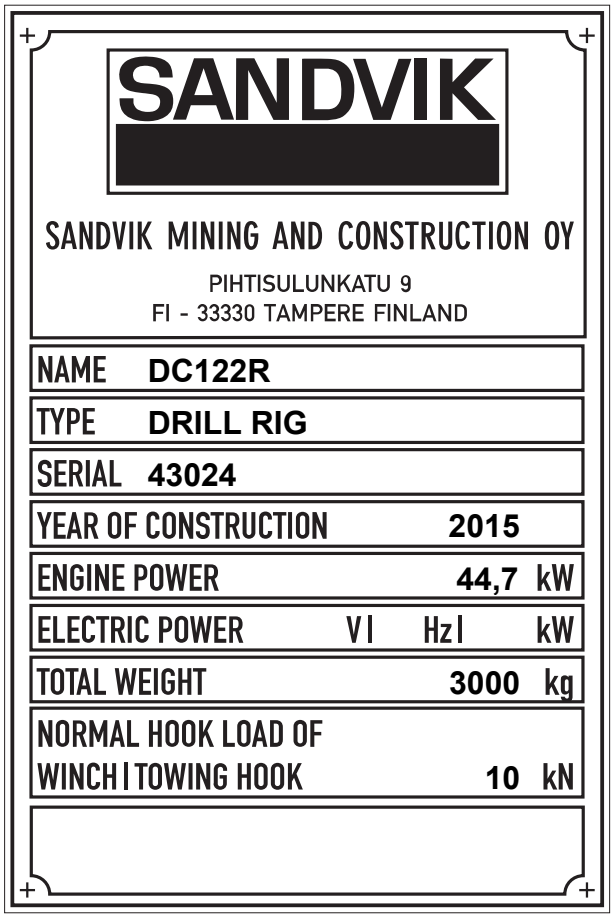
Original instructions

431 7 en 2011-06-03

DC122R

Operator's Manual

SANDVIK


SANDVIK
SANDVIK MINING AND CONSTRUCTION OY
PIHTISULUNKATU 9
FI - 33330 TAMPERE FINLAND
NAME DC122R
TYPE DRILL RIG
SERIAL 43024
YEAR OF CONSTRUCTION 2015
ENGINE POWER 44,7 kW
ELECTRIC POWER V Hz kW
TOTAL WEIGHT 3000 kg
NORMAL HOOK LOAD OF
WINCH TOWING HOOK 10 kN

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1. INTRODUCTION

1. INTRODUCTION

1.1. General

Preface

Thank you for choosing a product manufactured by Sandvik Mining and Construction Oy.

This manual describes the use of the product. Only people with the proper training are allowed to operate this product. In addition, the operator must read and understand the contents of the operation and maintenance manuals and the safety instructions.

The manual gives you information on the structure and operation of the product that is necessary for correct use and maintenance. It also instructs you in shift-specific service work. Regular maintenance procedures are explained in the maintenance instructions.

For more complicated maintenance and repair work, we recommend that you contact the nearest authorized service center. Our maintenance personnel have the skill and special tools needed for more demanding work.

Through correct use and by following the maintenance instructions, you can expect a high degree of utilization and a long service life for your product.

Storage

The manual is part of the product, and it must be kept throughout the life of the product. Attach any further changes to the manual. Keep the manual clean and readily accessible whenever needed. If the product is sold, the new owner must be provided with the manual.

Product information

The information in this manual corresponds to the model and appearance of the product at the time of delivery. Sandvik Mining and Construction Oy reserves the right to change the technical data and equipment without prior notice. All information included in the manual is valid at the time of publication.

Copyright

Manual contents

The operator's manual contains the following information:

- General information about the purpose and content of the operator's manual, instructions for reading the manual, and a request for feedback and correction of any inaccuracies.
- Information related to safety
- Daily checks
- Product’s operating instructions.

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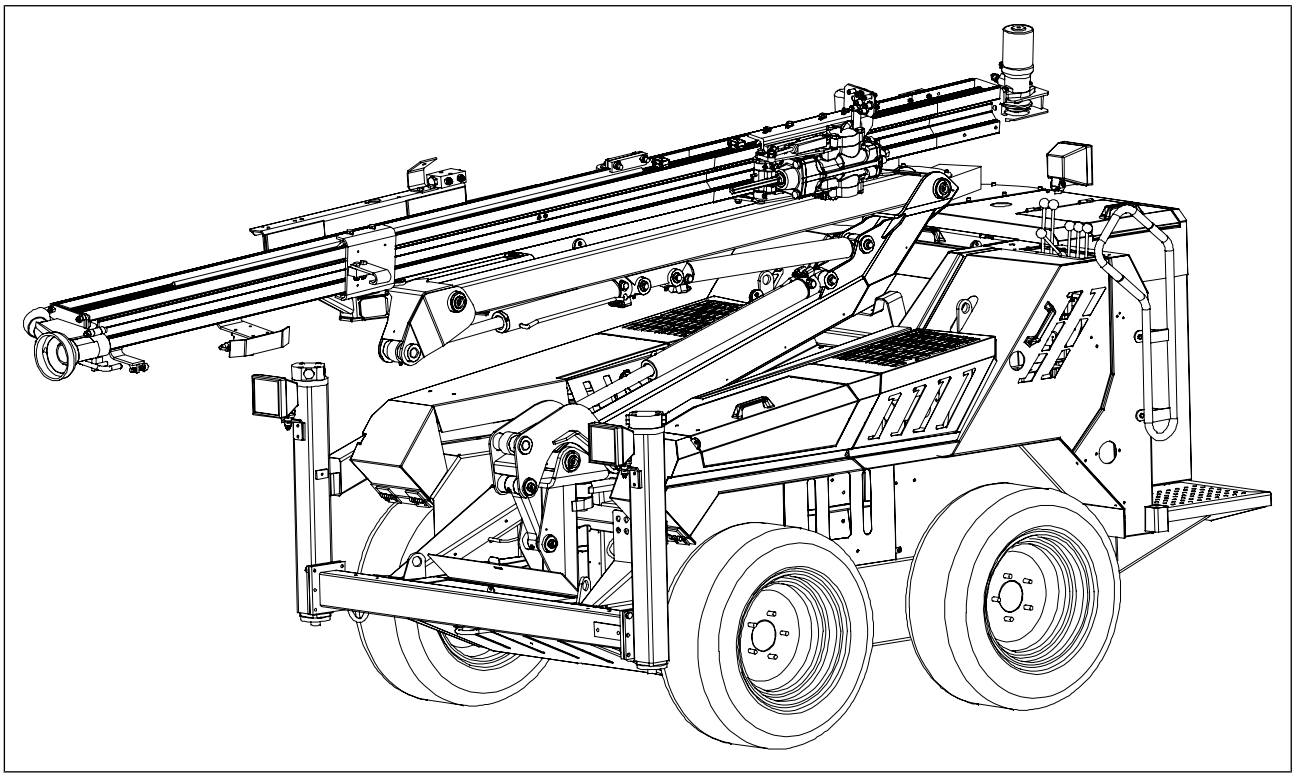
1.2. Intended use

The Rig is intended for 19 or 22 mm (3/4” or 7/8”) integral rod drilling. It is especially suited for drilling operations at foundation constructions sites and road construction sites, canal drilling, line drilling in stone quarries, and other special drilling tasks.

1.3. Recommended operating conditions

- Ambient temperature . . . . . –25 ºC ... +50 ºC
- Maximum allowed height from sea level . max. 3,000 m
- In special cases, please contact Sandvik’s engineering department.



1.4. Warning and information symbols used in this manual

The warnings in this manual have been divided into the following three categories.

DANGER The term "DANGER" Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING The term “WARNING” Indicates a hazardous situation which, if not avoided, could result in death or injury.

NOTICE The term "NOTICE" Indicates a situation which, if not avoided, could result in damage to property.

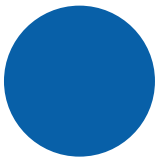
1.4.1. Safety Symbols

The safety symbols found in this manual may also be posted on the machine. All personnel who operate, repair, or service the machine MUST be familiar with and observe all safety symbols, labels, and instructions!

- Keep safety instructions and safety labels clean and visible at all times.
- Replace any illegible or missing safety instructions and safety labels before operating the machine.

Hazard
The black symbol inside a yellow triangle with a black border describes the hazard.

Prohibition
The black symbol inside a red ring with a diagonal red bar describes the action that should not be taken.



Mandatory action
The white symbol inside a blue circle describes the action that must be taken to avoid a hazardous situation.

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Hazard symbols

These symbols are used in warnings to indicate a hazardous situation or action.
Hazard symbols are divided into six categories according to their nature:

- Mechanical hazards
- Electrical hazards
- Noise hazards
- Radiation hazards
- Material/substance hazards
- Ergonomic hazards
- General hazard

The hazard symbols related to each hazardous situation are presented below.

Mechanical Hazard Symbols


Falling load hazard


Squashing hazard


Flying material hazard


Crushing hazard - feet


Crushing hazard - hands


Cutting hazard


Entanglement hazard


Entanglement hazard


Entanglement hazard

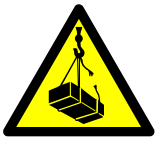

Entanglement hazard - rotating drill


Falling hazard


Trip hazard


Skin injection hazard


High pressure injection hazard


Hanging load hazard


Run over hazard


Slipping hazard


Sideways tipping hazard


Forward/backward tipping hazard


Sideways tipping hazard


Forward/backward tipping hazard

Electrical Hazard Symbols


Electrical hazard


Dangerous electrical voltage


Electrical shock/ Electrocution hazard

Noise Hazard Symbols


Noise hazard

Radiation Hazard Symbols


Radioactive hazard


Laser hazard

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Material / Substance Hazard Symbols


Hot surface hazard


Explosion hazard


Flammable hazard


Hazardous/poisonous material hazard


Chemical burn hazard


Silica/dust hazard


Hot coolant splashing hazard


Environment pollution hazard

Ergonomic Hazard Symbols

Lifting hazard

General Hazard Symbol


General hazard

Prohibited action symbols

These symbols are used in warnings and notifications to indicate a the action that should not be taken. The prohibition symbols are presented in the following table.

No climbing

No smoking

No open flames

Do not touch

Limit or restrict access

Do not weld

Do not remove safety guard

Do not modify

General symbol for prohibited action

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Mandatory action symbols

These symbols are used in warnings and notifications to indicate the action that must be taken to avoid a hazardous situation.
The mandatory action symbols are presented in the following table.


Wear safety gloves


Wear eye protection


Wear safety helmet


Wear safety harness

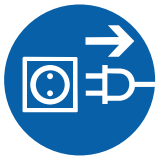

Wear ear protection


Wear steel toed safety boots


Wear close fitting overalls


Wear high visibility vest


Wear respirator


Disconnect from power source


Switch off and lockout equipment


Read the manual or instructions


Use cardboard for locating leaks in hoses


Use lap belt


General symbol for mandatory action

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2. SAFETY

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2. SAFETY

2.1. Main safety risks related to the use and maintenance of the rig

Make sure that there are no unauthorised persons in the working area when drilling or tramming.

WARNING! PERSONAL INJURY HAZARD! Hazardous moving parts and dangerous rig movements (boom, feed, rock drill, hatches, and gratings) could result in death or severe injury. Make sure there are no unauthorized persons in the danger areas during drilling, tramming, setting up or servicing the rig.

Dangerous rig movements. Keep an eye on the movements of the drilling rig when working close to the rig. Watch out in particular for the rotating drill rod.

WARNING! PERSONAL INJURY HAZARD! Hazardous boom movement could result in death or severe injury. Do not go beneath the boom(s) unless absolutely necessary. Stay out of the danger areas during drilling, tramming or setting up the rig. Support the boom before servicing the hydraulic system.

WARNING! MACHINE TIPPING HAZARD! Insufficient machine stability can cause unexpected machine movement which could result in death or severe injury. Never exceed the specified maximum inclination angles when parking or operating the machine.

Slipping, tripping and falling hazard. To avoid death or serious injury, keep the stairs, steps, handrails, handles, and working platforms clean of oil, dirt, and ice.

Danger of venting compressed air. Compressed air jets can cause serious injury. Allow the pressure to be released before opening the filling cap or the compressed air connector.

HIGH PRESSURE INJECTION HAZARD! Compressed air jets can cause serious injury. Allow the pressure to be released from the hydraulic circuit before opening the plugs or connectors.

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2.2. General operation and maintenance safety instructions

⚠ DANGER	
	**EXPLOSION HAZARD!** **Can cause death or serious injury.** **Charging the drill plan, even partially, is strictly forbidden during drilling!**

⚠ WARNING	
	**PERSONAL INJURY HAZARD!** **Operating or servicing the machine in a dangerous or incorrect manner or without adequate safety procedures can result in serious injury or death.** **Operating, service and adjustment procedures must be carried out only by personnel with specialized operation and service training. Read and ensure that you understand the operating, maintenance, and safety instructions before using or servicing the rig. Carefully plan your work beforehand to minimize risk of damage or injury.**

WARNING! PERSONAL INJURY HAZARD!

Gases generated during blasting include large amounts of noxious gases, which are hazardous to health, such as nitrogen dioxide and carbon monoxide. In areas where the ore contains sulphur, sulphur dioxide and other sulphur compounds are also formed.

Always make sure that the area is thoroughly ventilated after blasting.

WARNING! PERSONAL INJURY HAZARD!

Danger of death or severe injury.

Always follow all traffic regulations for the work site where tramming of this rig is concerned. Immediately notify the person responsible of all faults and defects.

WARNING! PERSONAL INJURY HAZARD!

Neglect of use the personal safety equipment can cause death or serious injury.

The operator must always wear the required safety equipment, such as a safety helmet, protective overalls, protective footwear, hearing protectors, eye protectors, etc.

FIRE HAZARD!

Danger of death or severe injury.

All heat insulation material must always be reinstalled after maintenance. The temperature in the engine compartment may not exceed 300 °C. The temperature may be higher than 300 °C, if there is no heat insulation in the rig.

PROPERTY DAMAGE RISK!

Do not use the zoom cylinder when the feed is in contact with the ground or rock.

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It is recommended to keep a record of the use of maintenance and wear parts. This way, the need for preventive maintenance can be predicted more easily, resulting in the rig's improved usability, service life, efficiency and safety.

Failure to take necessary precautions increases the safety risk for the service personnel. All maintenance personnel working with the rig must be fully aware of possible hazards and must apply safe working methods. Before any maintenance or repair work, the manufacturer's instructions must be read carefully, and they must be followed exactly.

The person responsible for maintenance and repair work must be clearly specified.

Pay attention to the following:

- Never attempt to carry out tasks for which you have not received the relevant training or authorisation.
- Inform the rig operator about the start of maintenance and repair work.
- Before starting the work, ensure that all unnecessary items are cleared from the vicinity of the site and that the area is safe to work in.
- If maintenance or repair work is to be carried out on the rig, always ensure that the rig cannot be accidentally started:
  - Turn the main switch off.
  - Remove the ignition key.
- Place a **DANGER - DO NOT START** warning sign on the main switch. The sign may only be removed by a person who is fully aware of the current status of the work.
- Clean and wash the rig regularly, and always before starting maintenance or repair work.
- Before washing the rig with water, a high-pressure cleaner, a steam cleaner, or any other method, protect any components that are susceptible to damage from the cleaning method or due to exposure to water. Pay special attention to the protection of electric motors, boxes, and cabinets.
- If necessary, equip the work site with appropriate steps or working platforms.
- Never use the components of the rig as steps. If the work is carried out at height, or in an otherwise dangerous position, use proper working platforms to prevent falling. Never climb on the rig's covers.
- Keep all stairs, rails, anti-slip devices, steps, etc. clean of oil, grease, snow, ice, unnecessary items, and dirt to prevent accidents caused by slipping.
- Use only undamaged, high-quality tools that are appropriate for the work in question.
- Before starting the work, ensure that the rig is on a level surface and the safety brake is engaged and that all tracks/wheels are wedged or that the jacks are lowered to prevent movement.
- Observe the operation and condition of the exhaust pipe and exhaust cleaner in particular, and ensure sufficient ventilation.
- Diesel engine overheating indicates a fault. Stop the engine and address the cause of the overheating in order to prevent damage to the engine. Ensure that air can flow freely through the engine's radiator. If necessary, clean the radiator and remove any obstructions.
- Stop the engine and allow it and the coolant to cool down before checking the coolant level. If this is not possible, use protective gloves and other protective clothing when opening the radiator cap, in order to prevent burns and related injuries. Stand as far to the side as possible, turn your face away, and carefully open the cap slightly. Before opening the cap fully and removing it, wait until the pressure or coolant stops discharging from the cooling system.
- Use appropriate hoists and lifting methods when moving heavy parts and equipment. Follow the hoist manufacturer's instructions.

2.3. Manner and operating conditions in which the rig should not be used

Risks to persons

- Insufficiently scaled drilling area.
- Explosive gases in the air.
- Inadequate training of the operator.
- Unauthorised personnel in the working area.
- Insufficient lighting.
- Insufficient ventilation.
- Insufficient grounding.
- Use for personnel transport.
- Defective safety systems.
- Fault detected in the rig.

Risks to the rig and environment

- Low/high supply voltage. The supply voltage of the rig must not vary by more than ±10% of the rated voltage in any operating situation.
- Fault detected in the rig.

Power supply to the rig must include the following:

- Overload protection
- Short-circuit protection
- Earth fault protection
- Other protection, such as control cable and screened cable, if required by the national standard

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2.4. Dust

Drilling creates dust, which stays at the drilling site and in its surroundings even when drilling is not in progress.
The dust may be so fine that it cannot be seen. Inhalation of fine, invisible dust can be extremely dangerous.

DANGER	
	**Breathing dust will cause death or severe injury. Always wear an approved respirator.**

- It is crucial that the respirator you use is effective enough to filter even the smallest dust particles, as these are most hazardous and can cause silicosis or other serious lung diseases.
- Do not start working before you have made sure that your respirator functions correctly.
- Check before starting work that the respirator is clean, the filter has been changed, and that the respirator is fully functional and in appropriate condition.
- Make sure that the dust protection systems of the devices you use are in order. Stop working immediately if the dust protection systems do not function correctly.
- After working, ensure that your boots and clothing are free of dust.

Dust collector system

Make sure that the dust collector system functions well and effectively at all times. Make sure that

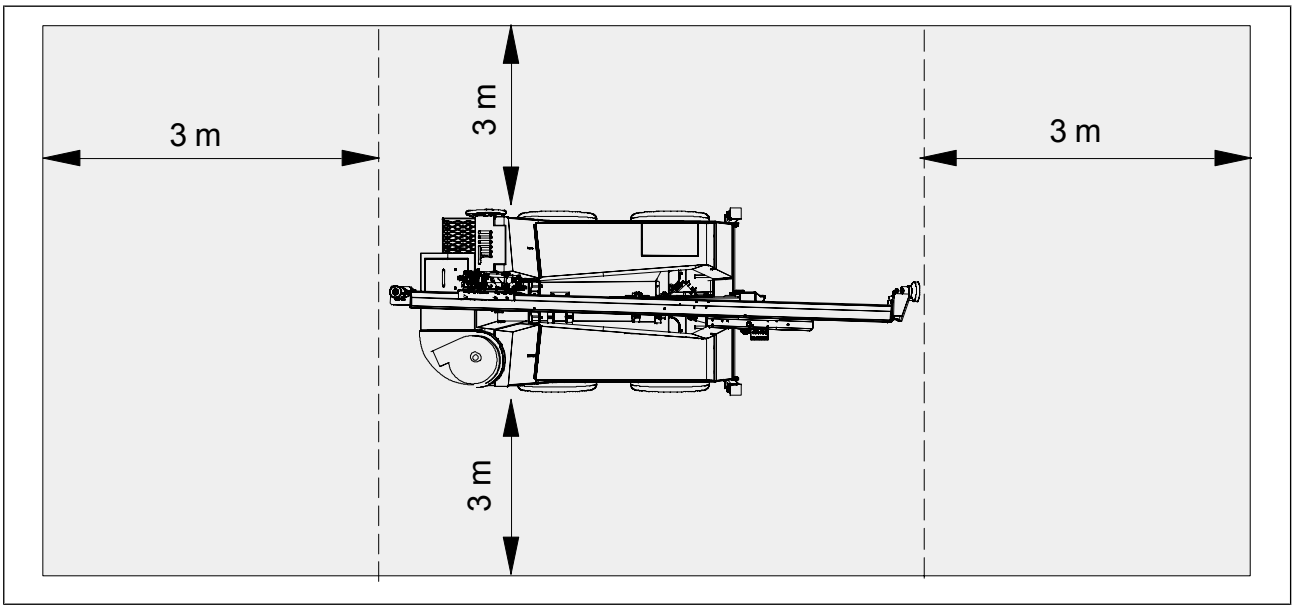
- The suction head is firmly against the ground during drilling.
- The suction head and the suction head rubbers are in good condition.
- The suction hoses are in good condition and tight.
- The dust collector filters are in good condition. Use only original spare parts.

Using the correct drilling parameters and keeping the drilling equipment in good condition reduces the amount of dust created.

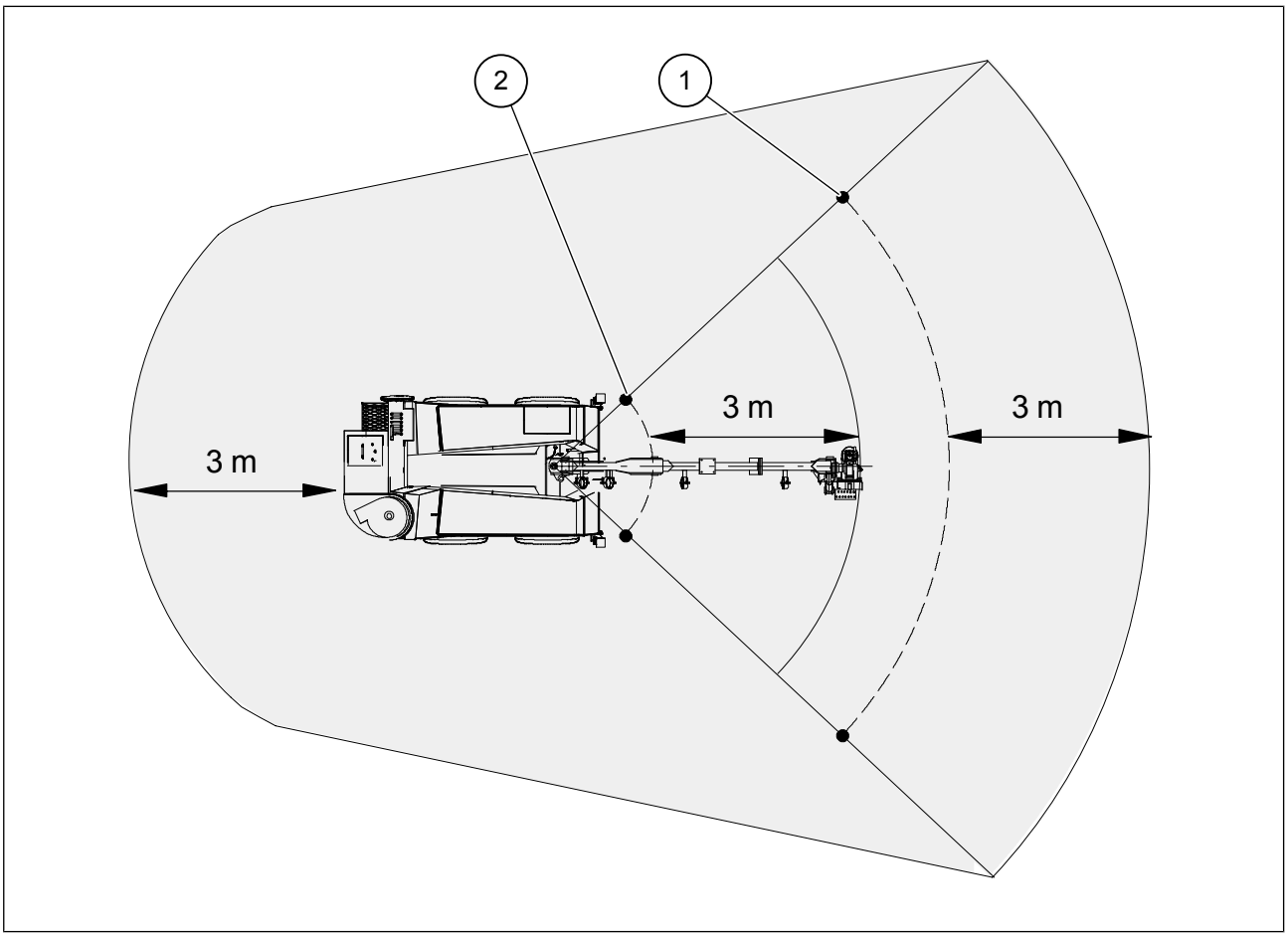
NOTICE	**Safe use of the rig requires skilled maintenance personnel trained by Sandvik, and the use of only original spare parts. The daily and periodical checks and maintenance must be carried out according to the instructions.**

2.5. Danger areas during tramming and drilling

During tramming



When drilling



1. max. boom extension
2. min. boom extension

2.6. Gradient angles

Never exceed the maximum permitted inclination angles when parking, drilling, or tramming.

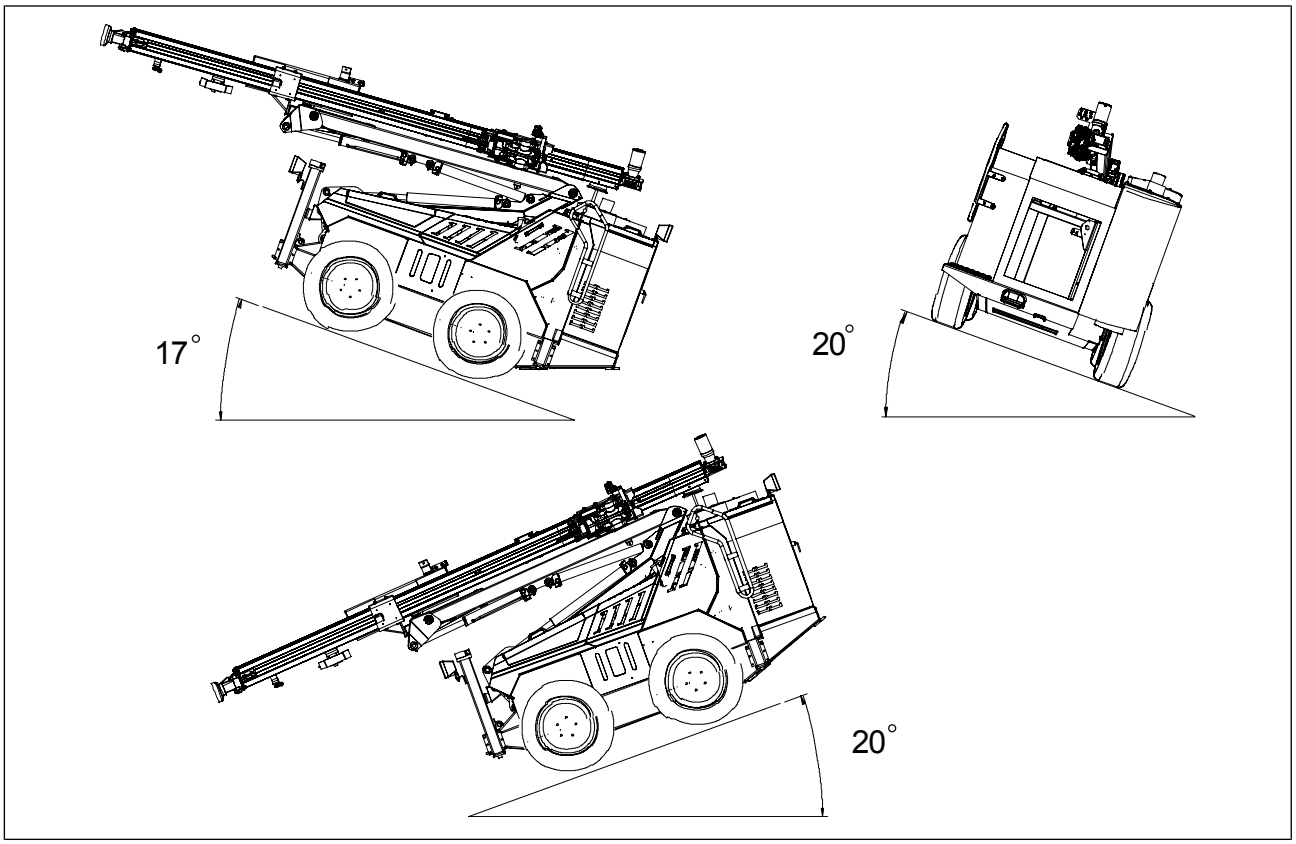
When tramming or drilling on a slippery surface, such as ice or plane rock, the safe inclination angle is noticeably smaller than on holding ground.

When tramming and parking:

During tramming, keep the boom in the lower position and run the feed to the front position.

