Lock the aiming direction value by selecting the arrow.
   ➔ The value selected to be locked is now visible in the field. The aiming direction remains the same until the operator selects a new direction.

Positioning with Semi-Auto Positioning Function

Semi-auto positioning: The feed is automatically positioned with the same hole angle as the first hole.

1. Set the hole angle of the first hole in the **Angle Indication** menu.
2. Press the button on the left lever for semi-auto positioning before drilling the second hole.
   ➔ The feed is automatically positioned with the same hole angle as the first hole.

Positioning Using Drill Plans

Condition ✓ The mode selector is in tram or positioning mode

1. Go to the **Navigation** menu.
2. Select the first hole to drill in the drill plan and press the button on the right lever.
   ➔ Values for the selected hole are communicated to the control system.
3. Move the rig towards the first hole.
4. Press and hold the semi-auto positioning button.
   ➔ The menu changes to the **Angle Indication** menu. The feed angles are automatically adjusted according to the drill plan.

5. Position the rig and boom until the positioning is correct for the first hole.
   ➔ When the tramming and positioning levers are used, the menu changes to the **Navigation** menu. The bars in the menu turn green when positioning is correct.
6. Release the semi-auto positioning button .
7. Set up the rig according to instructions in Machine Positioning.
8. Set the mode selector to drill mode .
   ➔ The menu changes to the **Drilling** menu.
9. Set the hole depth counter to zero .
   ➔ Hole length and target values from the drill plan are presented in the **Drilling** menu.
10. Drill the first hole.
    ➔ The drilling stops when the target is reached.

Saving Drill Plan

The drill plan must be saved after drilling.

Condition ✓ A USB stick is in the USB port.

1. Select **Drillplan** under **Data Save** in the **Data** menu and press Enter to confirm.
2. Select **Copy Logs To USB**.
   ➔ The drill plan is saved to the USB stick.

Adding a Hole in a Drill Plan

1. Position the drill bit in the intended location of the hole.
2. Go to the **Drillplan** menu.
3. Select **Add hole** and press Enter.
4. Confirm the new hole by selecting **Add hole** if the information for the hole is correct.

Deleting a Hole in a Drill Plan

1. Go to the **Drillplan** menu.
2. Select the hole to delete.
3. Select **Delete hole** and press Enter.

4.4 Rod Handling

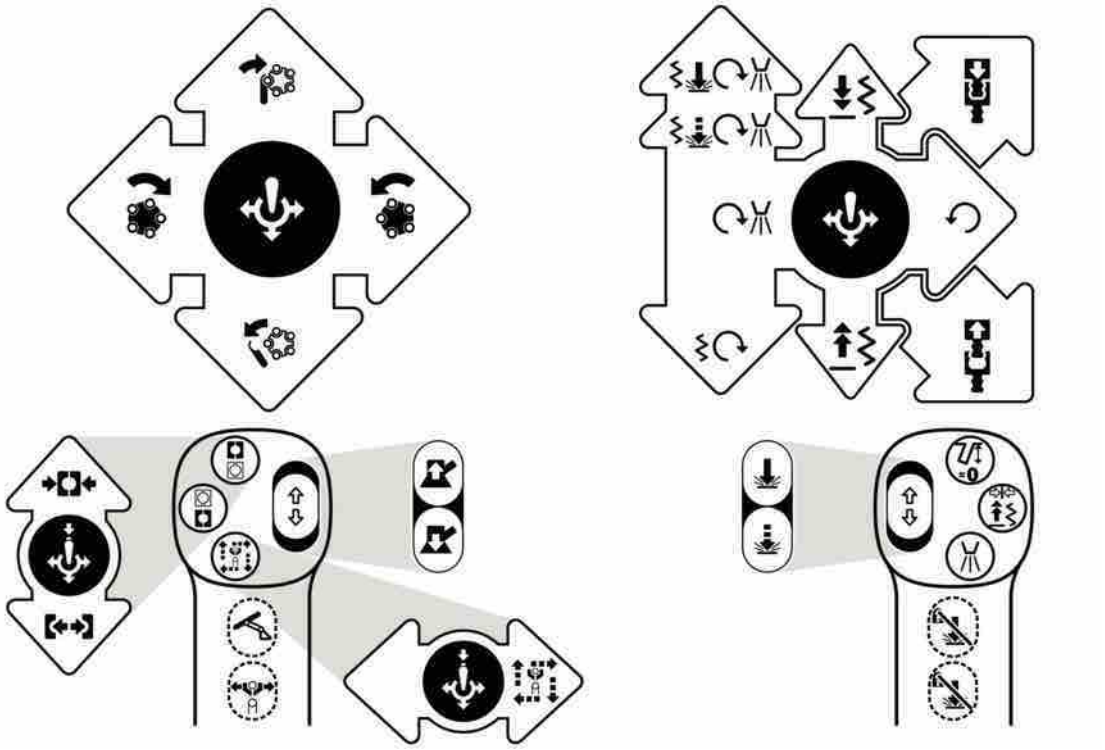
4.4.1 Loading the Rod Carousel

WARNING

Risk of Clamping or Crushing

Can cause serious injury or death.

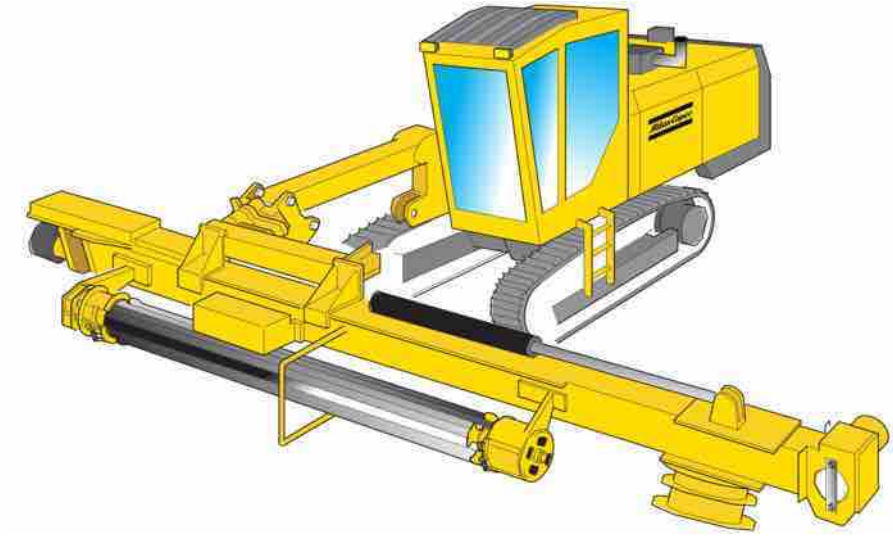
- Always use lifting assistance when loading the carousel.
- Follow the instructions carefully.
- Two persons are required to load or empty the rod carousel.



Condition ✓ Two persons who are trained and well conversant with the equipment are required to fill the drill pipes.
✓ Suitable lifting equipment must be used.

1. Set the mode selector to drill mode .
2. Move the rock drill to its top position on the feeder .

3. Position the feed beam to horizontal position.



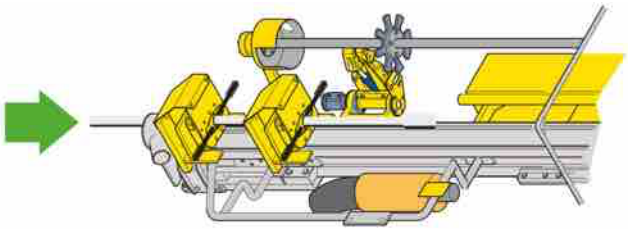
4. Rotate the rod carousel anticlockwise repeatedly until the carousel has reached its end position.
5. Activate the rapid feed stops to obtain the correct stops .
6. Run the rock drill down to its lowest position .
7. Open both drill steel supports + .
8. Insert the first drill rod through the drill steel supports and close the drill steel supports to grip the drill rod + .

WARNING

Moving Parts

Can cause serious injury or death

- Never stand close to the drill rod when closing the drill supports.



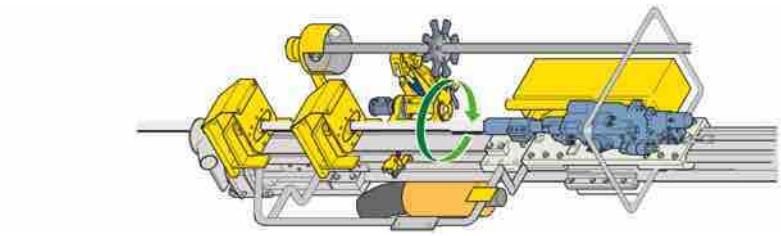
9. Thread the rock drill fully into the drill rod sleeve .

DANGER

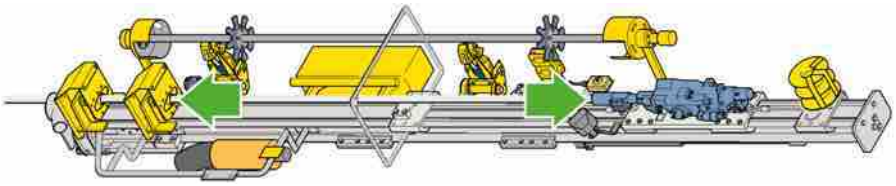
Rotating Parts

Will cause serious injury or death

- Never hold the drill rod during rotation.



10. Run the rock drill up with the drill rod until the rock drill stops with the thread inside the upper drill-steel support .



11. Open the rod handling grippers and move out the rod handling arms to grip the drill steel + .
12. Release the button .
    - ➔ The grippers close.
13. Release the left lever to the neutral position.
    - ➔ The grippers adopt loose grip.
14. Run the rock drill up to the position for inserting to carousel .
15. Activate hard grip .
16. Activate unthreading .
17. Insert the drill rod into the carousel when the rock drill has been unthreaded from the drill rod.
18. Rotate the carousel clockwise .
19. Open both drill steel supports + .
20. Repeat the procedure until the required number of drill rods are in the carousel.

21. Thread a drill bit onto the last drill pipe to finish the procedure.

DANGER

Rotating Parts

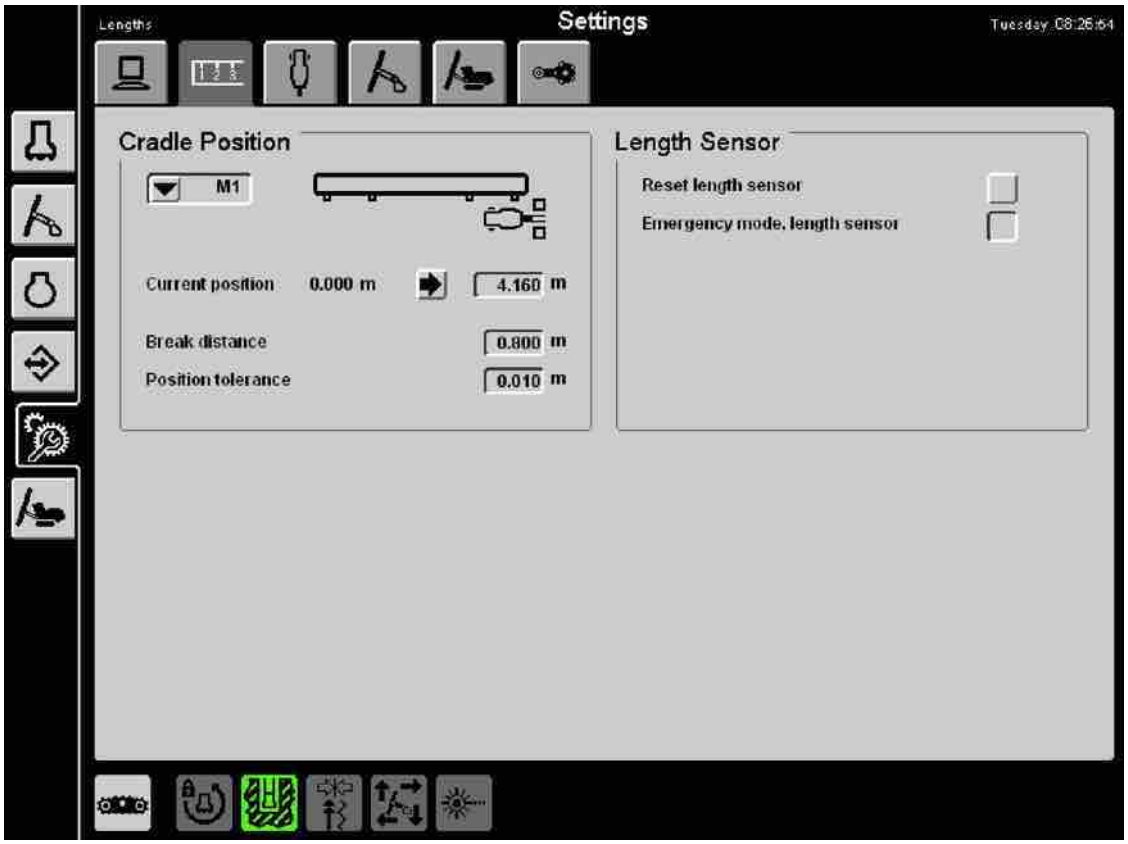
There is a risk of serious injury or death as clothing can get caught in the machine.

- Stop the drill rotation before adding a drill bit.

