KONECRANES

Maintenance Instructions

Forklift SMV 10–65, Gen C

MIFLTC_RevE

Original Instructions
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Contact information

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1 INTRODUCTION

1.1 About this document

This maintenance instruction offers guidance to enable safe and efficient maintenance of the equipment.

Taking the time to read this document helps to prevent damage to the equipment, and, most importantly, keep the personnel safe. The equipment is safe when used correctly. However, there are many potential hazards that are associated with incorrect operation and maintenance. These hazards can be avoided with knowledge about how to recognize and anticipate them.

This document increases the awareness of the responsibilities regarding the equipment. Following the content of this document will ensure that the equipment is kept in a safe operating condition throughout its lifetime.

This document is not intended as a substitute for proper training but provides recommendations and methods for safe and efficient operation and maintenance. The operational manager must ensure that operators are properly trained before operation. They must always comply with all the applicable and prevailing safety, as well as other standards, rules, and regulations.

1.1.1 Use of the document

Every person that is exposed to the equipment must, before operating, servicing and maintaining such products, read, and understand the contents of this document. Also to strictly adhere and conform their conduct with and to the information, recommendations, and warnings that are provided in this document.

NOTE ***Keep the maintenance instructions in a safe and accessible location for future reference.***

⚠ WARNING

IGNORING INSTRUCTIONS HAZARD

Failure to follow the given instructions could cause death or serious injury.

Read and understand the contents of this document before operating, servicing, and maintaining the equipment.

The manufacturer makes absolutely no warranty whatsoever regarding the contents of this document, express or implied, whether arising by operation of law or otherwise. This includes, but are not limited to, any implied warranties of merchantability or fitness for a particular purpose.

1.1.2 Terminology

All brand names, product names, and trademarks that are used in this document are registered trademarks of their respective owners.

The following terms and definitions may have been used in this document:

Authorized dealer	Company, or person authorized by **Konecranes Lifttrucks AB** to carry out service actions, and represent the manufacturer.
Authorized personnel	Persons who have the necessary training and who are authorized by **Konecranes Lifttrucks AB** or their representative to carry out operation, or service actions.
Manufacturer	Refers to **Konecranes Lifttrucks AB**, or supplier of part when otherwise specificed.
Operational manager	Person, or persons, with different areas of responsibility at the working site where the machine is used. The areas of responsibility include, but are not limited to risk assessments, daily operations and maintenance tasks.
Battery compartment	A compartment containing the 24V batteries and fuses, which are found on the right side of the machine.
CE marking	The CE marking of the machine is displayed on the lifting capacity plate. The symbol indicates that the machine complies with the appropriate CE regulations.
Check	A visual and functional assessment (not a test) of the machine without dismantling it.
Touch screen display	A touch screen where the user receives information, and enter commands by touching designated areas on the screen.
TRUCONNECT®	**TRUCONNECT®** is a suite of remote service products and applications to support maintenance operations and drive improvements in safety and productivity. The collected data from the machines can be viewed at **yourKONECRANES** customer portal.

1.1.3 Abbreviations

The following abbreviations and shortenings can occur in this document:

Abbreviation	Description	Abbreviation	Description
AEB	Automated determination of the filling paramaters (**A**utomatisiertes **E**rmitteln der **B**efüllparameter)	**LV**	Low Voltage
COG	Center Of Gravity	**NCD**	Nox Control Diagnostics
DEF	Diesel Exhaust Fluid	**PCB**	Printed Circuit Board
DOC	Diesel Oxidation Catalyst	**PCD**	Particle Control Diagnostics
DPF	Diesel Particulate Filter	**PPE**	Personal Protective Equipment
EATS	Engine After-treatment System	**PPS**	Power Pile Slope
ECM	Engine Control Module	**RFID**	Radio Frequency Identification
EMC	Electric Magnetic Compatibility	**SCR**	Selective Catalyst Reduction
FGO	Function Group Output	**SWL**	Safe Working Load

Abbreviation	Description	Abbreviation	Description
HLL	Hydraulic Long-Life	**TPMS**	Tire Pressure Monitoring System
HVAC	Heating, ventilation, and air conditioning	**ULSD**	Ultra-Low Sulphur Diesel
ISO	International Organization for Standardization	**VCU**	Vehicle Control Unit
LC	Load Center		

1.1.4 Copyright notice

1.1.5 Available technical documents

For this equipment, there are technical documents that serve different purposes and audiences. Contact your supplier if you require any of the documents that are listed here.

