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# **Maintenance Manual**





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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

This document must not be copied, presented, or delivered to a third party without our permission, nor used for purposes other than those allowed by us. We reserve the right to change the product's settings and equipment, as well as the maintenance and repair instructions, without separate notice. Sandvik Mining and Construction Oy

#### 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.

#### 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

- 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.



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

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

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.

#### 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



Crushing hazard - feet



Entanglement hazard



Entanglement hazard - rotating drill







Crushing hazard - hands



Entanglement hazard





High pressure injection hazard







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Forward/backward tipping hazard

#### **Electrical Hazard Symbols**



#### Noise Hazard Symbols



#### Radiation Hazard Symbols





Slipping hazard



Sideways tipping hazard



Forward/backward tipping hazard





#### Material / Substance Hazard Symbols





Hazardous/poisonous material hazard







Chemical burn hazard



Environment pollution hazard

Ergonomic Hazard Symbols



General Hazard Symbol







#### **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.



#### 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.



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# 2. SAFETY

#### 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.

2.2. General operation and maintenance safety instructions

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

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 conditions in which the rig should not be used

#### Risks of personal injury



- The operator has inadequate training
- Unauthorized persons are in the work area
- · Safety systems are inadequate or out of order
- The area to be drilled is charged
- The rig is used for personnel transportation
- The rig is being used for lifting

#### Environmental risks to the rig

- Risk of the embankment collapsing under the rig
- Possibility of a loose boulder falling on the rig
- An icy or otherwise slippery drilling site
- Drilling under power lines with the danger of contact with a live power line
- Inadequate lighting



#### 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.



- 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.



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 20°, 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.



### 2.7. Centre of Gravity

#### Centre of gravity when boom is in the tramming position



- 1 800mm
- 2 375mm
- 3 875mm

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#### 2.8. Location of 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.

#### 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

#### 2.11. Filling the fuel tank

Handle fuel with care: it is highly flammable.



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

	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.	
	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.	
	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.	
	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.	

### A 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

	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<sub>2</sub>. Before removing the pressure accumulators from the rock drill, release the accumulators' pressure by opening the filling valve.



#### 2.14. Maintenance of the electrical system

### \land 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

	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.	
# 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.

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- 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

# 



Compressed air jets can cause serious injury.

**HIGH PRESSURE INJECTION HAZARD!** 

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.



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 d	B (A)	ISO 1120	11995
		-		~ /		

### 2.20. Vibration

The whole-body vibration during drilling does not exceed 0.5 m/s<sup>2</sup> \*, when tested according to the European Standard Drill Rigs - Safety EN 791.

\* the highest root mean square value of weighted acceleration

# 2.21. Warning label locations



#### **68. WARNING**

The rig is remote- controlled.
+

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





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



Only lift the rig from these points.











Fuses



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





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



Checking the compressor oil level.

CHECK THE COMPRESSOR OIL LEVEL BE-FORE 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.			
	<ul> <li>Read the operating instructions carefully and ensure that you understand everything fully.</li> </ul>			
	<ul> <li>Keep the operating instructions safe and readily accessible.</li> </ul>			
	<ul> <li>Make sure that there are no radio controllers operating at the same frequency in the same area.</li> </ul>			
	<ul> <li>Only personnel with adequate training are permitted to use the radio controller.</li> </ul>			
	<ul> <li>Do not leave the radio controller anywhere where it might fall into the wrong hands.</li> </ul>			
	<ul> <li>Switch off the radio controller during breaks.</li> </ul>			
	<ul> <li>In the event of a hazardous situation, switch off the rig and determine the cause of the malfunction before operating the rig again.</li> </ul>			
	<ul> <li>In the event of a hazardous situation, press the emergency stop button on the transmitter.</li> </ul>			

# 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.

# 3. MACHINE DESCRIPTION

# 3. MACHINE DESCRIPTION

## 3.1. Main circuits and components

### 3.1.1. Drilling Module

- 1. Rock drill
- 2. Feed
- 3. Boom



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





### 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



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





### 3.1.6. Control devices

- 1. Tramming controls
- 2. Instrument panel



### 3.1.7. Drilling and boom controls



- 1. Boom control levers
- 2. Drilling controls

### 3.1.8. Remote control

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



### 3.1.9. Power pack

- 1. Diesel engine
- 2. Compressor
- 3. Hydraulic pumps



### 3.1.10. Receivers

- 1. Fuel tank
- 2. Hydraulic receiver

### 3.1.11. 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

### 3.2.1. Instrument panel



### Gauges



### Warning lights



### Switches



### 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
- 3 Start-up / pre-heating
- 5 Rotation anti-jamming / edge antijamming
- 7 Suction ON / Dust collector ON / OFF
- 9 Control lever functions
- 11 Automatic winch tensioning / manual winch operation

- 2 Power OFF
- 4 Full power / Idling
- 6 Water flushing ON / OFF
- 8 Automatic hole aiming ON / OFF
- 10 Adjusting the feed pressure
- 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



### 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





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
- 3 Percussion pressure
- 5 Feed pressure

- 2 Flushing pressure
- 4 Rotation 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. PERIODIC MAINTENANCE

# 4. PERIODIC MAINTENANCE

### 4.1. Importance of scheduled maintenance

The continued operation of the rig is ensured by regular maintenance carried out correctly at the proper intervals. The purpose of regular maintenance is to check the rig at regular intervals, ensuring a high uptime for the rig. This prevents high repair costs and lost productivity. Neglecting maintenance leads to high extra costs.

It is important to carry out daily maintenance routines carefully. All possible faults must be repaired immediately or reported to the person in charge. Daily maintenance includes general lubrication, inspections, and adjustments. Each new operator must be familiarised with the daily maintenance routines.

# NOTE! Intervals listed for scheduled maintenance are usually based on diesel engine hours or rock drill percussion hours.

### 4.2. General maintenance instructions



**RISK OF POLLUTION!** 

Dispose of used parts and fluids in accordance with the local environmental regulations.

# See the general safety instructions for maintenance-related environmental protection measures.

- 1. Park the rig on a steady and level surface.
- 2. Ensure that the rig cannot move by itself. Lift the rig onto the jacks, or use a safety brake and tire wedges.
- 3. Always stop the rig before commencing maintenance procedures. Prevent accidental starting of the rig by turning the main switch off or removing the ignition key.
- 4. Wash the rig before maintenance.
  - Do not use solvents that contain aromatic or chlorinated hydrocarbons. Using mineral-oilbased fuels, such as gasoline, diesel oil, or petroleum, as detergent is also forbidden! These substances can cause deterioration, cracking, or softening of rubber and plastic parts.
- 5. Ensure that all necessary tools, spare parts, and accessories (oils, lubricants, etc.) are to hand.
- 6. Clean the area around the filling cap thoroughly before adding fuel or oil.
- 7. When replacing the filters or changing oils, ensure that the oil added is pure. A high particle content in the oil (e.g., the filter becomes clogged rapidly) can indicate some kind of fault. Find out the reason for this situation before more serious damage is done.
- 8. Beware of hot surfaces and oils. Dispose of waste oil and used filters according to local regulations.
- 9. Reinstall protective rails and covers after maintenance.
- 10. Ensure that the hoses and cables cannot get entangled or tightened during use of the rig.