4.5 Drilling

4.5.1 Drilling Settings

Calibrating the Length Sensor



Length Settings Menu

The rig is fitted with an absolute position sensor and does not usually need calibration. The length sensor requires calibration in the following cases:

- Program loading
- Parameter loading
- The "Length sensor not calibrated" symbol is shown

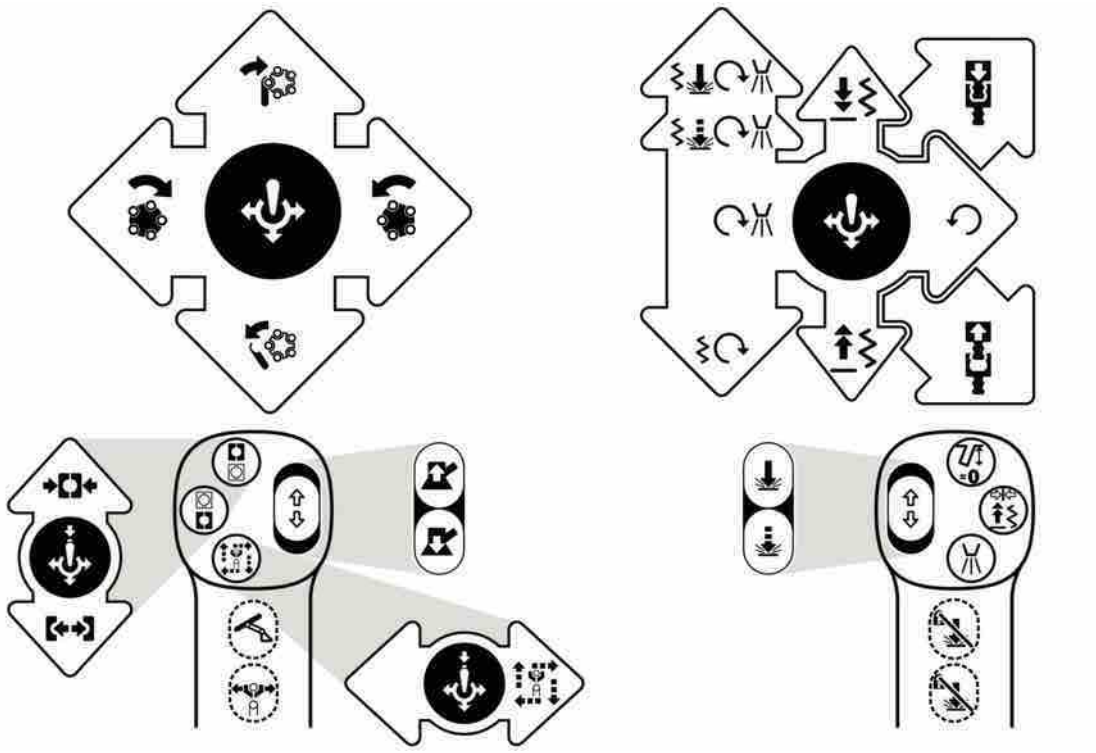
1. Change user to service (SE).
2. Reverse the rock drill to the mechanical stop with drill feed or unthreading.

3. Reset the length sensor by pressing the button **Reset length sensor** .

Setting the Depth Measuring System

1. Select desired measuring method **Hole Length** or **Hole Depth** in the **System** menu under **Settings**.
2. Set the desired hole depth in the **Drilling** menu when using automatic drill stop.
3. Reset the hole depth counter when the drill bit is positioned against the ground.

4.5.2 Drill a Hole



Condition ✓ The rock drill is in the upper position. A drill rod is coupled to the rock drill and a drill bit is mounted on to the drill rod.

1. Set the mode selector to drill mode on the operating panel.
2. Make sure that the upper and lower drill steel supports are closed.
3. Lower the drill bit to just above the ground .
4. Set the hole depth counter to zero .
5. Lower the suction hood to the ground .
6. Activate flush air on the operating panel.
7. Activate dust collector on the operating panel.
8. Activate rotation and flush air .
9. Activate collaring . Move the lever proportionally forward until the drill bit has entered into solid rock.

10. Lock collaring. Press the button on the right lever when the lever is in the section. The right lever can be released to neutral position when collaring is locked and the symbol is shown in the status bar.
    ➔ If collaring is unsuccessful the right lever must be moved back and the collaring process restarted.

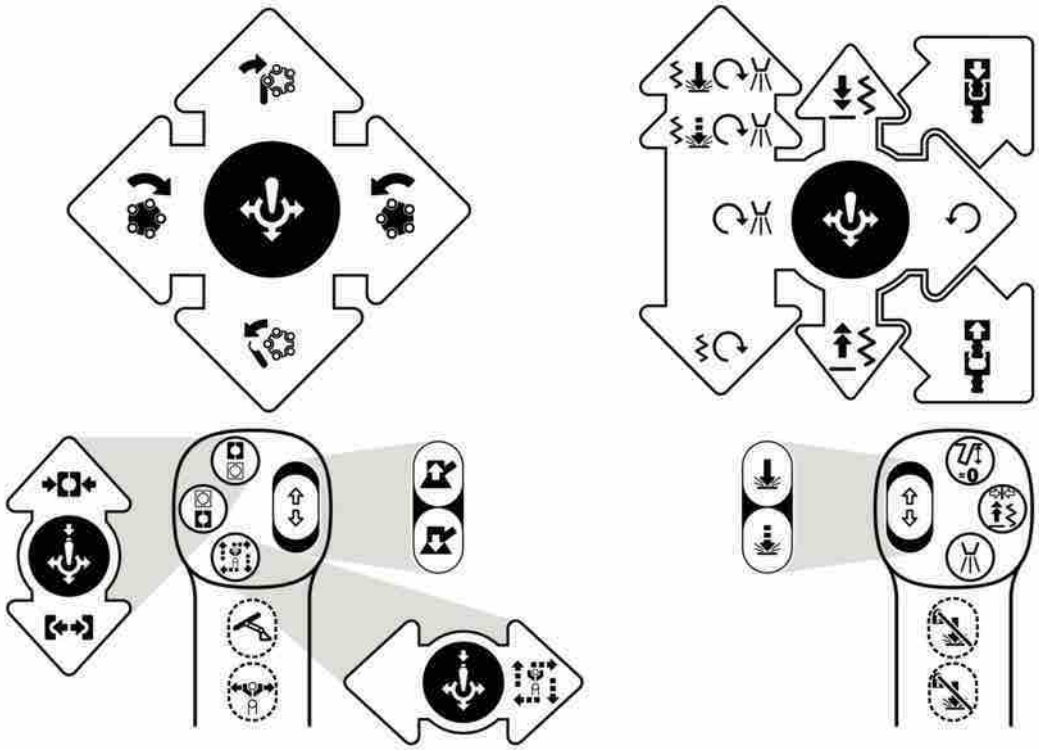
11. Activate full drilling after reaching homogenous rock or once the drill bit has entered far enough into the rock. Move the right lever to the position and hold it there for two seconds, or activate the button on right lever.
    ➔ A green symbol appears on the status bar of the display to indicate that full drilling is activated.

4.5.3 Stop Drilling

- Press the button to stop ongoing drilling.

4.5.4 Adding Drill Rods

Unthreading and Retraction of Rock Drill



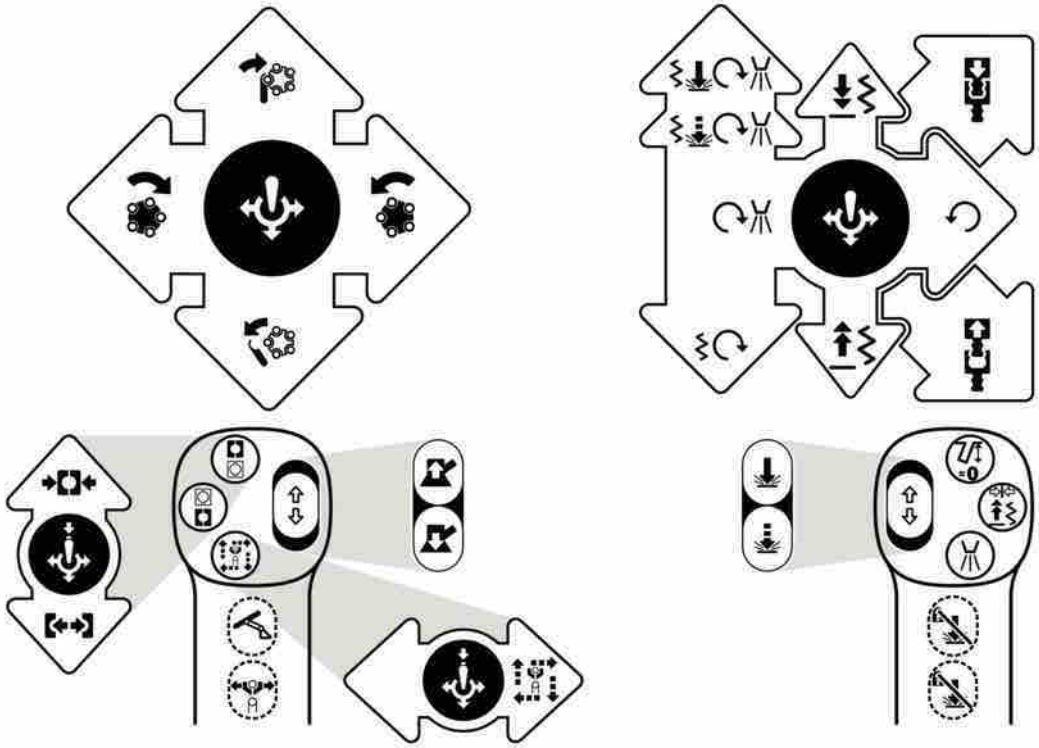
Condition
✓ The mode selector is in drill mode .
✓ The drill rod retraction function is deactivated.

1. Close the upper drill steel support to lock the coupling sleeve + .

2. Activate unthreading .
    ➔ The rock drill is unthreaded from the drill rod when the shank adapter is free from the sleeve.

3. Activate rapid feed up .
   ➔ The cradle stops automatically above the carousel so that a new drill rod can be added.
4. Move the right lever to neutral position.

Adding a New Drill Rod



Condition
✓ The mode selector is in drill mode .
✓ A new drill rod is in the RHS grippers.

1. Move the drill rod to drill centre .
2. Move the left lever to neutral position.
   ➔ The grippers adopt loose grip.
3. Activate threading .
   ➔ The rock drill is threaded onto the new drill rod and the new drill rod is threaded to the drill string.
4. Move the right lever to neutral position.
5. Move the rod handling arms to the carousel + . Release the button and the lever.

4.5.5 Changing a Drill Bit

DANGER

Rotating Parts

There is a risk of serious injury or death as clothing can get caught in the machine.

- Stop the drill rotation before changing drill bits.

NOTICE

High Impact Percussion

Risk of damage to drill

- Never start percussion with the drill bit in mid-air.

1. Move the feed until the feed dowel is approximately 10 cm from the rock.
2. Make sure that drill rotation is stopped.
3. Move the drill bit forward until it is pressed against the rock.
4. Activate high percussion for a few seconds. If the percussion pressure is engaged for too long then the drill steel can detach from the shank adapter.
5. Deactivate high percussion when the drill bit has loosened.
6. Unscrew the old drill bit by hand and replace with a new one.

4.5.6 Checks During Drilling

Check point	Inspection	Instructions
Rock drill hydraulic hoses	Abnormal vibrations in the hydraulic hoses.	Check the accumulator. For further details see the maintenance instructions for the rock drill”
Dust collector (DCT)	Suction ability and filter cleaning	In the event of dust build-up: Check the filter in the filter holder, the suction hose and the drill-steel support gasket. If water flushes out of the hole the dust collector must be switched off.
Drill rig	Visual check	Check for any signs of leaks -Hydraulic system -Fuel system -Cooling system -Compressor

Check point	Inspection	Instructions
Return oil filter	Operator's display in cabin	Check for any signs of leaks. 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.
Hydraulic system	Visual check	Monitor all pressure gauges in the **Drilling** menu.
Suction hood	Occurrence of crushed rock	Raise the suction hood now and then to check that crushed rock is flushed up properly from the hole.

4.5.7 In Case of Breakdown or Incident

Checking High Coupling Sleeve Temperature

NOTE: *Coupling sleeve temperature must not exceed 120ºC (248ºF).*

Depending on the layers of the rock, temperature can vary even within a small area. High coupling sleeve temperature is usually due to a poor ratio between drill feed pressure, percussion pressure and rotation pressure.

Excessive coupling sleeve temperature is indicated by:

- Measuring with a thermometer.
- Oil dripping from the rock drill vaporizing on the coupling sleeve.
- The coupling sleeve changing color.

Reducing Coupling Sleeve Temperature

1. Check the condition of the drill bit. An overdrilled bit generates less torque in the coupling sleeve.
2. Grind the drill bit.
3. Change to a drill bit with ballistic buttons.
4. Reduce rotation speed as much as possible without causing the drill string to rotate jerkily If the rock is too hard for ballistic bits.
5. Check the dampening pressure and set it to the recommended level. Reduce percussion pressure to below the basic setting (5-10 bar). A reasonable reduction in penetration rate must be accepted.
6. Check and/or adjust feed pressure so that the shank adapter is in “float position”.

Difficulties in Loosening the Coupling Sleeve

The best method of loosening the coupling sleeve is to “drill” the last few centimetres without feed pressure and rotation, leaving percussion active for a few seconds to break the coupling sleeve.

- Make sure the RPC-F system is set correctly. An RPC-F system that is set too high causes excessive torque in the coupling sleeve.

Avoiding Hole Deflection

1. Drill with as low drill feed pressure as possible.
2. Check the condition of the drill bit.
3. Use TAC tubes, drop center bits.
4. Drill the first drill steel with reduced drilling for at least half of the drill steel in order to minimize hole deflection at the start of the hole.

5 Transport

5.1 Preparations Before Hoisting

WARNING

Risk of Crushing

Crushing can cause serious personal injury or death.

- Use extreme caution when slinging and hoisting heavy objects.
- Hoisting must take place at the center of gravity.
- Only use slings that are intact and designed for the load they shall carry.
- Fasten the straps to lifting eyes, when available.
- Do not go near a suspended load.

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

- Clean the entire machine with water and/or detergent containing a grease solvent before dismantling.
- Mark hoses, pipes and other connections to make reassembly easier and prevent mix-ups.
- Make sure that everything is clean when dismantling hydraulic, compressed air and water flushing hoses. Immediately plug all hoses, nipples and hydraulic oil pipes, or seal.

5.2 Before Loading the Machine onto the Transport Vehicle

WARNING

Tipping Risk

The tipping over of a machine can cause serious injury or death.

- Lock the track oscillation before hoisting the machine.
- Adapt transportation equipment to the dimensions and weight of the machine.
- Check that all hatches are properly locked.

- Run the rock drill to the lowest position.

Use the boom and feed controls alternately to bring the feed down into the horizontal transport position.

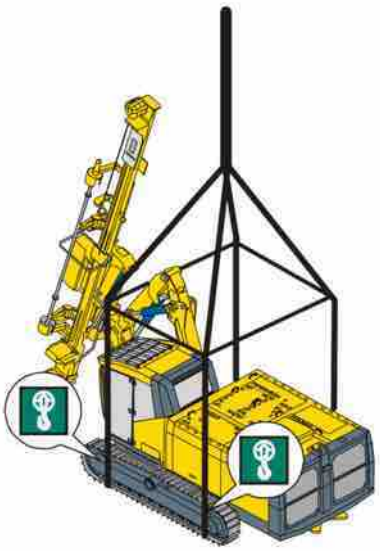
5.3 Hoisting a Drill Rig

WARNING

Risk of Crushing

Crushing can cause serious personal injury or death.