Operating instructions	Describes the responsibilities of the operator and the operating instructions, along with some mandatory daily maintenance tasks and safety information. The operating instruction must be stored in the cabin of the truck.
Maintenance instructions	Describes maintenance tasks such as lubrication and oil change and the recommended safety instructions.
Technical instructions	Describes in greater detail the hydraulic and electrical systems, vehicle control unit, and other components of the machine and its software.
Spare part catalogue	Includes part numbers of all components for the supplied parts, drawings, and exploded views.
Supplier documentation	Describes components that are assembled on the machine, and provided by approved suppliers to the manufacturer. This includes component-specific documents, for example, for installation, operation, and maintenance.

NOTE ***Store documents in a safe, dry place where they can be easily located when required.***

1.1.6 Feedback on documents

As the goal is constant improvement, this document may be updated or revised to provide operational managers and maintenance personnel with the most accurate information currently available. Current versions of instructions can be found at document portal www.kclifttrucks.com.

To communicate any inaccuracies or omissions, or to provide general feedback or suggestions regarding the quality of this document, send an email to lifttruck.documentation@konecranes.com.

1.2 About this product

1.2.1 Use of the product

The machine is designed to perform lifting and transporting of loads within the limits that are specified in the machine's lifting capacity plate. For more information, see the machine's lifting capacity plate in front of the left side cabin door.

Contact the manufacturer or manufacturer's representative in case of doubt.

1.2.2 Conditions of warranty

The terms under which seller's equipment and/or services are warranted are defined pursuant to the warranty set forth in the contract between seller and customer for seller's products and/or services and, if not so set forth, the warranty for seller's products and/or services is seller's standard warranty in effect at the time of sale, a copy of which is available from seller upon request. THE FOREGOING REPRESENTS THE SOLE AND EXCLUSIVE WARRANTY GIVEN BY SELLER AND IS IN LIEU OF AND EXCLUDES ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, ARISING BY OPERATION OF LAW OR OTHERWISE, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

Seller provides no warranties for products manufactured or services provided by parties other than seller ("Third Party Products"). Third Party Products may be warranted separately by their respective manufacturers or such other parties from whom seller purchases such Third Party Products and seller shall, to the extent possible, assign to you whatever rights seller may obtain under any such warranties. Modifying any seller product or incorporating any Third Party Product into any seller product or service without the seller's approval invalidates the warranty. Seller does not accept, shall not have any responsibility and disclaims any liability for accidents, injury or physical or property damage arising as a consequence of such unauthorized modifications and/or incorporation of Third Party Products.

Further, each of the following invalidates any warranty of seller and relieves seller from any responsibility to repair or replace any seller product due to a failure to operate and/or maintain seller products in accordance with the applicable manuals, instructions, guides, recommendations, and any other manuals, guidelines or recommendations of seller concerning the maintenance and operation of seller products that may be communicated to you from time to time; damage or defects caused by side-pulling of load, shock loading, excessive jogging, eccentric loading or overloading, accidental occurrence, improper repair, improper handling or storage of products, chemical exposure, abnormal operating conditions, or any other cause that in seller's sole discretion is not attributable to defects in the material and workmanship of seller’s product. The applicable seller manuals, instructions, guidelines, and recommendations must be strictly complied with by customer which may include, by way of example and not by limitation, installation and commissioning instructions, owner's manuals, operator's/user’s manuals, operating and maintenance instructions and user's guides.

