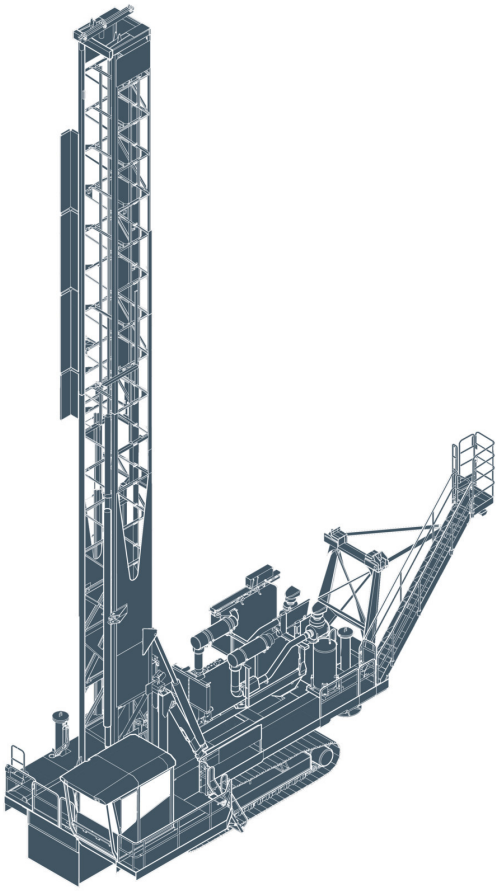
Maintenance

PV-271D / PV-291D RCS 5



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Epiroc

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Revision History

Revision No.	Date	Revision
001	June 2019	Original release
002	June 2022	Editorial updates Added procedure Do an Inspection of the Feed Cable Sheaves to 500-Hour Periodic Maintenance interval. Updated overfilling the grease tank safety message. Updated section 2.4.2, Environmental Instructions.
003	October 2022	Added procedure Change the Auto-Bit-Changer Gearbox Oil to 1,000-Hour Periodic Maintenance interval. Added PV-291D to title. Changed rotary head and gearbox references: Standard is now PV-271D, optional is now PV-291D.
004	June 2023	Added procedure Lubricate the Upper Spindle Bearing to Maintenance As Required interval. Added trunnion block cap screw maintenance procedures to Annual Maintenance and 250-Hour Periodic Maintenance chapters. Updated Filling the Grease Tank in the As required interval.

1 Introduction

1.1 Safety First

Always read and obey the information in the Safety manual before you operate the machine or before you start maintenance work. Also read and obey the safety messages in this manual.

1.2 The Purpose of this Publication

This manual provides the step-by-step sequence to do an inspection of and service a PV-271 machine.

Epiroc is aware that numerous customer jurisdictions are served. If a particular procedure conflict with the site-specific requirements or a particular country's occupational health and safety standards, the responsibility rests on the Epiroc Supervisor to amend those procedures, as applicable.

1.3 Target Group

This manual is for Epiroc certified technicians only. Service technicians doing maintenance procedures must have a Technical Level 1 or Technical Level 2 certification.

1.4 Customer Acknowledgment

Use only Epiroc original parts. Damage or breakdown that is caused by non-original spare parts are not covered by the warranty or product liability.

Epiroc is not responsible for damages that are caused by unauthorized modification of the machine and its associated equipment.

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

The following damages are not covered by the customer warranty policy:

- Damage from substandard repairs.
- Injury to personnel from unresolved repairs.
- Damage to equipment from unresolved repairs.

Always refer to the customer warranty policy.

Performance specifications are based on maximum computed values and are subject to revisions without notification. Nothing in this instruction extends any warranty or representation expressed or implied, regarding the products described. Any such warranties or other terms and conditions shall be in accordance with Epiroc standard terms and conditions of sale for such products, which are available upon request.

Specifications represented herein are calculated values at 100% efficiency. Epiroc is constantly striving for product improvements and enhancements. Accordingly, Epiroc reserves the right to make such changes in specifications and design as the company considers in conformity with this policy or due to unavailability of materials or assemblies.

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1.5 Feedback and Contact Information

At Epiroc, we work actively to develop and continuously improve our products and associated documentation. We value customer feedback and do our best to promptly answer questions. To provide feedback, contact your local supplier at Epiroc.com, under **CONTACT**.

> ***NOTE:*** *If you give feedback via email, make sure that you use a valid email address to be able to receive and reply.*

Postal Address:

Epiroc Drilling Solutions, LLC

2100 North First Street

Garland, Texas 75040 - USA

1.6 Abbreviations

Abbreviation	Definition
AHJ	Authority Having Jurisdiction
ASTM	American Society for Testing and Materials
ATD	After Treatment Device
AWS	American Welding Society
CCI	Common Communication Interface
CCV	Closed Crankcase Ventilation
CGI	Clean Gas Induction
CRS	CAT® Regeneration System
DEF	Diesel Exhaust Fluid
DOC	Diesel Oxidation Catalyst
DPF	Diesel Particulate Filter
ECM	Engine Control Module
EGR	Exhaust Gas Recirculation
EPA	Environmental Protection Agency

Abbreviation	Definition
EU	European Union
GUI	Graphical User Interface
HP	High Pressure
ISO	International Organization for Standardization
JHA	Job Hazard Analysis
JSEA	Job Safety and Environmental Analysis
kPa	Kilopascal
LP	Low Pressure
MPGM	Multipurpose Molybdenum Grease
NLGI	National Lubricating Grease Institute
OCV	Open Crankcase Ventilation
OEM	Original Equipment Manufacturer
OOS	Out of Specification
PM	Particulate Matter
PPE	Personal Protection Equipment
ppm	parts per million
psig	pounds per square inch gauge
RCS	Rig Control System
SE	Service Engineer
SAE	Society of Automotive Engineers
SCR	Selective Catalytic Reduction
ULSD	Ultra Low Sulfur Diesel
VGT™	Variable Geometry Turbocharger

2 Maintenance Safety

2.1 Safety Signs and Messages

- Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing maintenance procedures.
- Fully read and understand the task to be completed before work begins.
- Review and obey the information contained in the Safety and Operation manuals before work begins.

2.1.1 Machine Warning Signs

It is mandatory that the technician refer to and be familiar with the Safety manual. The Safety manual gives details of the important warning signs used on the machine.

2.1.2 Work Environment Warning Signs

It is mandatory that the technician identify and obey the local work environment warning signs.

2.1.3 Safety Messages in Publications

Safety messages in publications declare hazards and the related measures to avoid the hazards in that particular situation. The safety messages contain signal words (Danger, Warning, Caution, and Notice) that relate to the consequences of those specific hazards. The information in safety messages must be obeyed at all times.

The following is indicative of the structure of a Safety Message in these instructions:

- Signal word (determining the degree of the hazard),
- Hazard - stating what the hazard is (energized parts, tripping hazard, and the like),
- Consequence of the hazard if not avoided.

2.2 Responsibility

Employees authorized to attach safety locks and tags must be responsible for local operations and shall be instructed in the safety significance of the safety lock and tag procedures.

A document listing the responsibility of the safety locks and tags activities, along with the name and job title of the employee responsible must be available before the maintenance procedure is done. The responsibilities are listed in the following table.

Name	Job Title	Responsibility
	Administrator	Assign all the resources necessary to accomplish the procedures.
	Operations Manager	Implement, enforce, and complete procedures and control the work area. Manage actions for identified irregularities or issues. Communicate any issues, as needed, to the Administrator. If

Name	Job Title	Responsibility
		necessary, look for alternatives for any activity, including a partial or permanent standstill, until the issue is addressed or solved. Instruct and inform staff of risks and preventive measures involved with the task to be done. Propose corrective and preventive actions. Verify use of personal protection equipment as needed. Coordinate and lead activities as appropriate with the Administrator, Area Manager, and Risk Prevention Advisor. Verify compliance and completion of procedures and safety rules.
	Area Manager	Make sure that the procedures are completed and that they comply with all operational and safety requirements. Take necessary actions to correct any abnormalities identified. Communicate any issues, as needed, to the Operations Manager responsible. Instruct personnel of risks and preventive measures according to job task. Propose corrective and preventive actions. Verify use of personal protection equipment as needed. Verify compliance and completion of procedures and safety rules. Verify that tools and equipment are in good condition according to color codes.
	Risk Prevention Advisor	Verifiy that control measures for the procedure are adequate for implementation, applicability, and operability. Advises all facility workers/personnel of all identified hazards associated with the activity to jointly evaluate risks and identify actions needed for their control.
	Technical Advisor	Train new staff in work procedures. Work with Operations Manager, Area Manager, and Risk Prevention Adviser responsible to modify and update work procedures as necessary.
	Technician	Comply with the specifications of the procedure. Report any conditions that are sub-standard to the Shift Manager, Operations Manager, or Risk Prevention Adviser. Do not do or encourage acts that are sub-standard. Use and maintain personal protection equipment. Respect and obey all rules/policies involving Epiroc. Do not intervene with energized active equipment. Use the correct safety locks and tags procedures as required.

2.3 Safety Locks and Tags Minimum Requirements

Make sure that any person doing a service or maintenance activity described in the following maintenance procedures knows that the machine or components have potential to release stored energy unexpectedly, which could cause injuries to personnel and damage the machine or components. This manual provides guidance on attaching safety locks and tags to the machine or equipment before doing any activity described in the procedures. This reduces potentially hazardous energy when personnel are engaged in these activities.

2.3.1 Safety Locks and Tags

Safety locks and tags are required when doing service or any activity described in the maintenance procedures, where: hazardous energies may be involved, a guard is removed or safety device is bypassed, to protect against accidental or inadvertent operation. Safety locks are the preferred method of isolating machines or equipment and shall be used when possible. Local directives and mine site policy shall be obeyed and used to complement the requirements described in this manual.

2.3.2 Examining for Stored Energy

1. Identify sources and magnitude of hazardous energies, including all methods and modes of activation, operation, and release including the following.
    - Mechanical
    - Electrical; directly supplied, stored, or induced
    - Hydraulic
    - Pneumatic
    - Thermal
    - Gravity
    - Chemical; reactive, toxicological, atmospheric
    - Radiological
    - Magnetic
    - Stored energy of any type; for example: raised loads, springs, batteries, capacitors, cable reels, pressurized vessels, piping or cylinders, and extreme temperature capable of injury or driving a chemical reaction
    - Any other source of energy or motive force capable of harm
    - Identify means of isolation and dissipation
    - Identify sequence of isolation and dissipation
    - Identify and provide safety locks and tags applicable for the isolation devices, and safety locks and tags for each employee.
2. Safety locks and tags are not to be used for any other purpose than service or maintenance.
3. Safety locks and tags may include hasps, locks, tags, clamshells, chains or wire rope, car-seals, zip-ties, blocks, wedges, cap screws, and the like used in accordance with the Safety Locks and Tags Authority Having Jurisdiction (AHJ).
4. Identify, provide, and require the use of applicable Personal Protection Equipment (PPE) for tasks, worn at the applicable step in the procedure.
5. Training: verify qualifications and authorization.
6. Supervision: appointing a competent person to make sure the procedure is implemented correctly.
7. Review the procedure in its entirety before work begins. Account for all required tools, equipment, and PPE.
8. Conduct a Job Hazard Analysis (JHA) for the work. Make the work zone safe for the task.
9. In addition to the procedure, obey local AHJs and the customer's safety locks and tags requirements, using more protective requirements of either must they differ.

> ***NOTE:*** *Operation manuals, system schematics, and drawings (both Epiroc and suppliers) must be reviewed and understood.*

> ***NOTE:*** *Unless permitted by the AHJ, out-of-service locks (preventing operational use) are NOT addressed by service and maintenance safety locks and tags procedures. Safety locks and tags related to Out of Specification (OOS) procedures shall not be confused with those used for service or maintenance.*

2.3.3 Basic Safety Locks and Tags Procedures

1. Notify affected personnel. Make sure that all personnel are away from the particular work zone.
2. Stop the machine and wait for all moving parts to come to a complete stop.
3. Isolate energy with isolation devices.

> ***NOTE:*** *Controls, including E-stops, are not isolation devices, but can be used in addition to them.*

4. Attach safety locks and tags to isolation devices.
5. Dissipate, discharge, block, bleed, restrain, ground, and the like stored and residual energies.
6. Attach safety locks and tags to dissipation points as needed to maintain a zero-energy state.
7. Make sure that there is a zero-energy state with the correct procedure. Try to start the machine to make sure that it does not start.

> ***NOTE:*** *Direct testing, such as with a voltmeter, is usually associated with electrical work, but can involve other energies. Other tests can involve pressure gauges, pH paper, and gas monitors.*

2.3.4 Basic Restoring Equipment to Service

1. Confirm that work meets acceptance criteria and the machine is ready to be operational.
2. Account for all tools and spare parts.
3. Notify affected personnel and make sure that non-essential personnel are removed from the area.
4. Make sure that the controls are in neutral.
5. Remove the safety locks and tags.
6. Re-energize the machine or equipment.

7. Do the correct machine test to make sure that the machine is in good operational condition.

> ! ***NOTE:*** *Safe removal of some forms of blocking may require re-energizing the machine first.*

2.4 Before You Start a Maintenance Task

To prevent minor irregularities from developing into serious conditions, several other services or inspections are recommended for the same intervals as the periodic lubrication. These services or inspections reveal the need for adjustment caused by normal operation.

Before doing any maintenance work, make sure that the following instructions are observed:

- Make sure that a relevant and current Job Safety and Environmental Analysis (JSEA) exists for the task before doing any work. All hazards identified must be removed or minimized before any work begins.
- Attach safety locks and tags to the machine in accordance with site-specific procedures before doing any maintenance or repair work on the machine.
- All personnel must be trained and assessed as necessary by Epiroc to prove competency to do the tasks as necessary by the specific instruction.
- Park the machine on a firm, level surface.
- Stop the engine and let the components cool.
- Disconnect the battery cables and cover the uncovered terminals before working on the machine electrical system.
- Stop the engine and let the hydraulic oil pressure fall before working on the hydraulic hose installations or connections.
- Stop the engine and let the compressor air pressure completely release from the receiver tank before working on the compressor, receiver tank, and hose installations or connections.
- Wash all fittings, caps, plugs, and the like thoroughly with nonflammable and nontoxic cleaning solution before servicing to prevent the contamination while doing the service.

2.4.1 Service Condition Requirements

When there is a need for service personnel to work on the machine in the working area or danger zone and this involves energizing one or several machine functions, such work should only be done under the following conditions:

- There should always be two people present; both being fully instructed on the safety issues. One of them from the main operator station should supervise the safety of the service technician doing the work.
- The supervisor should have immediate access to the E-Stop button in all situations.
- The area where the service work is to be done should be sufficiently illuminated.
- Communication between the service technician and the supervisor at the main operator station shall be established in a reliable manner.
- Do repair and maintenance work on the machine only when the machine is shut off completely and the starting means are isolated.

2.4.2 Environmental Instructions

- Waste handling shall be conducted in accordance with local regulations and requirements.
- Minimize spills that occur during service. In the event of accidental spillage or leakage, collect the fluid with absorbents or some other method as dictated by the environment or a specific instruction. Handle fluids and chemicals as hazardous waste if not otherwise stated in the Material Safety Data Sheet.
- Used oils and greases shall be handled as hazardous waste.
- When you drain fluids, use approved sealable containers.
- Discard waste fluids in an environmentally safe manner at all times.
- Store used filters in secure containers and discard them in an environmentally safe manner at all times.
- Refurbish replaced parts and components, if possible, and use them again. If this is not possible, recycle the part or component.
- For additional information, refer to the Epiroc loss prevention standard and the Parts and Services Division Workshop audit processes.

2.4.3 Pre-Start Inspection

- Do an inspection of the machine for potential hazards.
- Make sure that all protective guards and covers are installed if a machine must be started to make adjustments or checks. To help prevent an accident caused by moving parts, work carefully around them.
- Do not disable or bypass automatic shutoff circuits. They are provided to prevent personal injury and machine damage.
- Do not start an engine with the governor linkage disconnected.
- Make provisions for shutting off the air or fuel supply to stop the engine if there is an overspeed condition on start-up after doing repair or maintenance to the engine.

2.4.4 Starting the Engine

- Do not start the engine or move any of the controls if there is a warning tag attached to the controls. Make sure with the person who attached the tag before starting.
- Make sure that no one is working on or near the engine or the engine driven components before starting the engine. Always do an inspection of the engine before and after starting the engine.
- Start the engine only from the operator station. Do not short across the starter terminals or the batteries as this could bypass the engine neutral-start system and damage the electrical system.
- Always start the engine according to the required Engine Starting Procedure described in the Operation manual to prevent major engine component damage and personal injury.
- Use only the Emergency Stop button in an emergency. Do not start the engine until the problem causing the emergency stop has been found and corrected.
- On initial startup or overhaul, be prepared to stop the machine if an overspeed condition occur. This may be accomplished by cutting the fuel and air supply to the engine.
- Monitor the jacket, oil, and water temperature gauges frequently during the operation of jacket water and/or lubrication oil heaters to make sure that they are operating correctly.

- Diesel engine exhaust contains products of combustion that may be harmful to operator health. Start and operate the engine always in a well-ventilated area and, if in an enclosed area, vent the exhaust to the outside.

2.4.5 Starting Aids

WARNING

Explosion Hazard

The glow plugs and the grid heater ignite vapors which can cause severe engine damage, personal injury, or death.

▶ Do not use volatile starting aids such as ether, propane, or gasoline in the engine air intake system.

- Ether and other starting aids are poisonous and flammable. Do not smoke while changing ether cylinders.
- Use ether only in well-ventilated areas.
- Keep ether cylinders out of the reach of unauthorized persons.
- Do not store the replacement ether cylinders in living areas, storage compartments, or cab.
- Do not store ether cylinders in the direct sunlight or at temperatures above 39 °C (102 °F). Discard cylinders in a safe place. Do not puncture or burn cylinders.

2.4.6 Stopping the Engine

- To avoid overheating and accelerated wear of the engine components, stop the engine in accordance with the engine stopping instructions in the Operation manual.
- Use the E-Stop button only in an emergency. Do not start the machine until the problem is resolved.
- Be prepared to stop the engine when an overspeed condition occurs. This may be accomplished by cutting the fuel and air supply to the engine.

2.5 Job Safety and Environmental Analysis (JSEA)

NOTE: *Refer to the local regulations and JSEA or equivalent type of job risk assessment documentation.*

Job Safety and Environmental Analysis provides job hazard identification, potential risk assessment, and suggested controls.

All hazards identified must be removed or minimized before work begins.

If hazards cannot be reduced to an acceptable level of risk, a complete review of the site-specific JSEA must be completed, signed, and updated in the local register.

3 Refill Capacities and Lubricants

> ***NOTE:*** *Refer to the Spare Parts Catalog for your specific machine for lubricant part numbers and ordering information.*

Lubrication is an essential part of preventive maintenance, affecting the useful life of the unit. Periodic lubrication of the moving parts reduces to a minimum the possibility of the mechanical failures.

Different lubricants are needed, and some components in the unit require more frequent lubrication than others. Therefore, it is important that the instructions regarding types and frequency of the application be closely followed.

The lubrication table that follows in this section shows those items requiring regular service and the interval at which they must be done. Details concerning the oil and other lubricants follow the lubrication chart. A regular service program must be geared to the items listed under each interval. These intervals are based on average operating conditions. In the event of severe dusty or wet operating conditions, more frequent lubrication than specified is necessary.

- Specific recommendations of the brand and grade of lubricants are not made here due to regional availability, operating conditions, and also the continual development of the improved products. For more information, refer to the component manufacturer manual.
- Do an oil level check with the machine parked on a level surface and while the oil is cold, unless otherwise specified.
- On plug-type check ports, the oil levels are to be at the bottom edge of the check port.
- All of the grease fittings are SAE-standard unless otherwise indicated. Lubricate the non-sealed fittings until the grease is seen extruding from the fitting. 28 grams (1 ounce) of EP-MPG equals one pump on a standard 0.45-kilogram (1-pound) grease gun.
- Over lubrication on non-sealed fittings does not harm the fittings or components, but less lubrication leads to a decreased component life.
- Items not equipped with grease fittings such as linkages, pins, levers, and the like, must be lubricated with oil once per week. Oil applied sparingly provides the necessary lubrication and helps prevent the formation of rust. An anti-seize compound may be used if rust has not formed. Otherwise, the component must be cleaned first.
- Grease fittings that are worn and do not hold the grease gun or those that have a stuck check ball must be changed.

To prevent minor irregularities from developing into serious conditions, several other services or checks are recommended for the same intervals as the periodic lubrication:

- Thoroughly wash all fittings, caps, plugs, and the like with a non-flammable and non-toxic cleaning solution before servicing to prevent the dirt from getting inside when doing the service.
- When draining, the lubricants must be at the operating temperature.
- During the regular lubrication service, do a visual check of the entire unit to make sure that caps screws and nuts are correctly secured.
- Spot check cap screws and nuts for the correct torque. If any are found loose, a full investigation must be made.

- If a defect is detected that requires special service, stop the machine operation until the defect has been corrected. If necessary, contact Epiroc for assistance.

3.1 Refill Capacities

The following fluid capacities are provided for servicing personnel who must do machine maintenance in remote locations where complete shop facilities and resources are not available. These capacities give the servicing personnel an approximation of the fluid capacities of the components to be serviced. Always use the specified method to do an inspection for proper fluid levels.

Capacities

Component	Approximate Quantity
Receiver tank	143 L (38 gal)
Hydraulic tank	594 L (157 gal)
Rotary head gearbox	34 L (9 gal)
Pump drive gearbox	PV-271D: 3.9 L (4 qt) PV-291D: 9.5 L (10 qt)
Engine	Refer to OEM manual
Hydraulic clutch	56.8 L (15 gal)
Radiator	166 L (44 gal)
Track final drive gearbox	10.2 L (2.7 gal) per drive
Air conditioning system refrigerant	1.8 kg (4 lb)

3.2 Hydraulic Oil

The quality of the hydraulic oil is important to the satisfactory performance of any hydraulic system. The oil serves as the power transmission medium, system coolant, and lubricant. Selection of the correct oil is essential to extend machine life and good system performance.

Hydraulic oil must meet the Parker-Denison® HF-O requirements.

- Maximum contamination count is ISO 20/17/14.
- Water content must be less than 500 ppm.
- Viscosity Index is calculated in accordance with ASTM D2270 standard:
  - Oils with VI suffix have a Viscosity Index greater than 95.
  - Oils with HVI suffix have a Viscosity Index greater than 145 and are preferred to be synthetic.
  - Oils with UHVI suffix have a Viscosity Index greater than 295 and must be synthetic.

Hydraulic Oil Recommendations

Ambient Temperature	Oil Specification
-9 to 46 °C (15 to 115 °F)	ISO 46 VI
-23 to 38 °C (-10 to 100 °F)	ISO 32 VI
-23 to 52 °C (-10 to 125 °F)	ISO 46 HVI
-29 to 43 °C (-20 to 110 °F)	ISO 32 HVI
-40 to 52 °C (-40 to 125 °F)	ISO 32 UHVI

3.3 Compressor and Receiver Tank Fluids

Fluids for Ingersoll Rand® Compressor

Design Operating Pressure	Ambient Temperature	Specification
Low pressure 689 to 2,068 kPa (100 to 300 psi)	-10 to 52 °C (14 to 125 °F)	Compressor LP-150 oil
High pressure 2,413 kPa (350 psi)	-10 to 52 °C (14 to 125 °F)	Compressor HP-350 oil
Arctic	-40 to 30 °C (-40 to 86 °F)	Compressor 200 oil

Fluids for AC Compressor

Design Operating Pressure	Ambient Temperature	Specification
Low pressure 689 to 2,068 kPa (100 to 300 psi)	-10 to 52 °C (14 to 125 °F)	Compressor M oil
High pressure 2,413 kPa (350 psi)	-10 to 52 °C (14 to 125 °F)	Compressor S xtreme oil
Arctic	-25 to 30 °C (-13 to 86 °F)	Compressor S oil

3.4 Engine Oil

Refer to the engine Operation and Maintenance manual for recommended oil specifications.

3.5 Grease System

The central automatic lubrication system and general purpose grease systems use grease with the following specifications:

Operating Conditions		Specifications
Normal	-20 to 121 °C (-4 to 250 °F)	NLGI 0, ISO viscosity 150, extreme pressure, lithium 12 hydroxy-stearate
Arctic	-54 to 121 °C (-65 to 250 °F)	Synthetic, non-soap thickener, ISO viscosity 32 at 40 °C, PAO oil type

3.6 Hydraulic Clutch Oil

Oils for Twin Disc Clutch

Ambient Conditions		Recommended Oil
Normal	-1 to 52 °C (30 to 125 °F)	Chevron® Delo 400 Multigrade 15W40
Arctic	-40 to 4 °C (-40 to 40 °F)	Mobil™ Hydraulic 10W

Oils for Clutch

Ambient Conditions		Recommended Oil
Normal	-23 to 27 °C (-10 to 80 °F)	Mobil™ fluid™ LT
		Shell® Spirax S3 TLV
		ESSO® Hydraul 50
Arctic	-40 to 4 °C (-40 to 40 °F)	Caterpillar® Arctic (Cold Weather) TDTO
Tropical	-1 to 49 °C (30 to 120 °F)	Mobil™ fluid™ 424
		Caterpillar® TDTO 10W
		Shell® Spirax S4 TXM
		ESSO® Hydraul 56
		Vermeer® VMF Ultra Gold

3.7 Hoist Gearbox Oil

The hoist gearbox uses gearbox oil with the following specifications:

Hoist Gearbox Oil

Ambient Temperature Range		Recommended Oil	Specifications
Normal	-15 to 26 °C (5 to 80 °F)	Exxon® Spartan EP150 or equivalent	ISO VG 150, AGMA 4EP
Arctic	-34 to 54 °C (-30 to 130 °F)	Mobil® SHC 629 or equivalent	ISO VG 150, synthetic

Ambient Temperature Range		Recommended Oil	Specifications
		Mobil® SHC 630 or equivalent	ISO VG 220, synthetic
Tropical	10 to 55 °C (50 to 130 °F)	Exxon® Spartan EP220 or equivalent	ISO VG 220, AGMA 5EP

> ***NOTE:*** *The optional Ramsey® SCH hoist does not require gearbox oil.*

3.8 Track Final Drive, Rotary Head, and Pump Drive Gearbox Oil

Gearbox Oil

Ambient Temperature Range		Recommended Oil
Normal	-12 to 49 °C (10 to 120 °F)	80W140 gear oil
Arctic	-40 to 43 °C (-40 to 110 °F)	75W140 gear oil
Tropical	-6 to 54 °C (20 to 130 °F)	ISO 460 with EP additives

3.9 Gearbox Drive Shaft Lubricant

The gearbox drive shaft uses grease with the following specifications:

Operating Conditions		Specifications
Normal	-20 to 121 °C (-4 to 250 °F)	NLGI 0, ISO viscosity 150, extreme pressure, lithium 12 hydroxy-stearate
Arctic	-54 to 121 °C (-65 to 250 °F)	Synthetic, non-soap thickener, ISO viscosity 32 at 40 °C, PAO oil type

3.10 Water Injection Pump Lubricant

Epiroc recommends using SAE 30 non-detergent oil.

3.11 Diesel Fuel

All bulk fuel used in Epiroc Drilling Solutions machines must comply with cleanliness standards 18/16/13.

4 Torque Specifications

4.1 Torque Values

⚠ CAUTION

Incorrect Tool Usage

Incorrect tools used with incorrect fittings can slip and cause injury.

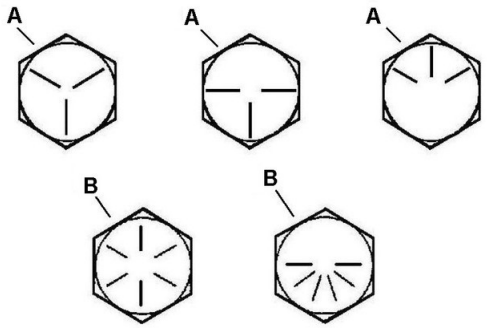
▶ Use the correct tools (standard or metric) based on the type of operation.

- Do not use these values if a different torque value or tightening procedure is listed for a specific application. Torque values listed are for general use only. All values are suggested maximum with dry-plated fasteners.
- Make sure that fastener threads are clean. Start the thread engagement correctly to prevent the fastener from failing when tightening.
- The following pages list the recommended tightening torques for various size cap screws. Correct torque specifications should be used at all times.
- The head of a Grade 5 fastener is marked with three short lines. The head of a Grade 8 is marked with six short lines.
- In the following tables, Dry means clean dry threads and lubricated means a light film of oil. Excess oil in a threaded dead end hole can create a hydraulic lock, giving a false torque reading.

! ***NOTE:*** *Torque values outside of the general information contained here will be contained in the specific procedures for which they apply.*

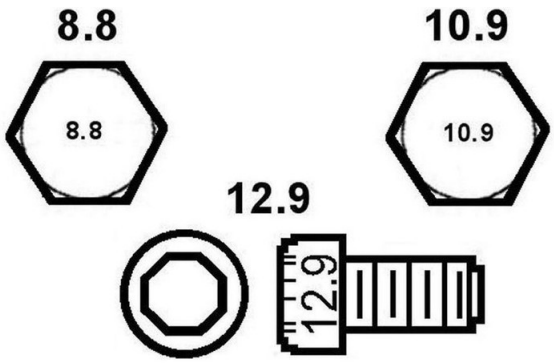
4.2 Head Markings

Change the fasteners with the same grade or higher grade. If higher grade fasteners are used, these must only be tightened to the strength of the original grade fastener.



Standard Head Markings

A	Grade 5 cap screw head marking	B	Grade 8 cap screw head marking



Metric Head Markings

4.3 Torque Specifications

Description	Torque Values
Hoist	108 N·m (80 ft·lb)
Engine mounting cap screws	500 N·m (369 ft·lb)
Axle shaft mounting cap screws	1,830 N·m (1,350 ft·lb)
Rotary head motors and mounting cap screws	215 ± 40 N·m (160 ± 30 ft·lb)
Jacks crosshead cap screws	650 N·m (480 ft·lb)
Receiver tank cover cap screws	325 N·m (240 ft·lb)
Undercarriage shaft retainer caps cap screws	921 N·m (680 ft·lb)
Mast-raising cylinder cap screws at mast	515 N·m (380 ft·lb)
Rotary head guide slide cap screws	298 N·m (220 ft·lb)
Mast pivot shaft	Lubricated: 922 N·m (680 ft·lb)
Mast support trunnion caps	Lubricated: 922 N·m (680 ft·lb)

Description	Torque Values
Drive shaft mounting cap screws	122 N·m (90 ft·lb)
Cab mounting cap screws	1,084 N·m (800 ft·lb)

4.4 Recommended Torques in Foot-Pounds

Recommended Torques in Foot-Pounds

Size	SAE Grade 5		SAE Grade 8	
	Dry	Lubricated	Dry	Lubricated
1/4 - 20 NC	8	6	12	9
1/4 - 28 NF	10	7	14	10
5/16 - 18 NC	17	13	25	18
5/16 - 24 NF	19	14	25	20
3/8 - 16 NC	30	23	45	35
3/8 - 24 NF	35	25	50	35
7/16 - 14 NC	50	35	70	55
7/16 - 20 NF	55	40	80	60
1/2 - 13 NC	75	55	110	80
1/2 - 20 NF	90	65	120	90
9/16 - 12 NC	110	80	150	110
9/16 - 18 NF	120	90	170	130
5/8 - 11 NC	150	110	220	170
5/8 - 18 NF	180	130	240	180
3/4 - 10 NC	260	200	380	280
3/4 - 16 NF	300	220	420	320
7/8 - 9 NC	430	320	600	460
7/8 - 14 NF	470	360	660	500
1 - 8 NC	640	480	900	680
1 - 12 NF	710	530	1,000	740
1-1/8 - 7 NC	800	600	1,280	960
1-1/8 -12 NF	880	660	1,440	1,080
1-1/4 - 7 NC	1,120	840	1,820	1,360
1-1/4 - 12 NF	1,240	920	2,000	1,500

Size	SAE Grade 5		SAE Grade 8	
	Dry	Lubricated	Dry	Lubricated
1-3/8 - 6 NC	1,460	1,100	2,380	1,780
1-3/8 - 12 NF	1,680	1,260	2,720	2,040
1-1/2 - 6 NC	1,940	1,460	3,160	2,360
1-1/2 - 12 NF	2,200	1,640	3,560	2,660

4.5 Recommended Torques in Newton Meters

Recommended Torques in Newton Meters

Size	SAE Grade 5		SAE Grade 8	
	Dry	Lubricated	Dry	Lubricated
1/4 - 20 NC	11	8	16	12
1/4 - 28 NF	14	9	19	14
5/16 - 18 NC	23	18	34	24
5/16 - 24 NF	26	19	34	27
3/8 - 16 NC	41	31	61	47
3/8 - 24 NF	47	34	68	47
7/16 - 14 NC	68	47	95	75
7/16 - 20 NF	75	54	108	81
1/2 - 13 NC	102	75	149	108
1/2 - 20 NF	122	88	163	122
9/16 - 12 NC	149	108	203	149
9/16 - 18 NF	163	122	230	176
5/8 - 11 NC	203	149	298	230
5/8 - 18 NF	244	176	325	244
3/4 - 10 NC	353	271	515	380
3/4 - 16 NF	407	298	569	434
7/8 - 9 NC	583	434	813	624
7/8 - 14 NF	637	488	895	678
1 - 8 NC	868	651	1,220	922
1 - 12 NF	963	719	1,356	1,003
1-1/8 - 7 NC	1,085	813	1,735	1,302
1-1/8 -12 NF	1,193	895	1,952	1,464

Size	SAE Grade 5		SAE Grade 8	
	Dry	Lubricated	Dry	Lubricated
1-1/4 - 7 NC	1,519	1,139	2,468	1,491
1-1/4 - 12 NF	1,681	1,247	2,712	2,034
1-3/8 - 6 NC	1,979	1,491	3,227	2,413
1-3/8 - 12 NF	2,278	1,708	3,688	2,766
1-1/2 - 6 NC	2,630	1,979	4,284	3,200
1-1/2 - 12 NF	2,983	2,224	4,827	3,606

4.6 Recommended Torques of Metric Cap Screws in Foot-Pounds

Recommended Torques of Metric Cap Screws in Foot-Pounds

Size	Class 8.8		Class 10.9		Class 12.9 (Socket Head Cap Screw)	
	Dry	Lubricated	Dry	Lubricated	Dry	Lubricated
M6x1	8	6	11	8	13	9
M8x1.25	19	15	27	20	31	23
M8x1	21	16	29	22	—	—
M10x1.5	39	29	53	40	62	47
M10x1.25	41	30	56	42	—	—
M12x1.75	67	50	93	70	108	81
M12x1.25	73	55	101	76	—	—
M14x2	107	80	148	111	173	130
M14x1.5	116	87	161	121	—	—
M16x2	167	125	231	173	269	202
M16x1.5	177	133	245	184	—	—
M20x2.5	325	244	450	337	525	394
M20x1.5	361	271	500	375	—	—
M24x3	562	422	778	583	908	681
M24x2	612	459	846	635	—	—
M30x3.5	1,117	838	1,545	1,159	1,804	1,353

Size	Class 8.8		Class 10.9		Class 12.9 (Socket Head Cap Screw)	
	Dry	Lubricated	Dry	Lubricated	Dry	Lubricated
M30x2	1,237	928	1,711	1,283	—	—
M36x4	1,952	1,464	2,701	2,026	3,154	2,366
M36x2	2,187	1,640	3,025	2,269	—	—
M42x4.5	3,123	2,342	4,320	3,240	—	—
M42x2	3,513	2,635	4,860	3,645	—	—
M48x5	4,684	3,513	6,479	4,860	—	—
M48x2	5,321	3,991	7,361	5,521	—	—

4.7 Recommended Torques of Metric Cap Screws in Newton Meters

Recommended Torques of Metric Cap Screws in Newton Meters

Size	Class 8.8		Class 10.9		Class 12.9 (Socket Head Cap Screw)	
	Dry	Lubricated	Dry	Lubricated	Dry	Lubricated
M6x1	11	8	15	11	17	13
M8x1.25	26	20	37	27	42	32
M8x1	28	22	39	30	—	—
M10x1.5	53	39	72	54	84	64
M10x1.25	56	41	76	60	—	—
M12x1.75	91	68	126	95	146	110
M12x1.25	99	75	137	103	—	—
M14x2	145	108	201	150	234	176
M14x1.5	157	118	218	164	—	—
M16x2	226	169	313	235	365	274
M16x1.5	240	180	332	249	—	—
M20x2.5	440	331	610	457	712	534
M20x1.5	489	267	678	508	—	—
M24x3	762	572	1,055	780	1,231	923

Size	Class 8.8		Class 10.9		Class 12.9 (Socket Head Cap Screw)	
	Dry	Lubricated	Dry	Lubricated	Dry	Lubricated
M24x2	830	622	1,147	861	—	—
M30x3.5	1,514	1,136	2,095	1,571	2,446	1,834
M30x2	1,677	1,258	2,320	1,740	—	—
M36x4	2,647	1,985	3,662	2,747	4,276	3,208
M36x2	2,965	2,223	4,101	3,076	—	—
M42x4.5	4,232	3,175	5,857	4,393	—	—
M42x2	4,763	3,573	6,589	4,942	—	—
M48x5	6,351	4,763	8,784	6,889	—	—
M48x2	7,214	5,411	9,980	7,485	—	—

5 Maintenance Schedule

Before each consecutive interval is done, all of the maintenance requirements from the previous interval must also be done.

> ! ***NOTE:*** *If the machine is operating in very severe conditions (such as very dusty air), the scheduled maintenance intervals should be reduced.*

5.1 Initial Maintenance Table

Maintenance Task		Diesel Engine Hours First Service
6.1.1	Change the Hydraulic Clutch Oil	50
6.1.2	Change the Hydraulic Clutch Oil Filter	50
6.1.3	Change the Water Injection Pump Oil	50
6.2.1	Do an Inspection of the Hoist	100
6.2.2	Do a Torque Inspection of the Final Drive Cap Screws	100
6.2.3	Change the Track Final Drive Oil	100

5.2 Periodic Maintenance Table

Maintenance Task		Diesel Engine Hours
8.1	Do a Test of the Overpressure Control System	10
8.2	Do an Inspection of the Air Cleaner Filter Restriction Indicators	10
8.3	Do an Inspection of the Engine and Compressor Air Intake Ducts	10
8.4	Do an Inspection of the Dust Collector	10
8.5	Clean the Filter Dust Cups	10
8.6	Do an Inspection of the Hydraulic Hoses	10
8.7	Do an Inspection of the Exhaust System	10
8.8	Do an Inspection of the Engine Belts and Tensioner	10
8.9	Drain the Water from the Fuel-Water Separator	10
8.10	Do an Engine Oil Level Check	10

Maintenance Task		Diesel Engine Hours
8.11	Do an Engine Coolant Level Check	10
8.12	Do a Fuel Level Check	10
8.13	Do a Compressor Oil Level Check	10
8.14	Drain the Water from the Receiver Tank	10
8.15	Do a Hydraulic Tank Oil Level Check	10
8.16	Do an Inspection of the Hydraulic Oil Filter Restriction Indicators	10
8.17	Do an Inspection of the Rotary Head	10
8.18	Do a Rotary Head Oil Level Check	10
8.19	Lubricate the Gearbox Drive Shaft	10
8.20	Do a Water Injection Pump Oil Level Check	10
9.1	Do a Pump Drive Gearbox Oil Level Check	50
9.2	Do an Inspection of the Rotary Head Oil Filter	50
10.1	Do an Inspection of the Battery	250
10.2	Do an Inspection of the Pump Drive Gearbox	250
10.3	Do an Inspection of the Track Final Drive	250
10.4	Do a Track Final Drive Oil Level Check	250
10.5	Do an Inspection of the Track Tension	250
10.6	Do an Inspection of the Hoist	250
10.7	Do an Inspection of the Cooler	250
10.8	Clean the Radiator and Oil Cooler	250
10.9	Do an Inspection of the Undercarriage	250
10.10	Do an Inspection of the Cab	250
10.11	Do an Inspection of the Starter Motor Cables and Connections	250
10.12	Change the Engine Oil and Filter	250
10.13	Lubricate the Pulldown Cable Jackscrews	250
10.14	Change the Fuel-Water Separator Filter	250
10.15	Do a Visual Inspection of the Trunnion Block Cap Screws	250
10.16	Do an Inspection of the Mast Pivot Shaft Cap Screws	250
11.1	Do an Inspection of the Rotary Head Guide Blocks	500

Maintenance Task		Diesel Engine Hours
11.2	Do an Inspection of the Feed Cable and Wire Rope	500
11.3	Do an Inspection of the Feed Cable Sheaves	500
11.4	Obtaining the Hydraulic and Compressor Oil Sample for Analysis	500
11.5	Change the Pump Drive Gearbox Oil	500
11.6	Do an Inspection of the Compressor Air Hoses and Clamps	500
11.7	Clean the Compressor Oil Strainer	500
11.8	Change the Compressor Oil Filters	500
11.9	Do a Grease Tank Electric Pump Oil Level Check	500
11.10	Do an Inspection of the Engine Mounting Cap Screws	500
11.11	Do an Inspection of the Input/Output Module	500
11.12	Do an Inspection of the Torsional Coupling Shaft	500
11.13	Change the Cab Air Return Filter	500
11.14	Change the Cab Pressurizer Air Filter	500
12.1	Change the Compressor Oil	1000
12.2	Change the Pump Drive Gearbox Oil	1000
12.3	Do an Inspection of the Feed Cable Tension	1000
12.4	Do a Torque Inspection of the Track Final Drive Cap Screws	1000
12.5	Change the Track Final Drive Oil	1000
12.6	Change the Water Injection Pump Oil	1000
12.7	Change the Grease Tank Electric Pump Oil	1000
12.8	Change the Engine and Compressor Air Filter Elements	1000
12.9	Change the Rotary Head Oil and Filters	1000
12.10	Change the Hydraulic Clutch Oil	1000
12.11	Change the Hydraulic Clutch Oil Filter	1000
12.12	Change the Auto-Bit-Changer Gearbox Oil	1000
16.2.6	Change the Coalescer Filter	1000
13.1	Change the Receiver Tank Discharge Hose and Clamps	2000
13.2	Change the Compressor Air Separator Element	2000
13.3	Change the Hydraulic Tank Breathers	2000

Maintenance Task		Diesel Engine Hours
13.4	Change the Hydraulic Clutch Tank Breather	2000
13.5	Change the Hydraulic Tank Oil Filters	2000
13.6	Change the Fuel Tank Breathers	2000
13.7	Change the Fuel Cap Vent Assembly	2000
13.8	Change the Engine Coolant Filter	2000
16.1.5	Change the Open Crankcase Ventilation (OCV) Filter	2000
16.1.6	Change the ARD Spark Plug	4500
16.2.7	Cleaning the Cummins Particulate Filter	4500
14.1	Change the Hydraulic Oil	5000
14.2	Change the Engine Coolant	5000
16.1.7	Clean the Diesel Particulate Filter	5000

6 Initial Maintenance

6.1 50-Hour Initial Maintenance

6.1.1 Change the Hydraulic Clutch Oil

Labor Resource (People/Skills)

Service Technician x 1

Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Container	61 L (16 gal)

Consumables

Description	Specification	Quantity
Hydraulic clutch oil	As specified in Refill Capacities and Lubricants	57 L (15 gal)

Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Changing the Hydraulic Clutch Oil	01:00

Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Environmental Instructions	Model specific Maintenance Manual
Refill Capacities and Lubricants	Model specific Maintenance Manual

Before Starting the Task

1. Park the machine on a dry level surface.
2. Raise the machine to a workable height to get access to the clutch tank.
3. Put all of the controls in the OFF or neutral position.

4. Stop the machine.
5. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

6. Make sure that the machine is in a zero-energy state.
7. Put blocks at the tracks, as applicable.

Draining the Clutch Tank

⚠ WARNING

Burn Hazard

Hot fluids or components can burn.

- ▶ Make sure that the fluids are at a safe working temperature when you service the machine.
- ▶ Do not touch hot fluids or components.

1.

⚠ CAUTION

Environmental Contaminant

Oil is an environmental contaminant and must be discarded correctly.

- ▶ Do not let the used oil drain onto the ground.
- ▶ Discard the used oil in accordance with local environmental regulations.

> ! ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

Put a container below the drain plug (Figure 1, item A) of the clutch tank to collect the used oil.

Figure 1

A	Drain plug		

2. Remove the drain plug (Figure 1, item A).
3. **CAUTION**

   Environmental Contaminant

   Oil is an environmental contaminant and must be discarded correctly.

   - ▶ Do not let the used oil drain onto the ground.
   - ▶ Discard the used oil in accordance with local environmental regulations.

   ! ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

   Let the oil drain completely into the container.
4. Clean the drain plug.
5. Install the drain plug onto the clutch tank and tighten it.

Filling the Clutch Tank with Oil

1. Clean the area around the clutch oil filler cap (Figure 2, item A).

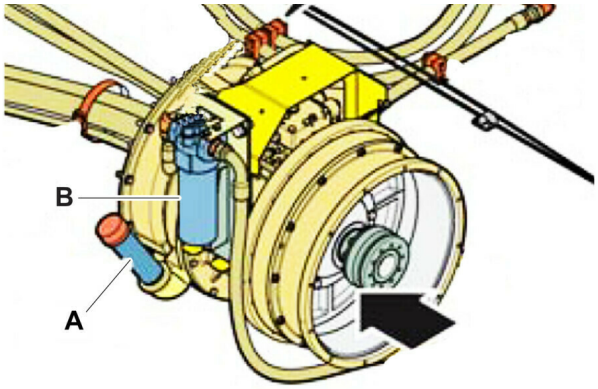


Figure 2

A	Clutch oil filler cap	B	Oil filter

2. Remove the clutch oil filler cap.
3. Fill the clutch tank with the specified oil until the oil level reach the FULL mark on the sight glass.
4. Clean the clutch oil filler cap.
5. Install the clutch oil filler cap and tighten it.

After Completing the Task

1. Clean the work area of all tools and unwanted materials.
2. **⚠ CAUTION**

   Environmental Contaminant

   Oil is an environmental contaminant and must be discarded correctly.

   - ▶ Do not let the used oil drain onto the ground.
   - ▶ Discard the used oil in accordance with local environmental regulations.

! ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

Remove the containers from the work area and discard the used oil in accordance with local environmental regulations.

3. Remove the safety locks and tags from the machine in accordance with the site-specific procedures or refer to Safety Locks and Tags Minimum Requirements.

6.1.2 Change the Hydraulic Clutch Oil Filter

Labor Resource (People/Skills)

Service Technician x 1

Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Strap wrench	
Tags	As required

Support Equipment

Description	Specification
Container	2 L (0.5 gal)

Consumables

Description	Specification	Quantity
Clutch oil	As specified in Refill Capacities and Lubricants	As required

Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Hydraulic clutch oil filter		1

Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Changing the Hydraulic Clutch Oil Filter	00:15

Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Maintenance Schedule	Model specific Maintenance Manual
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Refill Capacities and Lubricants	Model specific Maintenance Manual

Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.

4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

Removing the Hydraulic Clutch Oil Filter

1. **CAUTION**

   Environmental Contaminant

   Oil is an environmental contaminant and must be discarded correctly.

   - ▶ Do not let the used oil drain onto the ground.
   - ▶ Discard the used oil in accordance with local environmental regulations.

> ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

   Put a container below the oil filter to collect the used oil.

2. Remove the oil filter with a strap wrench.
3. Clean the sealing surface of the oil filter mounting base.
4. Remove the old oil filter O-ring and discard it.

Installing the Hydraulic Clutch Oil Filter

1. Apply clean oil to the new filter O-ring.
2. Install the new oil filter.
3. Turn the oil filter until the oil filter O-ring contacts the mounting base.

> ***NOTE:*** *Do not over-tighten the oil filter*

4. Tighten the oil filter by hand in accordance with the instructions on the oil filter.
5. Do an oil level check of the hydraulic clutch tank. Add oil, if necessary.

After Completing the Task

1. **CAUTION**

   Environmental Contaminant

   Oil is an environmental contaminant and must be discarded correctly.

   - ▶ Do not let the used oil drain onto the ground.
   - ▶ Discard the used oil in accordance with local environmental regulations.

   NOTE: *Refer to Environmental Instructions in the Maintenance manual.*

   Remove the container and discard the used oil in accordance with local environmental regulations.

2. Remove all tools and unwanted materials from the work area.
3. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

   NOTE: *Refer to Safety Locks and Tags Minimum Requirements.*

6.1.3 Change the Water Injection Pump Oil

Labor Resource (People/Skills)

Service Technician x 1

Personal Protection Equipment

NOTE: *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Container	8 L (2 gal)

Consumables

Description	Specification	Quantity
Pipe-thread sealant		As required
Non-detergent oil	As specified in Refill Capacities and Lubricants	As required

Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Changing the Water Injection Pump Oil	00:30

Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Environmental Instructions	Model specific Maintenance Manual
Refill Capacities and Lubricants	Model specific Maintenance Manual

Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

Draining the Water Injection Pump Oil

1. Clean the area around the drain plug (Figure 1, item B) of the water injection pump.

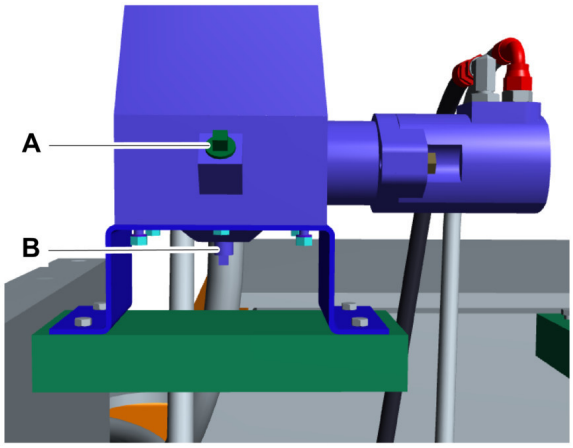


Figure 1

A	Fill plug	B	Drain Plug

2. **CAUTION**

Environmental Contaminant

Oil is an environmental contaminant and must be discarded correctly.

- ▶ Do not let the used oil drain onto the ground.
- ▶ Discard the used oil in accordance with local environmental regulations.

! ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

Put a container below the drain plug to collect the used oil.

3. Remove the drain plug from the water injection pump.
4. Let the oil drain completely into the container.
5. Clean the drain plug.
6. Install the drain plug onto the water injection pump.

Filling the Water Injection Pump with Oil

1. Clean the area around the fill plug of the water injection pump (Figure 1).

2. **⚠ CAUTION**

   Environmental Contaminant

   Oil is an environmental contaminant and must be discarded correctly.

   - ▶ Do not let the used oil drain onto the ground.
   - ▶ Discard the used oil in accordance with local environmental regulations.

   ! ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

   Put a container below the fill plug to collect the spilled oil.

3. Remove the fill plug.
4. Fill the pump with the specified oil through the fill port until the oil level is at the bottom of the fill port.
5. Clean the fill plug.
6. Apply pipe-thread sealant to the fill plug.
7. Install the fill plug onto the water injection pump.

After Completing the Task

1. Clean the work area of all tools and unwanted materials.
2. **⚠ CAUTION**

   Environmental Contaminant

   Oil is an environmental contaminant and must be discarded correctly.

   - ▶ Do not let the used oil drain onto the ground.
   - ▶ Discard the used oil in accordance with local environmental regulations.

   ! ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

   Remove the containers from the work area and discard the used oil in accordance with local environmental regulations.

3. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

6.2 100-Hour Initial Maintenance

6.2.1 Do an Inspection of the Hoist

Labor Resource (People/Skills)

Service Technician x 1

Personal Protection Equipment

> ! ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Body - Fall protection straps
- Safety devices

Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ! ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Elevated platform	

Consumables

Description	Specification	Quantity
Not applicable		

Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing an Inspection of the Hoist	00:30

Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

Before Starting the Task

1. Park the machine on a dry level surface.
2. **DANGER**

   Electrocution Hazard

   Operating near or contacting a power line with any part of the machine can cause electrocution, causing death.

   - ▶ Do not raise or lower the mast or operate the machine near electric power lines.
   - ▶ Keep at least 3 meters (10 feet) away from power lines.
   - ▶ If there appears any danger of wind or other obstruction decreasing the distance, do not drill in that area.

   Lower the mast to the horizontal position onto the mast rest.

3. Put all of the controls in the OFF or neutral position.
4. Stop the machine.
5. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

   ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

6. Make sure that the machine is in a zero-energy state.
7. Put blocks at the tracks, as applicable.

Doing an Inspection of the Hoist

WARNING

Risk of Falling

Can cause severe injury or death.

- ▶ Always put on fall-protection equipment when you work from a raised platform or scaffolding.
- ▶ Examine all lifting equipment before you start any maintenance task.