- Use extreme caution when slinging and hoisting heavy objects.
- Hoisting must take place at the center of gravity.
- Only use slings that are intact and designed for the load they will carry.
- Fasten the straps to lifting eyes, if available.
- Do not approach a suspended load..



To achieve maximum drill rig stability, position the boom, feed, and rock drill:

1. Boom lift cylinder maximum OUT.
2. Boom extension maximum IN.
3. Feed dump cylinder maximum OUT (make sure that the feed does not collide with the lifting equipment).
4. Rock drill in END POSITION (lower position).
5. Make sure that the hydraulic jack is retracted.
6. Track oscillation cylinders to LOCKED position.
7. Make sure that none of the hoses, controls, or any other components can get caught or sustain damage when the hoisting slings are tensioned and under load.
8. Place the hoisting slings at designated points under both crawler tracks.
9. Make sure the chassis is not damaged when positioning the feed in the transport/ hoisting position.

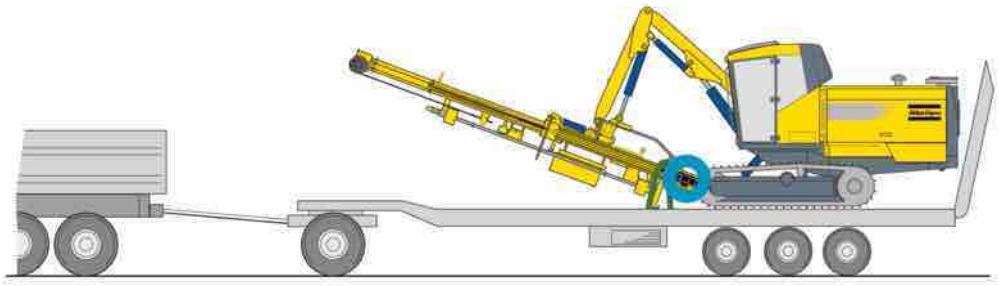
5.4 Before Transporting the Loaded Drill Rig

WARNING

Tipping Risk

The tipping over of a machine can cause serious injury or death.

- Lock the track oscillation before hoisting the machine.
- Adapt transportation equipment to the dimensions and weight of the machine.
- Check that all hatches are properly locked.



Transport Position

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

1. Extract the hydraulic jack.
2. Track oscillation cylinders to **LOCKED** position.
3. Support the feed beam against the vehicle to prevent overloading.
4. Switch off the diesel engine.
5. Strap the drill rig securely to the vehicle.

6 Daily Maintenance

6.1 Maintenance Table

	Additional information	Daily	
6.2	Visual Check	1	
6.3	Wash Machine Externally	1	
6.4	Check Lubrication Oil Level Tank	1	
6.5	Drain Condensate in Pressure Tank	1	
6.6	Check Fire Extinguishers	1	
6.7	Check Emergency Stops and Work Lights	1	
6.8	Check Coolant Level	1	
6.9	Check Track Frames	1	
6.10	Check Motor Oil Level	1	
6.11	Check Diesel Engine and Compressor	1	
6.12	Check Hydraulic Tank	1	
6.13	Drain Pre-Filter	1	
6.14	Check Compressor Oil Level	1	
6.15	Check Condition of CLS Pump	1	
6.16	Check Winch	1	
6.17	Check Small Remote Control	1	

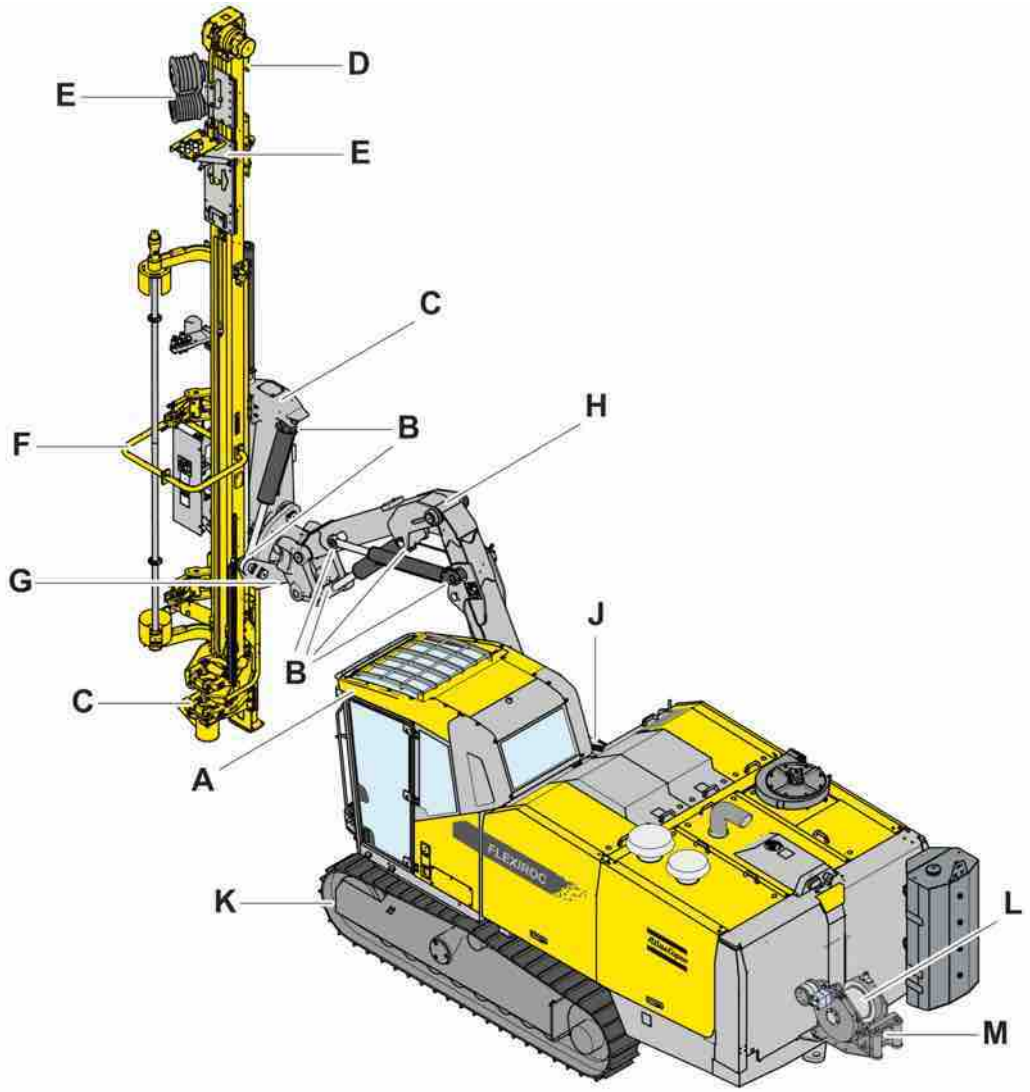
1 - Operating Personnel

6.2 Visual Check

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

- Damage that could give rise to structural weakness or cracks
- Wear that could have the same consequences

- Cracks of fractures in materials or welded joints



Check Points

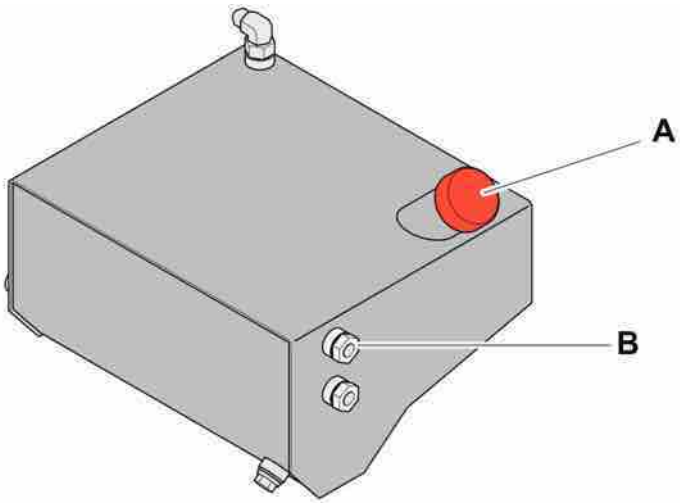
A	Operator's cabin with brackets
B	Cylinder brackets
C	Feed holder with brackets
D	Feed chain with brackets
E	Hose drum with cradle
F	Yoke for drill rods
G	Boom head
H	Boom
J	Boom support with pivot
K	Track frames with attachment
L	Winch with brackets (option)
M	Winch cable with eyelet (option)

6.3 Wash Machine Externally

- Rinse the machine with water at least once a day to remove drill cuttings, mud, and dirt.

The feed, front part of the boom, and track frames are particularly important to keep clean.

6.4 Check Lubrication Oil Level Tank

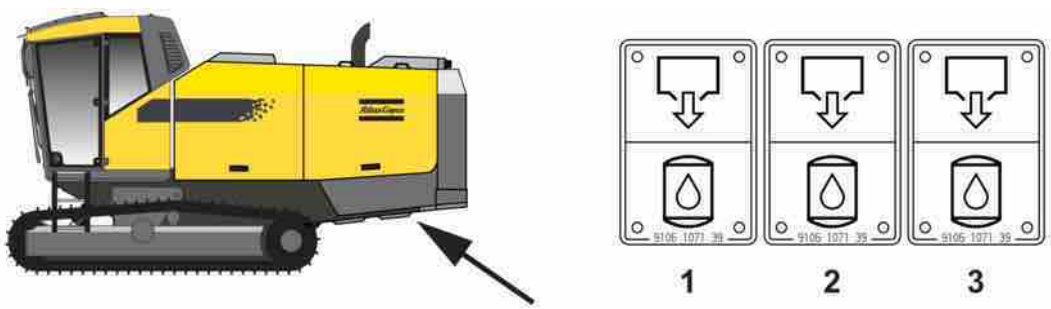


The lubricating oil tank is mounted on the left side of the machine frame.

- Check the tank and connections for signs of leakage.
- Make sure the lubrication oil level is above the top sight glass (B).
- Refill with lubrication oil (A,) if necessary. Always use a funnel with a strainer.

! ***NOTE:*** *The lubrication oil level should not be below 40 mm (1.6"). If the lubricating system is completely drained, the system will have to be bled.*

6.5 Drain Condensate in Pressure Tank

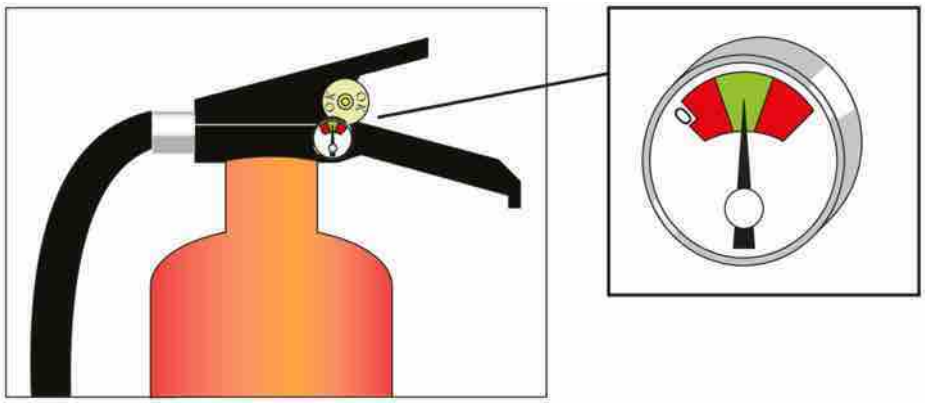


A	Compressor tank
B	Compressor cooler
C	Compressor element

Condition ✓ The machine must have been switched off for at least 1 hour.

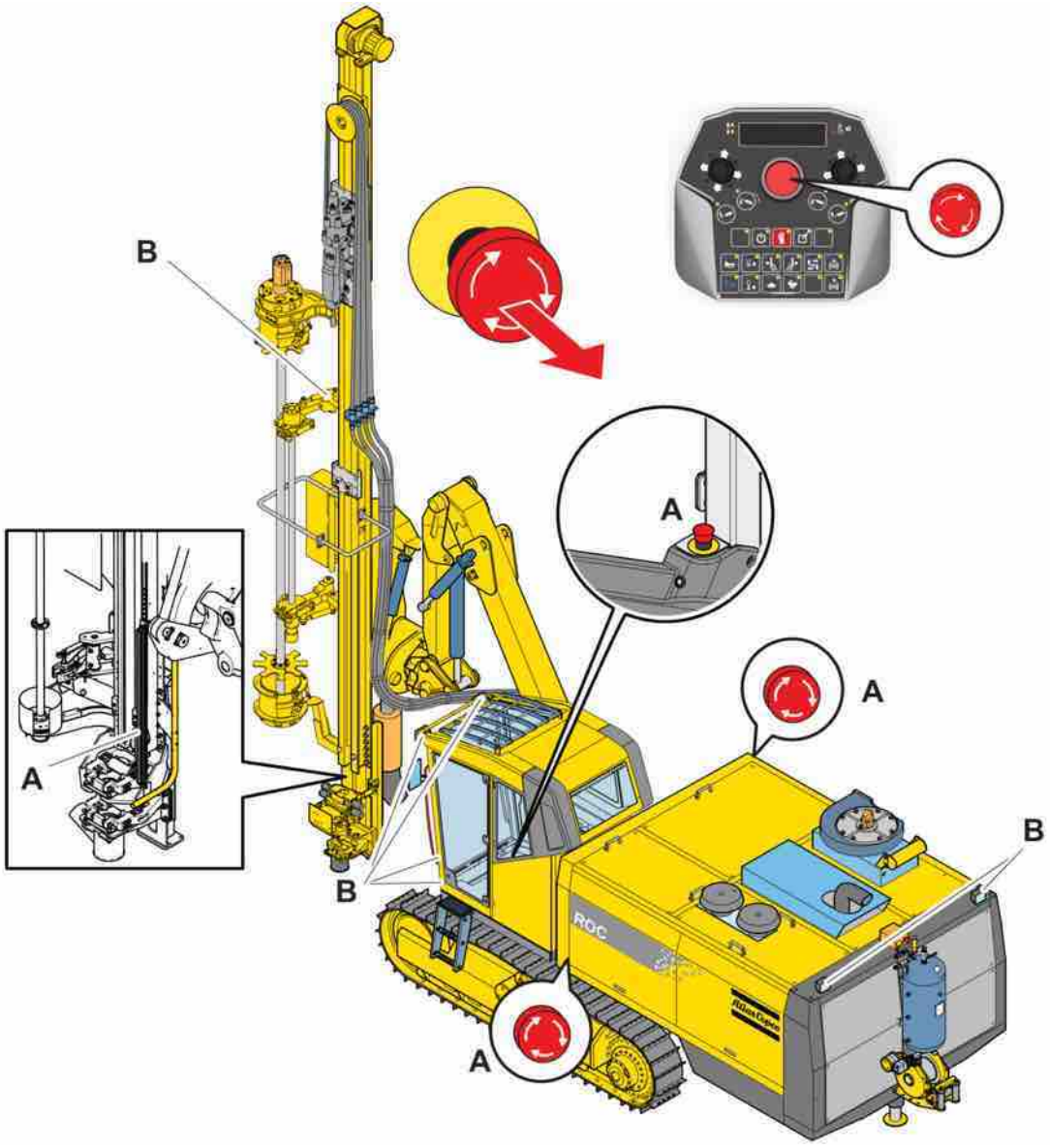
- Drain the condensate from plug 1 at the draining point on the right-hand side of the machine.