SELLER SHALL HAVE NO LIABILITY TO YOU OR ANY END USER OF PRODUCTS FOR LOST PROFITS OR FOR INDIRECT, SPECIAL, CONSEQUENTIAL, EXEMPLARY OR INCIDENTAL DAMAGES OF ANY KIND WHETHER ARISING IN, CONTRACT, TORT, PRODUCT LIABILITY, STRICT LIABILITY OR OTHERWISE, EVEN IF SELLER WAS ADVISED OF THE POSSIBILITY OF SUCH LOST PROFITS OR DAMAGES. SELLER’S LIABILITY IS LIMITED TO THE AMOUNT OF YOUR DIRECT DAMAGES UP TO THE AMOUNT OF THE CONTRACT PRICE AND IN NO EVENT SHALL SELLER BE LIABLE TO YOU FOR ANY DAMAGES WHATSOEVER IN EXCESS OF THE TOTAL PRICE PAID BY YOU FOR THE APPLICABLE SELLER PRODUCTS. YOU HEREBY WAIVE ANY CLAIM THAT THE EXCLUSIONS OR LIMITATIONS IDENTIFIED HEREIN DEPRIVE YOU OF AN ADEQUATE REMEDY OR CAUSES YOUR AGREEMENT WITH SELLER TO FAIL OF ITS ESSENTIAL PURPOSE. YOU SHALL BE ENTITLED TO NO OTHER REMEDY OTHER THAN THOSE IDENTIFIED IN THE CONTRACT BETWEEN YOU AND SELLER OR SELLER’S STANDARD

WARRANTY, WHICHEVER IS APPLICABLE, WITH RESPECT TO THE PROVISION OF PRODUCTS BY SELLER REGARDLESS OF THE FORM OF CLAIM OR CAUSE OF ACTION, WHETHER BASED IN AGREEMENT, NEGLIGENCE, STRICT LIABILITY OR OTHERWISE.

UNLESS OTHERWISE REQUIRED BY MANDATORY LAW, SELLER DISCLAIMS ALL WARRANTIES RELATING TO THE CONTENTS OF THIS DOCUMENT, EXPRESS OR IMPLIED, ARISING BY OPERATION OF LAW OR OTHERWISE.