1. Make sure that the vent plug (Figure 1, item A) on the drum is clear of grease and dirt and is able to pass air.

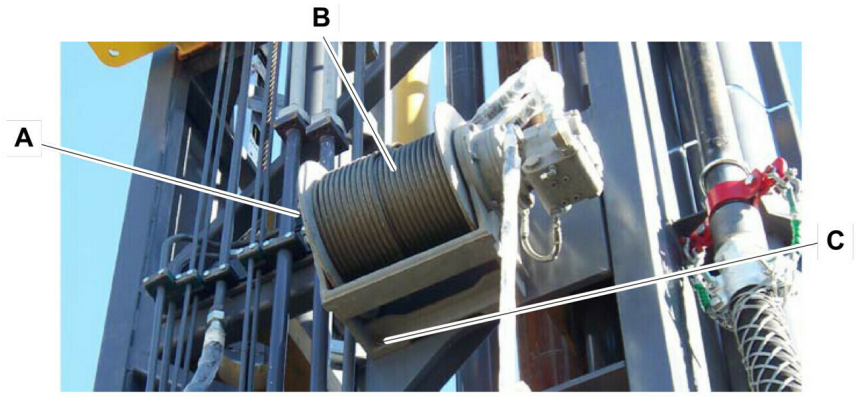


Figure 1

A	Vent plug	B	Wire rope
C	Cap screw, washer, and nut		

2. Examine the wire rope (item B), hoist, and hydraulic hoses for damage and oil leaks. Correct the defects immediately.
3. Make sure that at least five full wraps of wire rope remain on the drum.
4. Examine the entire length of the wire rope. Replace the wire rope that has kinked or broken strands. The kinked or broken strands of the wire rope can fail without warning at low loads.
5. Examine the drive lugs on the clutch and drum for rounding and cracking.
6. Examine the hoist mounting cap screws, washers, and nuts (item C) that secure the hoist to the mast. Replace the cap screws, washers, and nuts, if they are damaged.
7. Do a torque inspection of the hoist mounting cap screws.

After Completing the Task

1. Do all of the corrections to the hoist or the hoist motor that are found during the inspection.
2. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

!	***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

6.2.2 Do a Torque Inspection of the Final Drive Cap Screws

Labor Resource (People/Skills)

Service Technician x 1

Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Torque wrench, calibrated	Capacity up to 637 N·m (470 ft·lb)
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Not applicable		

Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing a Torque Inspection of the Track Final Drive Cap Screws	00:15

Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

   > ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

Doing a Torque Inspection of the Final Drive Cap Screws

○

⚠ WARNING

Burn Hazard

Hot fluids or components can burn.

- ▶ Make sure that the fluids are at a safe working temperature when you service the machine.
- ▶ Do not touch hot fluids or components.

Do an inspection of the final drive mounting cap screws (Figure 1, item C) for correct torque. Torque must be between 501 to 637 Newton meters (370 to 470 foot-pounds) dry.

! ***NOTE:*** *Mounting cap screws that are out of torque tolerance must be replaced due to over-torque or wear.*

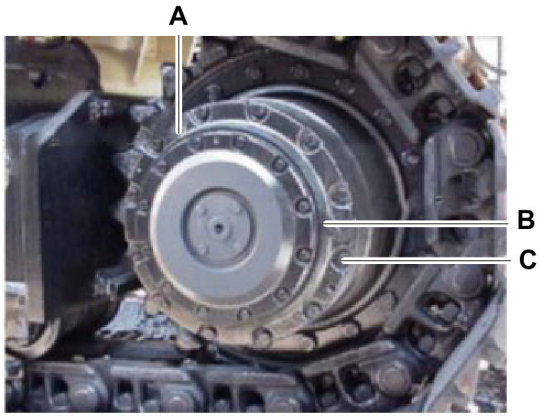


Figure 1

A	Plug	B	Seal
C	Mounting cap screws		

After Completing the Task

○ Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

6.2.3 Change the Track Final Drive Oil

Labor Resource (People/Skills)

Service Technician x 1

Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Container	11 L (3 gal)

Consumables

Description	Specification	Quantity
Gearbox oil	As specified in Refill Capacities and Lubricants	10 L (3 gal) each drive

Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Changing the Track Final Drive Oil	01:00

Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Environmental Instructions	Model specific Maintenance Manual
Refill Capacities and Lubricants	Model specific Maintenance Manual

Before Starting the Task

1. Park the machine on a dry level surface.
2. Make the machine level.

3. Position the track final drives (cab side and non-cab side) with the fill-and-drain plug (Figure 1, items A and B) at the bottom.

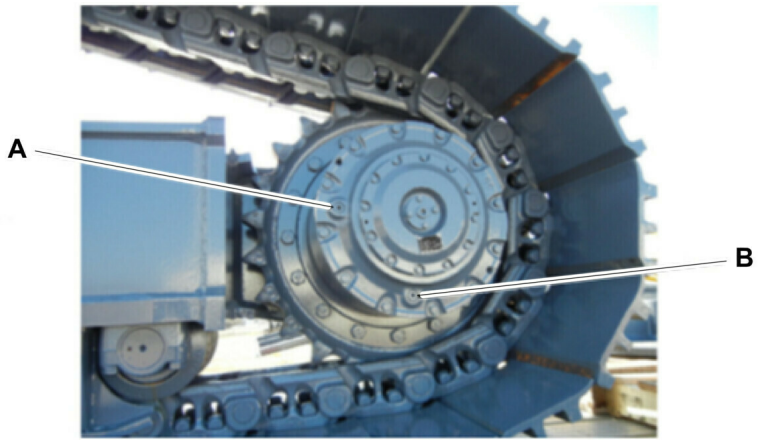


Figure 1

A	Fill plug	B	Fill/drain plug

4. Put all of the controls in the OFF or neutral position.
5. Stop the machine.
6. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

7. Make sure that the machine is in a zero-energy state.
8. Put blocks at the tracks, as applicable.

Draining the Track Final Drive Oil

WARNING

Hot Fluids or Components

Hot fluids or components can burn.

- Make sure that the fluids are at a safe working temperature when you service the machine.
- Do not touch hot fluids or components.
- Make sure that the final drive housings are cool before you proceed.

WARNING

High Pressure

Residual pressure in the track final drive housing can cause personal injury.

- ▶ Loosen the fittings enough to let the pressure release before you remove the track final drive housings fully.

! ***NOTE:*** *Make sure that the oil is warm before you drain it.*

! ***NOTE:*** *Make sure that the planetary housings are not too hot to touch. If they are hot, let them cool before you proceed.*

1. **CAUTION**

   Environmental Contaminant

   Oil is an environmental contaminant and must be discarded correctly.

   - ▶ Do not let the used oil drain onto the ground.
   - ▶ Discard the used oil in accordance with local environmental regulations.

   ! ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

   Put a container below the track final drive drain point.

2. Clean the area around the fill-and-drain plug and the level plug.
3. Remove the fill-and-drain plug and the level plug.
4. Let the oil drain completely into the container.
5. Clean the plugs and examine the O-ring seals. Replace them if they are worn or damaged.
6. If unwanted material is found on the fill-and-drain plug, contact the service department.
7. Install the fill-and-drain plug and the level plug.

8. **WARNING**

   Energized Machine

   Can cause serious injury.

   - The machine must be fully energized and the engine must be switched on to complete this procedure.
   - Be careful around moving parts and pinch points.

   Inform the supervisor, the lead hand, and all other persons concerned of the intent to restart the machine.

   NOTE: *Make sure that all personnel and bystanders are clear of the machine before startup.*

9. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

   NOTE: *Refer to Safety Locks and Tags Minimum Requirements.*

10. Start the machine.
11. Reposition the track final drive slowly, with the level plug at the 3 or 9 o'clock position and the fill-and-drain plug at the 12 o'clock position.

    NOTE: *Do not turn the final drive more than half turn.*

12. Put all of the controls in the OFF or neutral position.
13. Stop the machine.
14. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

    NOTE: *Refer to Safety Locks and Tags Minimum Requirements.*

Filling the Track Final Drive Oil

⚠ CAUTION

Environmental Contaminant

Oil is an environmental contaminant and must be discarded correctly.

- ▶ Do not let the used oil drain onto the ground.
- ▶ Discard the used oil in accordance with local environmental regulations.

! ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

NOTICE

Component Damage

Overfilling the track final drive can damage the track final drive components.

- ▶ Do not overfill the track final drive.

1. Position the oil drain port (Figure 2, item B) at the 6 o'clock position.

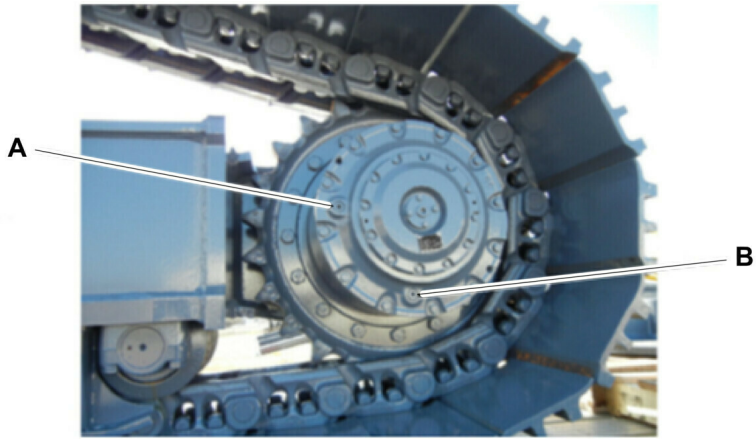


Figure 2

A	Oil fill-and-level plug	B	Oil drain port

2. Remove the oil fill-and-level plug (item A).
3. Fill the oil through the oil fill-and-level port until the oil starts to flow out of the fill-and-level port.
4. Clean the fill-and-level plug and examine the O-ring seals. Replace the O-rings if they are worn or damaged.
5. Install the fill-and-level plug.

6. **WARNING**

   Energized Machine

   Can cause serious injury

   - The machine must be fully energized to complete this procedure.
   - Be careful around moving parts and pinch points.

   Inform the supervisor, the lead hand, and all other persons concerned of the intent to restart the machine.

   NOTE: *Make sure that all personnel and bystanders are clear of the machine before start-up.*

7. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

   NOTE: *Refer to Safety Locks and Tags Minimum Requirements.*

8. Start the electric motor and let the final drives operate through several cycles.
9. Put all of the controls in the OFF or neutral position.
10. Stop the machine.
11. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

    NOTE: *Refer to Safety Locks and Tags Minimum Requirements.*

12. Make sure that the machine is in a zero-energy state.
13. Do a leak check. Repair leaks, as necessary.

After Completing the Task

1. **CAUTION**

   Environmental Contaminant

   Oil is an environmental contaminant and must be discarded correctly.

   - ▶ Do not let the used oil drain onto the ground.
   - ▶ Discard the used oil in accordance with local environmental regulations.

   NOTE: *Refer to Environmental Instructions in the Maintenance manual.*

   Remove the container and discard the used oil in accordance with local environmental regulations.

2. Make sure that the machine is leak-free and the components are clean.
3. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

   NOTE: *Refer to Safety Locks and Tags Minimum Requirements.*

7 Annual Maintenance

7.1 Do a Torque Inspection of the Trunnion Block Cap Screws

7.1.1 Labor Resource (People/Skills)

Service Technician x 1

7.1.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Body - Fall protection straps
- Safety devices

7.1.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Torque wrench, calibrated	Capacity up to 922 Nm (680 ft-lb)
Tags	As required

Support Equipment

Description	Specification
Man-lift	

Consumables

Description	Specification	Quantity
Molykote® grease		As required
Safety wire		As required

7.1.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Cap screw		As required
Washer		As required

7.1.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing a Torque Inspection of the Trunnion Block Cap Screws	02:00

7.1.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

7.1.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. **DANGER**

   Electrocution Hazard

   Operating near or contacting a power line with any part of the machine can cause electrocution, causing death.

   - Do not raise or lower the mast or operate the machine near electric power lines.
   - Keep at least 3 meters (10 feet) away from power lines.
   - If there appears any danger of wind or other obstruction decreasing the distance, do not drill in that area.

   Lower the mast to the horizontal position.

3. Put all of the controls in the OFF or neutral position.
4. Stop the machine.
5. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

   NOTE: *Refer to Safety Locks and Tags Minimum Requirements.*

6. Make sure that the machine is in a zero-energy state.
7. Put blocks at the tracks, as applicable.

7.1.8 Examining the Trunnion Block Cap Screws

1. **WARNING**

   Fall Hazard

   Can cause personal injury or death.

   - ▶ Put on fall-protection equipment when you work from a man-lift.
   - ▶ Examine all lifting equipment before you start any maintenance task.

   Position the forklift with man-basket to get access to the trunnion blocks (Figure 1, item B) on the top of the mast support.

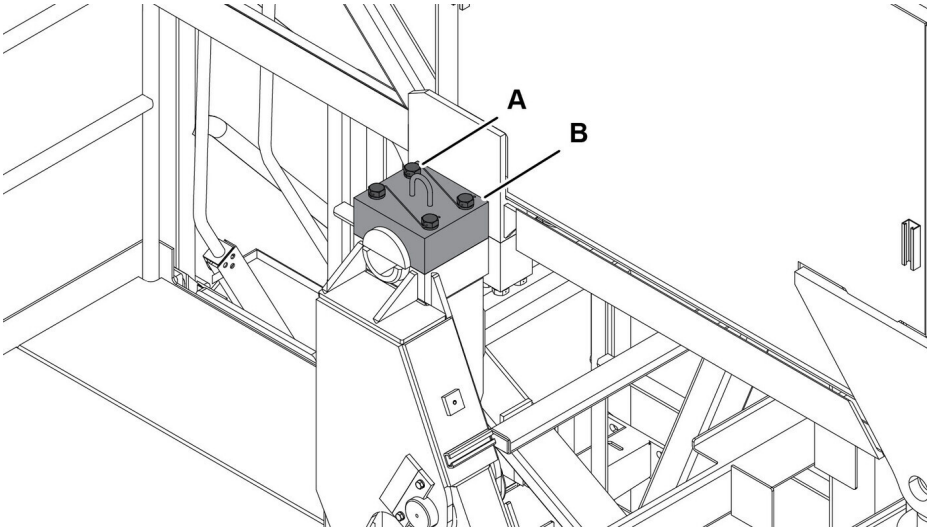


Figure 1

A	Cap screw and washer	B	Trunnion block

2. Do a visual inspection of the cap screws (item A) for loose or broken safety wire.
3. Do a torque check of the cap screws at 829 Newton meters (612 foot-pounds). If the cap screws are out of torque, replace them.

   ! ***NOTE:*** *This torque is 90% of the final torque of the cap screws.*

   ! ***NOTE:*** *Replace all of the cap screws on the trunnion blocks as a set, not individually.*

4. If the cap screws are to be replaced, continue to step 5.
5. Remove the wire from the cap screws. Discard the wire.

6. Remove the cap screws and washers from the trunnion blocks. Discard the cap screws and washers.
7. Clean the threads of the trunnion blocks with compressed air.
8. Apply Molykote grease to the threads and the bottom of the head on the new cap screws.
9. Insert the new cap screws with washers (Figure 1, item A) into the trunnion blocks. Hand-tighten the cap screws until they contact the surface of the trunnion blocks.
10. Torque the cap screws in a cross pattern to 922 Newton meters (680 foot-pounds) lubricated (Figure 2).

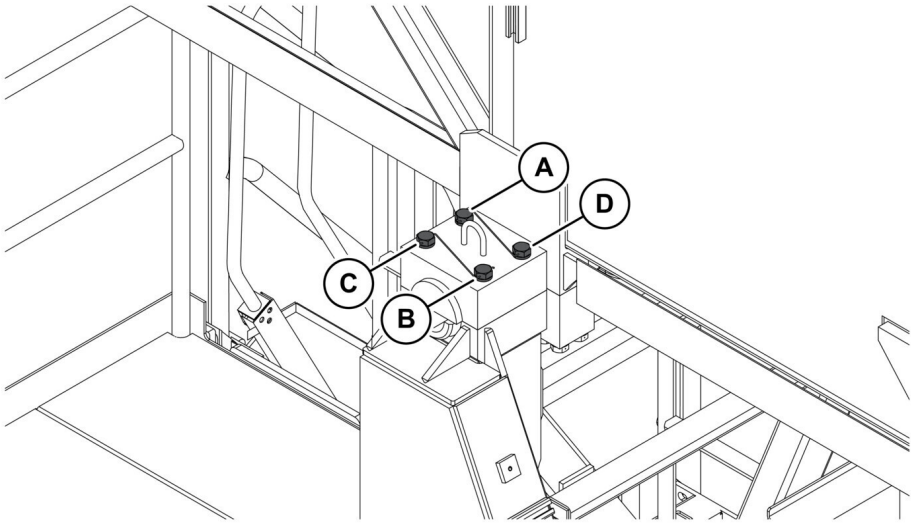


Figure 2

A through D	Torque sequence		

11. Safety the cap screws with wire (Figures 3).

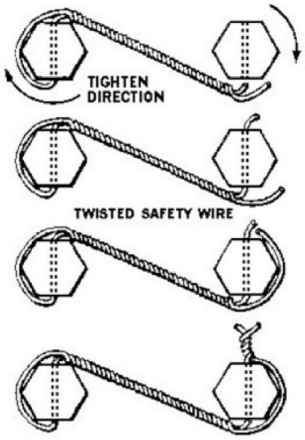


Figure 3

12. Repeat steps 4 through 11 for all of the cap screws, as required.

7.1.9 After Completing the Task

1. Clean the work area of all tools and unwanted materials.
2. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

7.2 Do a Torque Inspection of the Mast Pivot Shaft Cap Screws

7.2.1 Labor Resource (People/Skills)

Service Technician x 1

7.2.2 Personal Protection Equipment

> ! ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Body - Fall protection straps
- Safety devices

7.2.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ! ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Torque wrench, calibrated	Capacity up to 922 Nm (680 ft-lb)

Support Equipment

Description	Specification
Forklift with man basket	

Consumables

Description	Specification	Quantity
Molykote® grease		As required
Safety wire		As required

7.2.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Cap screw		As required
Washer		As required

7.2.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing a Torque Inspection of the Mast Pivot Shaft Cap Screws	02:00

7.2.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

7.2.7 Before Starting the Task

1. **WARNING**

   Energized Machine

   Can cause serious injury.

   - The machine must be fully energized and the engine must be switched on to complete this procedure.
   - Be careful around moving parts and pinch points.

   Inform the supervisor, lead hand, and all other parties concerned, of the intent to restart the machine.

   NOTE: *Make sure that all personnel and bystanders are clear of the machine before start-up.*

2. Start the machine.
3. **DANGER**

   Electrocution Hazard

   Operating near or contacting a power line with any part of the machine can cause electrocution, causing death.

   - Do not raise or lower the mast or operate the machine near electric power lines.
   - Keep at least 3 meters (10 feet) away from power lines.
   - If there appears any danger of wind or other obstruction decreasing the distance, do not drill in that area.

   Raise the mast to the vertical position and lock it in place.

4. Put all of the controls in the OFF or neutral position.
5. Stop the machine.
6. Set the main switch to the OFF position.
7. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

8. Make sure that the machine is in a zero-energy state.
9. Put blocks at the tracks, as applicable.

7.2.8 Examining the Mast Pivot Shaft Cap Screws

1. **⚠ WARNING**

   Fall Hazard

   Can cause personal injury or death.

   - ▶ Put on fall-protection equipment when you work from a man-lift.
   - ▶ Examine all lifting equipment before you start any maintenance task.

   Position the forklift with man-basket to get access to the mast pivot shaft at the mast support.

2. Do a visual inspection of the cap screws (Figure 1, item A) for loose or broken safety wire

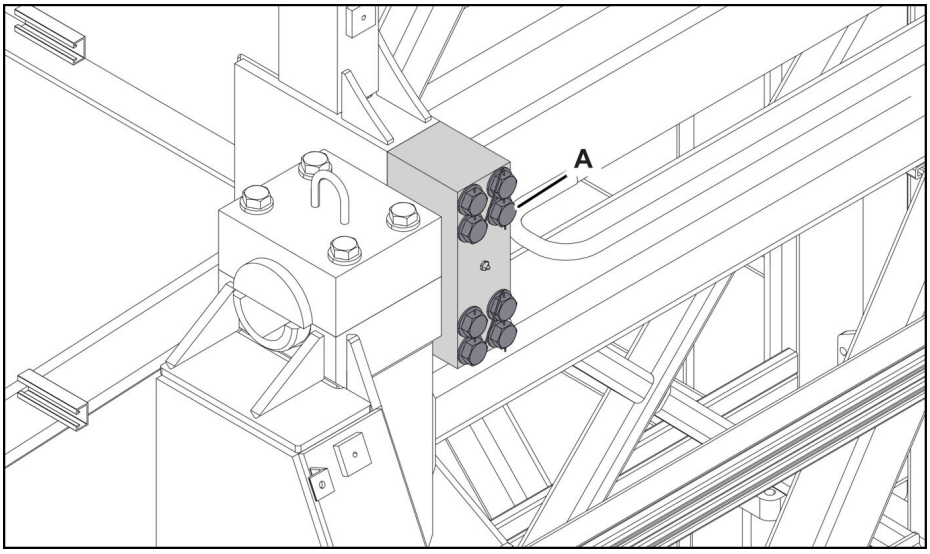


Figure 1

A	Cap screws with washers		

3. Remove the safety wire from the cap screws. Discard the safety wire.
4. Do a torque check of the cap screws at 829 Newton meters (612 foot-pounds). If the cap screws are out of torque, replace them.

> ! ***NOTE:*** *This torque is 90% of the final torque of the cap screws.*

> ! ***NOTE:*** *Replace all of the cap screws on the mast pivot shaft as a set, not individually. All cap screws are to be replaced at a minimum of every four years.*

5. If the cap screws are to be replaced, continue to step 6.

> ! ***NOTE:*** *Do not remove all of the cap screws from the mast pivot shaft at the same time.*

> ! ***NOTE:*** *Replace the cap screws in the correct torque order (Figure 1).*

6. Remove the cap screw and washer indicated by (Figure 1, item A). Discard the cap screw and washer.
7. Apply Molykote grease to the threads and the bottom of the head on the new cap screws.

8. Hand tighten the cap screws until they make contact with the mast pivot blocks.
9. Torque the cap screws to 678 Newton meters (500 foot-pounds) lubricated.
10. Repeat steps 6 through 9 only for cap screws 2 through 4 according to the sequence in Figure 2.

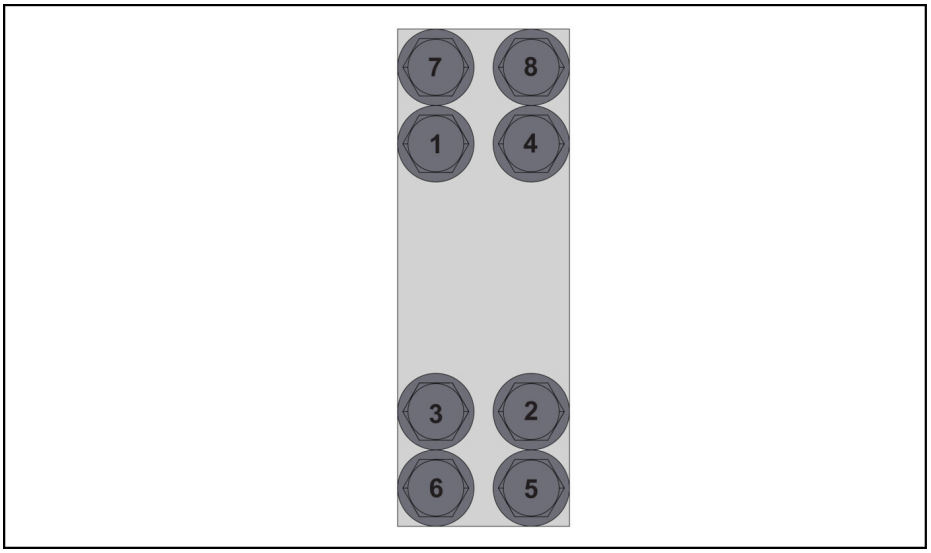


Figure 2

11. Repeat steps 6 through 10 for the mast pivot blocks on the opposite side of the mast.
12. **WARNING**

    Energized Machine

    Can cause serious injury.

    - The machine must be fully energized and the engine must be switched on to complete this procedure.
    - Be careful around moving parts and pinch points.

    Inform the supervisor, lead hand, and all other parties concerned, of the intent to restart the machine.

    NOTE: *Make sure that all personnel and bystanders are clear of the machine before start-up.*

13. Start the machine.

14. **DANGER**

    Electrocution Hazard

    Operating near or contacting a power line with any part of the machine can cause electrocution, causing death.

    - Do not raise or lower the mast or operate the machine near electric power lines.
    - Keep at least 3 meters (10 feet) away from power lines.
    - If there appears any danger of wind or other obstruction decreasing the distance, do not drill in that area.

    Lower the mast to the horizontal position.

15. Shut off the machine.
16. Attach the safety locks and tags to the machine in accordance with site specific regulations.
17. Remove the cap screw and washer that is indicated by item (Figure 1, item A). Discard the cap screw and washer.
18. Apply Molykote grease to the threads and the bottom of the head on the new cap screws.
19. Hand tighten the cap screws until they make contact with the mast pivot blocks.
20. Torque the cap screws to 678 Newton meters (500 foot-pounds) lubricated.
21. Repeat steps 17 through 20 for cap screws 6 through 8 for the mast pivot blocks on the opposite side of the mast.
22. Repeat steps 17 through 21 for the mast pivot blocks on the opposite side of the mast.
23. Torque each cap screw to a final torque of 922 Newton meters (680 foot-pounds) lubricated in accordance with the sequence in Figure 2.
24. Repeat step 23 for the mast pivot shaft on the opposite side of the mast.
25. Safety the cap screws with wire.

7.2.9 After Completing the Task

1. Remove all tools and trash from the work area.

2. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> **NOTE:** *Refer to Safety Locks and Tags Minimum Requirements.*

3. Release the machine to customer.

8 10-Hour Periodic Maintenance

8.1 Do a Test of the Overpressure Control System

8.1.1 Labor Resource (People/Skills)

Service Technician x 1

8.1.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

8.1.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Not applicable		

8.1.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

8.1.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing a Test of the Overpressure Control System	00:15

8.1.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

8.1.7 Before Starting the Task

1. Park the machine on a dry level surface.

2. **DANGER**

   Electrocution Hazard

   Operating near or contacting a power line with any part of the machine can cause electrocution, causing death.

   - Do not raise or lower the mast or operate the machine near electric power lines.
   - Keep at least 3 meters (10 feet) away from power lines.
   - If there appears any danger of wind or other obstruction decreasing the distance, do not drill in that area.

   Raise the mast to the vertical position and lock it in place.

3. Put all of the controls in the OFF or neutral position.
4. Stop the machine.
5. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

   NOTE: *Refer to Safety Locks and Tags Minimum Requirements.*

6. Make sure that the machine is in a zero-energy state.
7. Put blocks at the tracks, as applicable.
8. Remove the drill pipe from the rotary head and store it in the carousel.

8.1.8 Doing a Test of the Overpressure Control System

1. **WARNING**

   Energized Machine

   Can cause serious injury

   - The machine must be fully energized to complete this procedure.
   - Be careful around moving parts and pinch points.

   Inform the supervisor, lead hand, and all other persons concerned of the intent to restart the machine.

   NOTE: *Make sure that all personnel and bystanders are clear of the machine before start-up.*

2. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

3. Start the machine.
4. Raise the machine with the leveling jacks. Position the tracks at 25 to 51 millimeters (1 to 2 inches) off of the ground. The machine weight must be fully supported by the leveling jacks.
5. **WARNING**

   Risk of Personal Injury

   Doing a test of the Overpressure Control System with a drill pipe in the rotary head can cause personal injury.

   ▶ Do a system test only with the rotary head against the lower mast stops.

   Lower the rotary head against the bottom stops of the mast with the RCS controls.

6. Increase the pulldown pressure slowly to at least 172 bar (2,500 psi) down pressure.
7. Retract the cab side leveling jack slowly.

> ***NOTE:*** *This action causes the overpressure control to divert the feed pressure to the tank.*

8. The feed pressure must release immediately when the jack pad is lifted. Make sure that the feed pressure decreases below 35 bar (500 psi). The rotary head normally travels upwards slightly when the pressure releases.

> ***NOTE:*** *If the feed pressure does not release, decrease the system pressure with the feed controls, make the machine level, and then contact the supervisor immediately for system repairs.*

9. Repeat steps 5 through 7, this time retracting the dust collector side jack slightly. If the pressure releases when the jack pad is lifted slightly off the ground as in step 7, the system is working.

> ***NOTE:*** *If the feed pressure does not release, decrease the system pressure with the feed controls, make the machine level, and then contact the supervisor for system repairs immediately.*

Figure 1

A	Drill end leveling jack	B	Overpressure control pilot valve
C	Pilot valve plunger		

8.2 Do an Inspection of the Air Cleaner Filter Restriction Indicators

8.2.1 Labor Resource (People/Skills)

Service Technician x 1

8.2.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

8.2.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Not applicable		

8.2.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

8.2.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing an Inspection of the Air Cleaner Restriction Indicators	00:15

8.2.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Change the Engine and Compressor Air Filter Element	Model specific Maintenance Manual

8.2.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Set the key switch power to on with motor off.
3. Switch on the RCS monitor.

8.2.8 Doing an Inspection of the Air Cleaner Service Restriction Indicators

1. Monitor the filter restriction indicators using the RCS screen in the cab.
2. If a filter restriction indicator (Figure 1, items A and B) shows on the screen, replace the engine or compressor air filter.

> ! ***NOTE:*** *Refer to Change the Engine and Compressor Air Filter Elements in 1,000-Hour Periodic Maintenance.*

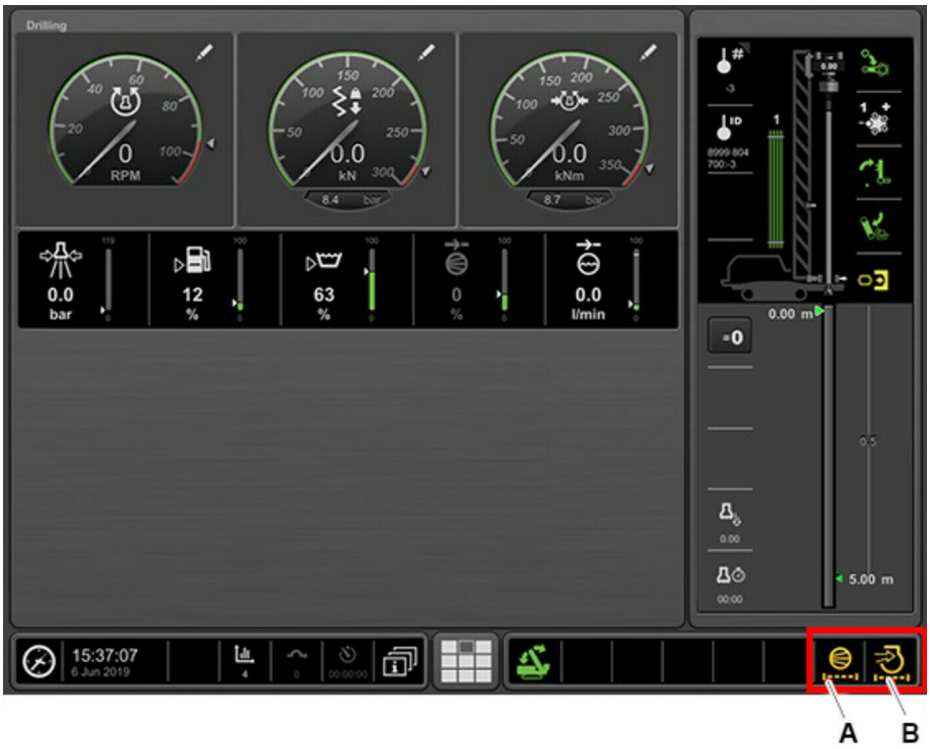


Figure 1

A	Compressor air filter icon	B	Engine air filter icon

8.3 Do an Inspection of the Engine and Compressor Air Intake Ducts

8.3.1 Labor Resource (People/Skills)

Service Technician x 1

8.3.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

8.3.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Not applicable		

8.3.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

8.3.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing an Inspection of the Engine and Compressor Air Intake Ducts	01:00

8.3.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

8.3.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. **DANGER**

   Electrocution Hazard

   Operating near or contacting a power line with any part of the machine can cause electrocution, causing death.

   - Do not raise or lower the mast or operate the machine near electric power lines.
   - Keep at least 3 meters (10 feet) away from power lines.
   - If there appears any danger of wind or other obstruction decreasing the distance, do not drill in that area.

   Raise the mast to the vertical position and lock it in place.

3. Put all of the controls in the OFF or neutral position.
4. Stop the machine.
5. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

   NOTE: *Refer to Safety Locks and Tags Minimum Requirements.*

6. Make sure that the machine is in a zero-energy state.
7. Put blocks at the tracks, as applicable.

8.3.8 Doing an Inspection of the Engine and Compressor Air Intake Ducts

WARNING

Burn Hazard

Hot fluids or components can burn.

- ▶ Make sure that the fluids are at a safe working temperature when you service the machine.
- ▶ Do not touch hot fluids or components.

1. Do a leak check of the air cleaners and the ducts before, during, and after every shift.
2. Make sure that all of the connections between the air cleaners and the compressors are tight and sealed.
3. Examine the ducts for cuts or cracks. If cuts or cracks are present, replace the ducts and the clamps immediately.
4. Examine the air transfer tubing or just inside the intake manifold inlet for traces of dust.

Figure 1

8.3.9 After Completing the Task

- ○ Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

NOTE: *Refer to Safety Locks and Tags Minimum Requirements.*

8.4 Do an Inspection of the Dust Collector

8.4.1 Labor Resource (People/Skills)

Service Technician x 1

8.4.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Nose and mouth - Dust mask
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

8.4.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Not applicable		

8.4.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Filter element		As required

8.4.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing an Inspection of the Dust Collector	00:30

8.4.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

8.4.7 Before Starting the Task

1. **WARNING**

   Energized Machine

   Can cause serious injury.

   - The machine must be fully energized and the engine/motor must be switched on to complete this procedure.
   - Be careful around moving parts and pinch points.

   Inform the supervisor, lead hand, and all other persons that are concerned, of the intent to restart the machine.

   > ***NOTE:*** *Make sure that all personnel and bystanders are clear of the machine before startup.*

2. Remove the safety locks and tags to the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

3. Start the machine.
4. **WARNING**

   Hot Components

   Hot components can burn.

   - Make sure that the components are at a safe working temperature when you service them.
   - Do not touch hot components.

   Energize the dust collector.

8.4.8 Doing an Inspection of the Dust Collector

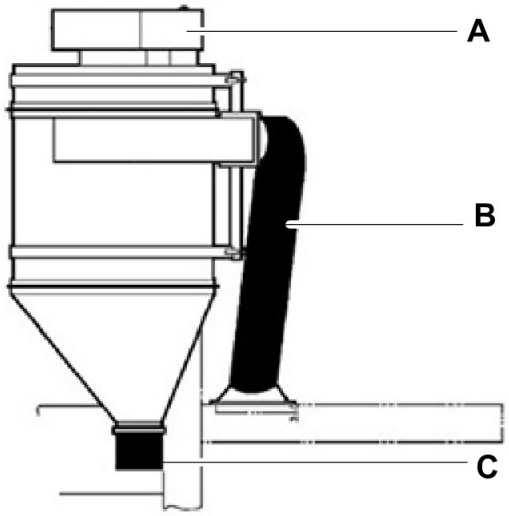


Figure 1

A	Blower Assembly	B	Suction hose
C	Dropout hose		

1. Do an inspection of the Blower Assembly (Figure 1, item A) as follows:
   a. Examine for visible dust emerging from the outlet of the blower housing. Replace the filter elements if there is dust escaping from the housing.

b. Listen for correct function of the dust collector. The air must pulse every two to three seconds.

c. Make sure that the supply air pressure to the dust collector is at 2.76 bar (40 psig).

d. Stop the machine.

e. Attach safety locks and tags to the machine in accordance with the site-specific procedures or refer to Safety Locks and Tags Minimum Requirements.

f. Examine the fan wheel for damage or missing blades. Replace the fan wheel, if damaged.

g. Examine the assembly housing for cracks or damage.

h. Examine the hydraulic hose connections for signs of oil loss.

2. Examine the suction hose (item B) as follows.

   a. Examine the suction hose for obstructions and buildup of dirt or mud.

   b. Correct kinks or sharp bends in the suction hose.

3. Examine the dropout hose (item C) as follows.

   a. Make sure that the dropout hose connection to the dropout cone is secure.

   b. Examine the hose for holes and for a tight seal around the cone.

4. Examine the filter elements for dust buildup and for rips or tears. Replace the filter elements if necessary.

Figure 2

8.4.9 After Completing the Task

1. Do the needed repairs or maintenance on the dust collector.
2. Remove all tools and unwanted materials from the work area.

3. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

8.5 Clean the Filter Dust Cups

8.5.1 Labor Resource (People/Skills)

Service Technician x 1

8.5.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

8.5.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Not applicable		

8.5.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

8.5.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Cleaning the Dust Cups	00:05

8.5.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

8.5.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.

4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

8.5.8 Cleaning the Dust Cups

> ! ***NOTE:*** *On air cleaners that has dust cups, the cups must be emptied when they become 2/3 full. The frequency of dust cup servicing varies with the operating conditions.*

1. Loosen the dust cup clamps (Figure 1, item B).

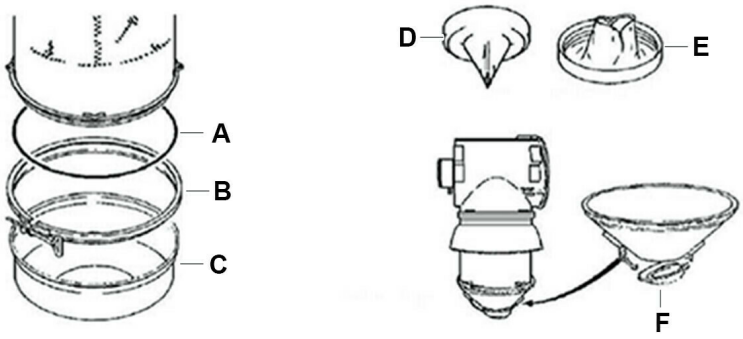


Figure 1

A	O-ring	B	Dust cup clamps
C	Dust cups	D	Vacuator valve
E	Vacuator valve	F	Quick release dust cup

2. Remove the dust cups (item C) on both the compressor and the engine air cleaner.
3. Empty any accumulations of dust and dirt in accordance with site-specific procedures.
4. Replace the dust cup.
5. Secure the dust cup clamps.
6. Examine the O-ring (item A) between the dust cup and the air cleaner body. Replace the O-ring, if damaged.
7. Position the dust cup and make sure that the dust cup seals all the way around the air cleaner body.
8. On air cleaners that has a quick release dust cup (item F), release the latch on the dust cup and let it swing down and empty completely.

9. Close the dust cup and lock the latch.
10. On air cleaners that has vacuator valves (items D and E), make sure that the vacuator valve is not inverted, damaged, or plugged.

8.5.9 After Completing the Task

- Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> **NOTE:** *Refer to Safety Locks and Tags Minimum Requirements.*

8.6 Do an Inspection of the Hydraulic Hoses

8.6.1 Labor Resource (People/Skills)

Service Technician x 1

8.6.2 Personal Protection Equipment

> **NOTE:** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with hard toes
- Safety devices

8.6.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> **NOTE:** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Not applicable		

8.6.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Hydraulic hoses		As required

8.6.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing an Inspection of the Hydraulic Hoses	02:00

8.6.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

8.6.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

8.6.8 Doing an Inspection of the Hydraulic Hoses

⚠ WARNING

Burn Hazard

Hot fluids or components can burn.

▶ Do not touch hot fluids or components.

1. Examine the hydraulic hoses for sharp edges that are rubbing into the hoses. Make corrections, as needed.
2. Replace the hoses that are visually damaged. Look for the following:
   - Uncovered wire-braided lining
   - Leaking fluids
   - Corrosion at the metal coupling or fittings
   - Crushed or flattened hoses
3. Examine the hoses for sharp kinks or twists in the routing. Make corrections, as needed.

8.6.9 After Completing the Task

1. Remove all tools and unwanted materials from the work area.
2. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

8.7 Do an Inspection of the Exhaust System

8.7.1 Labor Resource (People/Skills)

Service Technician x 1

8.7.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

8.7.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Not applicable		

8.7.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

8.7.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing an Inspection of the Exhaust System	00:30

8.7.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Exhaust System Removal and Installation	TIS0001223
Exhaust Blanket Removal and Installation	TIS0002613

8.7.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

8.7.8 Doing an Inspection of the Exhaust System

WARNING

Burn Hazard

Hot fluids or components can burn.

- Make sure that the fluids are at a safe working temperature when you service the machine.
- Do not touch hot fluids or components.

1. Examine the exhaust clamps (Figure 1, item C) for damage or excessive wear. Replace the exhaust clamps, if necessary.

Figure 1

A	Exhaust muffler	B	Exhaust heat blanket
C	Exhaust clamp		

2. Examine the exhaust muffler (item A) for cracks or damage. Replace the exhaust muffler, if necessary.

> ***NOTE:*** *Refer to Exhaust System Removal and Installation.*

3. Examine the exhaust heat blankets (item B) for damage. Replace the exhaust heat blankets, if necessary.

> ***NOTE:*** *Refer to Exhaust Blanket Removal and Installation.*

4. Examine the exhaust piping for cracks or damage. Replace the exhaust pipes if cracks or damage are found.

8.7.9 After Completing the Task

1. Remove all tools and unwanted materials from the work area.
2. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

8.8 Do an Inspection of the Engine Belts and Tensioner

Refer to the engine Operation and Maintenance manual for a maintenance schedule and maintenance procedures.

8.9 Drain the Water from the Fuel-Water Separator

8.9.1 Labor Resource (People/Skills)

Service Technician x 1

8.9.2 Personal Protection Equipment

> ! ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

8.9.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ! ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Container	19 L (5 gal)

Consumables

Description	Specification	Quantity
Not applicable		

8.9.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

8.9.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Draining the Water from the Fuel/Water Separator	00:30

8.9.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

8.9.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

   NOTE: *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

8.9.8 Draining the Water from the Fuel/Water Separator

WARNING

Flammable Liquid

Fuel is flammable and can cause serious injury or death.

- Stop the engine and extinguish all open flames.
- Do not smoke while you drain or fill the fuel tank.
- Wipe spilled fuel immediately.

1. **CAUTION**

   Environmental Contaminant

   Fuel is an environmental contaminant and must be discarded correctly.

   - ▶ Do not let the fuel drain into the ground.
   - ▶ Discard the used fuel in accordance with local environmental regulations.

   NOTE: *Refer to Environmental Instructions in the Maintenance manual.*

   Put the container below the filter ports (Figure 1, item A).

Figure 1

A	Filter ports		

2. Open the bottom drain valve to drain the water from the fuel.
3. Close the drain valve when the fuel starts to flow.
4. Discard the water in accordance with local environmental regulations.

8.9.9 After Completing the Task

1. Clean the work area and discard the waste in accordance with local environmental regulations.

2. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

8.10 Do an Engine Oil Level Check

8.10.1 Labor Resource (People/Skills)

Service Technician x 1

8.10.2 Personal Protection Equipment

> ! ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

8.10.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ! ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Quick-fill kit	
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Engine oil	Refer to OEM manual	As required

8.10.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

8.10.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing an Engine Oil Level Check	00:30

8.10.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)

Description	Reference
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Refill Capacities and Lubricants	Model specific Maintenance Manual

8.10.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

8.10.8 Doing an Engine Oil Level Check

WARNING

Burn Hazard

Hot fluids or components can burn.

- Make sure that the fluids are at a safe working temperature when you service the machine.
- Do not touch hot fluids or components.

1. Remove the engine oil dipstick (Figure 1, item A) from the engine.

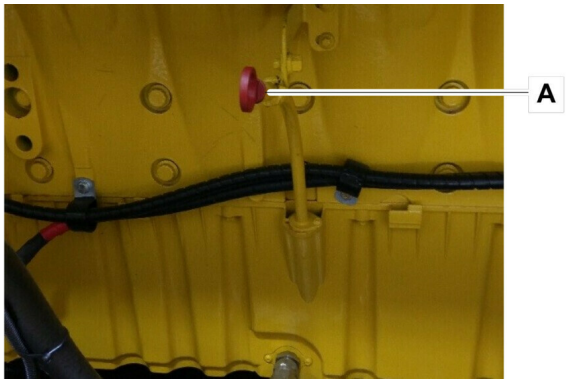


Figure 1

A	Dipstick		

2. Make sure that the engine oil level is at the FULL mark on the dipstick.
3. Add oil, if necessary.

8.10.9 Filling the Engine Oil

NOTICE

Risk of Contamination

Contamination during filling can damage the engine.

- Make sure that the oil is free of contamination before you add oil into the engine. The system uses filtration on the return oil only.

NOTICE

Component Damage

Can cause poor performance or early component failure.

- Do not overfill when adding oil.
- Use the correct oil grade. Refer to the OEM manual.

1. Find the engine oil quick-fill fitting (Figure 2, item A) in the quick-fill box.

Figure 2

A	Quick-fill fitting		

2. Remove the cap from the engine oil quick-fill fitting and clean the fitting of dirt and unwanted material.
3. Connect the quick-fill hose to the quick-fill fitting.
4. Fill with new, clean engine oil as per OEM specifications.
5. Make sure that the engine oil level is at the FULL mark on the engine dipstick.
6. Disconnect the quick-fill hose.
7. Clean the cap.
8. Install the cap on the quick-fill fitting.

8.10.10 After Completing the Task

1. Remove all tools and unwanted materials from the work area.
2. **⚠ CAUTION**

   Environmental Contaminant

   Oil is an environmental contaminant and must be discarded correctly.

   ▶ Do not let the used oil drain onto the ground.

   ▶ Discard the used oil in accordance with local environmental regulations.

   ! ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

   Remove the container and discard the used oil in accordance with local environmental regulations.

3. **WARNING**

   Energized Machine

   Can cause serious injury.

   - The machine must be fully energized and the engine must be switched on to complete this procedure.
   - Be careful around moving parts and pinch points.

   Inform the supervisor, lead hand, and all other persons concerned of the intent to restart the machine for testing purposes.

   NOTE: *Make sure that all personnel and bystanders are clear of the machine before start-up.*

4. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

   NOTE: *Refer to Safety Locks and Tags Minimum Requirements.*

5. Start the machine.
6. Operate the engine for one minute.
7. Put all of the controls in the OFF or neutral position.
8. Stop the machine.
9. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

   NOTE: *Refer to Safety Locks and Tags Minimum Requirements.*

10. Make sure that the machine is in a zero-energy state.
11. Do an oil leak check. Repair the leaks if observed.
12. Do an engine oil level check at the dipstick. Add oil as necessary.
13. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

    NOTE: *Refer to Safety Locks and Tags Minimum Requirements.*

8.11 Do an Engine Coolant Level Check

8.11.1 Labor Resource (People/Skills)

Service Technician x 1

8.11.2 Personal Protection Equipment

! ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

8.11.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

! ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Coolant	Refer to OEM manual	As required

8.11.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

8.11.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing an Engine Coolant Level Check and Adding Coolant	00:30

8.11.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Refill Capacities and Lubricants	Model specific Maintenance Manual

8.11.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

8.11.8 Doing an Engine Coolant Level Check

WARNING

Burn Hazard

Hot coolant or components can burn.

- Do not touch hot coolant or components.

WARNING

High Pressure

The pressurized system and hot coolant can cause serious injury.

- Be careful when you remove the filler cap.

1. Let the engine cool.
2. Do a coolant level check at the sight glass (Figure 1, item A) on the expansion tank.

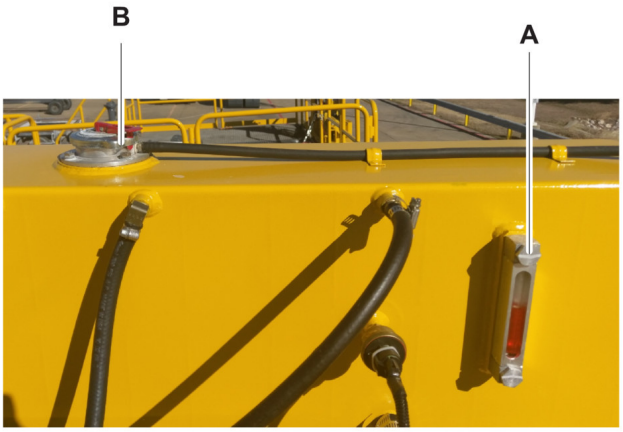


Figure 1

A	Sight glass	B	Filler neck

3. If the coolant level is below the middle of the sight glass, fill to the top of the sight glass.

8.11.9 Adding the Engine Coolant

CAUTION

Environmental Contaminant

Coolant is an environmental contaminant and must be discarded correctly.

- ▶ Do not let used coolant drain onto the ground.
- ▶ Obey all local standards and regulations for discarding the used coolant.

NOTE: *Refer to Environmental Instructions in the Maintenance manual.*

1. For the machines without quick-fill installed, remove the radiator cap and fill through the top cap filler neck.
2. For machine that have the quick-fill system, remove the cap (Figure 2, item A) on the coolant connection. Wipe the connection and the fill hose to clean the unwanted material and connect the fill hose.

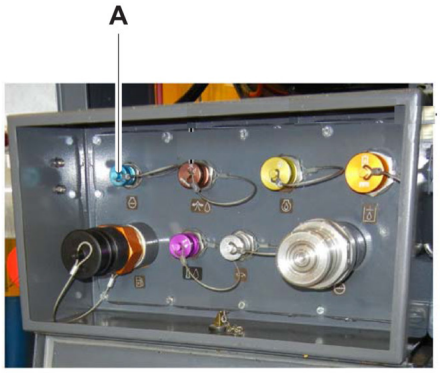


Figure 2

A	Cap		

3. **WARNING**

Energized Machine

Can cause serious injury.

- ▶ The machine must be fully energized and the engine must be switched on to complete this procedure.
- ▶ Be careful around moving parts and pinch points.

Inform the supervisor, lead hand, and all other persons concerned of the intent to restart the machine.

> ***NOTE:*** *Make sure that all personnel and bystanders are clear of the machine before start-up.*

4. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Start the machine and operate it at idle speed. Increase the engine speed to 1,500 rpm for one minute to remove the air from the engine and the radiator.
6. Put all of the controls in the OFF or neutral position.
7. Stop the machine.
8. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

9. **WARNING**

   Burn Hazard

   Hot coolant or components can burn.

   ▶ Do not touch hot coolant or components.

   Do a coolant level check again. Fill to the top of the sight glass as needed.

10. Install the filler neck pressure cap.
11. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

8.11.10 After Completing the Task

1. Remove all tools and unwanted materials from the work area.

2. **WARNING**

   Energized Machine

   Can cause serious injury.

   - The machine must be fully energized and the engine must be switched on to complete this procedure.
   - Be careful around moving parts and pinch points.

   Inform the supervisor, lead hand, and all other persons concerned of the intent to restart the machine.

   NOTE: *Make sure that all personnel and bystanders are clear of the machine before start-up.*

3. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

   NOTE: *Refer to Safety Locks and Tags Minimum Requirements.*

4. Set the main switch to ON.
5. Start the machine.
6. Do an inspection for correct operating temperature and operation.
7. Put all of the controls in the OFF or neutral position.
8. Stop the machine.
9. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

   NOTE: *Refer to Safety Locks and Tags Minimum Requirements.*

10. Do a leak check. Repair the leaks, if observed.
11. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

    NOTE: *Refer to Safety Locks and Tags Minimum Requirements.*

8.12 Do a Fuel Level Check

8.12.1 Labor Resource (People/Skills)

Service Technician x 1

8.12.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

8.12.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Diesel fuel		As required

8.12.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

8.12.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing a Fuel Level Check	Dependent on amount of fuel

8.12.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Environmental Instructions	Model specific Maintenance Manual

8.12.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

8.12.8 Doing a Fuel Level Check

1. Select the Main menu icon at the bottom of the screen.
2. On the Main menu, select the **Performance** icon to open the **Performance** screen (Figure 1).

Figure 1

3. Do a fuel level check at the fuel level gauge on the screen (Figure 1).
4. Fill the fuel tank if the fuel level is below one-fourth of the tank.