6.6 Check Fire Extinguishers



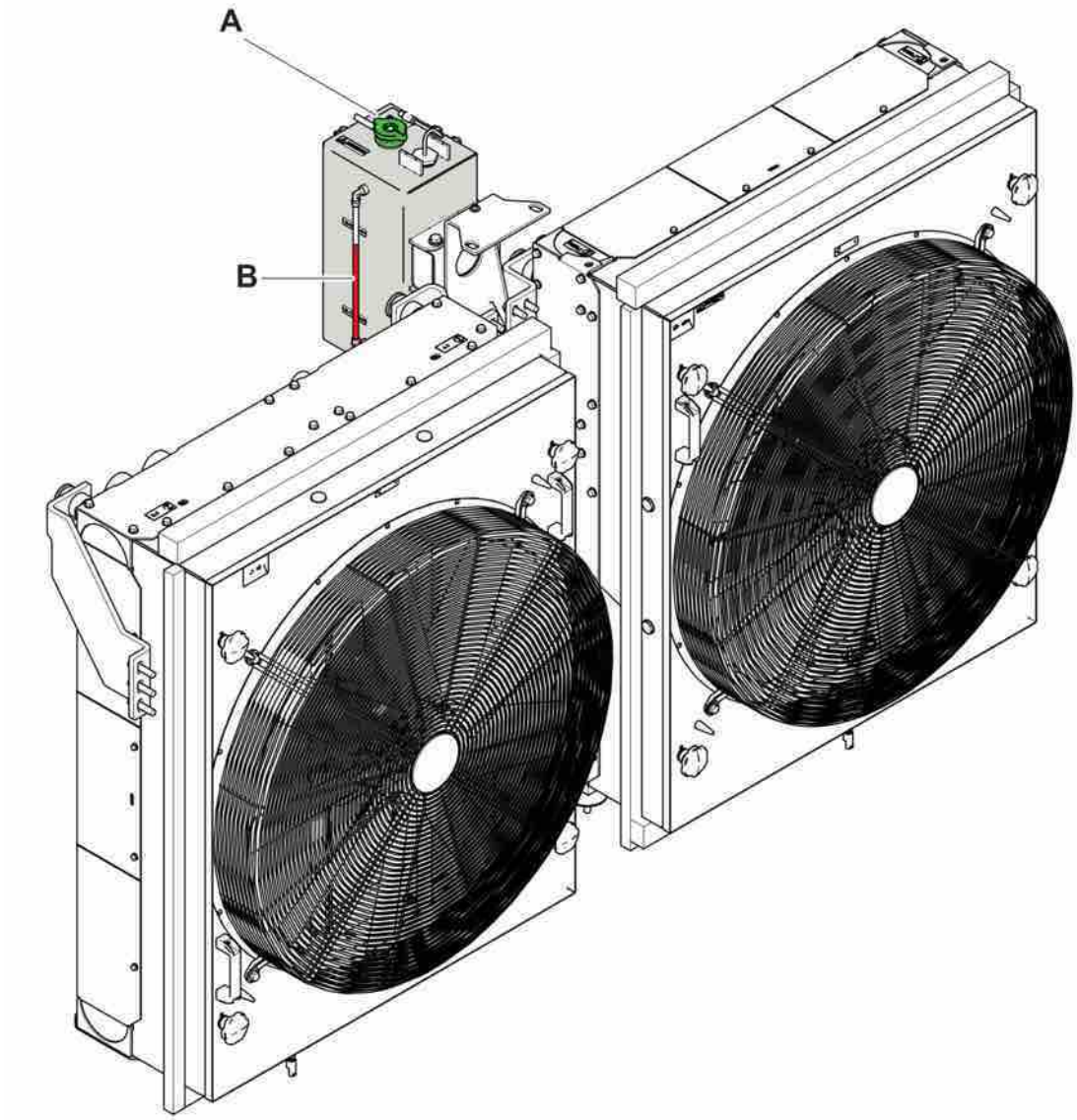
1. Check that the indicator is in the green zone.
   ➔ Replace the fire extinguisher if the indicator is within, or close to, any of the red zones.
2. Check that none of the seals are broken and that services have been performed within the prescribed time.
3. Inspect the complete fire extinguisher and holder for loose parts, defects, or damages.

6.7 Check Emergency Stops and Work Lights



- Check that each emergency stop (A) stops the engine when activated. Before checking the next emergency stop, the previous emergency stop must be reset.
- Check the functionality of the work lights, front and rear (B).

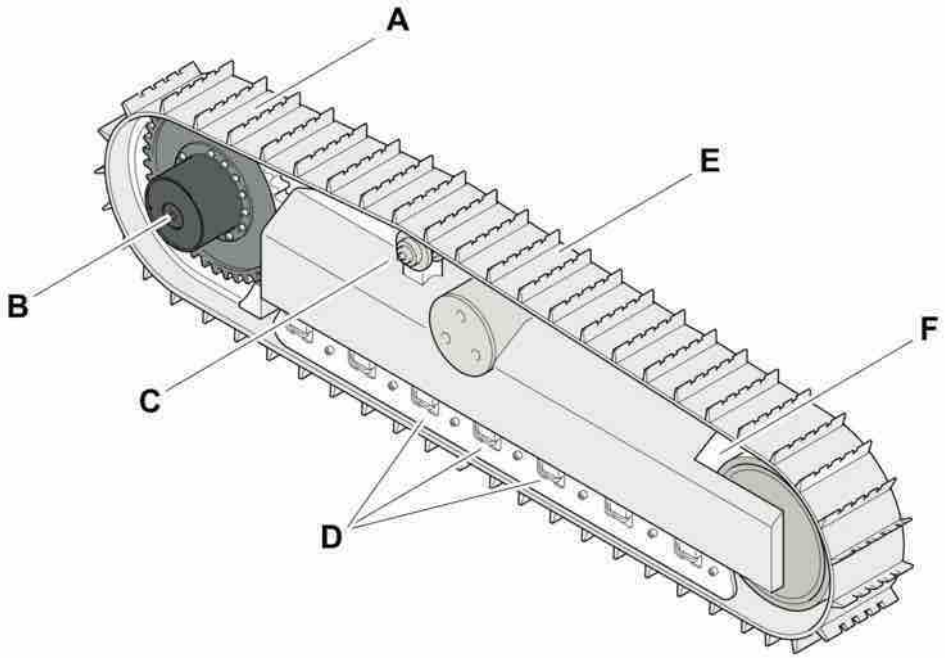
6.8 Check Coolant Level



Condition ✓ The coolant level must be checked when the diesel engine is cold.

- Check the coolant level (B).
  - ➔ The level should be between the upper and lower mark.

6.9 Check Track Frames



1. Check for signs of leakage on the traction motor (A).
2. Check for signs of leakage on the traction gears (B).
3. Check for signs of leakage on the carrier roller (C).
4. Check for signs of leakage on the track rollers (D).
5. Visually inspect the tension on the crawler tracks (E).
6. Check that the springs and dampeners move freely on the front wheel (F). Clean, if necessary.
7. Check for loose screws and nuts.

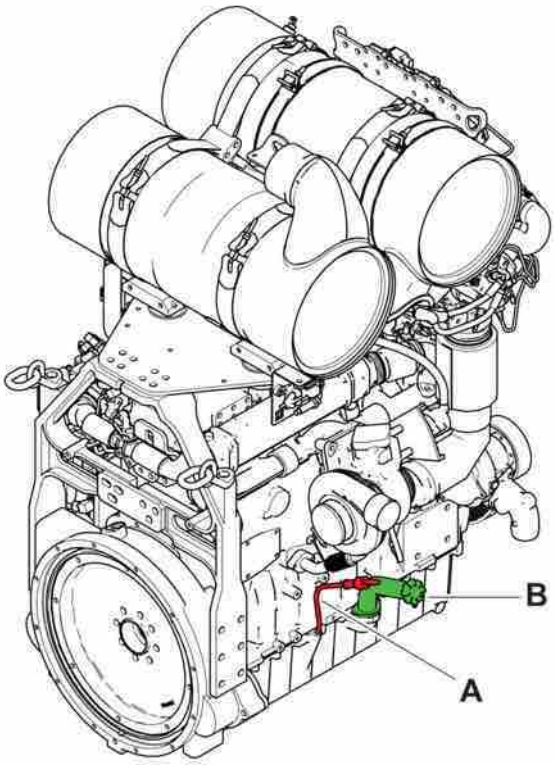
6.10 Check Motor Oil Level

WARNING

Burning Hazard

Hot components and surfaces can cause serious injury.

- Use working gloves and cover your arms with long sleeves.



Condition ✓ The diesel engine is off.

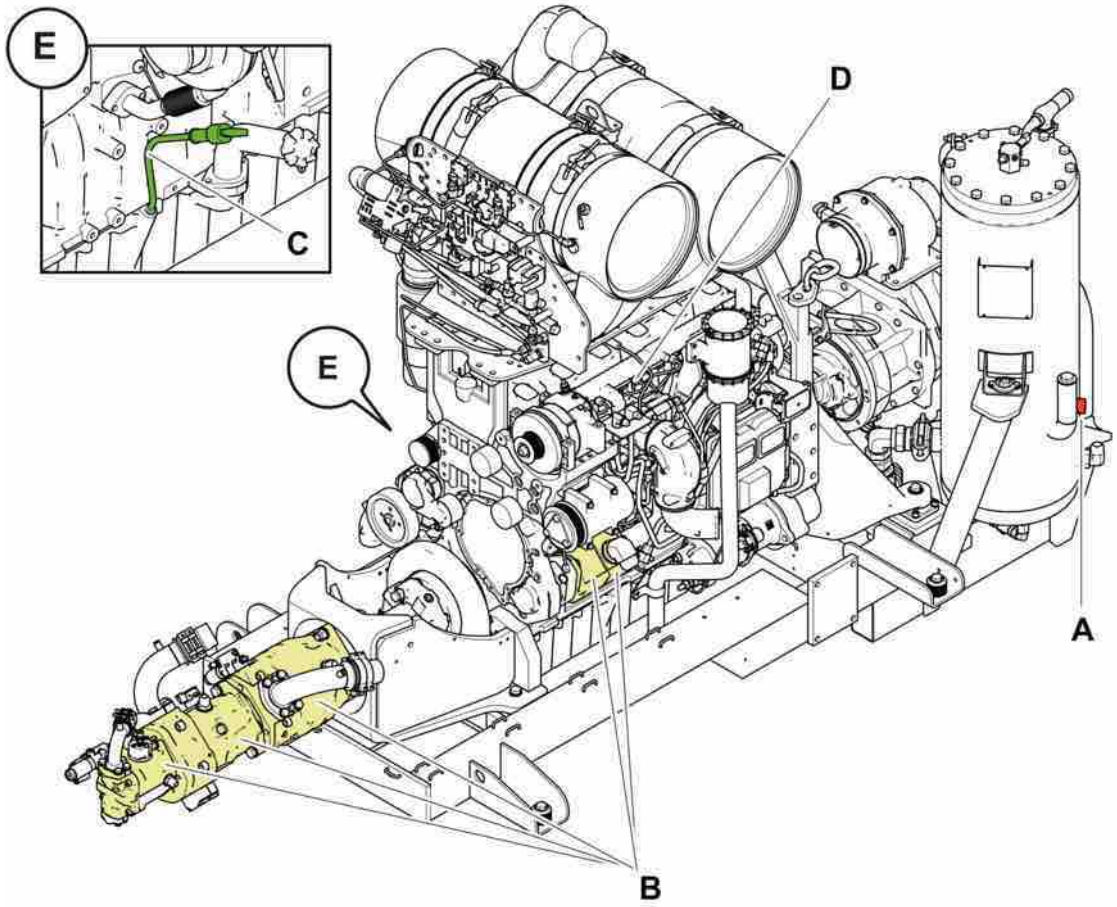
1. Check that the oil level is between the upper and lower mark on the dipstick (A).

2. Fill oil through the filler cap (B) if necessary.

See reference documentation

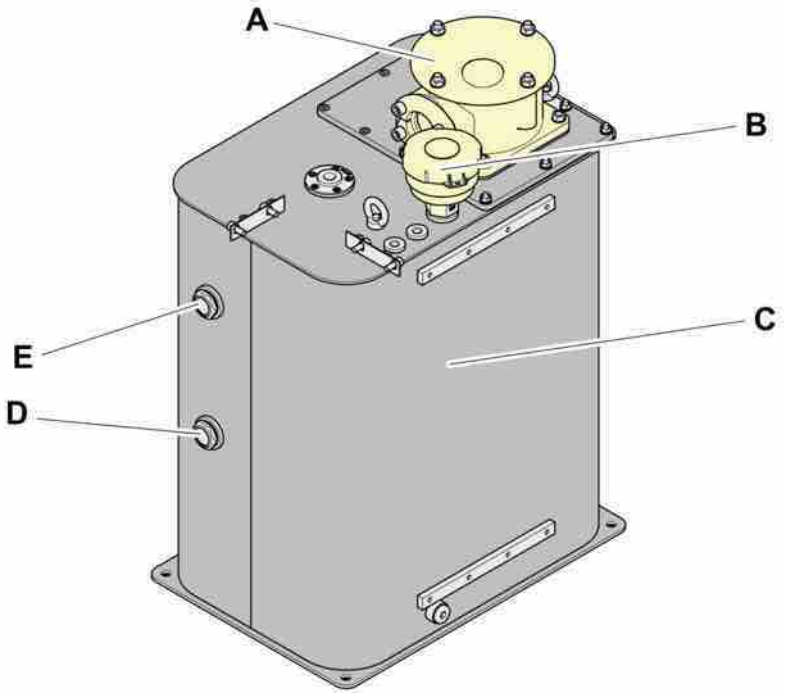
Diesel engine instruction manual

6.11 Check Diesel Engine and Compressor



- Check that the oil level indicator (A) on the compressor is in the green zone.
- Check for signs of leakage on the hydraulic pumps (B).
- Check that the diesel engine oil level is between the two marks on the dipstick (C).
- Check the diesel engine (D) for leaks.