1.2.3 Identification of the product

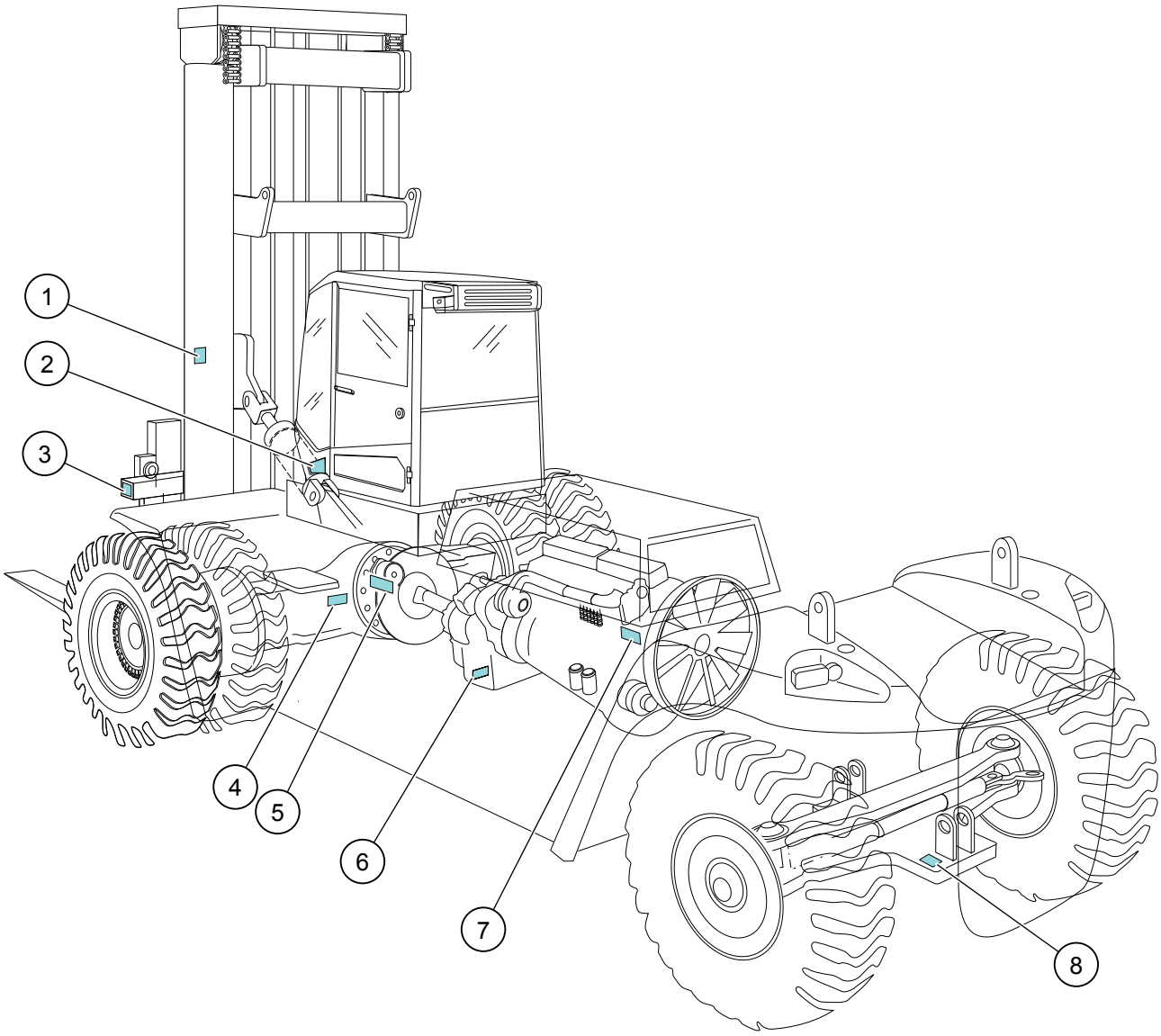


Figure 1. Plates and serial numbers

1. Mast serial number
2. Lifting capacity plate
3. Fork carriage number
4. Drive axle serial number
5. Chassis serial number (punched into the frame)
6. Transmission serial number
7. Engine serial number
8. Steer axle serial number

NOTE ***The appearance may deviate from the delivered product depending on model size.***

1.2.4 Standards and directives

This product has been designed and manufactured to conform to the following standards and directives:

- **Health and safety:**
  EU: Machinery directive 2006/42/EC

  UK: Supply of Machinery (Safety) Regulations 2008 S.I. 2008:1597

  - EN ISO 3691-1:2015/A1:2020. "Industrial trucks – Safety requirements and verification - Part 1: Self-propelled industrial trucks, other than driverless trucks, variable-reach trucks, and burden-carrier trucks".
  - ISO/TS 3691-8:2012,IDT. Industrial trucks – Safety requirements and verification. Regional requirements for countries outside the EC.
  - EN 16307-1:2013+A1:2015. "Safety requirements and verification. Supplementary requirements for self-propelled industrial trucks, other than driverless trucks, variable-reach trucks, and burden-carrier trucks" (EU/EFTA market).
  - EN 13059+A1:2008. "Safety of industrial trucks. Test methods for measuring vibration" (EU/EFTA market).
  - EN 12053+A1: 2008. "Safety of industrial trucks. Test methods for noise emission" (EU/EFTA market).
  - EN 1175-2+A1:2010 “Safety of industrial trucks – Electrical Requirements - Part 2: General requirements of internal combustion engine powered trucks“.
- **EMC**:
  EU: 2014/30/EU

  UK: Electromagnetic Compatibility Regulations 2016 S.I. 2016:1091

  - EN 12895:2015+A1:2019. Industrial trucks - Electromagnetic compatibility.
- **Emissions**:
  EU: 2016/1628/EC (EU/EFTA market, stage 4, and 5 engines).

  UK: The Non-Road Mobile Machinery (Type-Approval and Emission of Gaseous and Particulate Pollutants) Regulations 2018 2018 No. 764
- 2016/1628/EU “REGULATION (EU) 2016/1628 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 14 September 2016 on requirements relating to gaseous and particulate pollutant emission limits and type-approval for internal combustion engines for non-road mobile machinery, amending Regulations (EU) No 1024/2012 and (EU) No 167/2013, and amending and repealing Directive 97/68/EC"

Declaration of conformity and other certificates are included in the delivery package.