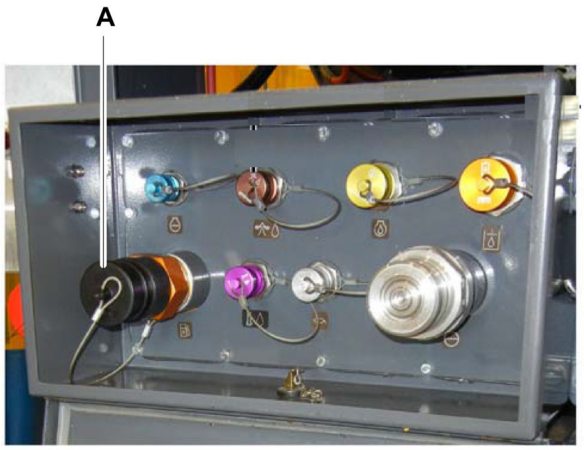
> ***NOTE:*** *Do not let the fuel tank become empty. The entire fuel system is needed to bleed if the fuel tank is empty.*

8.12.9 Filling the Fuel Tank

1. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

2. Find the correct quick-fill hose, clean the hose fitting, and connect it to the diesel fitting (Figure 2, item A) in the quick-fill box.



A	Diesel quick-fill fitting		

3. **WARNING**

Flammable Liquid

Fuel is flammable and can cause serious injury or death.

- ▶ Stop the engine and extinguish all open flames.
- ▶ Wipe the spilled fuel immediately.
- ▶ Do not smoke when you drain or fill the tank.

CAUTION

Environmental Contaminant

Fuel is an environmental contaminant and must be discarded correctly.

- ▶ Do not let the used fuel drain onto the ground.
- ▶ Discard the used fuel in accordance with local environmental regulations.

! ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

Fill the fuel tank with fuel until the fuel gauge on the display screen shows full.

4. Remove the quick-fill hose from the connection.
5. Wipe the diesel quick-fill fitting to clean it, and install the cap.

8.12.10 After Completing the Task

1. Remove all tools and unwanted materials from the work area.
2. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

8.13 Do a Compressor Oil Level Check

8.13.1 Labor Resource (People/Skills)

Service Technician x 1

8.13.2 Personal Protection Equipment

> ! ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

8.13.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ! ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Compressor oil	As specified in Refill Capacities and Lubricants	As required

8.13.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

8.13.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing a Compressor Oil Level Check	00:30

8.13.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Maintenance Schedule	Model specific Maintenance Manual

Description	Reference
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Refill Capacities and Lubricants	Model specific Maintenance Manual

8.13.7 Before Starting the Task

1. Park the machine on dry a level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine and let the receiver tank settle if any foam is created.

> ***NOTE:*** *Foam bubbles must not be visible, except small bubbles on the surface of the oil. When the oil temperature is above 70 °C (158 °F), the thermostatic valve directs the oil into the heat exchanger. If the equipment stops at that moment, some of the oil does not return to the receiver tank. This action causes the oil level to appear low or not appear in the site glass. Let the oil cool and then restart the machine to let the oil circulate for a minute. Stop the machine and proceed to the next step.*

4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.
7. **WARNING**

   High Pressure

   High pressure can cause severe injury or death.

   ▶ Release all of the air pressure from the system before you remove the filler plug, drain valve, and fittings.

   Open the ball valve on the side of the receiver tank to release the pressure.

> ***NOTE:*** *The pressure gauge must read zero bar (zero psig).*

8. Close the ball valve.

8.13.8 Doing a Compressor Oil Level Check

WARNING

Burn Hazard

Hot fluids or components can burn.

- Make sure that the fluids are at a safe working temperature when you service the machine.
- Do not touch hot fluids or components.

1. Do an oil level check at the receiver tank sight glass. Make sure that the oil level is visible in the sight glass, but does not exceed the top of the sight glass (Figure 1).

Figure 1

2. Add oil as needed:

NOTE: *The pressure gauge must read zero kPa (zero psig).*

a. **WARNING**

High Pressure

High pressure can cause severe injury or death.

- Release all of the air pressure from the system before you remove the filler plug, drain valve, and fittings.

Remove the oil filler plug.

b. Fill the oil through the filler neck.

> ***NOTE:*** *Oil must to be filtered through a 10-micron filter.*

c. Add oil until the oil level is visible in the sight glass, but do not exceed the top of the sight glass.

d. Clean and install the oil filler plug.

8.13.9 Examine the Compressor Oil Consumption Rate

If the compressor is consuming more than that specified in the table Compressor Oil Consumption Rate, do the following:

- Do a check of the air system for external leaks.
- Change the separator element.
- Make sure that the scavenge system is functioning correctly.
- Examine all air system components for damage.

Compressor Oil Consumption Rate

Compressor	Consumption Time for 5 L (1 gal) of Oil
41 m^3/min (1,450 cfm)	30.5 hours
54 m^3/min (1,900 cfm)	23 hours
74 m^3/min (2,600 cfm)	17 hours

8.13.10 After Completing the Task

1. Remove all tools and unwanted materials from the work area.
2. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

8.14 Drain the Water from the Receiver Tank

8.14.1 Labor Resource (People/Skills)

Service Technician x 1

8.14.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

8.14.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Container	8 L (2 gal)

Consumables

Description	Specification	Quantity
Not applicable		

8.14.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

8.14.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Draining the Water from the Receiver Tank	00:15

8.14.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Environmental Instructions	Model specific Maintenance Manual

8.14.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

   > ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

7.

WARNING

Burn Hazard

Hot fluids or components can burn.

- ▶ Make sure that the fluids are at a safe working temperature when you service the machine.
- ▶ Do not touch hot fluids or components.

WARNING

High Pressure

High pressure can cause severe injury or death.

- ▶ Release all of the air pressure from the system before you remove the filler plug, drain valve, and fittings.

Open the ball valve on the receiver tank to release any stored air pressure.

NOTE: *The pressure gauge must read zero kPa (zero psig).*

8. Close the ball valve.

8.14.8 Draining the Water from the Receiver Tank

1. Find the receiver tank drain valve (Figure 1, item A) below the receiver tank.

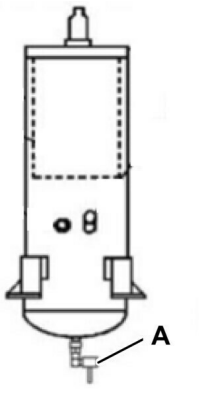


Figure 1

A	Drain valve		

2. **⚠ CAUTION**

   Environmental Contaminant

   Fluid is an environmental contaminant and must be discarded correctly.

   - ▶ Do not let the used fluid drain onto the ground.
   - ▶ Discard the used fluid in accordance with local environmental regulations.

   ! ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

   Put a container below the receiver tank to collect spilled fluid.

3. Remove the plug from the drain valve.
4. Open the drain valve slowly to drain the water that is in the receiver tank.
5. Close the drain valve immediately when the oil starts to flow.
6. Install the plug onto the drain valve.

8.14.9 After Completing the Task

1. **⚠ CAUTION**

   Environmental Contaminant

   Fluid is an environmental contaminant and must be discarded correctly.

   - ▶ Do not let the used fluid drain onto the ground.
   - ▶ Discard the used fluid in accordance with local environmental regulations.

   ! ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

   Remove the container and discard any fluid in accordance with local environmental regulations.

2. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

8.15 Do a Hydraulic Tank Oil Level Check

8.15.1 Labor Resource (People/Skills)

Service Technician x 1

8.15.2 Personal Protection Equipment

> ! ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

8.15.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ! ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Quick-fill connections	
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Hydraulic oil	As specified in Refill Capacities and Lubricants	As required

8.15.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

8.15.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing a Hydraulic Tank Oil Level Check	00:30

8.15.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)

Description	Reference
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Refill Capacities and Lubricants	Model specific Maintenance Manual

8.15.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Move the rotary head to the top of the mast.
3. **DANGER**

   Electrocution Hazard

   Operating near or contacting a power line with any part of the machine can cause electrocution, causing death.

   - ▶ Do not raise or lower the mast or operate the machine near electric power lines.
   - ▶ Keep at least 3 meters (10 feet) away from power lines.
   - ▶ If there appears any danger of wind or other obstruction decreasing the distance, do not drill in that area.

   Lower the mast to the horizontal position.

4. Retract all of the leveling jacks fully.
5. Put all of the controls in the OFF or neutral position.
6. Stop the machine.
7. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

   ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

8. Make sure that the machine is in a zero-energy state.
9. Put blocks at the tracks, as applicable.

8.15.8 Doing a Hydraulic Tank Oil Level Check

- Make sure that the oil level is near the maximum level that is indicated on the sight glass (Figure 1, item A).

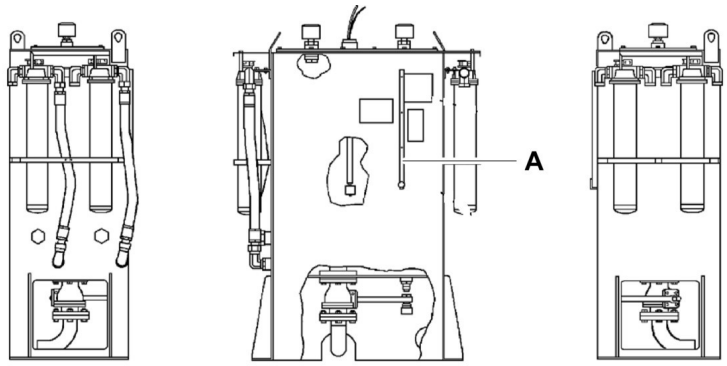


Figure 1

A	Sight glass		

8.15.9 Adding Oil to the Hydraulic Tank

1. Find the correct quick-fill fitting (Figure 2, item A) for the hydraulic oil in the quick-fill box

Figure 2

A	Quick-fill fitting		

2. Remove the cap from the quick-fill fitting and clean the fitting.
3. Connect the quick-fill hose to the quick-fill fitting.
4. Add oil to the hydraulic tank through the quick-fill fitting.

5. Make sure that the low hydraulic oil level icon and the operator alarm go out of view on the RCS screen when the float reaches the bottom of the sight glass (Figure 3).

Figure 3

6. **CAUTION**

Excessive Hydraulic Oil

Excessive hydraulic oil can rupture the hydraulic tank and cause injury or property damage.

- ▶ Do not fill the hydraulic tank with the hydraulic cylinders extended.
- ▶ Retract all of the cylinders and fill the tank to the indicated level.

Make sure that the hydraulic tank is not over filled.

7. Install the cap onto the quick-fill fitting.
8. Make sure that the main valve below the hydraulic tank is fully open.

8.15.10 After Completing the Task

1. Remove all tools and unwanted materials from the work area.
2. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

8.16 Do an Inspection of the Hydraulic Oil Filter Restriction Indicators

8.16.1 Labor Resource (People/Skills)

Service Technician x 1

8.16.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

8.16.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Not applicable		

8.16.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

8.16.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing an Inspection of the Restriction Indicators	00:15

8.16.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Change the Hydraulic Tank Oil Filter	Model specific Maintenance Manual

8.16.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Set the key switch power to on. Do not start the motor.
3. Switch on the RCS monitor.

8.16.8 Doing an Inspection of the Restriction Indicator

WARNING

Hot Fluids or Components

Hot fluids or components can burn.

- ▶ Make sure that the fluids are at a safe working temperature when servicing the machine.
- ▶ Do not touch hot fluids or components.

1. Do an inspection of each of the four filters on the hydraulic tank. If the filter restriction indicator is red, replace the filter element. If the filter restriction indicator is green, the filter does not need to be changed.

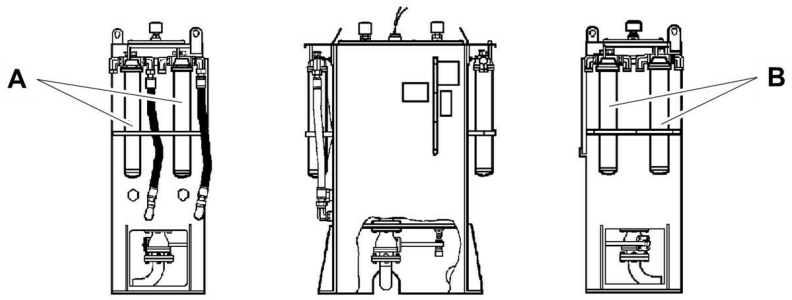


Figure 1

A	Drain filters	B	Return filters

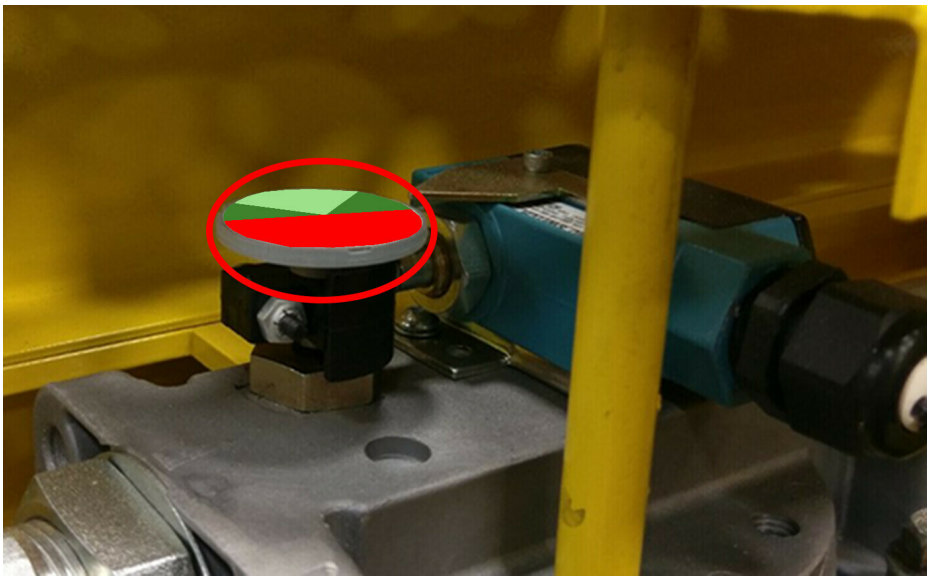


Figure 2

2. If the drain or return filters fault icon shows on the monitor screen (Figure 3), replace the filter element.

> **NOTE:** *Refer to Change the Hydraulic Oil Filters in 2,000-Hour Periodic Maintenance.*

Figure 3

A	Hydraulic drain filter #2	B	Hydraulic drain filter #1
C	Hydraulic return filter #1	D	Hydraulic return filter #2

8.17 Do an Inspection of the Rotary Head

8.17.1 Labor Resource (People/Skills)

Service Technician x 1

8.17.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

8.17.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Pressure washer	

Consumables

Description	Specification	Quantity
Not applicable		

8.17.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

8.17.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing an Inspection of the Rotary Head	00:30

8.17.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

8.17.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. **DANGER**

   Electrocution Hazard

   Operating near or contacting a power line with any part of the machine can cause electrocution, causing death.

   - Do not raise or lower the mast or operate the machine near electric power lines.
   - Keep at least 3 meters (10 feet) away from power lines.
   - If there appears any danger of wind or other obstruction decreasing the distance, do not drill in that area.

   Raise the mast to the vertical position and lock it in place.

3. **WARNING**

   Pinch Points

   Moving the rotary head can cause the pinch point hazard.

   - Do not put any part of yourself in the path of the rotary head when it is in motion.

   Move the rotary head to the bottom of the mast.

4. Put all of the controls in the OFF or neutral position.
5. Stop the machine.
6. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

7. Make sure that the machine is in a zero-energy state.
8. Put blocks at the tracks, as applicable.

8.17.8 Do an Inspection of the Rotary Head

⚠ WARNING

High Pressure

Can cause personal injury.

- ▶ Put on the applicable personnel protective clothing to protect eyes and uncovered parts of the body when using compressed air, water jets, or steam cleaning methods.
- ▶ Maximum air pressure at the nozzle must be less than 207 kPa (30 psig) for cleaning purposes.

1. Clean the area around the rotary head with a pressure washer to remove dirt and grease.
2. **⚠ WARNING**

   Burn Hazard

   Hot fluids or components can burn.

   - ▶ Make sure that the fluids are at a safe working temperature when you service the machine.
   - ▶ Do not touch hot fluids or components.

Do an oil leak check on the case and around the bottom of the rotary head motors, case, filter, drain valve, and hydraulic hoses.

Figure 1

3. Clean the outside of the case and around the bottom if there is oil leakage on the case. Make sure that the oil is from the case and not from another source.
4. Consult the maintenance personnel if a leak is found. Correct the leaks, as necessary.
5. Make sure that the oil level is at the middle of the sight glass. Add oil, if necessary.
6. Examine the fluid level sight glass for damage. Replace the glass, if necessary.
7. Examine the wear on the rotary head wear guide blocks. Replace the rotary head wear guide blocks, if necessary.

8.17.9 After Completing the Task

1. Remove all tools and unwanted materials from the work area.
2. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

8.18 Do a Rotary Head Oil Level Check

8.18.1 Labor Resource (People/Skills)

Service Technician x 1

8.18.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

8.18.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Gearbox oil	As specified in Refill Capacities and Lubricants	As required

8.18.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

8.18.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing a Rotary Head Oil Level Check	00:30

8.18.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Environmental Instructions	Model specific Maintenance Manual
Refill Capacities and Lubricants	Model specific Maintenance Manual

8.18.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. **DANGER**

   Electrocution Hazard

   Operating near or contacting a power line with any part of the machine can cause electrocution, causing death.

   - Do not raise or lower the mast or operate the machine near electric power lines.
   - Keep at least 3 meters (10 feet) away from power lines.
   - If there appears any danger of wind or other obstruction decreasing the distance, do not drill in that area.

   Raise the mast to the vertical position and lock it in place.

3. Remove all drill pipe from the rotary head.
4. Lower the rotary head to the bottom of the mast.
5. Put all of the controls in the OFF or neutral position.
6. Stop the machine.
7. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

8. Make sure that the machine is in a zero-energy state.
9. Put blocks at the tracks, as applicable.

8.18.8 Doing a Rotary Head Oil Level Check

⚠ WARNING

Risk of Falling

Can cause severe injury or death.

- ▶ Do not ride the rotary head.
- ▶ Do not climb on the raised mast.

⚠ WARNING

Falling Mast

Can cause severe injury or death.

- ▶ Make sure that all of the locking pins are in the locked position.

⚠ WARNING

Moving Shaft or Drill String

Can cause severe injury or death.

- ▶ Do not service the rotary head with the drill string in motion.

1. Do a leak check of the Rotary Head Assembly.

2. Examine the oil level sight glass (Figure 1, item B) for damage.

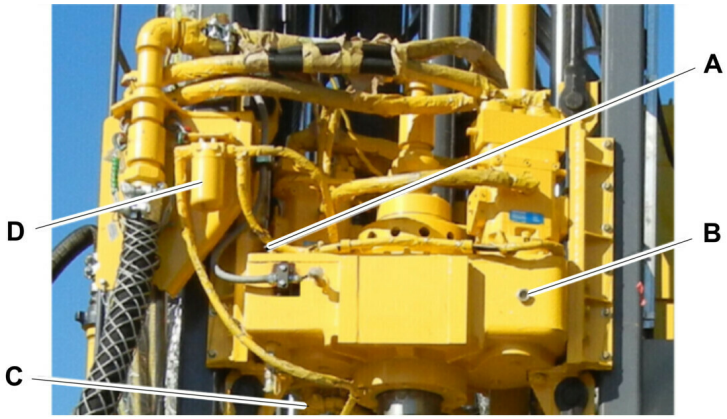


Figure 1

A	Fill plug	B	Oil level sight glass
C	Rotary head lubrication pump	D	Rotary head oil filter

3. Do a rotary head oil level check.

> ***NOTE:*** *The oil must be showing at the middle of the sight glass.*

4. **WARNING**

Burn Hazard

Hot fluids or components can burn.

- ▶ Do not touch hot fluids or components.

Add oil, if necessary:

a. Clean the area around the fill plug (item A).

b. **CAUTION**

Environmental Contaminant

Oil is an environmental contaminant and must be discarded correctly.

- ▶ Do not let the used oil drain onto the ground.
- ▶ Discard the used oil in accordance with local environmental regulations.

> ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

Put a container below the fill plug to collect the spilled oil.

c. Remove the fill plug.

d. Add gearbox oil through the fill port until the oil level is visible at the middle of the sight glass.

e. Clean the fill plug.

f. Install the fill plug onto the rotary head. Tighten the fill plug.

8.18.9 After Completing the Task

1. **CAUTION**

   Environmental Contaminant

   Oil is an environmental contaminant and must be discarded correctly.

   - ▶ Do not let the used oil drain onto the ground.
   - ▶ Discard the used oil in accordance with local environmental regulations.

> ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

Remove the container and discard the used oil in accordance with local environmental regulations.

2. Remove all tools and unwanted materials from the work area.
3. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

8.19 Lubricate the Gearbox Drive Shaft

8.19.1 Labor Resource (People/Skills)

Service Technician x 1

8.19.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

8.19.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
High-pressure grease gun	
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Grease	As specified in Refill Capacities and Lubricants	As required

8.19.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

8.19.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Lubricating the Gearbox Drive Shaft Universal Joints	00:15

8.19.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Environmental Instructions	Model specific Maintenance Manual
Refill Capacities and Lubricants	Model specific Maintenance Manual

8.19.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

   > ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.
7. Leave the guard in place.
8. Open the gearbox drive shaft cover doors.

8.19.8 Lubricating the Gearbox Drive Shaft Universal Joints

WARNING

Turning Shaft

Can cause severe injury or death.

- Do not operate the gearbox drive shaft with the guard removed.

1. Apply five shots of grease to the grease fittings (Figure 1, item A).

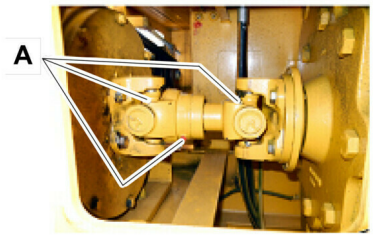


Figure 1

A	Grease fittings		

2. If the grease does not go into the fittings, remove and replace the grease fittings.
3. **CAUTION**

   Environmental Contaminant

   Grease is an environmental contaminant and must be discarded correctly.

   - Do not let the grease drain onto the ground.
   - Obey all local standards and regulations for discarding the grease.

> ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

Wipe away any excess grease after you grease all of the fittings. Discard the grease in accordance with local environmental regulations.

8.19.9 After Completing the Task

1. Clean the work area of all tools and unwanted material.

2. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

8.20 Do a Water Injection Pump Oil Level Check

8.20.1 Labor Resource (People/Skills)

Service Technician x 1

8.20.2 Personal Protection Equipment

> ! ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

8.20.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ! ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Container	19 L (5 gal)

Consumables

Description	Specification	Quantity
Pipe-thread sealant		As required
Non-detergent oil	As specified in Refill Capacities and Lubricants	As required

8.20.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

8.20.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing a Water Injection Pump Oil Level Check	00:30

8.20.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Environmental Instructions	Model specific Maintenance Manual
Refill Capacities and Lubricants	Model specific Maintenance Manual

8.20.7 Before Starting the Task

1. Park the machine on a dry level surface.

2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

8.20.8 Doing a Water Injection Pump Oil Level Check

1. Clean the area around the fill plug (Figure 1, item A) on the side of the water injection pump.

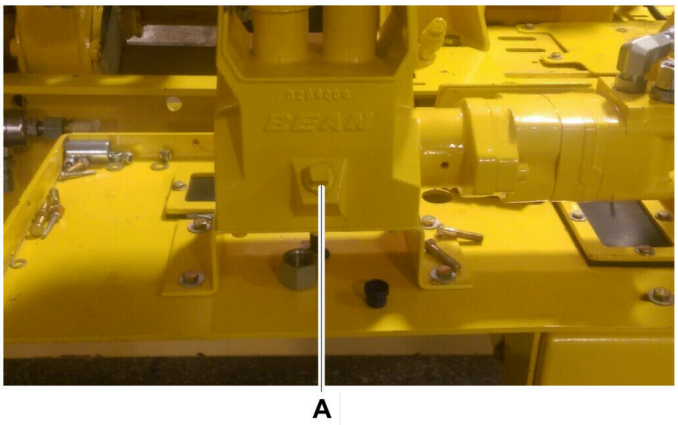


Figure 1

A	Fill plug		

2. Remove the fill plug.
3. Make sure that the oil level is at the bottom of the fill port in the water injection pump.
4. Add oil, if necessary:
   a. **⚠ CAUTION**

      Environmental Contaminant

      Oil is an environmental contaminant and must be discarded correctly.

      - ▶ Do not let the used oil drain onto the ground.
      - ▶ Discard the used oil in accordance with local environmental regulations.

> ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

Put a container below the fill plug to collect the spilled oil.

b. Add the specified oil through the fill port until the oil level reaches the bottom of the fill port in the water injection pump.

c. Clean the fill plug.

d. Apply pipe thread sealant to the fill plug.

e. Install the fill plug onto the water injection pump.

8.20.9 After Completing the Task

1. Clean the work area of all tools and unwanted material.

2. **CAUTION**

   Environmental Contaminant

   Oil is an environmental contaminant and must be discarded correctly.

   - ▶ Do not let the used oil drain onto the ground.
   - ▶ Discard the used oil in accordance with local environmental regulations.

> ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

Remove the containers from the work area and discard the used oil in accordance with local environmental regulations.

3. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

9 50-Hour Periodic Maintenance

9.1 Do a Pump Drive Gearbox Oil Level Check

9.1.1 Labor Resource (People/Skills)

Service Technician x 1

9.1.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

9.1.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Gearbox oil	As specified in Refill Capacities and Lubricants	As required

9.1.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

9.1.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing a Pump Drive Gearbox Oil Level Check	00:15

9.1.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Environmental Instructions	Model specific Maintenance Manual
Refill Capacities and Lubricants	Model specific Maintenance Manual

9.1.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.

4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

9.1.8 Doing a Pump Drive Gearbox Oil Level Check

WARNING

Burn Hazard

Hot fluids or components can burn.

- Make sure that the fluids are at a safe working temperature when you service the machine.
- Do not touch hot fluids or components.

1. Clean around the oil level dipstick (Figure 1, item B) and the breather-and-fill plug (item A).

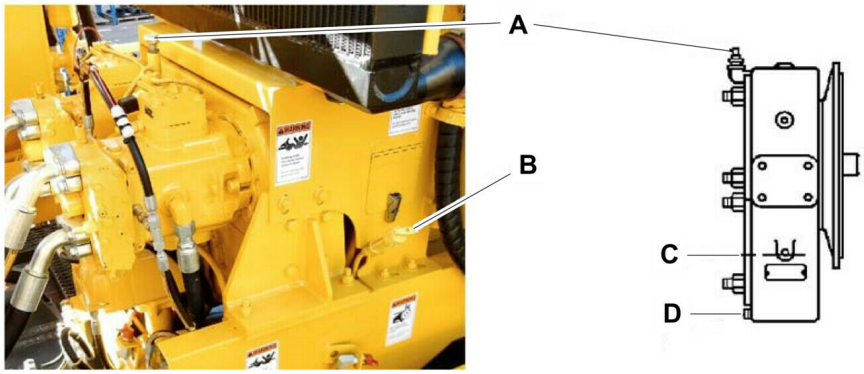


Figure 1

A	Breather-and-fill plug	B	Oil level dipstick
C	Oil level	D	Magnetic drain plug

2. Do an oil level check on the oil level dipstick (item B).

> ***NOTE:*** *The oil must be at the FULL mark on the oil level dipstick.*

3. **NOTICE**

Component Damage

Overfilling can cause poor performance or early component failure.

- ▶ Do not overfill the oil.
- ▶ Use the correct oil grade. Refer to Recommended Oils and Lubricants.

Add gearbox oil, if necessary.

a. **⚠ CAUTION**

Environmental Contaminant

Oil is an environmental contaminant and must be discarded correctly.

- ▶ Do not let the used oil drain onto the ground.
- ▶ Discard the used oil in accordance with local environmental regulations.

! ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

Put a container below the pump drive gear box to collect the spilled oil.

b. Fill the pump drive gearbox through the breather-and-fill port with the recommended oil to the correct level.

c. Remove the dipstick and do an oil level check.

! ***NOTE:*** *The oil must be at the FULL mark on the oil level dipstick.*

d. Clean the breather-and-fill plug.

e. Install the breather-and-fill plug onto the pump drive gearbox.

9.1.9 Examining the Gearbox Breather

1. Remove the gearbox breather.
2. Examine the gearbox breather for any blockage. Replace the breather, if damaged.

9.1.10 After Completing the Task

1. Clean the work area of all tools and unwanted material.
2. **CAUTION**

   Environmental Contaminant

   Oil is an environmental contaminant and must be discarded correctly.

   - ▶ Do not let the used oil drain onto the ground.
   - ▶ Discard the used oil in accordance with local environmental regulations.

   NOTE: *Refer to Environmental Instructions in the Maintenance manual.*

   Remove the containers from the work area and discard the used oil in accordance with local environmental regulations.
3. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

   NOTE: *Refer to Safety Locks and Tags Minimum Requirements.*

9.2 Do an Inspection of the Rotary Head Oil Filter

9.2.1 Labor Resource (People/Skills)

Service Technician x 1

9.2.2 Personal Protection Equipment

NOTE: *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

9.2.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Not applicable		

9.2.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

9.2.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing an Inspection of the Rotary Head Oil Filter	00:05

9.2.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

9.2.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. **DANGER**

   Electrocution Hazard

   Operating near or contacting a power line with any part of the machine can cause electrocution, causing death.

   - Do not raise or lower the mast or operate the machine near electric power lines.
   - Keep at least 3 meters (10 feet) away from power lines.
   - If there appears any danger of wind or other obstruction decreasing the distance, do not drill in that area.

   Raise the mast to the vertical position and lock it in place.
3. Remove the drill pipe and lower the rotary head to the bottom of the mast, as required.
4. Put all of the controls in the OFF or neutral position.
5. Stop the machine.
6. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

   ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

7. Make sure that the machine is in a zero-energy state.
8. Put blocks at the tracks, as applicable.

9.2.8 Doing an Inspection of the Rotary Head Oil Filter

- Do an inspection of the rotary head oil filter (Figure 1, item A). Make sure that the filter is installed tightly.

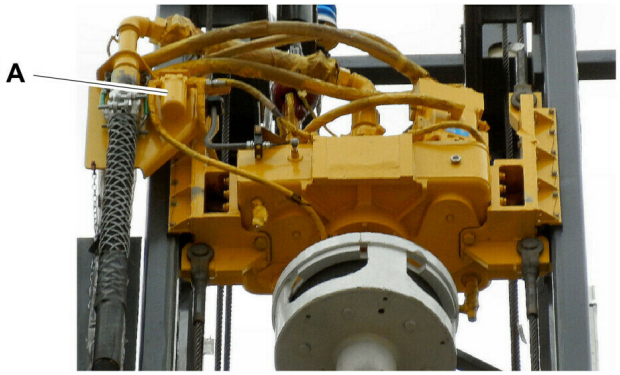


Figure 1

A	Rotary head oil filter		

9.2.9 After Completing the Task

- Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

!	***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

10 250-Hour Periodic Maintenance

10.1 Do an Inspection of the Battery

10.1.1 Labor Resource (People/Skills)

Service Technician x 1

10.1.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

10.1.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Clean water		As required
Baking soda or ammonia		As required
Insulating varnish		As required
5N-5561 silicone lubricant, petroleum jelly, or MPGM		As required

10.1.4 Spare Parts

! ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

10.1.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing an Inspection of the Battery	00:30

10.1.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Maintenance Schedule	Model specific Maintenance Manual
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

10.1.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.
7. Disconnect the battery cables when you work on the electrical system. Disconnect the ground wire first when you disconnect the batteries.

10.1.8 Doing an Inspection of the Electrolyte Level

⚠ WARNING

Acidic Batteries

Acid in batteries can cause injury. Battery acid burns skin, creates holes in clothing, and causes blindness if splashed into the eyes.

- ▶ Avoid skin and eye contact with battery acid.
- ▶ If skin or eye contact occurs, flush the area immediately with water.

⚠ WARNING

Battery Fumes

Can ignite and explode.

- ▶ Do not smoke when you observe the battery fluid level.

NOTICE

Component Damage

Overfilling can cause poor performance or early component failure.

- ▶ Do not overfill.

1. Do an inspection of the electrolyte level and keep the electrolyte level above the plates.
2. Refill with distilled water to the FULL mark on the battery, as necessary.

> ***NOTE:*** *If distilled water is not available, use clean water that is low in minerals. Do not use artificially softened water.*

10.1.9 Cleaning the Battery Terminals

1. Keep the battery (Figure 1, item A) terminals clean and the connections tight.

> ***NOTE:*** *Cleaning must occur only when light corrosion is present. Always replace the components with heavy corrosion or damage.*

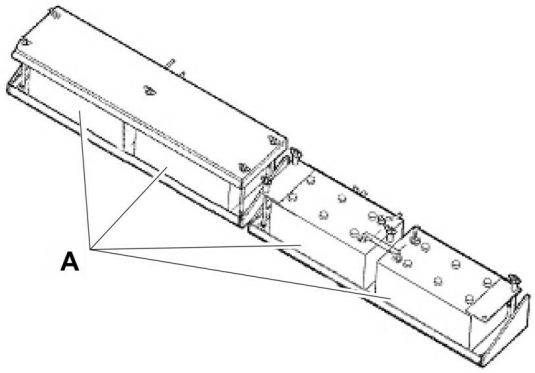


Figure 1

A	Batteries		

2. Clean the battery case with a mixture of 0.1 kilogram (0.2 pound) of baking soda and 1 liter (1 quart) of clean water.
3. Rinse the battery case thoroughly with clean water.
4. Apply a layer of either of the following to the clamps and the terminals:
   - Insulating varnish
   - Silicone lubricant, petroleum jelly, or MPGM

10.1.10 After Completing the Task

1. Connect the battery cables to the battery terminals. Connect the positive cable first, and the ground cable last.
2. Remove all tools and unwanted materials from the work area.

3. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

10.2 Do an Inspection of the Pump Drive Gearbox

10.2.1 Labor Resource (People/Skills)

Service Technician x 1

10.2.2 Personal Protection Equipment

> ! ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

10.2.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ! ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Not applicable		

10.2.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

10.2.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing an Inspection of the Pump Drive Gearbox	00:30

10.2.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

10.2.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.

4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

10.2.8 Doing an Inspection of the Pump Drive Gearbox

1. Look for signs of oil on the pump drive gearbox and around the bottom of the pump drive gearbox.
2. If there are signs of oil leakage, clean the outside of the pump drive gearbox and around the bottom. Make sure that the oil is from the pump drive gearbox and not from another source.
3. If a leak is verified, contact the maintenance personnel and take the corrective action.

10.2.9 After Completing the Task

- Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

10.3 Do an Inspection of the Track Final Drive

10.3.1 Labor Resource (People/Skills)

Service Technician x 1

10.3.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

10.3.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Torque wrench, calibrated	Capacity up to 637 N·m (470 ft·lb)
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Not applicable		

10.3.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

10.3.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing an Inspection of the Track Final Drive	01:00

10.3.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Do a Track Final Drive Oil Level Check	Model specific Maintenance Manual

10.3.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

   > ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

10.3.8 Doing an Inspection of the Track Final Drive

WARNING

Burn Hazard

Hot fluids or components can burn.

- Make sure that the fluids are at a safe working temperature when you service the machine.
- Do not touch hot fluids or components.

1. Use a gun thermometer to examine the temperature of the final drive.

> ***NOTE:*** *The temperature must not exceed an ambient temperature of +80 °C (+175 °F).*

2. Examine the track final drive for leaks around the plugs (Figure 1, item A) and the seals (item B). Replace any leaking plugs that are found.

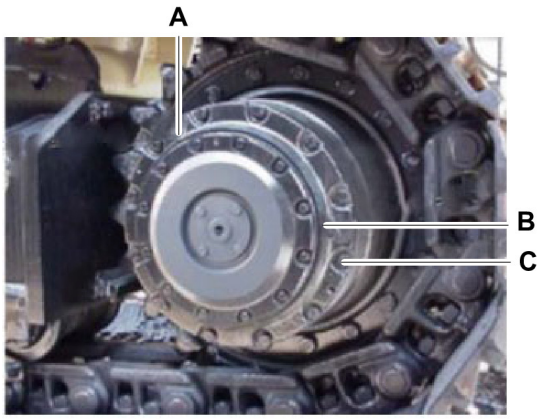


Figure 1

A	Plug	B	Seal
C	Mounting cap screws		

3. Do an inspection of the track final drive mounting cap screws for correct torque (item C). The torque must be between 501 to 637 Newton meters (370 to 470 foot-pounds) dry.

> ***NOTE:*** *Mounting cap screws that are out of torque tolerance must be replaced due to over-torque or wear.*

4. Do an oil level check in the track final drive housing. Add oil, if necessary.

> ! ***NOTE:*** *Refer to Do a Track Final Drive Oil Level Check in 250-Hour Maintenance.*

10.3.9 After Completing the Task

1. Remove all tools and unwanted material from the work area.
2. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

10.4 Do a Track Final Drive Oil Level Check

10.4.1 Labor Resource (People/Skills)

Service Technician x 1

10.4.2 Personal Protection Equipment

> ! ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

10.4.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ! ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Container	19 L (5 gal)

Consumables

Description	Specification	Quantity
Gearbox oil	As specified in Refill Capacities and Lubricants	As required

10.4.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

10.4.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing a Track Final Drive Oil Level Check	00:15

10.4.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Environmental Instructions	Model specific Maintenance Manual
Refill Capacities and Lubricants	Model specific Maintenance Manual

10.4.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Make the machine level.
3. Position the track final drive with one port at the 3 o'clock position (Figure 1, item B) and one port at the 12 o'clock position (item A).

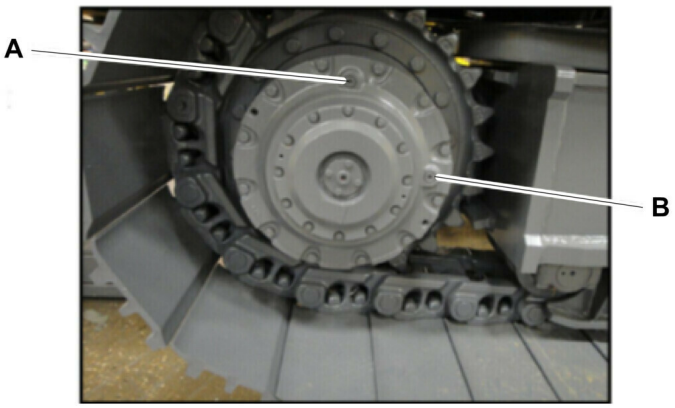


Figure 1

A	Port at 12 o'clock position	B	Port at 3 o'clock position

4. Put all of the controls in the OFF or neutral position.
5. Stop the machine.
6. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

7. Make sure that the machine is in a zero-energy state.
8. Put blocks at the tracks, as applicable.

9.

⚠ WARNING

Burn Hazard

Hot fluids or components can burn.

- ▶ Make sure that the fluids are at a safe working temperature when you service the machine.
- ▶ Do not touch hot fluids or components.

Make sure that the final drive housings are not too hot to touch. If they are hot, let them cool before you begin work.

10.4.8 Doing a Track Final Drive Oil Level Check

1.

⚠ CAUTION

Environmental Contaminant

Oil is an environmental contaminant and must be discarded correctly.

- ▶ Do not let the used oil drain onto the ground.
- ▶ Discard the used oil in accordance with local environmental regulations.

! ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

Put a container below the final drive to collect the spilled oil.

2. Clean around the full plug (Figure 2, item B) and then remove it.

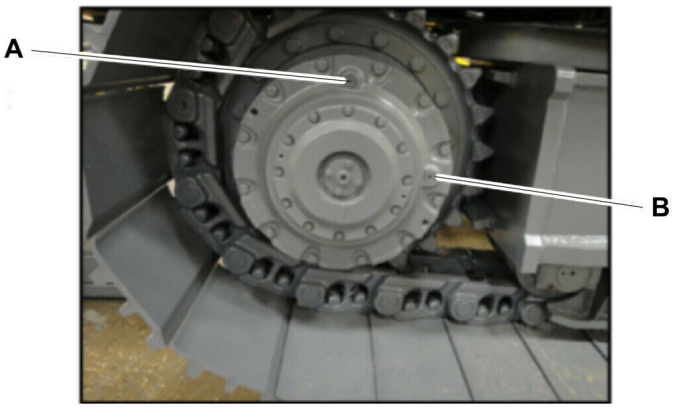


Figure 2

A	Fill plug	B	Full plug

3. Make sure that the final drive oil level is at the bottom of the full port.
4. If the final drive gearboxes need oil, do the following steps:

> ***NOTE:*** *For Caterpillar® tracks, refer to the OEM manual for track final drive gearbox lubrication procedures.*

a.

NOTICE

Component Damage

Overfilling the track final drive can damage the track final drive components.

- ▶ Do not overfill the track final drive.

Add the specified oil through the top (fill) port (item A) until the oil reaches the bottom of the full port (item B).

b. Clean the ports and the plug threads. Replace the plugs.

c. Repeat this procedure for the other final drive.

10.4.9 After Completing the Task

1. Clean the work area of tools and unwanted material.

2. **⚠ CAUTION**

   Environmental Contaminant

   Oil is an environmental contaminant and must be discarded correctly.

   - ▶ Do not let the used oil drain onto the ground.
   - ▶ Discard the used oil in accordance with local environmental regulations.

   ! ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

   Remove the container from below the final drive and discard the used oil in accordance with local environmental regulations.

3. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

   ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

10.5 Do an Inspection of the Track Tension

10.5.1 Labor Resource (People/Skills)

Service Technician x 1

10.5.2 Personal Protection Equipment

! ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

10.5.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Straight edge	2 m (5 ft)
High-pressure grease gun	
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Grease	As specified in Refill Capacities and Lubricants	As required

10.5.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

10.5.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing an Inspection of the Track Tension	02:00

10.5.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Refill Capacities and Lubricants	Model specific Maintenance Manual

10.5.7 Before Starting the Task

- Park the machine on a dry level surface.

10.5.8 Measuring the Track Tension

1. Propel one side of the undercarriage, either cab side or non-cab side, slowly in the direction of the idlers (Figure 1, item D).
2. Stop the machine.
3. Attach safety locks and tags to the machine in accordance with the site-specific procedures or refer to Safety Locks and Tags Minimum Requirements.

4. Stop with one track pin (Figure 1, item A) directly over the front carrier roller (item E).

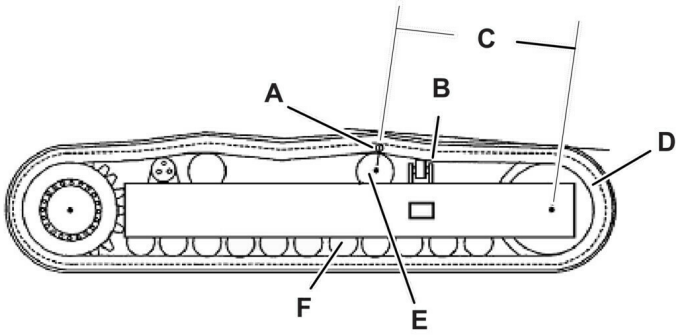


Figure 1

A	Track pin	B	Sag halfway between carrier roller and idler
C	Distance from carrier roller to top of idler	D	Idler
E	Carrier roller	F	Track rollers

> ***NOTE:*** *A sag must be present in the chain. On a length of 1 to 1.5 meters (39.4 to 59 inches), the sag must be 2 to 3 centimeters (0.79 to 1.18 inches). The correct sag (distance from the bottom of the straight edge to the top of the track shoe) is 3 to 4 percent of the distance between the top of the idler and the carrier roller.*

5. Put a straight edge (Figure 2, item A) on top of the shoe grousers between the front carrier roller (item B) and the idler (item E).

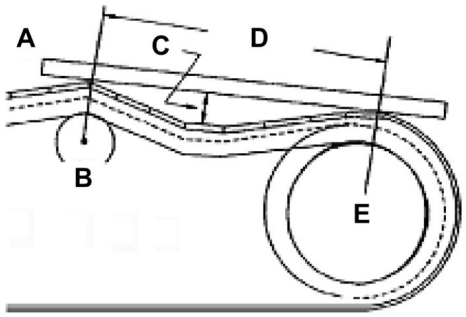


Figure 2

A	Straight edge	B	Front carrier roller
C	Sag halfway between carrier roller and idler	D	Distance from carrier roller to top of idler
E	Idler		

6. Measure the sag halfway between the carrier roller and the idler (item C).

7. Adjust the track when the sag exceeds the following:
   a. CAT tracks: Adjust the idler tension for a sag of 25 to 38 millimeters (1 to 1.5 inches).
   b. AC tracks: Adjust the idler tension for a sag of 22 to 38 millimeters (1 to 1.5 inches).

10.5.9 Adjusting the Track Tension

WARNING

Stored Energy

Track components have the presence of stored energy. This stored energy can cause severe injury or death.

- Read and obey the safety decals and the Safety manual.

NOTE: *If the track is too loose, the track must be tightened by adding grease to the track adjuster. If the track is too tight, grease must be removed from the track adjuster.*

1. Clean the single grease fitting (Figure 3, item A).

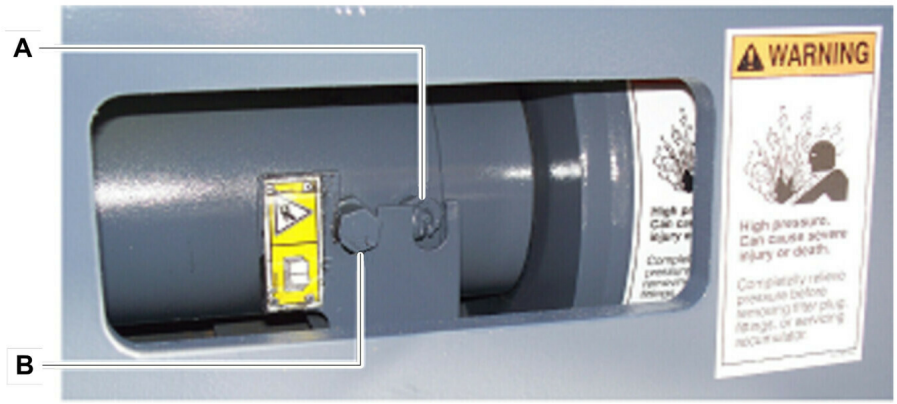


Figure 3

A	Grease fitting or port	B	Cover plug

2. Inject grease with a high-pressure grease gun until the required track tension is obtained.

3. **WARNING**

   High Pressure

   Can cause severe injury or death.

   ▶ Release all of the air pressure from the track before opening the drain valve.

   To reduce track tension, slightly loosen the cover plug (item B). The internal buffer spring relaxes and the grease is ejected.

4. To readjust, secure the cover plug and inject the grease in the grease port until the correct track tension is achieved.
5. Repeat the same procedure for the other track.

10.5.10 After Completing the Task

1. Clean the work area and remove all tools and unwanted materials.
2. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

   ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

10.6 Do an Inspection of the Hoist

Refer to Do an Inspection of the Hoist in 100-Hour Initial Maintenance.

10.7 Do an Inspection of the Cooler

10.7.1 Labor Resource (People/Skills)

Service Technician x 1

10.7.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

10.7.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Refractometer	
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Not applicable		

10.7.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

10.7.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing an Inspection of the Cooler	00:30

10.7.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

10.7.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

   > ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

10.7.8 Doing an Inspection of the Cooler

WARNING

Hot Fluids or Components

Hot fluids or components can burn.

- ▶ Make sure that the fluids are at a safe working temperature when you service the machine.
- ▶ Do not touch hot fluids or components.

1. Look for signs of coolant below the cooler and around the piping on the cooler and the engine. If a leak is found, contact the maintenance personnel and do the corrective action (Figure 1).

Figure 1

2. Examine the cooler cores for cracks or damage. Replace the cooler cores, if crack or damage is found.
3. Examine the cooler sight glass (Figure 2, item A) for damage. Replace the sight glass, if necessary.

Figure 2

A	Sight glass		

4. Make sure that the coolant level is at the middle of the sight glass. Fill with coolant, as needed.

5. Do a concentration check of the cooler with a refractometer (Figure 3). Replace the coolant if the concentration is lower than the engine manufacturer's specification.

Figure 3

6. Examine the cooler guards for loose cap screws or damage. Do the needed corrections.

10.7.9 After Completing the Task

1. Clean the work area of all tools and unwanted material.
2. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

10.8 Clean the Radiator and Oil Cooler

10.8.1 Labor Resource (People/Skills)

Service Technician x 1

10.8.2 Personal Protection Equipment

> ! ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

10.8.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Commercial cleaning detergent		As required

10.8.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

10.8.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Cleaning the Radiator and Oil Cooler	01:00

10.8.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

10.8.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.
7. Examine the radiator for damaged fins, corrosion, dirt, grease, insects, leaves, oil, and other unwanted material.

10.8.8 Cleaning the Radiator and Oil Cooler with Pressurized Air

⚠ WARNING

High Pressure

High-pressure cleaning with compressed air, water jets, or steam cleaning methods can cause personal injury.

- ▶ Put on applicable personnel protective clothing to protect eyes and uncovered parts of the body.
- ▶ Maximum air pressure at the nozzle must be less than 207 kPa (30 psi) for cleaning purposes.

! ***NOTE:*** *Adjust the cleaning frequency in accordance to the effects of the operating environment.*

! ***NOTE:*** *Hold the nozzle approximately 6 millimeters (0.25 inch) away from the fins.*

! ***NOTE:*** *If clogging is dried-on dirt, use liquid or dry air to remove from the cooling fins. If dry dust is present, use low-pressure compressed air to clean.*

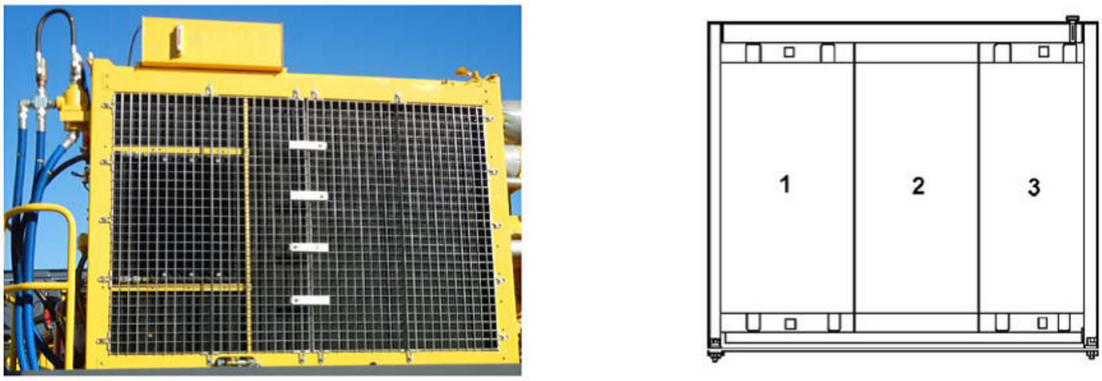


Figure 1

1. Direct the air in the opposite direction of the fan's air flow.
2. Move the air nozzle slowly in a direction that is parallel with the tubes. This action removes unwanted material between the tubes.

10.8.9 Cleaning the Radiator and Oil Cooler with Degreaser and Steam

⚠ WARNING

High Pressure

High-pressure cleaning with compressed air, water jets, or steam cleaning methods can cause personal injury.

- ▶ Put on applicable personnel protective clothing to protect eyes and uncovered parts of the body.
- ▶ Maximum air pressure at the nozzle must be less than 207 kPa (30 psi) for cleaning purposes.

! ***NOTE:*** *Clean both sides of the core.*

1. Wash the core with detergent and hot water.
2. Rinse the core thoroughly with clean water.

10.8.10 Cleaning the Radiator and Oil Cooler with a Water Jet

WARNING

High Pressure

High-pressure cleaning with compressed air, water jets, or steam cleaning methods can cause personal injury.

- ▶ Put on applicable personnel protective clothing to protect eyes and uncovered parts of the body.
- ▶ Maximum air pressure at the nozzle must be less than 207 kPa (30 psi) for cleaning purposes.

1. Use a commercial cleaning detergent when fluid leaks cause severe clogging.
2. Let the cleaning detergent soak in.
3. Wash off the cleaning detergent with a water jet.

10.8.11 After Completing the Task

1. Clean the work area of all tools and unwanted material.
2. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

NOTE: *Refer to Safety Locks and Tags Minimum Requirements.*

10.9 Do an Inspection of the Undercarriage

10.9.1 Labor Resource (People/Skills)

Service Technician x 1

10.9.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with hard toes
- Safety devices

10.9.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Torque wrench, calibrated	Capacity up to 915 N·m (675 ft·lb)
Tags	As required

Support Equipment

Description	Specification
Steam or pressure washer	As required

Consumables

Description	Specification	Quantity
Not applicable		

10.9.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

10.9.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing an Inspection of the Undercarriage	02:00

10.9.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

10.9.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Raise the machine on the jacks to get access to the inboard sides of the undercarriage.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

   > ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

7. **WARNING**

High Pressure

Can cause personal injury.

- Put on the applicable personnel protective clothing to protect eyes and uncovered parts of the body when using compressed air, water jets, or steam cleaning methods.
- Maximum air pressure at the nozzle must be less than 207 kPa (30 psig) for cleaning purposes.