### 4.3. First maintenance

The following steps should be carried out during the first week of use (in addition to the normal scheduled services):

Adjust the drilling pressures according to rock conditions.

### After the first five shifts (50 h)

- Check air suction hoses and connections.
- Change compressor oil and oil filter.
- Replace the hydraulic oil return filter.
- Change the oil in the final drives (4 pcs).
- · Check tightening torques of all bolts in rock drill.
- Tighten all loosened connections and bolts.

### Diesel engine

Contact the local Caterpillar dealer for commissioning the engine. Caterpillar "Engine Service Delivery Record" must be filled at that time.

# 4.4. Filter kits

### Filter kit ID 552 073 17 for 250h service:

Item	ID	Quantity
Fuel filter	550 308 88	1
Fuel filter / water separator	885 239 79	1
Engine oil filter	550 230 35	1

### Filter kit ID 552 073 18 for 500h / 1000h service:

Item	ID	Quantity
Fuel filter	550 308 88	1
Fuel filter / water separator	885 239 79	1
Engine oil filter	550 230 35	1
Compressor oil filter	816 492 09	1
Hydraulic oil return filter	550 295 08	1
Breather	872 204 59	2
Engine and compressor air filter	550 216 47	2

### Filter kit ID 552 073 19 for 1500h / 3000h service:

Item	ID	Quantity
Fuel filter	550 308 88	1
Fuel filter / water separator	885 239 79	1
Engine oil filter	550 230 35	1
Compressor oil filter	816 492 09	1
Hydraulic oil return filter	550 295 08	1
Breather	872 204 59	2
Engine and compressor air filter	550 216 47	2
Engine and compressor air filter safe- ty cartridge	870 280 09	2
Compressor oil separator	035 822 28	1
# 5. MAINTENANCE INSTRUCTIONS

## 5. MAINTENANCE INSTRUCTIONS

## 5.1. General maintenance

## 5.1.1. Cleaning the rig

1. Clean the rig.



#### 5.1.2. Testing the fire extinguisher

1. Test the fire extinguisher and refilling.



## 5.2. Boom

## 5.2.1. Lubricating the boom

1. Grease all the greasing points.



#### 5.2.2. Check the cradle and feed

1. Check the cradle and feed clearances. The correct clearance is 0.5 mm.

#### 5.2.3. Checking the boom weldings

1. Check the weldings of boom and cradle.



## 5.2.4. Checking the boom mountings

 Check the mountings of hydraulic cylinders (1).



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## 5.2.5. Checking the tightening torques of pin bolts

1. Check the tightening torque of the cylinder taper pin bolts (60Nm).



## 5.3. Feed

## 5.3.1. Lubricating the feed

1. Lubricate all the greasing points (see the Technical manual).



## 5.3.2. Checking the feed rail clearance

1. Check rock drill carriage / feed rail clearance.



#### 5.3.3. Checking the retainer wear pieces

1. Check condition of the retaining centralizer jaws (1).



## 5.3.4. Check the clearances of the sprocket wheel bearings

1. Check the clearances of the sprocket wheel bearings.



## 5.4. Hydraulic rock drill

## 5.4.1. Checking the accumulator valves and pressures

- 1. Check:
  - The Condition of accumulator filling valves/ caps.
  - The Accumulator pressures. See Pressure accumulators manual.



## 5.4.2. Check the tightness of the pressure accumulator bolts

1. Check the tightness of the pressure accumulator bolts.

Check the tightness using the correct tightening sequence and 10% higher tightening torque than specified.

If a bolt turns, it has loosened. In this case, other appropriate bolts must be opened and re-tightened according to the tightening instructions. The tightening torque is 200 Nm (20 kpm).



## 5.4.3. Check the tightness of the front cover bolts

 Check the tightness of the front cover bolts. Check the tightness using the correct tightening sequence and 10% higher tightening torque than specified.

If a bolt turns, it has loosened. In this case, other appropriate bolts must be opened and re-tightened according to the tightening instructions.

- 1. Lubricate the threads and nut faces with petroleum jelly.
- 2. Tighten to 200 Nm (20 kpm). The correct tightening sequence is 1-2-3-4.



## 5.4.4. Check the tightness of the rear cover bolts

 Check the tightness of the rear cover bolts. Check the tightness using the correct tightening sequence and 10% higher tightening torque than specified.

If a bolt turns, it has loosened. In this case, other appropriate bolts must be opened and re-tightened according to the tightening instructions.

- 1. Lubricate the threads and nut faces with petroleum jelly.
- 2. Tighten to 200 Nm (20 kpm). The correct tightening sequence is 1-2-3-4.

## 5.5. Dust collector system

#### 5.5.1. Lubricate the grease nipples

1. Lubricate the grease nipples of the cut-off cylinder and the butterfly valve.





#### 5.5.2. Checking the suction head rubbers

1. Check suction head rubbers.



## 5.5.3. Check the operation of the cut-off cylinder

1. Check the operation of the cut-off cylinder and the butterfly valve.



## 5.5.4. Check the condition of the impact plate

1. Check the condition of the impact plate.



## 5.6. Carrier

This section describes the operation and components of the carrier and provides instructions for safe maintenance, adjustment, and repair of the carrier.

## 5.6.1. Greasing points

1. Lubricate the greasing points.



## 5.6.2. Checking the winch rope

1. Check the condition and mounting of winch rope (1).

IF ANY OF THE ILLUSTRATED DEFECTS ARE DETECTED, THE WIRE ROPE MUST BE REPLACED. For more detailed information on checking and discarding a wire rope, see ISO standard 4309.



#### 5.6.3. Check batteries

1. Check the electrolyte and connections in the batteries.



## 5.6.4. Checking the brakes

1. Check the operation of brakes.

#### 5.6.5. Check the Winch Oil Level

1. Check the oil level form plug (1). Oil is added using the plug (2).



1. Check that there are no fractures in the welding seams.



### 5.6.7. Change the Final Drive Oil

1. Change the final drive oil.



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## 5.6.8. Change the Winch Oil

1. Drain the oil from the plug (2).



 Turn the drum so that the plug (2) points upwards.
Fill using the plug (2) up to the level of the plug (1).



## 5.7. Diesel engine

Perform the checks with the engine stopped.

## 5.7.1. Checking the air intake line

 Check air intake lines and connections and clean the radiator core.
Refer to your engine operation and maintenance manual to get the detailed instructions.



## 5.7.2. Cleaning the cooler core

1. Clean the cooler core.

#### 5.7.3. Changing the engine oil

- 1. Change the engine oil.
  - Oil drain (1).
  - Oil fill (2).
  - Dip stick (3).
  - Oil filter (4).