NOTE ***Manufacturer reserves the right to modify the design and material specifications without prior notice.***

Applicable sections of **EN13155** are used for all lifting ears on the machine.

1.2.5 Declaration of conformity

KONECRANES®
Lifting Businesses™

EC DECLARATION OF CONFORMITY OF THE MACHINERY

(Machinery Directive 2006/42/EC, Annex II, sub. A)

Manufacturer:
Konecranes Lifttrucks AB
Anders Anderssons väg 13, P.O. Box 103
SE-28523 MARKARYD
SE

Name and address of the person authorised to compile the technical file:
XXXXX XXXXX
Anders Anderssons väg 13, P.O. Box 103
SE-28523 MARKARYD
SE

The manufacturer declares that

Description:	**Forklift**
Model:	**XXXXX**
Serial number:	**XXXXX**

• Is in conformity with the relevant provisions of the DIRECTIVES OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL:

- of May 17, 2006, "relating to machinery" 2006/42/EC

- of February 26, 2014, "relating to electromagnetic compatibility" 2014/30/EU

- Directive 2000/14/EC as amended by Directive 2005/88/EC on the noise emission in the environment by equipment for use outdoors

and fulfils the requirements of the following harmonised standards:

• regarding Machinery Directive: EN ISO 3691-1

• regarding EMC Directive: EN 12895

Place and date of issue MARKARYD DD.MM.YYYY

Signature:

Anders Nilsson
Technical Director
Konecranes Lift trucks

Figure 2. EC Declaration of conformity of the machinery (template)

KONECRANES
Lifting Businesses

UK DECLARATION OF CONFORMITY OF THE MACHINERY

(Supply of Machinery (Safety) Regulations 2008, Annex II, sub. A)

Manufacturer:

Konecranes Lifttrucks AB
Anders Anderssons väg 13, P.O. Box 103
SE-28523 MARKARYD
SE

Name and address of the person authorised to compile the technical file:

XXXXX XXXXX
Coalfield Way
LE65 1NF Ashby De La Zouch
UK

The manufacturer declares that

Description: **Forklift**
Model: **XXXXX**
Serial number: **XXXXX**

• is in conformity with the relevant provisions of statutory instruments

- Supply of Machinery (Safety) Regulations 2008 No.1597

- Electromagnetic Compatibility Regulations 2016 No.1091

- Noise emission in the environment by Equipment for use Outdoors Regulations 2001 No.1071

and fulfils the requirements of the following designated standards:

• regarding 2008 No. 1597: EN ISO 3691-1

• regarding 2016 No. 1091: EN 12895

Place and date of issue: MARKARYD DD.MM.YYYY

Signature:

Anders Nilsson
Technical Director
Konecranes Lift trucks

Figure 3. UK Declaration of conformity of the machinery (template)

2 SAFETY AND ENVIRONMENT

2.1 Safety messages and symbols

2.1.1 Signal words

The following signal words and symbols are used to identify safety messages in these instructions.

DANGER

Indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury.

WARNING

Indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.

NOTICE

Indicates a potentially hazardous situation that, if not avoided, could result in damage to property or environment.

2.1.2 Hazard symbols

Hazard symbols are used to indicate the type of the hazard and the potential consequences. Hazard symbols are indicated by a yellow triangle with black symbols and a black triangle band. All personnel working on or in proximity of the machine must understand and follow the information that is given in all hazard symbols.

General hazard symbol

General hazard

The general hazard symbol identifies important safety messages in this document. When you see this symbol, carefully read and understand the message that follows, and inform other users when necessary.