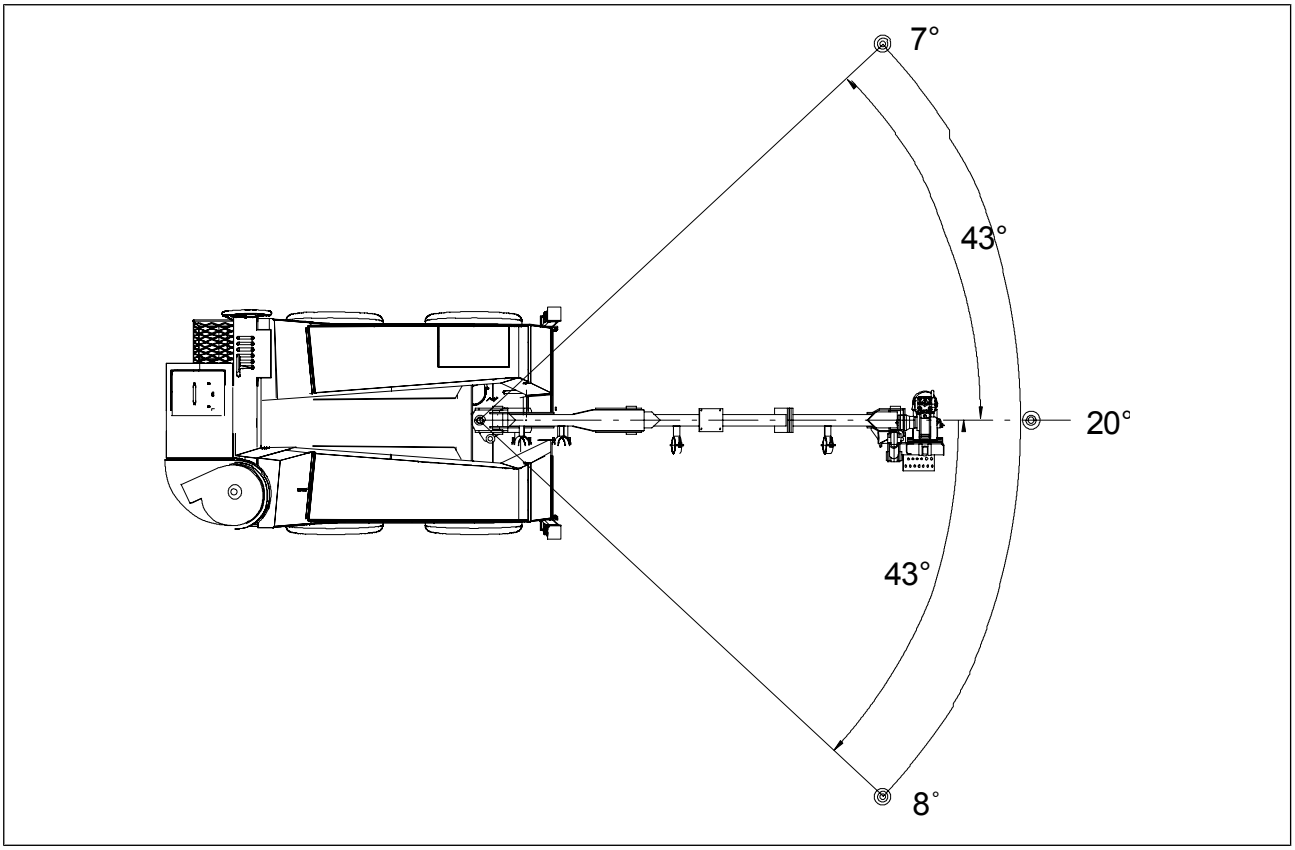
If the terrain inclination is more than 20º, a winch must be used.

Do not exceed the specified maximum inclination angles.



When drilling:

The figure indicates the maximum inclination angles into all directions when drilling is performed in different boom positions.



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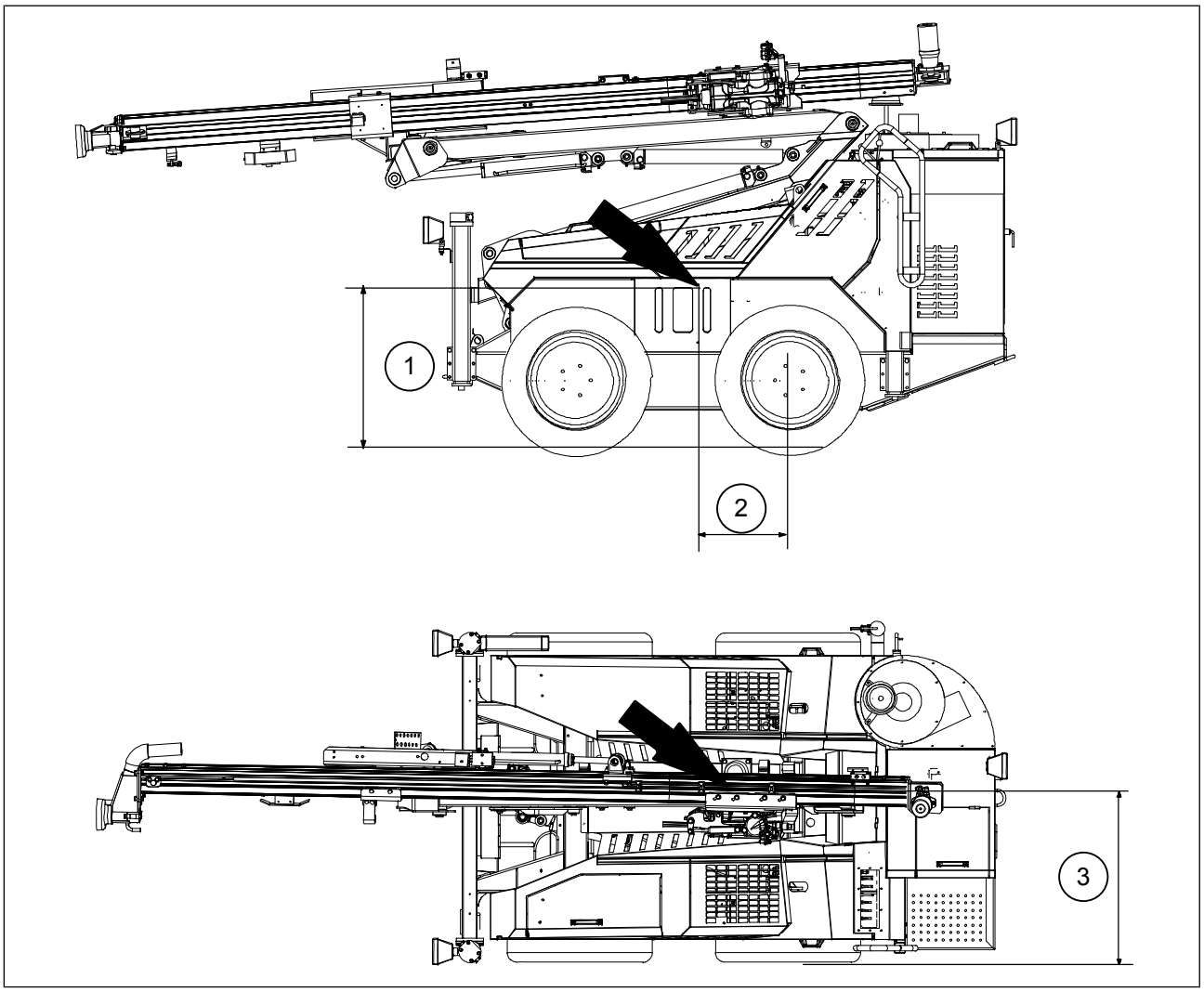
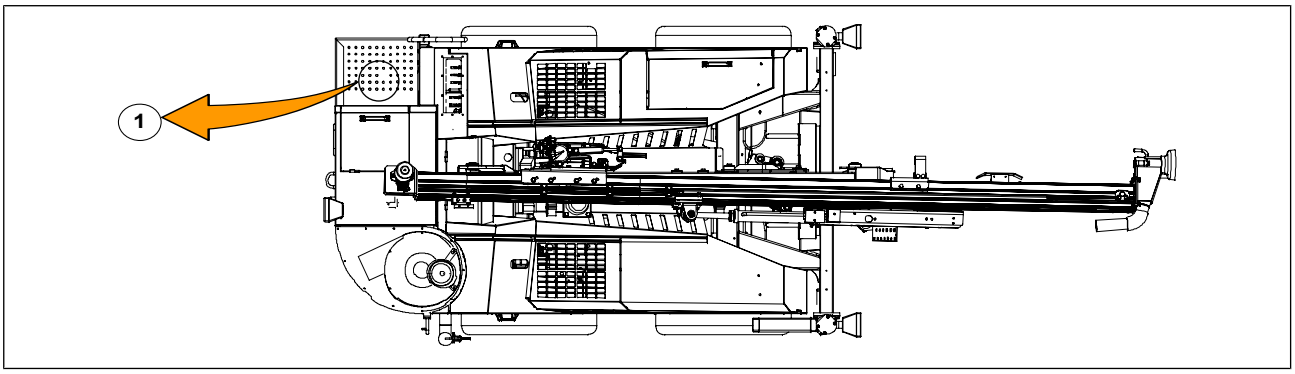
2.7. Centre of Gravity

Centre of gravity when boom is in the tramming position



1 800mm
2 375mm
3 875mm

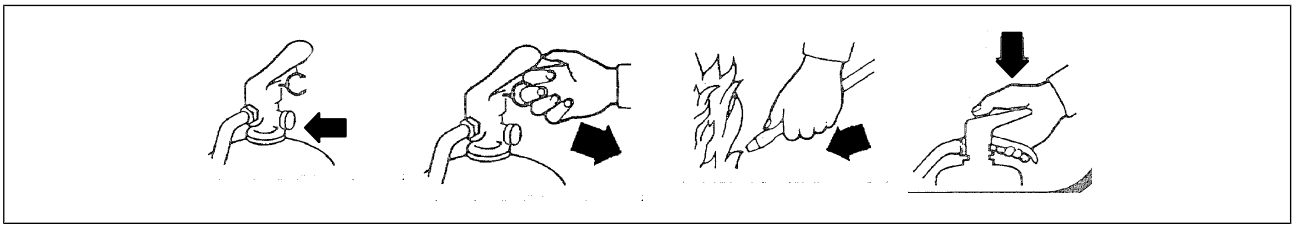
2.8. Location of fire extinguisher



1	Fire extinguisher	

2.8.1. Using the fire extinguisher

Read the operation instructions on the side of the fire extinguisher. Make sure that the extinguisher's indicator gauge is not in the red zone. If the indicator is in the red zone, the fire extinguisher must be serviced immediately at an authorised service shop.



1. Remove the extinguisher from its holder.
2. Shake the extinguisher once or twice to mix its contents.
3. Pull the ring pin out and take the hose from its holder.
4. Assume a secure position and a good hold on the hose, and aim the nozzle toward the flames.
5. Spray the extinguishing chemical by pressing the nozzle trigger. Stop spraying when the flames are extinguished, in order to save as much of the contents as possible in case the fire ignites again.

The extinguisher must be refilled at a service shop after each use.

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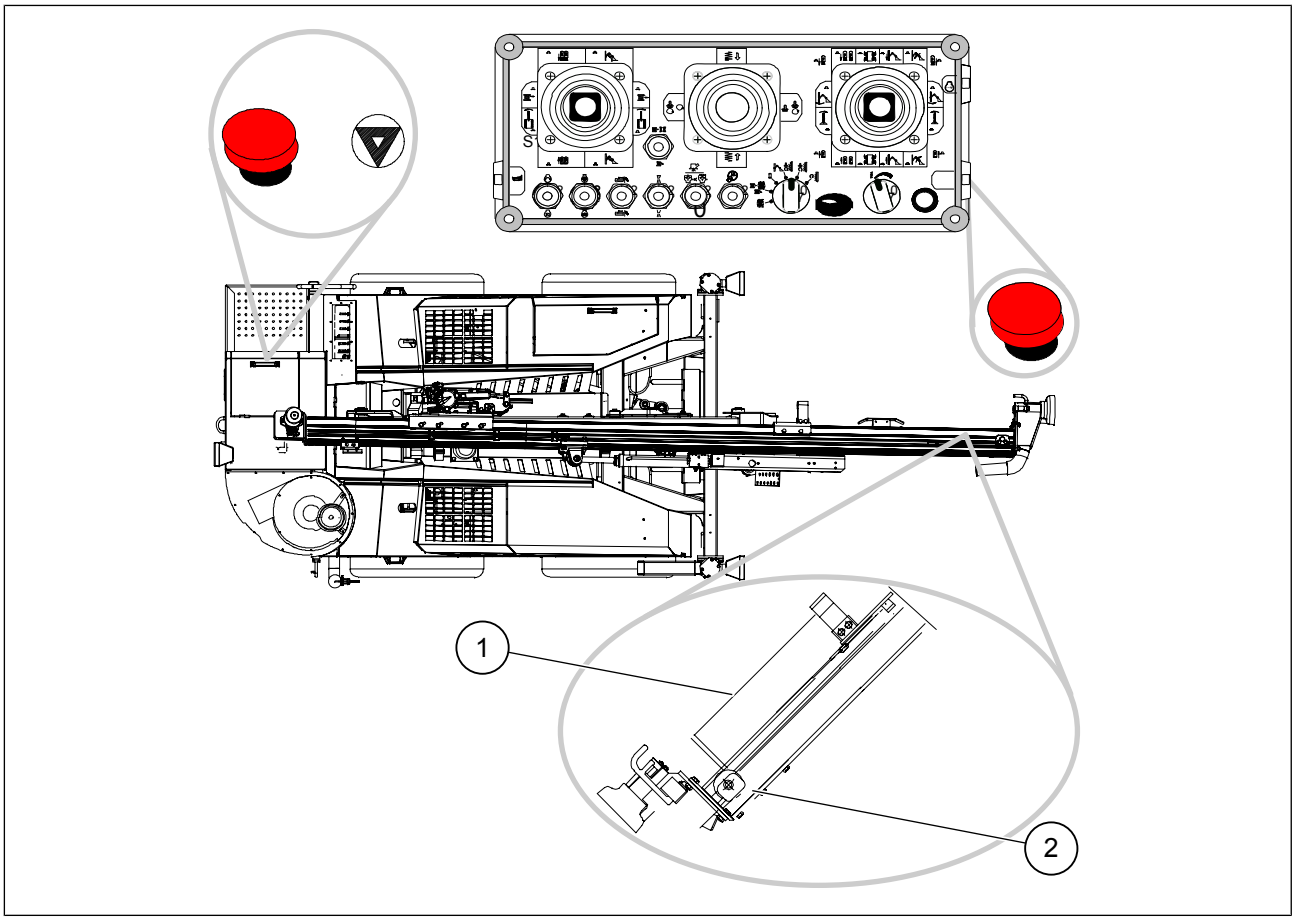
2.9. Emergency stops and safety wire

Make sure that the emergency stops can be accessed at all times.

Check the operation of the emergency stops and safety wire daily.

When one of the emergency stops is pressed or the safety wire is pulled with adequate force or the wire loosens, the engine stops and, along with this, all other functions cease. An indicator lamp lights up on the control panel. The engine can be restarted only after the emergency stop has been released or the safety wire reset button has been pressed.



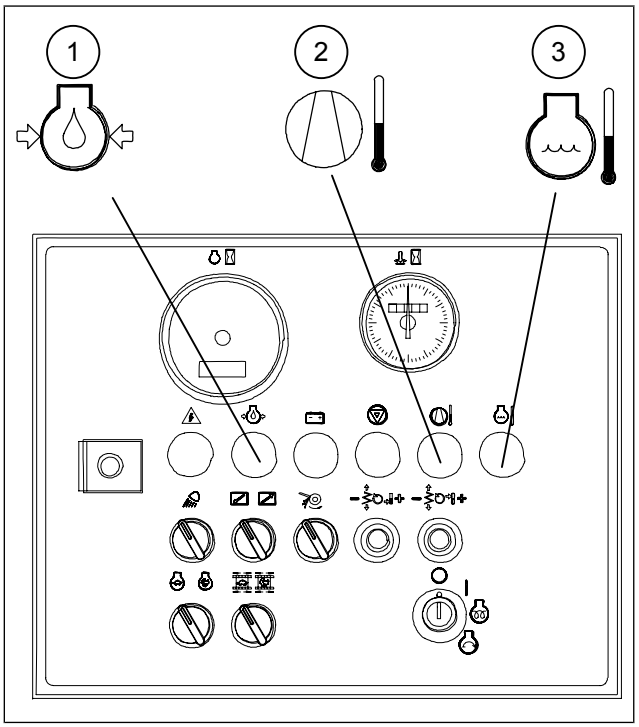
1. Feed safety wire
2. Safety wire reset button

2.10. Automatic stop functions

The engine is stopped automatically if:

- The oil pressure sinks too low, and the indicator lamp lights on the instrument panel.
- The compressor temperature rises above 115 °C, and the indicator lamp lights on the instrument panel.
- The engine coolant temperature rises too high, and the indicator lamp lights on the instrument panel.

Note that the engine oil pressure and charging indicator lamps are always illuminated when the power is turned on but the engine is not running.



1. Engine oil pressure
2. Compressor temperature
3. Coolant temperature

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2.11. Filling the fuel tank

Handle fuel with care: it is highly flammable.

⚠ WARNING	
	**FIRE HAZARD!** **Smoking, open flames, and sparks cause a highly dangerous situation when the fuel tank is filled or otherwise handled.** **Do not refuel the machine while smoking or when near open flame or sparks.**

When filling the fuel tank, follow these instructions:

Always stop the engine before refueling machine.

- In addition, switch the cabin heater / air conditioning off.
- Fill fuel tank outdoors.
- Keep the fuel gun in contact with the filling tube. This eliminates possible sparks caused by static electricity. If this is not possible, arrange for the gun to be earthed in some other way.
- Ensure that no fuel is spilled onto hot surfaces.
- Never lock the nozzle lever in motion without looking after.
- Wipe spilled fuel off before starting the engine.
- Prevent fires by keeping machine clean of accumulated trash, grease, and debris.

2.12. Maintenance of the hydraulics

⚠ DANGER

SQUASHING HAZARD!

Danger of death or severe injury.

Before removing the cylinders or their overcentre or non-return valves, support the boom, feed and rock drill carefully so that they do not move during the maintenance. Do not work under components that are supported only by hydraulics.

⚠ WARNING

HIGH-PRESSURE FLUID HAZARD!

High-pressure fluid remaining in hydraulic lines can cause serious injury.

Never carry out maintenance or repair work on a pressurized system. Relieve pressure before opening fittings, plugs or hydraulic valve cartridges. Always make sure the parts are not pressurized. Use a bleeder screw to relieve the pressure behind the valves or cartridges, or wait until the unit is depressurized, before removing the components.

⚠ WARNING

FIRE HAZARD!

Flammable spray can be generated by heating near pressurized fluid lines, resulting in severe burns to yourself and bystanders.

Do not heat by welding, soldering, or using a torch near pressurized fluid lines or other flammable materials. Pressurized lines can accidentally burst when heat goes beyond the immediate flame area.

⚠ WARNING

BURN HAZARD!

The oil circulating in the hydraulic systems is hot. It can cause severe burns to the skin.

Let the oil cool down before starting any maintenance work.

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⚠ WARNING	
 	**HYDRAULIC FLUID INJECTION HAZARD!** **High-pressure hydraulic fluid spray can penetrate under the skin, causing serious injury.** **Search for leaks with a piece of cardboard or wood. Never try to locate a leak by feeling with your hand. Immediate medical attention is required after injection.**

Maintenance and repair work on the hydraulics and installation of components may only be carried out by persons who have received the training required for the work. Do not start work that is not fully familiar to you.

Protect your eyes by wearing goggles.

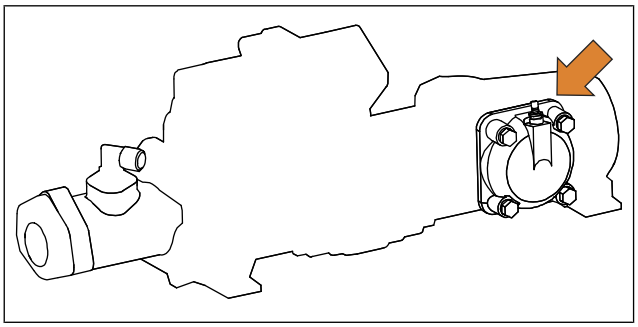
- Do not use the drilling rig if there is a leak in the hydraulic system.
- Stop the power pack and diesel engine before repairing a leaky hose or tightening a connector.
- Oil spray can also easily cause a fire.
- Prevent oil splashes by wrapping a cloth around the component.
- Avoid skin contact with oil.
- Ensure that the new hose connectors and hose types correspond to the types originally used by the manufacturer and are the same length. When replacing hoses and connectors, use original Sandvik parts or equivalent parts recommended by the manufacturer. Also ensure that the hoses and connectors are rated for the pressure level they will be subjected to.
- Ensure that all the connections will be made according to the hydraulic diagram.
- Check the movements of the rig before use.

2.13. Maintenance of the rock drill pressure accumulators

⚠ WARNING	
	**DANGER OF PRESSURE PNEUMATIC SYSTEM!** **Danger of death or severe injury.** **Do not pressurize the accumulators to a pressure greater than that specified.**

The disassembly, inspection, assembly, and pressurisation of the pressure accumulators are discussed in pressure accumulator instructions.

Rock drill pressure accumulators are filled with nitrogen N_2. Before removing the pressure accumulators from the rock drill, release the accumulators' pressure by opening the filling valve.



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2.14. Maintenance of the electrical system

DANGER

ELECTRICAL HAZARD. Cut the supply voltage to the light using the main switches before replacing the bulbs of the working and driving lights. Exercise extreme caution when performing maintenance or repair work on HID gas discharge lamps. The light components include high voltage parts. Failure to follow these procedures will result in death or serious injury!

Note that parts of the light may be hot after use, so allow it to cool before commencing repair work.
The bulbs of gas-discharge lamps are gas-filled, so handle with care.
Do not touch the lamp holder or the glass part of the bulb when carrying out the replacement.

Electrical modifications to the rig require written permission from Sandvik Mining and Construction Oy's electrical design department to ensure the correct operation of the modified device.

Stop the rig immediately if electrical failure occurs.

Work on electrical equipment or devices is to be performed only by persons with the required expertise and qualifications required by the authorities, or under the supervision of a person meeting these requirements. In addition, the work must be carried out according to current electrotechnical regulations.

Always follow local safety instructions and electrotechnical regulations.

Use only original electrical components.

- If required by regulations, switch off the voltage supply to the device or the device components before inspection, repair, or maintenance. Ensure that the components in question are not live, and then lock the main switch or arrange appropriate grounding.
- Check the condition of the rig's electrical devices regularly. Immediately repair any faults and defects observed, such as loose connections or damaged insulation.

NOTICE

Giving a jump start using a booster-type jump starter is prohibited. A booster type jump starter raises the voltage of the electrical system. The use of higher voltage will damage the electrical system. If a jump start is needed, use additional batteries of the same battery voltage.

Working with live components

⚠ WARNING	
	**If a component must be live, one employee must be ready on-hand at all times to switch the power off via the emergency stop or main switch. Follow the electrical safety regulations.**

Observe extreme caution.

Use a red and white safety chain and warning signs to mark the work area.

Use only insulated tools.

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2.15. Maintenance of the batteries

Sulfuric acid in battery electrolyte is poisonous and strong enough to burn skin, eat holes in clothing, and cause blindness if splashed into eyes. Personal protective equipment and eye flushing facilities must be available near the charging location. Always wear protective equipment such as goggles, protective overalls, protective footwear, and protective gloves when working with batteries. Open flames, smoking, and work that causes a spark are strictly prohibited during servicing of batteries! Static sparking must be prevented with insulating shoes or by safely discharging the static charge.

DANGER

EXPLOSION, ELECTRIC SHOCK AND CHEMICAL BURN HAZARD!

Incorrect handling of the battery will cause death or severe injury.

The following special instructions must always be followed in handling of the batteries.

- Electrical work concerning batteries that have a short-circuit current over 1000 A must be performed by qualified electricians only.
- Always consider the danger of explosion when handling the batteries. When the battery is charged or discharged, lead and acid generate oxygen and hydrogen, which, in turn, form a highly explosive gas. A battery in use must always be handled on the assumption that there is explosive gas in its cells and ventilation ducts. Gas is present even after charging of the battery for an extended time. A spark near the battery can ignite the explosive gas. If the battery explodes, the acid flows around it when it breaks open. The energy of the short circuit is sufficient for melting the metallic parts of the short-circuited parts. Thus, drops of melted metal can also fly around in the explosion. A spark can be caused by, for example,
  - disconnecting or connecting of the battery clamp
  - a short circuit between the battery terminals or between the positive terminal and the frame
  - grinding or welding
  - use of a match or a lighter
  - smoking
  - static electricity

  In order to eliminate the risk of explosion, the battery electrolyte level must be kept stable and checked regularly. Add distilled water, if required, before starting, never after that. The space remaining for gas in the cells can be eliminated by keeping the electrolyte level of the battery as high as possible.
- Open flames are strictly prohibited in the charging room and the immediate vicinity of the charging area.
- Battery acid must not be stored in the charging area.
- If you get acid on your skin, rinse it immediately with plenty of water. If battery acid gets in your eyes, neutralize it first with sodium carbonate. Then rinse with plenty of water and seek medical advice.

- Always loosen the battery cell caps before charging, to allow the gases generated during charging to escape. Ensure appropriate ventilation, to ensure the escape of the gases generated during charging to external air.
- Charging is done by the machine's own charger or a separate battery charger. If a separate battery charger is used, see charger manufacturer's instructions.
- Do not charge a frozen battery. Warm battery to 16°C (60°F).
- Be especially careful when you are charging a empty battery.
- Batteries cannot be tilted during charging, measurement, or start-up assistance.
- Do not test electrical equipment by using the battery terminals.
- Never check battery charge by placing a metal object across the posts. Use a voltmeter or hydrometer.
- Use a flashlight to check battery electrolyte level.

Disconnecting and connecting of the cable shoes:

- Connection and disconnection of the cables must always be done when the system is not energized. Turn the battery main switch to the open position.
- Use insulated tools only.
- Disconnect the grounded (-) battery clamp first, then the power (+) battery clamp.
- In order to prevent sparking, disconnect the charger cable or switch it off before connecting the cables to the battery.
- Before connecting the cable shoes, ensure that the power is switched off to all electrical equipment of the drilling rig.
- The cable shoes must be connected carefully, and the polarity must be taken into consideration.
- Connect first the power (+) battery clamp and then the grounded (-) battery clamp. Thus you can avoid sparks caused by the tool.
- Do not wear rings or a metallic wristwatch, since these may cause a short circuit, which could, in turn, can result in sparking and burns.
- Check that the battery terminal covers are intact, and put them in their correct place.

2.16. Pneumatic system maintenance

⚠ WARNING	
	**HIGH PRESSURE INJECTION HAZARD!** **Compressed air jets can cause serious injury.** **Ensure that the pneumatic system is not pressurised before starting maintenance of the compressor or other pneumatic system component.** **The system may not be pressurised to a higher pressure level than that specified by the manufacturer. Increasing the pressure level does not increase the rig's performance level.**

2.17. Safety During Welding

Before welding, determine the material to be welded and the appropriate welding method and consumables. If necessary, contact Sandvik Mining and Construction Oy's service division.

Never repair the boom or its components by welding (special materials that cannot be welded with normal methods are used in booms).

Use appropriate protective equipment.

Comply with the welding instructions and use appropriate welding methods.

The rig is equipped with electrical and electronic components that can be damaged if the rig is welded. When welding the rig, comply with the following instructions fully.

- Stop the engine and turn the ignition key to position 0.
- Open the main switch and disconnect the battery cables.
- Provide adequate ventilation and fire-extinguishing equipment.
- Protect the electric cables and other sensitive components from the weld splatters.
- Attach the welding equipment's ground cable directly to the part to be welded. Connect the cable as close to the welding point as possible and such that the welding current does not pass through bearings, hydraulic components, electrical/electronic components, or the rig's ground cable.

2.18. Safety equipment

Check the emergency stops and safety equipment for proper functioning and condition before the start of each shift and after tramming.

- Fire extinguisher
- Emergency stops
- Pressure gauges
- Indicators
- Tramming and working lights
- Parking brake
- Tramming brake
- Inclination gauges
- Warning labels

2.19. Noise level and noise emissions

Sound pressure level tests and volume measurements for the operator position have been performed according to European Standard EN 791, Drill Rigs – Safety.

HEX 1 -- rock drill

1. Operator position . . . . . LpA 105.5 dB (A) ISO 11201--1995
2. Noise emission . . . . . LwA 123 dB (A) ISO 4872--1978

2.20. Vibration

The whole-body vibration during drilling does not exceed 0.5 m/s² *, when tested according to the European Standard Drill Rigs - Safety EN 791.

* the highest root mean square value of weighted acceleration

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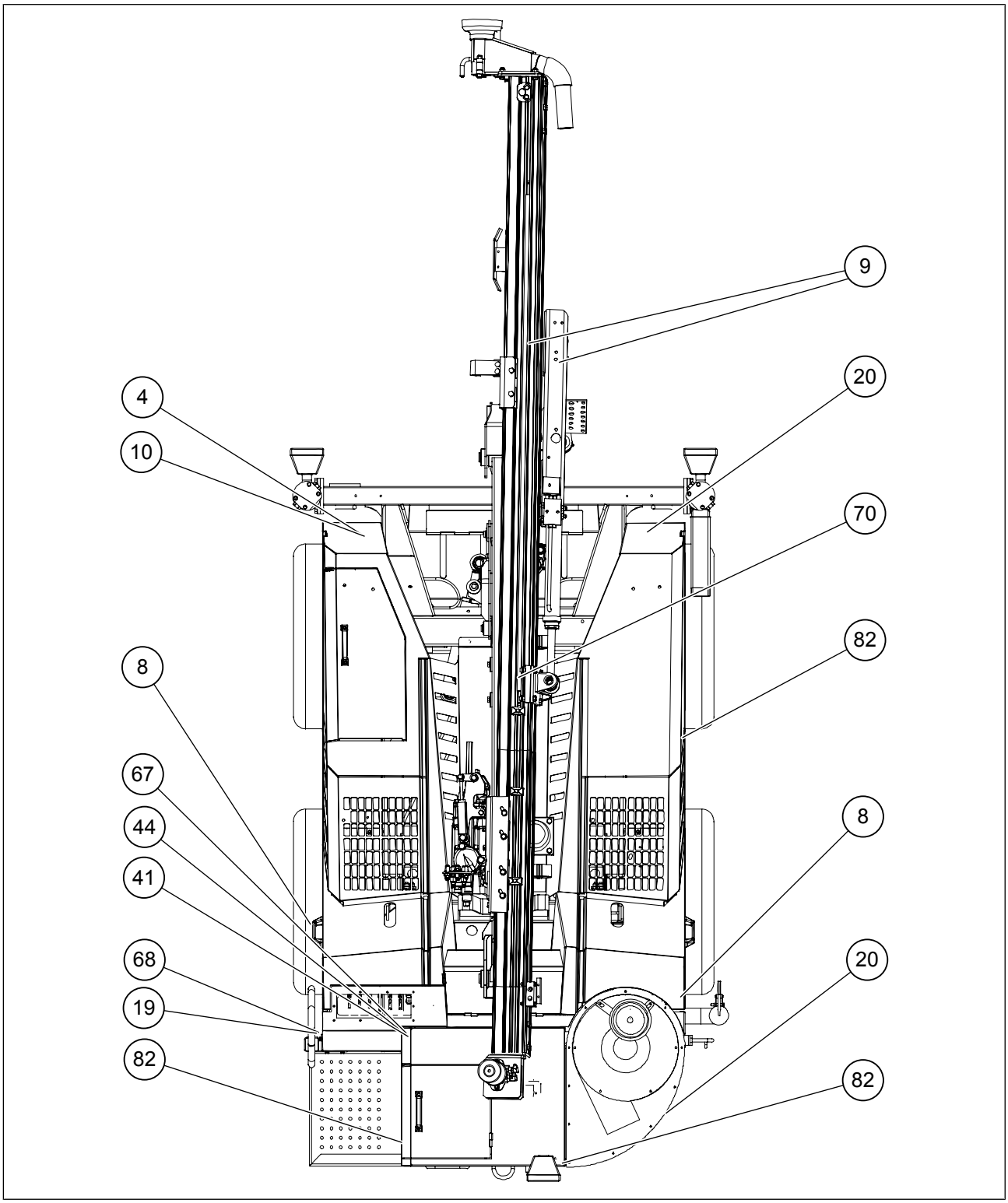
2.21. Warning label locations



68. WARNING

The rig is remote-controlled.