#### 5.7.4. Changing the oil filter

1. Change the oil filter (4).

## 5.7.5. Engine Grounding

1. Check the engine grounding.

## 5.7.6. Changing the air filter

1. Change the air filter (1).



## 5.7.7. Check the Condition of the Water Pump

1. Check the water pump for leaks.



## 5.7.8. Changing the safety filter cartridge

1. Change the safety filter element (2).



#### 5.7.9. Checking the Valve Clearances

1. Check the valve clearances.



## 5.7.10. Checking the Tightness of the Cylinder Head Bolts

1. Check the tightness of the cylinder head bolts. Contact Caterpillar representative.

## 5.7.11. Checking the engine vibration dampers

1. Check the engine vibration dampers. CAT\* \* Contact Caterpillar representative.



## 5.7.12. Checking the injector nozzles

1. Check the injector nozzles. CAT\* Contact Caterpillar representative.

## 5.7.13. Cleaning the crankcase breather

1. Clean the crankcase breather. CAT\* \* Contact Caterpillar representative.

## 5.7.14. Changing the engine coolant and thermostat

- 1. Change the engine coolant (1).
- 2. Replace the engine thermostat (2). CAT\* \*Contact Caterpillar representative.



## 5.7.15. Other engine checks

- 1. Check the water pump. CAT\*
- 2. Check the starter motor. CAT\*
- 3. Check the alternator. CAT\*

\*Contact Caterpillar representative

## 5.8. Fuel system

For detailed operation and maintenance instructions, refer to the instruction manual for the engine.

## 5.8.1. Draining the water trap

1. Drain fuel tank water trap.



#### 5.8.2. Changing the fuel filter

1. Change fuel prefilter (1).



#### 5.8.3. Changing the water separator

1. Change the fuel filter / water separator (2).

## 5.8.4. Cleaning the fuel tank

1. Clean fuel tank.



## 5.8.5. Changing the breather

1. Change the fuel tank breather.



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## 5.9. Hydraulic system

## 5.9.1. Replacing the hydraulics return filter

1. Replace the hydraulics return filter.



## 5.9.2. Changing the hydraulic oil

1. Change the hydraulic oil.



## 5.9.3. Cleaning the hydraulic oil receiver

1. Clean the hydraulic oil receiver.

## 5.9.4. Replacing the hydraulic oil receiver breather

1. Replace the hydraulic oil receiver breather.



## 5.10. Pneumatic system

#### 5.10.1. Checking the compressor air intake lines and connections

1. Check the compressor air intake lines and connections.



#### 5.10.2. Checking the compressor belt

 Check the compressor belt. Correct tightness for the belt (F) is 20 N. The belt must not move more than 7.5 millimeters when stretched.



#### 5.10.3. Cleaning the air filter

1. Clean the air intake filter (1).

The filter element must be cleaned or replaced when the service indicator shows red. The filter element must be replaced at least every 500 hours or every 6 months.

The filter element can be cleaned max. six times. Note that the filtering capacity and structure of the element are weakened after every cleaning.

When the filter element is cleaned or changed the safety filter element (2) must be kept in place.

The safety filter element (2) must not be cleaned.



## 5.10.4. Changing the air filter

1. Change the air filter (1).



## 5.10.5. Changing the compressor oil and filter

- 1. Change the compressor oil filter (1).
- 2. Change the compressor oil (2).



## 5.10.6. Checking the temperature switch

 Check the shut down temperature switch. Disconnect the wire of the switch and ground it.



## 5.10.7. Cleaning the strainer and orifice

1. Clean the oil regeneration line strainer (1) and orifice (2).



## 5.10.8. Changing the safety filter cartridge

1. Change the safety filter element (2).



#### 5.10.9. Changing the oil separator element

1. Change the oil separator element.



## 5.10.10. Cleaning the compressor oil receiver

1. Clean the compressor oil receiver.



# 6. LUBRICANTS AND CAPACITIES

## 6. LUBRICANTS AND CAPACITIES

## 6.1. General

All fluids and greases mentioned in this instruction are hazardous to health and to the environment.



ENVIRONMENT POLLUTION HAZARD! Dispose of all fluids and greases in accordance with local regulations.

## 6.1.1. Choosing the oil

Oil is chosen according to the properties of the oil and the application.

## Choosing the oil according to its properties

- viscosity
- stability of properties throughout the service life
- water separation ability
- anti-oxidation and anti-foaming properties
- health effects
- environmental effects

## NOTICE

# Check the original oil type from the machine card or the maintenance instructions.

## Choosing the oil according to the application

The following issues must be considered:

- Sandvik's oil recommendation
- the component manufacturer's oil recommendation (e.g. diesel engine, transmission)
- environmental/site-specific/safety requirements
  - biodegradable oils
  - less flammable fluids

#### Mistakes in choosing and using oil

Components may be damaged if

- a wrong oil type has been chosen
- a wrong oil viscosity has been chosen
- the recommended oil change interval is exceeded.

Oil must be changed at certain intervals because the properties of the oil and its additives deteriorate and are lost as the oil ages.

## NOTICE

Observe the colour and clearness of the oil. Water and other impurities in the oil can cause malfunctions in the hydraulic system and serious component damage (e.g. of rock drills). If the oil is light grey or dull, change the oil. Find the cause of the oil impurity.

## 6.1.2. Oil viscosity

#### SAE classification (engine oils)

(SAE = Society of Automotive Engineers) Viscosity indicates the oil's ability to flow. Viscosity is measured at a high and low temperature and is indicated as an SAE grade, e.g. SAE 40. For multigrade oils, e.g. 5W-40, the first value (5W) indicates the viscosity at low temperatures, and the second value (40) indicates the oil viscosity when it is hot.

## ISO classification (industrial oils)

(ISO = International Organization for Standardization) The viscosity of industrial oils is determined by the ISO-VG standard (ISO 3448). The ISO grade number indicates the oil viscosity at +40 °C, expressed in centistokes (cSt, kinematic viscosity). For example, oil graded as ISO-VG 68 has a viscosity of 68 cSt at + 40 °C.

#### Too low viscosity causes

- Breaking of the lubrication film between contact surfaces. The resulting metal-to-metal contact between surfaces causes rapid wear and increases the need for maintenance.
- Internal leaks in components, which reduces efficiency.

#### Too high viscosity causes

- Flow losses in the system, thus also reducing efficiency.
- Increase in the load on the seals due to increased return line pressure.
- For certain rock drills, wear of the rotation shaft and thrust bearing due to increased return line pressure.
- Too thick oil increases the risk of cavitation in pumps.

## 6.2. Hydraulic system

The oil viscosity recommendations are based on the operating temperature of the oil.

## NOTICE

# Never mix different types of hydraulic system oils. Mixing can damage the hydraulic components.

The selected hydraulic oil must be high quality and must retain its properties in fluctuating temperature conditions. Furthermore, it should contain additives typical of high performance hydraulic oils. When choosing the viscosity of the oil to be used, the temperature of the drilling environment is important. Pay attention to temperature fluctuation.

When choosing the oil, consider the following:

- 1. Check or estimate the operating temperature of the oil.
- 2. The viscosity of oils at their operating temperature should be close to 60 cSt, and any variation in continuous use should remain within the range 50–110 cSt.

The following variation limits are permitted temporarily (but not constantly):

- 110–200 cSt as a result of a low temperature peak, or
- 30–50 cSt as a result of a high temperature peak

The values indicated in the tables should be considered first and foremost. In each case it must always be ensured that the product in question has the required properties.