Mechanical hazard symbols

Moving vehicle hazard

Sideways tipping hazard

Forward or backward tipping hazard

Run over hazard

Moving parts hazard

Falling load hazard

Slipping hazard

Hanging load hazard

Crushing hazard

Crushing hand hazard

Flying objects to face hazard

Flying objects hazard

Skin injection hazard

Electrical hazard symbols

Electrical hazard

Material hazard symbols

Hot liquid hazard

Explosion hazard

Harmful substance hazard

High-pressure hazard

Ignition hazard

Corrosive chemical substance hazard

Pressurized gas hazard

Hazardous or poisonous material hazard

Thermal hazard symbols

Hot surface hazard

Slippery when frozen hazard

Noise hazard symbols

Noise hazard

Laser hazard symbols

Laser hazard

Ergonomic hazard symbols

Lifting hazard

2.1.3 Mandatory action symbols

Mandatory action symbols specify actions to be taken to avoid a hazard. Mandatory actions are indicated by blue circle with white symbols. All personnel working on or in proximity of the machine must understand and follow the information that is given in all mandatory action symbols.

Wear approved safety gloves

Wear approved hearing protectors

Wear approved protective clothing

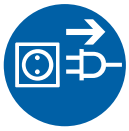
Wear approved safety shoes

Wear approved safety harness

Wear approved hard hat

Wear approved high visibility clothing

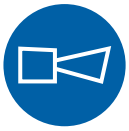
Wear approved eye protector



Disconnect equipment from power source

Apply indicator for pin-hole leak test

Use jack



Alarm horn

Read instructions

Two persons for handling

Wear approved respirator

Use seat belt

2.1.4 Prohibited action symbols

Prohibited action symbols indicate actions that are prohibited in order to avoid a hazard. Prohibited actions are indicated by a red circle with a red diagonal line across the circle. The action that is prohibited is always in black. All personnel working on or in proximity of the machine must understand and follow the information that is given in all prohibited action symbols.

General prohibition

Do not walk or stand here

Do not weld

No open fire

Do not smoke

Do not modify

Do not test for leak with hands

Do not touch

Restrict access

2.1.5 Safety and information labels on the product

The safety and information labels communicate the following:

- Level of risk that is based on the signal word **Danger**, **Warning**, or **Notice**
- Type of hazard, such as cutting parts, hanging load, hot surface, live parts
- Consequence of hazard, such as cutting, injection, crushing, burn, electric shock
- How to avoid the hazard

NOTE

Always keep safety and information labels visible, and check the condition of the labels daily. Before operating the machine, replace labels that are damaged, have come loose, or do not meet the readability requirements for safe viewing distance. New safety and information labels can be ordered from the manufacturer of the machine.