Clean all of the undercarriage components with a steam or pressure washer.

10.9.8 Doing an Inspection of the Undercarriage

WARNING

Burn Hazard

Hot fluids or components can burn.

- Make sure that the fluids are at a safe working temperature when you service the machine.
- Do not touch hot fluids or components.

1. Examine the track segments and the final drive sprocket for excessive wear or loose cap screws.
2. Do a torque check of the track sprocket cap screws. The torque must be between 712 to 915 Newton meters (525 to 675 foot-pounds) dry.
3. Do a leak check of the final drive.
4. Examine the final drive for loose cap screws.
5. Do a leak check of the plugs and the seals.
6. Do a torque check of the final drive mounting cap screws. The torque must be between 712 to 915 Newton meters (525 to 675 foot-pounds) dry.
7. Do a leak check of all of the rollers and cap screws. Examine them for wear or missing cap screws.
8. Do a torque check of the rollers mounting cap screws. The torque must be between 712 to 915 Newton meters (525 to 675 foot-pounds) dry.
9. Do a torque check of the track shoes. The torque must be between 434 to 569 Newton meters (320 to 420 foot-pounds) dry.

10. Examine the track shoes for excessive wear or damage. Replace the track shoes, as needed.
11. Examine the track rollers guide plate for damage.

10.9.9 After Completing the Task

1. Remove all tools and unwanted material from the work area.
2. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

10.10 Do an Inspection of the Cab

10.10.1 Labor Resource (People/Skills)

Service Technician x 1

10.10.2 Personal Protection Equipment

> ! ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Eyes - Safety glasses
- Nose and mouth - Dust mask
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

10.10.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ! ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Compressed air source	

Consumables

Description	Specification	Quantity
Not applicable		

10.10.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

10.10.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing an Inspection of the Cab	00:30

10.10.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

10.10.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

10.10.8 Doing an Inspection of the Cab

⚠ WARNING

Dust Inhalation

Can produce toxic effects and cause serious damage to lungs.

- ▶ Use a dust mask when cleaning the cab with compressed air.

⚠ WARNING

High Pressure

High-pressure cleaning with compressed air, water jets, or steam cleaning methods can cause personal injury.

- ▶ Put on applicable personnel protective clothing to protect eyes and uncovered parts of the body.
- ▶ Maximum air pressure at the nozzle must be less than 207 kPa (30 psi) for cleaning purposes.

1. Clean the cab interior and blow out the dust buildup.

2. Do a function check of the cab switches, RCS screen, seat, glass, interior/exterior lamps, and any other optional components in the cab (Figures 1 and 2). Replace them if necessary.

Figure 1

Figure 2

3. Do the following steps to examine the cab wipers assembly:
   a. Do a function check of the wiper motors. Replace the motors if necessary.
   b. Examine the wiper blades for excessive wear or damage. Replace the wiper blades if necessary.
   c. Examine the wiper arms for damage or incorrect movement. Replace the wiper arms if necessary.
   d. Make sure that the window cleaning fluid container is full. Add window cleaning fluid if necessary.
   e. Do a function check of the wiper sprayer nozzles. Clean the nozzles so that they can effectively spray on the glass.
4. Do a function check of the HVAC system. Repair the HVAC system if necessary.

5. Do a function check of the cab doors:
   a. Make sure that the cab doors open and close smoothly and securely. Repair the doors if necessary.
   b. Make sure that the cab doors seal is tight when closed to keep out excessive noise and dirt.
   c. Examine the weather stripping for damage. Replace the weather stripping if necessary.
   d. Make sure that the cab door locks are in proper working condition. Replace the locks if necessary.
6. Examine the RCS controls decals for damage (Figure 3). Replace the housing if necessary.

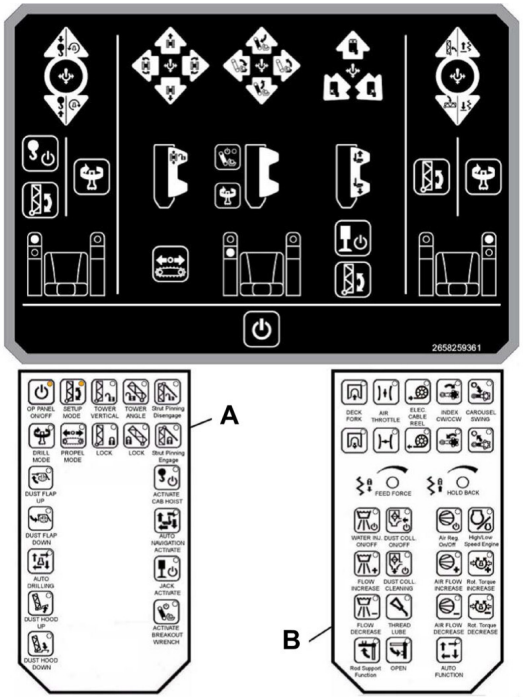


Figure 3

A,B	RCS control decals		

7. Examine the circuit breaker panel for any missing or damaged components (Figure 4). Replace it if necessary.

Figure 4

8. Examine the interior insulation for damage. Repair the insulation if necessary.
9. Examine the exterior cab metal for damage. Repair it if necessary.

10.10.9 After Completing the Task

1. Remove all tools and unwanted materials from the work area.
2. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

10.11 Do an Inspection of the Starter Motor Cables and Connections

10.11.1 Labor Resource (People/Skills)

Service Technician x 1

10.11.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

10.11.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Compressed air source	

Consumables

Description	Specification	Quantity
Insulating varnish spray		As required

10.11.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

10.11.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing an Inspection of the Starter Motor Connections	00:30

10.11.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

10.11.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

   > ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

10.11.8 Doing an Inspection of the Starter Motor Connections

WARNING

Burn Hazard

Hot fluids or components can burn.

- ▶ Do not touch hot fluids or components.

1. Examine the starter motor cables and connections for any corrosion or damage. Do the needed corrections.
2. Make sure that the starter cables are secure and tight. Do the needed corrections.
3. Spray the starter motor connection cables with an insulating varnish.

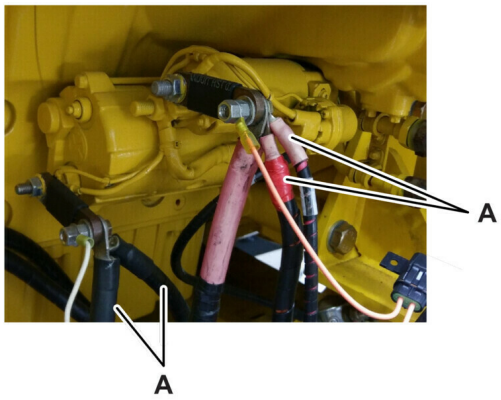


Figure 1

10.11.9 After Completing the Task

1. Remove all tools and unwanted material from the work area.
2. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

NOTE: *Refer to Safety Locks and Tags Minimum Requirements.*

10.12 Change the Engine Oil and Filter

10.12.1 Labor Resource (People/Skills)

Service Technician x 1

10.12.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

10.12.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Filter wrench	
Tags	As required

Support Equipment

Description	Specification
Container	76 L (20 gal)
Drain hose	

Consumables

Description	Specification	Quantity
Engine oil	Refer to OEM manual	As required

10.12.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Oil filter		2

10.12.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Changing the Engine Oil and Filter	02:00

10.12.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Environmental Instructions	Model specific Maintenance Manual

10.12.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

10.12.8 Removing the Engine Oil and Filter

! *NOTE: Use this procedure when draining the engine oil using the Central Drain Point System. When draining the oil without using the Central Drain Point System, refer to the engine manufacturer Operation and Maintenance manual.*

1. **⚠ CAUTION**

   Environmental Contaminant

   Oil is an environmental contaminant and must be discarded correctly.

   - ▶ Do not let the used oil drain onto the ground.
   - ▶ Discard the used oil in accordance with local environmental regulations.

   ! *NOTE: Refer to Environmental Instructions in the Maintenance manual.*

   Put a container below the engine oil central drain point on the cab side, non-drill end.

2. Connect a drain hose to the central drain point fitting (Figure 1, item A).

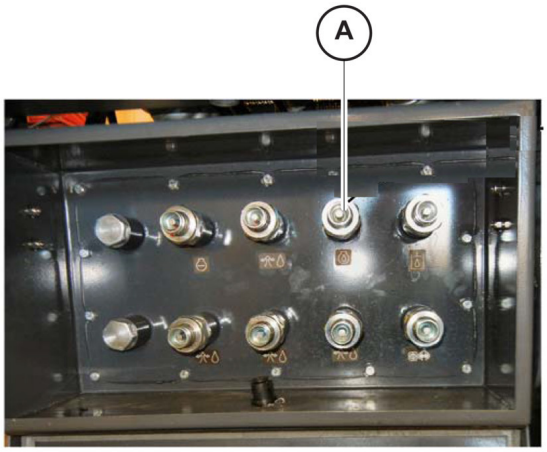


Figure 1

A	Central drain point fitting		

3. Let the engine oil drain completely into the container.

4. Disconnect the drain hose when the oil is fully drained.
5. Remove the container below the engine oil central drain point.
6. Remove the engine oil filters (Figure 2, item A) from the mounting base on the engine.

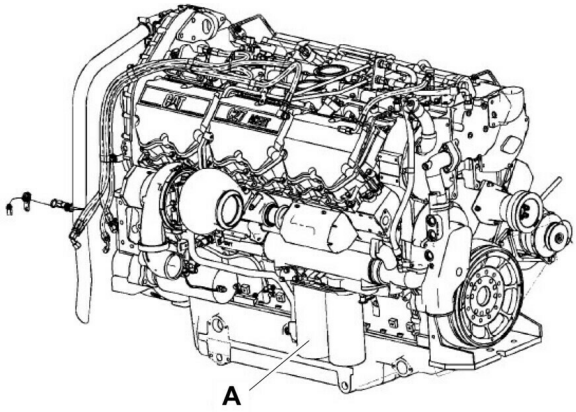


Figure 2

A	Engine oil filters		

10.12.9 Filling the Engine Oil and Replacing the Filter

1. Install the engine oil filters onto the mounting base. Tighten them by hand.
2. Remove the cap on the engine oil quick-fill and wipe the connection to clean it. Wipe the quick-fill hose connection (Figure 3, item A) to clean it and install the quick-fill hose.

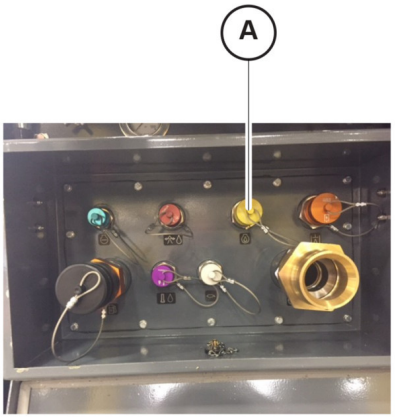


Figure 3

A	Quick-fill hose connection		

3. Fill to the FULL mark on the engine oil dipstick. After filling, remove the quick-fill hose from the connection port.

4. **WARNING**

   Moving Parts

   Can cause severe injury or death.

   - Make sure that no one is at danger or risk before you start or set the machine in motion.
   - Crew members must not put any part of their bodies or clothing on or near any energized machinery, gears, pinions, ropes, cables, chains, or wrenches.

   Inform the supervisor, lead hand, and all other persons concerned of the intent to restart the machine for testing purposes.

   NOTE: *Make sure that all personnel and bystanders are clear of the machine before start-up.*

5. Remove the safety locks and tags from the machine in accordance with the site-specific procedures or refer to Safety Locks and Tags Minimum Requirements.
6. Start the machine and operate the engine at idle speed.
7. Stop the machine.
8. Attach safety locks and tags to the machine in accordance with the site-specific procedures or refer to Safety Locks and Tags Minimum Requirements.
9. Do an engine oil level check.

10. Add oil as needed through the quick-fill port or through the engine fill port (Figure 4, item A).

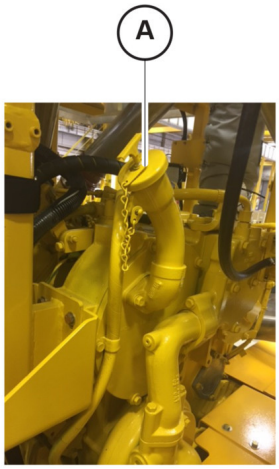


Figure 4

A	Engine fill port		

11. Fill to the FULL mark on the engine oil dipstick.
12. Examine the crankcase breather for blockage and clean as necessary.

10.12.10 After Completing the Task

1. **CAUTION**

Environmental Contaminant

Oil is an environmental contaminant and must be discarded correctly.

- ▶ Do not let the used oil drain onto the ground.
- ▶ Discard the used oil in accordance with local environmental regulations.

NOTE: *Refer to Environmental Instructions in the Maintenance manual.*

Remove the container and discard the used oil in accordance with local environmental regulations.

2. Clean the work area of tools and unwanted material.

3. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

10.13 Lubricate the Pulldown Cable Jackscrews

10.13.1 Labor Resource (People/Skills)

Service Technician x 1

10.13.2 Personal Protection Equipment

> ! ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

10.13.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ! ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
High-pressure grease gun	
Tags	As required

Support Equipment

Description	Specification
Compressed air source	

Consumables

Description	Specification	Quantity
Grease	As specified in Refill Capacities and Lubricants	As required

10.13.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

10.13.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Lubricating the Pulldown Cable Jackscrews	00:30

10.13.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

Description	Reference
Environmental Instructions	Model specific Maintenance Manual
Refill Capacities and Lubricants	Model specific Maintenance Manual

10.13.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. **DANGER**

   Electrocution Hazard

   Operating near or contacting a power line with any part of the machine can cause electrocution, causing death.

   - ▶ Do not raise or lower the mast or operate the machine near electric power lines.
   - ▶ Keep at least 3 meters (10 feet) away from power lines.
   - ▶ If there appears any danger of wind or other obstruction decreasing the distance, do not drill in that area.

   Lower the mast to the horizontal position onto the mast rest.

3. Put all of the controls in the OFF or neutral position.
4. Stop the machine.
5. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

   ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

6. Make sure that the machine is in a zero-energy state.
7. Put blocks at the tracks, as applicable.

10.13.8 Lubricating the Pulldown Cable Jackscrews

CAUTION

Component and Environmental Damage

Overfilling the grease tank damages the grease tank equipment and causes the grease to vent onto the ground.

- ▶ Do not overfill the grease tank.
- ▶ Do not let the grease fall onto the ground.

! ***NOTE:*** *The jackscrews must not be operated unlubricated. They are lubricated before leaving the factory with approximately 0.5 kilograms (17 ounces) of grease, and must be lubricated every 250 operation hours.*

- ○ Add ten shots (100 grams, 3.5 ounces) of grease to each lubrication point (Figure 1, item A) on the auto tensioner motor with a grease gun.

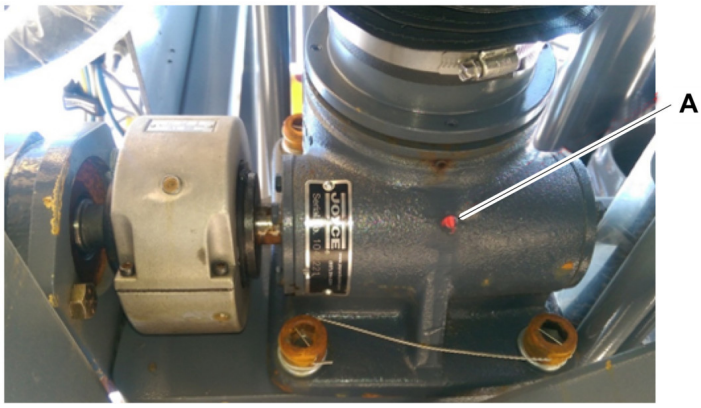


Figure 1

A	Lubrication point		

10.13.9 After Completing the Task

1. Clean the work area of all grease and tools.

2. **⚠ CAUTION**

   Environmental Contaminant

   Grease is an environmental contaminant and must be discarded correctly.

   ▶ Do not let the grease drain onto the ground.

   ▶ Obey all local standards and regulations for discarding the grease.

   ! ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

   Discard the grease in accordance with local environmental regulations.

3. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

   ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

10.14 Change the Fuel-Water Separator Filter

10.14.1 Labor Resource (People/Skills)

Service Technician x 1

10.14.2 Personal Protection Equipment

! ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

10.14.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Clean diesel fuel		As required

10.14.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Fuel/water separator filter		
Gasket		
O-rings		

10.14.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Changing the Fuel-Water Separator Filter	00:30

10.14.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

10.14.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

   ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

10.14.8 Removing the Fuel-Water Separator Filter

! ***NOTE:*** *Some machines have a fuel filter and some have fuel filter heaters. Change the filter for both the fuel filter and the fuel filter heaters, if applicable.*

1. Turn the T-handle (Figure 1, item A) counterclockwise and remove the lid.

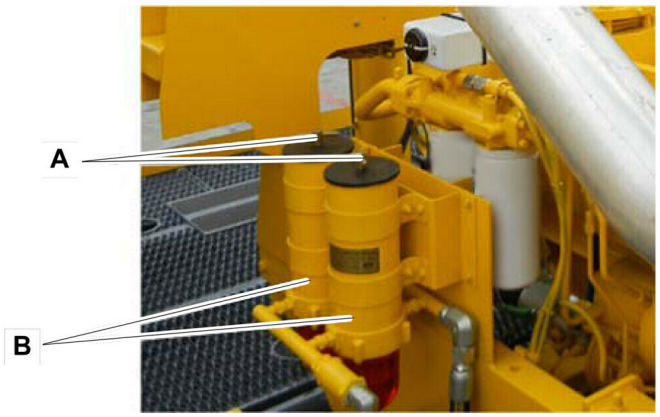


Figure 1

A	T-handles	B	Fuel/water separator filters

2. Hold the bail handles and pull the filter (item B) upward slowly with a twisting motion. Discard the filter correctly.

10.14.9 Installing the Fuel-Water Separator Filter

1. Replace the old lid gasket and T-handle O-ring with new seals (supplied with the new filter). Lubricate both the seals with clean diesel fuel before installation.
2. **WARNING**

   Flammable Liquid

   Fuel is flammable and can cause serious injury or death.

   - ▶ Stop the engine and extinguish all open flames.
   - ▶ Wipe the spilled fuel immediately.
   - ▶ Do not smoke when you drain or fill the tank.

   Fill the filter with clean fuel, then replace the lid and T-handle and tighten the handle snugly by hand. Do not use tools.

10.14.10 After Completing the Task

1. Clean the work area and discard the waste in accordance with local environmental regulations.

2. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

10.15 Do a Visual Inspection of the Trunnion Block Cap Screws

10.15.1 Labor Resource (People/Skills)

Service Technician x 1

10.15.2 Personal Protection Equipment

> ! ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Body - Fall protection straps
- Safety devices

10.15.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ! ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Man-lift	

Consumables

Description	Specification	Quantity
Not applicable		

10.15.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

10.15.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing a Visual Inspection of the Trunnion Block Cap Screws	00:30

10.15.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)

Description	Reference
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Do a Torque Inspection of the Trunnion Block Cap Screws	Model specific Maintenance Manual

10.15.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. **DANGER**

   Electrocution Hazard

   Operating near or contacting a power line with any part of the machine can cause electrocution, causing death.

   - Do not raise or lower the mast or operate the machine near electric power lines.
   - Keep at least 3 meters (10 feet) away from power lines.
   - If there appears any danger of wind or other obstruction decreasing the distance, do not drill in that area.

   Lower the mast to the horizontal position.

3. Put all of the controls in the OFF or neutral position.
4. Stop the machine.
5. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

   NOTE: *Refer to Safety Locks and Tags Minimum Requirements.*

6. Make sure that the machine is in a zero-energy state.
7. Put blocks at the tracks, as applicable.

10.15.8 Examining the Trunnion Block Cap Screws

1. **WARNING**

   Fall Hazard

   Can cause personal injury or death.

   - ▶ Put on fall-protection equipment when you work from a man-lift.
   - ▶ Examine all lifting equipment before you start any maintenance task.

   Position the forklift with man-basket to get access to the trunnion blocks (Figure 1, item B) on the top of the mast support.

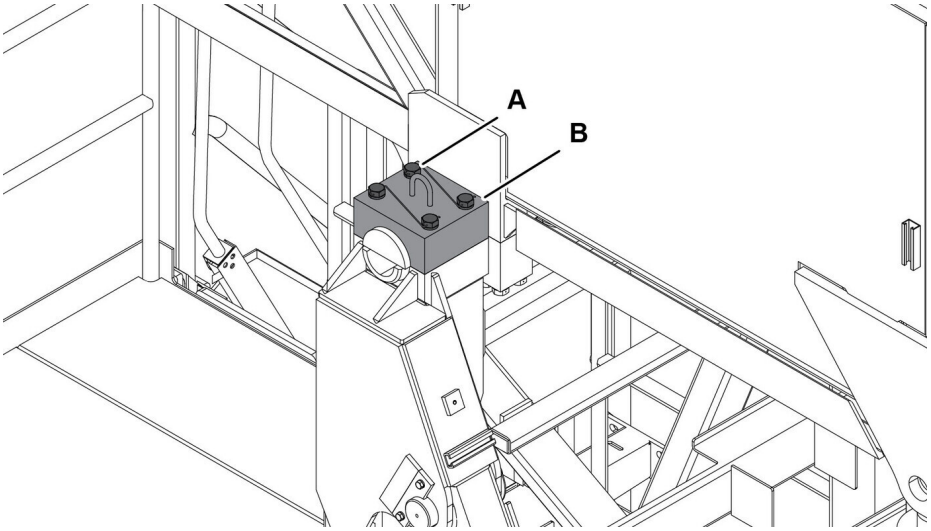


Figure 1

A	Cap screw and washer	B	Trunnion block

2. Do a visual inspection of the cap screws (item A) for loose or broken safety wire.
3. Replace the cap screws and washers, as needed.

> ***NOTE:*** *Replace all cap screws on the trunnion blocks as a set, not individually.*

> ***NOTE:*** *Refer to Do a Torque Inspection of the Trunnion Block Cap Screws.*

10.15.9 After Completing the Task

1. Clean the work area of all tools and unwanted materials.
2. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

10.16 Do an Inspection of the Mast Pivot Shaft Cap Screws

10.16.1 Labor Resource (People/Skills)

Service Technician x 1

10.16.2 Personal Protection Equipment

> ! ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Body - Fall protection straps
- Safety devices

10.16.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ! ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	

Support Equipment

Description	Specification
Forklift with man basket	

Consumables

Description	Specification	Quantity
Not applicable		

10.16.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

10.16.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing a Visual Inspection of the Mast Pivot Shaft Cap Screws	00:30

10.16.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Do a Torque Inspection of the Mast Pivot Shaft Cap Screws	Model specific Maintenance Manual

10.16.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Start the machine.
3. **DANGER**

   Electrocution Hazard

   Operating near or contacting a power line with any part of the machine can cause electrocution, causing death.

   - ▶ Do not raise or lower the mast or operate the machine near electric power lines.
   - ▶ Keep at least 3 meters (10 feet) away from power lines.
   - ▶ If there appears any danger of wind or other obstruction decreasing the distance, do not drill in that area.

   Raise the mast to the vertical position and lock it in place.

4. Put all of the controls in the OFF or neutral position.
5. Stop the machine.
6. Set the main switch to the OFF position.
7. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

   ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

8. Make sure that the machine is in a zero-energy state.
9. Put blocks at the tracks, as applicable.

10.16.8 Examining the Mast Pivot Shaft Cap Screws

1. **WARNING**

   Fall Hazard

   Can cause personal injury or death.

   - ▶ Put on fall-protection equipment when you work from a man-lift.
   - ▶ Examine all lifting equipment before you start any maintenance task.

Position the forklift with man-basket to get access to the mast pivot shafts on the top of the mast support.

2. Do a visual inspection of the cap screws (Figure 1, item A) for loose or broken safety wire.

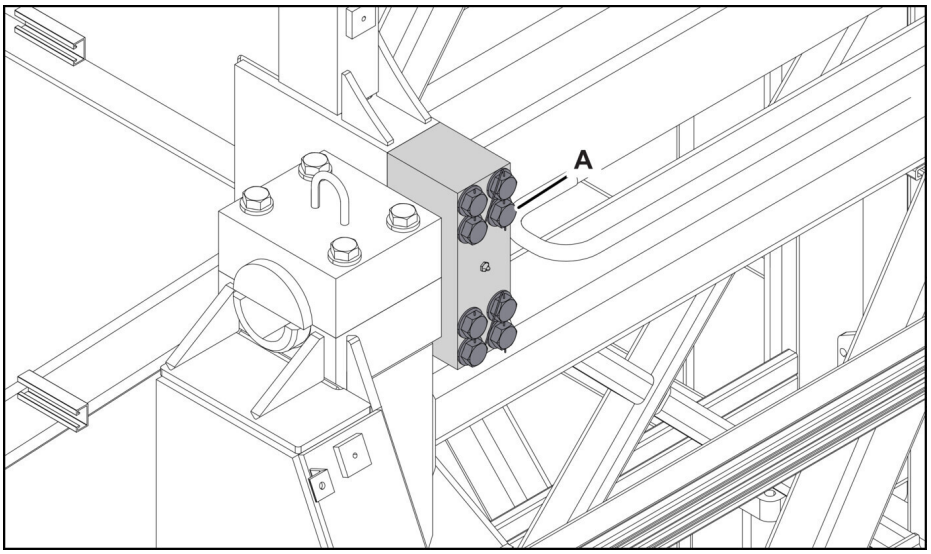


Figure 1

A	Cap screws with washer		

> ***NOTE:*** *Replace all cap screws on the mast pivot shafts as a set, not individually.*

3. Replace the cap screws and washers, as needed.

> ***NOTE:*** *Refer to Do a Torque Inspection of the Mast Pivot Shaft Cap Screws.*

10.16.9 After Completing the Task

1. Clean the work area of all tools and unwanted materials.
2. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

3. Release the machine to the customer.

11 500-Hour Periodic Maintenance

11.1 Do an Inspection of the Rotary Head Guide Blocks

11.1.1 Labor Resource (People/Skills)

Service Technician x 1

11.1.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

11.1.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Torque wrench, calibrated	Capacity up to 515 N·m (380 ft·lb)
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Not applicable		

11.1.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

11.1.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing an Inspection of the Rotary Head Guide Blocks	01:00

11.1.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Rotary Head Guide Block Removal and Installation	TIS0000477

11.1.7 Before Starting the Task

1. Park the machine on a dry level surface.

2. **DANGER**

   Electrocution Hazard

   Operating near or contacting a power line with any part of the machine can cause electrocution, causing death.

   - Do not raise or lower the mast or operate the machine near electric power lines.
   - Keep at least 3 meters (10 feet) away from power lines.
   - If there appears any danger of wind or other obstruction decreasing the distance, do not drill in that area.

   Raise the mast to the vertical position and lock it in place.

3. **WARNING**

   Pinch Points

   Moving the rotary head can cause the pinch point hazard.

   - Do not put any part of yourself in the path of the rotary head when it is in motion.

   Move the rotary head to the bottom of the mast.

4. Put all of the controls in the OFF or neutral position.
5. Stop the machine.
6. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

   NOTE: *Refer to Safety Locks and Tags Minimum Requirements.*

7. Make sure that the machine is in a zero-energy state.
8. Put blocks at the tracks, as applicable.
9. Do the instructions given in the Inspection Plan section.

11.1.8 Inspection Plan

Dept or Location: Epiroc Drilling Solutions		**ITP No. (Revision):**
Site No.:	**Maintenance Plan No.:**	**Work Order No.:**

Item Description: Rotary Head Slides						**Equipment No.:**
Step No:	Description of Activity	Acceptance Criteria (Procedure, Material, or Spec No.)	Performed and/or Witnessed By:			Full Signature and Date
			ECT	ECI	S	
1	Top side wear block 1/2" brass hex head screw fastener torque	27.11 N·m (20 ft-lb)	I			
2	Visually inspect the guide block is secured in place on the rotary head slide	N/A	I			
3	Top head slide mounting block 3/4" UNC SAE 8 fastener torque (using Loctite)	379.63 N·m (280 ft-lb)	I			
4	Bottom side wear block 1/2" brass hex head screw fastener torque	27.11 N·m (20 ft-lb)	I			
5	Visually inspect the guide block is secured in place on the rotary head slide.	N/A	I			
6	Bottom head slide mounting block 3/4" UNC SAE 8 fastener torque (using Loctite)	379.63 N·m (280 ft-lb)	I			
7	All hex head fasteners are tight and secured with wire correctly	Heads wired correctly	I	H		

Legend

H	Hold point: Do not progress past this step until it is correct/in place/complete.
I	Inspection and/or test completed.
V	Verify a record or document of an inspection or test.
N	Notification point
ECT	Epiroc Technician
ECI	Epiroc Inspector
S	Subcontractor/Supplier

11.1.9 Parts Clearance and Wear Limits

> ***NOTE:*** *There must be a minimal total gap of 3.2 millimeters (1/8 inch) between the mast chords and the rotary head guide blocks, or 1.6-millimeter (1/16-inch) gap between each guide block and mast chord (Figure 1).*

Figure 1

A	Mast chord	B	Guide block

1. Adjust the gap with the shims to maintain the 1.6-millimeter (1/16-inch) gap on each side.

> ***NOTE:*** *Refer to Rotary Head Guide Block Removal and Installation.*

2. Examine the guide block and replace it when there is 6.4 millimeters (1/4 inch) of material remaining (Figure 2).

> ***NOTE:*** *Refer to Rotary Head Guide Block Removal and Installation.*

> ***NOTE:*** *This gap prevents the bolts from rubbing and damaging the mast chords.*

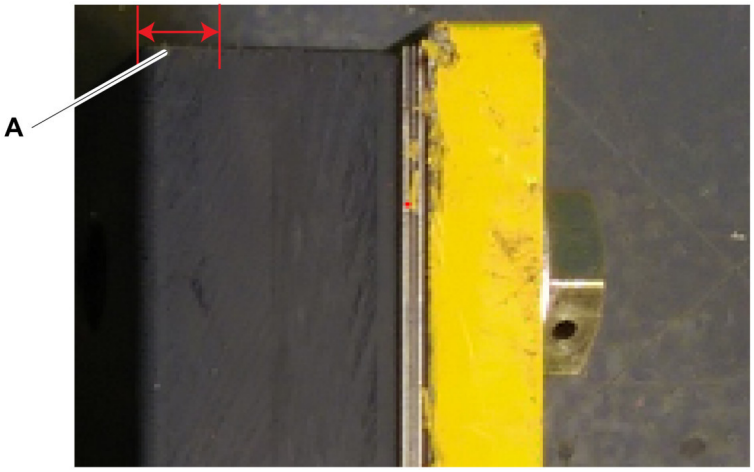


Figure 2

A	6.4 mm (1/4 in) of remaining material		

3. Adjust and shim the guide blocks to let the rotary head spindle pass through the center bushing without making contact.

> ***NOTE:*** *Refer to Rotary Head Guide Block Removal and Installation.*

11.1.10 After Completing the Task

- Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

11.2 Do an Inspection of the Feed Cable and Wire Rope

11.2.1 Feed Cable Replacement

Refer to the Spare Parts Catalog for your specific machine to make sure the correct feed cables, anchors, clamps, and hardware are used. Do not substitute. Do not reuse cable anchors or clamps.

Replace the feed cable wire rope in accordance with the criteria in ISO 4309.

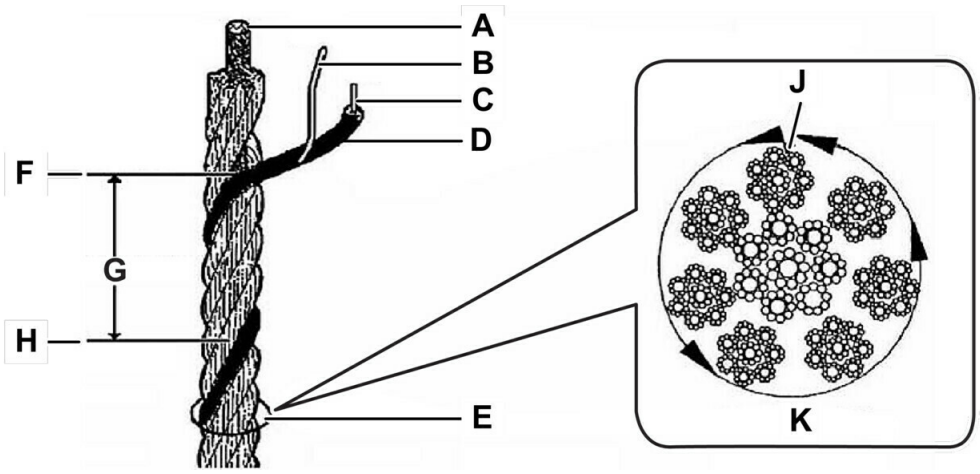


Figure 1

A	Core	B	Wire
C	Center wire	D	Strand
E	Wire rope	F	Start of lay length
G	Lay length	H	End of lay length
J	One strand	K	One revolution

11.2.2 Feed Cable Lubrication

Clean the wire ropes and the cables with a wire brush and lubricate about every 500 hours with one of listed lubricants. Lubricate the wire ropes and feed cables in accordance with the criteria in ISO 4309:

- Whitmore's Wire Rope Lubricant (Whitmore Manufacturing Co.)
- Liquid-O-Ring 772 (Oil Research Center)
- Texaco Crater A

Apply the lubricant with either a spray or a brush, and are recommended for protection against corrosion. The above lubricants must penetrate to the wire rope core.

The following lubricant is recommended to further protect the outer surface and sheave from wear:

- Normal operating temperatures - Whitmore's Drag Rope Lubricant HF (Whitmore Manufacturing Co.)
- For temperatures below 2 °C (35 °F) - Whitmore's Envirolube (Whitmore Manufacturing Co.)

11.2.3 Wire Rope

Hoist ropes, including their anchorage and other load-carrying components of the hoist system (sheave bearings, rope sheaves, and drill hooks) must be examined at least once a week.

Wire ropes must be examined and discarded in accordance with ISO 4309. On machines with a normal hook load of more than 1,000 kN (100.36 tons-force), the hoist rope must be regularly paid out and shortened according to a plan created by the manufacturer on the basis of experience.

Wire rope used in drilling operations becomes unusable because of wear and wire breakage. Replace the wire rope according to the criteria in ISO 4309.

11.3 Do an Inspection of the Feed Cable Sheaves

11.3.1 Labor Resource (People/Skills)

Service Technician x 1

11.3.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Body - Fall protection straps
- Safety devices

11.3.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, this section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See the machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Sheave No-Go gauge	Refer to the TSNB ADS141204922
Tags	As required

Support Equipment

Description	Specification
Flashlight	

Consumables

Description	Specification	Quantity
Not applicable		

11.3.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

11.3.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing an Inspection of the Feed System Sheaves	01:00

11.3.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

11.3.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. **DANGER**

   Electrocution Hazard

   Operating near or contacting a power line with any part of the machine can cause electrocution, causing death.

   - ▶ Do not raise or lower the mast or operate the machine near electric power lines.
   - ▶ Keep at least 3 meters (10 feet) away from power lines.
   - ▶ If there appears any danger of wind or other obstruction decreasing the distance, do not drill in that area.

   Lower the mast to the horizontal position.

3. Put all of the controls in the OFF or neutral position.
4. Stop the machine.
5. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

   ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

6. Make sure that the machine is in a zero-energy state.
7. Put blocks at the tracks, as applicable.

11.3.8 General Instructions for Sheave Maintenance

- ○ Examine the sheaves periodically for wear in the grooves. Wear can cause abrasions, pinching, and bird-caging of the rope.

  ! ***NOTE:*** *When grooves are worn or are too large, they can cause excessive movement, which stresses the rope and reduces its longevity.*

11.3.9 Using the Sheave Gauge

> ***NOTE:*** *The sheave gauge is a NO-GO gauge. If the sheave is within the acceptable wear limit, the gauge does not fit. The gauge fits when the sheave exceeds the acceptable wear limit.*

- Select the correct sheave gauge from the set of gauges (Figure 1) based on rope diameter and machine model.

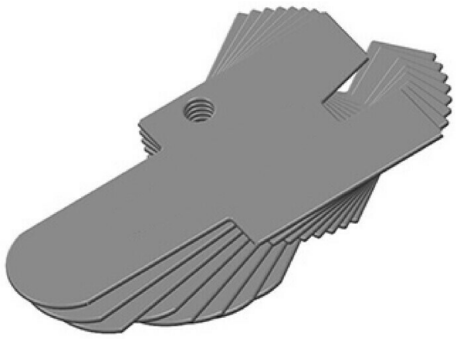


Figure 1

11.3.10 Doing an Inspection of the Groove Wear

1. Position the gauge (Figure 2) in the sheave groove.

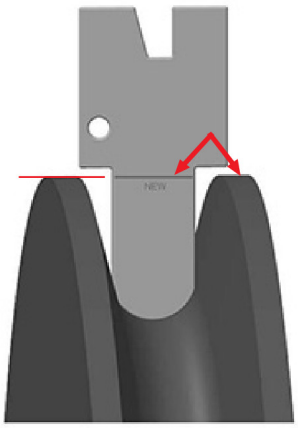


Figure 2

> ***NOTE:*** *If the groove is not worn, the 'NEW' mark line is level with the sheave edges.*

2. Look for a gap between the gauge and the sheave top edge.

> ***NOTE:*** *When the sheave groove is not worn or is within an acceptable amount of wear, the gauge does not touch the sheave top surface.*

3. Replace the sheave if the gauge touches the sheave top surface (Figure 3).

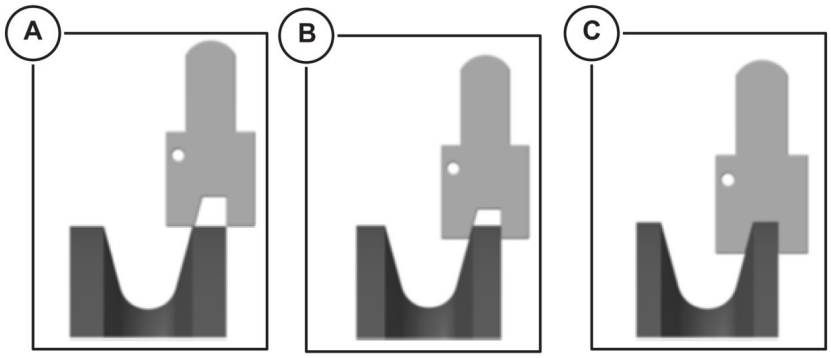


Figure 3

A	No wear, good	B	Within accepted limit, good
C	Worn beyond limit, not good		

11.3.11 After Completing the Task

1. Remove all tools and unwanted material from the work area.
2. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

11.4 Obtaining the Hydraulic and Compressor Oil Sample for Analysis

11.4.1 Labor Resource (People/Skills)

Service Technician x 1

11.4.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

11.4.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Not applicable		

11.4.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Oil Analysis Sample Kit		As required

11.4.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Obtaining the Sample for Oil Analysis	00:30

11.4.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Environmental Instructions	Model specific Maintenance Manual

11.4.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

   > ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

11.4.8 Obtaining the Sample for Oil Analysis

1. Open the live oil sample access door on the cab side, non-drill end of the machine.

2. **CAUTION**

   Environmental Contaminant

   Oil is an environmental contaminant and must be discarded correctly.

   - Do not let the used oil drain onto the ground.
   - Discard the used oil in accordance with local environmental regulations.

   NOTE: *Refer to Environmental Instructions in the Maintenance manual.*

   Put a container below the oil port.

3. Remove the cap on the oil sample port that requires analysis (Figure 1).

Figure 1

4. Push the button on the port and release 20 milliliters (1 ounce) of oil out of the port.
5. Put a clean container below the oil port.
6. Push the button on the port and fill the container with the oil to be sampled.
7. Install the cap onto the oil sample fitting.
8. Seal the oil sample container.

11.4.9 After Completing the Task

1. Do an oil level check after you get the oil sample. Add oil, as needed.

2. **⚠ CAUTION**

   Environmental Contaminant

   Oil is an environmental contaminant and must be discarded correctly.

   ▶ Do not let the used oil drain onto the ground.

   ▶ Discard the used oil in accordance with local environmental regulations.

   ! ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

   Remove the container and discard the used oil in accordance with local environmental regulations.

3. Remove all tools and unwanted material from the work area.

4. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

   ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

11.5 Change the Pump Drive Gearbox Oil

11.5.1 Labor Resource (People/Skills)

Service Technician x 1

11.5.2 Personal Protection Equipment

! ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

11.5.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Container	Standard gearbox: Capacity of 4 L (1 gal) Optional gearbox: Capacity of 10 L (3 gal)

Consumables

Description	Specification	Quantity
Gearbox oil	As specified in Refill Capacities and Lubricants	As required

11.5.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

11.5.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Changing the Pump Drive Gearbox Oil	01:00

11.5.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Environmental Instructions	Model specific Maintenance Manual
Refill Capacities and Lubricants	Model specific Maintenance Manual

11.5.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.
7. **⚠ CAUTION**

   Environmental Contaminant

   Oil is an environmental contaminant and must be discarded correctly.

   - ▶ Do not let the used oil drain onto the ground.
   - ▶ Discard the used oil in accordance with local environmental regulations.

> ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

Put a container below the drain point (Figure 1, item A). If the machine is equipped with a Central Drain System, connect to the drain connection.

Figure 1

A	Drain point		

8. Clean around the breather, fill plug, and drain plug areas.

11.5.8 Draining the Pump Drive Gearbox Oil

> ***NOTE:*** *If the machine has a Central Drain System, connect to the drain connection to drain the pump drive gearbox oil.*

1. Remove the magnetic drain plug (Figure 2, item D) and the breather-and-fill plug (item A).

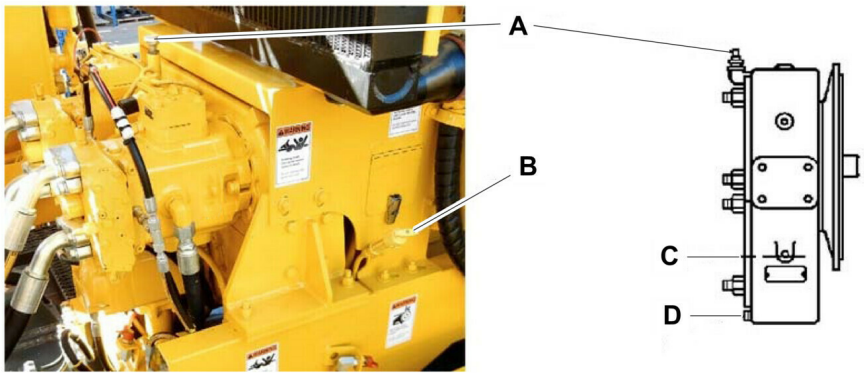


Figure 2

A	Breather-and-fill plug	B	Oil level dipstick
C	Oil level	D	Magnetic drain plug

2. **WARNING**

Burn Hazard

Hot fluids or components can burn.

- Make sure that the fluids are at a safe working temperature when you service the machine.
- Do not touch hot fluids or components.

Drain the oil while the pump drive gearbox is still warm.

NOTE: *Metal particles can reveal the pump drive gearbox failure in the near future. If unwanted material is found, find the reason for the unwanted material and do the needed repairs.*

3. Examine the magnetic drain plug and the gearbox oil for any contamination or metal particles.

4. **⚠ CAUTION**

   Environmental Contaminant

   Oil is an environmental contaminant and must be discarded correctly.

   ▶ Do not let the used oil drain onto the ground.

   ▶ Discard the used oil in accordance with local environmental regulations.

   ! ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

   Let the oil drain completely into the container.

5. Clean the magnetic drain plug.

6. Install the magnetic drain plug onto the pump drive gearbox.

11.5.9 Filling the Pump Drive Gearbox with Oil

1. ***NOTICE***

   Component Damage

   Overfilling can cause overheating and possible malfunction of the gearbox.

   ▶ Do not overfill when you refill the gearbox oil.

   Fill the pump drive gearbox through the breather-and-fill port with the recommended oil to the correct level.

2. Remove the dipstick and do an oil level check.

   ! ***NOTE:*** *The oil must be at the FULL mark on the oil level dipstick.*

3. Clean the breather-and-fill plug.

4. Install the breather-and-fill plug onto the pump drive gearbox.

11.5.10 After Completing the Task

1. **CAUTION**

   Environmental Contaminant

   Oil is an environmental contaminant and must be discarded correctly.

   - ▶ Do not let the used oil drain onto the ground.
   - ▶ Discard the used oil in accordance with local environmental regulations.

   NOTE: *Refer to Environmental Instructions in the Maintenance manual.*

   Remove the container and discard the used oil in accordance with local environmental regulations.

2. Clean the work area and remove all tools and unwanted materials.
3. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

   NOTE: *Refer to Safety Locks and Tags Minimum Requirements.*

11.6 Do an Inspection of the Compressor Air Hoses and Clamps

11.6.1 Labor Resource (People/Skills)

Service Technician x 1

11.6.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

11.6.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Torque wrench, calibrated	Capacity up to 135 N·m (100 ft·lb)
Tags	As required

Support Equipment

Description	Specification
Compressed air source	
Container	19 L (5 gal)

Consumables

Description	Specification	Quantity
Not applicable		

11.6.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Compressor air hose clamp		As required
Hose restraint		As required

11.6.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing an Inspection of the Compressor Air Hose and Clamps	01:00

11.6.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Environmental Instructions	Model specific Maintenance Manual

11.6.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.

4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> **NOTE:** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.
7. Let the machine cool to a safe temperature before you do any service.

11.6.8 Doing an Inspection of the Compressor Air Hose and Clamps

WARNING

High Pressure

Pressure in the air hose clamps can cause severe injury or death.

- ▶ Release the pressure completely from the system before you remove the air hose clamps. Stored energy is present.

NOTICE

Component Damage

The compressor air hose is subject to the highest temperatures in the compressor system and is always in contact with synthetic oil. If the hose is not replaced periodically, the inner lining begins to erode. Lining material can clog the cooler and damage the compressor lubrication pump.

- ▶ Replace the compressor air hose periodically.

1. Determine what kind of compressor air hose clamp is installed on the compressor (Figure 1).

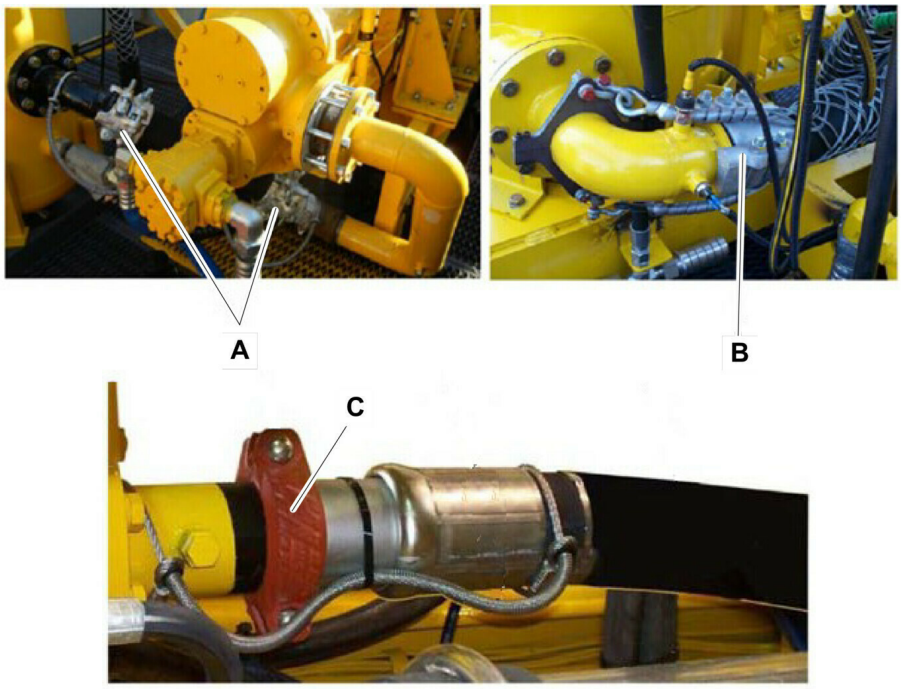


Figure 1

A	Dixon Boss clamp	B	IC (Campbell) clamp
C	Victaulic clamp		

2. Examine the compressor air hose clamp for any cuts or damage. If the hoses are to be replaced, then the air hose clamps also need to be replaced.

3. **WARNING**

Burn Hazard

Hot fluids or components can burn.

- ▶ Make sure that the fluids are at a safe working temperature when you service the machine.
- ▶ Do not touch hot fluids or components.

⚠ CAUTION

Environmental Contaminant

Oil is an environmental contaminant and must be discarded correctly.

- ▶ Do not let the used oil drain onto the ground.
- ▶ Discard the used oil in accordance with local environmental regulations.

! ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

If the air hose needs to be replaced, use a container to collect the spilled oil.

4. **⚠ WARNING**

Risk of Personal Injury

Reusing air hose clamps can cause personal injury.

- ▶ Air hose clamps hold the hose connections under a large amount of pressure and are for single use only (including the nuts and cap screws). Do not reuse any part of the air hose clamps.

Examine the hose clamps for loose cap screws or cracks. If damage is found on the clamp, replace it immediately.

11.6.9 Re-torqueing the Compressor Air Hose and Clamps

⚠ WARNING

Safety Precautions

Failure to obey these instructions can cause serious injury or death.

- ▶ Reattach safety restraint devices for replaced hoses and clamps if they are previously removed.
- ▶ Attach a safety chain or an applicable locking device (whip check) for air hoses of 19 millimeter (0.75 inch) diameter or larger. The device holds the hose if it becomes dislodged for any reason.
- ▶ The whip check must always remain on the hose.

- Periodically re-tighten, as necessary, due to cold-flow present in all rubber hoses.

> ***NOTE:*** *Refer to the manufacturer's torque procedure for each different clamp style.*

11.6.10 After Completing the Task

1. **CAUTION**

   Environmental Contaminant

   Oil is an environmental contaminant and must be discarded correctly.

   - Do not let the used oil drain onto the ground.
   - Discard the used oil in accordance with local environmental regulations.

   > ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

   Remove the container and discard the used oil in accordance with local environmental regulations.

2. Discard any removed hoses and clamps in accordance with site-specific procedures.
3. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

   > ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

11.7 Clean the Compressor Oil Strainer

11.7.1 Labor Resource (People/Skills)

Service Technician x 1

11.7.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

11.7.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Container	8 L (2 gal)

Consumables

Description	Specification	Quantity
Cleaning solvent		As required

11.7.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

11.7.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Cleaning the Compressor Oil Strainer	00:30

11.7.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Environmental Instructions	Model specific Maintenance Manual

11.7.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

   > ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

7. **WARNING**

High Pressure

High pressure can cause severe injury or death.

- Release all of the air pressure from the system before you remove the filler plug, drain valve, and fittings.

Open the ball valve on the side of the receiver tank to release the pressure inside of the receiver tank.

! ***NOTE:*** *The pressure gauge must read zero kPa (zero psig).*

8. Close the ball valve.

11.7.8 Cleaning the Compressor Oil Strainer

WARNING

High Pressure

Can cause severe injury or death

- Release all of the air pressure in the system before you remove the filler plug, drain valve, fittings, or receiver tank lid.

WARNING

Burn Hazard

Hot fluids or components can burn.

- Make sure that the fluids are at a safe working temperature when you service the machine.
- Do not touch hot fluids or components.

1. Clean the area around the compressor oil strainer.

2. **⚠ CAUTION**

Environmental Contaminant

Oil is an environmental contaminant and must be discarded correctly.

- ▶ Do not let the used oil drain onto the ground.
- ▶ Discard the used oil in accordance with local environmental regulations.

! ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

Put a container below the compressor oil strainer to collect any spilled oil.

3. Remove the cover (Figure 1, item A) with a wrench.

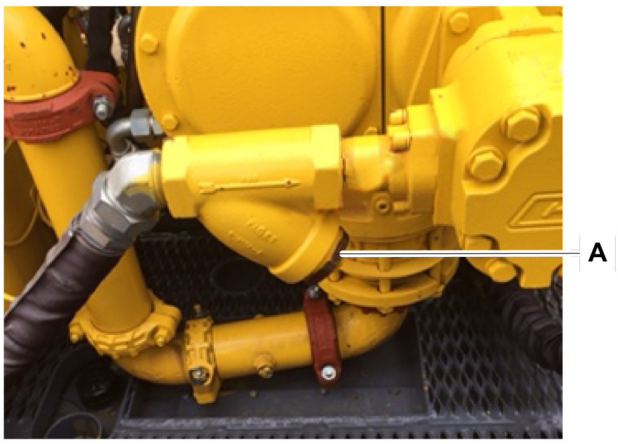


Figure 1

A	Cover		

4. Remove the screen or strainer (Figure 2, item A).

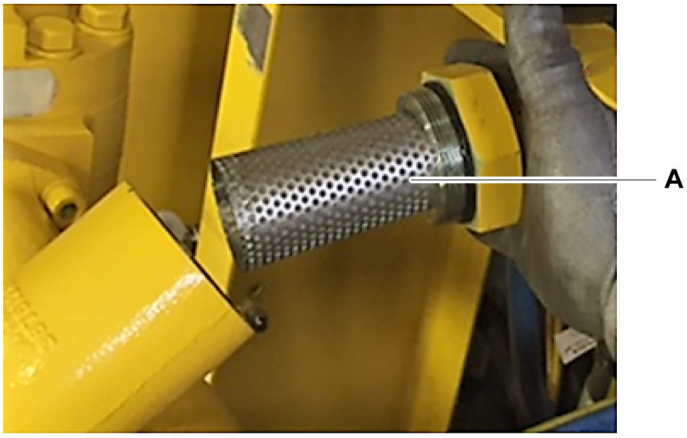


Figure 2

A	Screen or strainer		

5. Clean the strainer and the magnetic plug with cleaning solvent.
6. Install the strainer element.
7. Install the cover and tighten it with a wrench.