- 3. If the drilling environment temperature does not vary greatly, it is most recommended to use single-grade oils which undergo minimal viscosity variation during use.
- 4. If the drilling conditions are such that single-grade oils do not remain within the given viscosity limits, a multigrade oil should be chosen.
- 5. The oil should be changed once a year unless heavy use requires more frequent changes. This change interval recommendation is based on the the extent that the oil ages and gathers moisture over a one-year period.

For arctic conditions (temperatures below –20 °C), synthetic oils are recommended.

## 6.2.1. Engine oils in the hydraulic system

Only use high-quality oils.

Classification (SAE)	Operating temperature												
Multigrade oil													
	°C -	30 -	20 -	10	0	+10	+20	+30	+40	+50	+60	+7	0
	°F -	22 -	4 +	14	+32	+50	+68	+86	+104	+122	+140	+1	58
5W-20	•									_			
5W-30		•											
10W-30			<b>•</b>										
10W-40				<b>•</b>									
Single-grade oil						_							
10W			•								_		
20W-20				<u> </u>									
SAE 30					<u> </u>								
SAE 40						•							
Synthetic oil		_											
5W-30	•												
•	Recommended temperature range Temporarily allowed temperature range Lowest permitted starting temperature												

Table: Viscosity/temperature table

Oils and fluids suitable for hydraulic systems are, e.g.

• Shell Rimula R3 (engine oil)

## 6.2.2. Hydraulic oils

DIN 51524, ISO 6743-4

Viscosity cSt (40 °C)		Operating temperature										
	°C	-30	-20	-10	0	+10	+20	+30	+40	+50	+60	+70
	°F	-22	-4	+14	+32	+50	+68	+86	+104	+122	+140	+158
32				•								
46				•								
68					•							
100					(	•						
150						•						
•	Reo Ter Lov	Recommended temperature range Temporarily allowed temperature range Lowest permitted starting temperature										

Table: Viscosity/temperature table

Oils and fluids suitable for hydraulic systems are, e.g.

• Shell Tellus S (hydraulic oil)

## 6.2.3. Biodegradable hydraulic oils

Sandvik sets the same high technical quality requirements for biodegradable oils as are set for conventional mineral oils. In addition, the oils must be environmentally friendly in terms of the following quality requirements:

- biodegradability
- toxicity
- use and disposal.

The international standard ISO 15380 specifies the requirements for environmentally acceptable hydraulic fluids.

Viscosity cSt (40 °C)	Operating temperature											
	°C	-30	-20	-10	0	+10	+20	+30	+40	+50	+60	+70
	°F	-22	-4	+14	+32	+50	+68	+86	+104	+122	+140	+158
46												
68				•								
•	Reco Tem Low	Recommended temperature range Temporarily allowed temperature range Lowest permitted starting temperature										

Table: Viscosity/temperature table

Instructions for changing biodegradable oils are provided in the manual "Biodegradable Hydraulic Oils – Changing instructions for biodegradable hydraulic oils", Sandvik instruction 130.

## NOTICE

When biodegradable oils (optional) are used, Sandvik factory fill oils are SHELL NATURELLE HFE 46 or HFE 68 (synthetic ester). The guarantee is valid only when these olis are used.

Oils and fluids suitable for hydraulic systems are, e.g.

• Shell Naturelle HFE (biodegradable hydraulic oil, synthetic ester)

## 6.2.4. Fire retardant hydraulic fluids

Sandvik sets the same high technical quality requirements for less flammable hydraulic fluids as are set for conventional mineral oils. In addition, the oils must be non-flammable, with self-extinguishing properties. A range of fire retardant fluids are available on the market, the properties of which differ greatly.

In risk-prone conditions, Sandvik recommends use of fluids that comply with the ISO 6743-4 HFD standard for synthetic fluids.

## NOTICE

NOTICE

## However, for safety, performance and environmental reasons Sandvik does not allow mixing of different hydraulic oils/fluids.

These fluids must be compatible with the majority of metals and seal materials.

Sandvik uses fire retardant and biodegradable HFD fluids as factory-fill oils: Fuchs Plantoflux 68-AT-S (Tampere plant) and Condat D68 (Lyon plant). Sandvik recommends these fluids for use in drilling rigs. Since the availability of these fluids can be limited in certain market areas, Sandvik also approves the following alternative:

• Quintolubric 888-68 (Quaker Chemicals)

Sandvik factory fill oils are totally miscible with the fluid mentioned above. Thus, the factory filled oil can be changed as necessary in connection with the rig start-up inspection without flushing the hydraulic system. Sandvik does not approve continuous mixing of hydraulic fluids.

The guarantee is valid only if the recommended fluids are used.

Oils and fluids suitable for hydraulic systems are, e.g.

• Fuchs Plantoflux 68-AT-S (less flammable hydraulic fluid)

## 6.3. Rock drill shank lubrication

## 6.3.1. Shank lubrication with oil

## **NOTICE** Use only recommended shank lubrication oils. Using waterbased lubricants for this purpose is forbidden.

The oil recommendations are based on the ambient temperature.

Viscosity cSt (40 °C)	Ambient temperature											
	°C	-30	-20	-10	0	+10	+20	+30	+40	+50	+60	+70
	°F	-22	-4	+14	+32	+50	+68	+86	+104	+122	+140	+158
32												
68												
100												
150												
220												
320												
	Rec	Recommended temperature range										

Table: Viscosity/temperature table

Examples of rock drill oils:

SHELL	Torcula
ESSO (EXXON)	Arox
GULF	Gulf Rock Drill Oil
MOBIL	Almo
BP	Energol RD-E
TEXACO	Rock drill lube

## 6.3.2. Shank lubrication with grease

The grease used must provide sufficient lubrication properties at high temperatures.

NLGI grade	2
Penetration, beaten, 25 °C, ASTM D 217, 0.1 mm	265–295
Operating temperature range, °C	-30+210
Dropping point, ASTM D 2265, °C	> +260
Corrosion protection, ASTM D 1743, SKF EM- COR, classification	Approved
Water flushing test, ASTM D 1264, 79°C, % wt. loss	<3
Oxidation, ASTM D 942, psi decrease / 100 hours	<5
Evaporation, ASTM D 2595, 100 °C, wt %	<2

#### Table: Recommendations

High mechanical durability.

Suitable for heavy shock loads as well as high vibration and oscillatory conditions.

Grease type	Manufacturer
VISO 808-2	VISO
MOBILITH SHC220	MOBIL
ALMAGARD 3752	LUBRICATION ENGINEERS
ALBIDA HLS 2	SHELL
SYNTEC GREASE	TEBOIL

Table: Recommended greases

## 6.4. Diesel engine

## 6.4.1. API engine oil classification

The API (American Petroleum Institute) diesel engine oil classification has two-letter designations, the first letter being "C". The current classification designations for four-stroke diesel engines are API CG-4, API CH-4, API CI-4 ja API CJ-4. The higher the second letter in the alphabet, the higher the oil quality.

## 6.4.2. Fuel sulphur content

A fuel sulphur content exceeding 0.5 % can affect the oil selection and the length of oil change intervals. For more information, refer to the engine manufacturer's maintenance instructions.