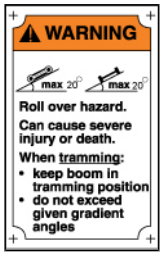
19. WARNING

DO NOT OPERATE THIS VEHICLE UNLESS YOU: 1. HAVE READ THE OPERATOR'S / SERVICE MANUAL. 2. UNDERSTAND AND OBSERVE ALL CAUTIONS AND WARNINGS 3. HAVE BEEN FULLY TRAINED. DO NOT WORK UNDER THE BOOM WHEN DRILLING. BEFORE TRAMMING TURN THE BOOM TO A TRAMMING POSITION. BEFORE TRAMMING BE SURE THAT THE DUST COLLECTOR FAN HAS STOPPED. AFTER TRAMMING RAISE THE DRILL RIG ON THE JACKS, LEVEL THE RIG BEFORE LEAVING THE DRIVING PLATFORM. NEVER OPERATE WITH LESS THAN THREE (3) ROPE COILS REMAINING ON THE WINCH DRUM.

67. WARNING

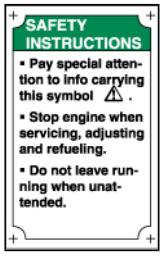
Roll over hazard. Can cause severe injury or death. When drilling: do not exceed given gradient angles.

44. WARNING



Tipping hazard. Risk of serious injury or death. When one is tramming:Keep the boom in the tramming position.Do not exceed the specified tilting angles.

41. SAFETY INSTRUCTIONS



Pay special attention to info carrying this symbol. Stop engine when servicing, adjusting and refueling. Do not leave running when unattended.

4. WARNING

High pressure air injection hazard. Can cause severe injury. Relieve pressure before removing filler plug or fittings.

10. WARNING

High pressure hydraulic oil injection hazard. Can cause bodily injury. Unpressurise hydraulic system before removing plugs or fittings.

9. WARNING

Hazardous boom motion. Can cause bodily injury. Secure boom before servicing hydraulic system.

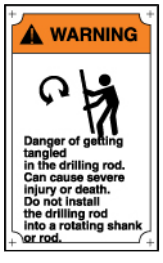
20. WARNING

WARNING: REMAINING IN THE WORKING AREA WITHOUT AUTHORIZATION IS STRICTLY PROHIBITED!

8. WARNING

Hazardous moving and rotating parts. Can cause severe injury. Do not enter working range with machine in operation.

70. WARNING



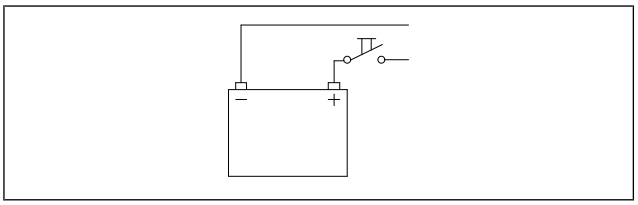
Danger of getting tangled in the drilling rod. Can cause severe injury or death. Do not install the drilling rod into a rotating shank or rod.

82. DANGER

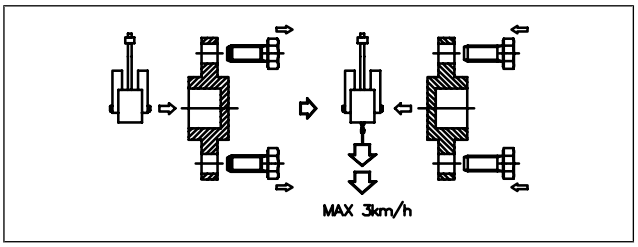
Breathing dust can cause serious injury or even death. Always wear an approved respirator.

2.22. Symbol plates

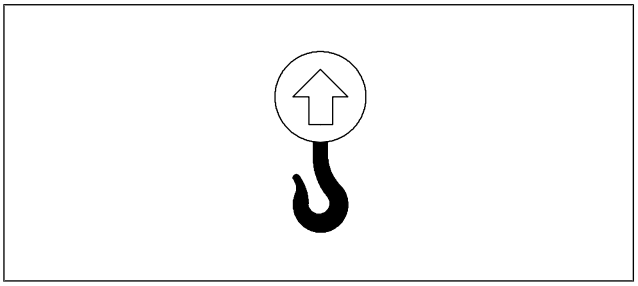
Main switch, carrier



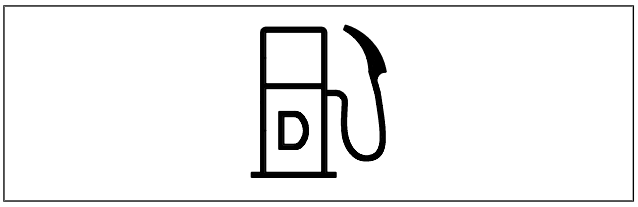
If you need to tow the rig, the tramming motors must be released.



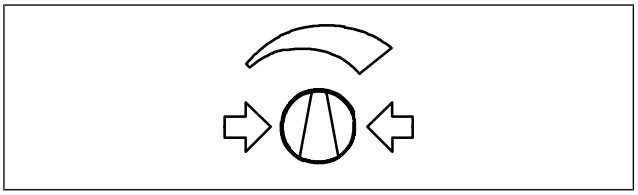
Only lift the rig from these points.



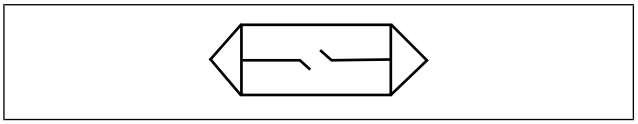
Fuel tank / filling the tank



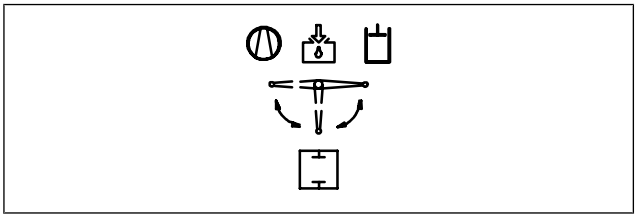
Compressor pressure controller



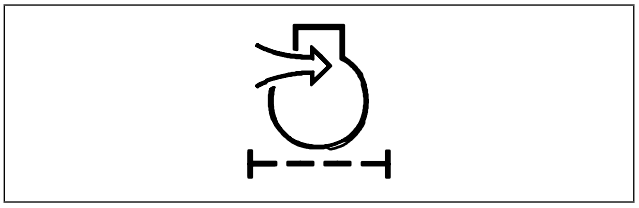
Fuses



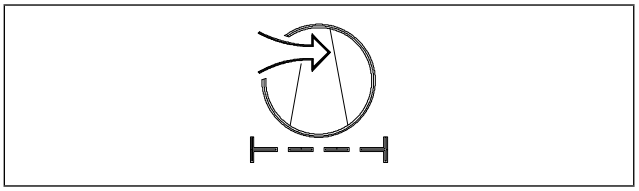
Selector valve for filling the hydraulic oil tank or compressor air/oil tank.



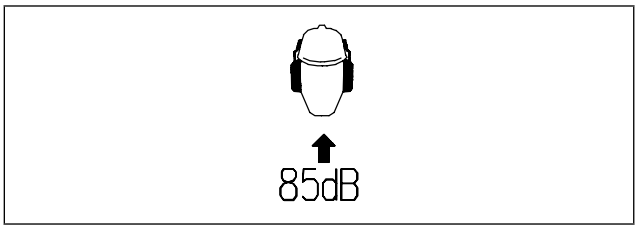
Engine air filter



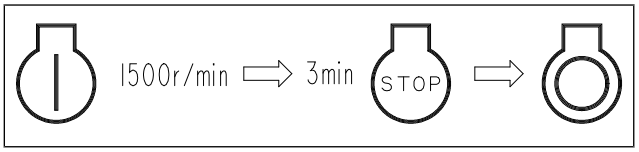
Compressor air filter



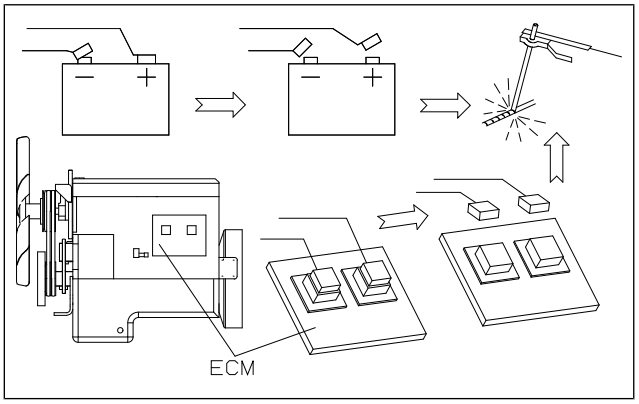
Avoid noise exposure. Use hearing protectors whenever the engine is running.



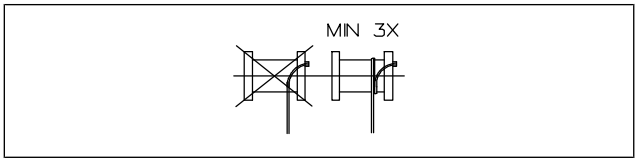
To avoid temperature stress, let the motor idle for three (3) minutes before stopping it.



Open the main switch and disconnect the battery cables before starting welding.



The winch drum should always have a minimum of three loops of cable.

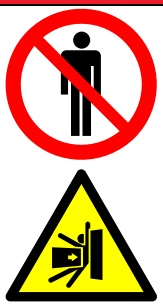


Checking the compressor oil level.

CHECK THE COMPRESSOR OIL LEVEL BEFORE STARTING THE ENGINE

2.23. Radio control

The rig operator must have sufficient knowledge of this function before attempting to control the rig via the radio controller.

DANGER	
	**Crushing hazard. Risk of serious injury or death. Ensure that there are no persons in the rig's danger area. If necessary, provide monitoring of the blind area behind the rig.**

- **Read the operating instructions carefully and ensure that you understand everything fully.**
- **Keep the operating instructions safe and readily accessible.**

- **Make sure that there are no radio controllers operating at the same frequency in the same area.**
- **Only personnel with adequate training are permitted to use the radio controller.**
- **Do not leave the radio controller anywhere where it might fall into the wrong hands.**

- **Switch off the radio controller during breaks.**
- **In the event of a hazardous situation, switch off the rig and determine the cause of the malfunction before operating the rig again.**
- **In the event of a hazardous situation, press the emergency stop button on the transmitter.**

2.24. Making modifications and corrections to the product

Changes and modifications like mentioned here without risk assesment, elimination or reduction of risk if necessary and without appropriate safety measures may lead even to death, serious personal injuries or damage to property.

All modifications and corrections not mentioned in the maintenance manual which may affect the operation, safety, and availability of the machine need to be approved by Sandvik before implementation. Approval requires careful risk assessment in the planning phase, taking into consideration the residual risks and any new risks that the modifications may bring.

- If modifications and corrections that affect the operation, safety, and usability of the machine are made without the permission of the manufacturer, the manufacturer is not responsible for any incidents resulting in death, injury, or property damage brought about by such modifications and corrections.
- Should you consider a modification or correction necessary, please contact the Sandvik service organisation and deliver adequate documentation: a description of the modification or correction, related blueprints, photos, and other material if necessary. Sandvik's service organisation will contact the factory that manufactured the machine in order to plan and implement the modification.
- If a modification or correction as described above has been implemented without the manufacturing factory's permission, its effect on warranty liability will be considered case-by-case. Thus, the warranty application may be rejected altogether.

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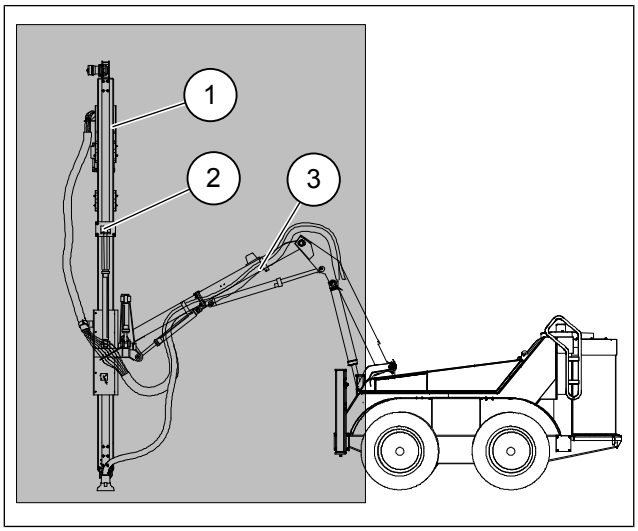
3. MACHINE DESCRIPTION

3. MACHINE DESCRIPTION

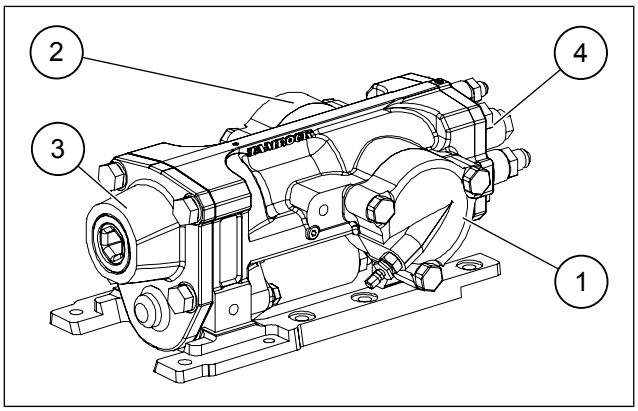
3.1. Main circuits and components

3.1.1. Drilling Module



1. Rock drill
2. Feed
3. Boom

3.1.2. Rock Drill



1. Low-pressure accumulator
2. High-pressure accumulator
3. Front cover
4. Rear cover

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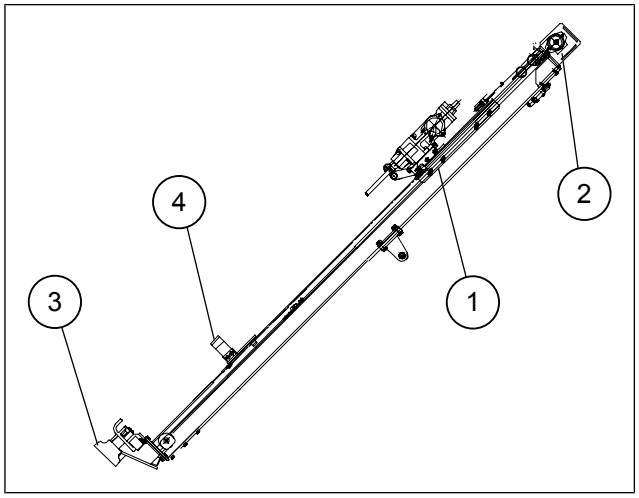
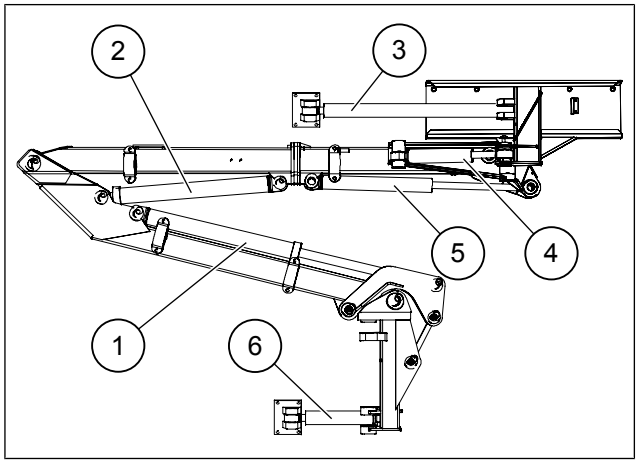
3.1.3. Feed



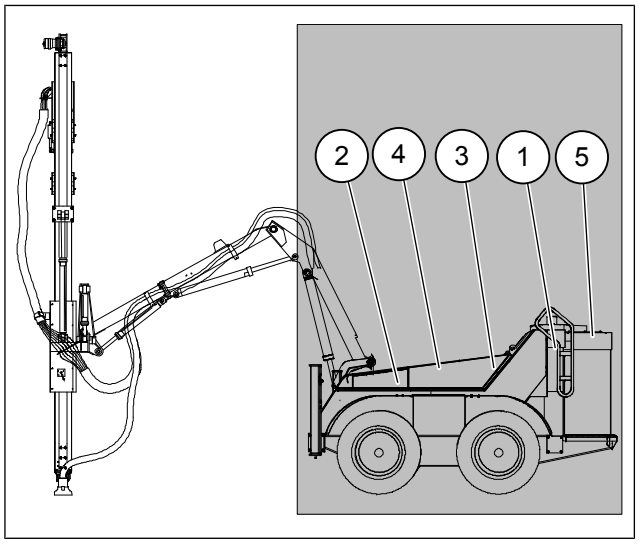
1. Carriage
2. Feed motor
3. Suction head
4. Travelling centraliser

3.1.4. Boom



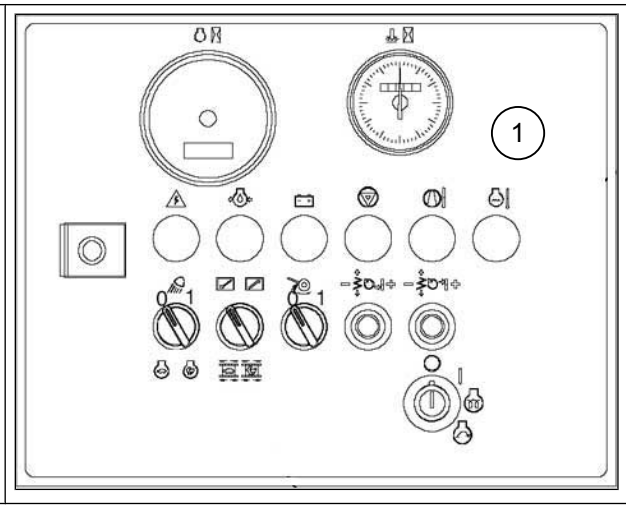
1. Boom lift cylinder
2. Boom knee cylinder
3. Feed extension cylinder
4. Feed swing cylinder
5. Feed tilt cylinder
6. Boom swing cylinder

3.1.5. Carrier Module



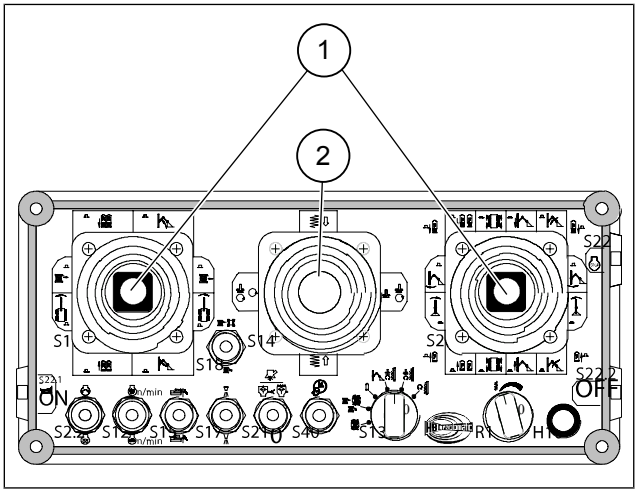
1. Tramming controls
2. Drilling and boom controls
3. Power pack
4. Receivers
5. Dust collector

3.1.6. Control devices

1 Instrument panel	

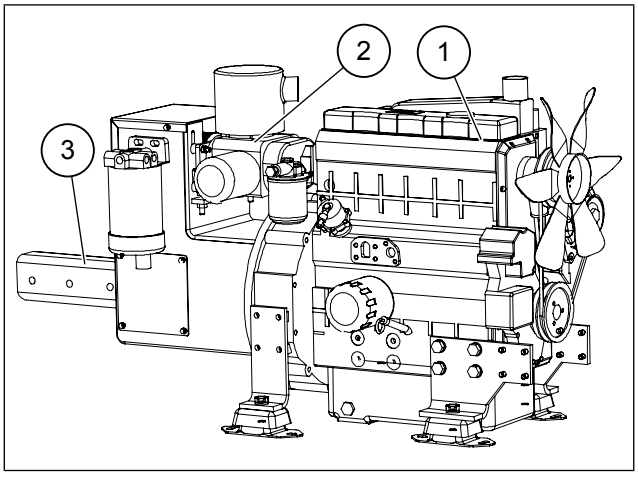
3.1.7. Remote control

1. Remote control, boom control levers
2. Remote control, drilling control lever



3.1.8. Power pack

1. Diesel engine
2. Compressor
3. Hydraulic pumps



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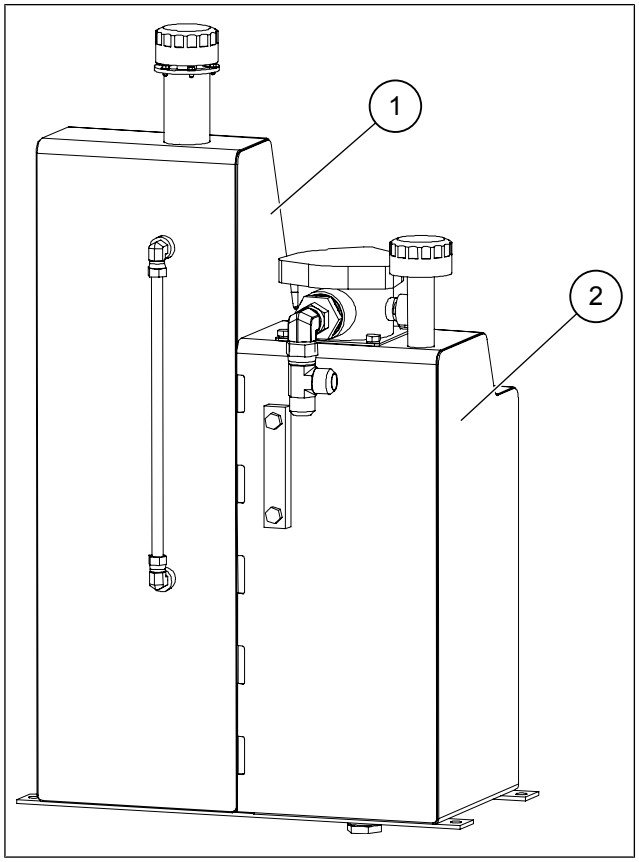
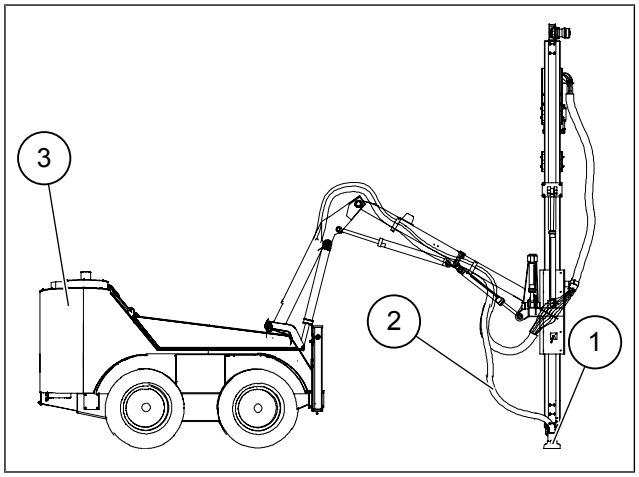
3.1.9. Receivers



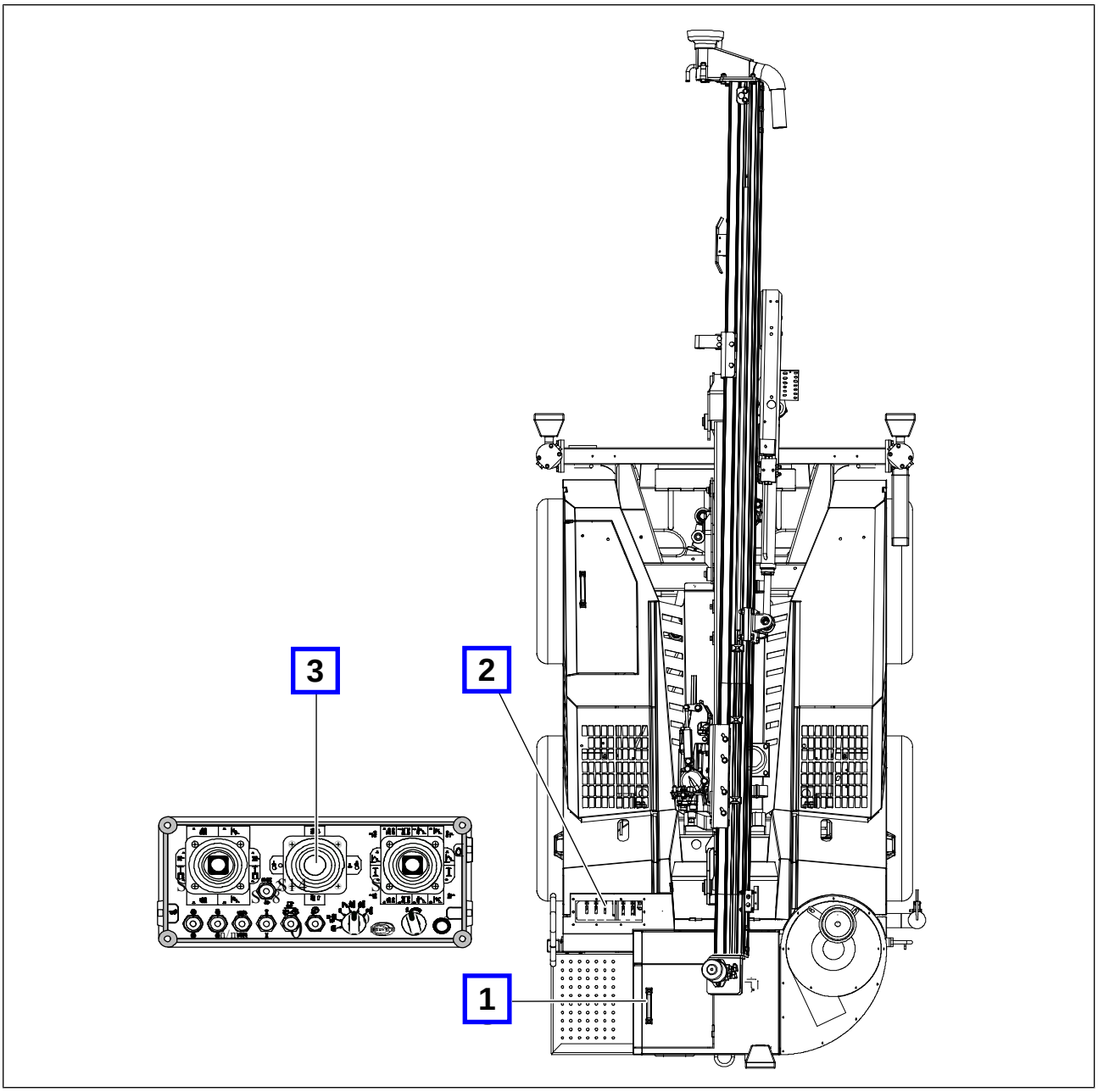
1. Fuel tank
2. Hydraulic receiver

3.1.10. Dust collector system



1. Suction head
2. Suction hose
3. Dust collector

3.2. Control devices



1 Instrument panel
2 Tramming controls
3 Remote control

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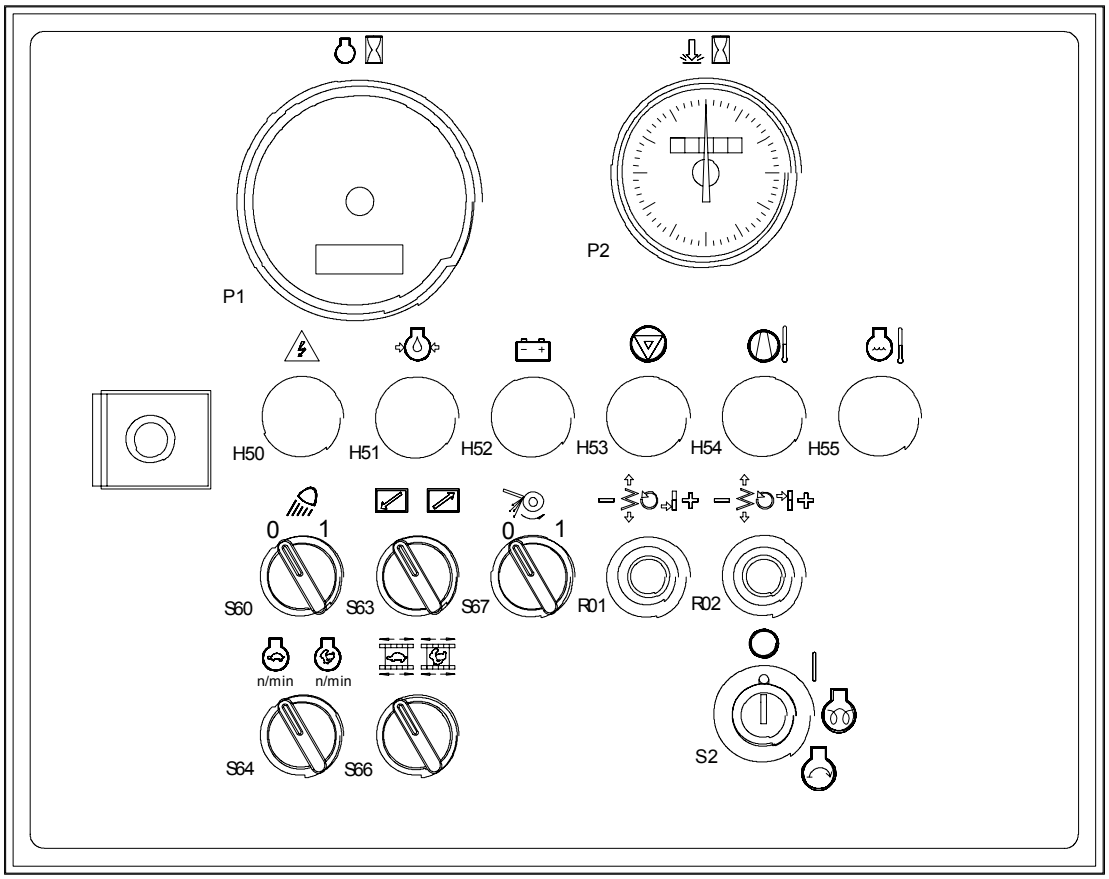
3.2.1. Instrument panel