11.7.9 After Completing the Task

1. Clean the work area of tools and unwanted material.
2. **⚠ CAUTION**

   Environmental Contaminant

   Oil is an environmental contaminant and must be discarded correctly.

   - ▶ Do not let the used oil drain onto the ground.
   - ▶ Discard the used oil in accordance with local environmental regulations.

! ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

Remove the container from below the final drive and discard the used oil in accordance with local environmental regulations.

3. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

11.8 Change the Compressor Oil Filters

11.8.1 Labor Resource (People/Skills)

Service Technician x 1

11.8.2 Personal Protection Equipment

> ! ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

11.8.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ! ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Oil filter strap wrench	
Tags	As required

Support Equipment

Description	Specification
Container	19 L (5 gal)

Consumables

Description	Specification	Quantity
Not applicable		

11.8.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Compressor oil filter		2 (HP) 1 (LP)

11.8.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Changing the Compressor Filters	00:30

11.8.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)

Description	Reference
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Environmental Instructions	Model specific Maintenance Manual

11.8.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Make the machine level.
3. Put all of the controls in the OFF or neutral position.
4. Stop the machine.
5. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

6. Make sure that the machine is in a zero-energy state.
7. Put blocks at the tracks, as applicable.
8. **⚠ WARNING**

   High Pressure

   High pressure can cause severe injury or death.

   ▶ Release all of the air pressure from the system before you remove the filler plug, drain valve, and fittings.

   Open the ball valve on the side of the receiver tank to release the pressure inside of the receiver tank.

> ! ***NOTE:*** *The pressure gauge must read zero kPa (zero psig).*

9. Close the ball valve.

11.8.8 Removing the Compressor Oil Filter

WARNING

Burn Hazard

Hot fluids or components can burn.

- ▶ Make sure that the fluids are at a safe working temperature when you service the machine.
- ▶ Do not touch hot fluids or components.

1. Wipe all of the external dirt and oil from the filter housing and the head area to minimize the contamination from getting into the system.
2. **CAUTION**

   Environmental Contaminant

   Oil is an environmental contaminant and must be discarded correctly.

   - ▶ Do not let the used oil drain onto the ground.
   - ▶ Discard the used oil in accordance with local environmental regulations.

   ! ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

   Put a container below the oil filter to collect the spilled oil.
3. Remove the compressor oil filters (Figure 1, item A) for the HP compressor with an oil filter strap wrench.

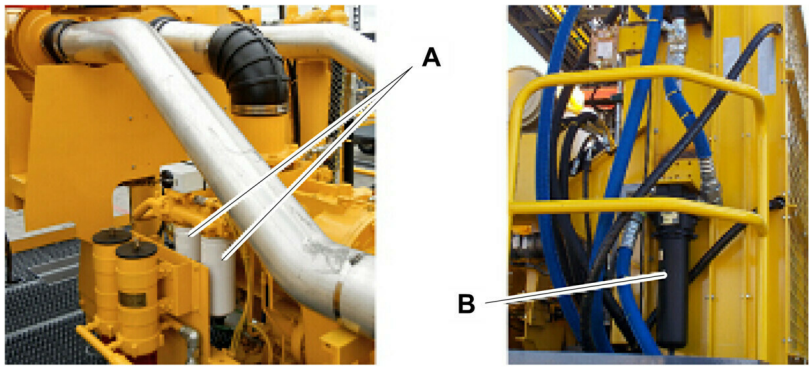


Figure 1

A	High-pressure oil filters	B	Housing

4. For the LP compressor, remove the housing (item B) to access the filter.

11.8.9 Installing the Compressor Oil Filter

1. Clean the sealing surface of the filter mounting base. Make sure that all of the oil filter gaskets are removed.
2. Apply a thin layer of clean compressor oil to the seal of the new filter.
3. Install the new oil filters on the HP compressor. Tighten them by hand.
4. For the LP compressor, change the O-ring, insert the new filter on the housing, and tighten it by hand.

> ***NOTE:*** *Do not over-tighten the oil filter.*

5. Tighten the oil filter in accordance with the instructions on the oil filter.

11.8.10 After Completing the Task

1. **CAUTION**

   Environmental Contaminant

   Filters can contain oil residue, which is an environmental contaminant and must be discarded correctly.

   ▶ Discard the used filter in accordance with local environmental regulations.

> ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

Clean the work area and discard the old filters in accordance with local environmental regulations.

2. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

11.9 Do a Grease Tank Electric Pump Oil Level Check

11.9.1 Labor Resource (People/Skills)

Service Technician x 1

11.9.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

11.9.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Motor oil	SAE 10W30	As required

11.9.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

11.9.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing a Grease Tank Electric Pump Oil Level Check	00:05

11.9.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

11.9.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

   > ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

11.9.8 Doing a Grease Tank Electric Pump Oil Level Check

1. Remove the oil level dipstick (Figure 1, item A) from the motor.

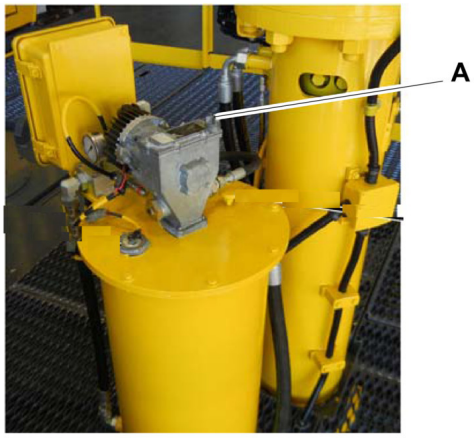


Figure 1

A	Oil level dipstick		

> ***NOTE:*** *The oil level must be at the FULL mark on the dipstick.*

2. Add oil through the oil level dipstick port until it shows FULL mark on the dipstick.
3. Install the dipstick into the motor.

11.9.9 After Completing the Task

1. Remove all tools and unwanted material from the work area.
2. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

11.10 Do an Inspection of the Engine Mounting Cap Screws

11.10.1 Labor Resource (People/Skills)

Service Technician x 2

11.10.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

11.10.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Torque wrench, calibrated	Capacity up to 515 N·m (380 ft·lb)
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Not applicable		

11.10.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

11.10.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing an Inspection of the Engine Mounting Cap Screws	02:00

11.10.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

11.10.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

   > ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

11.10.8 Doing an Inspection of the Engine Mounting Cap Screws

WARNING

Burn Hazard

Hot fluids or components can burn.

- Make sure that the fluids are at a safe working temperature when you service the machine.
- Do not touch hot fluids or components.

1. Examine the front engine mounting cap screws (Figure 1, item A) for damage or corrosion. Replace the cap screws, if necessary.

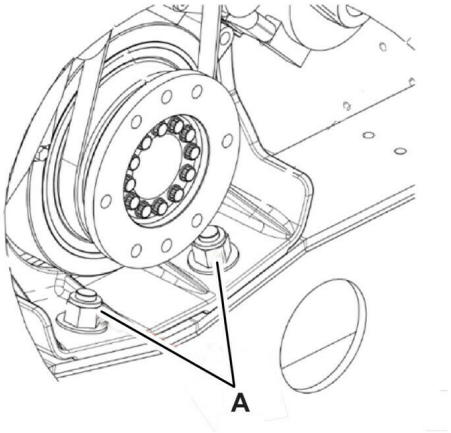


Figure 1

A	Engine mounting cap screws		

2. Do a torque inspection of the front engine mounting cap screws (Figure 1). The torque must be 515 Newton meters (380 foot-pounds) dry.

NOTE: *If the cap screws do not meet the torque requirements, do not torque the cap screws. Discard the cap screws and replace them with new cap screws.*

3. Examine the rear engine mounting cap screws (Figure 2, items A and B) at the mounting bracket and the engine for damage or corrosion. Replace the cap screws, if necessary.

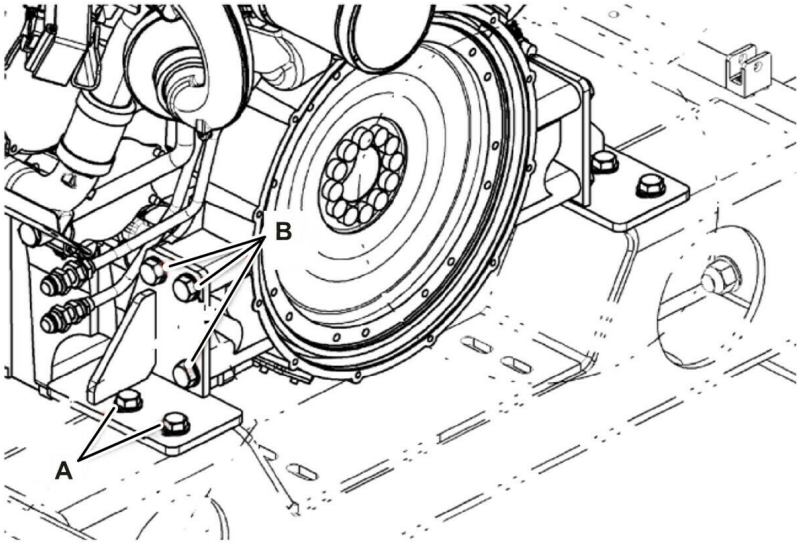


Figure 2

A	Cap screws at the mounting bracket	B	Mounting cap screws at the engine

4. Do a torque inspection of the rear engine mounting cap screws at the mounting bracket and the engine. The torque must be 515 Newton meters (380 foot-pounds) dry.

> ! ***NOTE:*** *If the cap screws do not meet the torque requirements, do not torque the cap screws. Discard the cap screws and replace them with new cap screws.*

11.10.9 After Completing the Task

1. Remove all tools and unwanted material from the work area.
2. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

11.11 Do an Inspection of the Input/Output Module

11.11.1 Labor Resource (People/Skills)

Service Technician x 1

11.11.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

11.11.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Compressed air source	

Consumables

Description	Specification	Quantity
Dielectric grease		As required

11.11.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

11.11.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing an Inspection of the Input/Output Module	00:30

11.11.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

11.11.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

   > ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

11.11.8 Cleaning the Input/Output Module

WARNING

Burn Hazard

Hot fluids or components can burn.

- ▶ Make sure that the fluids are at a safe working temperature when you service the machine.
- ▶ Do not touch hot fluids or components.

WARNING

High Pressure

High-pressure cleaning with compressed air, water jets, or steam cleaning methods can cause personal injury.

- ▶ Put on applicable personnel protective clothing to protect eyes and uncovered parts of the body.
- ▶ Maximum air pressure at the nozzle must be less than 207 kPa (30 psi) for cleaning purposes.

1. Find the Input/Output module on the machine.
2. Clean the surface of the modules lightly with a blower or compressed air to remove any loose dirt and unwanted material.
3. Wipe the surface of the modules with a clean rag to have a clear view of the LED.

11.11.9 Examining the Input/Output Module

1. Examine the modules and the RCS cables for physical damage.
2. Examine the modules for loose RCS cable connections (Figure 1). Do the corrections, as needed.

Figure 1

3. Torque the connections to 0.8 to 0.9 Newton meters (7.1 to 7.9 inch-pounds) dry.

> ***NOTE:*** *If the cable is removed during the examination, do not lose the O-ring from the port.*

4. Tighten the connectors manually or with the Turck® torque tool.

> ***NOTE:*** *Do not use pliers to tighten the connectors.*

5. **CAUTION**

   Component Damage

   Dielectric grease in the end of the cable can cause the cable to press out of the Ferrell nut and permanently damage the cable.

   ▶ Do not put dielectric grease in the end of the cable.

   If it is necessary to install a cable, apply a small amount of dielectric grease to the face of the port only.

6. Make sure that the cables are not in a bind or pulled tight. This action damages the port.
7. Make sure that the hardware that holds the module is tight.
8. Make sure that open port is covered or sealed.

11.11.10 After Completing the Task

1. Remove all tools and unwanted material from the work area.
2. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

11.12 Do an Inspection of the Torsional Coupling Shaft

11.12.1 Labor Resource (People/Skills)

Service Technician x 1

11.12.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

11.12.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Not applicable		

11.12.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

11.12.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing an Inspection of the Torsional Coupling Shaft	01:00

11.12.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

11.12.7 Doing an Inspection of the Torsional Coupling Shaft

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

   > ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

7. **WARNING**

Moving Shaft

A moving shaft can cause severe injury or death.

▶ Do not operate the machine with the guard removed.

Open the access panels in the drive shaft guard to get access to the torsional coupling.

8. Remove any loose dirt from the coupling.
9. Examine the rubber elements of the torsional coupling visually. Be careful with the wear zones on the rubber coupling that are indicated in Figure 1.

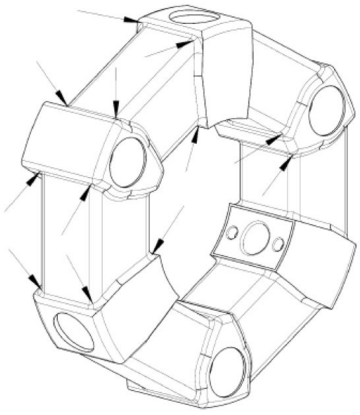


Figure 1

***NOTE:** Be careful with the cracks or adhesion of rubber and the metal parts of the coupling.*

10. Replace the rubber elements if the cracks are deeper than 3 millimeters (0.19 inches) on the torsional coupling.

***NOTE:** Refer to the manufacturer's information to replace any part of the torsional coupling.*

11. Examine the torsional coupling shaft for any amounts of movement. If there is any play or movement, examine or replace the shaft bearings.

***NOTE:** Refer to the manufacturer's information to replace any part of the torsional coupling.*

11.12.8 After Completing the Task

1. Clean the work area of all tools and unwanted materials.
2. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

11.13 Change the Cab Air Return Filter

11.13.1 Labor Resource (People/Skills)

Service Technician x 1

11.13.2 Personal Protection Equipment

> ! ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

11.13.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ! ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Not applicable		

11.13.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Air return filter		1

11.13.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Changing the Cab Air Return Filter	00:30

11.13.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

11.13.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

11.13.8 Removing the Cab Air Return Filter

1. Find the cab air return filter housing at the bottom side of the cab (Figure 1).

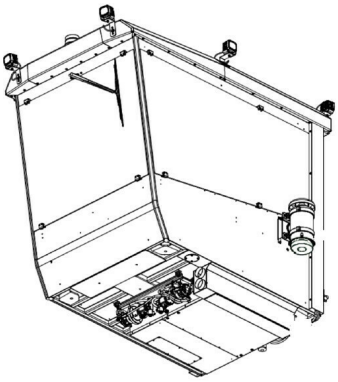


Figure 1

2. Loosen the door straps (Figure 2, item A) at the air return filter housing.

Figure 2

A	Door strap	B	Air return filter housing door

3. Open the door (item B) to the air return filter housing.
4. Remove the air return filter from the housing.

11.13.9 Installing the Cab Air Return Filter

1. Install the new air return filter into the housing.
2. Close the door of the air return filter housing (Figure 2).
3. Tighten the door straps of the air return filter housing (Figure 2).

11.13.10 After Completing the Task

1. Discard the air filter in accordance with local environmental regulations.
2. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

11.14 Change the Cab Pressurizer Air Filter

11.14.1 Labor Resource (People/Skills)

Service Technician x 1

11.14.2 Personal Protection Equipment

> ! ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Nose and mouth - Dust mask
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

11.14.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Cleaning rags		As required

11.14.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Pressurizer air filter		1

11.14.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Changing the Cab Pressurizer Air Filter	00:15

11.14.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

11.14.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

   NOTE: *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

11.14.8 Removing the Cab Pressurizer Air Filter

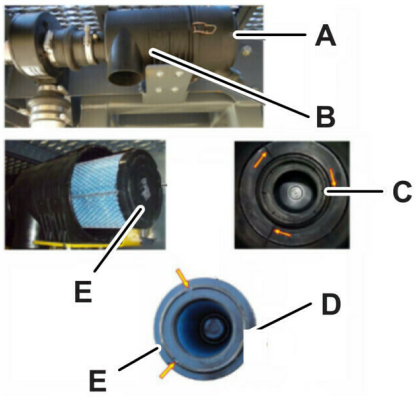
WARNING

Dust Inhalation

Dust inhalation can produce toxic effects and cause serious damage to your lungs.

- ▶ Use a dust mask when you service the air filters.

1. Remove the cover (Figure 1, item A) on the pressurizer air filter housing.



A	Cover	B	Housing
C	Inside housing	D	Slots on bottom of filter
E	Air filter		

2. Remove the air filter (item E) from the housing (item B).
3. Clean inside the cover and the housing with a clean, dry cloth.

11.14.9 Installing the Cab Pressurizer Air Filter

1. Install the new air filter (Figure 1, item C).

> ! ***NOTE:*** *The yellow arrows on the air filter show the three proper slot locations for mating with the three ribs inside the housing.*

2. Align the air filter slots (item E) with the ribs in the housing.
3. Push the air filter all the way into the housing.

> ! ***NOTE:*** *Installation in any other manner lets the dirt enter by passing the filter through the slots. These slots are designed for clearance around the ribs and around the ribs themselves due to formation of gaps.*

4. Install the cover (item A) on the housing and latch the three clips to secure the cover. Make sure that the dust nozzle is pointing downward.

11.14.10 After Completing the Task

1. Discard the old air filter in accordance with local environmental regulations.

2. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

12 1,000-Hour Periodic Maintenance

12.1 Change the Compressor Oil

12.1.1 Labor Resource (People/Skills)

Service Technician x 1

12.1.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

12.1.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Quick-fill kit	

Description	Specification
Quick-drain kit	
Tags	As required

Support Equipment

Description	Specification
Container	189 L (50 gal)

Consumables

Description	Specification	Quantity
Compressor oil	As specified in Refill Capacities and Lubricants	As required

12.1.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

12.1.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Changing the Compressor Oil	00:30

12.1.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Refill Capacities and Lubricants	Model specific Maintenance Manual

12.1.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Make the machine level.
3. Put all of the controls in the OFF or neutral position.
4. Stop the machine.
5. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

6. Make sure that the machine is in a zero-energy state.
7. Put blocks at the tracks, as applicable.
8. **⚠ WARNING**

   High Pressure

   High pressure can cause severe injury or death.

   ▶ Release all of the air pressure from the system before you remove the filler plug, drain valve, and fittings.

   Open the ball valve on the side of the receiver tank to release the pressure inside of the receiver tank.

   > ! ***NOTE:*** *The pressure gauge must read zero kPa (zero psig).*

9. Close the ball valve.

12.1.8 Draining the Compressor Oil without the Quick-Drain Box

1. **⚠ CAUTION**

   Environmental Contaminant

   Oil is an environmental contaminant and must be discarded correctly.

   ▶ Do not let the used oil drain onto the ground.

   ▶ Discard the used oil in accordance with local environmental regulations.

> ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

Put a container below the drain port (Figure 1, item A) of the receiver tank.

Figure 1

A	Drain port		

2. Attach a hose to the ball valve and insert the other end of the hose into the container.
3. Open the ball valve below the receiver tank.
4. Close the ball valve when the receiver tank is drained of oil.
5. Remove the drain hose from the ball valve.
6. Remove the container from the work area.

12.1.9 Draining the Compressor Oil with the Quick-Drain Box

1. **CAUTION**

   Environmental Contaminant

   Oil is an environmental contaminant and must be discarded correctly.

   - ▶ Do not let the used oil drain onto the ground.
   - ▶ Discard the used oil in accordance with local environmental regulations.

> ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

Put a container below the quick-drain box on the non-drill end of the machine.

2. Attach the quick-drain hose to the compressor oil fittings (Figure 2, items A, B, C, and D) in the quick-drain box.

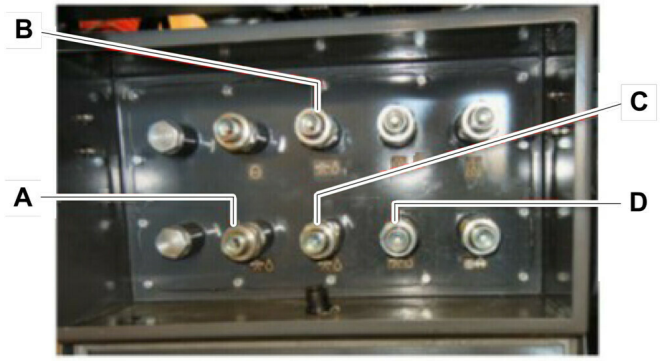


Figure 2

A,B,C,D	Compressor oil fittings		

3. Insert the other end of the hose into the container.
4. Let the compressor oil drain into the container.
5. Remove the quick-drain hose from the compressor oil fittings in the quick-drain box.
6. Remove the oil container from the work area.

12.1.10 Filling the Compressor with Oil

1. Put the new compressor oil container below the quick-fill box.
2. Install the quick-fill hose onto the compressor oil fitting (Figure 3, item A) in the quick-fill box.

Figure 3

A	Compressor oil fitting		

3. Fill the machine with compressor oil until the receiver tank shows full on the sight glass.
4. Remove the quick-fill hose from the compressor oil fitting in the quick-fill box.
5. **WARNING**

   Energized Machine

   Can cause serious injury.

   - The machine must be fully energized and the engine must be switched on to complete this procedure.
   - Be careful around moving parts and pinch points.

   Inform the supervisor, lead hand, and all other parties that are concerned of the intent to restart the machine.

   NOTE: *Make sure that all personnel and bystanders are clear of the machine before start-up.*

6. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

   NOTE: *Refer to Safety Locks and Tags Minimum Requirements.*

7. **WARNING**

   Moving Parts

   Can cause severe injury or death.

   - Make sure that no one is at danger or risk before you start or set the machine in motion.
   - Crew members must not put any part of their bodies or clothing on or near any energized machinery, gears, pinions, ropes, cables, chains, or wrenches.

   Set the main switch to ON.

8. Start the machine and let it idle for five seconds.
9. Put all of the controls in the OFF or neutral position.
10. Stop the machine.

11. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

12. Do a compressor oil level check.
13. Repeat the filling process until the receiver tank shows full at the sight glass when the engine is stopped.

> ! ***NOTE:*** *Foam bubbles must not be visible, except small bubbles on the surface of the oil. When the oil temperature is above 70 °C (158 °F), the thermostatic valve directs the oil into the heat exchanger. If the equipment stops at that moment, some of the oil does not return to the receiver tank. This action causes the oil level to appear low or not appear in the site glass. Let the oil cool and then restart the machine to let the oil circulate for a minute. Stop the machine and proceed to the next step.*

14. Disconnect the quick-fill hose from the compressor oil fitting in the quick-fill box.
15. Remove the compressor oil container from the work area.

12.1.11 Examining the Compressor for Oil Leaks

1. **⚠ CAUTION**

   Environmental Contaminant

   Oil is an environmental contaminant and must be discarded correctly.

   - ▶ Do not let the used oil drain onto the ground.
   - ▶ Discard the used oil in accordance with local environmental regulations.

> ! ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

Remove the used oil container and discard the used oil in accordance with local environmental regulations.

2. **WARNING**

   Energized Machine

   Can cause serious injury.

   - The machine must be fully energized and the engine must be switched on to complete this procedure.
   - Be careful around moving parts and pinch points.

   Inform the supervisor, lead hand, and all other persons concerned of the intent to restart the machine.

   NOTE: *Make sure that all personnel and bystanders are clear of the machine before start-up.*

3. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

   NOTE: *Refer to Safety Locks and Tags Minimum Requirements.*

4. **WARNING**

   Moving Parts

   Can cause severe injury or death.

   - Make sure that no one is at danger or risk before you start or set the machine in motion.
   - Crew members must not put any part of their bodies or clothing on or near any energized machinery, gears, pinions, ropes, cables, chains, or wrenches.

   Set the main switch to ON.

5. Start the machine.
6. Start the compressor and operate it for one minute, then turn off the compressor.
7. Put all of the controls in the OFF or neutral position.
8. Stop the machine.

9. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

10. Do a compressor oil level check at the sight glass on the receiver tank. If the oil level is low, add compressor oil to the middle of the receiver tank sight glass.
11. Do an oil leak check of the compressor and the compressor hoses.
12. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

12.1.12 After Completing the Task

- Remove all tools and unwanted materials from the work area.

12.2 Change the Pump Drive Gearbox Oil

Refer to Change the Pump Drive Gearbox Oil in 500 Hour Periodic Maintenance.

12.3 Do an Inspection of the Feed Cable Tension

12.3.1 Labor Resource (People/Skills)

Service Technician x 1

12.3.2 Personal Protection Equipment

> ! ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Body - Fall protection straps
- Safety devices

12.3.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Pressure gauge or transducer	Capable of measuring 70 bar (1,000 psi)
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Not applicable		

12.3.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

12.3.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing an Inspection of the Feed Cable Tension	01:00

12.3.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

12.3.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Move the rotary head to the top of the mast.
3. **DANGER**

   Electrocution Hazard

   Operating near or contacting a power line with any part of the machine can cause electrocution, causing death.

   - Do not raise or lower the mast or operate the machine near electric power lines.
   - Keep at least 3 meters (10 feet) away from power lines.
   - If there appears any danger of wind or other obstruction decreasing the distance, do not drill in that area.

   Lower the mast to the horizontal position.

4. Put all of the controls in the OFF or neutral position.
5. Stop the machine.
6. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

   NOTE: *Refer to Safety Locks and Tags Minimum Requirements.*

7. Make sure that the machine is in a zero-energy state.
8. Put blocks at the tracks, as applicable.

12.3.8 Doing an Inspection of the Feed Cable Tension

1. Measure the feed cable sag.

> ***NOTE:*** *The feed cable sag must be 51 to 76 millimeters (2 to 3 inches).*

2. Adjust the feed cable tension if the measurement is not within the given range.

> ***NOTE:*** *The measurement is to be taken from the centerline of the front mast tubing (chord) (Figure 1, item A) to the centerline of the cables (item B).*

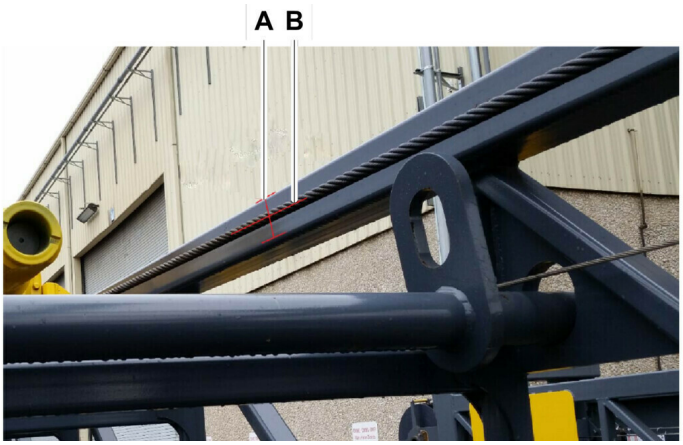


Figure 1

A	Chord	B	Cable

12.3.9 Preliminary Adjustments (Machine Operating)

> ***NOTE:*** *The upper tensioner relief valve is factory pre-set at 159 bar (2,300 psi). Adjustment of a new or replacement part is not required.*

1. **WARNING**

   Energized Equipment

   Can cause serious injury

   - The machine must be fully energized and the engine must be on to complete this procedure.
   - Be careful around moving parts and pinch points.

   Inform the supervisor, lead hand, and all other persons that are concerned, of the intent to restart the machine.

   NOTE: *Make sure that all personnel and bystanders are clear of the machine before startup.*

2. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

   NOTE: *Refer to Safety Locks and Tags Minimum Requirements.*

3. Start the machine.
4. Adjust the pressure valve for the upper cable-tensioning cylinder to 51.7 bar (750 psig).

   NOTE: *The pressure reducing valve is on the cab side of the power pack at the main pumps area.*

5. Set the fan speed on high.

6. Break loose the jam nut (Figure 2, item A) on the valve and adjust with a hex wrench to 51 bar (750 psi).

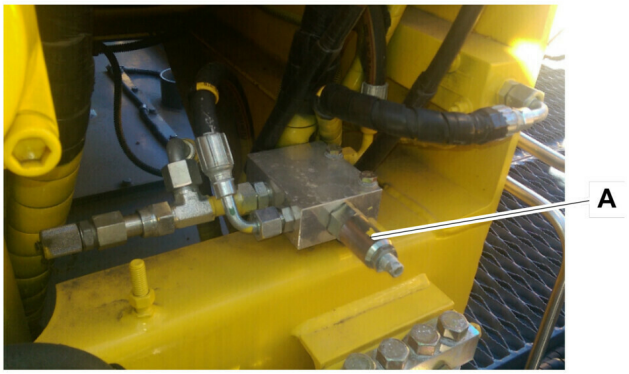


Figure 2

A	Jam nut		

7. Tighten the jam nut to hold the pressure when it is set.
8. Set the sequence valve (Figure 3, item D) cartridge at 35 to 38 bar (500 to 550 psi).

> **NOTE:** *The sequence valve cartridge is in the port that is labeled RSDC in the manifold (Figure 3).*

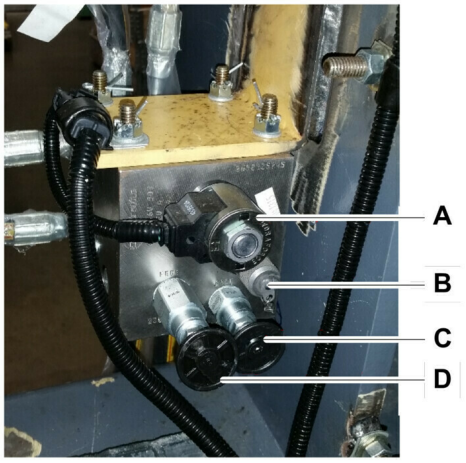


Figure 3

A	Tensioner solenoid	B	Test fitting port
C	Upper tensioner relief valve	D	Sequence valve

9. Attach a 69 bar (1,000 psi) gauge or transducer to the test fitting in the sequence valve inlet.

10. Hold the upper tensioner solenoid valve in the open position by supplying 24 volts DC to the valve coil or Use the **Setting** > **Rig** > **Parameters** > **Cable Tension Adjustment** screen to activate the solenoid and select **Cable Tension Release** (Figure 4).

> ***NOTE:*** *Log in at the SE level to access the* **Cable Tension Adjustment** *screen.*

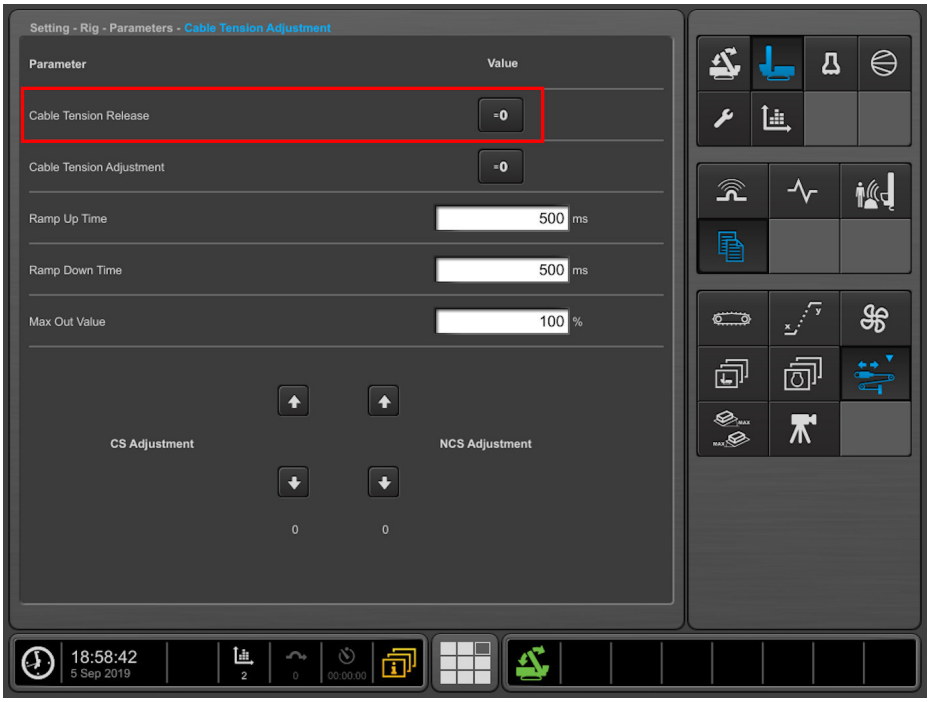


Figure 4

11. Break loose the jam nut on the valve. Turn the adjustment screw clockwise or counterclockwise with a hex wrench to adjust the pressure.

12. Adjust the sequence valve until the gauge reads 35 to 38 bar (500 to 550 psi).

13. Tighten the jam nut (Figure 5, item A) to hold the valve setting when the valve is set to the needed pressure.

Figure 5

A	Sequence valve jam nut		

14. Cancel **Cable Tension Release** on the **Cable Tension Adjustment** screen to remove power from the valve coil.

12.3.10 Adjusting the Cable (Machine Operating)

> ***NOTE:*** *The next three steps must be done with the mast in the vertical position.*

1. **DANGER**

   Electrocution Hazard

   Operating near or contacting a power line with any part of the machine can cause electrocution, causing death.

   - ▶ Do not raise or lower the mast or operate the machine near electric power lines.
   - ▶ Keep at least 3 meters (10 feet) away from power lines.
   - ▶ If there appears any danger of wind or other obstruction decreasing the distance, do not drill in that area.

   Raise the mast to the vertical position and lock it in place.

2. Extend the feed cylinders fully for three times to release all of the air from the feed system.

3. Extend the feed cylinders fully to move the rotary head to the bottom of the mast until the head guides make contact with the lower stops.
4. If the head guides do not reach the stops, select **Cable Tension Release** on the **Cable Tension Adjustment** screen. This action releases the upper tensioning cylinders so that contact can be made.
5. Pull the head guides to the stops using the lower cable jack screws (Figure 6). Use the arrows on the **Cable Tension Adjustment** screen to control the tension screws (Figure 7).

Figure 6

> ***NOTE:*** *Pushing the up or down arrow boxes either increases or decreases the amount of cable sag for each side of the mast.*

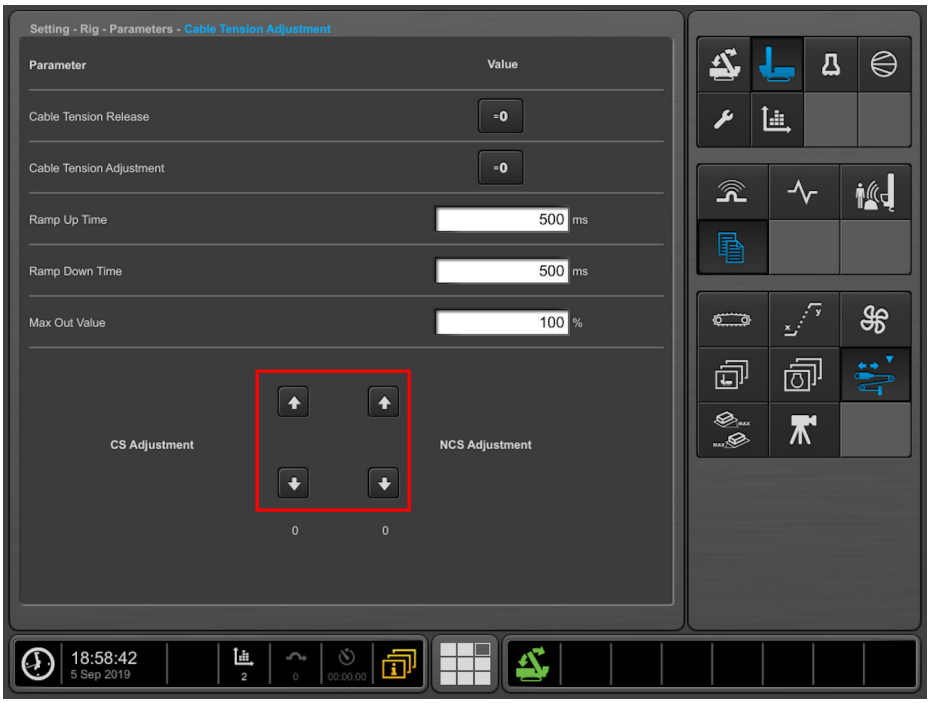


Figure 7

6. Select **Cable Tension Release** on the **Cable Tension Adjustment** screen again to cancel it. This action re-energizes the upper tensioning cylinders to make sure that the head guides are not lifted off the stops.
7. Move the rotary head up and down the mast several times to make sure that the head guides make contact with the lower stops.
8. Move the rotary head to the upper stops.
9. **DANGER**

   Electrocution Hazard

   Operating near or contacting a power line with any part of the machine can cause electrocution, causing death.

   - ▶ Do not raise or lower the mast or operate the machine near electric power lines.
   - ▶ Keep at least 3 meters (10 feet) away from power lines.
   - ▶ If there appears any danger of wind or other obstruction decreasing the distance, do not drill in that area.

   Lower the mast to the horizontal position.

10. Repeat steps 6, 7, 8, and 9 until step 11 is achieved.

11. Adjust the cable sag using the cab side cable tension jack screws. The cable sag must be between 51 to 76 millimeters (2 to 3 inches).

> ***NOTE:*** *Take the measurement from the centerline of the front mast tubing (chord) to the centerline of the cables (Figure 8).*

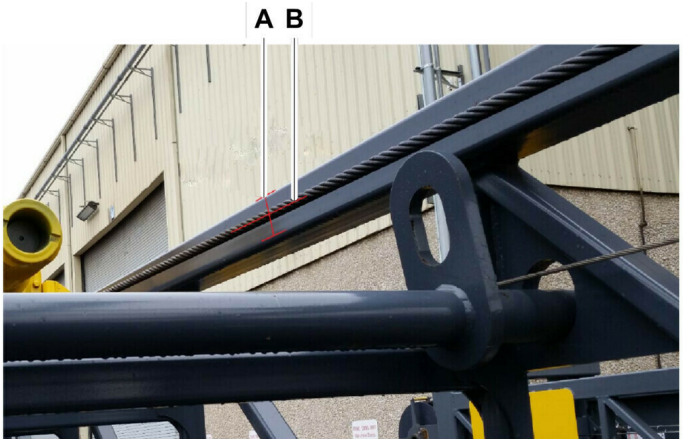


Figure 8

A	Chord	B	Cable line

12. Adjust the cable sag to match the cab side lower cable using the non-cab side jack screw.

> ***NOTE:*** *Both the cables must be adjusted for the identical amount of sag to have the same cable preloaded.*

> ***NOTE:*** *The adjustment direction of this valve is opposite to that of conventional pressure control valves. Clockwise adjustment decreases the valve settings.*

12.3.11 After Completing the Task

1. Remove all tools and unwanted materials from the work area.
2. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

12.4 Do a Torque Inspection of the Track Final Drive Cap Screws

Refer to Do a Torque Inspection of the Track Final Drive Cap Screws in 100-Hour Initial Maintenance.

12.5 Change the Track Final Drive Oil

Refer to Change the Track Final Drive Oil in 100-Hour Initial Maintenance.

12.6 Change the Water Injection Pump Oil

Refer to Change the Water Injection Pump Oil in 50-Hour Initial Maintenance.

12.7 Change the Grease Tank Electric Pump Oil

12.7.1 Labor Resource (People/Skills)

Service Technician x 1

12.7.2 Personal Protection Equipment

! ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

12.7.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

! ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Container	19 L (5 gal)

Consumables

Description	Specification	Quantity
Motor oil	SAE 10W30	1 L (1 qt)

12.7.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

12.7.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Changing the Grease Tank Electric Pump Oil	00:30

12.7.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Environmental Instructions	Model specific Maintenance Manual

12.7.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

12.7.8 Changing the Grease Tank Electric Pump Oil

1. Disconnect the electric plug from the motor.
2. **CAUTION**

   Environmental Contaminant

   Oil is an environmental contaminant and must be discarded correctly.

   - ▶ Do not let the used oil drain onto the ground.
   - ▶ Discard the used oil in accordance with local environmental regulations.

> ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

Put a container below the drain port to collect the used oil.

3. Remove the oil level dipstick (Figure 1, item A).

Figure 1

A	Dipstick	B	Drain plug

4. Remove the drain plug (item B) and drain the oil into the container.
5. Install the drain plug when the oil flow is stopped.
6. Fill with new oil through the dipstick port.

> ***NOTE:*** *The oil level must be at the FULL mark on the dipstick.*

7. Insert the dipstick into the motor.

12.7.9 After Completing the Task

1. **CAUTION**

   Environmental Contaminant

   Oil is an environmental contaminant and must be discarded correctly.

   - ▶ Do not let the used oil drain onto the ground.
   - ▶ Discard the used oil in accordance with local environmental regulations.

> ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

Remove the container and discard the used oil in accordance with local environmental regulations.

2. Clean the work area and remove all tools and unwanted materials.
3. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

12.8 Change the Engine and Compressor Air Filter Elements

12.8.1 Labor Resource (People/Skills)

Service Technician x 1

12.8.2 Personal Protection Equipment

> ! ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Nose - Respirator
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

12.8.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ! ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Not applicable		

12.8.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Primary filter elements		2
Safety filter elements		2
Cotter pin		1
Seal cover		1
Dust cover		1
Wing nut		1
Washer		1

12.8.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Changing the Engine and Compressor Air Filter Elements	00:10

12.8.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

12.8.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Make the machine level.
3. Put all of the controls in the OFF or neutral position.
4. Stop the machine.
5. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

6. Make sure that the machine is in a zero-energy state.
7. Put blocks at the tracks, as applicable.

12.8.8 Removing the Engine and Compressor Air Filter

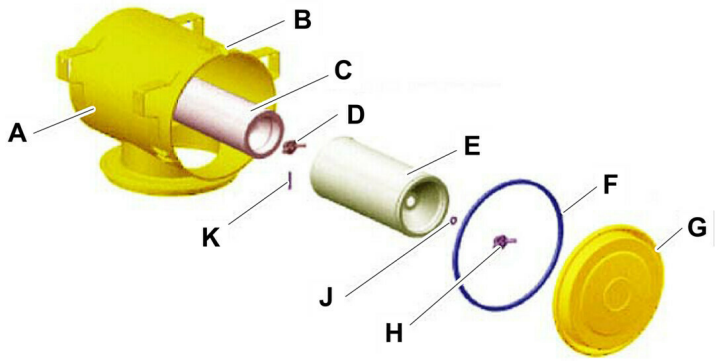
WARNING

Dust Inhalation

Can cause personal injury.

- ▶ Use a respirator when you do maintenance on the air filters.

1. Remove the three clamps (Figure 1, item B) that hold the dust cover.



A	Upper body assembly	B	Clamp
C	Safety element	D	Safety element restriction indicator
E	Primary air cleaner element	F	Seal
G	Dust cover	H	Wing nut
J	Washer	K	Cotter pin

2. Remove the dust cover (item G).
3. Remove the wing nut (item H) and the washer (item J).
4. Carefully withdraw the primary air cleaner element (item E).
5. Examine the safety element restriction indicator (item D). If the indicator is red, replace the safety element.

> ! ***NOTE:*** *Make sure that the safety element wing nut is tight. Do not try to clean a safety element. Change the safety element after three primary element changes or as indicated by the safety element restriction indicator.*

6. To replace the safety element, remove the cotter pin (item K) and the restriction indicator (item D). Remove the safety element (item C) carefully.
7. Discard the used element correctly.

12.8.9 Installing the Engine and Compressor Air Filter

1. Clean inside the filter cover and the housing with a clean, damp cloth.

> ! ***NOTE:*** *Make sure that the new elements arrive enclosed in plastic or in a protective membrane. Do not install the elements that have been sitting on the shelf unprotected. This condition is a dust hazard.*

2. Install a new safety element and secure it with the restriction indicator and the cotter pin.
3. Examine the new primary element for torn or damaged pleats, bent end covers, liners, seal, and gaskets.
4. Make sure that the primary element wing nut and washer are not cracked or damaged. Replace them if necessary.
5. Install the new primary element carefully. Secure it with the wing nut and the washer.
6. Install the dust cover. Make sure that all clamps are tight.

12.8.10 After Completing the Task

1. Remove all tools, equipment, and materials from the work area and store them correctly.
2. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

12.9 Change the Rotary Head Oil and Filters

12.9.1 Labor Resource (People/Skills)

Service Technician x 1

12.9.2 Personal Protection Equipment

> ! ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

12.9.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Drain hose	
Strap wrench	
Torque wrench, calibrated	Capacity up to 135 N·m (100 ft·lb)
Tags	As required

Support Equipment

Description	Specification
Container	34 L (9 gal)

Consumables

Description	Specification	Quantity
Gearbox oil	As specified in Refill Capacities and Lubricants	34 L (9 gal)

12.9.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Suction filter		1
Rotary head oil filter		1

12.9.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Changing the Rotary Head Oil and Filters	00:30

12.9.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Environmental Instructions	Model specific Maintenance Manual
Refill Capacities and Lubricants	Model specific Maintenance Manual

12.9.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. **DANGER**

   Electrocution Hazard

   Operating near or contacting a power line with any part of the machine can cause electrocution, causing death.

   - Do not raise or lower the mast or operate the machine near electric power lines.
   - Keep at least 3 meters (10 feet) away from power lines.
   - If there appears any danger of wind or other obstruction decreasing the distance, do not drill in that area.

   Raise the mast to the vertical position and lock it in place.
3. Remove the drill pipe and lower the rotary head to the bottom of the mast.
4. Put all of the controls in the OFF or neutral position.
5. Stop the machine.

6. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> **NOTE:** *Refer to Safety Locks and Tags Minimum Requirements.*

7. Make sure that the machine is in a zero-energy state.
8. Put blocks at the tracks, as applicable.
9. **CAUTION**

   Environmental Contaminant

   Oil is an environmental contaminant and must be discarded correctly.

   - ▶ Do not let the used oil drain onto the ground.
   - ▶ Discard the used oil in accordance with local environmental regulations.

> **NOTE:** *Refer to Environmental Instructions in the Maintenance manual.*

   Put a container below the rotary head drain point.

10. Clean the area around the fill port to prevent unwanted material get into the fill port during the oil change.

12.9.8 Draining the Rotary Head Oil

WARNING

Burn Hazard

Hot fluids or components can burn.

- ▶ Make sure that the fluids are at a safe working temperature when you service the machine.
- ▶ Do not touch hot fluids or components.

⚠ CAUTION

Environmental Contaminant

Oil is an environmental contaminant and must be discarded correctly.

- ▶ Do not let the used oil drain onto the ground.
- ▶ Discard the used oil in accordance with local environmental regulations.

! ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

1. Remove the drain plug (Figure 1, item E) and connect a drain hose to the drain port.

! ***NOTE:*** *Make sure that the oil is warm before you drain the oil.*

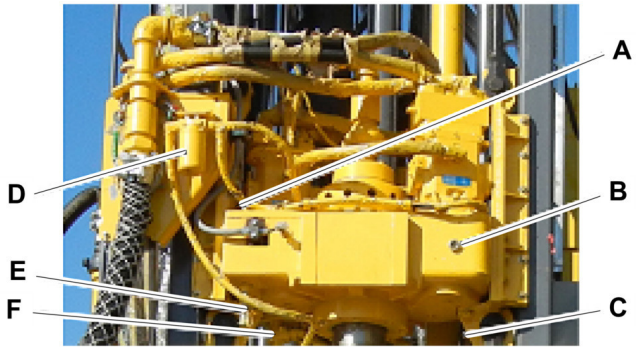


Figure 1

A	Fill plug	B	Fluid level sight glass
C	Rotary head lube pump suction filter	D	Rotary head oil filter
E	Drain plug	F	Rotary head lube pump

2. Open the drain valve.
3. Remove the fill plug (item A) to let the air go into the rotary head housing.

! ***NOTE:*** *Make sure that no contamination get into the fill ports.*

4. Let the oil drain completely into the container.
5. Close the drain valve.
6. Disconnect the drain hose.
7. Clean the drain plug.

8. Install the drain plug. Torque the drain plug to 81 Newton meters (60 foot-pounds) dry.
9. Disconnect the hose from the rotary head lubrication pump suction filter (item C). Plug the hose and cap the port immediately.
10. Loosen the suction filter from the bottom of the rotary head case.
11. Install the new suction filter and tighten it.
12. Remove the plug from the hose and connect the hose to the rotary head lubrication pump filter and tighten it.
13. Remove the rotary head oil filter (item D) with a strap wrench.
14. Install the new rotary head oil filter and tighten it.

12.9.9 Filling the Rotary Head with Oil

1. Fill the rotary head gearbox through the fill port with the specified gearbox oil until the oil is near the top of the oil level sight glass.
2. Clean the fill plug.
3. Install the fill plug and tighten it

12.9.10 After Completing the Task

1. **⚠ CAUTION**

   Environmental Contaminant

   Oil is an environmental contaminant and must be discarded correctly.

   - ▶ Do not let the used oil drain onto the ground.
   - ▶ Discard the used oil in accordance with local environmental regulations.

   ! ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

   Remove the container and discard the used oil in accordance with local environmental regulations.

2. Remove all tools and unwanted materials from the work area.
3. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

   ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

12.10 Change the Hydraulic Clutch Oil

Refer to Change the Hydraulic Clutch Oil in 50-Hour Initial Maintenance.

12.11 Change the Hydraulic Clutch Oil Filter

Refer to Change the Hydraulic Clutch Oil Filter in 50-Hour Initial Maintenance.

12.12 Change the Auto-Bit-Changer Gearbox Oil

12.12.1 Labor Resource (People/Skills)

Service Technician x 2

12.12.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Body - Fall protection straps
- Safety devices

12.12.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Container	8 L (2 gal)

Consumables

Description	Specification	Quantity
Gearbox oil	As specified in Refill Capacities and Lubricants	0.95 L (1 qt)
Thread sealant		As required

12.12.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

12.12.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Changing the Auto-Bit-Changer Gearbox Oil	00:15

12.12.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

Description	Reference
Environmental Instructions	Model specific Maintenance Manual
Refill Capacities and Lubricants	Model specific Maintenance Manual

12.12.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Raise the machine high enough to work below the Auto Bit Changer.
3. Put all of the controls in the OFF or neutral position.
4. Stop the machine.
5. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

6. Make sure that the machine is in a zero-energy state.
7. Put blocks at the tracks, as applicable.

12.12.8 Draining the Gearbox Oil

⚠ WARNING

Hot Fluids or Components

Hot fluids or components can burn.

- ▶ Make sure that the fluids are at a safe working temperature when servicing the machine.
- ▶ Do not touch hot fluids or components.

⚠ WARNING

Low Overhead Clearance Hazard

Can cause severe head injury

- ▶ Be careful when you go into the work area below the machine.
- ▶ Use correct head protection when you work below the machine.

CAUTION

Environmental Contaminant

Oil is an environmental contaminant and must be discarded correctly.

- ▶ Do not let the used oil drain onto the ground.
- ▶ Discard the used oil in accordance with local environmental regulations.

! ***NOTE:*** *Refer to Environmental Instructions.*

1. Put a container below the auto-bit-changer gearbox drain plug (Figure 1, item B).

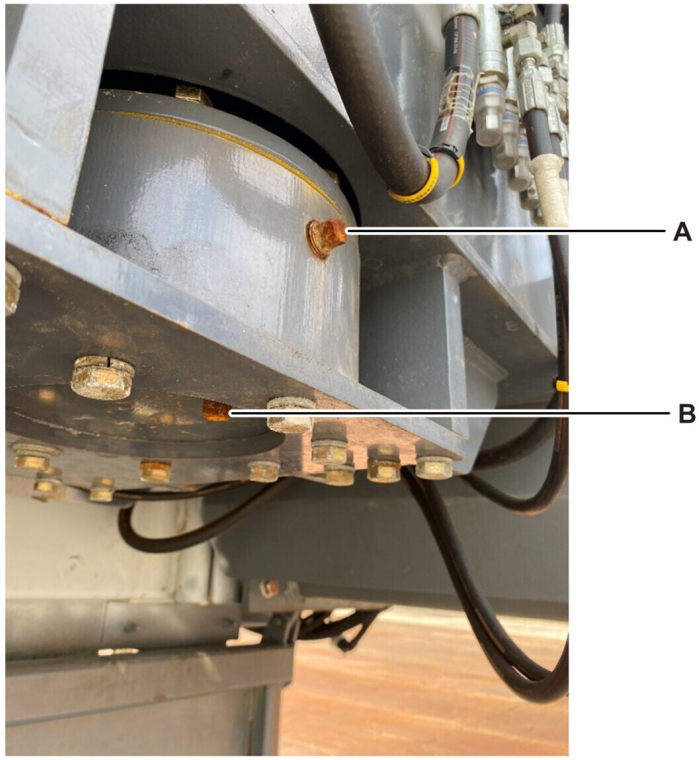


Figure 1

A	Fill port	B	Drain plug

2. Clean the area around the fill port (item A) and the drain plug (item B).
3. Remove the drain plug from the gearbox.
4. Drain the oil from the gearbox into the container.