## NOTICE

# For the engine oil selection, refer to the engine manufacturer's maintenance instructions.

## Caterpillar

- API CJ-4 multigrade oil (recommended oil)
- API CI-4 multigrade oil that meets Caterpillar ECF-1-a or ECF-2 specifications (acceptable oil)
- API CH-4 multigrade oil that meets Caterpillar ECF-1-a or ECF-2 specifications (acceptable oil)
- API CG-4 multigrade oil that meets Caterpillar ECF-1-a or ECF-2 specifications (acceptable oil)

Classification (SAE)		Ambient temperature											
	°C	-40	-30	-20	-10	0	+10	+20	+30	+40	+50	+60	)
	°F	-40	-22	-4	+14	+32	+50	+68	+86	+104	+122	+14	40
SAE 0W - 20													
SAE 0W - 30													
SAE 0W - 40													
SAE 5W - 30													
SAE 5W - 40													
SAE 10W - 30													
SAE 15W - 40													
Recommended temperature range													

## 6.5. Compressor

## 6.5.1. Gardner Denver compressor

Mineral-based engine oil or synthetic compressor oil can be used in the compressor.

# **NOTICE** Never mix different types of oil. Mixing may damage the compressor.

When changing the oil type, the compressor circuit must be flushed with new oil:

- 1. Drain the oil from the compressor circuit.
- 2. Fill the compressor circuit with new oil and run the compressor to warm it up.
- 3. Drain the oil from the compressor circuit.
- 4. Replace the oil filter and oil separators.
- 5. Fill the compressor circuit with new oil.

## Mineral-based engine oil

Mineral-based engine oil can be used in the compressor. The flash point of the oil must be over 180 °C. The lowest allowable viscosity at the operating temperature is 7 cSt.

## NOTICE

If the operating temperature is continuously over 90 °C, the oil change interval for mineral-based oils is 250 engine hours (500 engine hours for synthetic compressor oils).

The mineral-based engine oil recommendations are based on the ambient temperature.

Classification (SAE)		Ambient temperature										
	°°, F	-40 -40	-30 -22	-20 -4	-10 +14	0 +32	+10 +50	+20 +68	+ 30 + 86	+40 +104	+50 +122	+60 +140
SAE SW - 20												
SAE 10W												
SAE 20W - 20												
SAE 10 - 30							20					
	Re Te	ecomi empor	mendeo arily all	d temp lowed t	erature tempera	range ature ra	ange					
#### Synthetic compressor oil

## NOTICE

If the operating temperature is continuously over 100 °C (ambient temperature over 40 °C) or below –20 °C (in arctic conditions), synthetic compressor oil must be used.

The synthetic compressor oil recommendations are based on the ambient temperature.

ISO VG Viscosity cSt (40 °C)	Ambient temperature												
	°C	-40	-30	-20	-10	0	+10	+20	+30	+40	+50	+60	
	°F	°F -40 -22 -4 +14 +32 +50 +68 +86 +104 +122 +140											
32													
46													
	Recommended temperature range												
	Ten	npora	rily allo	wed te	mperat	ture rai	nge						

Recommended synthetic oils:

- Shell Corena AS 46
- Mobil Rarus SHC 1025
- Esso Cetus Pao 46
- BP Enersyn RC-S46

#### 6.6. Classifications for transmission and driveline oils

#### 6.6.1. Quality classifications

#### **API classification**

The API (American Petroleum Institute) transmission oil recommendations are API GL-1...API GL-5. The higher the last digit, the higher the EP additive level is.

For example, API-GL-5 is an EP oil with a high additive level, suitable for hypoid gears.

#### ISO 12925-1 classification

ISO (International Organization for Standardization) industrial transmission oil recommendations are ISO 12925-1 type CKB... ISO 12925-1 type CKD. The higher the third letter, the more additives there are in the oil.

For example, ISO 12925-1 type CKD. Lubricants with oxidation resistance, anti-corrosion, anti-foam, pressure resistance, and anti-wear properties. Improved thermal/oxidation resistance properties enable use at high temperatures.

#### 6.6.2. Viscosity classifications

#### SAE classification (transmission)

**SAE** (Society of Automotive Engineers) Viscosity indicates the oil's ability to flow. Viscosity is measured at a high and low temperature and is indicated as an SAE grade, e.g. SAE 90. For multigrade oils, e.g. 75W-90, the first value 75W indicates the viscosity at low temperatures, and the second value 90 indicates the oil viscosity when it is hot.

#### ISO classification (industrial oils)

( **ISO** = International Organization for Standardization) The viscosity of industrial lubricants is determined by the ISO-VG standard (ISO 3448). The ISO grade number indicates the oil viscosity at + 40  $^{\circ}$ C, expressed in centistokes (cSt, kinematic viscosity). For example, oil graded as ISO-VG 150 has a viscosity of 150 cSt at + 40  $^{\circ}$ C.

#### 6.7. Transmission oils (surface rigs)

Oils that meet the following requirements: API GL-5, SAE 80W-90, or synthetic SAE 75W-90.

#### 6.7.1. Winch

Winch



#### 6.7.2. Tramming gear DC 120-122

#### Tramming gear DC 120-122

Oil that meets the following requirements: ISO 12925-1 type CKD (synthetic oil). ISO VG 100, ambient temperature –35...+60 °C ISO VG 220, ambient temperature –25...+80 °C E.g. Shell Omala HD 220



### 6.8. Thread grease for drill rods

#### Recommended lubrication grease:

Sandvik Coromant thread grease

#### 6.9. Lubrication grease

The hardness of greases is indicated by the NLGI grade, which indicates the grease's penetration value as determined in laboratory tests. The NLGI grade can be 000, 00, 0, 1, 2, 3, 4, 5, or 6. Number 2 indicates the so-called normal hardness for a bearing grease. The higher the figure, the harder the grease. The hardness grade of a grease is usually indicated after the product name.

#### 6.9.1. General lubrication greases

## **NOTICE** Never use the greases listed below for lubricating the shank of a rock drill!

SHELL	Alvania EP Grease 2 Retinax HDX
ESSO	Beacon EP 2 Beacon Q 2
GULF	Gulfcrown Grease EP 2 Gulflex Moly
MOBIL	Mobilux EP 2 Mobilgrease Special
BP	Energrease LS-EP 2 Energrease L 21 M
TEXACO	Marfax All Purpose Molytex Grease 2
CASTROL	Speeroll AP 2 Castrol MS 1 Grease

Table: Recommended lubrication greases from different manufacturers

### 6.10. Engine coolant

Engine coolant is a mixture of water and corrosion preventing agents/anti-freeze agent. To prevent corrosion and to elevate the boiling point of the coolant, the mixture must be used in the cooling system throughout the year.

When choosing the corrosion preventing agents/anti-freeze agent for the engine coolant, refer to the engine manufacturer's maintenance manual.

Engine coolant must be changed at certain intervals. The characteristics of the coolant and its additives weaken and are lost as the coolant ages. Refer to the engine manufacturer's maintenance manual.