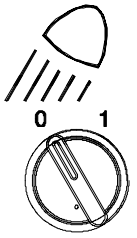
Gauges

P1 Engine's operating hour meter	**P2** Percussion hour meter

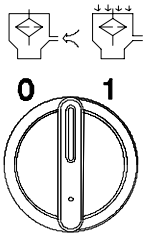
Warning lights

H50 Power On	**H51** Engine oil pressure
H52 Charging	**H53** Emergency stop
H54 Compressor temperature	**H55** Engine coolant temperature

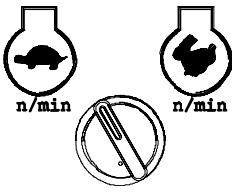
Switches



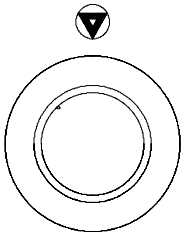
S 60
OFF
Working lights



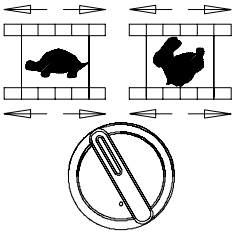
S 63
Control from the carrier panel
Operation by remote control



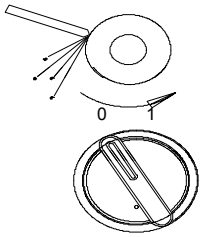
S 64
Idling
Full power



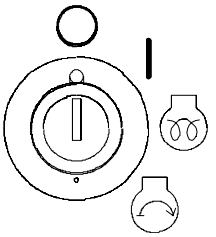
S 3
Emergency stop



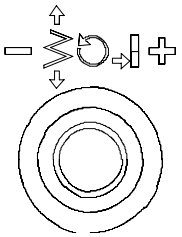
S 66
Slow tramming
Fast tramming



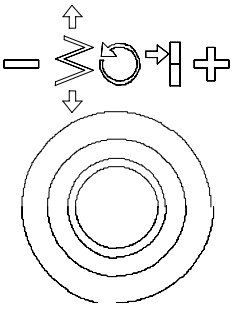
S 67
Grinding unit OFF
Grinding unit ON



S 2
OFF
Power ON
Pre--heating
Start--up



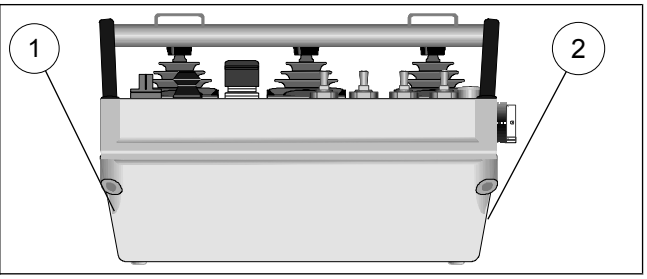
R 01
Load relief controller



R 02
Retraction
controller

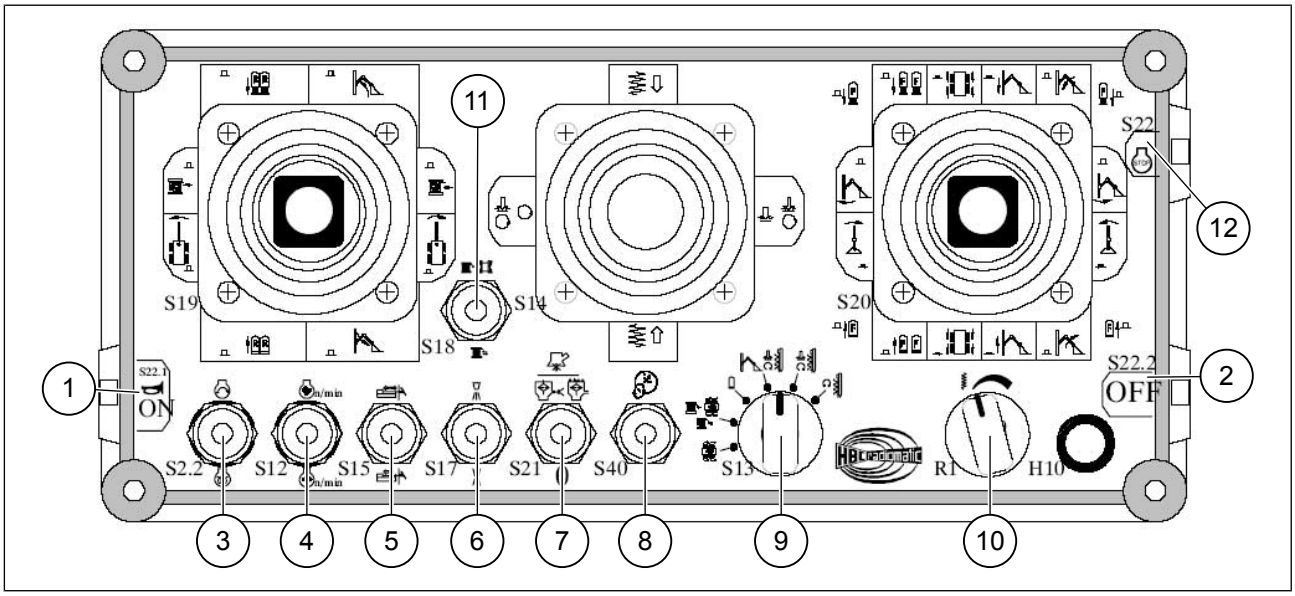
3.2.2. Remote control

1. Code key (iON)
2. Emergency stop



NOTICE

Never leave the remote control in the rain, and prevent it from getting wet when the rig is washed. If the remote control is used in the rain or in otherwise moist conditions, keep it in normal operating position (levers upward).

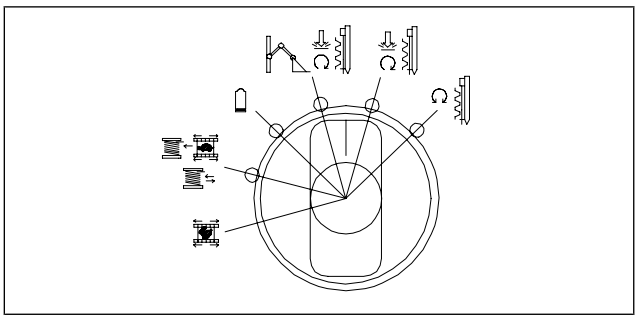


1	Power ON, Horn	2	Power OFF
3	Start-up / pre-heating	4	Full power / Idling
5	Rotation anti-jamming / edge anti-jamming	6	Water flushing ON / OFF
7	Suction ON / Dust collector ON / OFF	8	Automatic hole aiming ON / OFF
9	Control lever functions	10	Adjusting the feed pressure
11	Automatic winch tensioning / manual winch operation	12	Stopping the engine

3.2.3. Remote control of tramming, winch, and jacks

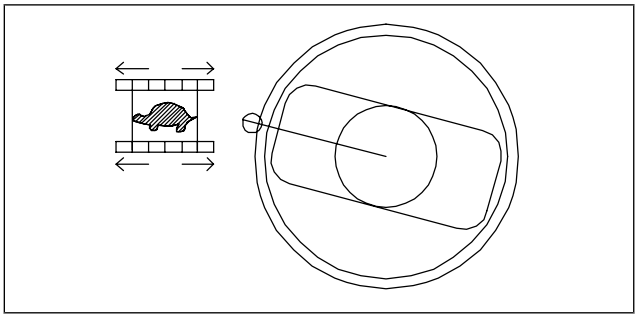
control lever functions

The control lever functions are selected using the switch.

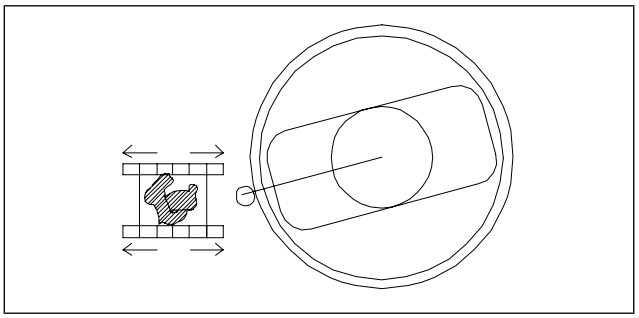


tramming speed selection

Slow tramming

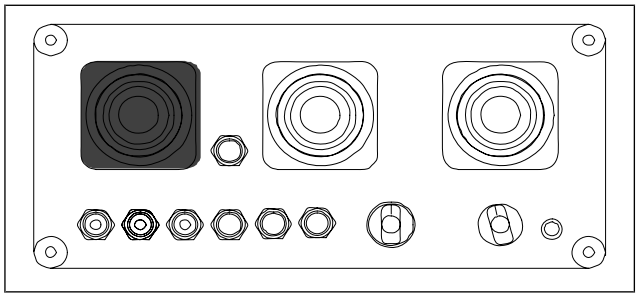


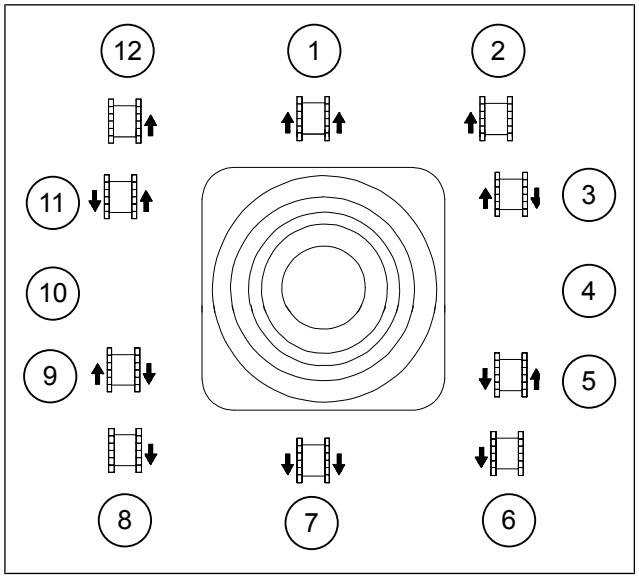
Fast tramming



tramming directions

Right control lever

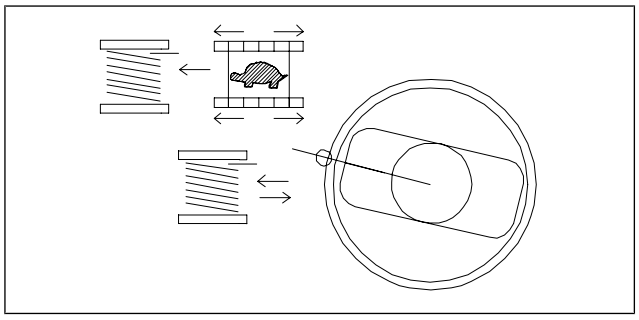




1. Forward
2. Left forward
3. Left forward, right backward
4. No movements
5. Left backward, right forward
6. Left backward
7. Backward
8. Right backward
9. Right backward, left forward
10. No movements
11. Right forward, left backward
12. Right forward

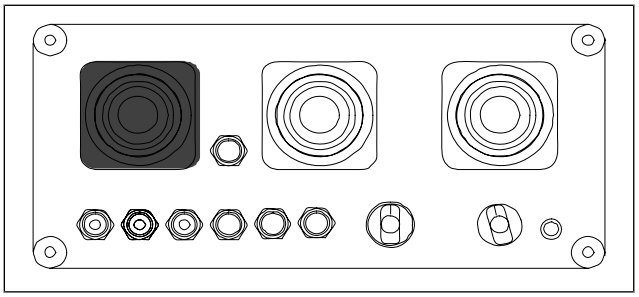
winch speed

winch speed

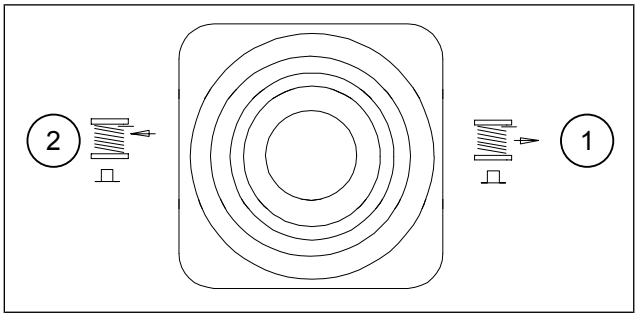


Winch reel control

Use left control lever

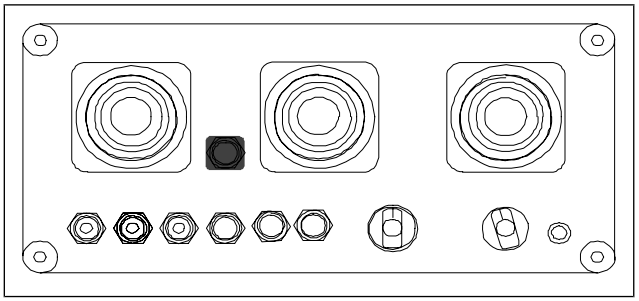


1. Reel out the winch cable
2. Reel in the winch cable

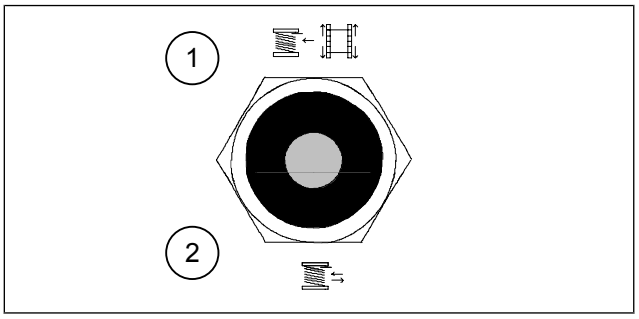


Automatic winch tensioning

Tensioning Switch



1. Automatic winch tensioning
2. Manual winch operation



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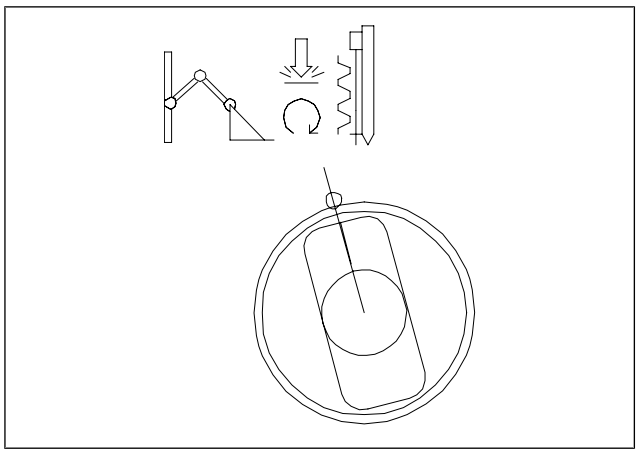
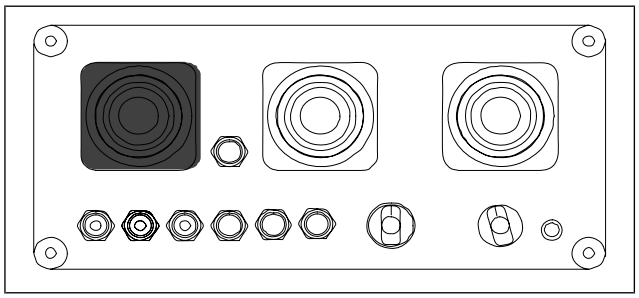
3.2.4. Boom and drilling control

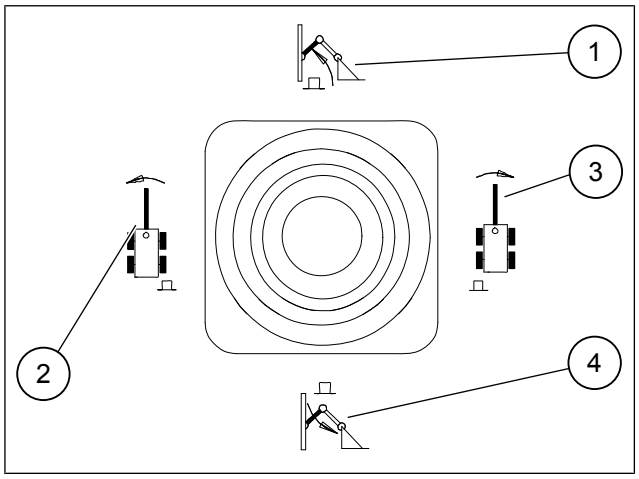
Boom control



Control level in middle position
NOTE! When the lever is in this position, the drilling functions too can be operated.



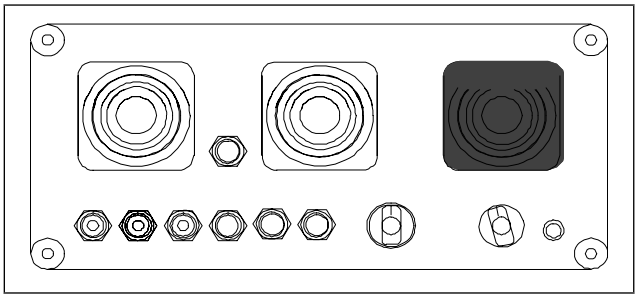
Left control lever

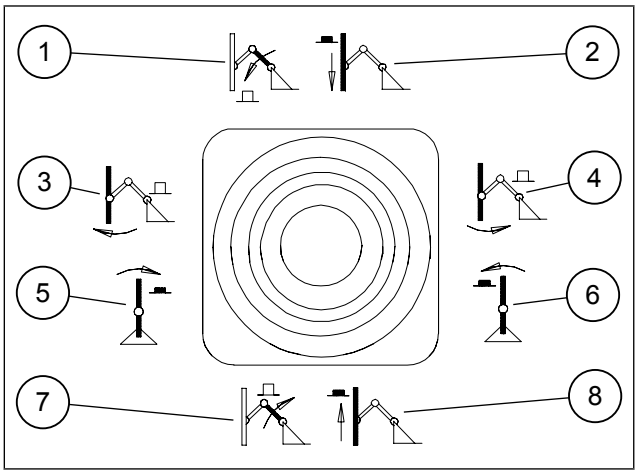


Boom controls using left control lever

1. Knee boom up
2. Boom swing to the left
3. Boom swing to the right
4. Knee boom down

Right control lever.



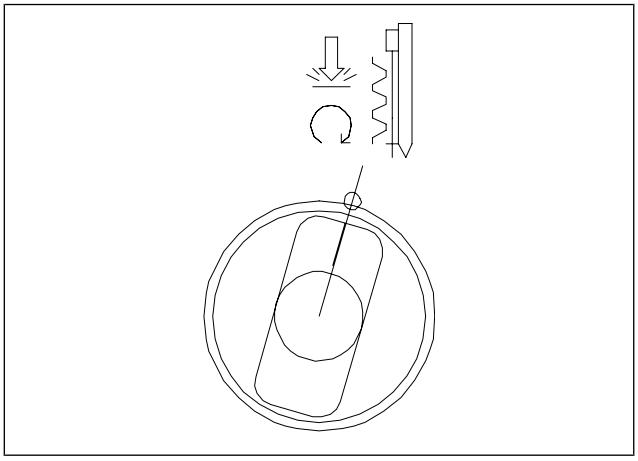


Boom controls using right control lever.

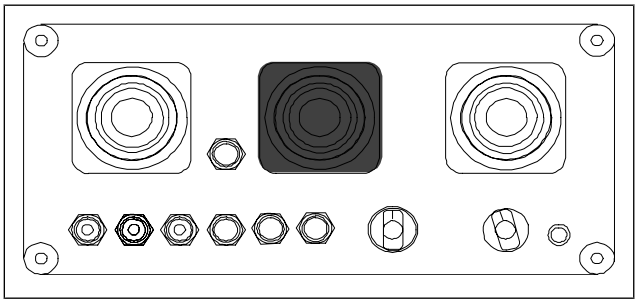
1. Base boom down
2. Feed down
3. Lower end of feed forward
4. Lower end of feed backward
5. Lower end of feed left
6. Lower end of feed right
7. Base boom up
8. Feed up

Drilling control

Control lever in the middle position



Using middle control lever



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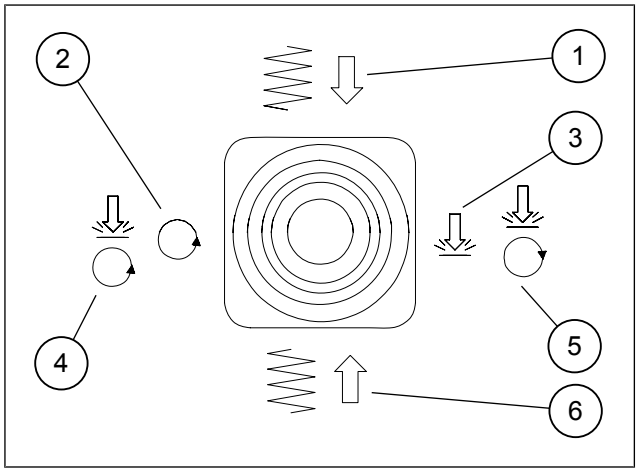
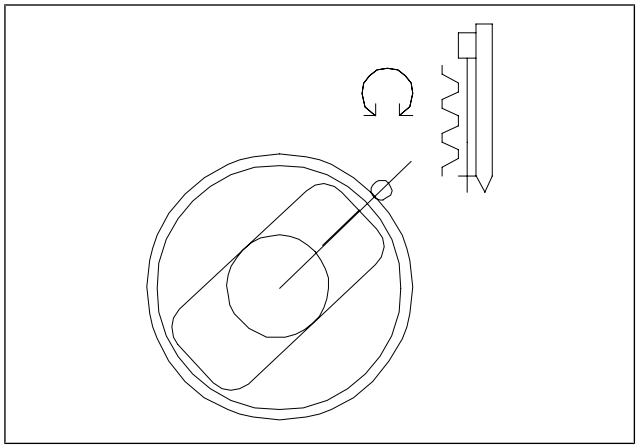
Drilling controls using middle control lever and control lever in midle position

1. Feed
2. Rotation anti--clockwise
3. Hammering
4. Percussion + rotation anti--clockwise
5. Percussion + rotation clockwise
6. Feed return

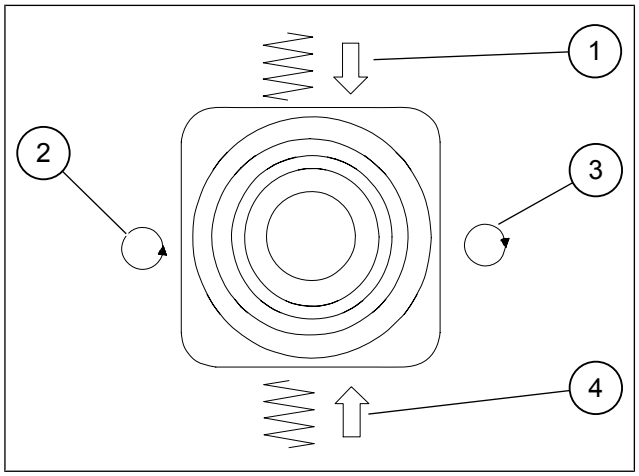


Control lever in the right position

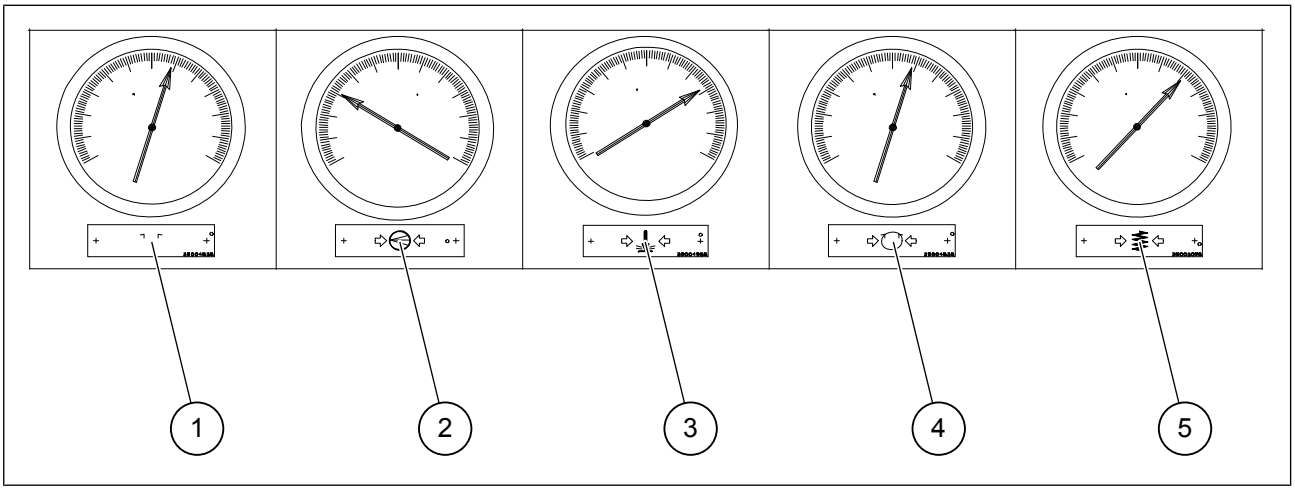


Drilling control using middle control lever.

1. Feed
2. Rotation anti--clockwise
3. Rotation clockwise
4. Feed return



3.2.5. Drilling gauges

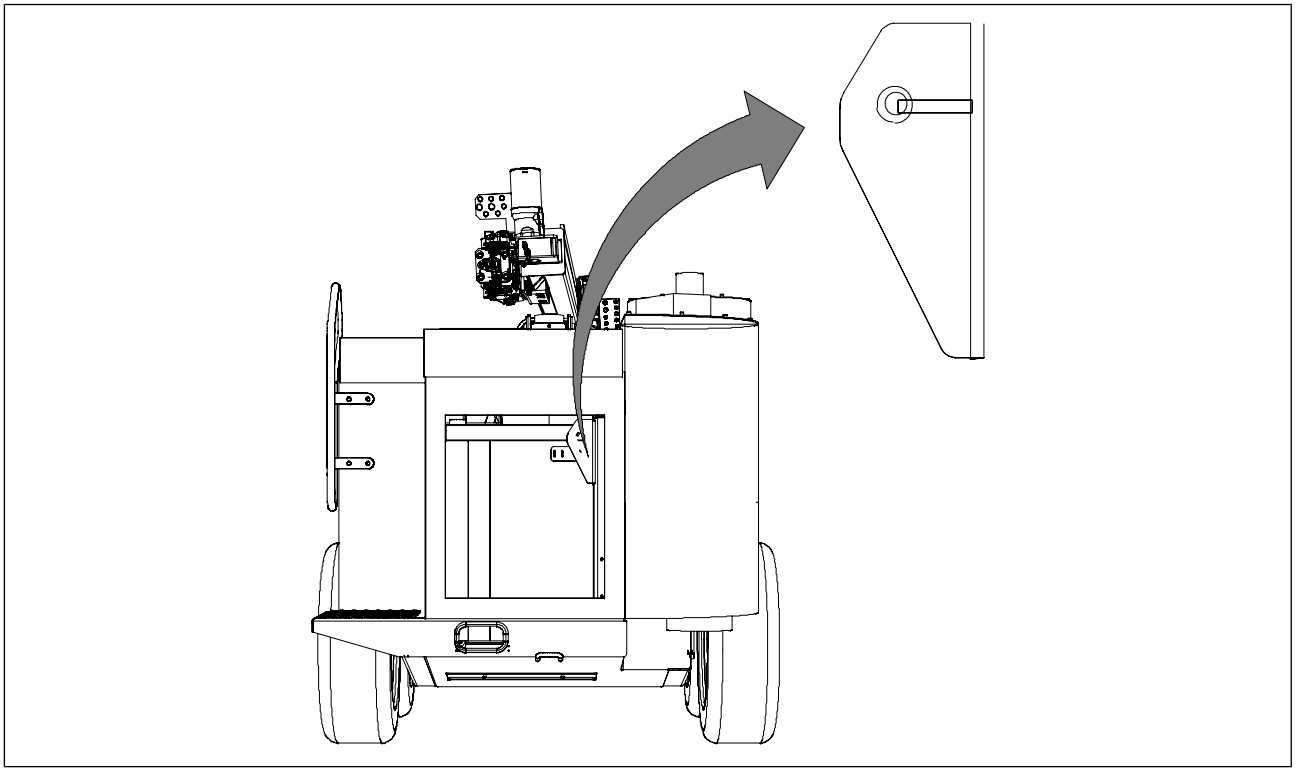


1	Hydraulic oil temperature	2	Flushing pressure
3	Percussion pressure	4	Rotation pressure
5	Feed pressure		

3.3. Mains switch and fuses

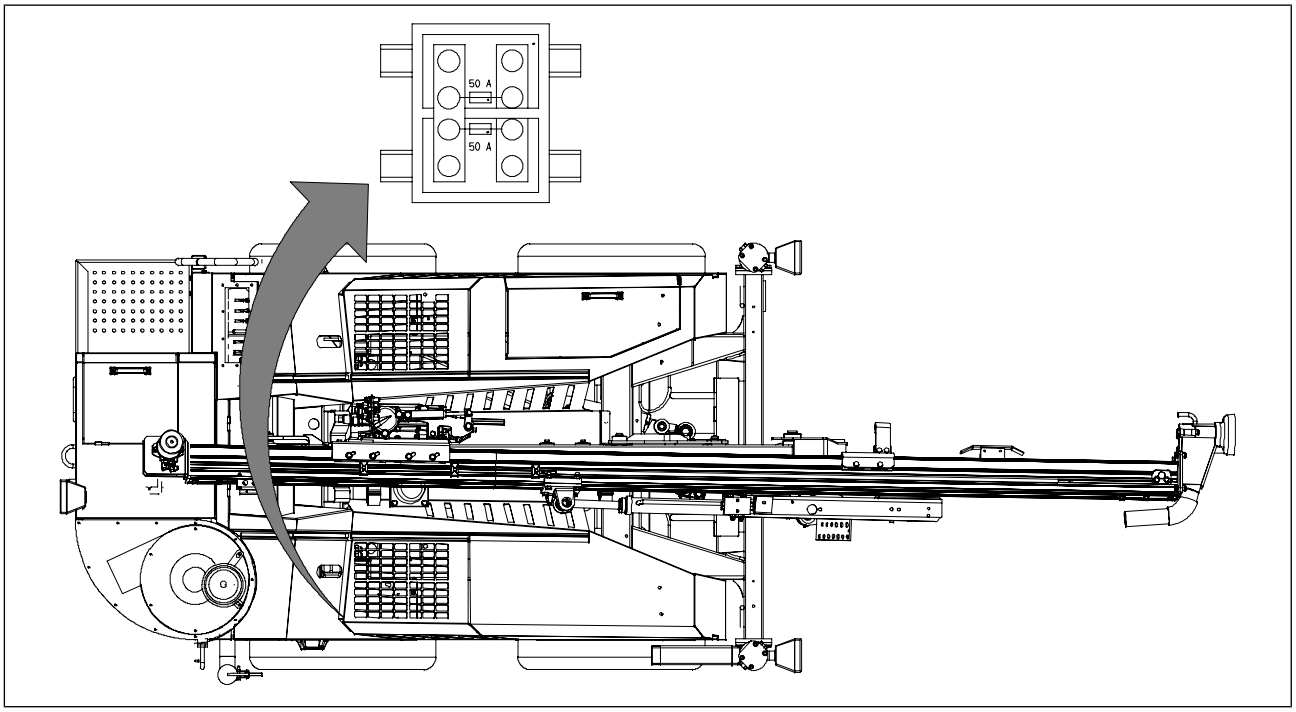
Main switch

The main switch is located at the rear of the rig next to the dust collector. 3.4.2. Fuses