! ***NOTE:*** *Use thread sealant on all NPT threads.*

5. Clean the drain plug threads.
6. Install the drain plug into the gearbox.

12.12.9 Filling the Gearbox with Oil

1. Remove the plug from the gearbox fill port (item A).
2. Fill the gearbox with oil through the gearbox fill port.
3. Stop filling the gearbox with oil when the oil level is at the bottom of the fill port.

> ***NOTE:*** *Use thread sealant on all NPT threads.*

4. Clean the threads of the plug.
5. Install the plug into the gearbox fill port.

12.12.10 After Completing the Task

1. Remove all tools and trash from the work location.

> **CAUTION**
>
> **Environmental Contaminant**
>
> Oil is an environmental contaminant and must be discarded correctly.
>
> ▶ Do not let the used oil drain onto the ground.
>
> ▶ Discard the used oil in accordance with local environmental regulations.

> ***NOTE:*** *Refer to Environmental Instructions.*

2. Remove the container and discard the used oil in accordance with local environmental regulations.
3. Remove the safety locks and tags to the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

4. Release the machine to the customer clean and free of leaks.

13 2,000-Hour Periodic Maintenance

13.1 Change the Receiver Tank Discharge Hose and Clamps

13.1.1 Labor Resource (People/Skills)

Service Technician x 1

13.1.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

13.1.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Torque wrench, calibrated	Capacity up to 271 N·m (200 ft·lb)
Tags	As required

Support Equipment

Description	Specification
Container	8 L (2 gal)

Consumables

Description	Specification	Quantity
Compressor oil	As specified in Refill Capacities and Lubricants	As required

13.1.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Clamp, hose (Victaulic ,Campbell, or Dixon)		2

13.1.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Changing the Receiver Tank Discharge Hose and Clamps	02:00

13.1.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Change the Compressor Oil and Filter	Model specific Maintenance Manual
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Refill Capacities and Lubricants	Model specific Maintenance Manual
Environmental Instructions	Model specific Maintenance Manual

13.1.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.
7. **⚠ WARNING**

   Hot Fluids or Components

   Can cause serious burns.

   ▶ Be careful when you work with any hot fluid or change the filters.

   ⚠ WARNING

   High Pressure

   Can cause severe injury or death.

   ▶ Release all of the air pressure from the system before you remove any plugs or open the ball valve.

   Open the ball valve on the side of the receiver tank to release the air out of the receiver tank.

   > ! ***NOTE:*** *The pressure gauge must read zero kPa (zero psig).*

8. Close the ball valve.

13.1.8 Removing the Receiver Tank Discharge Hose and Clamp

1. Drain the receiver tank of compressor oil.

> ***NOTE:*** *Refer to Change the Compressor Oil in 1,000-Hour Periodic Maintenance.*

2. **CAUTION**

Environmental Contaminant

Oil is an environmental contaminant and must be discarded correctly.

- Do not let the used oil drain onto the ground.
- Discard the used oil in accordance with local environmental regulations.

> ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

Put a container below the discharge hose to collect the spilled oil.

3. Determine the type of clamp that is installed on the discharge hose: a Dixon clamp (Figure 1, item D), a Campbell clamp (item C), or a Victaulic clamp (Figure 2, item A).

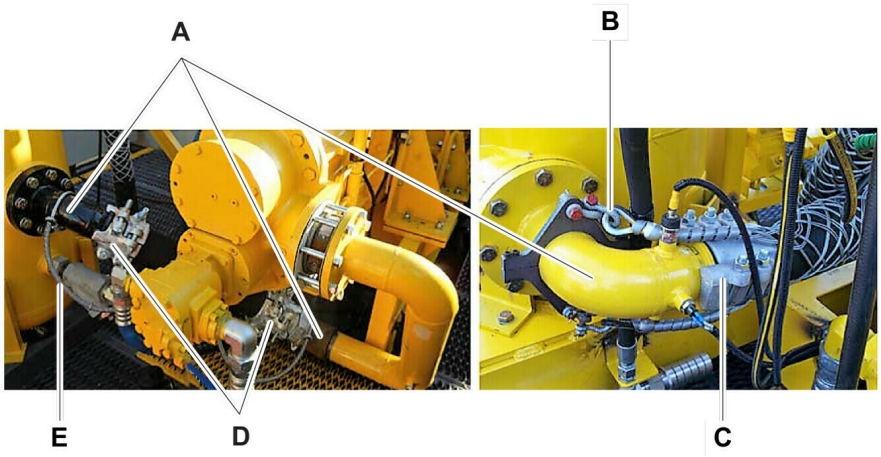
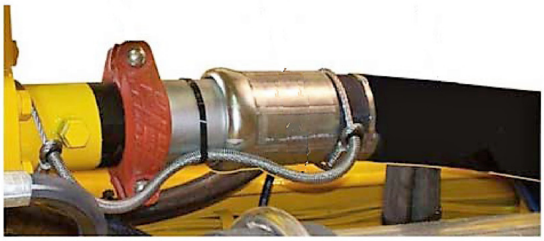


Figure 1

A	Discharge hose	B	Whipsock
C	Campbell clamp	D	Dixon clamp
E	Safety restraint cable		



A

Figure 2

A	Victaulic clamp		

4. Remove the cap screws and clamps from the discharge hose. Discard the cap screws and the clamps.
5. Do either of the following steps:
   - Move the safety restraint cable (Figure 1, item E) to the outlet stems on the compressor and receiver tank.
   - Remove the safety whipsock (item B) eyelets from the compressor and receiver tank valve stem.
6. Disconnect and remove the discharge hose (Figure 1, items A) from the compressor and receiver tank stems.
7. Remove the safety whipsock (Figure 1, item B) from the discharge hose, if available.
8. Discard the removed hose in accordance with local environmental regulations.

13.1.9 Installing the Receiver Tank Discharge Hose and Clamp

1. Install the removed whipsock onto the new discharge hose if it was removed.
2. Connect the discharge hose onto the receive tank and compressor outlet stems.
3. Move the safety restraint cable to the discharge hose or move the safety whipsock eyelets to the compressor and receiver tank valve stem shackles.
4. Install the new clamps onto the discharge hose, Dixon, Campbell, or Victaulic clamps.
5. Torque the clamps in accordance with the manufacturer instructions.
6. Fill the receiver tank with oil to the middle of the sight glass.

> ! ***NOTE:*** *Refer to Change the Compressor Oil in 1,000-Hour Periodic Maintenance.*

13.1.10 After Completing the Task

1. **CAUTION**

   Environmental Contaminant

   Oil is an environmental contaminant and must be discarded correctly.

   - ▶ Do not let the used oil drain onto the ground.
   - ▶ Discard the used oil in accordance with local environmental regulations.

   NOTE: *Refer to Environmental Instructions in the Maintenance manual.*

   Remove the container and discard the used oil in accordance with local environmental regulations.

2. Remove all tools and unwanted materials from the work area.
3. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

   NOTE: *Refer to Safety Locks and Tags Minimum Requirements.*

13.2 Change the Compressor Air Separator Element

13.2.1 Labor Resource (People/Skills)

Service Technician x 2

Crane Operator x 1

13.2.2 Personal Protection Equipment

NOTE: *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

13.2.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Torque wrench, calibrated	Capacity up to 325 N·m (240 ft·lb)
Tags	As required

Support Equipment

Description	Specification
Crane	As required
Lifting equipment	As required

Consumables

Description	Specification	Quantity
Compressor oil	As specified in Refill Capacities and Lubricants	As required

13.2.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Separator element		1
Cap screws		12

13.2.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Changing the Compressor Air Separator Element	04:00

13.2.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Environmental Instructions	Model specific Maintenance Manual
Refill Capacities and Lubricants	Model specific Maintenance Manual

13.2.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.
7. Make sure that the receiver tank has cooled to a temperature that can be handled safely.

13.2.8 Removing the Compressor Air Separator Element

⚠ WARNING

Burn Hazard

Can cause severe burns.

- ▶ Do not touch hot oil or components.
- ▶ Let the receiver tank cool below operating temperatures.

WARNING

High Pressure

Can cause severe injury or death

- Release all of the air pressure in the system before you remove the filler plug, drain valve, fittings, or receiver tank lid.

1. Open the ball valve (Figure 1, item A) on the side of the receiver tank to release the residual pressure.

> ***NOTE:*** *The pressure gauge must read zero kPa (zero psig).*

> ***NOTE:*** *The receiver tank to mast main air hose can remain connected when doing the next step.*

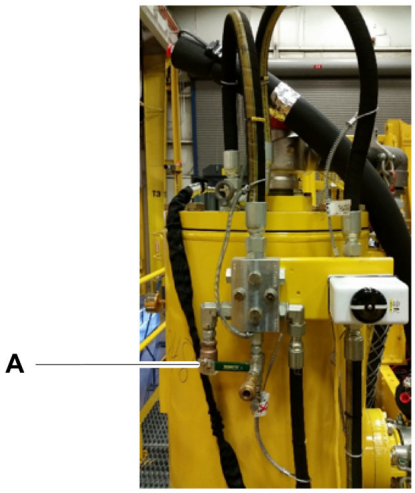


Figure 1

A	Ball valve		

2. Close the ball valve when the pressure gauge shows zero Kpa (zero psig).
3. Disconnect the cables that are attached to the receiver tank lid.
4. Clean, label, and disconnect the hoses from the receiver tank lid. Plug the hoses and cap the ports immediately.

5. Remove the cap screws and washers (Figure 2, item A) from the receiver tank lid. Discard the cap screws and washers.

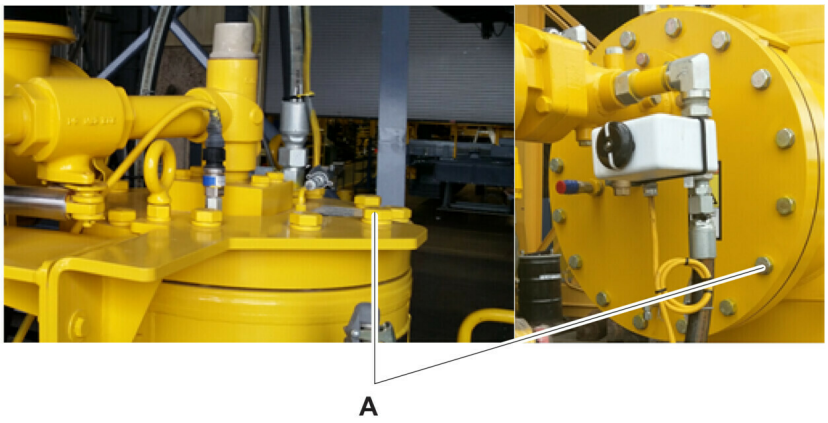


Figure 2

A	Cap screws and washers		

6. **WARNING**

Equipment Interference Hazard

Can cause severe injury or property damage.

- ▶ Make sure that no overhanging power lines or any other obstructions are present that can interfere with the use of a boom truck crane or mobile crane.

Position the crane next to the machine.

7. **WARNING**

Crushing Hazard

Can cause personal injury.

- ▶ Lifting equipment must be adequately sized, have the correct lifting capacity, and be in good condition.
- ▶ Be careful when you lift heavy components.

Attach an approved lifting device through each of the two eye bolts or the lifting hook on the receiver tank lid.

> ***NOTE:*** *Machines that are equipped with an LP 2600 compressor have a receiver tank with the separator element that is mounted horizontally (Figure 3).*

8. Lift the lid and store it in a safe location.

Figure 3

> ***NOTE:*** *Do not damage the scavenger hose that is attached internally on the lid.*

9. Remove the separator element from the tank.

> ***NOTE:*** *A second technician is needed to assist you for safe removal of the separator element.*

10. Examine the removed separator element for any missing filter material.
11. Change the compressor oil cooler filter if the separator element is damaged or any filter material pieces are missing.
12. Examine inside of the receiver tank to make sure that the internal baffle is secure and not cracked. If it is damaged, report it to the supervisor.

13.2.9 Installing the Compressor Air Separator Element

1. Clean and dry the mounting surfaces of the lid and the tank.

2. Make sure that the new element has a metal clip (Figure 4, item A) in the gasket area.

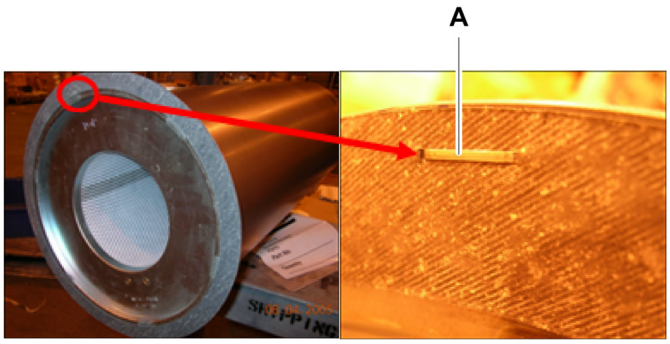


Figure 4

A	Metal clip		

> ***NOTE:*** *The new separator element has a metal staple in the gasket on the flange. It dissipates static electricity. Do not remove this staple.*

3. Install the new separator element into the tank carefully. Make sure that the new filter is centered within the receiver tank with the TOP marking (Figure 5, item A) positioned at the top and the two drain holes (item B) at the bottom.

> ***NOTE:*** *A second technician is needed to assist you for safe removal of the separator element.*

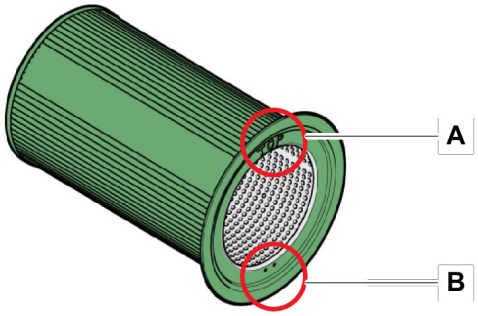


Figure 5

A	TOP marking	B	Drain holes

4. Make sure that the scavenger hose inside of the lid is clear of unwanted material and contaminants.

5. **WARNING**

   Crushing Hazard

   Can cause personal injury.

   - ▶ Lifting equipment must be adequately sized, have the correct lifting capacity, and be in good condition.
   - ▶ Be careful when you lift heavy components.

   Attach the lid to the crane with an approved lifting device.

6. Install the lid to the receiver tank.
7. Remove the lifting device and the crane from the work area.
8. Torque the receiver tank cover cap screws in 30%, 60% and final torque increments. Follow the torque sequence as shown in Figure 6:

   NOTE: *Refer to Figure 6 for the correct torque sequence.*

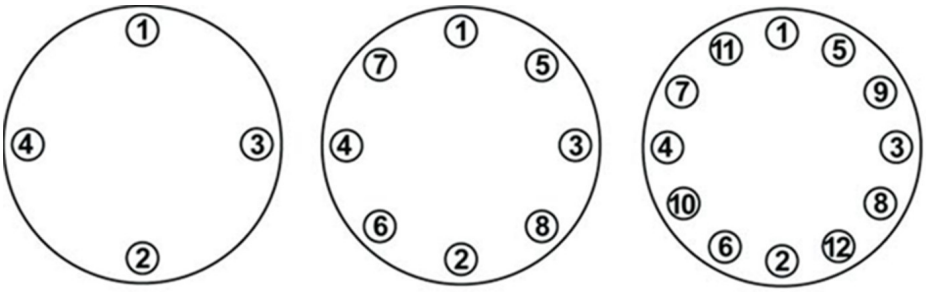


Figure 6

   NOTE: *Refer to the table for applicable torque value for each cap screw.*

Table 1

Compressor	Cap screw size	Initial torque (30%)	Secondary torque (60%)	Final torque (100%)
LP 2600	19.0 mm (3/4 in.)	97 Nm (72 ft-lb)	195 Nm (144 ft-lb)	325 Nm (240 ft-lb)
HP 1450	22.2 mm (7/8 in.)	97 Nm (72 ft-lb)	195 Nm (144 ft-lb)	325 Nm (240 ft-lb)
LP 1900	25.4 mm (1 in.)	100 Nm (74 ft-lb)	199 Nm (147 ft-lb)	332 Nm (245 ft-lb)

9. Connect all of the cables and the hoses onto the receiver tank lid.

13.2.10 After Completing the Task

⚠ CAUTION

Environmental Contaminant

Filters can contain oil residue, which is an environmental contaminant and must be discarded correctly.

▶ Discard the used filter in accordance with local environmental regulations.

! ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

1. Discard the removed separator element in accordance with the local environmental regulations.
2. Do a compressor oil level check at the receiver tank sight glass. Add oil, if necessary.

! ***NOTE:*** *The compressor oil must be visible at the middle of the sight glass.*

3. Do a leak check at the hoses and mounting surfaces on the receiver tank. Do the corrections as needed.
4. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

13.3 Change the Hydraulic Tank Breathers

13.3.1 Labor Resource (People/Skills)

Service Technician x 1

13.3.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

13.3.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Compressed air source	

Consumables

Description	Specification	Quantity
Not applicable		

13.3.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Hydraulic tank breathers		2

13.3.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Changing the Hydraulic Tank Breathers	00:30

13.3.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

13.3.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

   > ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

13.3.8 Examining the Breathers

1. Clean the area around the breather.
2. Examine the two breathers on the top of the hydraulic tank for damage or blockage. Replace the breathers, if necessary.

13.3.9 Removing the Breathers

1. Loosen the two breathers (Figure 1, item A) from the top of the hydraulic tank and remove them.

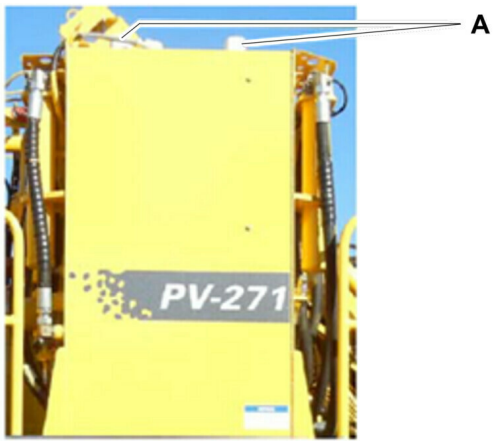


Figure 1

A	Hydraulic tank breathers		

2. Cover the open ports of the hydraulic tank until the new breathers are installed.

13.3.10 Installing the Breathers

1. Remove the cover on the breather ports of the hydraulic tank.
2. Install the two new breathers into the hydraulic tank breather ports.

13.3.11 After Completing the Task

⚠ CAUTION

Environmental Contaminant

Filters can contain oil residue, which is an environmental contaminant and must be discarded correctly.

▶ Discard the used filter in accordance with local environmental regulations.

> ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

1. Discard the removed breathers in accordance with local environmental regulations.
2. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

13.4 Change the Hydraulic Clutch Tank Breather

13.4.1 Labor Resource (People/Skills)

Service Technician x 1

13.4.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

13.4.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, this section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See the machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Not applicable		

13.4.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Breather		1

13.4.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Changing the Hydraulic Clutch Tank Breather	00:05

13.4.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

13.4.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Raise the machine to a workable height to get access to the clutch tank below the hydraulic tank.
3. Put all of the controls in the OFF or neutral position.
4. Stop the machine.
5. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

   ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

6. Make sure that the machine is in a zero-energy state.
7. Put blocks at the tracks, as applicable.

13.4.8 Removing the Hydraulic Clutch Tank Breather

WARNING

Burn Hazard

Hot fluids or components can burn.

- ▶ Make sure that the fluids are at a safe working temperature when you service the machine.
- ▶ Do not touch hot fluids or components.

1. Remove the breather (Figure 1, item A) from the top of the clutch tank.

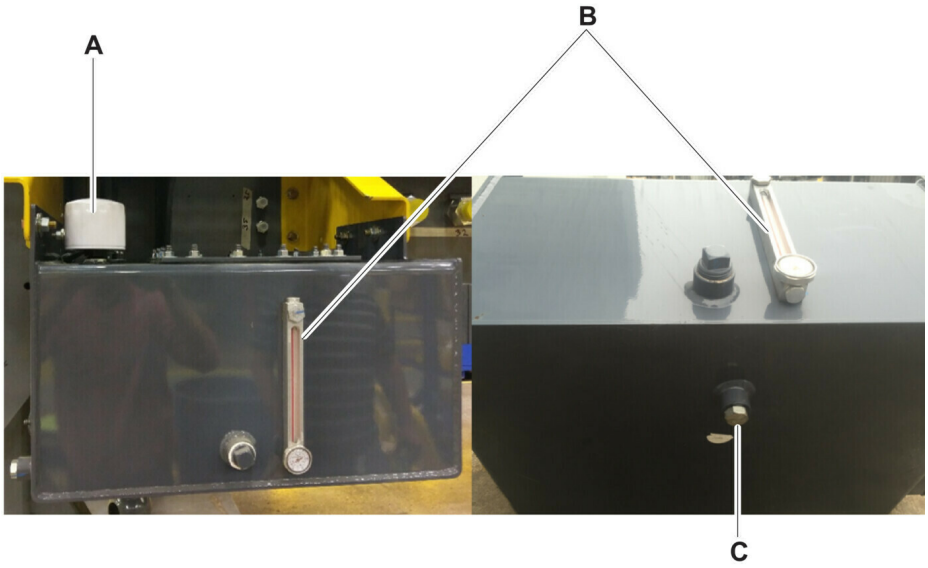


Figure 1

A	Breather	B	Sight glass
C	Drain port plug		

2. Cover the breather port to prevent dirt and unwanted material get into the clutch tank.

13.4.9 Installing the Hydraulic Clutch Tank Breather

1. Uncover the breather port.
2. Install a new breather onto the clutch tank.

> ! ***NOTE:*** *Do not over-tighten the breather.*

3. Tighten the breather by hand.

13.4.10 After Completing the Task

1. Clean the work area of all tools and unwanted material.
2. Remove the safety locks and tags from the machine with site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

3. Return the machine to the customer.

13.5 Change the Hydraulic Tank Oil Filters

13.5.1 Labor Resource (People/Skills)

Service Technician x 1

13.5.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

13.5.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Compressed air source	
Container	19 L (5 gal)

Consumables

Description	Specification	Quantity
Hydraulic oil	As specified in Refill Capacities and Lubricants	As required
Cleaning solvent		As required

13.5.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Element, filter		4

13.5.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Changing the Hydraulic Oil Filters	00:30

13.5.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Environmental Instructions	Model specific Maintenance Manual
Refill Capacities and Lubricants	Model specific Maintenance Manual

13.5.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.

4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.
7. **WARNING**

   Burn Hazard

   Hot fluids or components can burn.

   - Make sure that the fluids are at a safe working temperature when you service the machine.
   - Do not touch hot fluids or components.

   Let the oil in the hydraulic tank cool to a safe working temperature.

13.5.8 Filter Indicators

- Make sure that the hydraulic filter restriction indicator windows at the hydraulic tank filters are red or the RCS screen filter icon is showing on the screen (Figure 1).

Figure 1

A	Hydraulic drain filter #2	B	Hydraulic drain filter #1
C	Hydraulic return filter #1	D	Hydraulic return filter #2

13.5.9 Removing the Hydraulic Oil Filters

WARNING

High Pressure

Hydraulic pressure in the system can cause personal injury.

▶ Release all of the hydraulic pressure from the system before you service the filters.

NOTE: *The pressure gauge must read zero kPa (zero psig).*

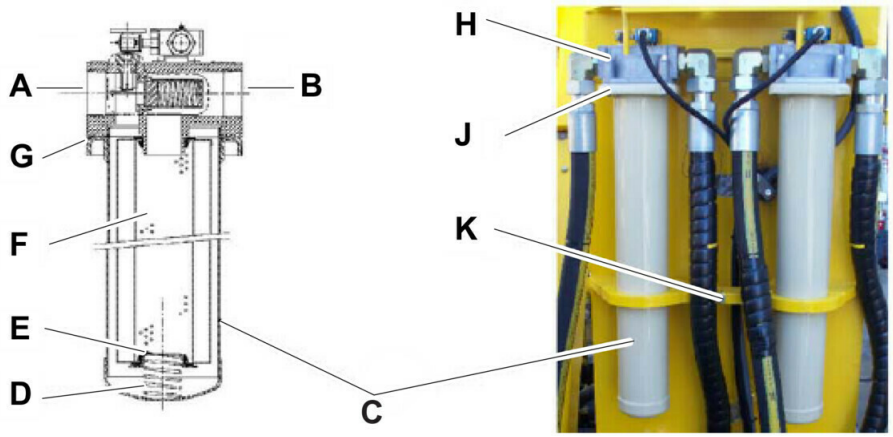


Figure 2

A	In	F	Element
B	Out	G	O-ring
C	Filters	H	Cap screw
D	Spring	J	Retaining ring
E	Plate	K	Filter clamp and cap screw

1.

CAUTION

Environmental Contaminant

Oil is an environmental contaminant and must be discarded correctly.

- ▶ Do not let the used oil drain onto the ground.
- ▶ Discard the used oil in accordance with local environmental regulations.

NOTE: *Refer to Environmental Instructions in the Maintenance manual.*

Put a container below the oil filters to prevent the oil spill from contaminating the ground.

2. **⚠ WARNING**

   Pinch Points

   Removing the hydraulic filter from the bracket can cause pinch points.

   ▶ Be careful when removing the hydraulic filter from the bracket.

   Remove the cap screw (Figure 2, item K) that secures the filters clamp to the hydraulic tank.

3. Remove the four cap screws (item H) that secure the retaining ring (item J) to the filter head.
4. Remove the elements (item F) from the filter housing (item C).
5. Clean the filter housing and the filter head with an approved cleaning solvent.

13.5.10 Installing the Hydraulic Oil Filters

1. Install the compression spring and the spring plate into the bottom of the element before you insert the element into the housing.
2. ***NOTICE***

   Component Damage

   Tightening the cap screws too much damages the housing and the O-ring washer seal, or both.

   ▶ Do not tighten the cap screws too tight.

   Attach the housing to the filter head and tighten the four cap screws evenly and in sequence.

3. Install the filter clamp and tighten the cap screw.
4. Repeat the procedure until all of the hydraulic filter elements are replaced.

13.5.11 After Completing the Task

1. Remove all tools and unwanted materials from the work area.

2. **⚠ CAUTION**

   Environmental Contaminant

   Oil is an environmental contaminant and must be discarded correctly.

   - ▶ Do not let the used oil drain onto the ground.
   - ▶ Discard the used oil in accordance with local environmental regulations.

   ! ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

   Remove the container and discard the used oil and oil filter elements in accordance with local environmental regulations.

3. **⚠ WARNING**

   Energized Equipment

   Can cause serious injury

   - ▶ The machine must be fully energized and the engine must be on to complete this procedure.
   - ▶ Be careful around moving parts and pinch points.

   Inform the supervisor, lead hand, and all other persons that are concerned, of the intent to restart the machine for testing purposes.

   ! ***NOTE:*** *Make sure that all personnel and bystanders are clear of the machine before startup.*

4. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

   ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Start the machine and let the machine operate for five minutes.
6. Put all of the controls in the OFF or neutral position.
7. Stop the machine.

8. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

9. Do a leak check of the hydraulic oil filters. Repair the leaks, as necessary.
10. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

13.6 Change the Fuel Tank Breathers

13.6.1 Labor Resource (People/Skills)

Service Technician x 1

13.6.2 Personal Protection Equipment

> ! ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

13.6.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ! ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Not applicable		

13.6.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Fuel tank breather		1

13.6.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Changing the Fuel Tank Breathers	00:15

13.6.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Environmental Instructions	Model specific Maintenance Manual

13.6.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

13.6.8 Removing the Fuel Tank Breathers

⚠ WARNING

Risk of Personal Injury

Can cause personal injury.

▶ Be careful while bending and reaching.

1. Clean the area around the fuel tank breathers (Figure 1, item A) throughly.

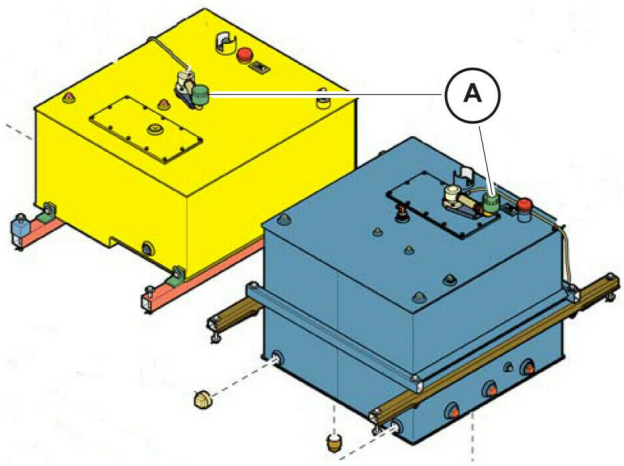


Figure 1

A	Fuel tank breathers		

2. Remove the fuel tank breathers.
3. Cover the breather ports to prevent contamination getting into the fuel tank.

13.6.9 Installing the Fuel Tank Breathers

1. Uncover the breather port.
2. Install the new breather.

> ***NOTE:*** *Do not over-tighten the breather.*

3. Tighten the breather by hand.
4. Repeat steps from 1 through 3 to install the other breather.

13.6.10 After Completing the Task

1. **CAUTION**

   Environmental Contaminant

   Fuel is an environmental contaminant and must be discarded correctly.

   - ▶ Discard the fuel breathers correctly.
   - ▶ Obey all local standards and regulations for discarding the fuel.

> ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

   Discard the fuel tank breathers in accordance with local environmental regulations.

2. Clean the work area of all tools and unwanted materials.
3. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

13.7 Change the Fuel Cap Vent Assembly

13.7.1 Labor Resource (People/Skills)

Service Technician x 1

13.7.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

13.7.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Not applicable		

13.7.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Filter cap		1

13.7.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Changing the Fuel Filter Vent Cap	00:15

13.7.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

13.7.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

   > ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.
7. Remove any dirt or unwanted material from the fuel tank vent assembly.

13.7.8 Removing the Fuel Filter Vent Cap

⚠ WARNING

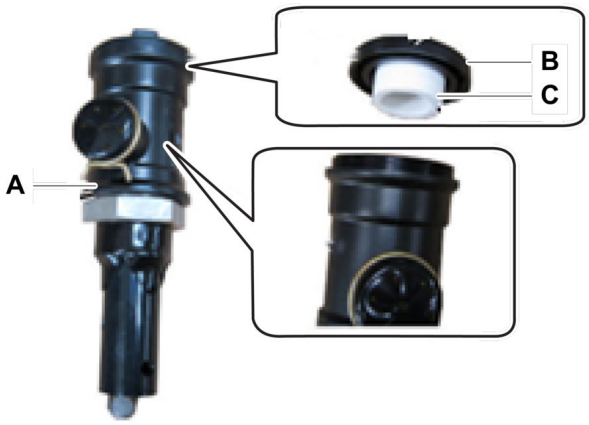
Flammable Liquid

Fuel can ignite and explode and cause serious injury.

- ▶ Do not smoke when you work with or around fuel.
- ▶ Avoid skin and eye contact with fuel. If contact occurs, flush the area immediately with water.

! ***NOTE:*** *The Fuel Tank Vent Assembly filter cap is specific to machines with a quick-fill system.*

1. Hold the Fuel Tank Vent Assembly (Figure 1, item A) in place.



A	Fuel Tank Vent Assembly	B	Filter cap
C	Filter		

2. Remove the filter cap (item B).
3. **⚠ CAUTION**

   Environmental Contaminant

   Fuel is an environmental contaminant and must be discarded correctly.

   - ▶ Discard the fuel breathers correctly.
   - ▶ Obey all local standards and regulations for discarding the fuel.

> ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

Discard the old filter cap in accordance with local environmental regulations.

13.7.9 Installing the Fuel Filter Vent Cap

> ***NOTE:*** *The filter is attached to the cap.*

1. Make sure that the new cap is fitted with an O-ring seal.
2. Install the new filter cap onto the Fuel Tank Vent Assembly.

13.7.10 After Completing the Task

1. Clean the work area of all tools and unwanted materials.
2. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

13.8 Change the Engine Coolant Filter

Refer to the engine manufacturer's Operation and Maintenance manual.

14 5,000-Hour Periodic Maintenance

14.1 Change the Hydraulic Oil

14.1.1 Labor Resource (People/Skills)

Service Technician x 1

14.1.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

14.1.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Container	662 L (175 gal)

Consumables

Description	Specification	Quantity
Hydraulic oil	As specified in Refill Capacities and Lubricants	As required
Oil spill rags or material		As required

14.1.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

14.1.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Changing the Hydraulic Oil	01:00

14.1.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Hydraulic Oil Filter Change	Model specific Maintenance Manual
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Refill Capacities and Lubricants	Model specific Maintenance Manual
Environmental Instructions	Model specific Maintenance Manual

14.1.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Retract all of the hydraulic cylinders.
3. **DANGER**

   Electrocution Hazard

   Operating near or contacting a power line with any part of the machine can cause electrocution, causing death.

   - Do not raise or lower the mast or operate the machine near electric power lines.
   - Keep at least 3 meters (10 feet) away from power lines.
   - If there appears any danger of wind or other obstruction decreasing the distance, do not drill in that area.

   Lower the mast to the horizontal position with the rotary head at the top of the mast.

4. Make sure that all of the leveling jacks are fully retracted.
5. Put all of the controls in the OFF or neutral position.
6. Stop the machine.
7. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

   NOTE: *Refer to Safety Locks and Tags Minimum Requirements.*

8. Make sure that the machine is in a zero-energy state.
9. Put blocks at the tracks, as applicable.
10. **WARNING**

    Burn Hazard

    Hot fluids or components can burn.

    - Do not touch hot fluids or components.

    Let the hydraulic oil cool to 49 °C (120 °F).

14.1.8 Draining the Hydraulic Oil with the Central Drain Point System

WARNING

Liquid Explosion

Can cause severe injury.

- ▶ Disconnect the hydraulic tank high-voltage heater, if equipped, before you drain the system.
- ▶ Release all of the hydraulic and air pressure from the system before you remove any plugs or open the drain valve.

WARNING

High Pressure

High pressure can cause severe injury or death.

- ▶ Release the system pressure before you try to remove any plugs or open the drain valve.

! ***NOTE:*** *The pressure gauge must read zero kPa (zero psig).*

1. Make sure that the breathers on the top of the tank are clean.
2. **CAUTION**

   Environmental Contaminant

   Oil is an environmental contaminant and must be discarded correctly.

   - ▶ Do not let the used oil drain onto the ground.
   - ▶ Discard the used oil in accordance with local environmental regulations.

   ! ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

   Put a container below the central drain point on the cab side, non-drill end of the machine.

3. Close the tank main valve (Figure 1, item B) below the tank.

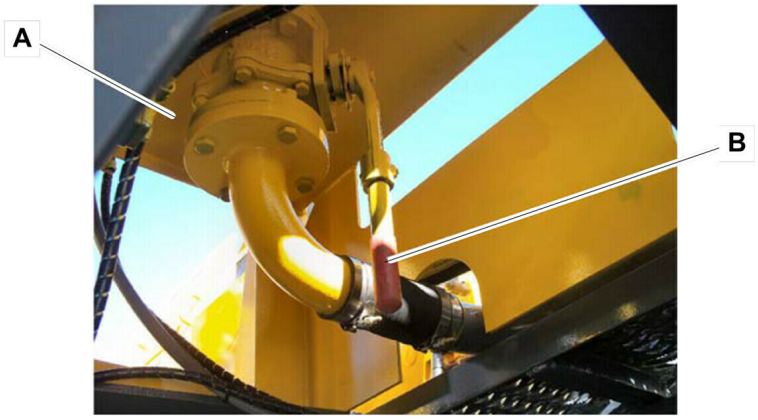


Figure 1

A	Hydraulic tank	B	Hydraulic tank main valve

4. Connect a drain hose to the central drain point (Figure 2, item A).

Figure 2

A	Central drain point		

5. Let the hydraulic oil drain into the container.
6. When the hydraulic tank has stopped draining, remove the drain hoses and the container.

14.1.9 Draining the Hydraulic Oil without the Central Drain Point System

WARNING

Liquid Explosion

Can cause severe injury.

- ▶ Disconnect the hydraulic tank high-voltage heater, if equipped, before you drain the system.
- ▶ Release all of the hydraulic and air pressure from the system before you remove any plugs or open the drain valve.

WARNING

High Pressure

High pressure can cause severe injury or death.

- ▶ Release the system pressure before you try to remove any plugs or open the drain valve.

1. Make sure that the breathers (Figure 3, item C) on the top of the tank are clean.

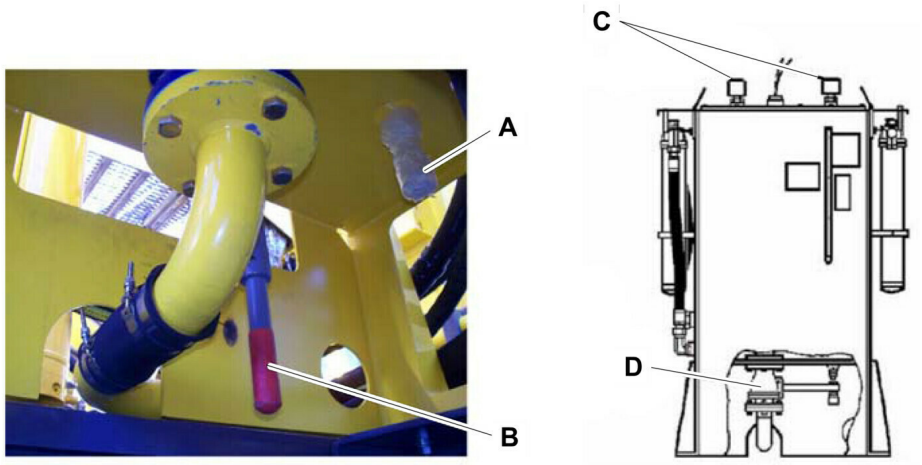


Figure 3

A	Oil drain point or quick hose connection	B	Hydraulic tank main shut off valve
C	Breathers	D	Drain plug

2. **⚠ CAUTION**

   Environmental Contaminant

   Oil is an environmental contaminant and must be discarded correctly.

   - ▶ Do not let the used oil drain onto the ground.
   - ▶ Discard the used oil in accordance with local environmental regulations.

   ! ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

   Put a container below the hydraulic tank oil drain point (item A).

3. Close the hydraulic tank main shutoff valve (item B).
4. Connect a drain hose to the quick connection (item A) below the tank and put the other end of the hose into the container.
5. Let the hydraulic fluid drain into the container.

14.1.10 Filling the Hydraulic Tank

1. Make sure that the breathers on the top of the tank are clean.
2. Close the main tank valve below the tank.
3. Find the correct fitting on the quick-fill connection below the tank for the hydraulic oil and then connect the correct hose to the quick-fill station to the tank.
4. On the fast-fill station on the cab side non-drill end, remove the quick-fill cap and clean the fitting for the hydraulic oil fast-fill.

   ! ***NOTE:*** *Any contamination goes into the hydraulic tank during filling will seriously risk damage to the pumps and motors. The system uses filtration only on the return oil and therefore oil in the tank must be free of contamination.*

5. Replace the hydraulic filters.

   ! ***NOTE:*** *Replace the hydraulic filters every time the hydraulic oil is changed.*

   ! ***NOTE:*** *Refer to Change the Hydraulic Oil Filters in 2,000 Hour Periodic Maintenance.*

6. Fill with new, clean hydraulic oil. The tank holds approximately 594 liters (157 gallons) of hydraulic oil.
7. Make sure that the low hydraulic oil level alarm goes out of view on the RCS monitor when the float reaches the bottom of the sight glass.
8. **NOTICE**

   Component Damage

   Can cause poor performance or early component failure.

   - ▶ Do not overfill when adding oil.
   - ▶ Use the correct oil grade. Refer to the OEM manual.

   Make sure that the tank is not overfilled.

   ! ***NOTE:*** *The fluid must be to the FULL mark on the sight glass.*

9. Open the main tank valve below the tank.
10. Do an oil level check of the reservoir at the sight glass.
11. Remove the quick-fill hose or fast-fill hose.
12. ⚠ **WARNING**

    Energized Machine

    Can cause serious injury

    - ▶ The machine must be fully energized to complete this procedure.
    - ▶ Be careful around moving parts and pinch points.

    Inform the supervisor, lead hand, and all other persons that are concerned, of the intent to restart the machine.

    ! ***NOTE:*** *Make sure that all personnel and bystanders are clear of the machine before startup.*

13. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

14. Start the machine.
15. Let the machine operate until it reaches normal operating temperatures.
16. Put all of the controls in the OFF or neutral position.
17. Stop the machine.
18. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

19. Do a leak check of the hydraulic system.

14.1.11 After Completing the Task

1. Clean the work area of all tools and oil spill materials.
2. **CAUTION**

   Environmental Contaminant

   Oil is an environmental contaminant and must be discarded correctly.

   - Do not let the used oil drain onto the ground.
   - Discard the used oil in accordance with local environmental regulations.

> ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

   Remove the container and discard the used oil in accordance with local environmental regulations.

3. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

14.2 Change the Engine Coolant

14.2.1 Labor Resource (People/Skills)

Service Technician x 1

14.2.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

14.2.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Container	19 L (5 gal)

Consumables

Description	Specification	Quantity
Coolant	Refer to OEM manual	166 L (44 gal)

14.2.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

14.2.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Changing the Engine Coolant	02:00

14.2.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

14.2.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

   > ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

7. **WARNING**

Hot Coolant or Components

Hot coolant or components can burn.

- ▶ Coolant must be at a safe working temperature when you service the machine.
- ▶ Do not touch hot coolant or components.

Let the coolant temperature cool below 49 °C (120 °F).

14.2.8 Draining the Engine Coolant

1. If the machine has a quick-drain port, do the following steps:

a. **CAUTION**

Environmental Contaminant

Coolant is an environmental contaminant and must be discarded correctly.

- ▶ Do not let used coolant drain onto the ground.
- ▶ Obey all local standards and regulations for discarding the used coolant.

! ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

Put a container below the drain port to collect the used coolant.

b. Clean the area around the filler cap on the top of the cooler.

c. **WARNING**

High Pressure

Steam or fluid escaping from the radiator can burn and cause severe injury.

- ▶ Stop the engine and let it cool before you remove the radiator cap.
- ▶ Remove the cap slowly to release the pressure.

Loosen the filler cap slowly to release the pressure and leave it off when draining the system.

> **NOTE:** *Make sure that no dirt is drawn into the radiator while you drain the coolant.*

d. Connect the drain hose to the drain port (Figure 1, item A).

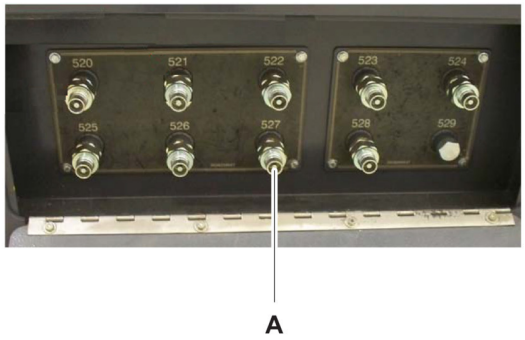


Figure 1

A	Drain port		

e. Drain the coolant into the container.

2. If the machine does not have a quick-drain port, do the following steps:

a. Find the drain valve (Figure 2, item B) on the non-cab side, non-drill end of the machine.

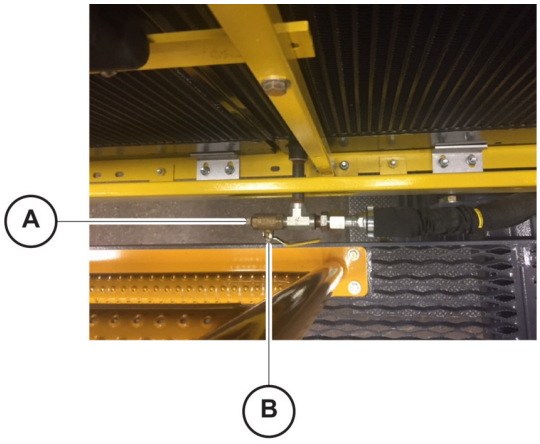


Figure 2

A	Plug	B	Drain valve

b. Remove the plug (item A) and connect a hose.

c.

⚠ CAUTION

Environmental Contaminant

Oil is an environmental contaminant and must be discarded correctly.

- ▶ Do not let the used oil drain onto the ground.
- ▶ Discard the used oil in accordance with local environmental regulations.

> ! ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

Put a container in position to collect the used coolant.

d. Open the drain valve.

e. Loosen the filler cap slowly to release the pressure and leave it off when draining the system.

> ! ***NOTE:*** *Make sure that no dirt is drawn into the radiator while you drain the coolant.*

f. Remove the filler cap completely to speed the draining process.

g. Let the coolant completely drain into the container

h. Close the drain valve.

i. Disconnect the hose.

j. Clean the plug and install it onto the drain valve.

14.2.9 Filling the Engine Coolant

1. Find the correct quick-fill hose.
2. Clean the hose quick-fill fitting.

3. Connect the quick-fill hose to the coolant fitting (Figure 3, item A) in the quick-fill box.

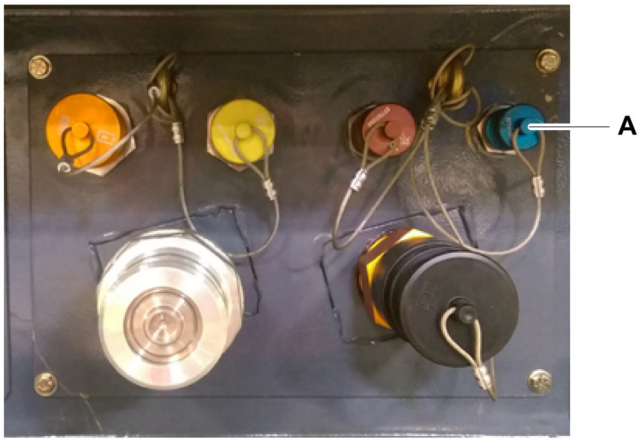


Figure 3

A	Coolant fitting		

4. Fill the coolant to the top of the sight glass (Figure 4, item A) as needed.

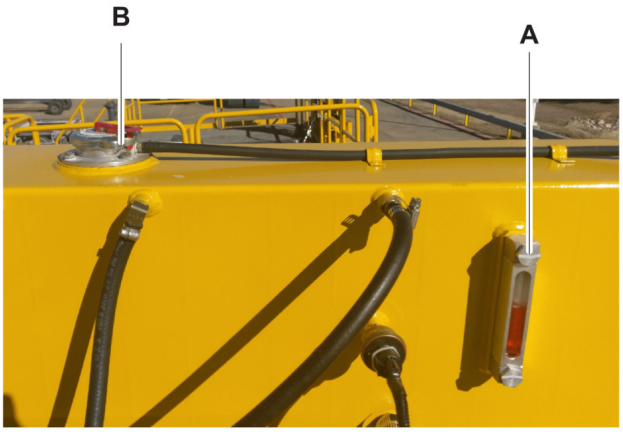


Figure 4

A	Sight glass	B	Filler neck

5. Disconnect the quick-fill hose from the connection.

14.2.10 After Completing the Task

1. Clean the work area of all tools and unwanted materials.

2. **CAUTION**

   Environmental Contaminant

   Oil is an environmental contaminant and must be discarded correctly.

   - ▶ Do not let the used oil drain onto the ground.
   - ▶ Discard the used oil in accordance with local environmental regulations.

   ! ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

   Remove the containers from the work area and discard the coolant in accordance with local environmental regulations.

3. **WARNING**

   Energized Machine

   Can cause serious injury.

   - ▶ The machine must be fully energized and the engine must be switched on to complete this procedure.
   - ▶ Be careful around moving parts and pinch points.

   Inform the supervisor, lead hand, and all other persons that are concerned, of the intent to restart the machine for testing purposes.

   ! ***NOTE:*** *Make sure that all personnel and bystanders are clear of the machine before startup.*

4. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

   ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Start the machine and let the engine idle long enough for the thermostat to open.
6. Put all of the controls in the OFF or neutral position.
7. Stop the machine.

8. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> **NOTE:** *Refer to Safety Locks and Tags Minimum Requirements.*

9. Do a coolant level check. Add coolant, if necessary.
10. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> **NOTE:** *Refer to Safety Locks and Tags Minimum Requirements.*

15 Maintenance As Required

Maintenance Task	
14.1	Do an Inspection of the Air Cleaner Filter Restriction Indicators
14.2	Do an Inspection of the Engine and Compressor Air Intake Ducts and Connections
14.3	Clean the Filter Dust Cups
14.4	Change the Engine and Compressor Air Filter Elements
14.5	Do an Inspection of the Compressor Air Hoses and Clamps
14.6	Clean the Machine
14.7	Tighten Loose Bolted Connections on the Machine
14.8	Do an Inspection of the Feed Cable and Wire Rope
14.9	Adjust the Feed Cable Tension
14.10	Change the Hydraulic Oil Filters
14.11	Change the Hydraulic Tank Breather
14.12	Change the Compressor Air Separator Element
14.13	Fill the Grease Tank
14.14	Change the Hoist Cable
14.15	Change the Dust Collector Filter
14.16	Do an Inspection of and Charge the Air Conditioning System
14.17	Do a Long Distance Propelling
14.18	Do a Test of the RCS-Controlled Brake
14.19	Welding Recommendations
14.20	Lubricate the Upper Spindle Bearing

15.1 Do an Inspection of the Air Cleaner Filter Restriction Indicators

Refer to Do an Inspection of the Air Cleaner Filter Restriction Indicators in 10-Hour Periodic Maintenance.

15.2 Do an Inspection of the Engine and Compressor Air Intake Ducts and Connections

Refer to Do an Inspection of the Engine and Compressor Air Intake Ducts and Connections in 10-Hour Periodic Maintenance.

15.3 Clean the Filter Dust Cups

Refer to Clean the Filter Dust Cups in 10-Hour Periodic Maintenance.

15.4 Change the Engine and Compressor Air Filter Elements

Refer to Change the Engine and Compressor Air Filter Elements in 1,000-Hour Periodic Maintenance.

15.5 Do an Inspection of the Compressor Air Hoses and Clamps

Refer to Do an Inspection of the Compressor Air Hoses and Clamps in 500-Hour Periodic Maintenance.

15.6 Clean the Machine

Refer to Clean the Machine in 10-Hour Periodic Maintenance.

15.6.1 Labor Resource (People/Skills)

Service Technician x 2

Crane Operator x 1

15.6.2 Personal Protection Equipment

! ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

15.6.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Pressure washer	

Consumables

Description	Specification	Quantity
Non-flammable, non-toxic cleaning solution		As required

Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Cleaning the Machine	04:00

15.6.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

15.6.5 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

15.6.6 Before Starting the Task

1. Park the machine in the designated work area.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

15.6.7 Cleaning the Machine

⚠ WARNING

High Pressure

Can cause personal injury.

- ▶ Put on the applicable personnel protective clothing to protect eyes and uncovered parts of the body when using compressed air, water jets, or steam cleaning methods.
- ▶ Maximum air pressure at the nozzle must be less than 207 kPa (30 psig) for cleaning purposes.

NOTICE

Component Damage

High pressure cleaning can cause component damage.

- ▶ Protect all electric components and control panels against water or steam entry when using high pressure cleaning methods.
- ▶ Cover the fuel and hydraulic fill cap breathers on each tank.

! ***NOTE:*** *Daily cleaning is required if material is adhering to the mast or the truck working parts.*

1. Clean your boots of excess mud before you get in the cab or on the machine.
2. Clean inside the operator cab and the operator areas, steps, and grab rails. Make sure that those areas are free of oil, grease, snow, ice, or mud.
3. **WARNING**

   Moving Shaft

   Can cause severe injury or death.

   - ▶ Do not remove unwanted material from the track rollers by hand.

   Examine the tracks for material that may be jammed between the track sprockets and the track tensioners. Clean as necessary.

4. **WARNING**

   Moving Shaft

   Can cause severe injury or death.

   - ▶ Do not remove unwanted material from the sheave area by hand.

   Examine the mast feed installation for unwanted material buildup around the sheaves. Clean as necessary.