Do not mix different coolants. Mixing coolants can lead to clogging the cooler's duct and seriously damage the engine.

#### 6.10.1. Caterpillar engines

The cooling system is filled at the factory with a prepared mixture of water and Caterpillar Extended Life Coolant. Cat ELC is a red ethylene glycol based fluid. Only this same Cat ELC fluid or distilled water can be added to the cooling system.

Anti-freezing to temperature °C / °F	ELC fluid percentage of volume (%)	ELC concentrate percentage of volume (%)
-37 °C / -34 °F	100	
-52 °C / -62 °F	80	20 (ELC concentrate added)

Table: Coolant mixing ratio

Boiling prevention 1 bar with cooler cap to temperature °C / °F	Water percentage of vol- ume (%)	Cat ELC fluid percentage of vol- ume (%)
129 °C / 265 °F	50	50
132 °C / 270 °F	40	60 (ELC concentrate added)

### 6.11. Filling capacities

#### Filling Quantities

Item	Quantity	50h	250h	500h	1000h	1500h	3000h
Engine Oil	8.2L		X	Х	Х	X	Х
Hydraulic Oil	45L				Х		X
Compressor Oil	6L			Х	Х	X	Х
Final Drive Oil (4 pcs.	0.7L			Х	Х	X	Х
Winch oil	0.7L						Х
Engine cooling sys- tem	10L						Х

## 7. ADDITIONAL INSTRUCTIONS

### 7. ADDITIONAL INSTRUCTIONS

## 7.1. Towing

	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.					

### 7.1.1. 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.

## 7.2. 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.



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

### 7.3. 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.
- 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.



### 7.4. Welding of the rig



DC1228

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



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.

#### 7.5. Storage

#### Storage conditions:



#### 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)

## 8. MAINTENANCE CARDS

### 8. MAINTENANCE CARDS

## 8.1. Maintenance program

Maintenance program									
	Drilling	ria ongin	o houre		Maintenance card hours				
	Drining	ng engin	enours	-	250	500	1000	1500	3000
250	6250	12250	18250	24250	X				
500	6500	12500	18500	24500		X			
750	6750	12750	18750	24750	X				
1000	7000	13000	19000	25000			X		
1250	7250	13250	19250	25250	X				
1500	7500	13500	19500	25500				Х	
1750	7750	13750	19750	25750	X				
2000	8000	14000	20000	26000			X		
2250	8250	14250	20250	26250	X				
2500	8500	14500	20500	26500		X			
2750	8750	14750	20750	26750	X				
3000	9000	15000	21000	27000					X
3250	9250	15250	21250	27250	X				
3500	9500	15500	21500	27500		X			
3750	9750	15750	21750	27750	X				
4000	10000	16000	22000	28000			X		
4250	10250	16250	22250	28250	X				
4500	10500	16500	22500	28500				Х	
4750	10750	16750	22750	28750	X				
5000	11000	17000	23000	29000			X		
5250	11250	17250	23250	29250	X				
5500	11500	17500	23500	29500		X			
5750	11750	17750	23750	29750	X				
6000	12000	18000	24000	30000					X

## 8.2. Maintenance performed according to diesel engine hours

### 8.2.1. Every 50 hours

DIESEL HOURS – EVERY 50 HOURS						
MAINTENANCE PROCEDURE				NOTES		
GENERAL MAINTENANCE						
Clean the rig	⊃€	74				
BOOM						
Grease all the greasing points		75				
Check the cradle and feed clearances	3	75				
FEED						
Lubricate all the greasing points		76				
Check rock drill carriage / feed rail clearance	٩	76				
HYDRAULIC ROCK DRILL						
Check accumulator valves and pres- sures	3	78				
Check the tightness of the pressure ac- cumulator bolts	3	78				
Check the tightness of the front cover bolts	3	78				
Check the tightness of the rear cover bolts	3	79				
DUST COLLECTOR SYSTEM						
Lubricate the grease nipples of the cut- off cylinder and the butterfly valve		79				
CARRIER						
Lubricate the greasing points		81				
Check the condition and mounting of winch rope	3	81				
Check the electrolyte and connections in the batteries	3	82				
DIESEL ENGINE						
Check air intake lines and connections		84				
Clean the cooler core	$\geq \leq$	85				
FUEL SYSTEM						
Drain fuel tank water trap	<u>ال</u> ام ال	88				

DIESEL HOURS – EVERY 50 HOURS						
MAINTENANCE PROCEDURE				NOTES		
PNEUMATIC SYSTEM						
Check the compressor air intake lines and connections	3	91				
Check the compressor belt	3	92				

When completed:

Date	•
Approved	

Diesel hours .....

#### 8.2.2. Every 250 hours

DIESEL HOURS – EVERY 250 HOURS						
MAINTENANCE PROCEDURE				NOTES		
GENERAL MAINTENANCE						
Clean the rig	$\supset \leqslant$	74				
BOOM						
Grease all the greasing points		75				
Check the cradle and feed clearances	3	75				
FEED						
Lubricate all the greasing points		76				
Check rock drill carriage / feed rail clearance	٢	76				
Check condition of the retaining cen- tralizer jaws	3	77				
HYDRAULIC ROCK DRILL						
Check accumulator valves and pres- sures	3	78				
Check the tightness of the pressure ac- cumulator bolts	3	78				
Check the tightness of the front cover bolts	3	78				
Check the tightness of the rear cover bolts	3	79				
DUST COLLECTOR SYSTEM						
Lubricate the grease nipples of the cut- off cylinder and the butterfly valve		79				
Check suction head rubbers		79				
Check the operation of the cut-off cyl- inder and the butterfly valve	3	80				
Check the condition of the impact plate		80				
CARRIER						
Lubricate the greasing points		81				
Check the condition and mounting of winch rope	٩	81				
Check the electrolyte and connections in the batteries	٩	82				
Check the operation of brakes	٢	82				
Check the winch oil level	3	82				

DIESEL HOURS – EVERY 250 HOURS						
MAINTENANCE PROCEDURE				NOTES		
DIESEL ENGINE						
Check air intake lines and connections		84				
Clean the cooler core	$\geq \leqslant$	85				
Change the engine oil		85				
Change the oil filter	22	85				
Check the engine grounding		85				
FUEL SYSTEM						
Drain fuel tank water trap	<u>ال</u> الح	88				
Change the fuel filter		88				
Change the fuel filter / water separator	2	88				
PNEUMATIC SYSTEM						
Check the compressor air intake lines and connections	٩	91				
Check the compressor belt		92				

When completed:

Date ..... Approved .....

Diesel hours .....