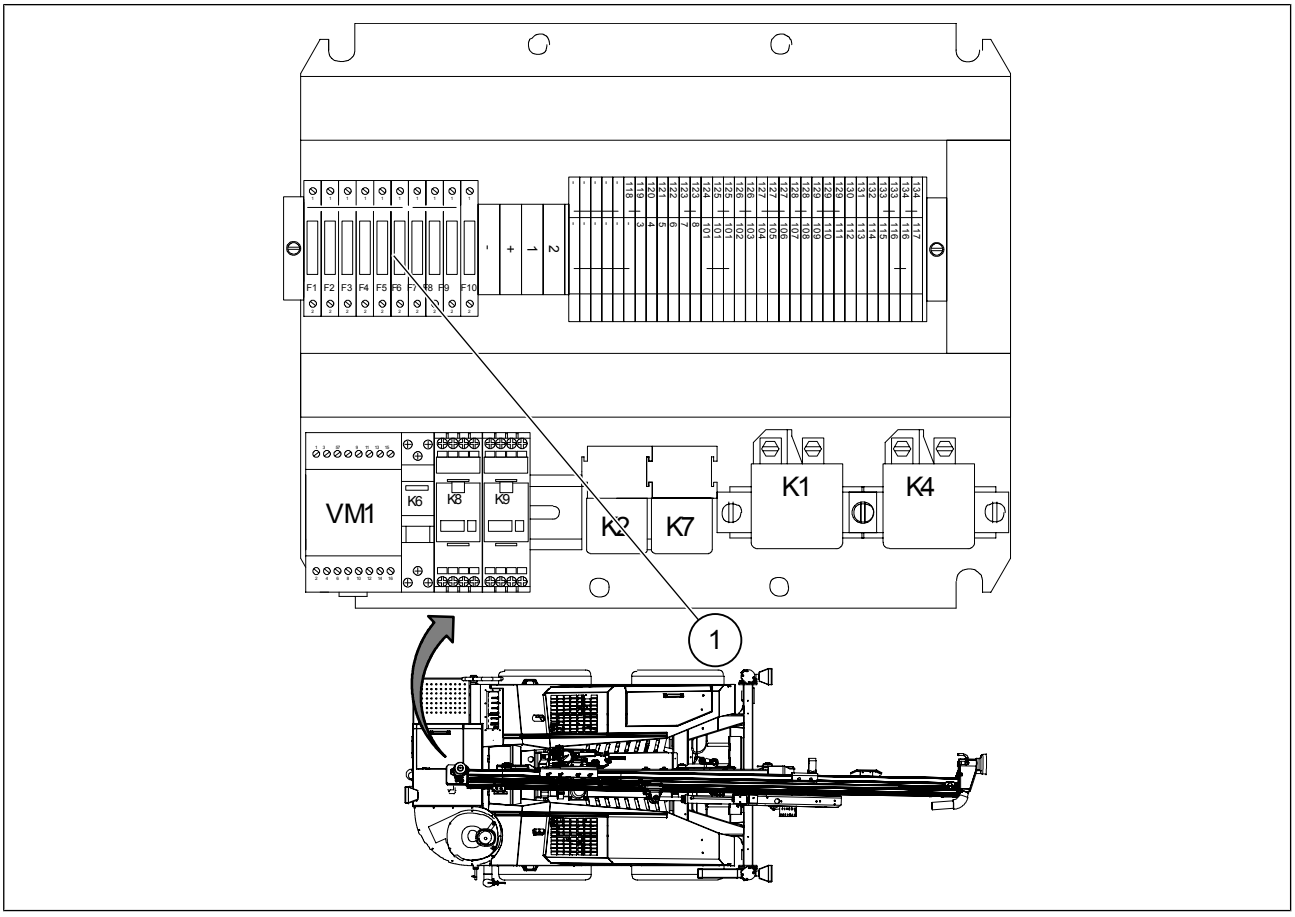
Main fuses

The main fuses (2 fuses, 50 A) are located under the side panel.



3.3.1. Additional fuses

Additional fuses F1 -- F10 (10 pcs.) are located in the electric cabinet.



1 F1–F10

4. OPERATING INSTRUCTIONS

4. OPERATING INSTRUCTIONS

4.1. Starting and Stopping the machine

4.1.1. Starting the diesel engine

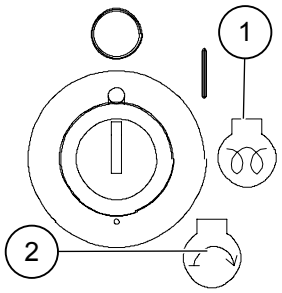
Before start–up, you must always check that there are no unauthorized persons within the danger area and that the control devices are not switched to operating position.

NOTICE **Do not attempt starting for longer than 30 seconds at a time. Let the starter motor cool off before restarting.**

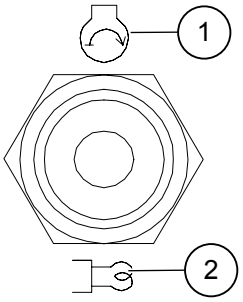
NOTICE **The engine cannot be started by towing.**

Starting a cold engine

1. Turn the main contact switch to the ON position.
2. Turn the remote control ON.
   For starting from the carrier panel, the selector switch (S63) must be in the position that indicates control from the carrier panel.
3. When the engine is cold, turn the ignition key to the pre--heating position and keep it there – pre–heating is now switched on.



1. Pre–heating
2. Start–up



1. Start–up
2. Pre–heating

NOTE: The normal pre–heating time is approximately 20 seconds. The necessary pre–heating time depends on such factors as the ambient temperature and the engine temperature. However, do not exceed the following pre–heating times:

Ambient temperature:

above +5ºC . . . . . approx. 20 s

+5 ºC.... –5ºC . . . . . approx. 30 s

below –5 ºC . . . . . approx. 60 s

4. Start the engine by turning the ignition key to the starting position. As soon as the engine starts, release the ignition key and make sure that the charging and oil pressure indicator lamps are not illuminated.
5. Additional starter batteries are recommended if you intend to start the equipment at a temperature of under –18°C. It might be necessary to warm up the engine coolant.

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4.1.2. When the engine is running

DANGER	
	**The main health risks of the exhaust fumes of a diesel engine are nitrogen oxides and carbon monoxide. GOOD VENTILATION MUST ALWAYS BE ENSURED WHEN THE ENGINE IS RUN INDOORS.**

NOTICE **Never leave the rig running unattended.**

4.1.3. Stopping engine

NOTICE **Before stopping the engine, allow it to idle for three minutes to equalize thermal stresses.**

1. Stop the engine by turning the ignition key into 0 position.

NOTICE **In danger situations the engine can also be stopped with one of the emergency stop buttons.**

NOTICE **Never turn the main switch off when the engine is running. This may damage the alternator or the voltage regulator.**

4.2. Operation with the cable, in remote control mode

The remote control is powered by the drilling rig's electrical system when the cable is connected.

In cold conditions, use of the cable is recommended.

4.2.1. Connecting the remote control

1. Turn the power off using the carrier's ignition key.
2. Turn the remote control off.
3. Connect the connecting cable: Receiver – Remote control.
4. Turn the carrier power on.
5. Turn the remote control on.

4.2.2. Charging the remote control's battery

The charger is in the tool box.

A 230–V charger is available for the rig.

The charging time is about three hours.

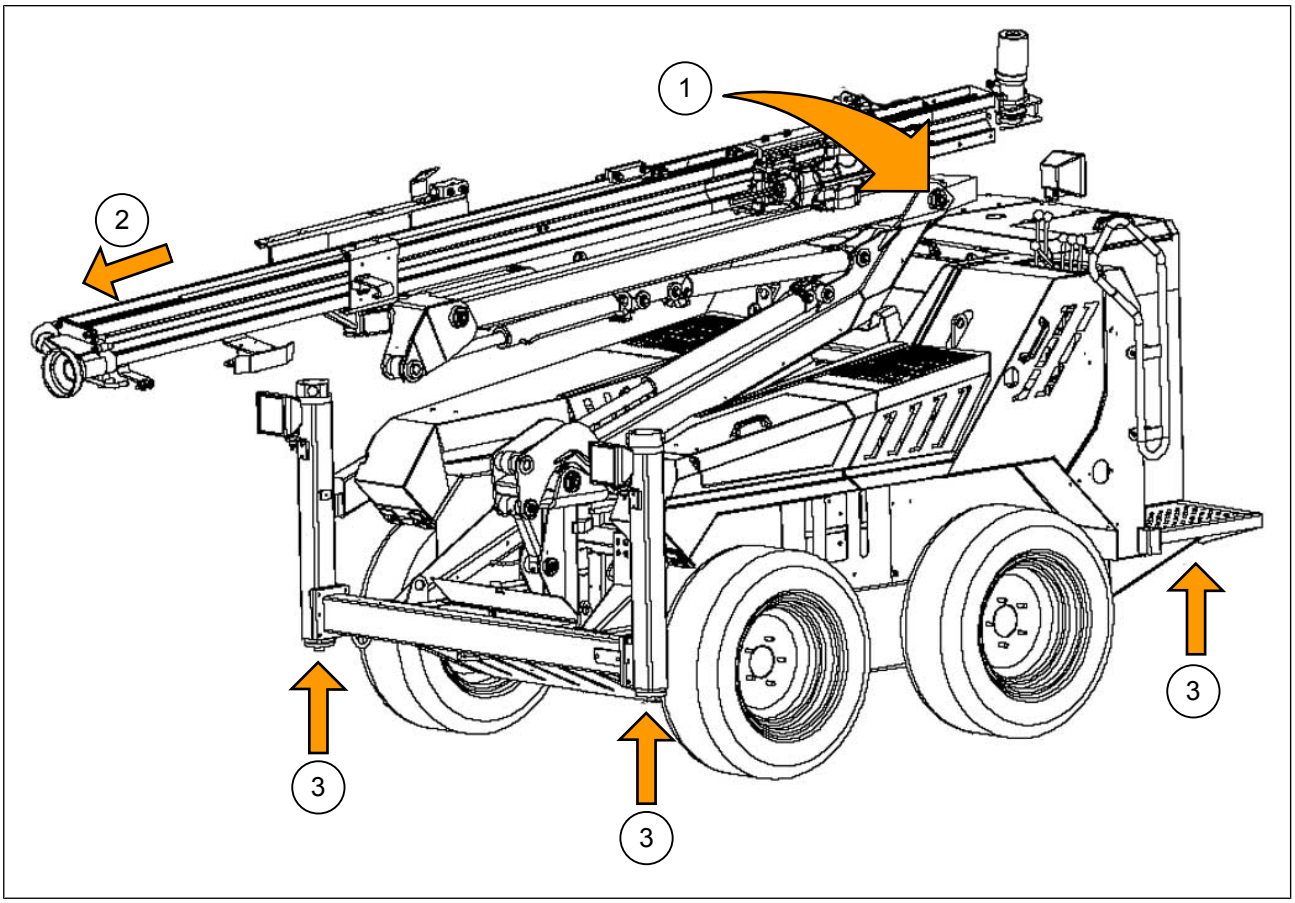
The charger features overcharge protection.

Recommended charging temperature is +10 ... +40ºC.

The battery should be charged daily.

4.3. Tramming instructions

4.3.1. Equipment positions during tramming



1 Boom in the lower position.
2 Feed is in the front position.
3 The jacks are up.

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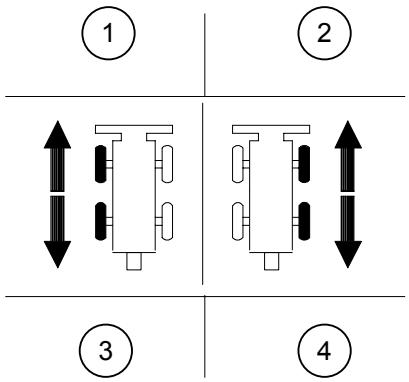
4.3.2. Tramming

NOTICE **Never tram the rig when the dust collector is running.**

1. Tram left forward
2. Tram right forward
3. Tram left back
4. Tram right back



Tramming

- Tramming is controlled using the tramming control levers.
- The carrier hydraulic system is connected in a manner that allows the wheels on the left--hand side to be controlled by the left control lever, and the wheels on the right--hand side with the right--hand lever.
- The rig starts moving when both tramming control levers are pushed slowly forward. To reach the maximum speed, push the levers forward as far as they will go. When you want to reverse, pull the levers toward you.
- If you want to turn right when tramming forward, push the left tramming control lever forward and centre the right--hand lever.
- A sharper turn can be made when the left lever is pushed forward and the right lever pulled back.

4.3.3. Stopping

- The rig has four hydraulic motors, all of which have hydraulic--pressure operated brakes. The system is connected in such a way that the brakes are switched on automatically whenever the rig is not moving and the tramming control levers are centred. The brakes are released with hydraulic pressure when the operator starts tramming the rig.
- The tramming control levers should not be centred too quickly when the rig is moving.

4.3.4. Tramming to another drilling site

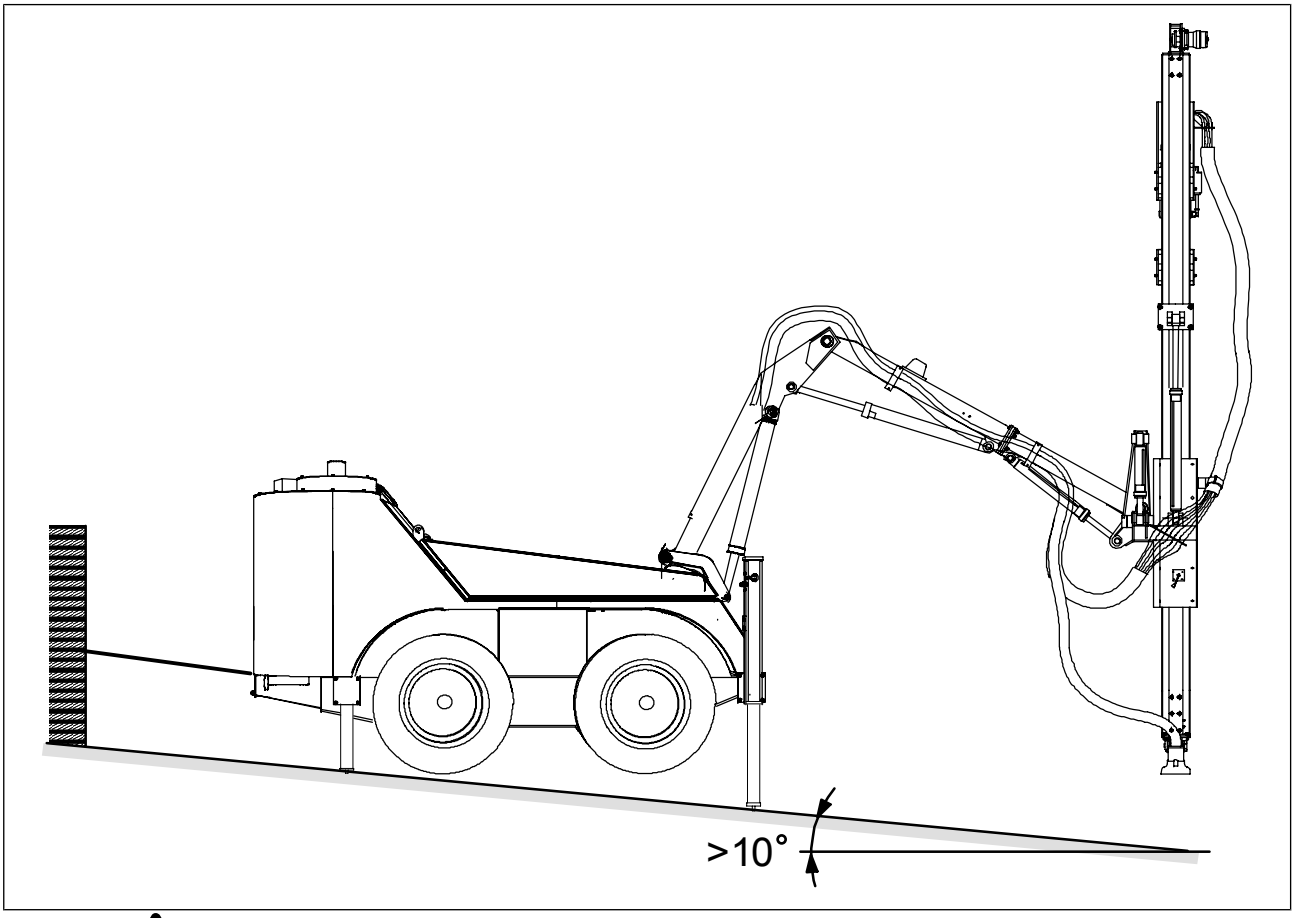
1. Lower the boom onto the transportation support.
2. Stop the dust collector using the remote control switch.
3. Lift the jacks up.
4. Release the hand brake, and drive with utmost care to the next drilling site.

4.3.5. Using winch

Tipping hazard. Can cause severe injury or death. Never exceed maximum allowed inclination angles (when drilling or tramming).

When using the winch, always make sure that the winch drum has a minimum of three loops of cable. Merely locking the cable in the drum is inadequate because the cable is subjected to tugging.

If the inclination of the drilling site is greater than 10 degrees, secure the rig by attaching a winch cable to a firm location on the uphill side.



If the terrain inclination is more than 20°, a winch must be used.

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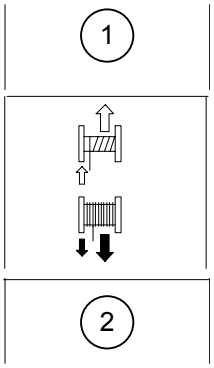
1. Winch cable in
2. Winch cable out



The lever operating the winch control valve is located on the rig's tramming panel. When you pull the lever back, the cable is reeled out. If you push the lever forwards, the cable is reeled in. Reeling speed depends on the position of the lever; maximum speed is achieved when the lever is tilted as far as it will go.

Monitor the condition of the cable. Replace the cable if the strands are frayed; refer to the winch instructions.

Always keep a slight tension in the cable when tramming. This ensures that the cable will not sag. This will prevent sudden tugs and the breaking of the cable. Make sure you reel the cable evenly onto the drum. A tangled cable breaks easily.

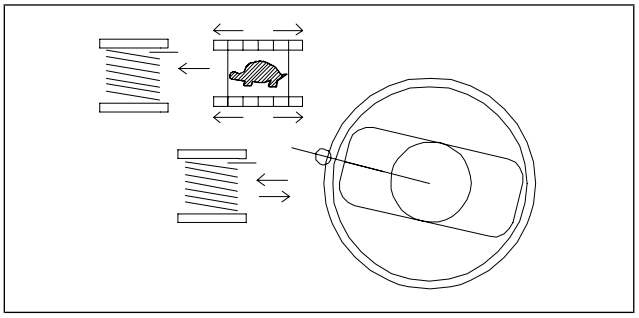
To ensure proper operation of the winch brake, the cable must be reeled onto the drum anticlockwise, as seen from the direction of the hydraulic motor. If the cable is reeled in the wrong way, the winch brake will not function. The rig will then not be kept in place by the winch.

4.3.6. Using the winch by remote control

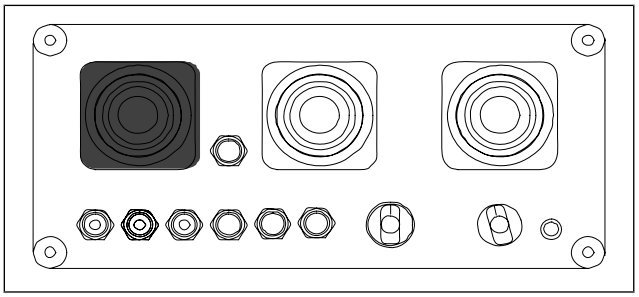
Reeling control

The operating lever of the winch control valve is located on the remote control. When you tilt the lever to the right, the cable is reeled out. When you tilt it to the left, the cable is reeled in. Reeling speed depends on the position of the lever; maximum speed is achieved when the lever is tilted as far as it will go.

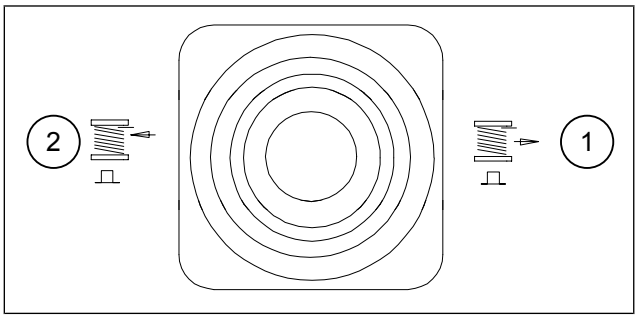
Winch speed



Use left control lever

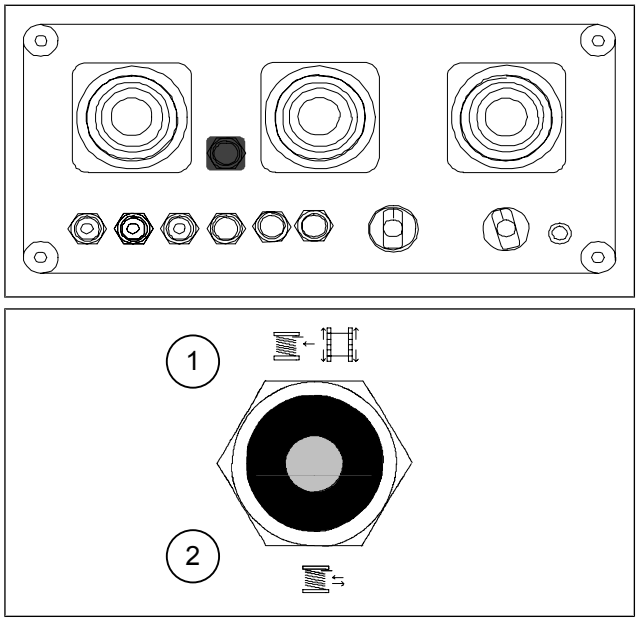


1. Reel out the winch cable
2. Reel in the winch cable



Automatic winch tensioning

Tensioning Switch



1. Automatic winch tensioning
2. Manual winch operation

4.4. Drilling instructions

4.4.1. Safety instructions

Operating, service and adjustment procedures must be carried out only by personnel with specialized operation and service training. Read and ensure that you understand the operating, maintenance, and safety instructions before using or servicing the rig.

WARNING! PERSONAL INJURY HAZARD! Hazardous moving parts and dangerous rig movements (boom, feed, rock drill, hatches, and gratings) could result in death or severe injury. Make sure there are no unauthorized persons in the danger areas during drilling, tramming, setting up or servicing the rig.

Dangerous rig movements. Keep an eye on the movements of the drilling rig when working close to the rig. Watch out in particular for the rotating drill rod.

Take all safety factors into consideration and perform your work with care. Follow all drilling site safety regulations.

Make sure that all control levers are in the middle position before you start the power pack.

NOTICE

PROPERTY DAMAGE RISK! Ensure that rock drill lubrication is working. Faults arise in the rock drill very quickly if shank lubrication does not operate correctly.

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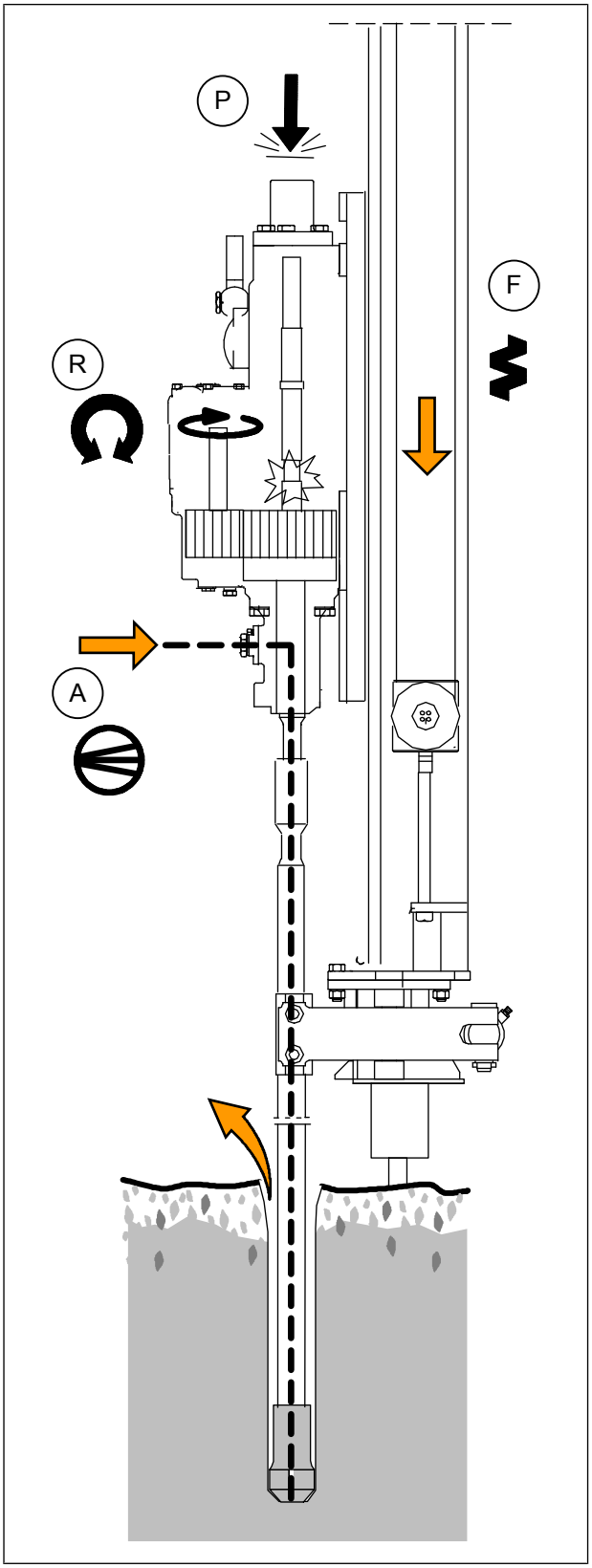
4.4.2. Principles of percussion drilling

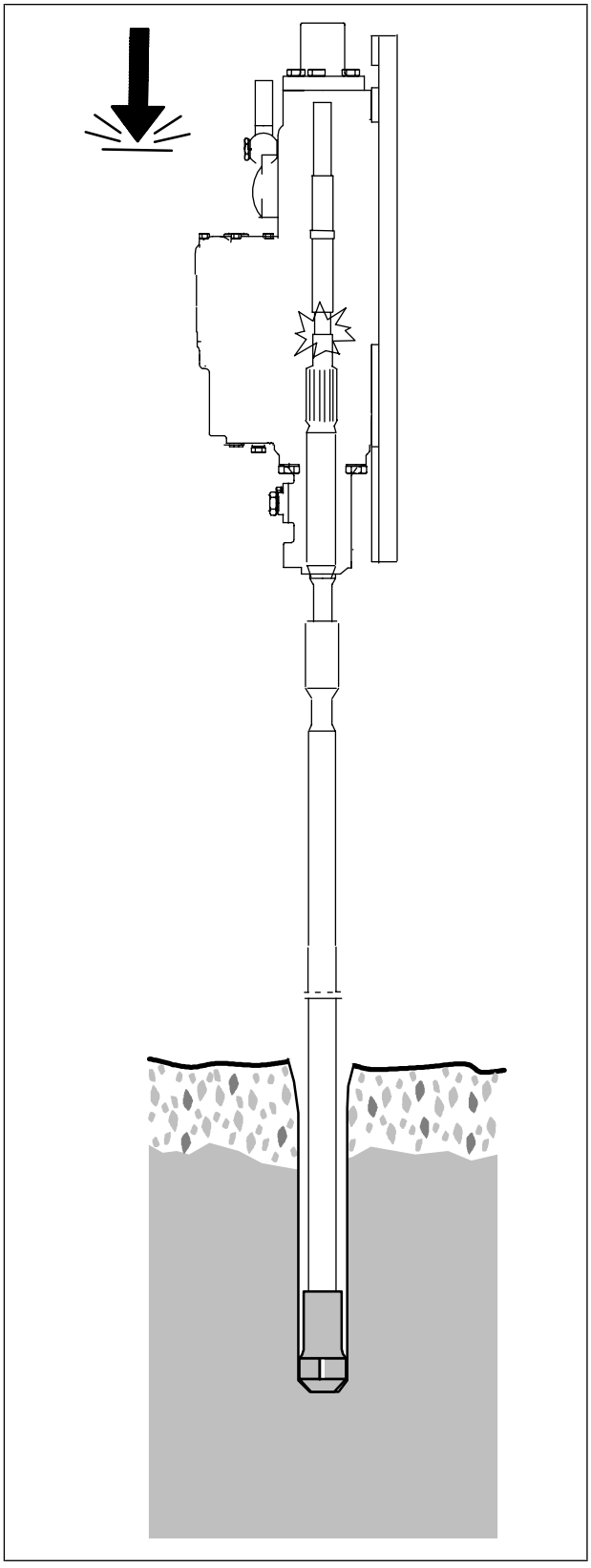


Percussion drilling has four main functions:

- Percussion (P), which makes the drill bit penetrate the rock.
- Feed (F), which keeps the drill bit in tight contact with the rock.
- Rotation (R), which turns the drill bit to a new position before the next percussion.
- Flushing (A), which removes the cuttings and cools the drilling equipment.