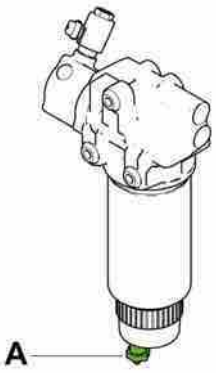
6.12 Check Hydraulic Tank



Condition ✓ The machine must be standing on a flat surface to obtain an accurate reading.
✓ The oil temperature should be 40°C (104°F).

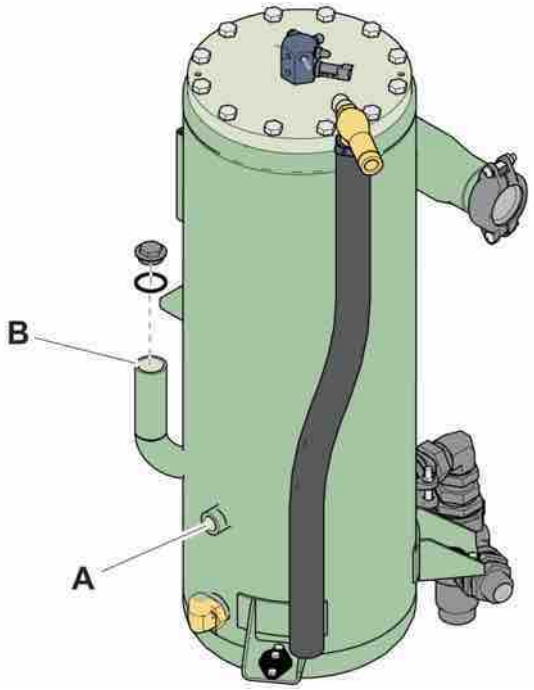
- Replace the return oil filter (A) if the warning sign is displayed.
- Check the breather filter (B).
- Check the tank (C) and connections for signs of leakage.
- Check that the oil level covers the lower sight glass (D) and half of the upper sight glass (E).

6.13 Drain Pre-Filter



- Drain water from the pre-filter by opening the drain outlet (A).

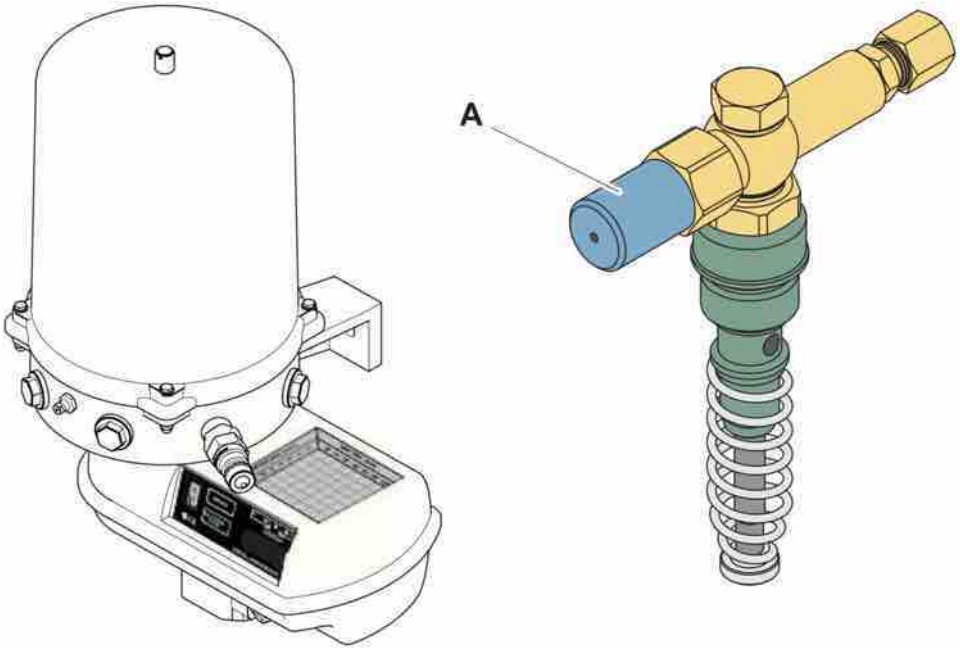
6.14 Check Compressor Oil Level



1. Make sure the machine is on level ground.
2. Switch off the machine and allow the oil level to settle for at least 5 minutes.
3. Check the compressor oil level. The indicator on the gauge (A) must be in the green zone.

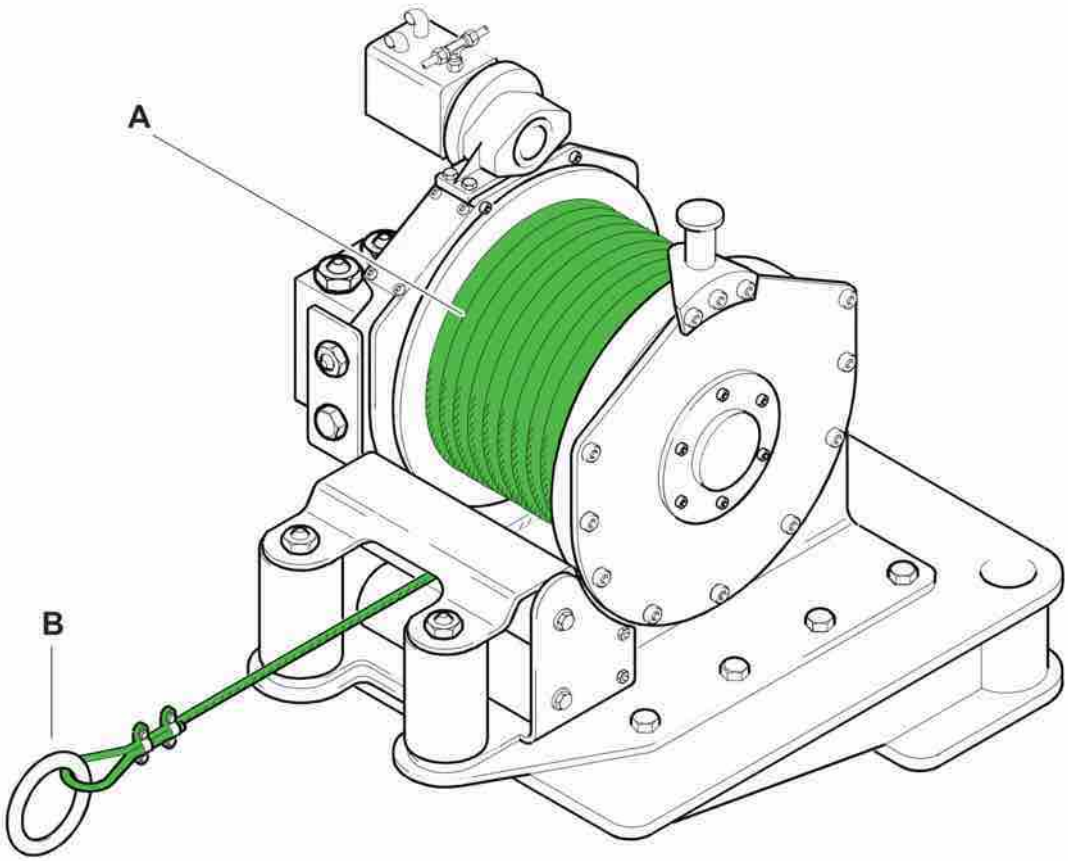
➤ Fill with oil at (B), if required. Use the correct amount and oil grade.

6.15 Check Condition of CLS Pump



- Check that there is no leakage on the safety valve (A) of the CLS pump.

6.16 Check Winch



- Check for damage, unwinding, wear, and corrosion on the winch cable (A).
- Check for damage, cracks, and wear on the hook (B) and check that it is properly mounted.

6.17 Check Small Remote Control

- Make sure none of the rubber bellows (A) on the switches/levers of the control unit are damaged

7 Technical Data

7.1 Technical Data

Weight (Standard Equipment without Drill Steel)		
SmartROC T45-11	Weight	17700 kg

Performance		
Diesel engine, Caterpillar	Power output at 1900 rpm	242 kW
Temperature range in operation		-25° to +50°C
Tramming speed, maximum		3.4 km/h
Tractive force		112 kN
Ground pressure, average		110 kPa
Ground clearance		405 mm
Maximum hydraulic pressure		280 bar
Track oscillation		±10 °

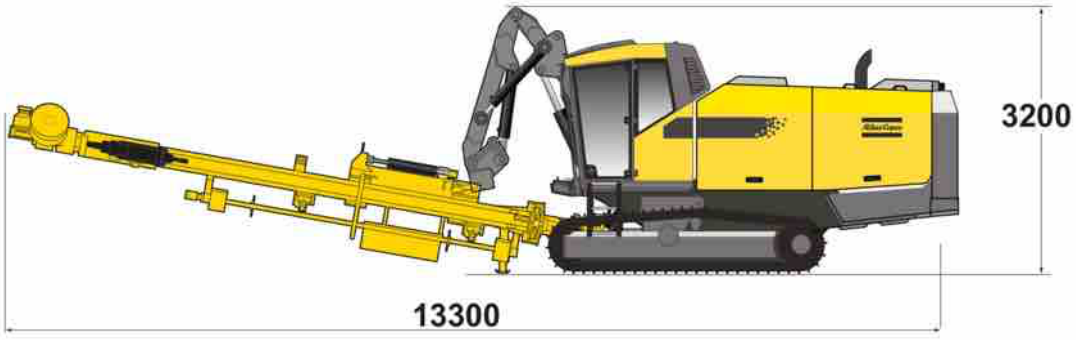
Permitted Inclination Angles on SmartROC T45-11		
Stability is specified with respect to CE standards stipulating that rigs must not be operated on inclinations steeper than 20 degrees without the use of a winch. ANGLES MUST NOT BE COMBINED!		
Maximum permitted inclination angles during tramming:	Down/Up (lengthways) without winch	20°/20°
	Down/Up (lengthways) with winch	25°/25°
	Left/Right (sideways)	20°/20°
Maximum permitted inclination angles when drilling:	Down/Up (lengthways)	13°/20º
	Left/Right (sideways) on extreme inclinations	9°/6°

Hydraulic Systems		
Hydraulic oil cooler for maximum ambient temperature		+50°C

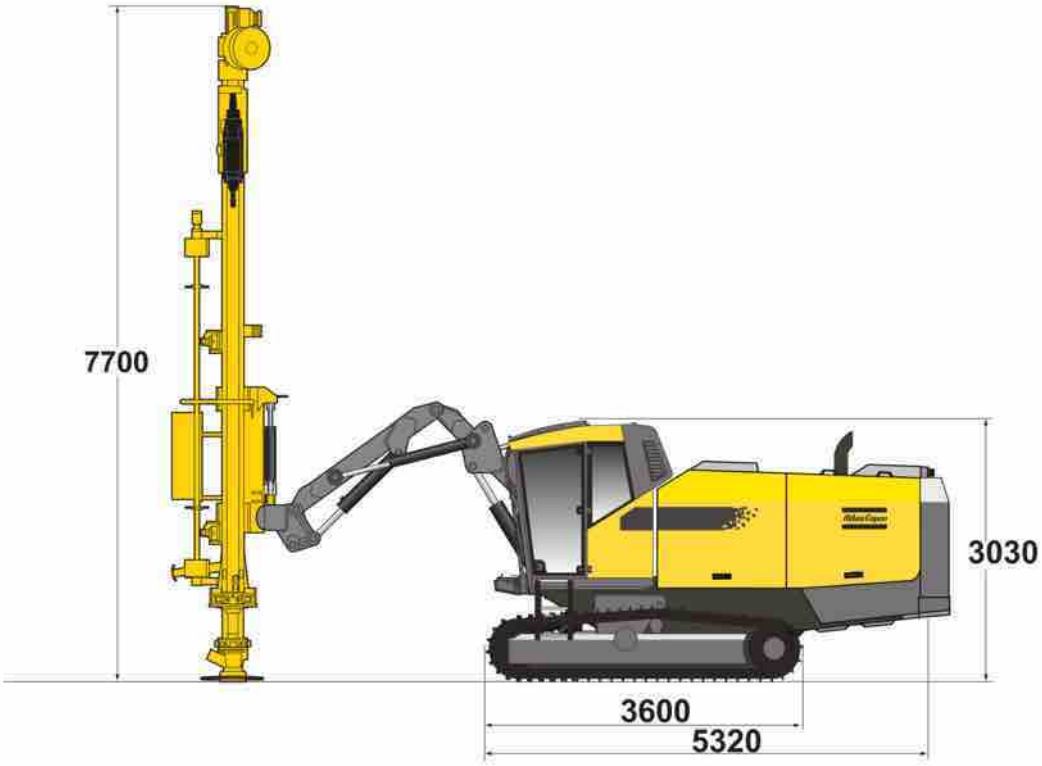
Air System		
Compressor: C146 M-07	Maximum air pressure	14 bar
	Free air delivery at 12 bar	223 l/s

Electrical System		
Voltage		24 V
Batteries	Voltage	2 * 12 V/185 Ah
Working lights	Voltage	24 V
	Luminous flux	3500 lm
Alternator	Voltage	24V/95 Ah
Capacities		
Hydraulic oil reservoir		100 l
Hydraulic systems	Total	240 l
Fuel tank		400 l
Traction gear oil		3 l
Compressor oil		52 l
Lubricating oil tank		23 l
Diesel engine oil		32 l
Engine cooling system		75 l
Air Conditioning Unit		
Red Dot	Refrigerant, type	R134 A
	Refrigerant, quantity	2.53 kg
Others		
Fire extinguisher	A-B-C powder	2 * 6 kg