#### Filter kit ID 552 073 17 for 250h service:

Item	ID	Quantity
Fuel filter	550 308 88	1
Fuel filter / water separator	885 239 79	1
Engine oil filter	550 230 35	1

#### Filling Quantities 250h

Item	Quantity
Engine Oil	8.2L

### 8.2.3. Every 500 hours

DIESEL HOURS – EVERY 500 HOURS					
MAINTENANCE PROCEDURE				NOTES	
GENERAL MAINTENANCE					
Clean the rig	)\$	74			
BOOM					
Grease all the greasing points		75			
Check the cradle and feed clearances		75			
Check the weldings of boom and cradle		75			
Check the mountings of hydraulic cyl- inders	٩	75			
Check the tightening torque of the cyl- inder taper pin bolts	3	76			
FEED					
Lubricate all the greasing points		76			
Check rock drill carriage / feed rail clearance	٩	76			
Check condition of the retaining cen- tralizer jaws	3	77			
Check the clearances of the sprocket wheel bearings	3	77			
HYDRAULIC ROCK DRILL					
Check accumulator valves and pres- sures	3	78			
Check the tightness of the pressure ac- cumulator bolts	3	78			
Check the tightness of the front cover bolts	3	78			
Check the tightness of the rear cover bolts	3	79			
DUST COLLECTOR SYSTEM					
Lubricate the grease nipples of the cut- off cylinder and the butterfly valve		79			
Check suction head rubbers		79			
Check the operation of the cut-off cyl- inder and the butterfly valve	٩	80			
Check the condition of the impact plate		80			
CARRIER					
Lubricate the greasing points		81			

DIESEL HOURS – EVERY 500 HOURS					
MAINTENANCE PROCEDURE				NOTES	
Check the condition and mounting of winch rope	٩	81			
Check the electrolyte and connections in the batteries	3	82			
Check the operation of brakes		82			
Check the winch oil level		82			
Check the weldings		83			
DIESEL ENGINE					
Check air intake lines and connections	3	84			
Clean the cooler core	>€	85			
Change the engine oil		85			
Change the oil filter	2	85			
Check the engine grounding	٩	85			
Change the air filter		85			
Check the Water Pump for Leaks		86			
FUEL SYSTEM					
Drain fuel tank water trap	all ال	88			
Change the fuel filter		88			
Change the fuel filter / water separator	23	88			
Change the fuel tank breather	2	89			
HYDRAULIC SYSTEM					
Replace the hydraulics return filter		90			
Replace the hydraulic oil receiver breather		91			
PNEUMATIC SYSTEM					
Check the compressor air intake lines and connections	3	91			
Check the compressor belt	3	92			
Change the air filter		93			
Change the compressor oil filter and compressor oil	R	93			
Check the shut down temperature switch	3	93			

When completed:	
Date	
Approved	

Diesel hours .....

#### Filter kit ID 552 073 18 for 500h / 1000h service:

ltem	ID	Quantity
Fuel filter	550 308 88	1
Fuel filter / water separator	885 239 79	1
Engine oil filter	550 230 35	1
Compressor oil filter	816 492 09	1
Hydraulic oil return filter	550 295 08	1
Breather	872 204 59	2
Engine and compressor air filter	550 216 47	2

#### Filling Quantities 500h

Item	Quantity
Engine Oil	8.2L
Compressor Oil	6L
Final Drive Oil (4 pcs.	0.7L

DIESEL HOURS – EVERY 1000 HOURS				
MAINTENANCE PROCEDURE				NOTES
GENERAL MAINTENANCE				
Clean the rig	$\supset \leqslant$	74		
воом				
Grease all the greasing points		75		
Check the cradle and feed clearances		75		
Check the weldings of boom and cradle		75		
Check the mountings of hydraulic cyl- inders	3	75		
Check the tightening torque of the cyl- inder taper pin bolts	3	76		
FEED				
Lubricate all the greasing points		76		
Check rock drill carriage / feed rail clearance	3	76		
Check condition of the retaining cen- tralizer jaws	٩	77		
Check the clearances of the sprocket wheel bearings	3	77		
HYDRAULIC ROCK DRILL				
Check accumulator valves and pres- sures	3	78		
Check the tightness of the pressure ac- cumulator bolts	3	78		
Check the tightness of the front cover bolts	3	78		
Check the tightness of the rear cover bolts	3	79		
DUST COLLECTOR SYSTEM				
Lubricate the grease nipples of the cut- off cylinder and the butterfly valve		79		
Check suction head rubbers		79		
Check the operation of the cut-off cyl- inder and the butterfly valve	٩	80		
Check the condition of the impact plate		80		
CARRIER				
Lubricate the greasing points		81		

DIESEL HOURS – EVERY 1000 HOURS					
MAINTENANCE PROCEDURE		Ð		NOTES	
Check the condition and mounting of winch rope	0	81			
Check the electrolyte and connections in the batteries	3	82			
Check the operation of brakes		82			
Check the winch oil level	٩	82			
Check the weldings	٩	83			
Change the Final Drive Oil		83			
DIESEL ENGINE					
Check air intake lines and connections	٩	84			
Clean the cooler core	$\geq \leq$	85			
Change the engine oil		85			
Change the oil filter		85			
Check the engine grounding	٩	85			
Change the air filter		85			
Check the Water Pump for Leaks	٩	86			
Check the Valve Clearances	٢	86			
Check the Tightness of the Cylinder Head Bolts	3	86			
FUEL SYSTEM					
Drain fuel tank water trap	<u>ال</u>	88			
Change the fuel filter	23	88			
Change the fuel filter / water separator		88			
Change the fuel tank breather		89			
Clean fuel tank	$\geq \leqslant$	89			
HYDRAULIC SYSTEM					
Replace the hydraulics return filter		90			
Replace the hydraulic oil receiver breather		91			
Change the hydraulic oil		90			

## MAINTENANCE MANUAL

DIESEL HOURS – EVERY 1000 HOURS					
MAINTENANCE PROCEDURE				NOTES	
PNEUMATIC SYSTEM					
Check the compressor air intake lines and connections	3	91			
Check the compressor belt		92			
Change the air filter	2	93			
Change the compressor oil filter and compressor oil		93			
Check the shut down temperature switch	3	93			
Clean the oil regeneration line strainer and orifice	>€	94			
Clean the compressor oil receiver	$\supset \leqslant$	95			

When completed:

Date	• •
Approved	

Diesel hours .....

#### Filter kit ID 552 073 18 for 500h / 1000h service:

Item	ID	Quantity
Fuel filter	550 308 88	1
Fuel filter / water separator	885 239 79	1
Engine oil filter	550 230 35	1
Compressor oil filter	816 492 09	1
Hydraulic oil return filter	550 295 08	1
Breather	872 204 59	2
Engine and compressor air filter	550 216 47	2

#### Filling Quantities 1000h

Item	Quantity
Engine Oil	8.2L
Compressor Oil	6L
Final Drive Oil (4 pcs.	0.7L
Hydraulic Oil	45L

DIESEL HOURS – EVERY 1500 HOURS				
MAINTENANCE PROCEDURE				NOTES
GENERAL MAINTENANCE				
Clean the rig	$\leq$	74		
воом				
Grease all the greasing points		75		
Check the cradle and feed clearances	3	75		
Check the weldings of boom and cradle		75		
Check the mountings of hydraulic cyl- inders	3	75		
Check the tightening torque of the cyl- inder taper pin bolts	3	76		
FEED				
Lubricate all the greasing points		76		
Check rock drill carriage / feed rail clearance		76		
Check condition of the retaining cen- tralizer jaws		77		
Check the clearances of the sprocket wheel bearings	6	77		
HYDRAULIC ROCK DRILL				
Check accumulator valves and pres- sures	3	78		
Check the tightness of the pressure ac- cumulator bolts	3	78		
Check the tightness of the front cover bolts	6	78		
Check the tightness of the rear cover bolts	Q	79		
DUST COLLECTOR SYSTEM				
Lubricate the grease nipples of the cut- off cylinder and the butterfly valve		79		
Check suction head rubbers	3	79		
Check the operation of the cut-off cyl- inder and the butterfly valve	٩	80		
Check the condition of the impact plate	٢	80		
CARRIER				
Lubricate the greasing points		81		