The percussion energy created by the rock drill piston is transferred to the rock through the drilling equipment.

Percussion



Percussion refers to the rock drill piston's impacting, reciprocating movement generated by the hydraulics. The rock drill's shank transfers the piston's percussion energy into the drill rod, and the rod does the same through the drill bit to the rock. The striking point is the point where the piston hits the shank.
The percussion power is generated by the percussion force, the percussion frequency, and the drill bit’s penetration. The percussion power is conveyed to the rock through the drilling equipment. The percussion power can be directly controlled by using percussion pressure.
One of the basic issues in drilling is the energy transfer capacity of the drilling equipment. Only a certain maximum amount of kinetic energy can be transferred using drilling equipment of a certain size. When the equipment’s ability to transfer energy is exceeded, equipment damage increases rapidly.
The percussion power used depends on the quality of the rock to be drilled. If the rock is soft, a lower percussion pressure can be used. If the rock is hard, a higher percussion pressure is used.
Setting the percussion pressure always involves a compromise between penetration rate and equipment durability.

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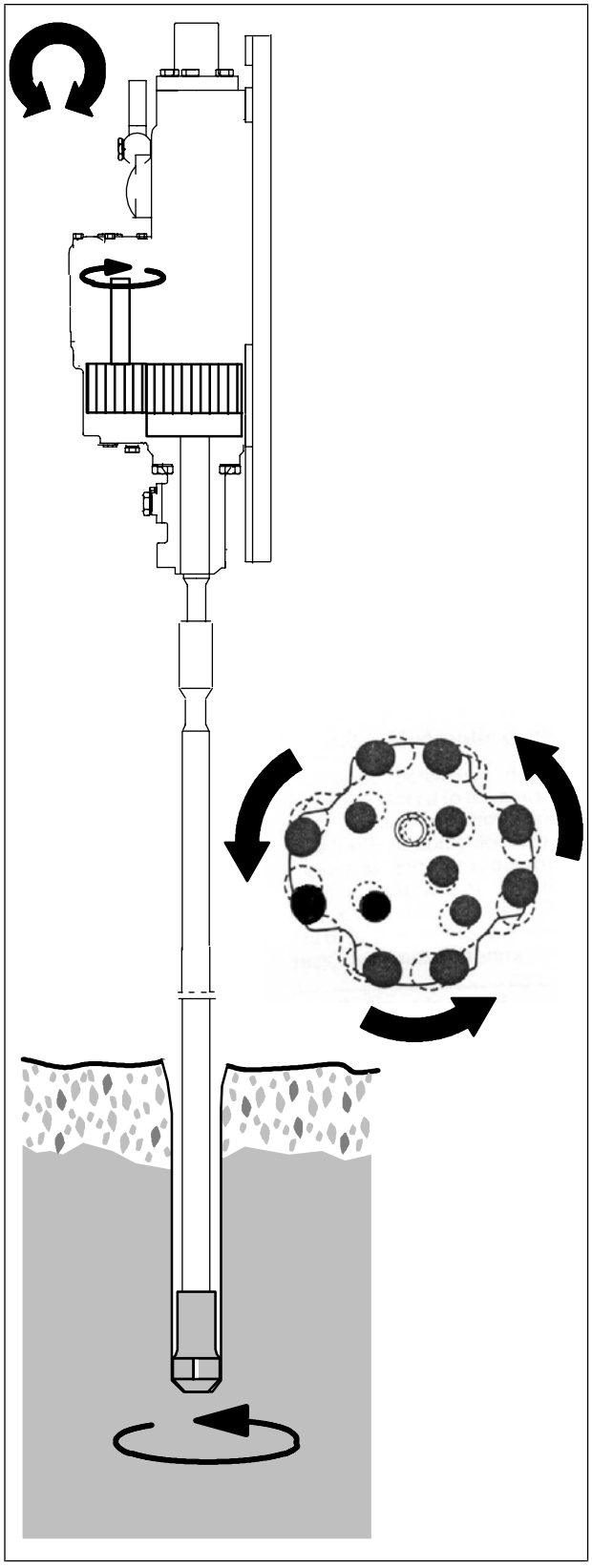
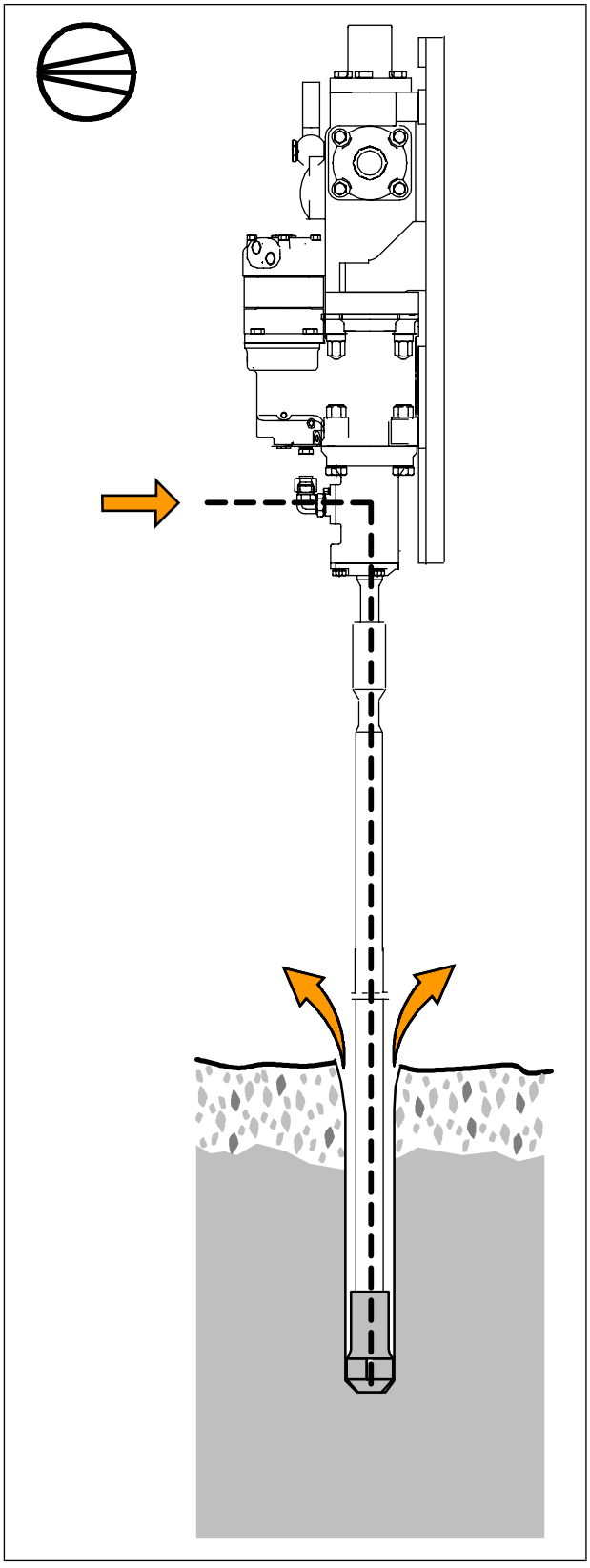
Rotation



Rotation is the drill rod's rotation movement that aims to move the drill bit buttons between percussions. The hydraulic motor inside the rock drill rotates the drill rod through a gearing.
The correct rotation speed depends on the form and diameter of the drill bit, hole depth, rock conditions, and the other main functions of drilling.
Inadequate rotation speed causes energy loss (the cuttings are ground too finely) and leads to poor penetration.
Too high a rotation speed results in excessive bit wear, since the rock is broken by rotation rather than percussion. Excessive rotation speed also leads to overtightening of threaded connections.

Flushing



Flushing means transferring the loose rock material (cuttings) created in drilling away from the drill hole. The other task of the flushing function is to cool the structures of the rock drill and the drilling equipment.
Poor flushing leads to low penetration (cuttings are ground at the bottom of the hole), to short drilling equipment service life (risk of rod jamming is increased), and to rapid wear of the drill bit.

Water flushing

Water flushing is a flushing method that binds rock dust. Flushing is led to the rock drill's flushing housing, from which it flows through the shank to the drill rod, and onward through the flushing holes in the drill bit to the drill hole.

Air flushing

The flushing air is carried to the bottom of the hole through the rod hole and the holes in the drill bit. The mix of flushing air and cuttings is directed out of the hole through the space between the rod and the hole wall.

Water mist flushing (optional)

In water mist flushing, a certain amount of water is sprayed into the flushing air. The amount of water is adjusted according to the hole size, drilling direction, and rock type.

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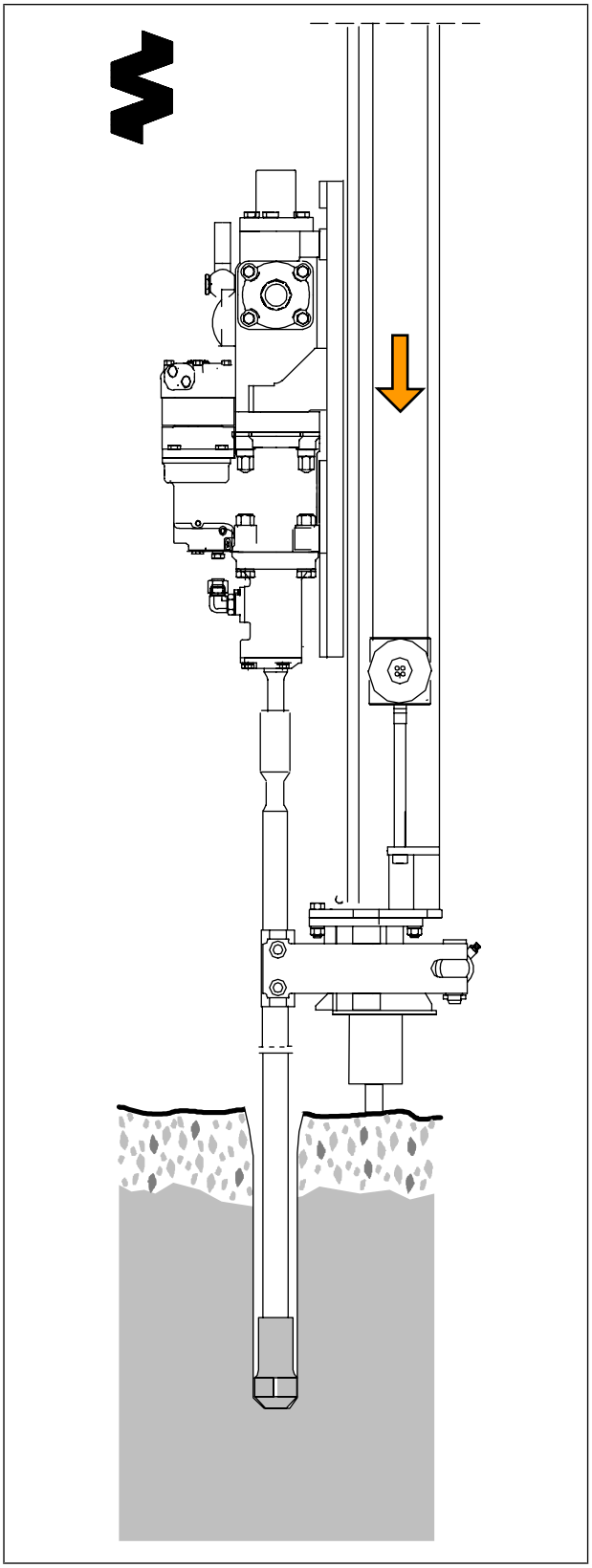
Feed



The feed movement means the rock drill's linear movement on the feed.
The purpose of the feed is to keep the shank tightly connected to the rock drill and the drill bit in firm contact with the rock.
When the percussion pressure is increased, the feed pressure must also be increased. The correct feed power depends on the percussion pressure, rock conditions, hole depth, and the size and type of the drilling equipment.
Broken rock should be drilled using low percussion pressure and low feed pressure.
The correct feed pressure can be determined by observing and listening.
OBSERVE the following, which should be present:

- Constant progressive movement of the rock drill (the drill carriage should not shake)
- Constant rotation of the rock drill (constant rpm)
- Tight shank connection (the connection must not overheat / turn blue / emit smoke)
- Constant penetration

LISTEN for the following:

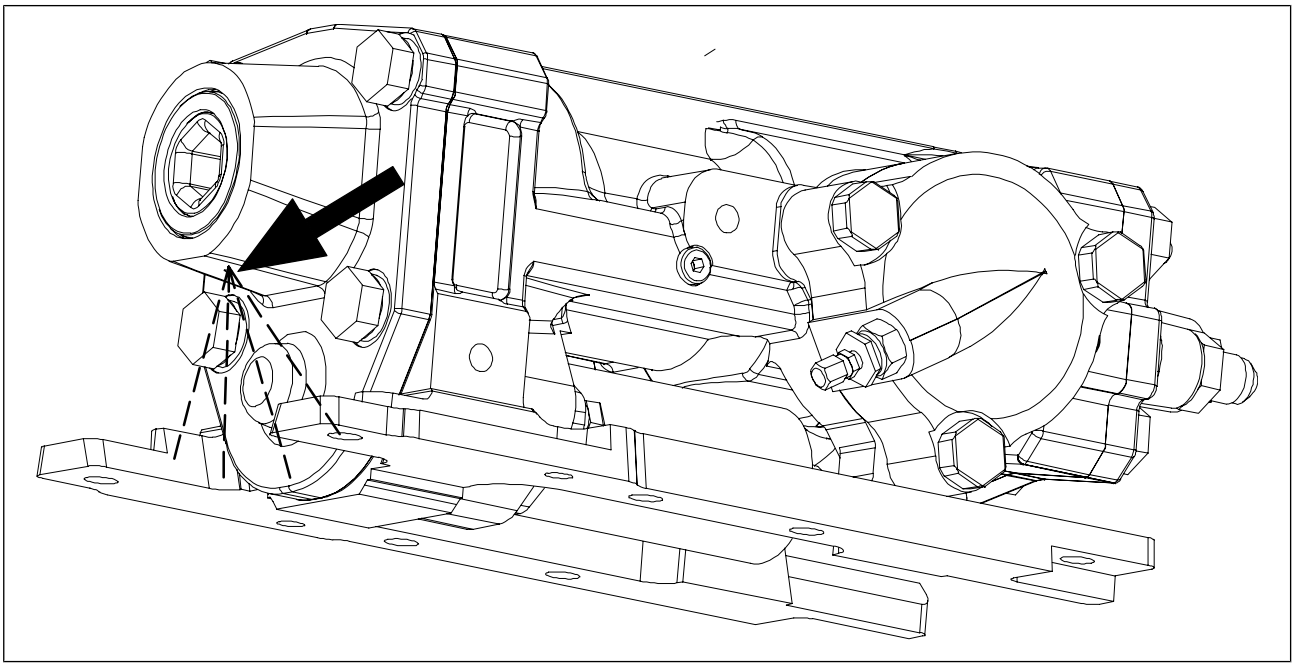
- Constant drilling sound (no rattling or shaking sounds)

Excessive feed power does not increase penetration. It only increases drill bit wear, causes irregularity in the drilled holes, and bends the rod, causing unusually high rotation pressures. Inadequate feed power leads to loss of contact between the drill bit and the rock. This causes the percussion energy to be reflected back to the drilling equipment, causing damage to the equipment, the rock drill, and the drill carriage.

4.4.3. Shank lubrication

Flushing and shank lubrication start automatically when percussion is initiated.

A mixture of oil and compressed air is used for lubricating the rock drill rotation mechanism and shank. Check that the shank is slightly covered with oil and that oil mist comes out of the hole under the flushing housing, so that the shank and chuck receive an adequate amount of oil during drilling.



NOTICE

Proper shank lubrication is necessary. Inadequate lubrication quickly causes serious damage to the rock drill. Inadequate lubrication causes the chuck and the shank to overheat, and this leads to rapid wear of these components. Overheating of the shank also causes shank breakage.

NOTICE

Always ensure that the shank lubrication oil used fulfils the requirements. Choose the oil viscosity on the basis of the ambient temperature.

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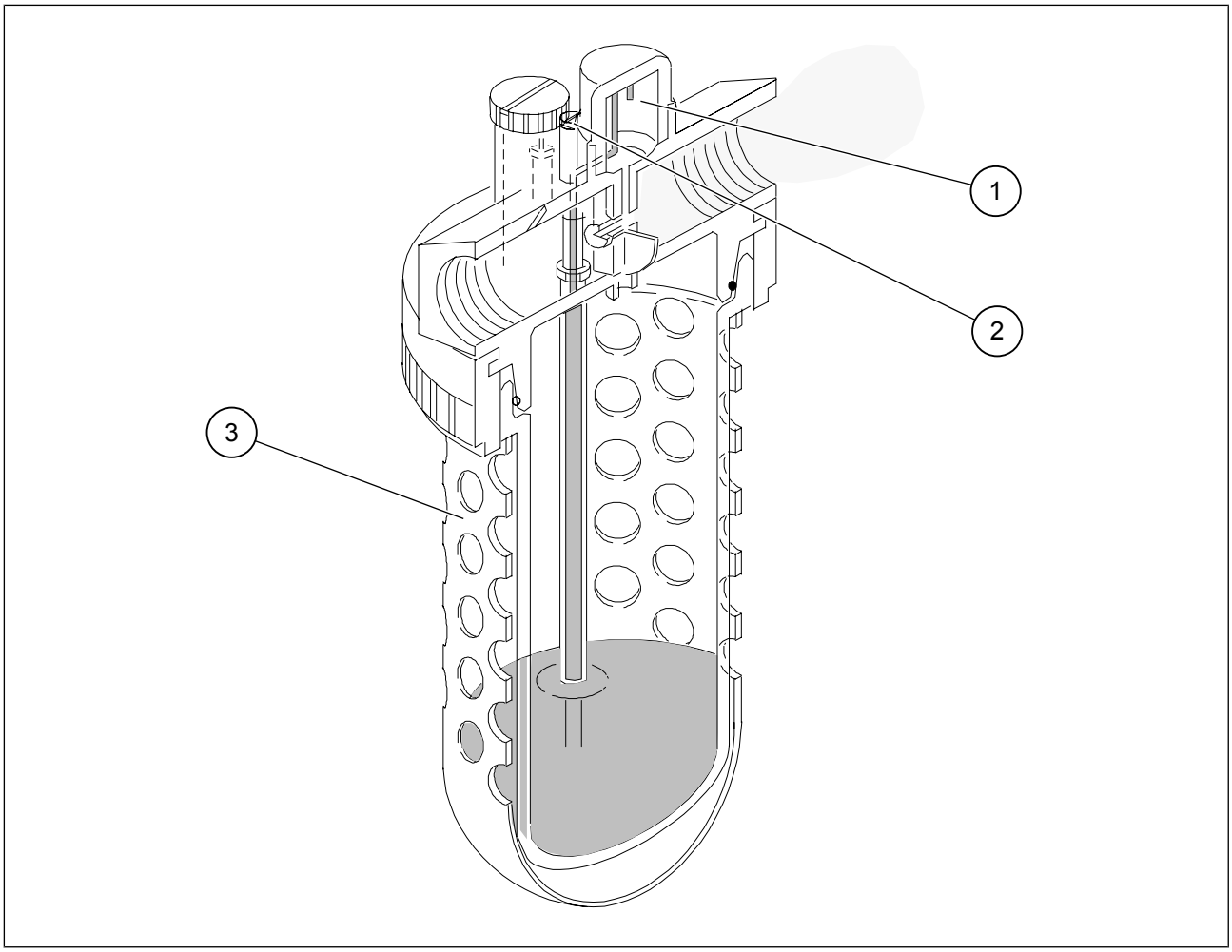
Adjusting the shank lubrication device

1. Monitor the dripping of oil from the drip pipe
2. turn the mixture--adjusting screw, if necessary
3. Adjust the drip rate to 30 to 50 drops/minute.

The lubrication is sufficient when the drill rod is oily for a length of 25 cm from the rock drill.

NOTICE **Never leave the lubrication device without its metal housing.**

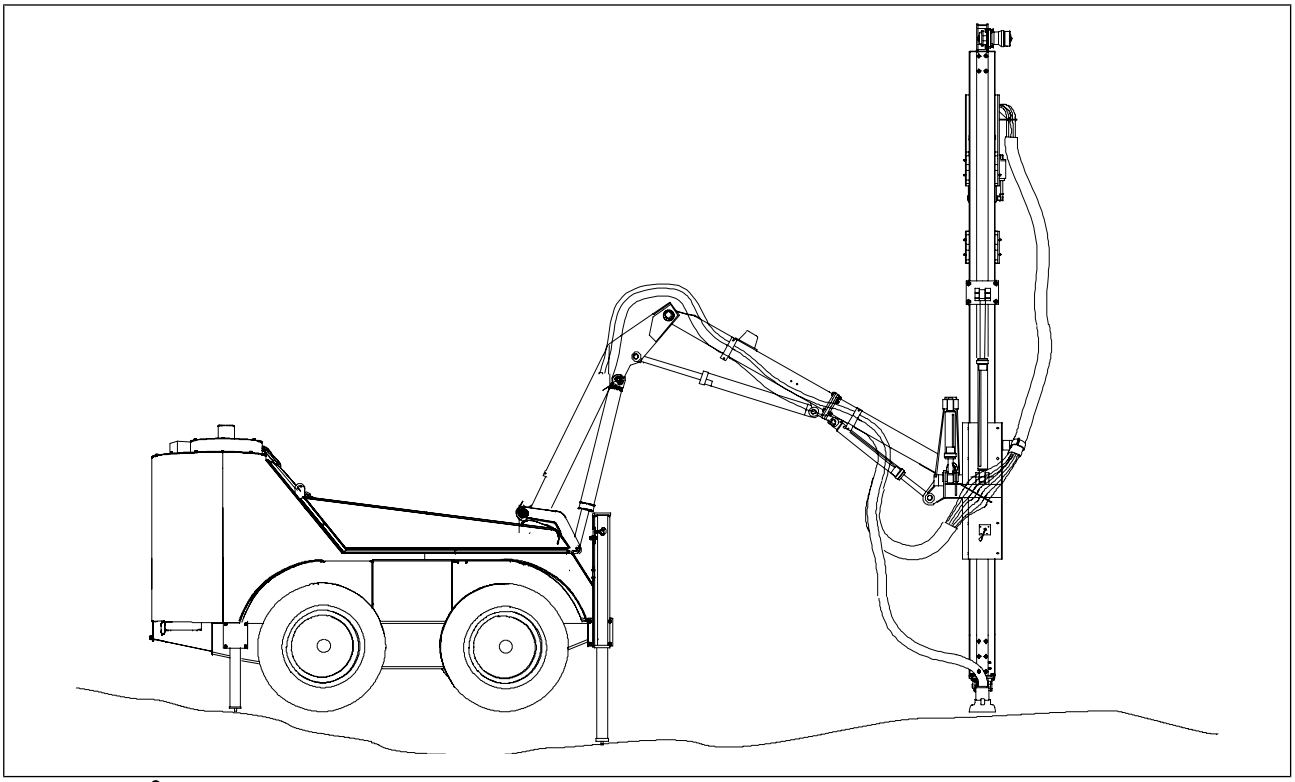


1. Drip pipe
2. Adjusting screw
3. Metal housing

Recommendations on oil and detailed instructions on the use of the shank lubrication device are contained in separate instructions.

4.4.4. Positioning and support

1. Run the front jacks down,
   so that the rig is straight laterally;
2. Lower the rear jacks,
   so that the rig is straight.



The tramming control levers must be in their middle position.
Make sure that nobody touches the levers.

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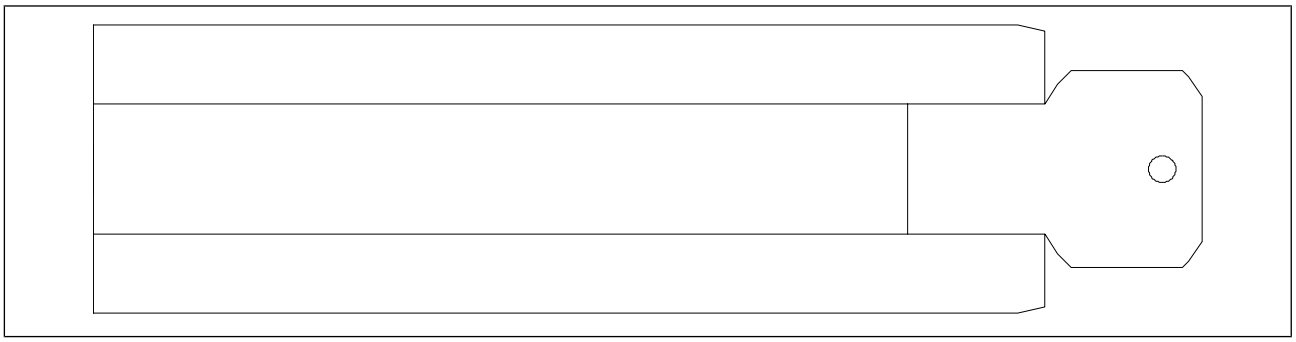
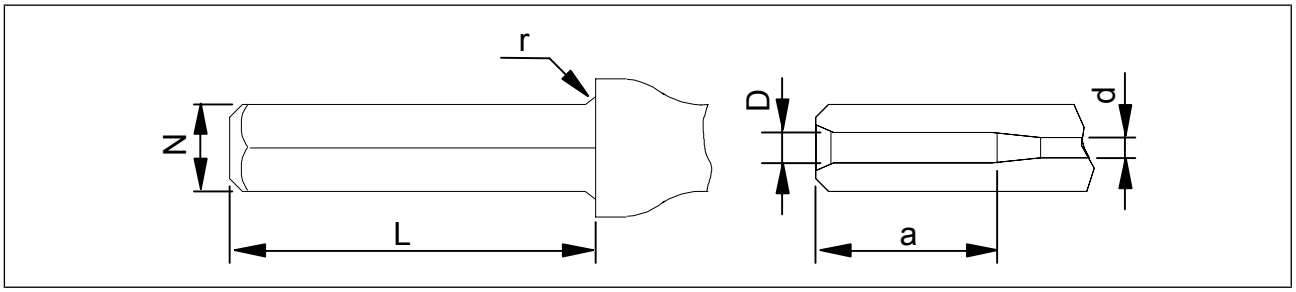
Preparations

1. Position the rig, and lift it horizontally on the jacks.
2. Check the shank lubrication device oil level. Daily, purge the water collected in the lubrication device.
3. Always check the condition of the flushing pipe and the chuck before starting to drill. The chuck should not be too worn. Use a chuck bushing. PREVENT DIRT FROM GETTING INTO THE CHUCK.



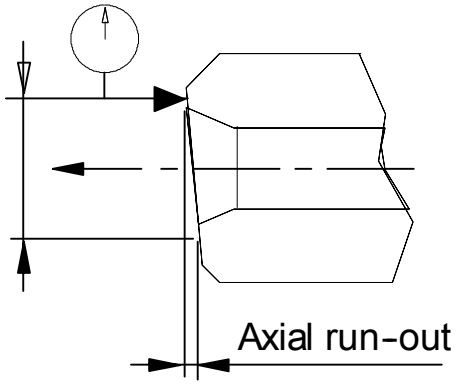
4. Regularly check the condition of the drill shank, the chuck, and the rotation bushing and the bearing surfaces that come into contact with it. A mixture of oil and compressed air is used for lubricating the rock drill rotation mechanism and shank. Check that oil mist comes out of the hole under the flushing housing and from the shank, so that the rotation gear and the drill shank receive oil during drilling.
   INADEQUATE LUBRICATION CAUSES THE CHUCK AND THE SHANK TO OVERHEAT, AND THIS LEADS TO RAPID WEAR OF THESE COMPONENTS. Overheating of the shank also causes shank breakage.
5. It is better to grind the drill bits too often than too infrequently. In drilling granite with a chisel bit, the normal grinding interval is approximately 15 to 20 drill metres. Request instructions for maintaining and grinding your drill equipment from your drill supplier.
6. Checking the drill equipment: When using stationary equipment, be sure that it fills at least the requirements set forth in the ISO 723 standard.
   We recommend that you use equipment manufactured by established drill manufacturers. In particular, the condition of the shank should be under constant monitoring. In order to achieve the best possible results, the shank dimensions should meet the following tolerance requirements.



L	Length of shank	N	Width across flats
r	Radius of curvature of the collar	a	Flushing hole dimensions
d	Flushing hole dimensions	D	Flushing hole dimensions

Shank	L	N	N Tolerance	d min.	D	a min.	r max
19mm (3/4*)	108±0.5	19.2mm	0-0.4	5.5	8±0.3	50	4.5
22mm (7/8 *)	108±0.5	22.4	0-0.4	6.1	9±0.3	50	4.5

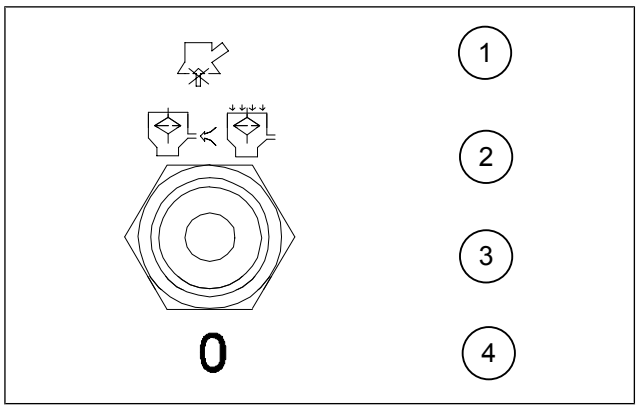
- Flushing pipe hole centricity: Difference between the centre lines of the hole and the shank max. 0.5 mm.
- Deviation angle of the shank percussion surface: Max. axial run--out measured at a 7-mm radius 0.1 mm.