5. Wash all fittings, caps, and plugs thoroughly with nonflammable, non-toxic cleaning solution before servicing to prevent dirt from entering while doing the service.
6. While cleaning, examine the hoses for cracks, chafing, or deterioration and replace them as needed.

15.6.8 After Completing the Task

1. After cleaning, examine for defects in the air cleaner ducts as follows:
   a. Examine the intake for accumulation of unwanted materials that can restrict the air flow.
   b. Examine the air cleaner mounting hardware for security.
2. Remove all tools and the pressure washer from the work area.
3. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

15.7 Tighten Loose Bolted Connections on the Machine

Refer to Torque Specifications for torque information and recommended torque values.

15.8 Do an Inspection of the Feed Cable and Wire Rope

Refer to Do an Inspection of the Feed Cable and Wire Rope in 500-Hour Periodic Maintenance.

15.9 Adjust the Feed Cable Tension

Refer to Do an Inspection of the Feed Cable Tension in 1,000-Hour Periodic Maintenance.

15.10 Change the Hydraulic Oil Filters

Refer to Change the Hydraulic Oil Filters in 2,000-Hour Periodic Maintenance.

15.11 Change the Hydraulic Tank Breathers

Refer to Change the Hydraulic Tank Breathers in 2,000-Hour Periodic Maintenance.

15.12 Change the Compressor Air Separator Element

Refer to Change the Compressor Air Separator Element in 2,000-Hour Periodic Maintenance.

15.13 Fill the Grease Tank

15.13.1 Labor Resource (People/Skills)

Service Technician x 1

15.13.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

15.13.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Grease	As specified in Refill Capacities and Lubricants	As required
Shop rags		

15.13.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

15.13.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Filling the Grease System	00:30

15.13.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Environmental Instructions	Model specific Maintenance Manual
Refill Capacities and Lubricants	Model specific Maintenance Manual

15.13.7 Before Starting the Task

1. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

2. Do a grease level check at the grease level gauge (Figure 1, item B) on the top of the container.

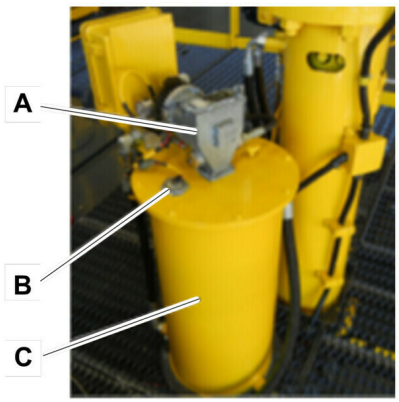


Figure 1

A	Grease pump	B	Grease level gauge
C	Grease drum		

> ***NOTE:*** *When the grease is low, a fault icon* *shows at the bottom of the monitor screen.*

Figure 2

15.13.8 Filling the Grease System

1. Remove the grease quick-fill port cap (Figure 1, item A) at the quick-fill station on the cab side, non-drill end of the machine.

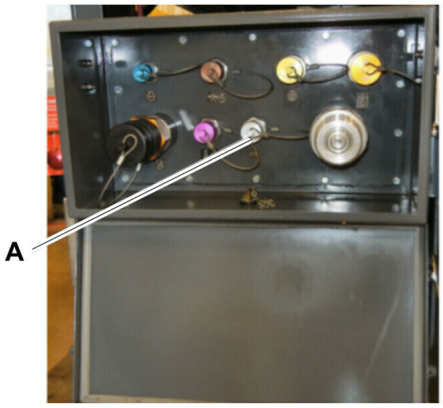


Figure 1

A	Quick-fill port cap		

2. Clean the quick-fill port of dirt and unwanted material with a clean shop rag.
3. Clean the supply grease hose of dirt and unwanted material.
4. Attach the supply grease hose to the grease quick-fill port.
5. **CAUTION**

   Overfilling

   Overfilling the grease tank damages the grease tank equipment and causes grease to vent onto the ground.

   ▶ Do not exceed the limit 8 L/min (2 GPM) when filling the grease tank.

   Add grease until the container is full.

6. Monitor the **Performance** screen (Figure 2) while filling the grease tank. Observe the grease tank symbol in the middle of the **Performance** screen for the percentage amount or monitor the grease tank level gauge. Do not exceed 90 percent when filling the grease tank.

Figure 2

7. Remove the grease quick-fill supply hose.
8. Clean the connection port and install the quick-fill port cap.

15.13.9 After Completing the Task

1. Remove and store all tools and cleaning equipment.
2. **CAUTION**

   Environmental Contaminant

   Grease is an environmental contaminant and must be discarded correctly.

   ▶ Obey all local standards and regulations for discarding the used grease and grease rags.

NOTE: *Refer to Environmental Instructions in the Maintenance manual.*

Remove the grease supply from the work area.

3. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> **NOTE:** *Refer to Safety Locks and Tags Minimum Requirements.*

15.14 Change the Hoist Cable

15.14.1 Labor Resource (People/Skills)

Service Technician x 3

15.14.2 Personal Protection Equipment

> **NOTE:** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Face - Welding mask
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Body - Fall protection straps
- Body - Welding clothing
- Safety devices

15.14.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> **NOTE:** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Acetylene or propane cutting torch	
Cable handling bar	
Tags	As required

Support Equipment

Description	Specification
Elevated working platform	
Forklift or boom truck crane	As required

Consumables

Description	Specification	Quantity
Not applicable		

15.14.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Cable Assembly ½-in non-rotating type		1
Safety swivel hook		1
Sheave Assembly at top of mast		2
Ball	23 kg (50 lb)	1
Cable clamps		4

15.14.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Changing the Hoist Cable	04:00

15.14.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

15.14.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. **DANGER**

   Electrocution Hazard

   Operating near or contacting a power line with any part of the machine can cause electrocution, causing death.

   - Do not raise or lower the mast or operate the machine near electric power lines.
   - Keep at least 3 meters (10 feet) away from power lines.
   - If there appears any danger of wind or other obstruction decreasing the distance, do not drill in that area.

   Lower the mast to the horizontal position.

15.14.8 Removing the Hoist Cable

WARNING

Energized Machine

Can cause serious injury.

- The machine is energized during this procedure. Take all precautions necessary for a safe work environment.

1. Lower the hoist hook to the ground in front of the rear deck.

2.

WARNING

Risk of Explosion

Can cause personal injury or death.

- Before you weld, flame cut, or grind on the machine, clean the machine and the surrounding area from dust and other flammable substances with a nonflammable cleaner.
- Make sure that the premises are adequately ventilated.

WARNING

Risk of Personal Injury

The electric arc includes visible, ultraviolet, and infrared light. Failure to follow these instructions can cause serious personal injury.

- Put on protective clothing and equipment during all welding operations.
- Use safety goggles to protect the eyes from heat, glare, and flying fragments of hot metals during all oxyacetylene welding and cutting processes.
- Use safety goggles and a hard hat that has an applicable filter glass to protect against the intense ultraviolet and infrared rays during all electric welding processes.
- When others are near the electric welding processes, the area must be screened to prevent the arc from being seen either directly or by reflection from glass or metal.

WARNING

Burn Risk

Can cause personal injury.

- Make sure that a Hot Work Permit is completed.
- Obey all safety precautions regarding molten metal and open flame.

Separate the hoist cable of 15 centimeters (6 inches) above the 23-kilogram (50-pound) hook ball with a cutting torch.

3. Retract the cable up through the sheaves and into the mast until it falls onto the ground in front of the rear deck.

4. **WARNING**

   Risk of Personal Injury

   Can cause personal injury.

   - Stay at least 3 meters (10 feet) away from wire rope while it is under tension.
   - Examine the wire rope when unwound and replace the wire rope when broken strands are found.

   Command the hoist down and unwind all of the cable onto the ground as a technician guides the cable away from the machine.

5. Continue to unwind all of the cable until one wrap remains on the hoist drum.
6. **WARNING**

   Risk of Falling

   Climbing a raised mast can cause severe injury or death.

   - Do not climb a raised mast.

   Raise the mast to get access to the hoist drum.

7. Remove the cable wedge and the last cable wrap.
8. Examine the removed ball and hook assembly for cracks or damage. If cracks or damage are found, replace it with a new ball and hook assembly.

15.14.9 Installing the Hoist Cable

WARNING

Falling Objects

Can cause severe injury or death.

- Do not attempt to lift a load with less than five wraps of cable on the drum. The cable clamp is not designed to hold the full load alone.

⚠ CAUTION

Risk of Personal Injury

Can cause personal injury.

▶ Put on applicable gloves when handling the hoist cable.

! ***NOTE:*** *The hoist cable winds over the top of the hoist drum. Make sure to wind the cable onto the drum as tight and as evenly as possible.*

! ***NOTE:*** *Winding the cable requires the use of two technicians: one at the machine controls and the other to guide the cable onto the drum. When winding the cable onto the drum, always use a hand-over-hand technique.*

1. Position the new cable up and over the mast support into the hoist drum in the same direction as the removed cable.
2. Use the cable wedge and firmly attach the new cable onto the drum.
3. Take the free end of the cable and insert it through the small opening of the anchor pocket.
   a. Insert the large end first for 10-millimeter (3/8-inch) wire rope and 11-millimeter (7/16-inch) wire rope.
   b. Insert the small end first for 13-millimeter (1/2-inch) wire rope and 14-millimeter (9/16-inch) wire rope.
4. Loop the cable and push the free end about 3/4 of the way back though the pocket.
5. Install the wedge, then pull the slack from the cable. The wedge slips into the pocket and secures the cable into the drum.

! ***NOTE:*** *The anchor is designed to accommodate several sizes of wire rope.*

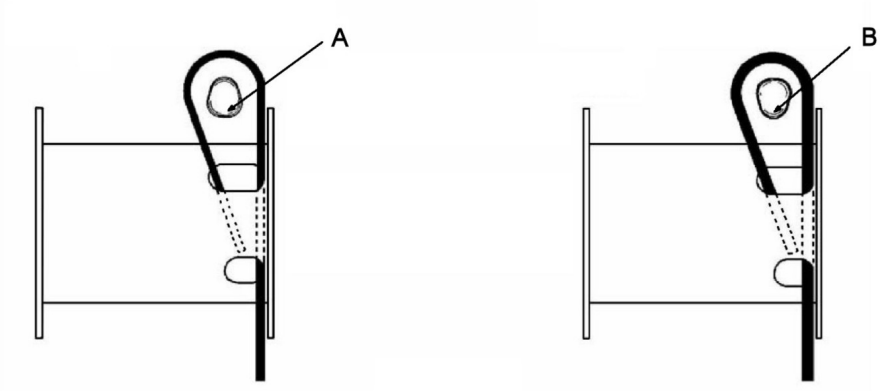


Figure 1

A	Insert large end first for 10-mm (3/8-in) wire rope and 11-mm (7/16-in) wire rope	B	Insert small end first for 13-mm (1/2-in) wire rope and 14-mm (9/16-in) wire rope

6. Hold the new cable with enough resistance to keep the cable tight while the other technician commands the hoist up to retract and roll five full wraps of cable onto the hoist drum smoothly and evenly.

Figure 2

7. **WARNING**

   Fall Hazard

   Can cause personal injury or death

   - ▶ Put on fall-protection equipment when you work from a man basket.
   - ▶ Examine all of the lifting equipment before you start any maintenance task.

   Position the man basket on a 4x4 forklift or boom crane truck.

8. Guide the new cable up to the two cable sheaves on the top of the mast.

9. Examine the two cable sheaves for damage. Replace the cable sheaves, if necessary.

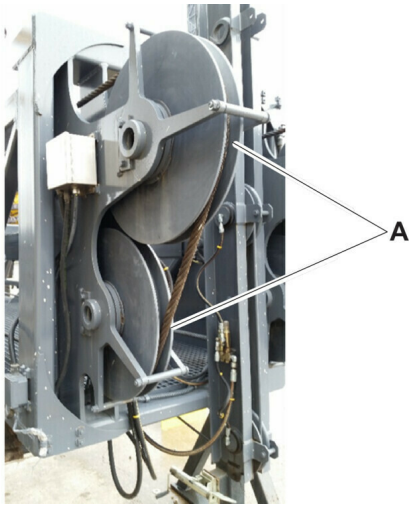


Figure 3

A	Cable sheaves		

10. **NOTICE**

Equipment Failure

Can result in impaired machine performance or equipment failure.

- ▶ Replace all non-serviceable sheaves.
- ▶ Do not use new replacement cable on defective sheaves.

Move the cable through the two sheaves and onto the ground. Remove the slack between the top of the mast and the hoist drum.

11. Install the Hook and Ball Assembly onto the cable end with locking pins.

Figure 4

12. **CAUTION**

Falling Objects

Can cause personal injury.

- ▶ Make sure that the hook does not become entangled on the rod-catcher chain while it is slowly hoisted up.

Raise the mast slowly while a technician guides the Hook and Ball Assembly around the dust collector side of the machine towards the machine deck.

15.14.10 After Completing the Task

1. Discard the damaged cable, sheaves, and Hook and Ball Assembly in accordance with the site-specific procedures.
2. Raise the Hook and Ball Assembly to the top of the mast and back down again to the machine deck with the hoist controls.
3. Make sure that the hoist cable is spooling correctly onto the hoist drum. If it is not spooling correctly, lay the mast in the horizontal position to correctly spool the cable back onto the drum.
4. Use normal start-up procedures.

15.15 Change the Dust Collector Filter

15.15.1 Labor Resource (People/Skills)

Service Technician x 2

Crane Operator x 1

15.15.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Nose and mouth - Dust mask
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Body - Fall protection straps
- Safety devices

15.15.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Torque wrench, calibrated	Capacity up to 75 N·m (55 ft·lb)
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Not applicable		

15.15.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Element assembly for model 7SB		9
Screws		8

15.15.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Changing the Dust Collector Filter	02:00

15.15.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual

15.15.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.

4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

15.15.8 Changing the Dust Collector Filter

WARNING

Dust Inhalation

Dust inhalation can produce toxic effects and causes serious damage to lungs.

- Use a breathing respirator when servicing the air filters.

WARNING

Risk of Falling

Can cause severe injury or death.

- Put on fall-protection equipment when you work from a lifted platform.
- Examine all equipment before you start any maintenance task.

1. Get access to the dust collector with a ladder.
2. Remove the eight screws (Figure 1, item A) that attach the lower and upper halves together. Discard the screws.

> ***NOTE:*** *Do not remove the rotation screw (item B).*

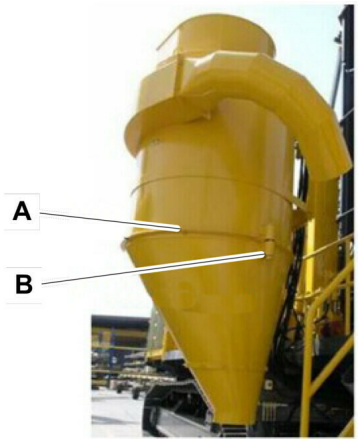


Figure 1

A	Screws	B	Rotation screw

3. Move the lower half cover around the rotation screw (item B) to get access to the dust collector filters.
4. Remove the nut (Figure 2, item B). The filter (item A) drops out.

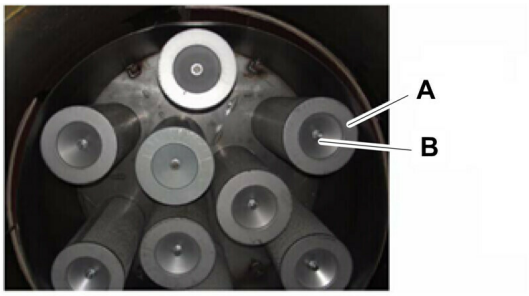


Figure 2

Item	Description	Quantity
A	Filter	9
B	Nut	9

5. Repeat step 4 for all of the filters.
6. Install the new filters and the adjusting nuts.

> ! ***NOTE:*** *Do not overtighten the nut. Overtightening can damage the filter.*

7. Align the upper and lower halves together and insert the eight screws.
8. Torque the screws to 75 Newton meters (55 foot-pounds) lubricated.

15.15.9 After Completing the Task

1. Remove all tools and unwanted materials from the work area.
2. Fill all fluids to their correct levels.
3. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

15.16 Do an Inspection of and Charge the Air Conditioning System

15.16.1 Personal Protection Equipment

> ! ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and properly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

15.16.2 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ! ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification	Quantity
Standard mechanic toolkit		
A/C manifold and gauges (optional)		1
Refrigerant scale		1
Probe thermometer		1
Tags		As required

Consumables

Description	Specification	Quantity
A/C compressor oil	As specified in Refill Capacities and Lubricants	
A/C system refrigerant	R134a	
Dry nitrogen		
Spray bottle with soapy water		0.56 L (0.15 gal)

15.16.3 Spare Parts

! ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

15.16.4 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing an Inspection of and Charge the Air Conditioning System	01:00

15.16.5 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance manual
Refill Capacities and Lubricants	Model specific Maintenance manual

15.16.6 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

15.16.7 Doing an Air Conditioning System Leak Test with Nitrogen

NOTICE

Component Damage

Refrigerant is a pollutant to the environment. Failure to obey the following instruction can damage the components.

- ▶ Do not remove air conditioner hoses or components if there is any refrigerant charge in the air conditioning system. Contain all refrigerant with a recovery machine.

1. Connect the hoses to their correct locations.

> ! ***NOTE:*** *The high-pressure side hoses (Figure 1, item B) are usually red and have bigger fitting connections. The low-pressure side hoses (Item A) are usually blue and have smaller fitting connections.*

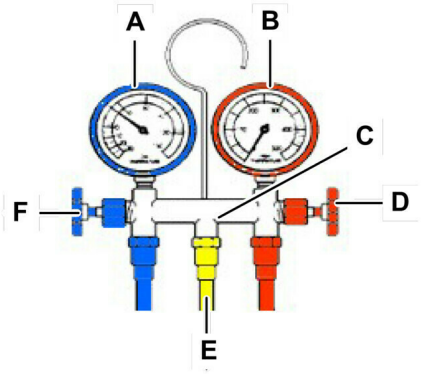


Figure 1

A	Low-pressure (vacuum gauge) side	B	High-pressure side
C	Manifold	D	Shutoff valve
E	Utility (vacuum or charge) port	F	Shutoff valve

2. Open both of the valves on the gauge manifold side by turning each valve counter-clockwise.

3. **WARNING**

   High Pressure in Nitrogen Bottle

   Can cause severe injury or death

   ▶ Make sure to secure the nitrogen bottle while handling it.

   Connect the dry nitrogen to the utility port (item E). Charge the system with 17 to 21 bar (250 to 300 psi).

4. Spray all of the system connections with a spray bottle and soapy water. Monitor the connections for bubbles.

   a. If bubbles are present or if the nitrogen pressure decreases after 20 minutes, correct or repair as needed and do the leak test again.

   b. If the pressure does not decrease and no bubbles are present, evacuate or release the nitrogen and continue to the next step.

15.16.8 Doing an Air Conditioning System Leak Test with a Vacuum Pump

NOTICE

Component Damage

Refrigerant is a pollutant to the environment. Failure to obey the following instruction can damage the components.

- Do not remove air conditioner hoses or components if there is any refrigerant charge in the air conditioning system. Contain all refrigerant with a recovery machine.

1. Connect the hoses to their correct locations.

> ***NOTE:*** *The high-pressure side hoses (Figure 2, item B) are usually red and have bigger fitting connections. The low-pressure side hoses (item A) are usually blue and have smaller fitting connections.*

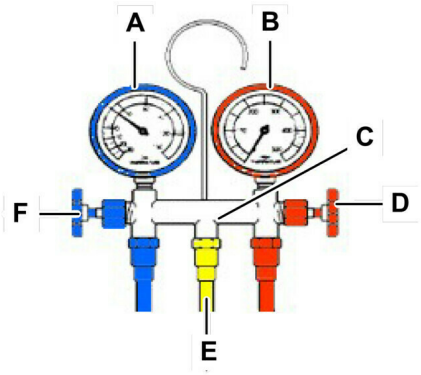


Figure 2

A	Low-pressure (vacuum gauge) side	B	High-pressure side
C	Manifold	D	Shutoff valve
E	Utility (vacuum or charge) port	F	Shutoff valve

2. With the valves closed, connect the high-pressure and low-pressure hoses to the machine air conditioner service fittings.

> ***NOTE:*** *The equipment that is used to recover or service any air conditioning system must have shutoff valves within 30 centimeters (12 inches) of the service ends. Each refrigerant type has its own unique service fittings to prevent the mixing of different refrigerants and to protect the purity of recovered or recycled refrigerant.*

3. Connect the air conditioner vacuum machine to the utility port (item E).
4. Open the high-pressure side and low-pressure side valves by turning each valve counterclockwise.
5. Pull a minimum vacuum of -10 inch mercury.

> ! ***NOTE:*** *In Epiroc machines, 27 to 30 inch mercury is the average vacuum from the factory. Operating time for this step is approximately one hour.*

6. Close both of the valves by turning each valve clockwise.
7. Stop the vacuum pump.

> ! ***NOTE:*** *Leave the pump connected and the valves closed for approximately 20 minutes to make sure that the vacuum does not decrease.*

15.16.9 Evacuating the Air Conditioning System with a Recovery or Charging Machine

NOTICE

Component Damage

Refrigerant is a pollutant to the environment. Failure to obey the following instruction can damage the components.

▶ Do not remove air conditioner hoses or components if there is any refrigerant charge in the air conditioning system. Contain all refrigerant with a recovery machine.

1. Connect the hoses to their correct locations.

> ! ***NOTE:*** *The high-pressure side hoses (item B) are usually red and have bigger fitting connections. The low-pressure side hoses (item A) are usually blue and have smaller fitting connections.*

2. Switch on the recovery or charge machine and follow the instructions on recovery, vacuum, and charge. When connecting to the service ports, do the steps as prompted by the machine until the task is complete. Refer to the table below for the timed actions.

Action	Time
Vacuum	60 minutes
Leak test	20 minutes

> ***NOTE:*** *If charging the system slows or if prompted by the machine, then remove the safety locks and tags from the machine and start the engine. The machine must be at full idle and the air conditioner controls at maximum to continue with the charging procedure.*

15.16.10 Charging the Air Condition Without a Recovery or Charging Machine

NOTICE

Component Damage

Refrigerant is a pollutant to the environment. Failure to obey the following instruction can damage the components.

- ▶ Do not remove air conditioner hoses or components if there is any refrigerant charge in the air conditioning system. Contain all refrigerant with a recovery machine.

1. Connect the hoses to their correct locations.

> ***NOTE:*** *The high-pressure side hoses (Figure 3, item B) are usually red and have bigger fitting connections. The low-pressure side hoses (item A) are usually blue and have smaller fitting connections.*

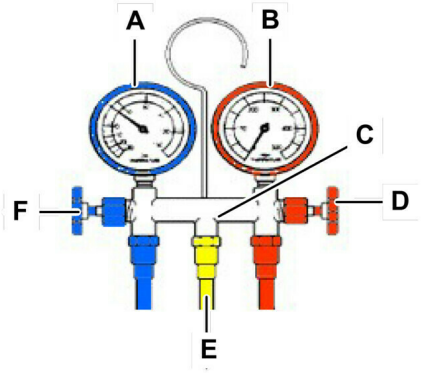


Figure 3

A	Low-pressure (vacuum gauge) side	B	High-pressure side
C	Manifold	D	Shutoff valve
E	Utility (vacuum or charge) port	F	Shutoff valve

2. With the valves closed, connect the high-pressure side and low-pressure side hoses to the machine air conditioner service fittings.

> ***NOTE:*** *The equipment that is used to recover or service any air conditioning system must have shutoff valves within 30 centimeters (12 inches) of the service ends. Each refrigerant type has its own unique service fittings to prevent the mixing of different refrigerants and to protect the purity of recovered or recycled refrigerant.*

3. Put the refrigerant scale on a solid flat surface near all of the air conditioner hoses to be used.

> ***NOTE:*** *Using the refrigerant scale is the most accurate way to determine the amount of refrigerant being charged.*

4. Put the refrigerant tank on the scale and set the scale to zero.
5. Connect the refrigerant tank to the utility port (item E).
6. Release the air between the tank refrigerant hose and the manifold:
   a. Open the tank valve.
   b. Loosen the utility line at the manifold slowly counterclockwise until a slight hiss is heard, then turn the connection clockwise to close immediately.

> ***NOTE:*** *Some refrigerant is released into the atmosphere when removing the air from the connecting line.*

> ***NOTE:*** *Avoid injecting air into the machine air conditioning system.*

7. Open both of the high-pressure side and low-pressure side valves by turning each valve counterclockwise.

> ***NOTE:*** *Do not start the machine air conditioning system with the tank connected, tanks valve open, and high-pressure side valve open. The air conditioner compressor compresses the air back into the refrigerant tank and can cause over-pressurization.*

8. Let the refrigerant flow from the tank to the system until it equalizes and no movement shows on the scale.
9. At the manifold gauges, close both of the high-pressure side and low-pressure side valves by turning each valve clockwise.

10. **WARNING**

    Energized Equipment

    Can cause serious injury

    - The machine must be fully energized and the engine must be on to complete this procedure.
    - Be careful around moving parts and pinch points.

    Inform the supervisor, lead hand, and all other persons that are concerned of the intent to restart the machine.

    NOTE: *Make sure that all personnel and bystanders are clear of the machine before start-up.*

11. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

    NOTE: *Refer to Safety Locks and Tags Minimum Requirements.*

12. Start the machine.
13. Switch on the machine air conditioning system and set it to maximum.
14. **CAUTION**

    Safety Precaution

    Failure to obey the instruction can cause damage to the air conditioning system recovery or charging machine.

    - Do not open the high-pressure side while the refrigerant tank is connected up and open.

    Open the low-pressure side valve (item F) at the gauge manifold. Let the air conditioner compressor continue pulling the refrigerant from the tank.

15. After you add the specified amount of refrigerant, close the refrigerant tank valve and disconnect the refrigerant tank from the gauge manifold. Install the caps that were removed from the valves to prevent contamination from going into the system.
16. Disconnect both of the high-pressure side and low-pressure side hoses from the service ports. Install the caps that were removed to prevent contamination from entering the system.

15.16.11 Doing a Test of the Air Conditioning System Operation

1. Make sure that the blower works at all speeds.
2. Insert the thermometer probe into the cab air conditioner vent. Make sure the difference between the air conditioner vent and cab temperature is approximately -6 °C (20 °F).

> ! ***NOTE:*** *This difference is the approximate difference in ambient temperatures of 13 °C (55 °F) and above.*

15.16.12 After Completing the Task

1. Remove all tools and unwanted material from the work area.
2. **⚠ CAUTION**

   Environmental Contaminant

   Oil and refrigerant that you recover from the air conditioner system are an environmental contaminant and must be discarded correctly.

   - ▶ Do not let the used oil and refrigerant drain onto the ground.
   - ▶ Obey all local standards and regulations for discarding the used oil and refrigerant.

   > ! ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

   If used oil or refrigerant was recovered, discard or recycle it in accordance with local environmental regulations.

3. **⚠ WARNING**

   High Pressure

   Can cause personal injury.

   - ▶ Put on the applicable personnel protective clothing to protect eyes and uncovered parts of the body when using compressed air, water jets, or steam cleaning methods.
   - ▶ Maximum air pressure at the nozzle must be less than 207 kPa (30 psig) for cleaning purposes.

   Clean the machine to remove any oil and grease with a pressure washer.

4. Fill all of the fluids to their correct levels.
5. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

15.17 Do a Long Distance Propelling

15.17.1 Labor Resource (People/Skills)

Service Technician x 2

15.17.2 Personal Protection Equipment

> ! ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and properly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

15.17.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ! ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification	Quantity
Standard mechanic toolkit		
Temperature gun		
Tags		As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Not applicable		

15.17.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

15.17.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing Long Distance Propelling	Time needed is determined by distance required.

15.17.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)

15.17.7 Before Starting the Task

DANGER

Electrocution Hazard

Operating near or contacting a power line with any part of the machine can cause electrocution, causing death.

- ▶ Do not raise or lower the mast or operate the machine near electric power lines.
- ▶ Keep at least 3 meters (10 feet) away from power lines.
- ▶ If there appears any danger of wind or other obstruction decreasing the distance, do not drill in that area.

- ○ Lower the mast to the horizontal position.

15.17.8 Propelling the Machine

! ***NOTE:*** *The time that is required to move the machine is determined by how far the machine must be relocated.*

WARNING

Hot Fluids or Components

Hot fluids or components can burn.

- ▶ Make sure that the fluids are at a safe working temperature when you service the machine.
- ▶ Do not touch hot fluids or components.

1. Position the fill-and-drain plug of the track final drive at the three o'clock position.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

   ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements in the Maintenance manual.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

7.

WARNING

High Pressure

Residual pressure in the track final drive can cause personal injury.

- ▶ Carefully loosen the fittings enough to release the pressure fully before you remove the fill plug.

Remove the fill-and-drain plug and do an oil level check. Make sure that the oil is full and at the bottom of the fill-and-drain port. Add oil, if necessary.

! ***NOTE:*** *Do not propel the machine for an extended distance while the track final drive oil level is low.*

8.

WARNING

Energized Machine

Can cause serious injury.

- ▶ The machine must be fully energized and the engine/motor must be switched on to complete this procedure.
- ▶ Be careful around moving parts and pinch points.

Inform the supervisor, lead hand, and all other persons concerned of the intent to restart the machine for testing purposes.

! ***NOTE:*** *Make sure that all personnel and bystanders are clear of the machine before start-up.*

9. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

10. Start the machine.
11. Propel the machine to the predetermined destination.

12. Use the following list to record the track final drive temperature during the long distance propel:
    - Record the track final drive temperature values for every five minutes at different locations on the track final drive. Identify the locations on the track final drive that you record the temperature values.
    - Record the temperature values at those same locations each time.
    - Record the measurements of temperature with time (seconds) and distance (meters or feet).
    - Stop propelling the machine when the track final drive temperature reaches 100 °C (212 °F).
    - Record the ambient temperature and compare it to the track final drive temperature. The difference in two temperatures must be 40 °C (72 °F) or more.
    - Take the track final drive temperature only when the machine is OFF.
    - Repeat the temperature readings until the machine has reached its destination.

15.17.9 After Completing the Task

- Let the machine oil level cool to a safe temperature level, if maintenance is required.

15.18 Do a Test of the RCS-Controlled Brake

15.18.1 Labor Resource (People/Skills)

Service Technician x 2

15.18.2 Personal Protection Equipment

! ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and properly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Safety devices

15.18.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

! ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification	Quantity
Standard mechanic toolkit		
Tags		As required

Support Equipment

Description	Specification
Barricades	

Consumables

Description	Specification	Quantity
Not applicable		

15.18.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

15.18.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Doing a Test of the RCS Controlled Brake	04:00

15.18.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance manual

15.18.7 Before Starting the Task

1. **WARNING**

   Energized Machine

   Can cause serious injury

   - The machine must be fully energized to complete this procedure.
   - Be careful around moving parts and pinch points.

   Inform the supervisor, lead hand, and all other persons concerned of the intent to restart the machine.

   NOTE: *Make sure that all personnel and bystanders are clear of the machine before start-up.*

2. **WARNING**

   Moving Machinery

   Personnel can be pinched, entangled, or crushed by moving machinery.

   - Make sure that no one is at danger or risk before you start or set the machine in motion.
   - Crew members must not put any part of their body or clothing on or near energized machinery, gears, pinions, ropes, cables, chains, or wrenches.

Turn on the ignition switch on the control panel and wait for RCS to activate (Figures 1 and 2).

Figure 1

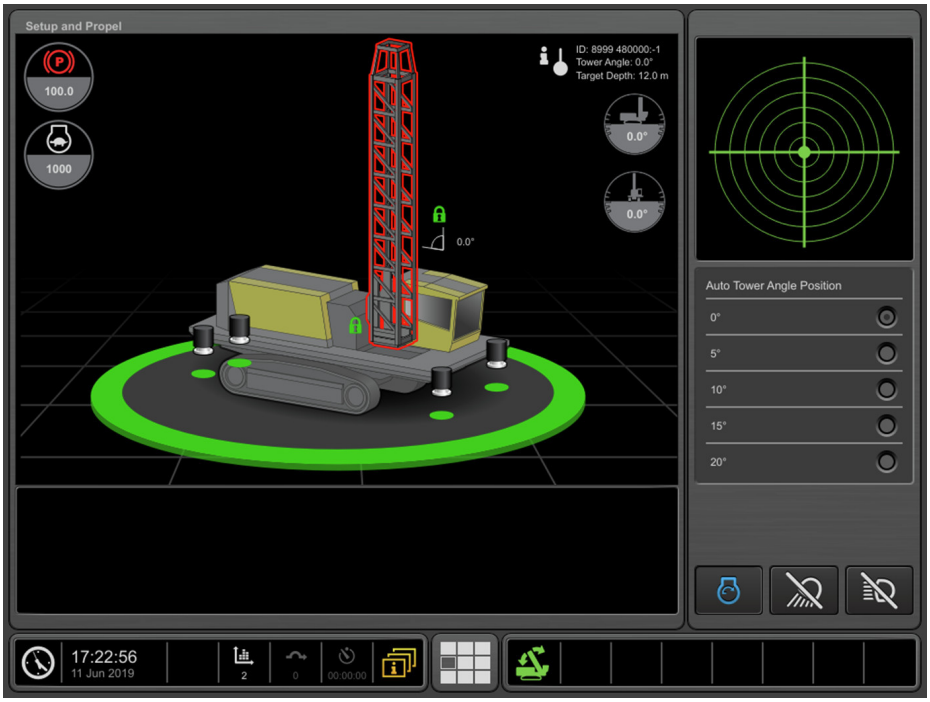


Figure 2

3. Start the machine by turning the ignition switch clockwise. Hold the ignition switch to start the machine (Figure 1).
4. Let the machine get to normal operating temperature.
5. Raise the rotary head to the top of the mast.
6. Put the carousel in the closed position.

7. **DANGER**

Electrocution Hazard

Operating near or contacting a power line with any part of the machine can cause electrocution, causing death.

- Do not raise or lower the tower or operate the machine near electric power lines.
- Keep at least 3 meters (10 feet) away from power lines.
- If there appears any danger of wind or other obstruction decreasing the distance, do not drill in that area.

Lower the tower to the horizontal position.

8. Retract all of the leveling jacks fully.
9. Set the brake pressure in accordance with the procedure in the test manual.

15.18.8 Doing a Test of the Brakes

NOTE: *Only personnel who are trained and assessed as competent must operate the machine during the test.*

NOTE: *The operator must remain in the cab always.*

NOTE: *When the spotter is observing for track movement, they must cross the other side of the machine by walking around the high side of the incline. Only the operator and spotter can be in the barricaded area during testing. Park all machines outside the barricaded area.*

NOTE: *Button numbers are given in the procedure and the figures for reference purposes only. The operator panels lack numbers to identify the function buttons.*

1. Press the ON button on the left operator panel (Figure 3, button 0) to turn on the RCS operator panel.

Figure 3

2. Press the engine/motor throttle button on the right operator panel (Figure 4, button 14) to increase the engine/motor rpm.

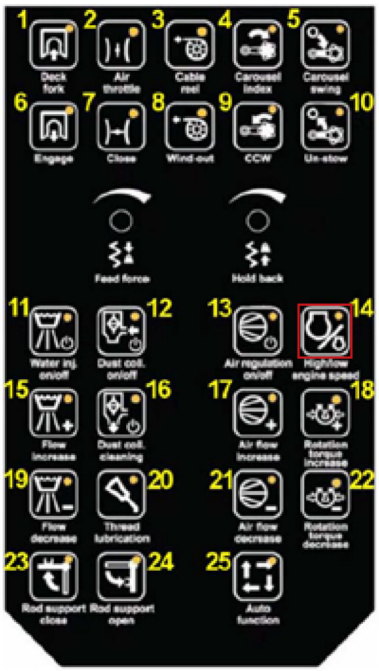


Figure 4

3. Select the propel button on the left operator panel (Figure 5, button 6).

Figure 5

4. Propel the machine to a designated ramp with a minimum angle of 5° and not exceeding your specific machine stability angle limit using the multi-axis propel joystick (Figure 6, item A) on the left control panel.

> ! ***NOTE:*** *The toggle switch (item B) can be pressed in either the up or down position to release the brakes.*

> ! ***NOTE:*** *The toggle switch must be activated for two seconds before moving the joystick or the RCS displays the message 'propel brake loss of signal' and stop the propelling function.*

Figure 6

A	Propel control lever	B	Brake toggle switch

5. Release the propel lever to the neutral position and release the brake.

> ***NOTE:*** *The spotter must observe the machine for a period no less than 1 minute. During this time, the undercarriage must not move.*

6. Propel the machine down the slope to the level ground.
7. Position the machine to the required position. Turn the ignition key counterclockwise to the off position (Figure 7) to stop the machine.

Figure 7

8. Turn off the battery isolators after two minutes. The air system needs this time to bleed correctly.

9. Isolate the machine (Figure 8).

Figure 8

10. Attach safety locks and tags to the machine in accordance with the site-specific procedures or refer to Safety Locks and Tags Minimum Requirements.

15.18.9 Setting the Brake Pressure

1. **WARNING**

Energized Equipment

Can cause serious injury

- The machine must be fully energized and the engine must be on to complete this procedure.
- Be careful around moving parts and pinch points.

Inform the supervisor, lead hand, and all other persons concerned of the intent to restart the machine.

! ***NOTE:*** *Make sure that all personnel and bystanders are clear of the machine before start-up.*

2. **WARNING**

Moving Machinery

Personnel can be pinched, entangled, or crushed by moving machinery.

- Make sure that no one is at danger or risk before you start or set the machine in motion.
- Crew members must not put any part of their body or clothing on or near energized machinery, gears, pinions, ropes, cables, chains, or wrenches.

Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

> ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

3. Turn on the machine power and start the isolators (Figure 8).
4. Turn on the ignition switch on the control panel and wait for RCS to activate (Figure 9).

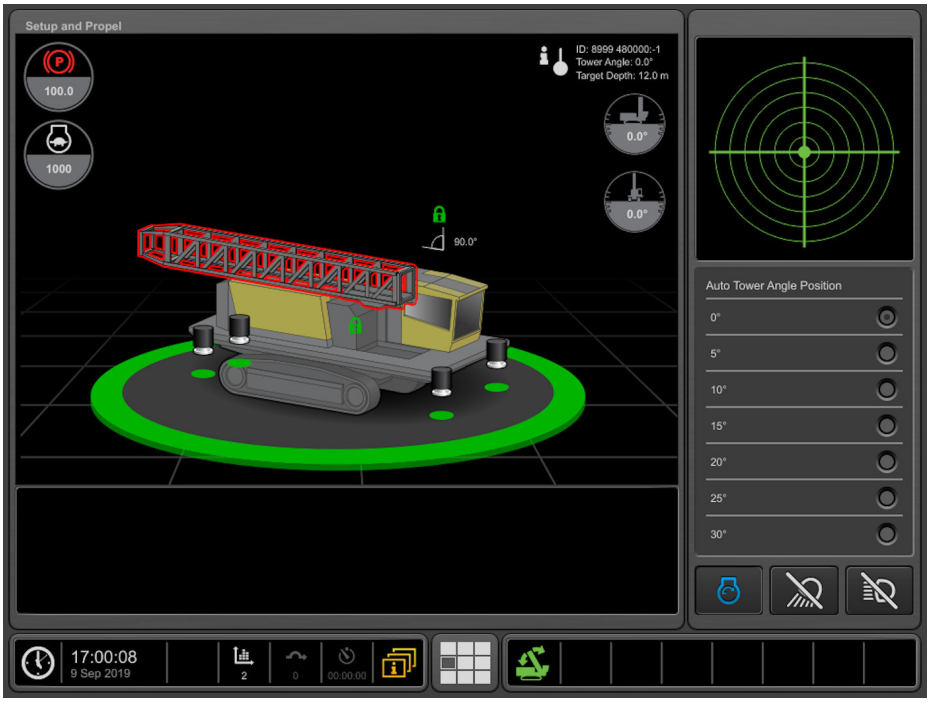


Figure 9

5. Start the machine by turning the ignition switch clockwise.

   Hold the switch to start the engine (Figure 10).

> ***NOTE:*** *There can be a time delay between turning the switch and the engine starting due to the engine oil primer pump.*

Figure 10

6. Let the machine temperature increase to normal operating condition.
7. Press the ON button on the left operator panel (Figure 11, button 0) to turn on the RCS operator panel.

Figure 11

8. Press the engine symbol on the right operator panel (Figure 12, button 14) to increase the engine rpm.

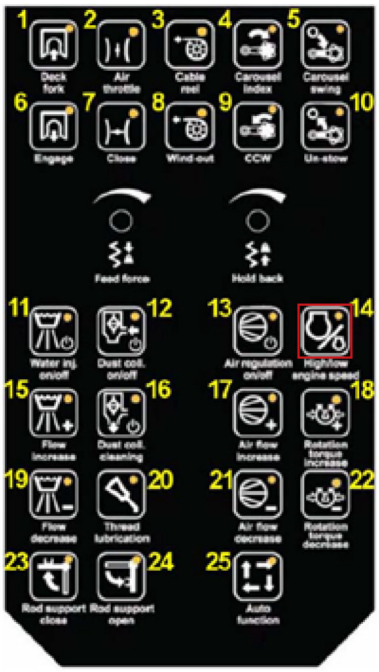


Figure 12

9. Select the propel button on the left operator panel (Figure 13, button 6).

Figure 13

10. Find the propel brake pressure on the left side of the **Setup and Propel** screen.

> ***NOTE:*** *The propel brake pressure is also on the* **Setting** > **Rig** > **Sensors** *screen.*

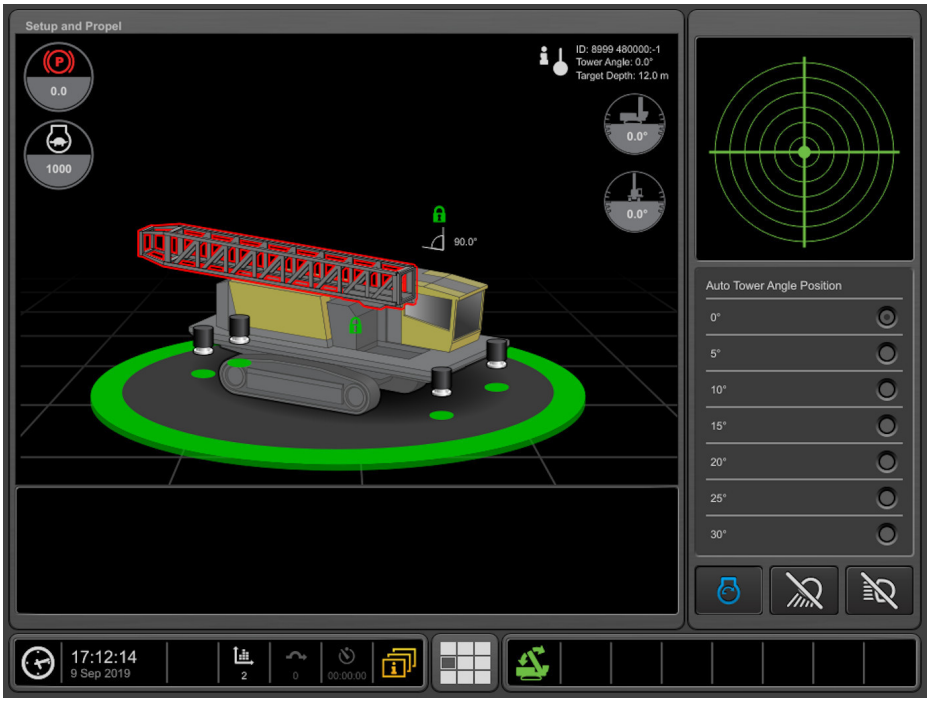


Figure 14

11. Release the brakes and examine that the pressure on the brake release is at 35 bar (500 psi) (Figure 15).

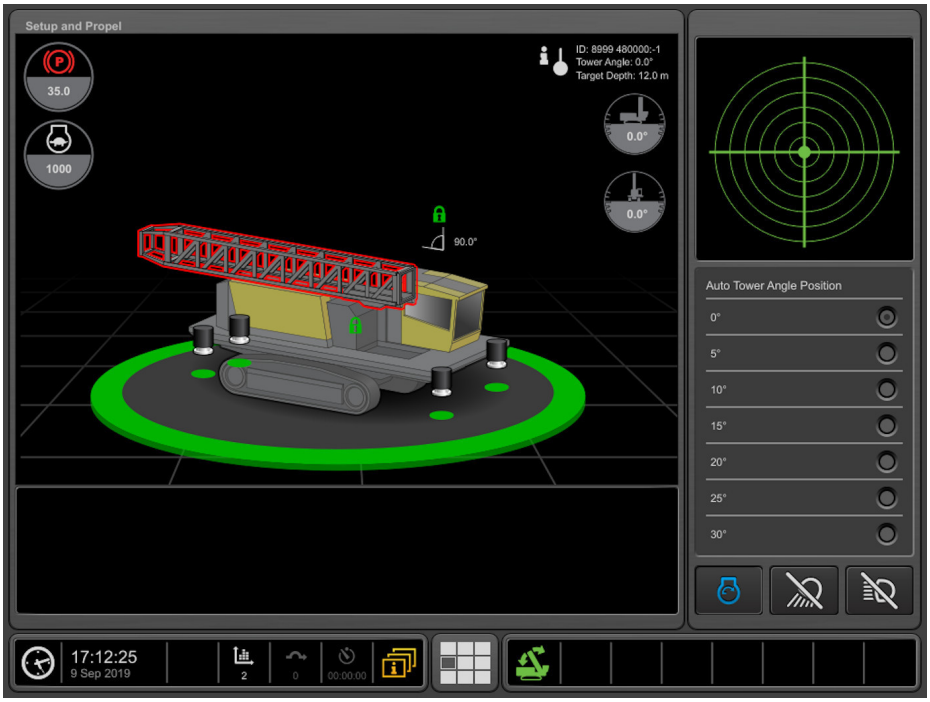


Figure 15

12. Adjust the brake pressure on the machine. Refer to the hydraulic schematic to locate the pressure control valve port (PPDB).

    Adjust the pressure setting until 35 bar (500 psi) is reached.

> ***NOTE:*** *Always turn the pressure control valve counterclockwise first.*

15.18.10 Brake Pressure Release Adjustment Locations

- PV-270 location is below the main pump on the drill propel valve (Figure 16).

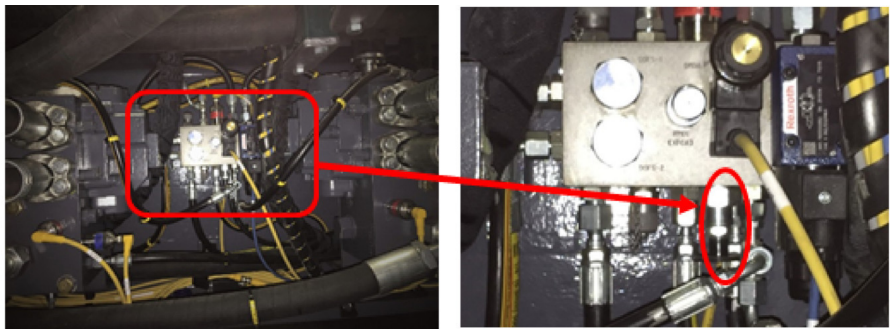


Figure 16

15.18.11 Brake Pressure Circuit

- The hydraulic schematic (Figure 17) represents how the brake circuit functions on the Pit Viper Series machines.
- The brake pack releases only when the hydraulic pressure is applied to overcome the internal spring tension.

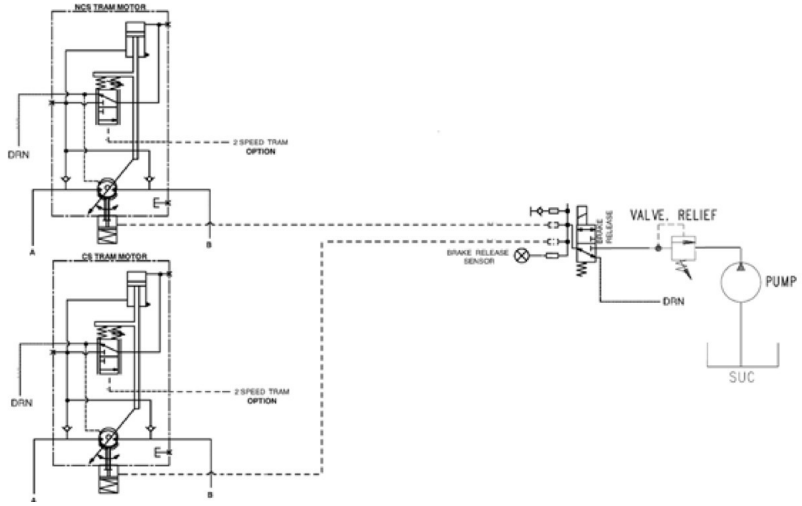


Figure 17

15.18.12 After Completing the Task

1. Remove all tools and unwanted materials from the test area.
2. Discard all unwanted materials, oil, and oil rags in accordance with local environmental regulations.
3. Remove all barricades from the test area and store them for future use.

15.19 Welding Recommendations

15.19.1 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Face - Welding mask
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Body - Welding clothing
- Safety devices

15.19.2 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Grounding clamp	
Tags	As required

Support Equipment

Description	Specification
Not applicable	

Consumables

Description	Specification	Quantity
Not applicable		

15.19.3 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

15.19.4 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
AWS Welding Procedure	

15.19.5 Before Starting the Task

1. Park the machine on a dry level surface.
2. Put all of the controls in the OFF or neutral position.
3. Stop the machine.
4. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

   > ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

5. Make sure that the machine is in a zero-energy state.
6. Put blocks at the tracks, as applicable.

15.19.6 Welding Preparation Instructions

> ***NOTE:*** *Weld all of the Epiroc machines in accordance with the AWS Welding Procedure.*

1. Put the ground cable on bare metal (unpainted) less than 1 meter (3 feet) away from the area to be welded without passing through the following:
   - Clevises
   - Electrical components
   - Hydraulic components
   - Gearboxes
   - Compressors
   - Cylinders
   - Swivels
   - Bearings
   - Components with relative motion (sliding, rolling, or rotating).

> ***NOTE:*** *The ground cable must be placed on bare metal.*

> ***NOTE:*** *When a conventional ground clamp (Figure 1, item A) is not possible due to irregular or large shapes, use a magnetic grounding device (item B).*

2. **WARNING**

   Risk of Electric Shock

   Stray current can cause personal injury.

   ▶ Put the welding ground cable less than 1 meter (3 feet) away from the area to be welded.

NOTICE

Component Damage

Incorrect grounding or clamp location while welding can cause component damage.

▶ Make sure that the grounding and clamping are done correctly, as it prevents the welding of moving parts together without notice.

Do the preparations in Electronic Air Regulation System before welding on the machine.

Figure 1

A	Example ground clamp	B	Example ground magnetic clamp

> ***NOTE:*** *Sections Electronic Air Regulation System and Rig Control System must be obeyed when welding on the machine main frame.*

> ***NOTE:*** *Refer to Rig Control System for additional welding when welding on the machine cab.*

3. Paint the area where the ground or magnetic clamp was placed once the welding is complete. The painted surface must have the following:
   - A minimum dry thickness of 2 to 3 mills.
   - Be hard, smooth, and free from runs, sags, and blemishes.
   - Withstand a minimum of six months of outdoor exposure to environmental elements.

15.19.7 Power Pack

Diesel Engine

Batteries

WARNING

Energized Equipment

Can damage the electrical system and cause personal injury.

- ▶ Disconnect the terminals from the battery when you work on the electrical system or when you weld on the machine.
- ▶ Disconnect the negative terminal first, then disconnect the positive terminal.

NOTE: *There are two sets of batteries per machine. The battery link does not need to be removed.*

- ○ Disconnect the positive and negative connections from the battery to the machine for each set of batteries.