DIESEL HOURS – EVERY 1500 HOURS						
MAINTENANCE PROCEDURE				NOTES		
Check the condition and mounting of winch rope	٩	81				
Check the electrolyte and connections in the batteries	3	82				
Check the operation of brakes		82				
Check the winch oil level		82				
Check the weldings		83				
Change the Winch Oil		84				
DIESEL ENGINE						
Check air intake lines and connections		84				
Clean the cooler core	)\$	85				
Change the engine oil		85				
Change the oil filter		85				
Check the engine grounding	٩	85				
Change the air filter		85				
Check the Water Pump for Leaks	3	86				
Change the safety filter element		86				
Check the engine vibration dampers	٩	87				
Check the injector nozzles	٩	87				
Clean the crankcase breather	$\geq$	87				
Change the engine coolant and replace the engine thermostat		87				
Check the water pump, the starter mo- tor and the alternator	3	87				
FUEL SYSTEM						
Drain fuel tank water trap		88				
Change the fuel filter		88				
Change the fuel filter / water separator		88				
Change the fuel tank breather		89				
HYDRAULIC SYSTEM						
Replace the hydraulics return filter		90				

## MAINTENANCE MANUAL

DIESEL HOURS – EVERY 1500 HOURS					
MAINTENANCE PROCEDURE				NOTES	
Replace the hydraulic oil receiver breather		91			
PNEUMATIC SYSTEM					
Check the compressor air intake lines and connections	3	91			
Check the compressor belt	٩	92			
Change the air filter		93			
Change the compressor oil filter and compressor oil		93			
Check the shut down temperature switch	3	93			
Change the safety filter element	27	94			
Change the oil separator element		94			

When completed:

Date
Approved

Diesel hours .....

#### Filter kit ID 552 073 19 for 1500h / 3000h service:

Item	ID	Quantity
Fuel filter	550 308 88	1
Fuel filter / water separator	885 239 79	1
Engine oil filter	550 230 35	1
Compressor oil filter	816 492 09	1
Hydraulic oil return filter	550 295 08	1
Breather	872 204 59	2
Engine and compressor air filter	550 216 47	2
Engine and compressor air filter safe- ty cartridge	870 280 09	2
Compressor oil separator	035 822 28	1

#### Filling Quantities 1500h

Item	Quantity
Engine Oil	8.2L
Compressor Oil	6L
Final Drive Oil (4 pcs.	0.7L

DIESEL HOURS – EVERY 3000 HOURS				
MAINTENANCE PROCEDURE				NOTES
GENERAL MAINTENANCE				
Clean the rig	⊃€	74		
Test the fire extinguisher and refilling.		74		
BOOM				
Grease all the greasing points		75		
Check the cradle and feed clearances		75		
Check the weldings of boom and cradle		75		
Check the mountings of hydraulic cyl- inders	3	75		
Check the tightening torque of the cyl- inder taper pin bolts	3	76		
FEED				
Lubricate all the greasing points		76		
Check rock drill carriage / feed rail clearance	3	76		
Check condition of the retaining cen- tralizer jaws	3	77		
Check the clearances of the sprocket wheel bearings	6	77		
HYDRAULIC ROCK DRILL				
Check accumulator valves and pres- sures	6	78		
Check the tightness of the pressure ac- cumulator bolts	۲	78		
Check the tightness of the front cover bolts	3	78		
Check the tightness of the rear cover bolts	3	79		
DUST COLLECTOR SYSTEM				
Lubricate the grease nipples of the cut- off cylinder and the butterfly valve		79		
Check suction head rubbers		79		
Check the operation of the cut-off cyl- inder and the butterfly valve	۲	80		
Check the condition of the impact plate	٩	80		

DIESEL HOURS – EVERY 3000 HOURS					
MAINTENANCE PROCEDURE				NOTES	
CARRIER					
Lubricate the greasing points		81			
Check the condition and mounting of winch rope	٩	81			
Check the electrolyte and connections in the batteries	3	82			
Check the operation of brakes	٢	82			
Check the winch oil level		82			
Check the weldings		83			
Change the Final Drive Oil	23	83			
Change the Winch Oil	27	84			
DIESEL ENGINE					
Check air intake lines and connections		84			
Clean the cooler core	$\geq $	85			
Change the engine oil	23	85			
Change the oil filter	23	85			
Check the engine grounding		85			
Change the air filter	23	85			
Check the Water Pump for Leaks		86			
Check the Valve Clearances		86			
Check the Tightness of the Cylinder Head Bolts	٩	86			
Change the safety filter element		86			
Check the engine vibration dampers		87			
Check the injector nozzles		87			
Clean the crankcase breather	$\supset $	87			
Change the engine coolant and replace the engine thermostat		87			
Check the water pump, the starter mo- tor and the alternator	٩	87			
FUEL SYSTEM					
Drain fuel tank water trap	<u>ال</u> الح	88			

## MAINTENANCE MANUAL

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DIESEL HOURS – EVERY 3000 HOURS					
MAINTENANCE PROCEDURE				NOTES	
Change the fuel filter		88			
Change the fuel filter / water separator		88			
Change the fuel tank breather	2	89			
Clean fuel tank	$\geq \leqslant$	89			
HYDRAULIC SYSTEM					
Replace the hydraulics return filter		90			
Replace the hydraulic oil receiver breather		91			
Change the hydraulic oil		90			
PNEUMATIC SYSTEM					
Check the compressor air intake lines and connections	٩	91			
Check the compressor belt		92			
Change the air filter		93			
Change the compressor oil filter and compressor oil		93			
Check the shut down temperature switch	3	93			
Clean the oil regeneration line strainer and orifice	>€	94			
Clean the compressor oil receiver	>€	95			
Change the safety filter element		94			
Change the oil separator element		94			

When completed:

Date ..... Approved ..... Diesel hours .....

#### Filter kit ID 552 073 19 for 1500h / 3000h service:

Item	ID	Quantity
Fuel filter	550 308 88	1
Fuel filter / water separator	885 239 79	1
Engine oil filter	550 230 35	1
Compressor oil filter	816 492 09	1
Hydraulic oil return filter	550 295 08	1

Item	ID	Quantity
Breather	872 204 59	2
Engine and compressor air filter	550 216 47	2
Engine and compressor air filter safe- ty cartridge	870 280 09	2
Compressor oil separator	035 822 28	1

### Filling Quantities 3000h

Item	Quantity
Engine Oil	8.2L
Compressor Oil	6L
Final Drive Oil (4 pcs.	0.7L
Hydraulic Oil	45L
Winch oil	0.7L
Engine cooling system	10L



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