4.4.5. Drilling

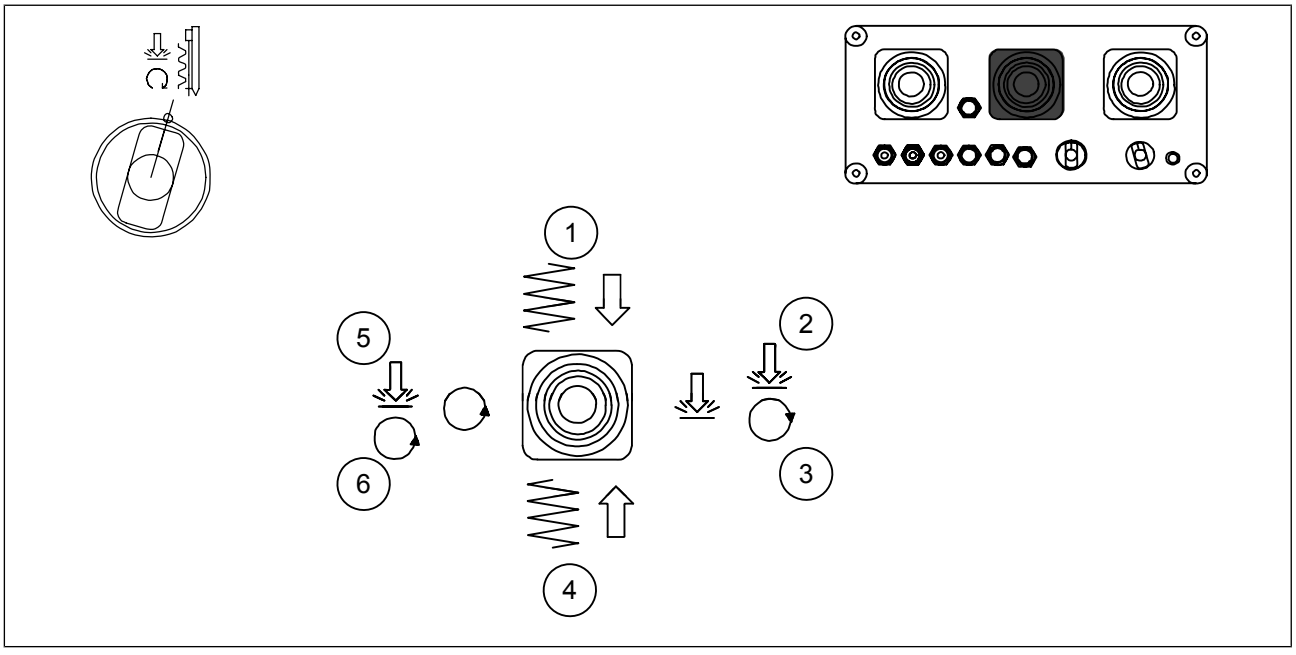
1. Engage the dust collector.

1. Suction cut-off
2. Suction ON. Dust
3. collector ON + blow-off
4. OFF



2. Begin drilling by tilting the drilling control lever to the left/right.
   Rotation and half-power percussion begin.
   - Half-power percussion can be used to facilitate starting when the drill bit meets the rock.
   - Half-power percussion can be switched on from the remote control as well.

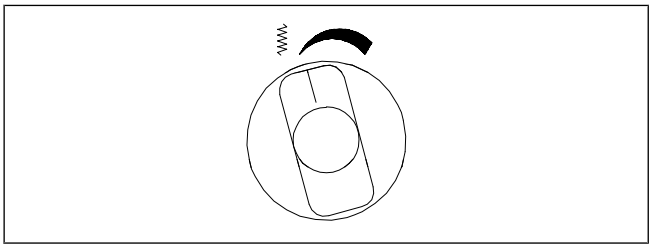
3. Engage the feed by tilting the control lever forward.



1	Feed	2	Hammering
3	Percussion + rotation clockwise	4	Feed return
5	Percussion + rotation	6	Rotation anti-clockwise

After drilling has started, full-power percussion begins automatically.

4. Use the feed adjustment when beginning to drill a hole.



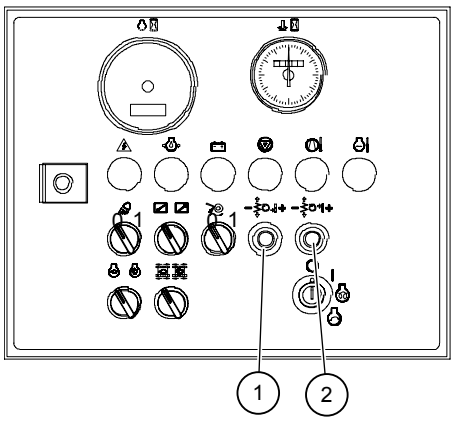
5. Hold the tip of the feed device in contact with the rock during drilling.
   This is to avoid unnecessary shaking as well as rapid wear to the centraliser, drilling equipment, and rock drill. Also, the penetration rate decreases if the feed is not in contact with the rock.
   When the percussion is engaged, the rpm cylinder affects the throttle levers and the rotation speed of the motor increases.

Flushing and shank lubrication start automatically when percussion is initiated.

Adjusting the drilling

The rotation direction changes when the control lever is moved from the left to right, and vice versa. When you are drilling with integral rods, the rotation direction should be changed after each hole so that the drilling equipment will wear evenly.

1. Adjust the feed pressure and the anti-jamming automatics.



- Fully tighten the anti-jamming automatics' load relief (1) and retraction (2) adjustment knobs (clockwise).
- Adjust the feed by turning the remote control adjustment knob clockwise or anti-clockwise. Pay special attention to the rotation pressure gauge and the rotation of the drill rod, and to the sound and vibration of the rock drill. The feed pressure is determined by the hole size and the type of rock being drilled.
- Keep opening the anti-jamming automatics' load relief adjustment knob (1) until the penetration decreases and the sound of the rock drill changes to a jingling sound. Slightly tighten the adjustment knob. Then adjust the retraction (2). The anti-jamming automatics are now adjusted. The correct adjustment value is 15 to 20 bar higher than the rotation pressure during normal drilling. (The basic adjustment value of the anti-jamming automatics is 50 to 60 bar. The adjustment value varies according to hole size and rock type.)

Monitor the operation of the anti-jamming automatics, opening or tightening the adjustment knobs as necessary. If drilling using anti-jamming is not successful, switch off the anti-jamming automatics (disengage rotation first) and tram through the rock fracture using manual control.
When the oil is cold, the anti-jamming automatics might function without proper reason.

NOTICE

The feed and the anti-jamming automatics must usually be readjusted when hole size, rock type, or rotation speed changes!

If, despite this, the drill rod gets jammed, proceed as follows:

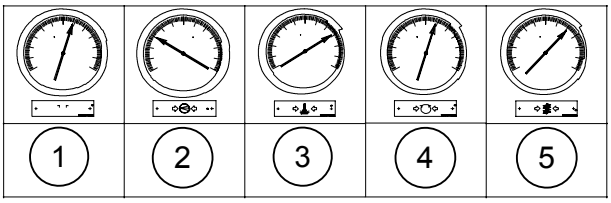
- Return the drilling control lever to its middle position.
- Turn the anti-jamming automatics off with the remote control selector switch.
- Detach the rod from the fracture by using rotation, feed, and percussion.
- After the rod is loose, switch the anti-jamming automatics on again.
- Continue drilling as usual, but adjust the anti-jamming automatics as soon as possible because the adjustments are clearly not correct.

2. Adjust the rotation speed.
   - Open the rotation flow control valve screw (small hexagonal screw at the side of the adjusting wheel).
   - Adjust the rotation speed according to the rock type being drilled (between 150 and 300 rpm, usually 200 - 270 rpm), and tighten the screw.

NOTICE **In general, the rotation speed must be readjusted when hole size or rock type changes!**

3. Monitor the gauge readings during drilling, especially the readings of the oil temperature gauge and the pressure gauges for flushing and rotation. Deviations in oil temperature and flushing pressure are signs of a malfunction (clogged drill bit, dirty radiator, etc.). Note that a clogged drill bit usually manifests itself as an increase in flushing pressure.
4. The flushing air pressure can be adjusted during drilling by using the adjustment knob close to the gauges. The pressure can fluctuate between 4 and 7 bar depending on the drilling conditions (rock type, drill bit size, rod length, hole depth).

1. Hydraulic oil temperature
2. Flushing pressure
3. Percussion pressure
4. Rotation pressure
5. Feed pressure



5. When the rock drill has travelled the entire feed length or the desired hole depth has been reached, return the control lever to its middle position, which will stop the percussion, rotation, and feed. Drive the rock drill back to the upper end of the feed by tilting the control lever back.
   The cleaning automatics of the dust collector filters are engaged automatically when the percussion is disengaged.

NOTICE **The dust collector filters must be replaced immediately if drilling dust appears from the dust collector outlet.**

NOTICE **Never tram the rig when the dust collector is running. Stop the dust collector by turning the switch to the ‘0’ position.**

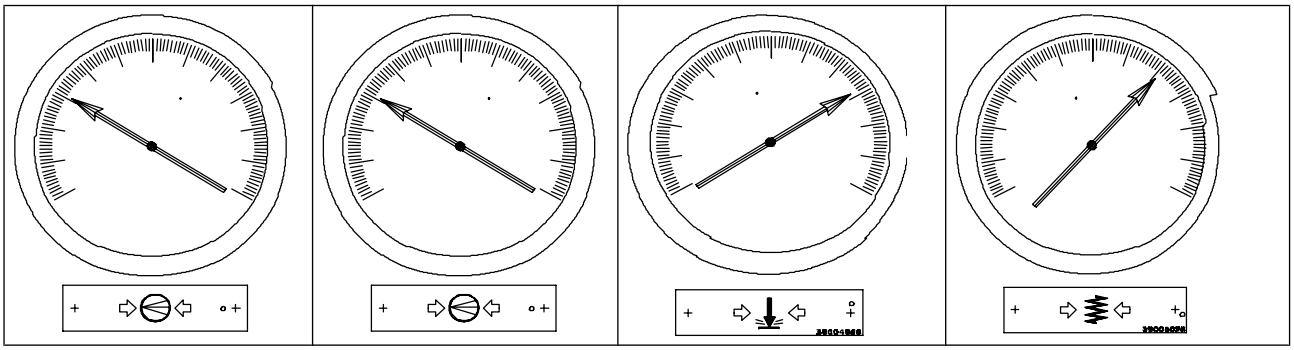
Replacing drill rods

If the hole to be drilled is deeper than the effective length of the rod, the rod must be replaced when the first rod has been drilled to its full length. The rod is replaced as follows:

1. Open the front centraliser.
2. Open the drill--steel retainer, and remove the rod from the drill shank.
3. Place the longer rod into the existing drill shaft. Lift the rod to the drill shank.
4. Close the drill--steel retainer and the front centraliser
5. Continue the drilling.

4.4.6. Drilling parameters

The level and ratio of percussion pressure, feed power, and rotation speed vary according to the rock type being drilled and the hole size. Drilling parameters must be adjusted whenever the drilling conditions change. The following tables present the basic drilling pressure, typical parameter adjustment errors, and their consequences. Use the tables to correct adjustment errors.



Rock drill HEX 1	Flushing	Percussion	Rotation	Feed
Drilling	6–7 bar	125–135 bar	25–40 bar	60–80 bar

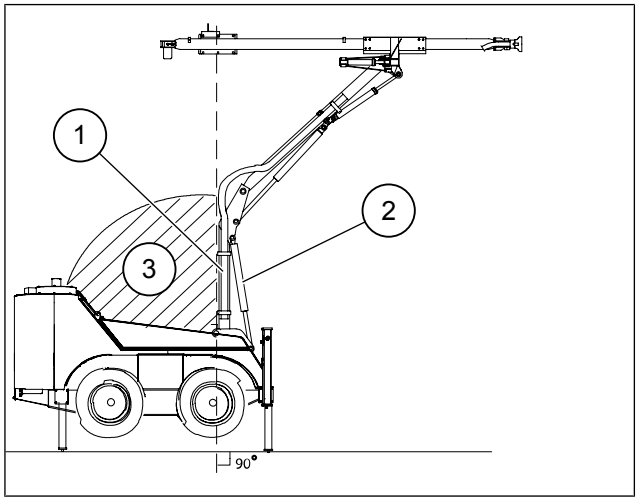
	FAULT	SYMPTOMS
PERCUSSION	Percussion pressure too high	- Feed power requirement increases - Service life of rock drill and drilling equipment shortens - Hydraulic oil overheats. - Risk of the rod getting stuck increases.
	Percussion pressure too low	- Penetration rate decreases (in drilling soft stone, the best penetration performance and drilling equipment life is achieved with a percussion pressure lower than that used when drilling hard rock).
ROTATION	Rotation speed too high	- The outer edge of the drill bit wears down too quickly (‘risk of anti-tapered bit’) - Drilling cuttings are fine-grained. - The components of the rock drill and rotation mechanism wear down.
	Rotation pressure too low	- The drill rod rotates irregularly.. - The penetration rate decreases. - The drill rod and the rotation mechanism are under greater stress than is normal.

	FAULT	SYMPTOMS
FEED	Feed power too high	- Rotation falters (presents as uneven rotation pressure) - Rotation moment increases (presents as an increase in rotation pressure), causing overstrain on the drilling equipment and the rock drill rotation mechanism NOTE! Increased rotation pressure may also be caused by a bent drill rod or other abnormal rotation resistance. - The drill rod bends, the centralisers and chuck wear down, and the risk of the piston hitting the rod shank at an angle is increased. - The sound of the rock drill changes. **NOTE! INCREASING FEED EXCESSIVELY DOES NOT INCREASE THE PENETRATION RATE.**
	Feed power too low	- The rock drill jumps and shakes (clinking sound) - Excessive wear occurs to the front end of the chuck and the drill rod collar. - The rock drill's jointing surfaces wear down (shortened service interval). - The penetration rate decreases. The rock drill is not in the correct position when the piston strikes; this means that only a small proportion of the percussion power is conveyed to the rock. - The service life of the drilling equipment decreases (equipment exhibits high tensile stress).
FLUSHING	Too low flushing pressure	- The risk of the rod getting stuck increases. - The drill bit wears down quickly. - Shank lubrication operates poorly. - The penetration rate decreases. - Drilling cuttings are fine-grained.
	Too high flushing pressure	- The drill bit wears down needlessly. - The diesel engine of the rig is stressed needlessly.

4.5. Upward horizontal drilling forward and bolting upward

The rig must not be used for drilling forward or bolting upward, unless the base boom is lifted to its upright position.

If the base boom is tilted backward, the overcentre valve of the lift cylinder can open as a result of feed power and boom weight. This will allow the boom to fall backward and thus cause a hazardous situation.



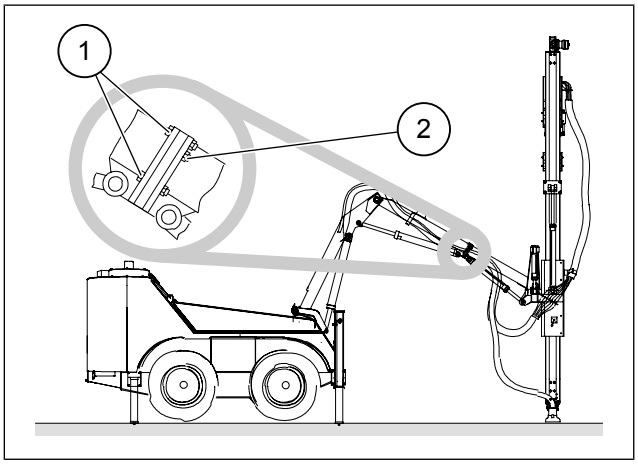
1. Base boom
2. Lift cylinder
3. Danger area

4.6. Turning the boom head to horizontal drilling position

1. Run the boom out, turn the feed so that it is vertical, and lift the feed slightly off the ground.
2. Remove the rod, and run the rock drill to the lower end of the feed.
3. Open the four bolts (1) at the corners of the flanges at the middle of the boom head.

Do not open the other two flange nuts (part 2 in the figure below), as otherwise the boom head will fall and possibly cause injury.

4. Tilt the feed left (swing).
5. Run the rock drill upward carefully just below the middle section of the feed.
6. Take hold of the lower end of the feed and lift it so that the boom head turns 90º. Tighten the flange bolts.



1. Open these
2. Do not open these

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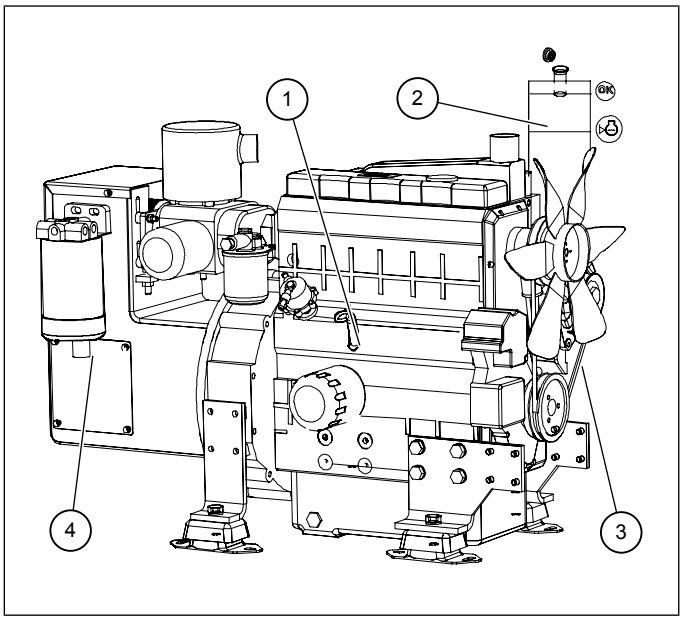
5. OPERATOR'S MAINTENANCE INSTRUCTIONS

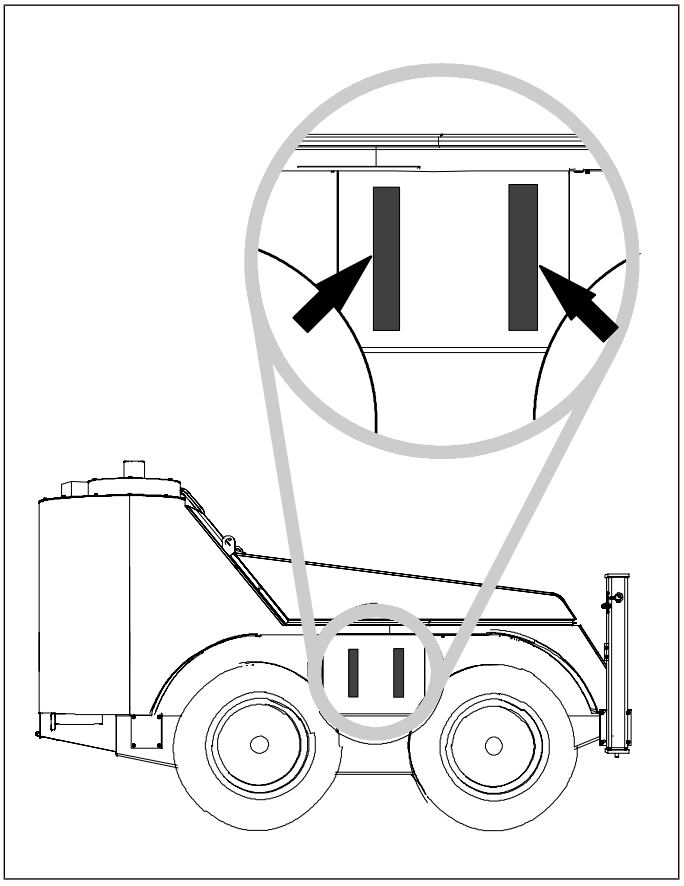
5. OPERATOR'S MAINTENANCE INSTRUCTIONS

5.1. Checks before starting the engine

- Check the engine oil level. The oil level must be between the markings ‘add’ and ‘full’.
- Check the engine coolant level. as well as the tightness and condition of cooler hoses and connections.
- Check the tightness and condition of the V-- belt.
- Drain the water from the water collector .



- Check the hydraulic oil level.
- Check the fuel level.



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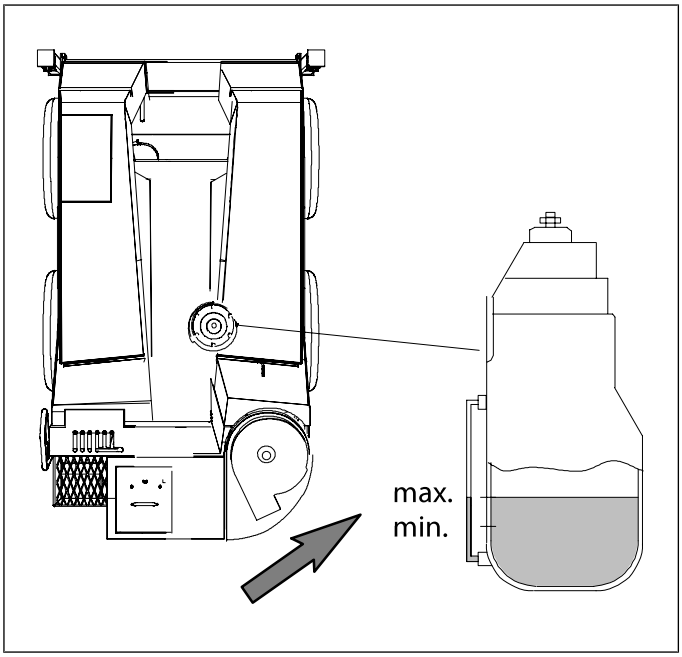
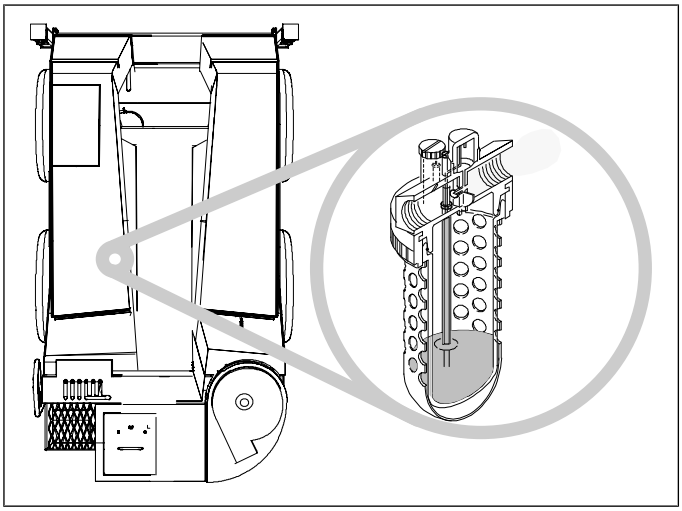
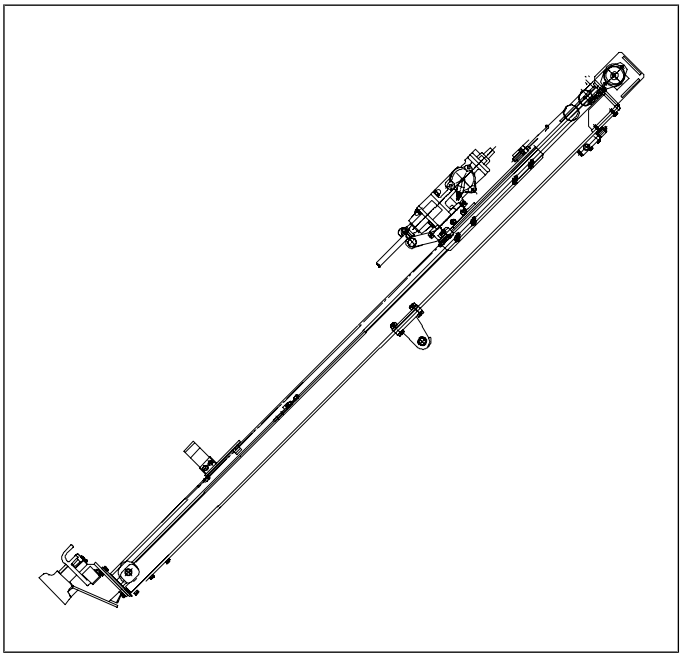
- Check the compressor oil level.



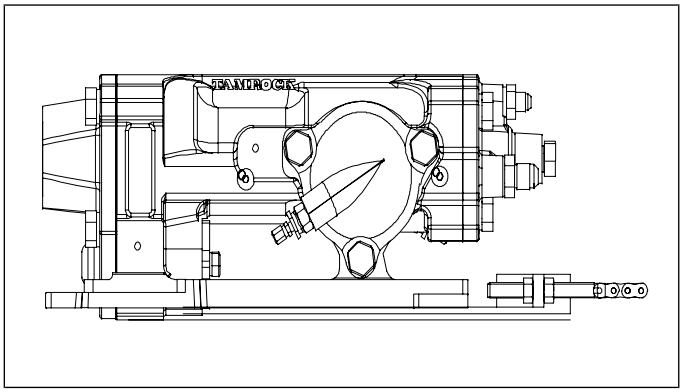
- Check the shank lubrication oil level.



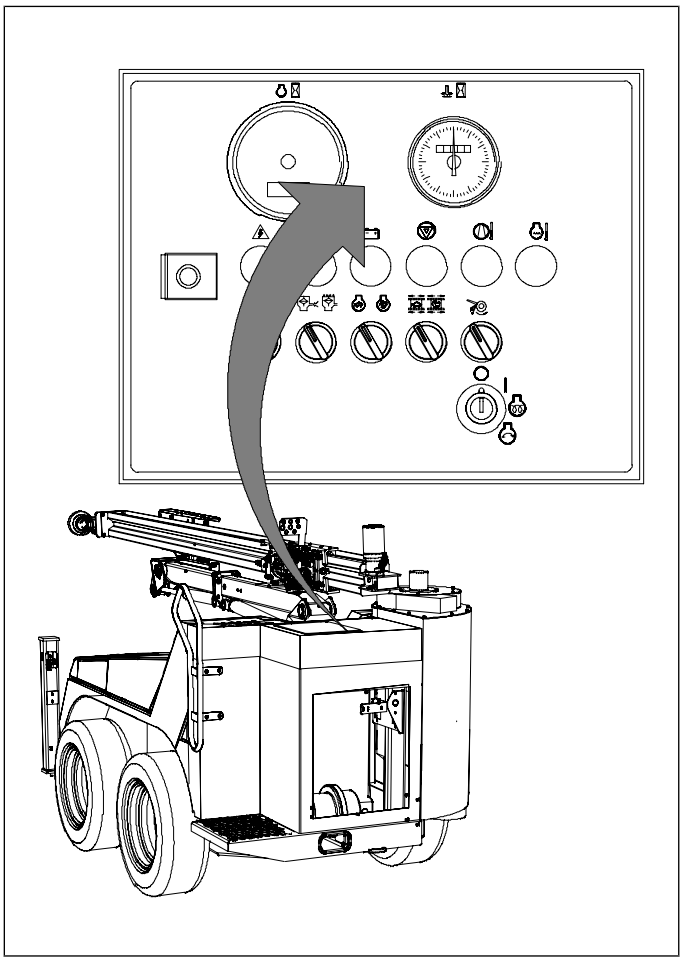
- Check the tightness and condition of the feed chain.



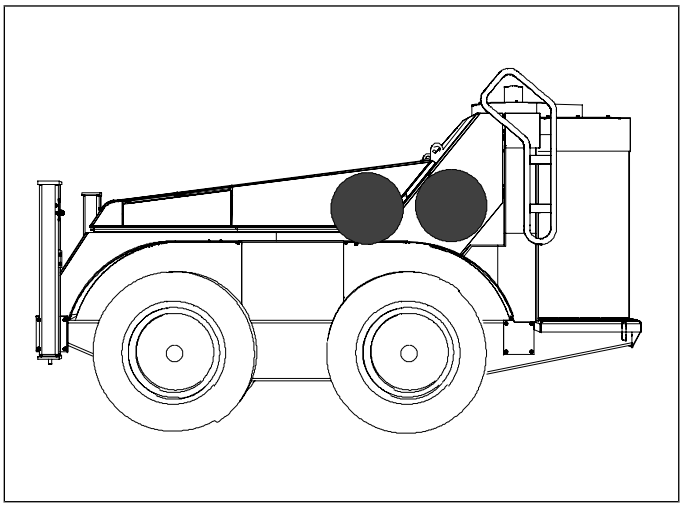
- Check the condition of the chuck.
- Check the condition of the flushing pipe.
- Check the mounting of the rock drill.



- Check the percussion hour meter and the diesel engine operation hour meter readings.

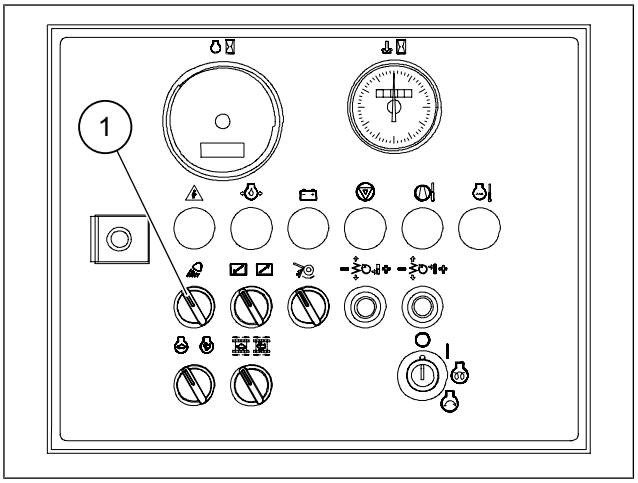


- Check the diesel engine and compressor suction hoses and their connections.

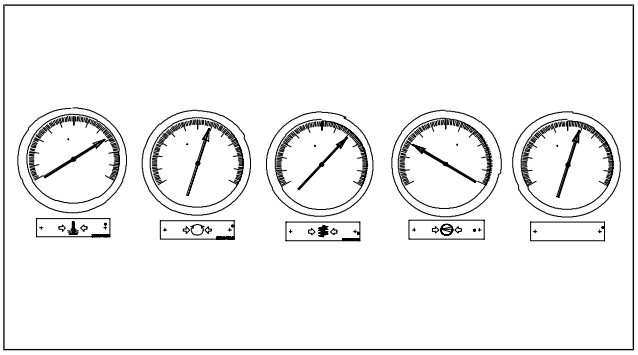


5.2. Routine checks before operating the rig

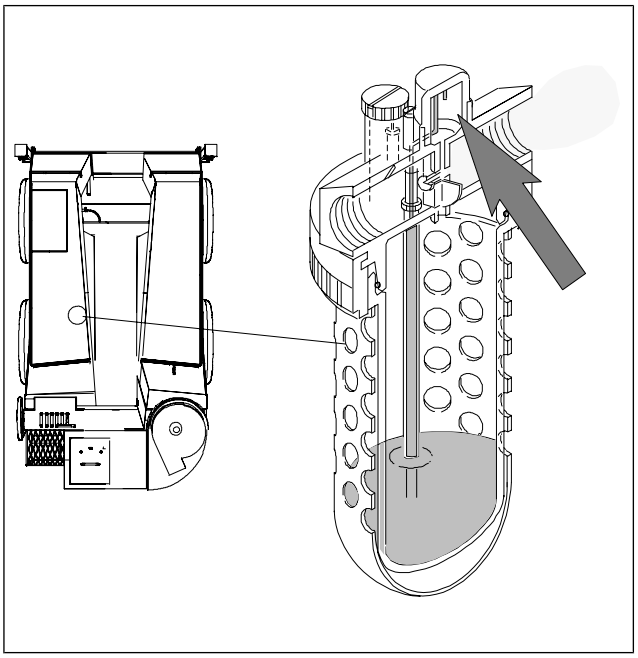
- Check the working lights (1).