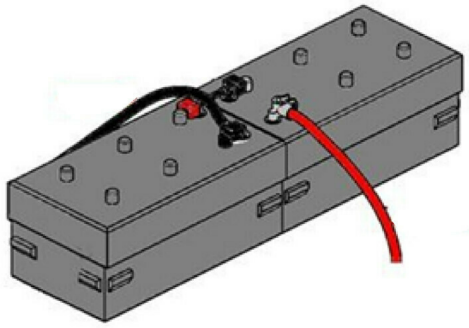


Figure 2

Engine Fuse

NOTE: *Do this procedure if the welding-ground-cable cannot be put less than 1 meter (3 feet) away from the area to be welded.*

1. Disconnect the engine fuse from the Engine Control Module (ECM).

2. Disconnect the wiring harness if you are not able to find the engine fuse.

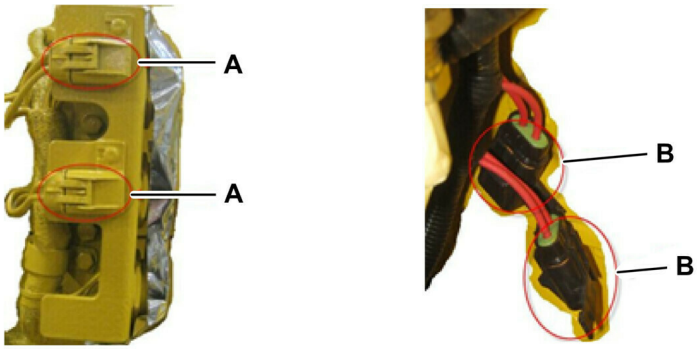


Figure 3

A	Cummins engine fuses	B	Caterpillar engine fuses

> ***NOTE:*** *Cummins engine fuses (Figure 3, item A) are on the ECM bracket.*

> ***NOTE:*** *Caterpillar engine fuses (item B) are on the wiring harness, usually at the same level as the oil pan.*

15.19.8 Electronic Air Regulation System

> ***NOTE:*** *This option may not be installed on all machines.*

> ***NOTE:*** *Do this procedure if the welding-ground-cable cannot be placed less than 1 meter (3 feet) away from the area to be welded.*

- Remove the fuse from the EARS interface board when welding on the main frame.

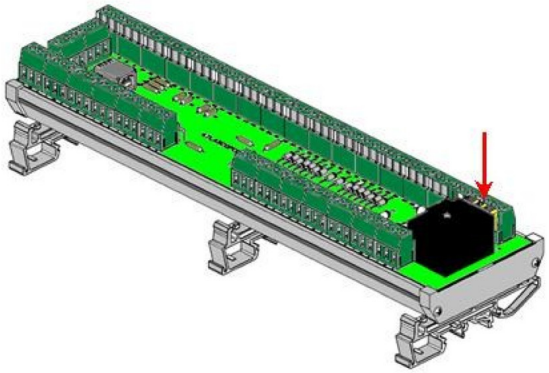


Figure 4

15.19.9 Clutch

> **NOTE:** *This option may not be installed on all machines.*

> **NOTE:** *Do this procedure if the welding-ground-cable cannot be placed less than 1 meter (3 feet) away from the area to be welded.*

- If the machine has the clutch option, remove the inline fuse from the clutch control module (Figure 5, item A) when welding on the main frame.

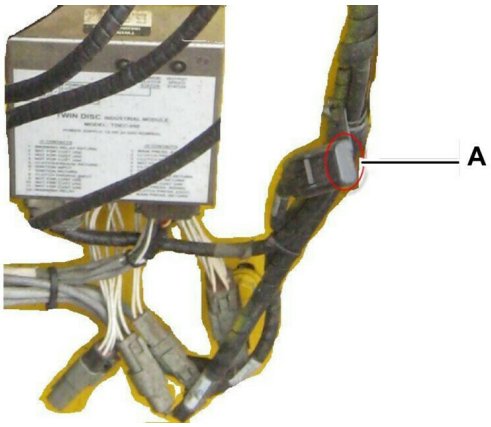


Figure 5

A	Clutch control module		

15.19.10 Rig Control System

- Disconnect the RCS components when welding on the main frame or cab if the welding-ground-cable cannot be placed less than 1 meter (3 feet) away from the area to be welded.

Graphic User Interface Screen

> ***NOTE:*** *Do not remove the terminating resistor, address plugs, and other cabling.*

- Disconnect the power cable (X1) (Figure 6, item A) from the GUI screen.

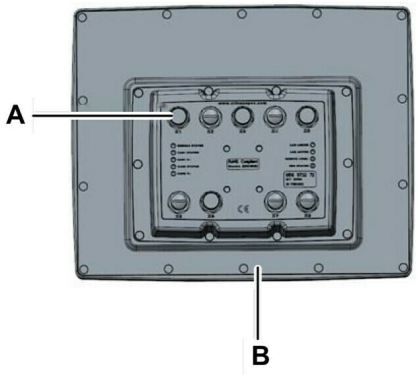


Figure 6

A	Power cable (X1)	B	RCS display unit

Decoder Modules

> ***NOTE:*** *Do not remove the terminating resistor, address plugs, and other cabling.*

- Disconnect the power cable (X1) (Figure 7, item A) from the decoder modules.

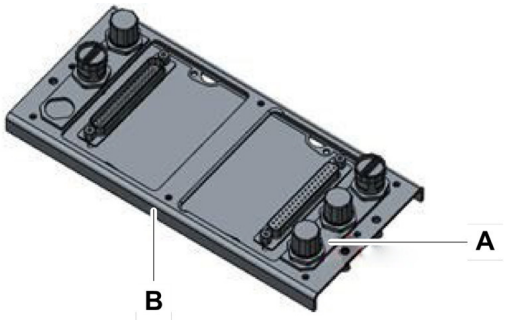


Figure 7

A	Power cable (X1)	B	RCS decoder

Customer Communication Interface Module

> **NOTE:** *Do not remove the terminating resistor, address plugs, and other cabling.*

- Disconnect the power cable (X1) (Figure 8, item A) from the CCI module if the CCI option is installed.

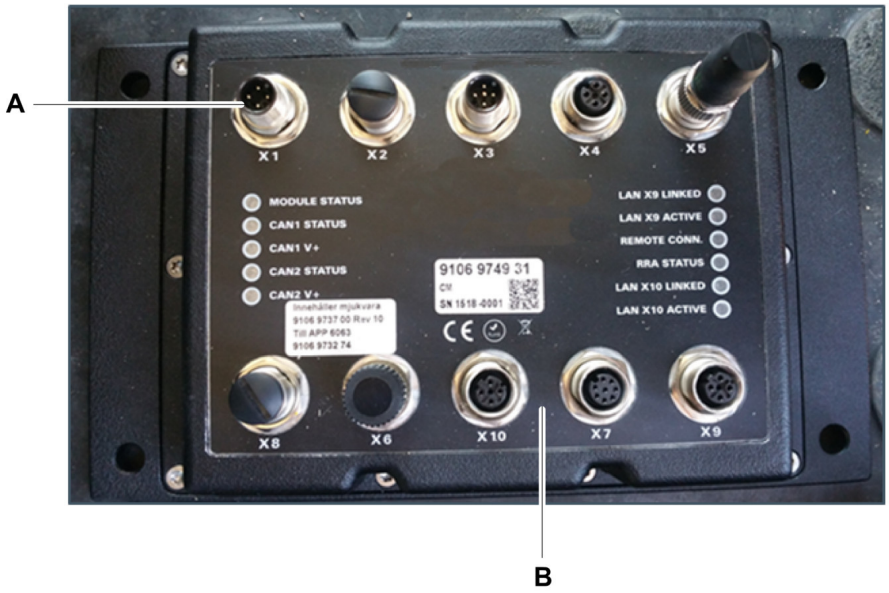


Figure 8

A	Power cable (X1)	B	CCI module

Rig Remote Control Module

> **NOTE:** *Do not remove address plug, and other cabling.*

Do the following procedure if the rig remote control (RRC) option is installed:

1. Disconnect the power cable (X1) (Figure 9, item A) from the RRC machine unit (MU) (item B).

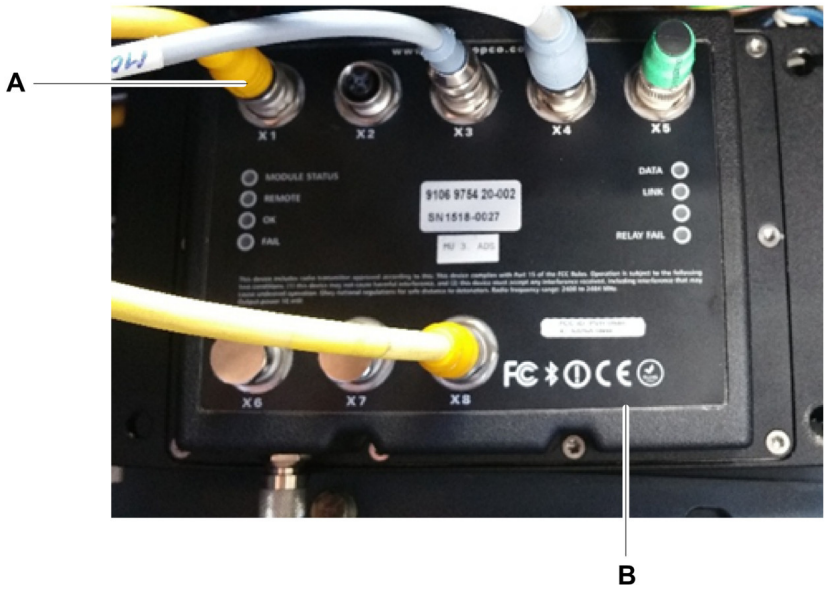


Figure 9

A	Power cable (X1)	B	RRC machine unit

2. Disconnect the OU (operator unit) X1 port charge cable (Figure 10, item A).

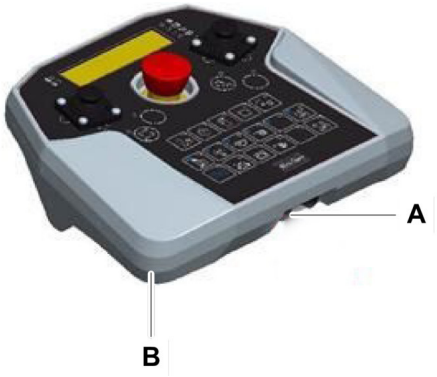


Figure 10

A	X1 port charge cable	B	RRC operator unit

Input/Output Modules

> ***NOTE:*** *Do not remove terminating resistor, address plugs, and other cabling.*

> ***NOTE:*** *Protect the cable that is removed from the X25 and the port from all environmental elements when it is disconnected.*

- Disconnect the power cable (X25) from the Input/Output module.

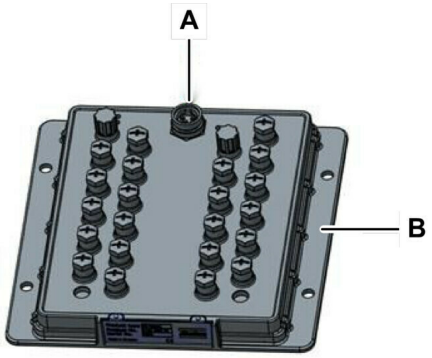


Figure 11

A	Power cable (X25)	B	Input/Output module

> ***NOTE:*** *There are six Input/Output modules that are installed on the machine.*

15.20 Lubricate the Upper Spindle Bearing

15.20.1 Labor Resource (People/Skills)

Service Technician x 1

15.20.2 Personal Protection Equipment

> ***NOTE:*** *Make sure that all necessary personal protection equipment (PPE) is available and correctly used when doing this procedure.*

- Head - Hard hat
- Ears - Hearing protection
- Eyes - Safety glasses
- Hands - Applicable gloves
- Feet - Safety shoes with steel toes
- Body - Fall protection straps
- Safety devices

15.20.3 Technical Data

To select the correct lifting devices, stands, tools, and so forth, the section provides general technical specifications.

> ***NOTE:*** *Due to the variation of machine options and components, actual values can differ from the data below. Data is for reference only.*

Machine Technical Data

See machine-specific manuals for weight, dimensions, and other data relevant to bringing the machine to the work area and doing the task.

Tools

Description	Specification
Standard mechanic toolkit	
Grease tool	
Tags	As required

Support Equipment

Description	Specification
Container	8 L (2 gal)

Consumables

Description	Specification	Quantity
Molykote grease		0.95 L (1 qt)

15.20.4 Spare Parts

> ***NOTE:*** *To obtain part numbers for the spare parts listed below, refer to the Spare Parts Catalog for your specific machine model and serial number.*

Description	Specification	Quantity
Not applicable		

15.20.5 Time Required (Standard Planning Hours)

Description	Planned Time (HH:MM)
Lubricating the Upper Spindle Bearing	00:15

15.20.6 Reference Documentation

Description	Reference
Safety Manual	Model specific
Spare Parts Catalog	Machine specific (per serial number)
Safety Locks and Tags Minimum Requirements	Model specific Maintenance Manual
Environmental Instructions	Model specific Maintenance Manual

15.20.7 Before Starting the Task

1. Park the machine on a dry level surface.
2. **DANGER**

   Electrocution Hazard

   Operating near or contacting a power line with any part of the machine can cause electrocution, causing death.

   - Do not raise or lower the mast or operate the machine near electric power lines.
   - Keep at least 3 meters (10 feet) away from power lines.
   - If there appears any danger of wind or other obstruction decreasing the distance, do not drill in that area.

   Raise the mast to the vertical position and lock it in place.

3. **WARNING**

   Pinch Points

   Moving the rotary head can cause the pinch point hazard.

   - Do not put any part of yourself in the path of the rotary head when it is in motion.

   Lower the rotary head to the bottom of the mast against the bottom stops.

4. Put all of the controls in the OFF or neutral position.
5. Stop the machine.
6. Attach safety locks and tags to the machine in accordance with the site-specific procedures.

> ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

7. Make sure that the machine is in a zero-energy state.
8. Put blocks at the tracks, as applicable.

15.20.8 Lubricating the Upper Spindle Bearing

1. Locate the upper spindle bearing lubrication fitting (Figure 1, item A) on the top of the rotary head at the spindle bearing housing.

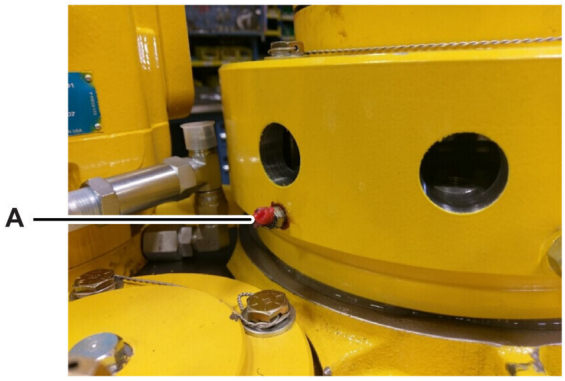


Figure 1

A	Lubrication fitting		

2. Attach the grease tool to the lubrication fitting.

3. Pump grease into the upper bearing spindle housing until grease comes out of the relief port (Figure 2, item A).

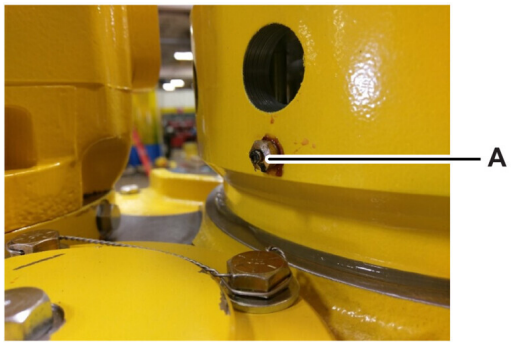


Figure 2

A	Relief port		

4. Remove the grease tool from the lubrication fitting.

15.20.9 After Completing the Task

1. Clean the work area of all tools and trash.
2. **⚠ CAUTION**

   Environmental Contaminant

   Oil is an environmental contaminant and must be discarded correctly.

   ▶ Do not let the used oil drain onto the ground.

   ▶ Discard the used oil in accordance with local environmental regulations.

   ! ***NOTE:*** *Refer to Environmental Instructions in the Maintenance manual.*

   Remove the container and discard the used oil in accordance with local environmental regulations.

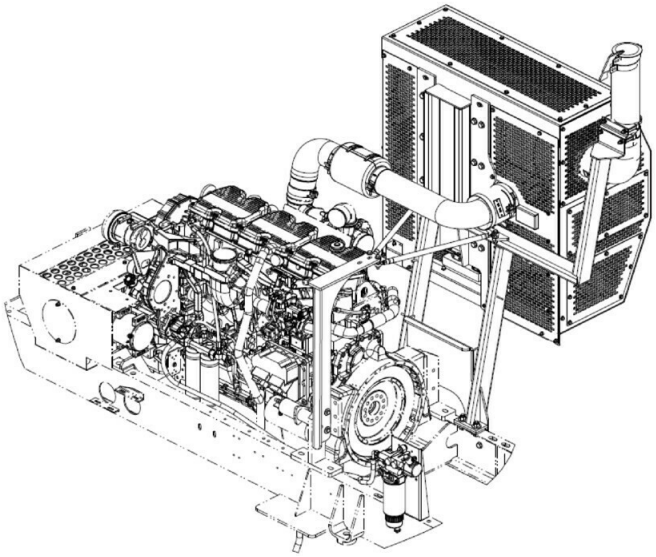
3. Remove the safety locks and tags from the machine in accordance with the site-specific procedures.

   ! ***NOTE:*** *Refer to Safety Locks and Tags Minimum Requirements.*

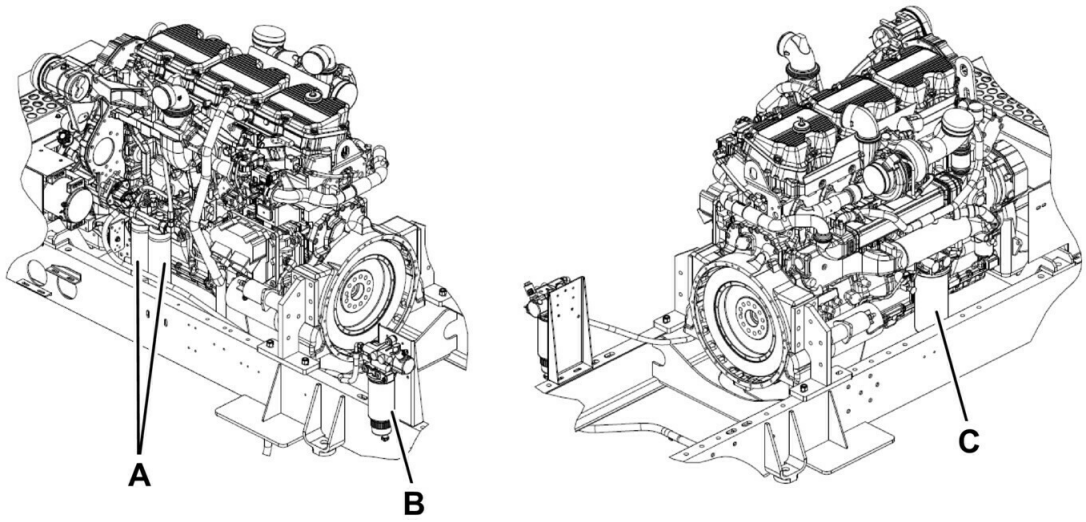
16 Tier 4 Engine Maintenance

16.1 Caterpillar Engine

The Caterpillar C15 Tier 4 final/stage IV engine is provided with an aftertreatment regeneration control, a fumes disposal filter control, and a muffler with a 25.4-mm (1-inch) high temperature wrap. An independent air inlet cleaner with quick release dust drop cover is standard for engine air intake.



Caterpillar C15 Tier 4 final/Stage IV Engine



Caterpillar Filter Locations

A	Fuel filters	B	Fuel filter/separator
C	Oil filter		

16.1.1 Engine Specification

Specification	ACERT C15	ACERT C18	C27	C32
Power	328-403 kW (440-540 HP)	470 kW (630 HP)	597 kW (800 HP)	708 kW (950 HP)
Displacement	15 L (915 in^3)	18 L (1,098 in^3)	27 L (1,648 in^3)	32 L (1,953 in^3)
Rated speed	1,800 rpm			
Fuel system	Mechanically actuated electronically controlled unit injection system (MEUI-C)			
Air filter	One 3-stage air cleaner with one primary and one safety element			
Fumes reduction filter	Open crankcase ventilation filter (OCV)			
Regeneration	CAT active and passive regeneration			
Emission control	Clean gas induction (CGI), CAT self-regenerating diesel particulate filter (DPF), and selective catalytic reduction (SCR) system		Diesel oxidation catalyst (DOC)	
Electrical system	24 V, 150 A charging alternator			
Turbocharger	One fixed-vane, fixed-geometry turbo in series with one fixed vane, high-pressure turbo with mechanical wastegate		Two fixed-vane, fixed-geometry turbo in series with one fixed vane, high-pressure turbo with mechanical wastegate	

Specification	ACERT C15	ACERT C18	C27	C32
Required fuel	Ultra low sulfur diesel fuel (ULSD), 15-ppm sulfur			
Required engine oil	CAT DEO-ULS (15W40) or API-CJ4 Low Ash Oil			

16.1.2 Refill Capacities and Lubricants

Lubrication Table

The following lubrication requirements are intended as an example only. Refer to the OEM manual for your specific engine for the correct lubrication information.

Fluid Level Specifications Example

Description	Fluid	Remarks
C15 ACERT engine oil	Cat DEO-ULS (15W40) or API-CJ4 Low Ash Oil is mandatory.	Stop the engine for ten minutes before filling with oil. Maintain the oil level to the FULL mark on the oil level gauge.
Diesel fuel	Tier 4 engines require ultra low sulfur diesel fuel (ULSD), 15-ppm sulfur. Will also have ULSD B20 biodiesel capability.	Fill the fuel to the FULL mark on the fuel gauge.
Aftertreatment (Diesel exhaust fluid tank)	Diesel exhaust fluid (DEF)	Fill the diesel exhaust fluid tank when filling the diesel fuel tank.

Refill Capacities

The table Approximate Refill Capacities/Recommendation Example is an example of the fluid capacities. This is provided for the maintenance personnel for machine maintenance in remote locations where complete shop facilities and resources are not available. Refer to the OEM manual for your specific engine for the actual fluid information. These capacities give the maintenance personnel an approximation of the fluid capacities of the components to be serviced. Always make sure that the specified method for examining the accurate fluid levels is used.

Approximate Refill Capacities/Recommendation Example

Component	Fluid	Approximate Quantity
C15 ACERT Tier 4 engine	Cat DEO-ULS (15W40) or API-CJ4 Low Ash Oil is mandatory.	38 L (10 gal)
Fuel tank	Tier 4 engines require ultra low sulfur diesel fuel (ULSD), 15-ppm sulfur. Also have ULSD B20 biodiesel capability.	Varies with machine model
Diesel exhaust fluid (DEF) tank	Diesel exhaust fluid (DEF)	Varies with machine model

16.1.3 Aftertreatment Technologies

Technology	Description
Diesel oxidation catalyst (DOC)	The DOC uses a chemical process to transform pollutants in the exhaust stream into less harmful components.
Diesel particulate filter (DPF)	A DPF traps additional particulate matter that is carried in the exhaust stream, preventing it from being released into the atmosphere.
Passive Regeneration System	All Caterpillar Tier 4 final/stage IV engines use a passive regeneration system that continuously regenerates at a slow rate, during normal machine operation, using the heat from the engine exhaust gas.
CAT Regeneration System (CRS)	The CRS is an active regeneration system used in engines rated 130-560 bkW (175-750 bhp) when supplemental regeneration is needed. CRS elevates exhaust gas temperatures to promote oxidation and burn off soot in the DPF.
Selective catalytic reduction (SCR)	SCR is an advanced active emissions control technology that injects a liquid-reductant agent, urea, also known as diesel exhaust fluid (DEF), into the exhaust stream of the engine. The DEF sets off a chemical reaction that converts nitrogen oxides into nitrogen, water, and small amounts of carbon dioxide, natural components of the air, and expels this through the tailpipe.

16.1.4 Open Crankcase Ventilation (OCV) Filter

The open crankcase ventilation (OCV) filter removes vaporized oil droplets, contaminates, and particulate matter from the crankcase blow-by stream. Oil returns to a liquid state as it passes through the filter element. The oil is then captured in the filter housing and recycled back to the engine oil pump. Particulate matter and contaminates are trapped in the filter element. Cleaned blow-by is routed to the atmosphere through the OCV system outlet tube.

16.1.5 Change the Open Crankcase Ventilation (OCV) Filter

Removing the Open Crankcase Ventilation (OCV) Filter

1. Park the machine on a dry level surface.
2. Stop the engine.
3. Attach safety locks and tags to the machine in accordance with the site-specific procedures or refer to Safety Locks and Tags Minimum Requirements.
4. **CAUTION**

   Environmental Contaminant

   Fluid is an environmental contaminant and must be discarded correctly.

   - Do not let the used fluid drain onto the ground.
   - Discard the used fluid in accordance with local environmental regulations.

   Put a container below the OCV filter (Figure 1, item A) to collect any spilled fluid.

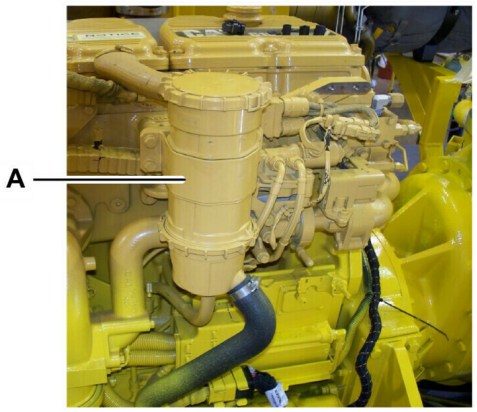


Figure 1

A	OCV filter		

5. Remove either the cap or the cup from the housing for the OCV filter.
6. Remove the OCV filter.
7. Discard the OCV filter in accordance with local environmental regulations.

Installing the Open Crankcase Ventilation (OCV) Filter

1. Attach safety locks and tags to the machine in accordance with the site-specific procedures or refer to Safety Locks and Tags Minimum Requirements.
2. Clean the inside of the canister and inspect the cover gasket.
3. Install the new OCV filter and replace the cover gasket, if necessary.
4. Install the cap or cup on the housing and tighten it by hand.
5. Remove the safety locks and tags from the machine in accordance with the site-specific procedures or refer to Safety Locks and Tags Minimum Requirements in the Maintenance manual.

16.1.6 Change the ARD Spark Plug

Removing the Spark Plug

WARNING

Risk of Personal Injury

Do not service the spark plug when the engine is in operation or the key is in the ON position.

▶ Set the key to the OFF position while you service the spark plug.

1. Park the machine on a dry level surface.
2. Stop the engine.
3. Attach safety locks and tags to the machine in accordance with the site-specific procedures or refer to Safety Locks and Tags Minimum Requirements.

4. Disconnect the wiring harness (Figure 1, item A) from the spark plug (item B).

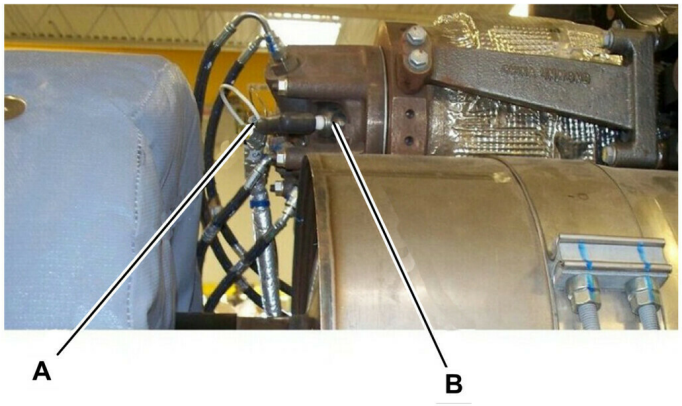


Figure 1

A	Wiring harness	B	Spark plug

5. **WARNING**

High Pressure

Can cause personal injury.

- Put on the applicable personnel protective clothing to protect eyes and uncovered parts of the body when using compressed air, water jets, or steam cleaning methods.
- Maximum air pressure at the nozzle must be less than 207 kPa (30 psig) for cleaning purposes.

Clean the spark plug thoroughly with compressed air to remove any unwanted material that is collected in the spark plug.

NOTE: *Make sure that the area around the spark plug is clean and free of dirt and unwanted material.*

6. Loosen the spark plug with a deep well socket and breaker bar and remove the spark plug by hand.

NOTE: *If the spark plug cannot not be removed by hand, clean the threads with a brush.*

7. Do a visual check of the spark plug threads for damage.
8. Inspect the used spark plug and the gasket.

Examining the Spark Plug

NOTICE

Component Damage

A thread tap removes the metal unnecessarily. Threads could be stripped and the combustion group could be damaged.

▶ Do not use a thread tap.

- Examine the spark plug closely for damage. The condition of the spark plug can indicate the operating condition of the engine.
- Make sure that the terminal post must not move by hand.

> ***NOTE:*** *If the terminal post can be moved by hand, discard the spark plug.*

- Examine the insulator for cracks.

> ***NOTE:*** *If a crack is found on the insulator, discard the spark plug.*

- Examine the shell for damage. Over tightening of the spark plug causes the shell to crack or loose.

> ***NOTE:*** *If the shell is cracked or loose, discard the spark plug.*

- Examine the electrode for excessive wear.

Installing the Spark Plug

> ***NOTE:*** *Do not use anti-seize compound on the spark plug. Most of the heat is transferred through the threads and the seat area of the spark plug. Contact of the metal surfaces must be maintained to provide the heat transfer that is needed.*

1. Attach safety locks and tags to the machine in accordance with the site-specific procedures or refer to Safety Locks and Tags Minimum Requirements.
2. Make sure that the spark plug is clean and free of dirt and oil.

3.

NOTICE

Component Damage

Over tightening the spark plug can damage the gasket, cause crack or stretch on the shell, deform the metal, loosen the seal between the shell and the insulator, lets the combustion pressure to blow past the seal, and damage the engine.

- ▶ Torque the spark plug to the correct specification.

Install the spark plug by hand until the spark plug contacts the ARD. Torque the spark plug to the correct specification.

4. Connect the wiring harness.
5. Remove the safety locks and tags from the machine in accordance with the site-specific procedures or refer to Safety Locks and Tags Minimum Requirements in the Maintenance manual.

16.1.7 Clean the Diesel Particulate Filter

Cleaning the Diesel Particulate Filter

NOTICE

Component Damage

Improper cleaning or repair of the diesel particulate filter can damage the diesel particulate filter and the engine aftertreatment system.

- ▶ Use only OEM recommended ash service tool.
- ▶ Contact OEM for more information.

- Clean the diesel particulate filter to remove ash and soot (Figure 1).

Figure 1

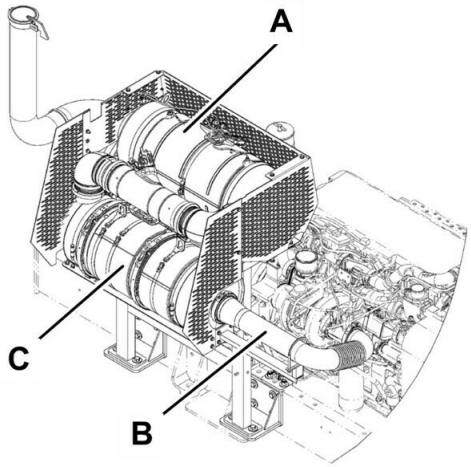
- Use the following products to optimize performance between diesel particulate filter cleaning intervals:
  - Oil that meets the performance requirements of the OEM specification
  - Ultra low sulfur diesel fuel.

16.1.8 Selective Catalytic Reduction System

Selective catalytic reduction is an advanced active emissions control technology system. This system involves the injection of a liquid-reductant agent through a special catalyst into the exhaust stream of the diesel engine. The reductant source is called urea, also known as diesel exhaust fluid (DEF). The diesel exhaust fluid sets off a chemical reaction that converts nitrogen oxides into nitrogen, water, and small amounts of carbon dioxide, natural components of the air, and expels them through the exhaust pipe.

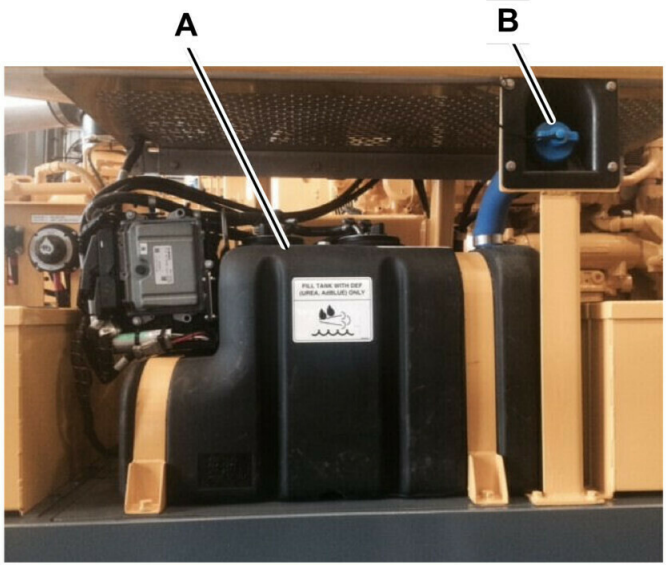
Caterpillar engines C15-C18 have a delayed shutdown feature that lets the diesel exhaust fluid injectors to cool. The engines operate for up to two minutes after the key switch is turned off to cool the injectors.

Fill the diesel exhaust fluid tank with diesel exhaust fluid when the diesel fuel tank is filled.



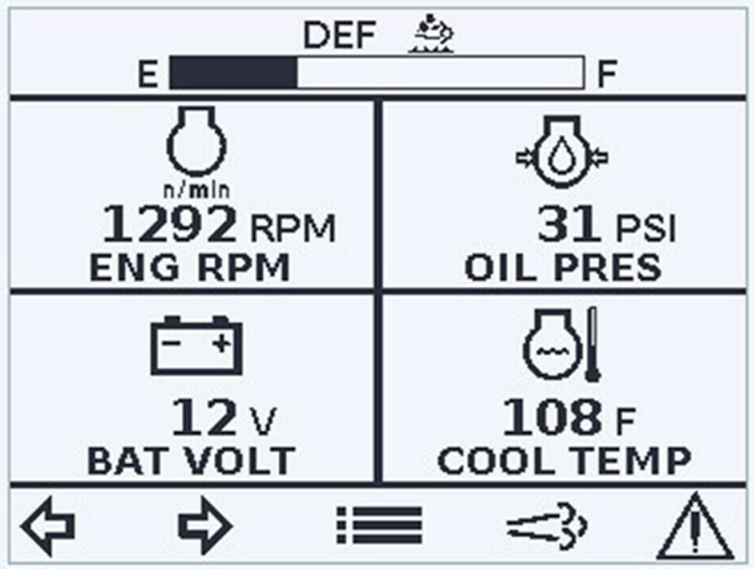
Selective Catalytic Reduction System

A	Selective catalytic reduction	B	Exhaust pipe
C	Diesel particulate filter		



Caterpillar DEF Tank and Fill Port

A	Diesel exhaust fluid (DEF) tank	B	Fill port



Powerview Screen

> ***NOTE:*** *Monitor the diesel exhaust fluid (DEF) level in the Powerview screen. The DEF level appears at the top of the screen.*

> ***NOTE:*** *To extend the life of diesel exhaust fluid (DEF), store it at 25 °C (77 °F) temperature or below.*

Storage of diesel exhaust fluid (DEF)

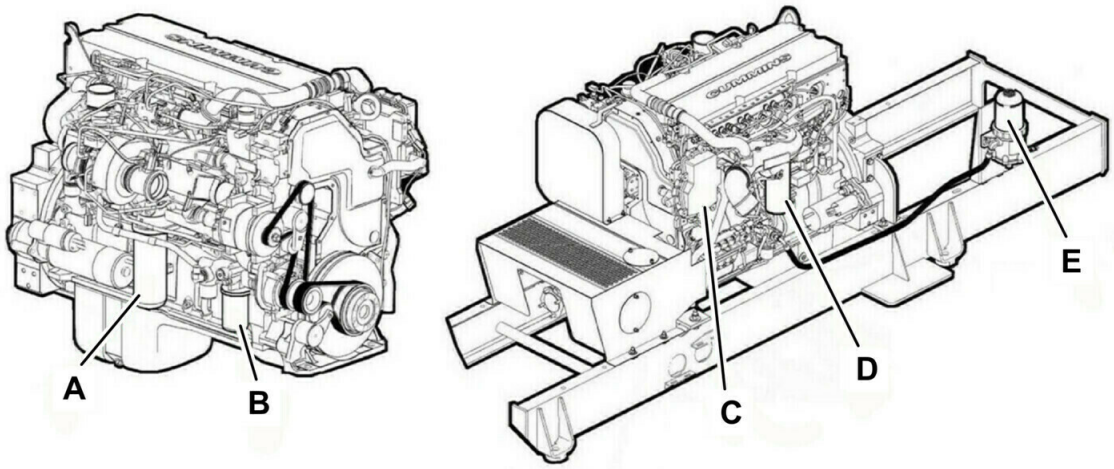
Storage Temperature	Expected Diesel Exhaust Fluid (DEF) Life
Below 25 °C (77 °F)	18 months
25 to 30 °C (77 to 86 °F)	12 months
30 to 35 °C (86 to 95 °F)	6 months

16.2 Cummins Engine

Cummins core technology includes Cummins particulate filter, exhaust aftertreatment and exhaust gas recirculation (EGR). Engine enhancements include use of variable geometry turbocharger (VGT™), advanced electronic controls (ECM), high-pressure common rail fuel system, and a crankcase ventilation system.

Cummins QSX15 Tier 4 final/stage IV engines are equipped with an air-intake-to-exhaust aftertreatment system to meet 2014 EPA Tier 4 final and EU stage IV regulations. The QSX15 Tier 4 final/stage IV engines use a Cummins particulate filter to reduce particulate matter emissions and incorporate a cooled exhaust gas recirculation system to reduce oxides of nitrogen emissions.

The Cummins QSX15 Tier 4 final/stage IV engine must use an independent Direct Flow™ air filter. QSX15 engines are integrated with the Direct Flow™ air cleaner. The Direct Flow™ housing features an integral sensor for monitoring temperature and pressure to make sure that optimum airflow is delivered to the engine during all operating conditions.



A	Oil filter	B	Coolant filter
C	Crankcase breather	D	Secondary fuel filter
E	Primary fuel filter		

16.2.1 Engine Specification

> ***NOTE:*** *For engine oil, Cummins recommends Valvoline Premium Blue in North America. The European Union requires ACEA0E9 in Europe.*

Specification	**QSX15**
Power	298 − 447kW (400 − 600HP)
Displacement	15 L (915 in^3)
Rated speed	1,800 rpm
Fuel system	Extra-high pressure injection system (XPI)
Air filter	Direct Flow™ air cleaner
Regeneration	Active and passive regeneration
Crankcase breather	Coalescing filter
Electronic controls	Cummins CM2250 electronic control module (ECM)

Specification	QSX15
Emission control	Cooled exhaust gas regulation (EGR), Cummins particulate filter, and selective catalytic reduction (SCR)
Turbocharger	One variable geometry turbocharger (VGT™)
Required fuel	Ultra low sulfur diesel fuel (ULSD), 15-ppm sulfur
Required engine oil	API-CJ4 Low Ash Oil

16.2.2 Aftertreatment Technologies

Technology	Description
Diesel particulate filter (DPF)	Cummins uses a combination diesel oxidation catalyst (DOC) and diesel particulate filter (DPF) which is called as Cummins particulate filter. Exhaust flows out of the engine and into the Cummins particulate filter. It passes through the DOC and then into the DPF where particulate matter (PM) is collected on the walls of the DPF. The PM is then oxidized to remove it from the DPF. This is known as regeneration.
Passive regeneration	When operating conditions maintain sufficient exhaust temperatures, the DPF is continually selfregenerating. This is known as passive regeneration and results in clean exhaust. Infrequently, an active self-regeneration is required to remove buildup of PM due to insufficient exhaust temperatures.
Active regeneration	Exhaust temperatures are raised by injecting a small amount of fuel upstream of the Cummins particulate filter. The resulting chemical reaction over the diesel particulate filter (DOC) raises exhaust temperatures high enough to oxidize the particulate matter (PM) from the filter. This is all done without operator intervention.
Exhaust gas recirculation (EGR)	The primary function of exhaust gas recirculation (EGR) is to lower amount of nitrous oxides (NOx) produced by combustion of diesel fuel. A portion of the engine exhaust gas is recirculated into the engine and combusted again. This lowers the amount of excess oxygen and lowers peak combustion temperatures. Since NOx formation occurs much faster at high temperatures, the EGR limits the generation of NOx. NOx is formed when a mixture of nitrogen and oxygen is subjected to high temperatures.
Selective catalytic reduction (SCR)	Selective catalytic reduction is an advanced active emissions control technology that injects a liquid reductant agent, urea, also known as diesel exhaust fluid (DEF), into the exhaust stream of the engine. The DEF sets off a chemical reaction that converts NOx into nitrogen, water, and small amounts of carbon dioxide, natural components of the air, and expels this through the exhaust pipe.

16.2.3 Refill Capacities and Lubricants

Lubrication Table

An example of the lubrication requirements is shown in the table Fluid Level Specifications. These requirements are an example of those specific to the Cummins QSX15 tier 4 final/EU stage IV diesel engines. Refer to OEM manual for the actual lubrication requirements for your specific engine.

Fluid Level Specifications

Description	Fluid	Remarks
Engine oil	10W40 Low Ash Oil, API CJ-4 (ACEA-E9 in Europe) is lubricant specification for diesel engines using exhaust aftertreatment (DPF and EGR). Cummins recommends Valvoline Premium Blue.	Stop the engine for 10 minutes before examining the oil level. Maintain the oil level to the FULL mark on the dipstick.
Diesel fuel	Tier 4 diesel engines require ultra low sulfur diesel fuel (ULSD) of 15 ppm or less sulfur content. ! ***NOTE:*** *For Cummins® QSK23 Tier 4 engines, do not use a biodiesel blend exceeding 5% unless otherwise approved by Cummins® Service Bulletin.*	Fill the fuel to the FULL mark shown on the fuel gauge on the operator console.
Aftertreatment - Diesel Exhaust Fluid (DEF) tank	Diesel exhaust fluid (DEF), also known as urea	Fill the DEF tank when filling the diesel fuel tank.

Refill Capacities

The table Approximate Refill Capacities/Recommendation Example is an example of the fluid capacities. This is provided for the maintenance personnel for machine maintenance in remote locations where complete shop facilities and resources are not available. Refer to the OEM manual for your specific engine for the actual fluid information. These capacities give the maintenance personnel an approximation of the fluid capacities of the components to be serviced. Always make sure that the specified method for examining the accurate fluid levels is used.

Approximate Refill Capacities/Recommendation Example

Component	Lubrication	Quantity
Cummins QSX15 Tier 4 diesel	10W40 Low Ash Oil, API CJ-4 (ACEA-E9 in Europe) is the lubrication oil specification for diesel engines using exhaust aftertreatment (DPF and EGR). Cummins recommends Valvoline Premium Blue.	49 L (13 gal) Engine oil capacity
Fuel tank	Tier 4 diesel engines require ultra low sulfur diesel fuel (ULSD) with 15-ppm or less sulfur content. ! ***NOTE:*** *For Cummins® QSK23 Tier 4 engines, do not use a biodiesel blend exceeding 5% unless otherwise approved by Cummins® Service Bulletin.*	Varies with machine model
Diesel exhaust fluid (DEF) tank	Diesel exhaust fluid (DEF), also known as urea.	Varies with machine model

16.2.4 Cummins Filtration Closed Crankcase Ventilation System

The Cummins filtration closed crankcase ventilation (CCV) system is designed to remove emissions from the open crankcase system on a diesel engine with blow-by flows of 0.3 m^3/minute (12 ft^3/min) or less. Along with reducing emissions, this system helps to reduce oil consumption, mist, fumes, and drips in the engine compartment.

The gases that are vented out though the crankcase is the result of leakage around the piston rings in the combustion chamber and are composed of hydrocarbon particles, soot from diesel, engine oil, and its contaminants. These crankcase gases are then vented into the air intake system to be consumed by the combustion process.

A crankcase filter left unchecked and unchanged can result in lower efficiencies and fouling of the turbocharger and heat exchanger. A plugged filter can also cause the crankcase pressure to rise. Cummins Filtration recommends that the Coalescer filter is serviced once every year or 1,000 hours, whichever occurs first.

16.2.5 Cummins Particulate Filter

Cummins Tier 4 final/stage IV engines use an after treatment device (ATD) to control emissions. This means that a special canister assembly replaces the typical muffler. This assembly contains a diesel oxidation catalyst (DOC) and a diesel particulate filter (DPF). The DPF is a ceramic filter that captures soot and ash from the exhaust. Over time, soot and ash buildup in the filter and must be removed. The Cummins Diesel Particulate Filter Assembly is equipped

with a differential pressure transducer and three temperature transducers. These sensors allow the engine to monitor soot buildup for cleaning requirements. Exhaust temperatures during a normal regeneration event can reach 600 °C (1,112 °F).

The engine control system can differentiate between soot buildup and ash buildup. The Cummins particulate filter is service-free up to 5,000 hours when low ash oil is used and the base engine is correctly maintained. At that point, ash cleaning is needed. The environmental protection agency (EPA) has set minimum ash cleaning intervals of 4,500 operating hours. Maintenance depends on duty cycle, type of oil used and oil consumption rate. CES20081/API CJ-4 oil maximizes the Cummins DPF maintenance interval. When the engine senses a buildup of ash, it lights the check engine light and activate a fault code on the powerview diagnostic gauge that is located on the operator engine control panel.

16.2.6 Change the Coalescer Filter

Removing the Coalescer Filter

1. Park the machine on a dry level surface.
2. Stop the engine.
3. Attach safety locks and tags to the machine in accordance with the site-specific procedures or refer to Safety Locks and Tags Minimum Requirements.

4. Loosen the 8-millimeter (5/16-inch) hex head cap screws (Figure 1, item E) that hold the Coalescer service element cover (item A) and base (item C) together.

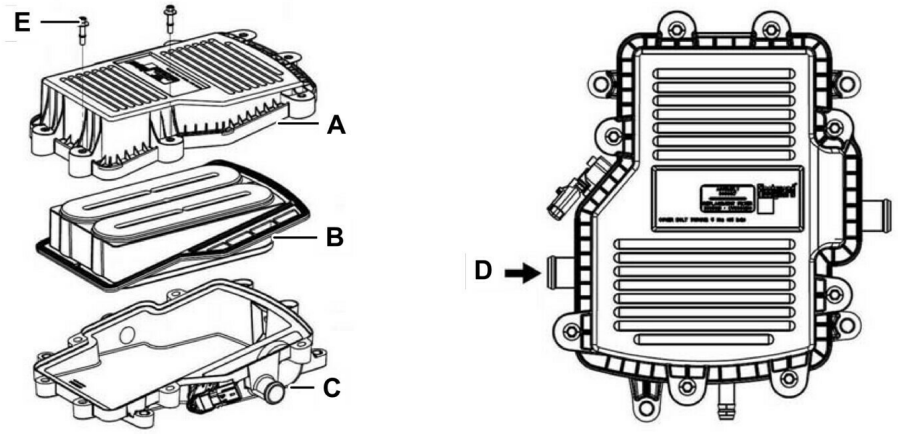


Figure 1

A	Cover	B	Filter service element
C	Base	D	Flow
E	Cap screw		

5. Lift the cover off of the base with all of the cap screws remain on the cover.
6. Remove the old filter service element (item B) from the base.
7. **CAUTION**

   Environmental Contaminant

   Filters can contain oil residue, which is an environmental contaminant and must be discarded correctly.

   ▶ Discard the used filter in accordance with local environmental regulations.

   Discard the old filter service element in accordance with the local environmental regulations.

Examine the Coalescer Filter

NOTICE

Component Damage

Cleaning or reconditioning of the filter service element can cause lower efficiency, fouling of the turbocharger and heat exchanger, and an increase in crankcase pressure.

- ▶ Do not clean or recondition the filter service element.

- ○ Examine the oil level gauge that is used in the coalescing crankcase ventilation system for dislodge from its correct installed position.

> ! ***NOTE:*** *If the oil level gauge becomes dislodged, examine the Coalescer filter for any dirt or it becomes plugged, and replace if necessary.*

Installing the Coalescer Filter

1. Attach safety locks and tags to the machine in accordance with the site-specific procedures or refer to Safety Locks and Tags Minimum Requirements.
2. Insert the new filter service element into the base.
3. Install the cover and torque the eight cap screws to 5 Newton meters (3.7 foot-pounds) dry in star shaped pattern.
4. Examine the hoses for leaks and failures such as cracks and loose connections. Replace the hoses, as needed.
5. Remove the safety locks and tags from the machine in accordance with the site-specific procedures or refer to Safety Locks and Tags Minimum Requirements in the Maintenance manual.

16.2.7 Cleaning the Cummins Particulate Filter

Cleaning the Cummins Particulate Filter

NOTICE

Component Damage

Unapproved cleaning method can cause component damage.

- The Cummins particulate filter must be removed and cleaned by a Cummins approved cleaning method and authorized technician.
- No modification of the exhaust between the engine and the diesel particulate filter is allowed per the Environmental Protection Agency.

- Remove the soot buildup on the filter by heating the filter until the soot oxidizes and turns into carbon dioxide gas.

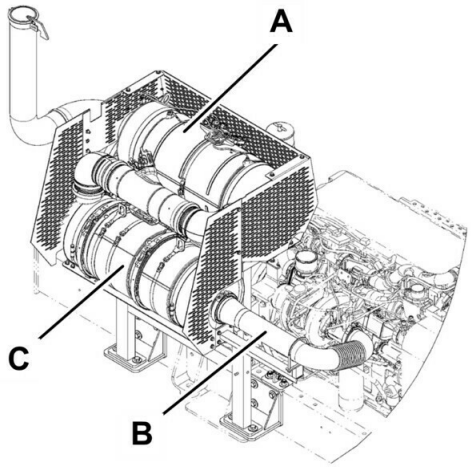
  ! ***NOTE:*** *This process is commonly known as regeneration.*

- Remove the ash buildup from the filter by periodic cleaning in a special cleaning machine.

16.2.8 Selective Catalytic Reduction System

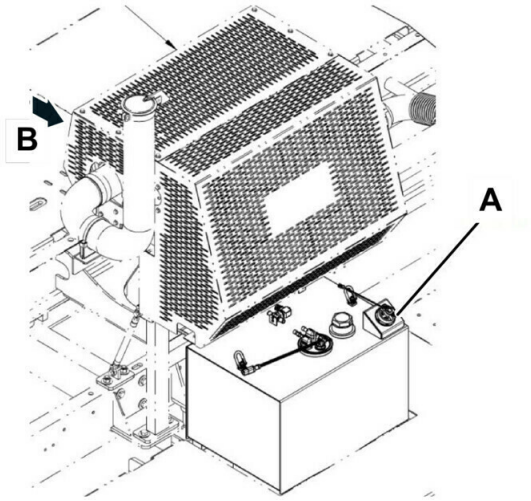
Selective catalytic reduction is an advanced active emissions control technology system. This system involves the injection of a liquid-reductant agent through a special catalyst into the exhaust stream of the diesel engine. The reductant source is called urea, also known as diesel exhaust fluid (DEF). The diesel exhaust fluid sets off a chemical reaction that converts nitrogen oxides into nitrogen, water, and small amounts of carbon dioxide, natural components of the air, and expels them through the exhaust pipe.

Fill the diesel exhaust fluid tank with diesel exhaust fluid when the diesel fuel tank is filled.



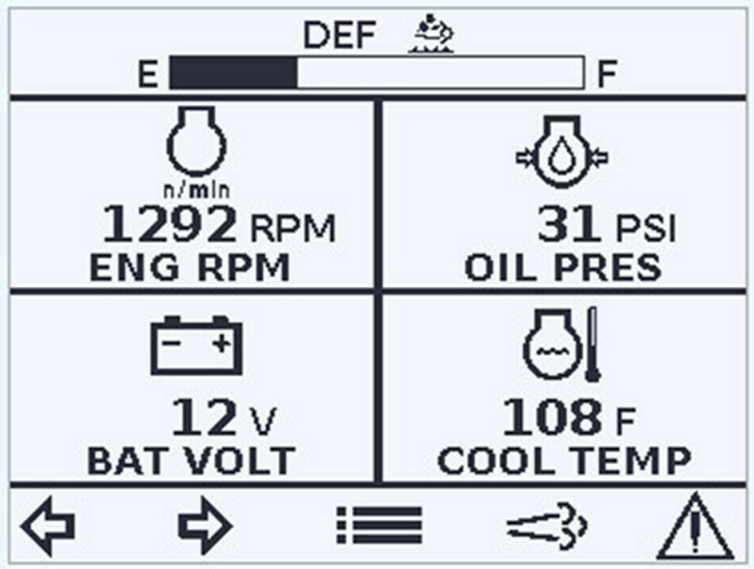
Selective Catalytic Reduction System

A	Selective catalytic reduction	B	Exhaust pipe
C	Diesel particulate filter		



Cummins DEF Tank and Fill Port

A	Fill port	B	Diesel exhaust fluid tank



Powerview Screen

> ***NOTE:*** *Monitor the diesel exhaust fluid (DEF) level in the Powerview screen. The DEF level appears at the top of the screen.*

> ***NOTE:*** *To extend the life of diesel exhaust fluid, store it at 25 °C (77 °F) temperature or below.*

Storage of Diesel Exhaust Fluid

Storage Temperature	Expected Diesel Exhaust Fluid Life
Below 25 °C (77 °F)	18 months
25 to 30 °C (77 to 86 °F)	12 months
30 to 35 °C (86 to 95 °F)	6 months

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