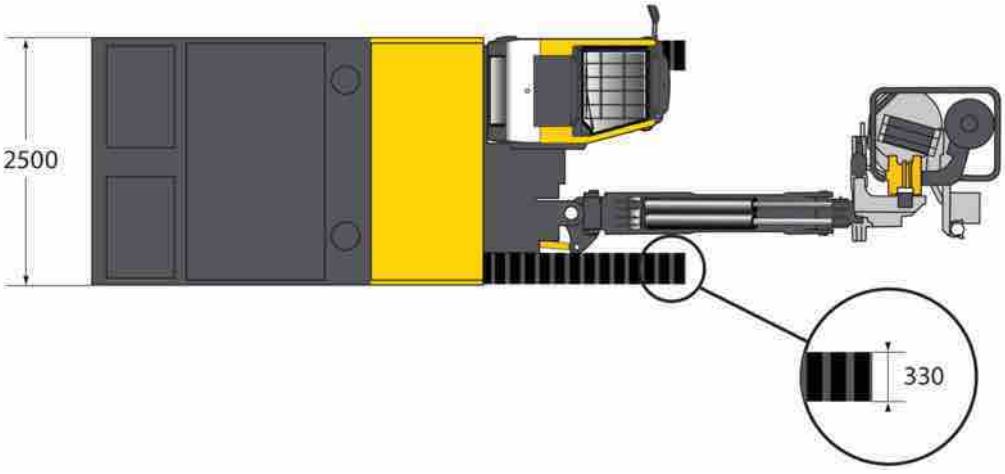
7.2 Dimensions



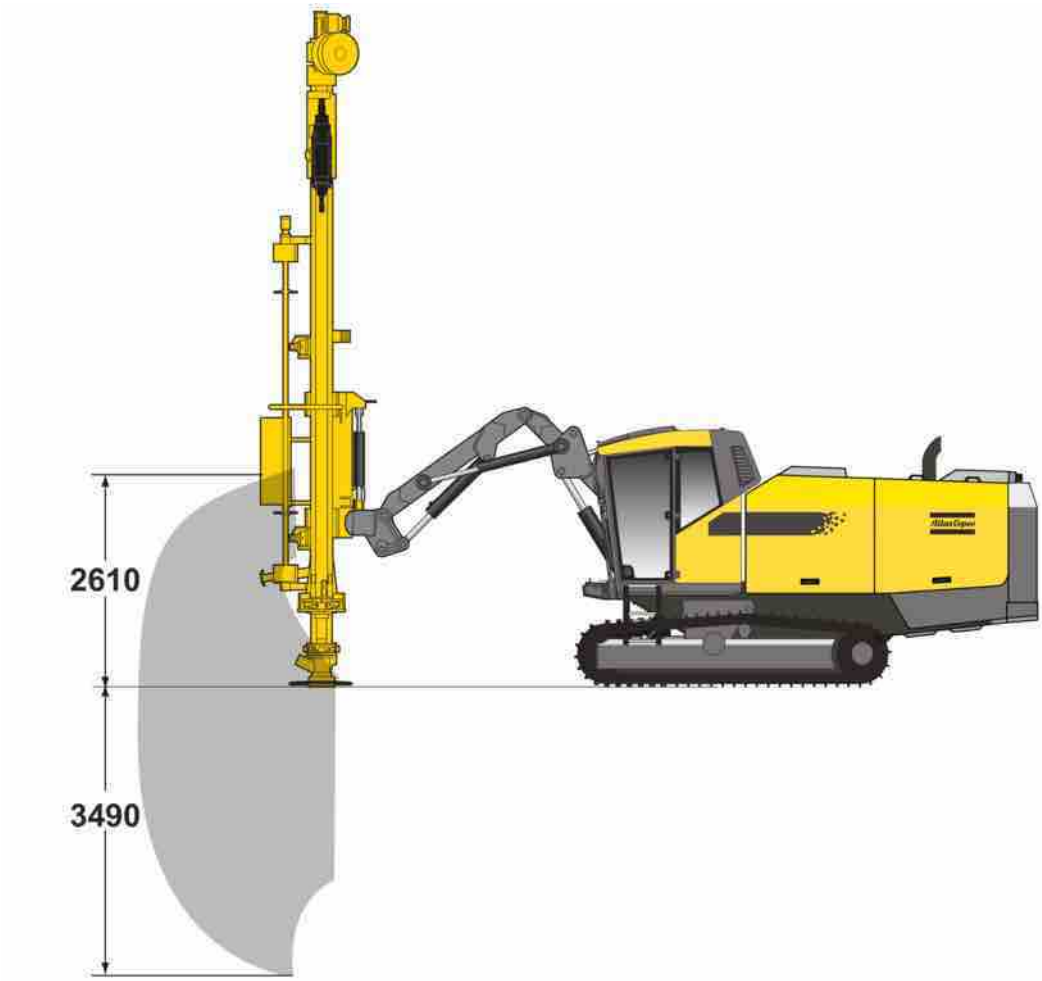
Transport Dimensions (mm)



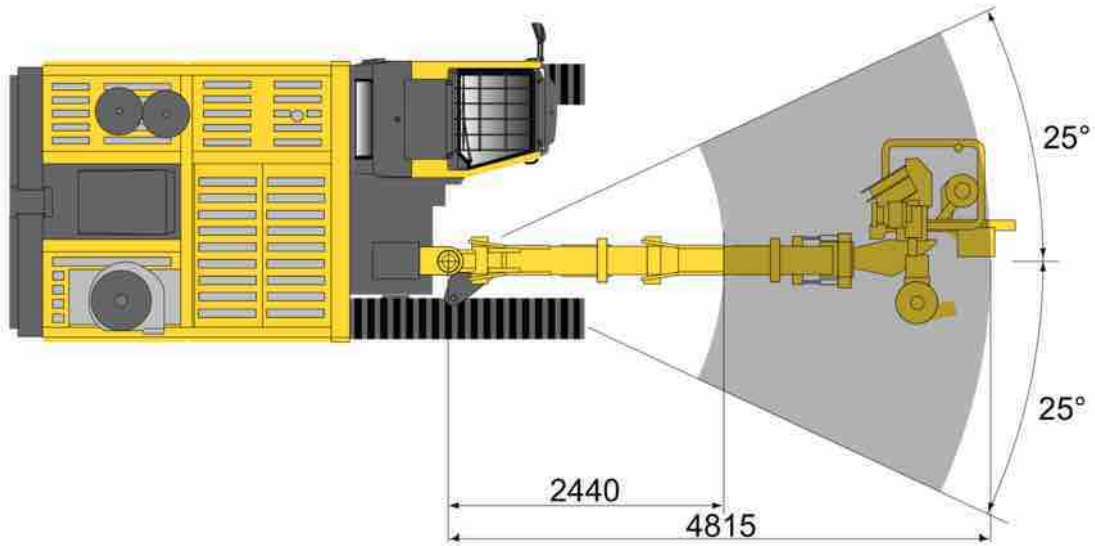
Side View (mm)



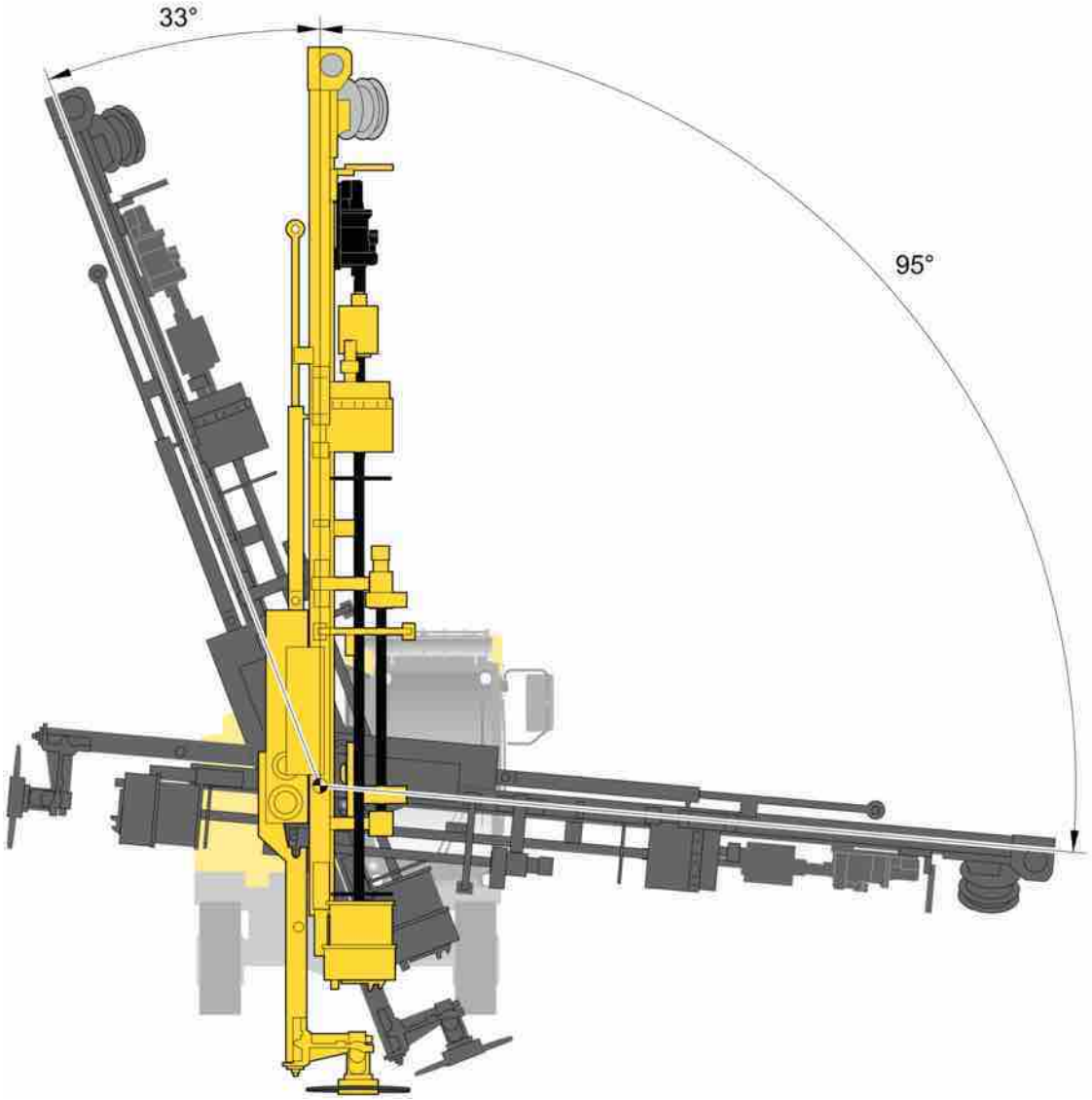
View from Above (mm)



Vertical Reach (mm)



Horizontal Reach (mm)



Feed Swing Angles

The machine is equipped to allow both vertical and horizontal drilling without reconnection of the feed beam.

7.3 Highest Permitted Inclination Angles for Tramming and Drill Rig Setup

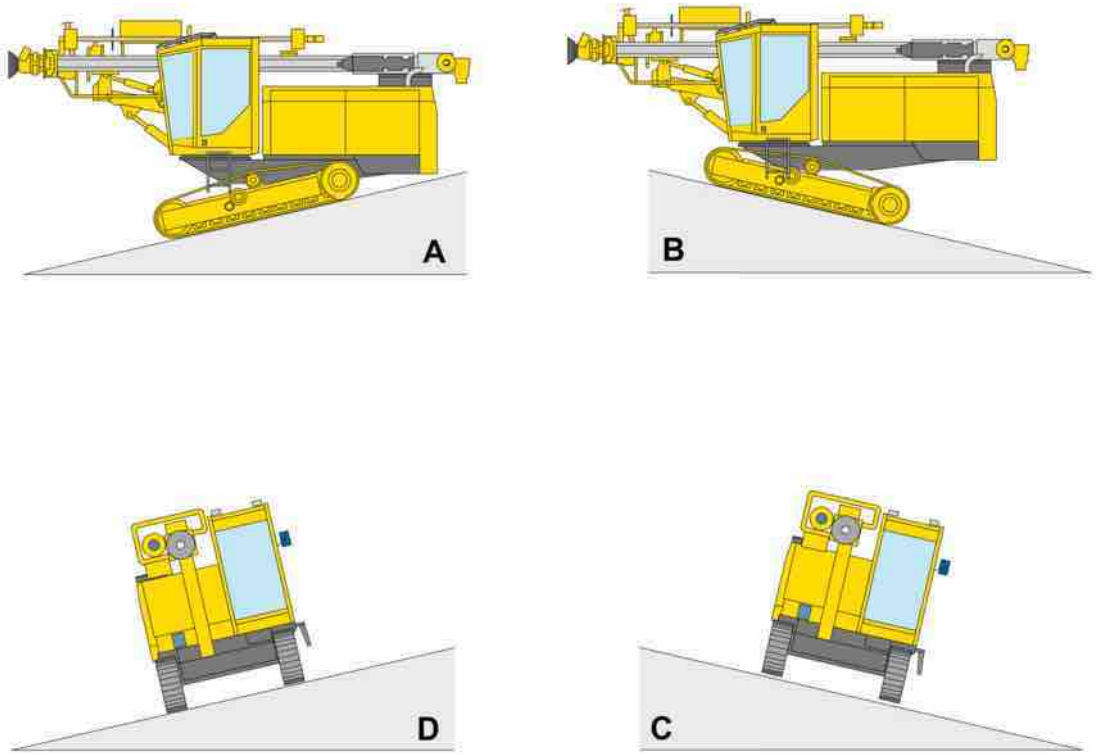
WARNING

Tipping Risk

The tipping over of a machine can cause serious injury or death.

- Never exceed the maximum allowed inclination angles for the machine.
- Never combine inclination angles.