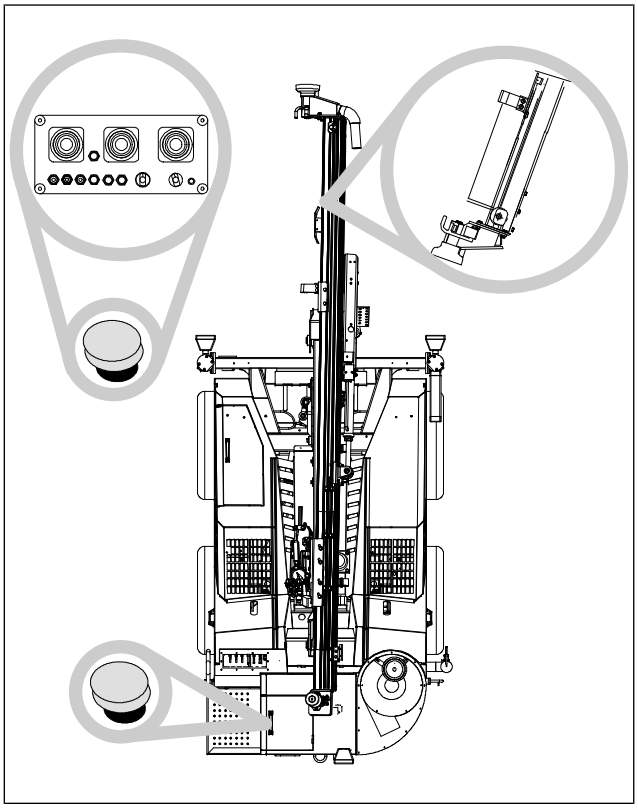


- Check the operation of the gauges

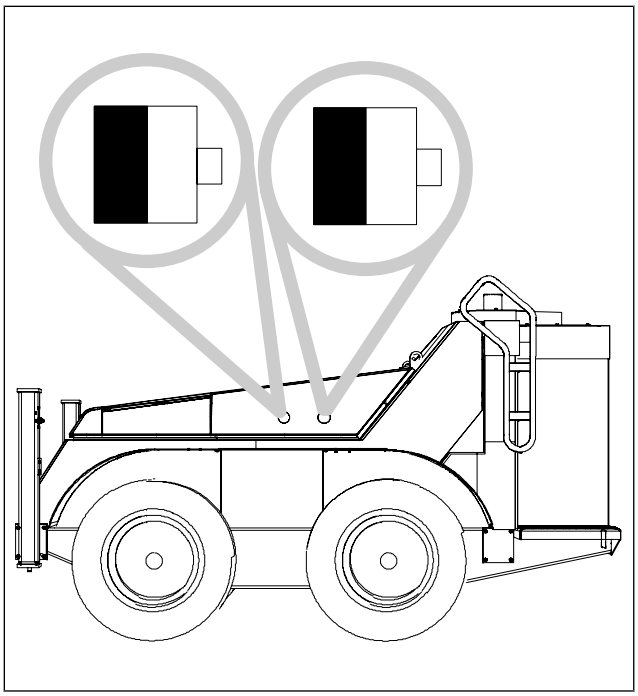


- Check the function of the shank lubrication.
- There should be 30 to 50 drops per minute during drilling.



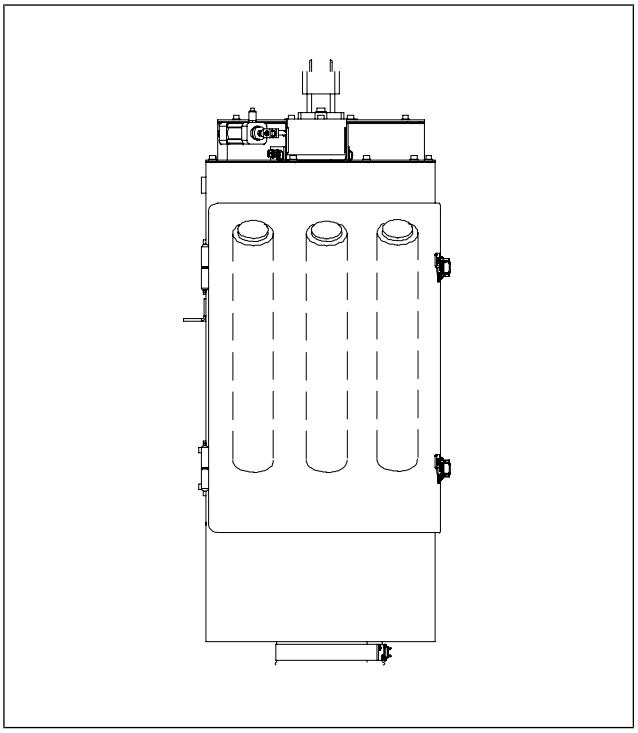


- Check the operation of the emergency stops, safety wire, and alarm.

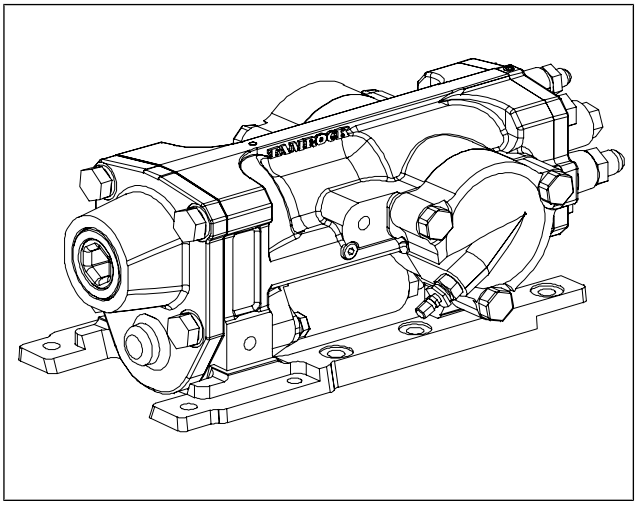


- Check the service indicators of the compressor and engine intake air filters

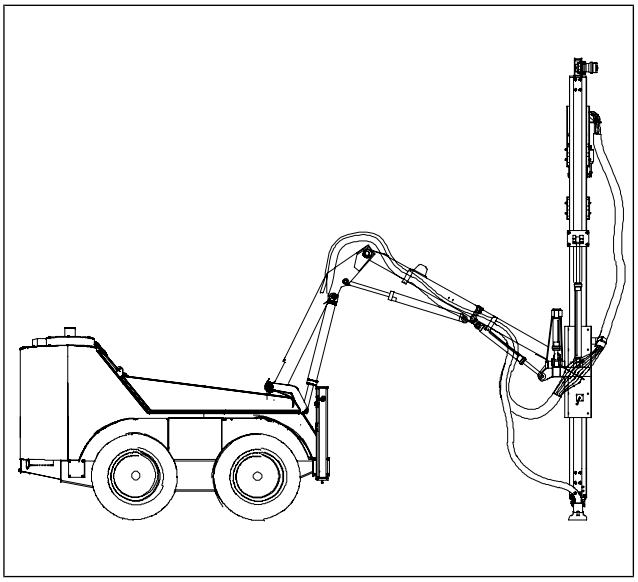
- Check the condition of the dust collector filters.



- Check for possible oil leaks during drilling.



- Check that there are no oil leaks in the rig.



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6. ADDITIONAL INSTRUCTIONS

6. ADDITIONAL INSTRUCTIONS

6.1. Welding of the rig

NOTICE **Never repair the boom, boom components, or cylinders by welding.**

NOTICE **The rig is equipped with electrical and electronic components that can be damaged if the rig is welded. When welding the rig, comply with the following instructions fully.**

1. Stop the engine by turning the ignition key to the STOP position.
2. Open the main switch.
3. If the machine is equipped with a radio control system, disconnect the cables from the radio receiver when welding near the receiver.
4. Attach the welding ground cable directly to the part to be welded.
   The cable must be attached as close to the welding point as possible and such that the welding current does not pass through bearings, hydraulic components, electrical/electronic components, or the rig's ground cable.
5. Check the grounding; ensure that proper grounding is not prevented by, e.g., paint.
6. Follow the welding instructions.

6.2. Towing

⚠ WARNING	
	**ACCIDENT HAZARD!** **Could cause death or severe injury.** **Always exercise great caution when towing the rig.** **Make sure that the brakes of the towing vehicle are in proper condition and that they are efficient enough to stop both vehicles in an emergency.** **Only use a fixed bar for towing. Do not use a rope or cable for towing the rig.** **Before towing, release the brakes of the rig to be towed.** **A winch is not allowed to be used for towing.**

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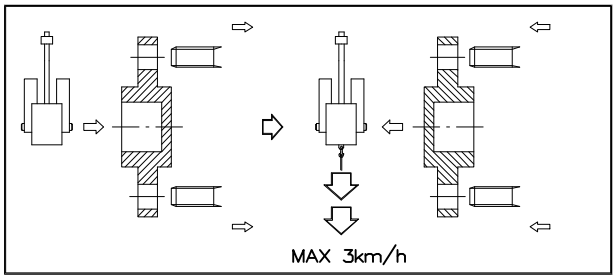
6.2.1. Releasing the brakes

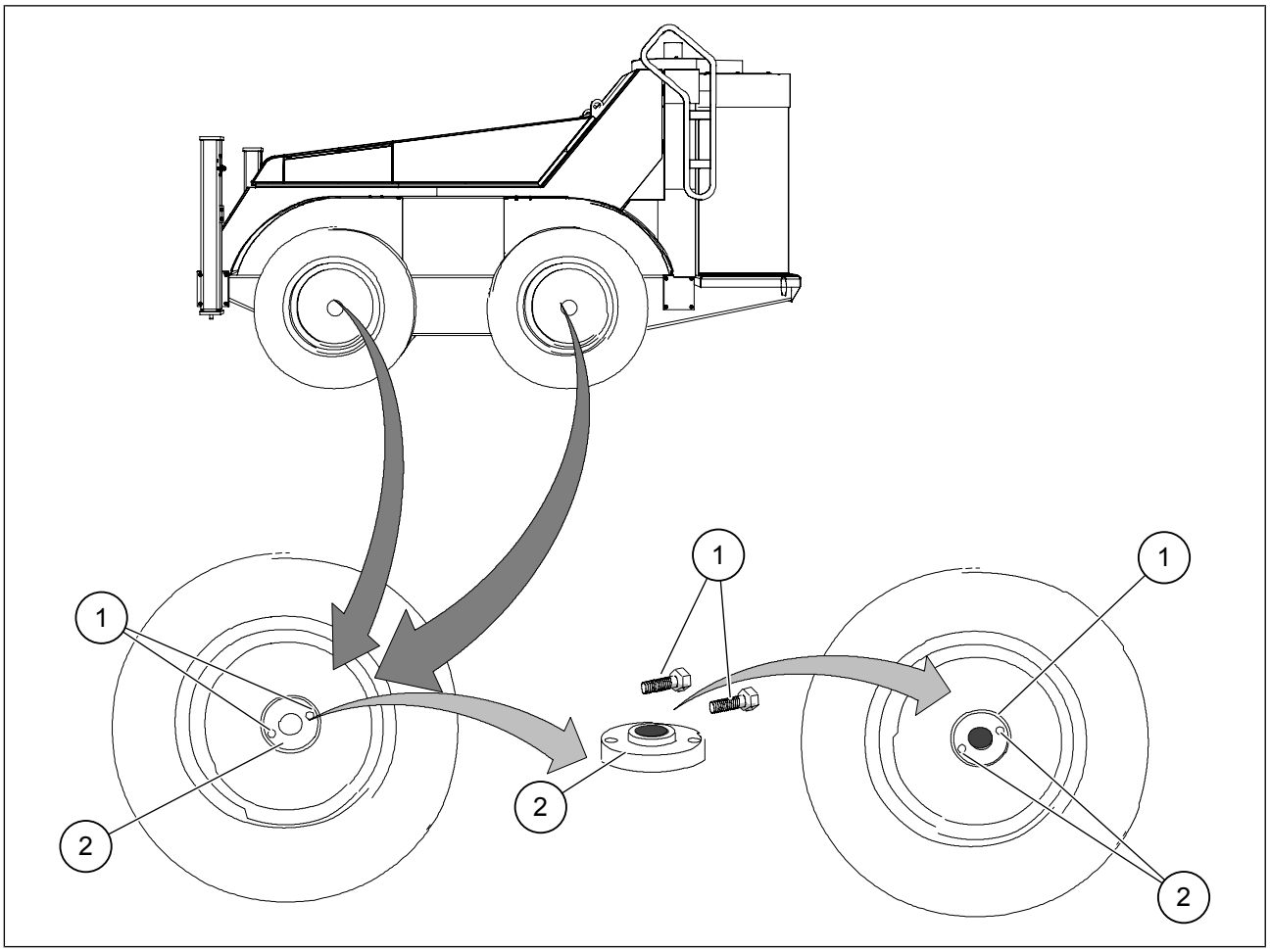
If the rig is to be towed, the driving motors must be disconnected. Before doing so, make sure that the rig cannot move by itself.

When the driving motors are disconnected, the rig has no brakes.

Before disconnecting themotors (brakes), connect the rig to the towing vehicle.



You need a 8 mm spanner to remove and fasten the screws.



1. Remove the two hex. head screws (1) from the cover (2).
2. Remove the cover (2), turn it upside down, and fasten it back with the screws (1) as shown.

NOTE! **Note that these procedures must be done on both driving gears.**

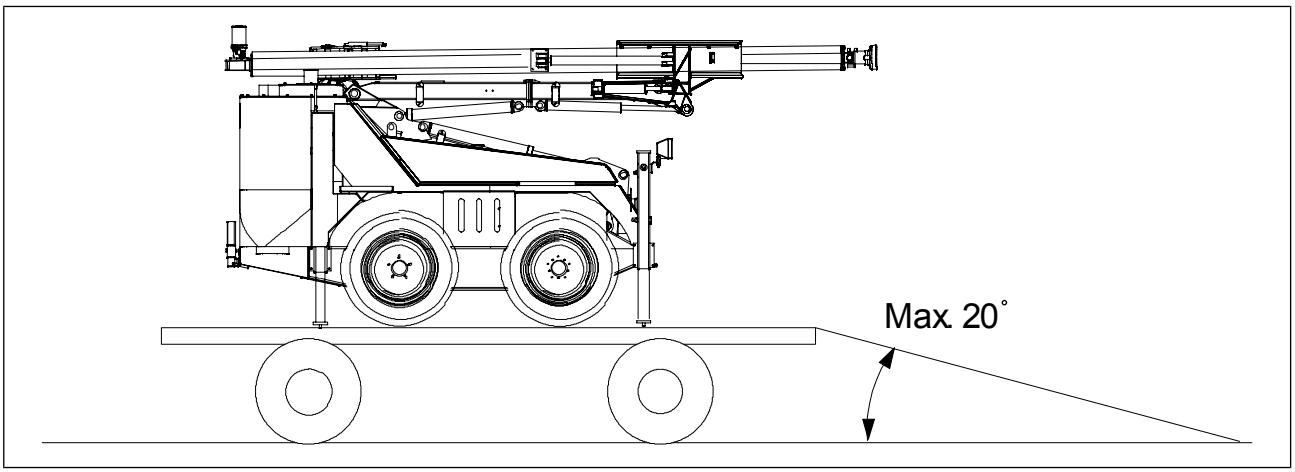
When the brakes have been released, a rigid towing bar must be used. The max. towing speed for the rig's is 3 km/h.

Before disconnecting the rig from the towing vehicle, the driving gears must be reconnected.

6.3. Transporting the rig

Tramming onto a transportation platform

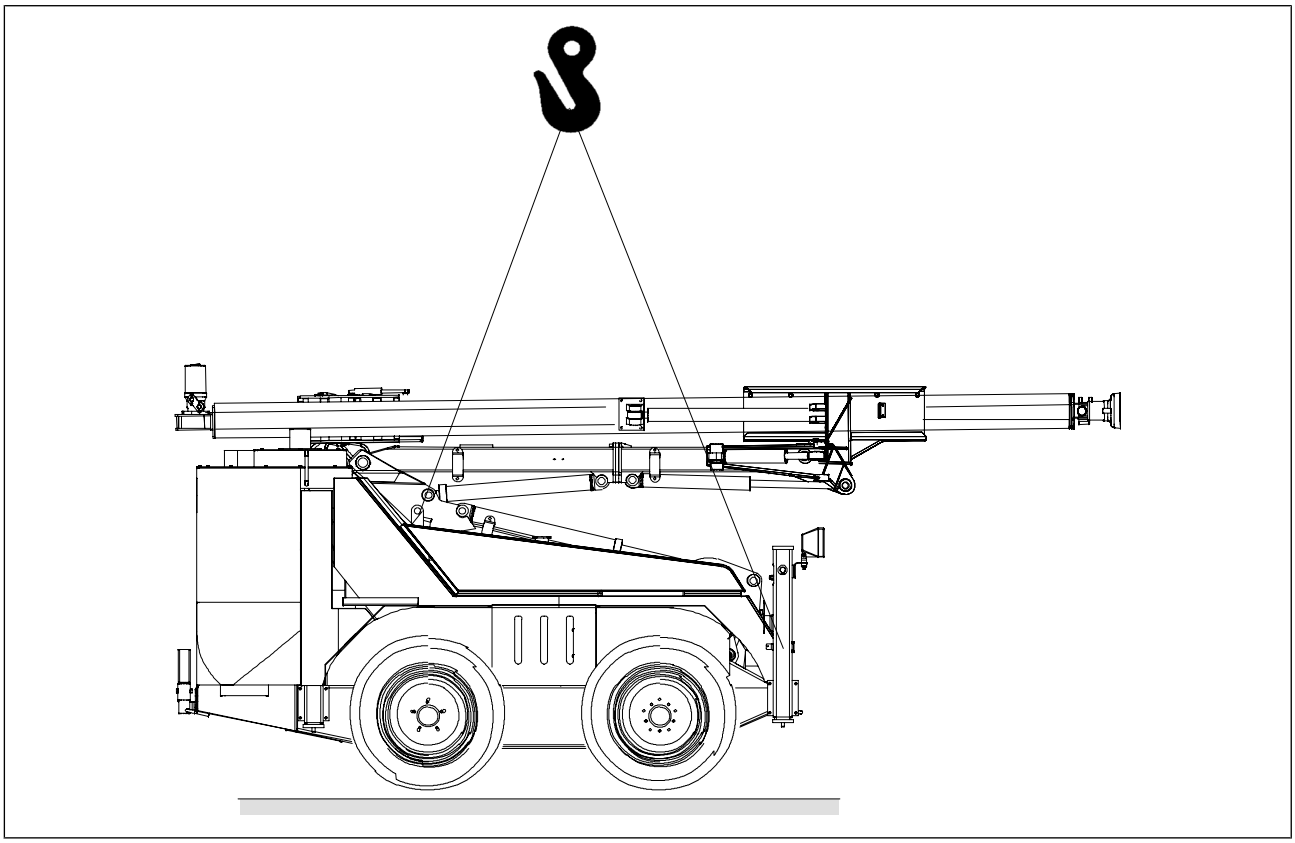
Before tramming onto a transportation platform, the boom, feed, dust collector, and grinding unit must be placed in their transport positions. Never exceed the maximum allowed inclination angle.

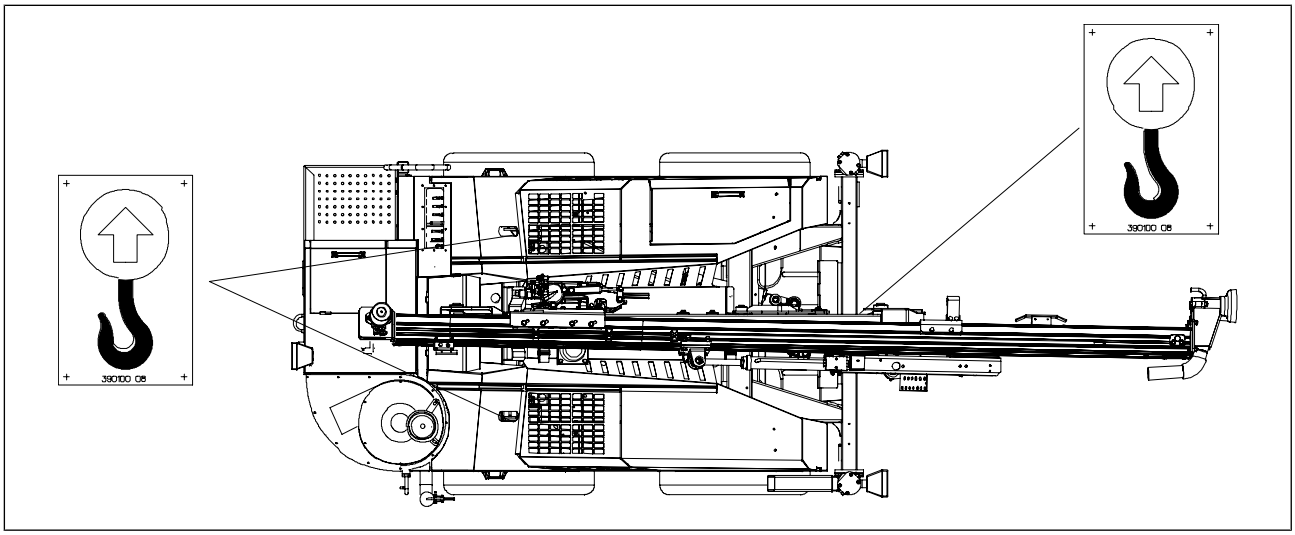


1. When you are tramming the rig onto a transport platform and off it, use access ramps. Loading must always be performed on level ground.
2. Always use low speed and observe great caution when tramming the rig from the ramps to the transport platform.
3. Lower the jacks before transport.
4. Use straps or chains to fasten the rig so that it cannot move during transport.

NOTICE **Always take into consideration the maximum height and width of the transport vehicle.**

6.4. Lifting methods and lifting points



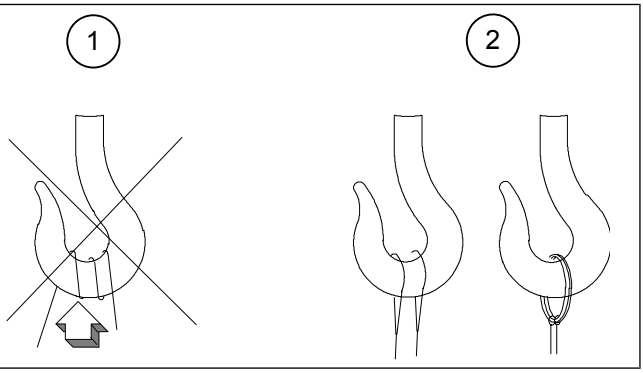


Always follow the appropriate legislation and safety regulations concerning lifting safety in the location where lifting will take place.

Consider the rig's total weight, which is indicated in the technical specifications contained in this manual.

1. Use only a lifting device of the appropriate type and with sufficient lifting capacity.
2. You must know the weight of the load, and the capacity of the lifting device, as specified by the manufacturer, is not to be exceeded.

3. Lifting routes must be planned so that loads are not lifted over people or locations where there might be people.
4. Check that the lifting device is in good condition.
5. The lifting wires and chains must be checked regularly.
   Damaged wires and chains must be marked clearly and removed from use immediately.
7. Make sure that the load is properly fastened and balanced.
   To check fastening and balance, lift the load up only a few centimetres initially. Do not continue lifting until you are certain that the fastening and balance are good.
8. Never twist the wires and chains around the lifting hook.
   Lifting wires and chains must be fastened according to the manufacturer's instructions.

1. Wrong 2. Right	

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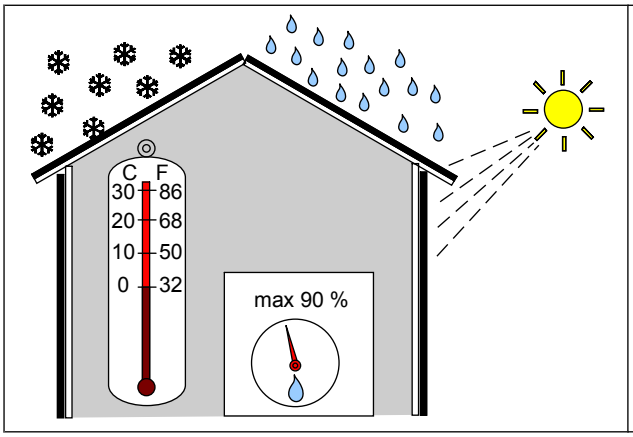
6.5. Storage

Storage conditions:



The temperature of the storage location should be 0 °C…35 °C. The rig must be protected against direct sunlight and rain.
NOTE! The relative humidity of the air must be below 90%.

Rig

- Wash the rig if it has been in use or has been transported by sea. Use high-pressure steam washing.
- Empty the water circuit and blow some anti-freeze agent into it (an anticorrosive agent).
- Lubricate the rig (all greasing points).
- Lift the rig with the jacks.
- Tilt the feed's front end downward.
- Empty the rock drill's pressure accumulators and prominently hang a sign to this effect (the pressure accumulators must be filled before the drilling rig is used).
- All hydraulic cylinder piston rods must be protected with grease.
- Empty the water separator.
- Replace all lubricants and fluids, which may have deteriorated in use.
- Protect all electrical devices from corrosion so that there will be no contact failures.

NOTICE

RISK OF DAMAGING THE RIG!

Too high a humidity level in the storage location could damage the rig.

Ensure that the storage space does not collect water, that the humidity will not become too high, and that the location is otherwise protected from the elements.

Protect the electrical connections in accordance with set of instructions 571: “Protecting electrical and electronic components and connectors with protective agents”.

Proceed as specified in set of instructions 571, and use a suitable protective agent to protect, for example, the following points:

- coupling box connections
- screw terminals of the multi-pole switches
- battery terminals
- multi-pole switch coupling contacts
- contacts of the connecting caps of magnetic valves, pressure switches, and corresponding parts (fill the caps with grease)

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7. TROUBLESHOOTING

7. TROUBLESHOOTING

7.1. Engine

FAULT	POSSIBLE REASON / PROCEDURE
1. The starter motor does not crank the engine.	1. The emergency stop button is pressed down. Release the button. 2. Power is not switched on at the main switch. Switch power ON. 3. The battery has discharged. Detach and charge. 4. Break in the circuit. Check, and repair if necessary 5. The main fuse has blown. Replace the fuse. 6. Faulty starter motor. Check, and repair if necessary. 7. Faulty starter motor relay K1. Replace the relay.
2. The engine starts poorly or not at all.	1. The automatic stop function has stopped the engine. Inspect to find the reason and repair, or let it cool off before attempting to restart. 2. Pre--heating time too short. Pre--heat longer. 3. Fuel has run out. Add fuel. 4. Incorrect fuel. Change fuel. 5. Fault in the transfer pump, spray pump, or nozzles. Check, and repair if necessary. 6. Not all control panel levers are in the middle position. Return the levers to the middle position.
3. The engine overheats.	1. Engine overloads. Find out the reason and repair. 2. Fan belt broken or slipping. Replace or tighten belt. 3. Coolant level too low. Add coolant. 4. Radiator clogged. Clean the radiator. 5. Faulty thermostat. Check, and repair if necessary.

7.2. Compressor

FAULT	POSSIBLE REASON / PROCEDURES
1. Air supply is insufficient	1. Compressor poly--V--belt broken or slipping. Replace or tighten belts. 2. Clogged suction air filter. Clean or replace the filter. 3. Clogged oil separator. Replace oil separator. 4. Pressure release valve open. Check the valve. 5. Output valve closed. Check for jamming. 6. The ø 1.0 mm leak hole next to the control valve is clogged. Check and clean. 7. Air consumption too high. Check air-- consuming devices (e.g., the blow--off valve and drill--steel retainer), and inspect for leaks. 8. Compressor screws worn down.
2. The compressor has overheated.	1. Insufficient oil level. Check the oil, and add more if needed. 2. Radiator clogged. Clean the radiator. 3. Wrong oil in the compressor. Switch oil (refer to oil recommendations). 4. Compressor screws worn down. 5. Faulty thermostat.
3. Oil consumption is too high.	1. Oil return pipe and its filter and/or orifice clogged. Open and clean. 2. Oil separator damaged or loose. Check, and repair if necessary. 3. Oil separator clogged. Replace oil separator. 4. Wrong oil in the compressor. Switch oil (refer to oil recommendations).
4. System pressure rises above the predetermined threshold.	1. Control valve not operational. Check, and repair if necessary. 2. The intake valve does not close. Check, repair, or replace intake valve. 3. The shaft seal of the air end is leaking. Replace the shaft seal.

7.3. Hydraulic circuit

FAULT	POSSIBLE REASON / PROCEDURES
1. Pump output is insufficient or there is not enough pressure	1. Pressure relief valve incorrectly adjusted, or internal leak in the valve. Adjust and check. 2. Leak in the hoses. Check, and repair if necessary. 3. Clog in the hoses. Check, and repair if necessary. 4. Gearing from motor to pump broken. Check, and repair if necessary. 5. Pump damaged. Repair or replace pump. 6. Motor rotation speed too low. Adjust rotation speed. 7. Faulty rock drill. Check, and repair if necessary.
2. Hydraulic oil overheats.	1. Insufficient oil level. Check the oil, and add more if needed. 2. Radiator clogged. Clean the radiator. 3. Thermostat valve damaged. Check, and repair if necessary 4. Incorrect hydraulic oil. Switch hydraulic oil (refer to oil recommendations). 5. Motor rotation speed too high. Adjust rotation speed. 6. Fan V--belt broken or slipping. Replace or tighten belt.

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