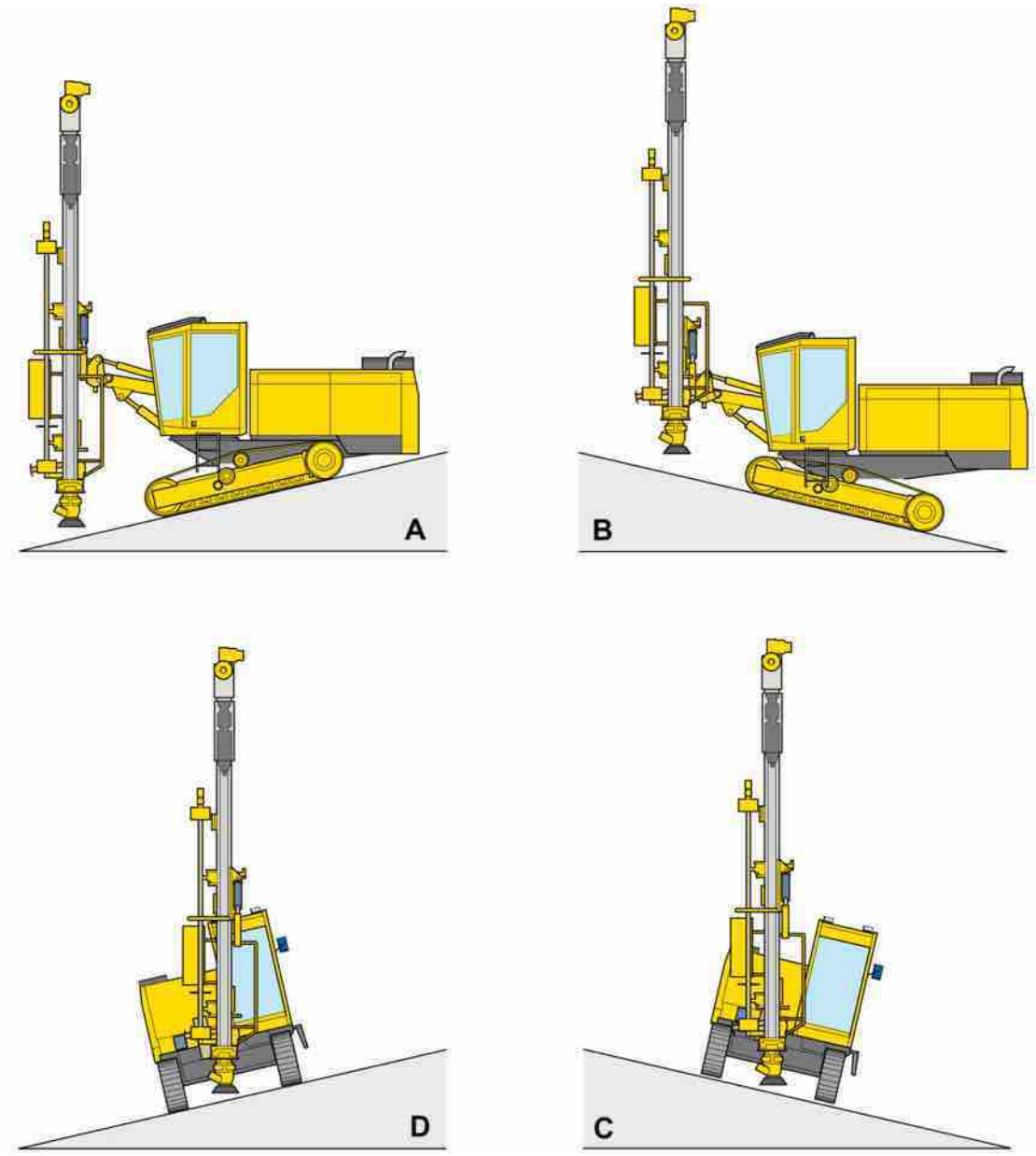
7.3.1 Ordinary Tramming



Tramming

	Direction	Maximum Angle of Inclination (°)
A	Forward	20
B	Reverse	20
C	Left	20
D	Right	20

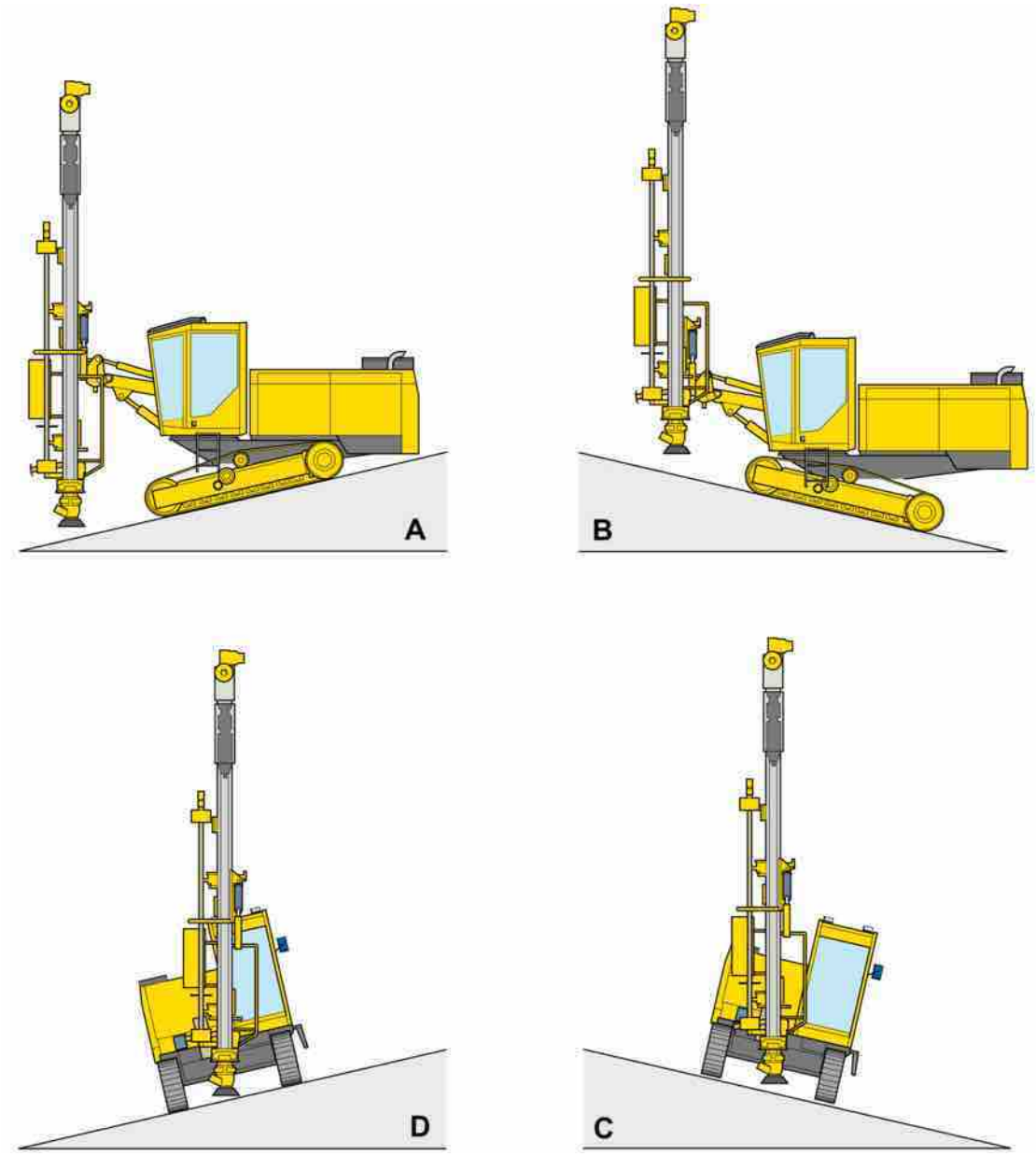
7.3.2 Tramming with the Feed in Vertical Position and Centered Between the Track Frames



Tramming with the Feed in Vertical Position and Centered Between the Track Frames

	Direction	Maximum Angle of Inclination (°)
A	Forward	9
B	Reverse	20
C	Left	20
D	Right	20

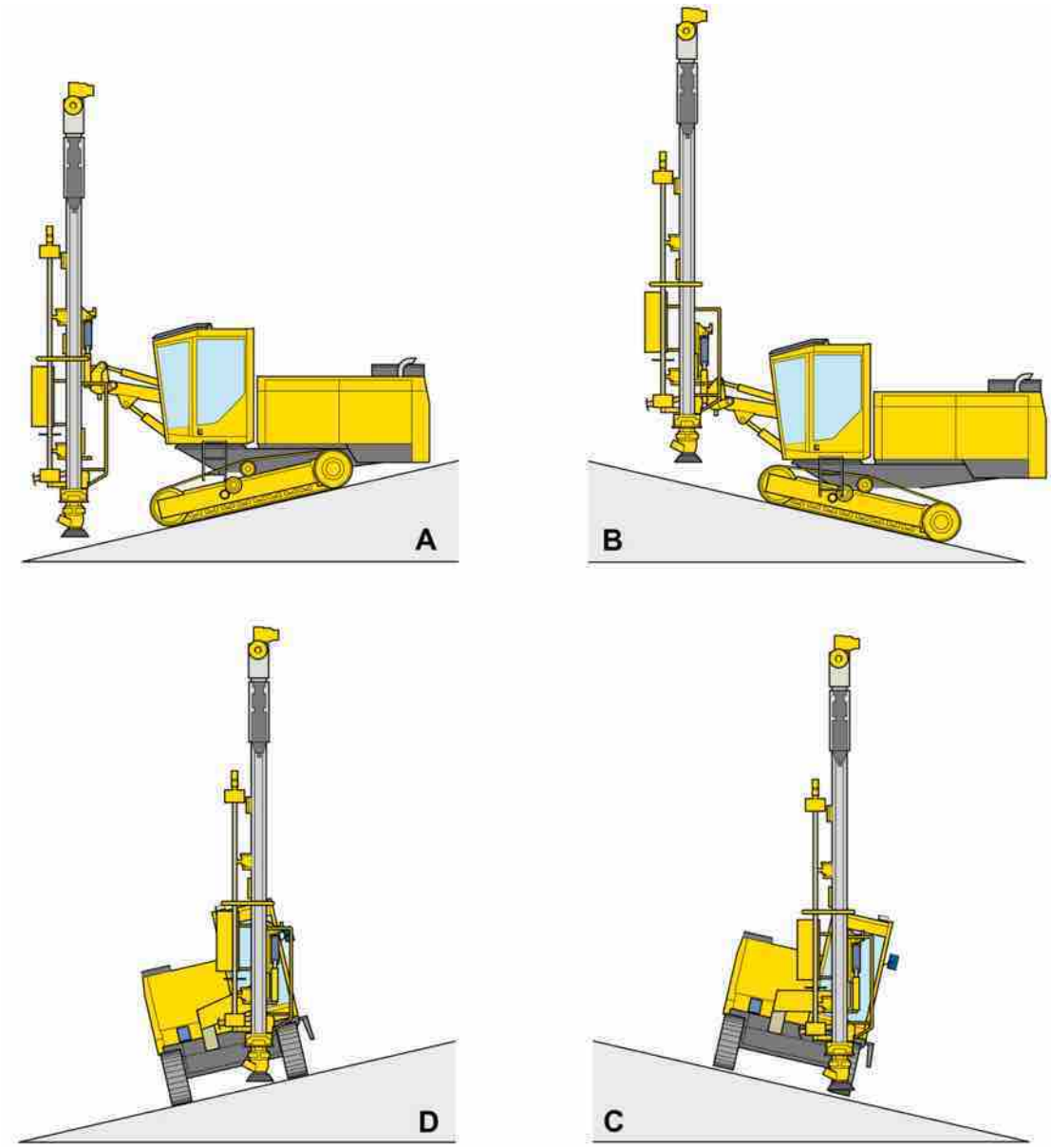
7.3.3 Drill Rig Setup: the Feed in Vertical Position and Centered Between the Track Frames



Drill Rig Setup: the Feed in Vertical Position and Centered Between the Track Frames

	Direction	Maximum Angle of Inclination (°)
A	Forward	14
B	Reverse	20
C	Left	20
D	Right	20

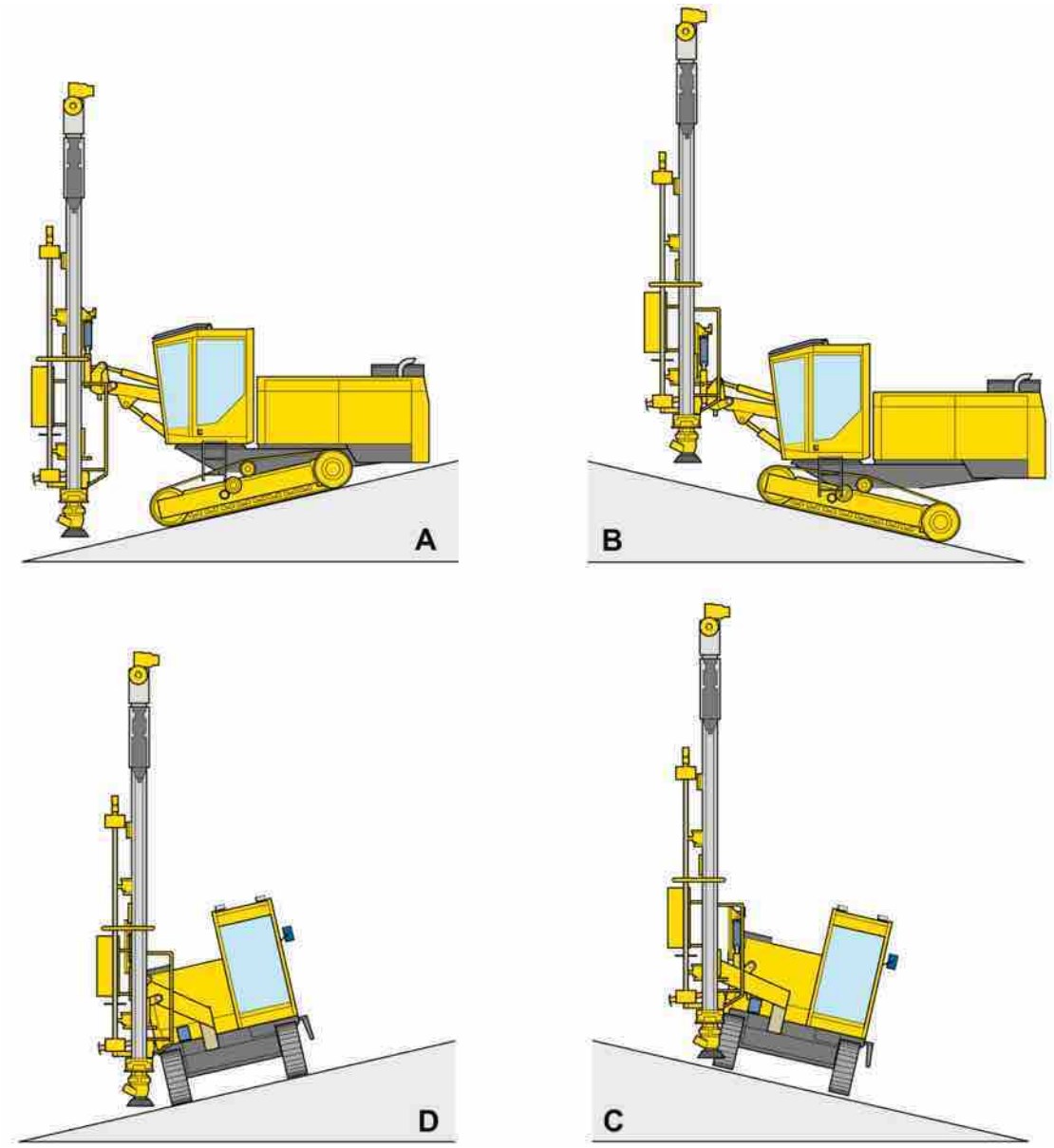
7.3.4 Drill Rig Setup: the Feed in Vertical Position and the Boom Swung Maximum to the Left



Drill Rig Setup: the Feed in Vertical Position and the Boom Swung Maximum to the Left

	Direction	Maximum Angle of Inclination (°)
A	Forward	18
B	Reverse	20
C	Left	20
D	Right	20

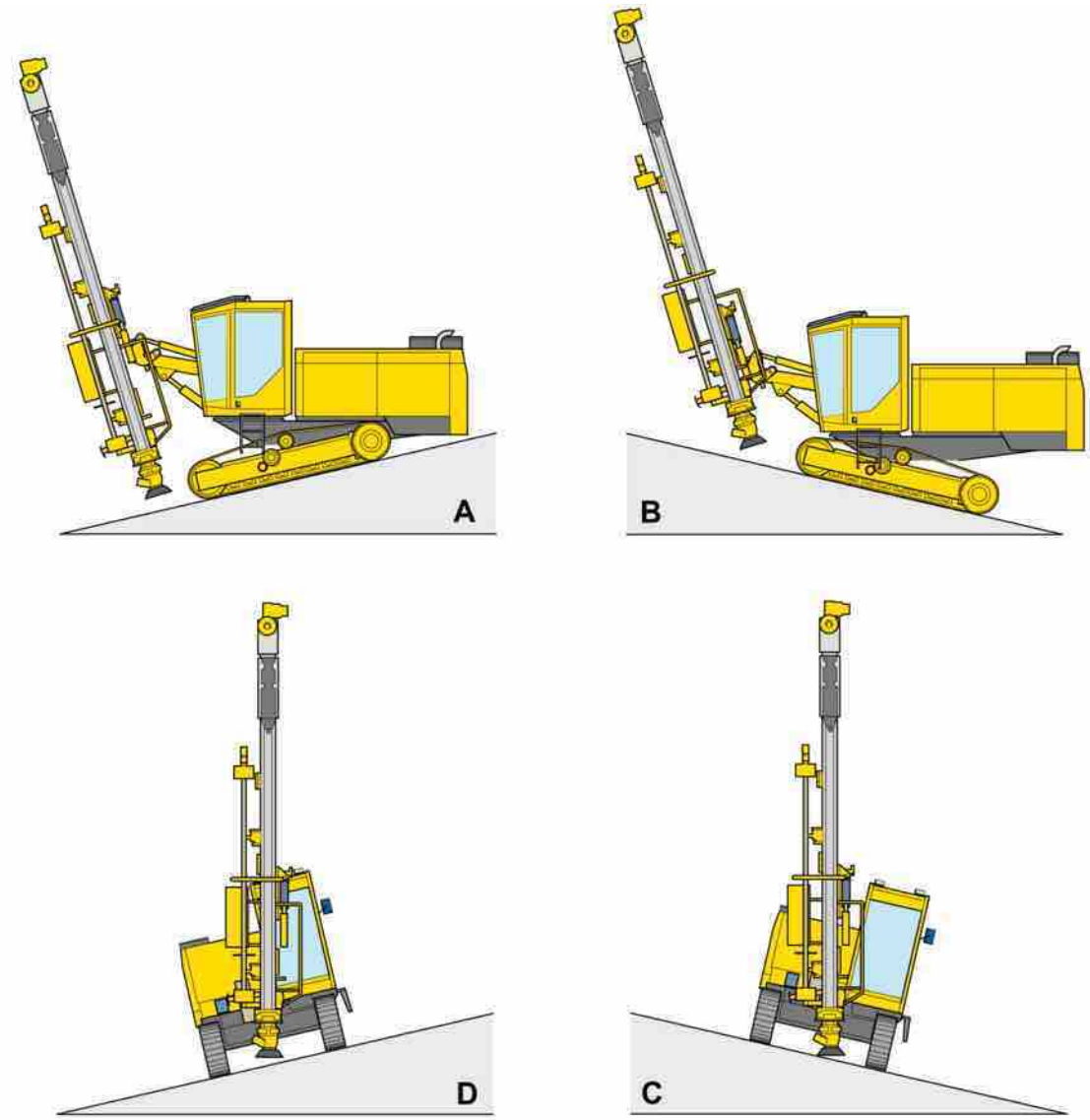
7.3.5 Drill Rig Setup: the Feed in Vertical Position and the Boom Swung Maximum to the Right



Drill Rig Setup: the Feed in Vertical Position and the Boom Swung Maximum to the Right

	Direction	Maximum Angle of Inclination (°)
A	Forward	17
B	Reverse	20
C	Left	20
D	Right	12

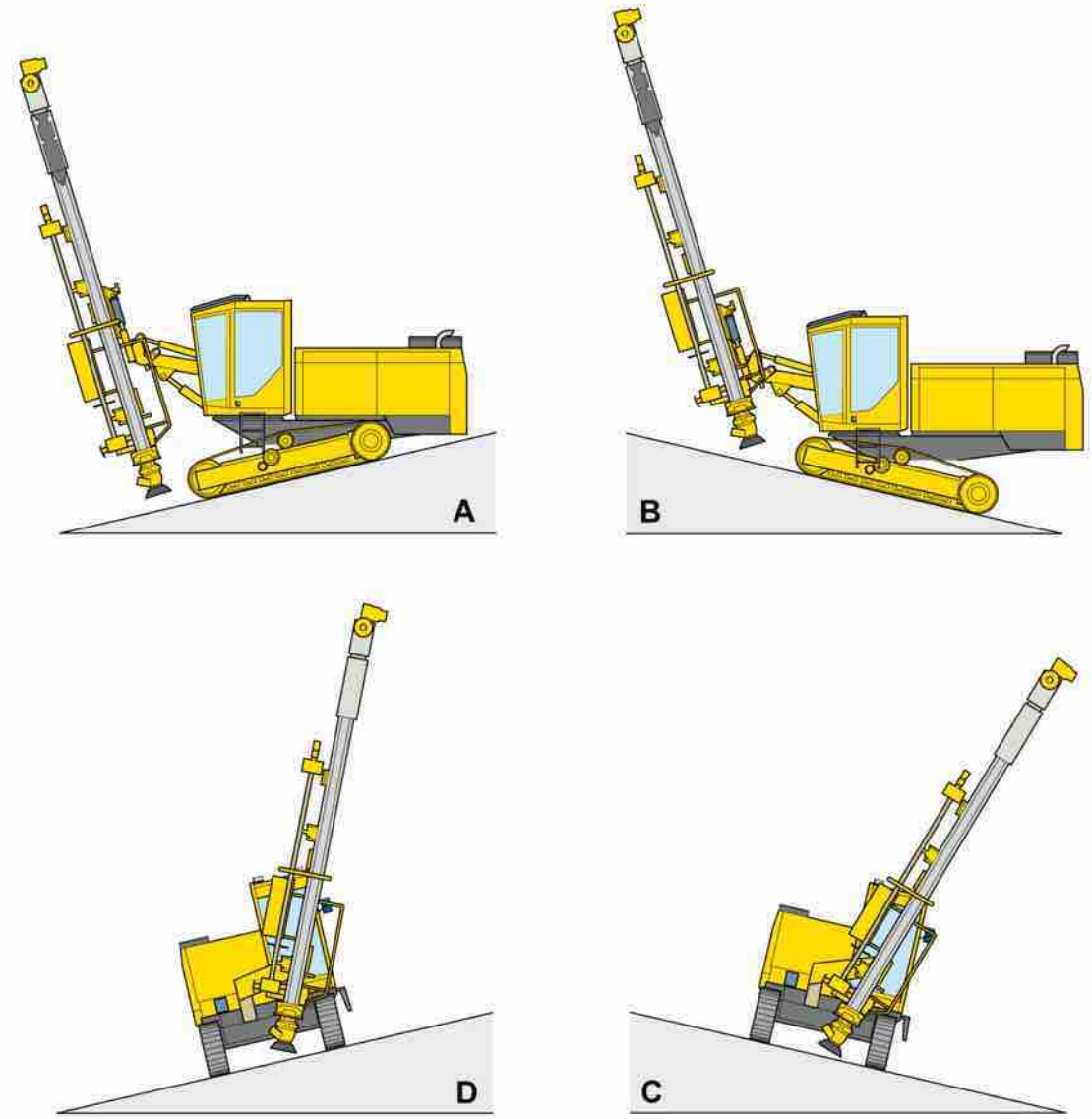
7.3.6 Drill Rig Setup: the Feed Top in Extreme Position Forward, the Feed Laterally Vertical and Centered Between the Track Frames



Drill Rig Setup: the Feed Top in Extreme Position Forward, the Feeder Laterally Vertical and Centered Between the Track Frames

	Direction	Maximum Angle of Inclination (°)
A	Forward	12
B	Reverse	20
C	Left	20
D	Right	20

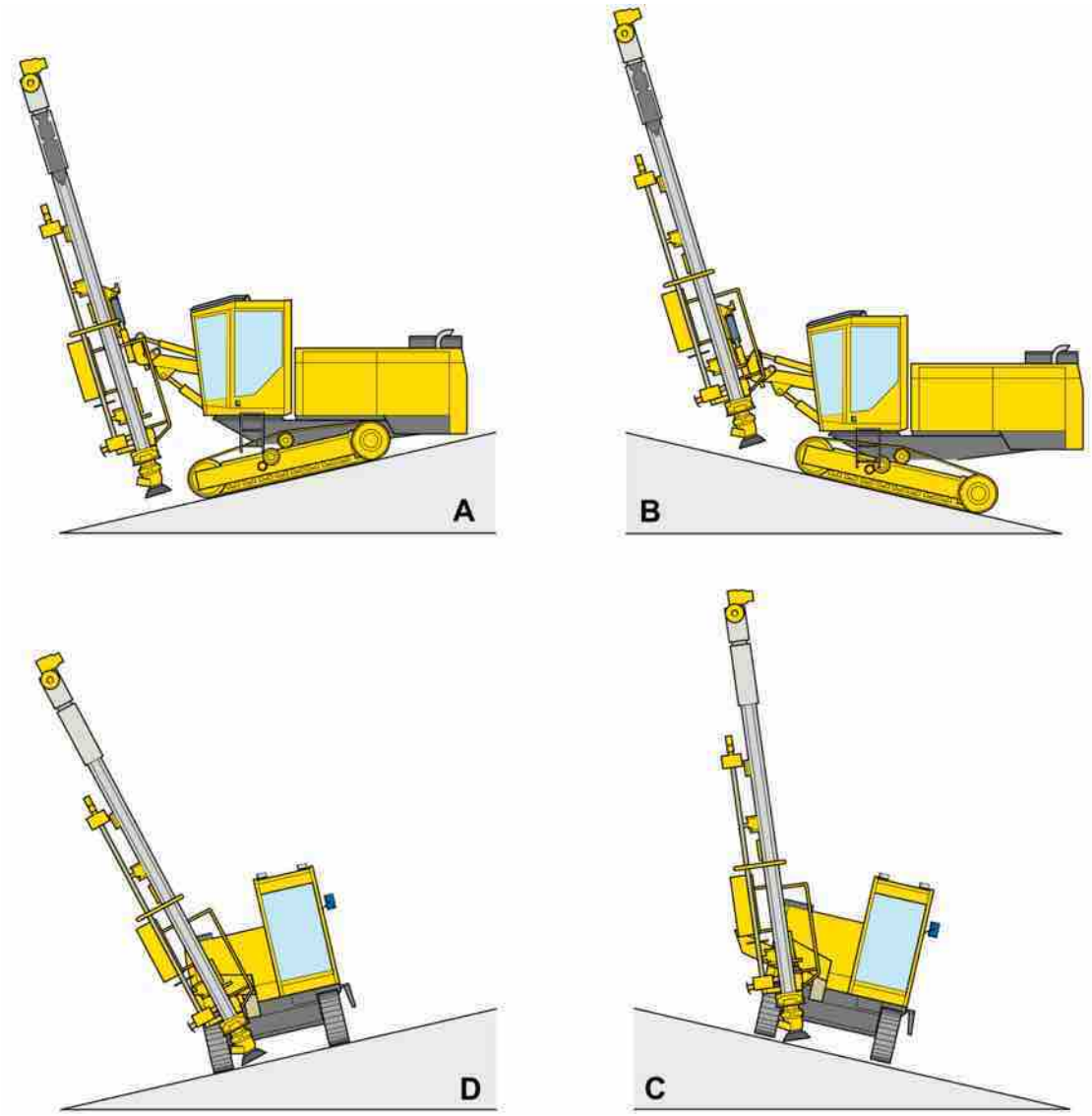
7.3.7 Drill Rig Setup: the Feed Top in Extreme Position Forward and to the Left, and with the Boom Swung Maximum to the Left



Drill Rig Setup: the Feed Top in Extreme Position Forward and to the Left, and with the Boom Swung Maximum to the Left

	Direction	Maximum Angle of Inclination (°)
A	Forward	18
B	Reverse	20
C	Left	9
D	Right	20

7.3.8 Drill Rig Setup: the Feed Top in Extreme Position Forward and to the Right, and with the Boom Swung Maximum to the Right



Drill Rig Setup: the Feed Top in Extreme Position Forward and to the Right, and with the Boom Swung Maximum to the Right

	Direction	Maximum Angle of Inclination (°)
A	Forward	18
B	Reverse	20
C	Left	20
D	Right	6