2.1.6 Location of the safety and information labels

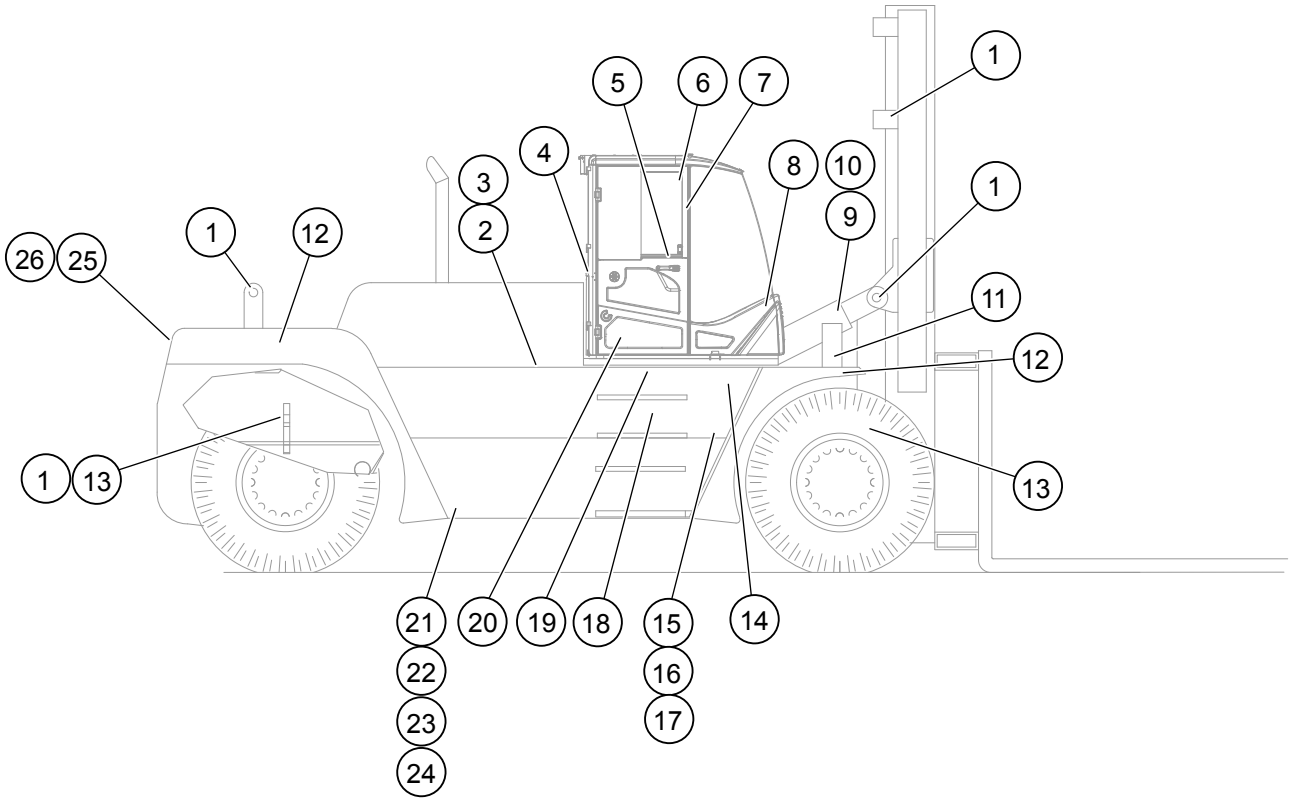


Figure 4. Location of the safety and information labels

1. Lifting point
2. Engine oil
3. Transmission oil
4. Fuses and relays, PCB
5. Emergency exit only
6. Seat belt
7. In case of rollover
8. Working zone
9. Crush injury risk
10. Injection hazard
11. Do not stand under or on lifted load
12. Tire pressure 10 bar (1.0 MPa)*)
13. Tie down point when transporting the machine
14. Accumulator pressure
15. Hydraulic oil
16. Diesel fuel
17. Brake cooling oil
18. Do not step here
19. Remove pressure before demounting tire
20. Read operating instructions first
21. Battery main switch
22. Cab tilting
23. Fuses and relays, battery compartment
24. Warning-Acid and explosion risk
25. Crushing risk by tire
26. Machine working zone

*) Sign present above all tires.

Table 1. Labels

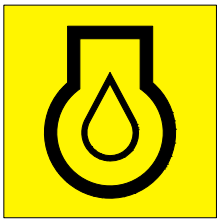
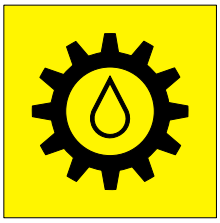
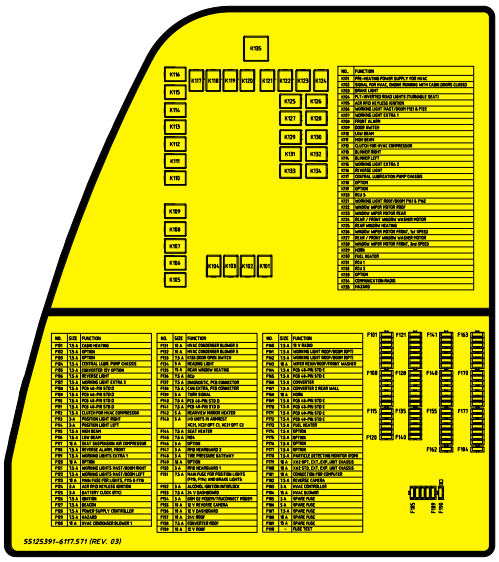
	**1. Lifting point**
	**2. Engine oil**
	**3. Transmission oil**
	**4. Fuses and relays, PCB**
	**5. Emergency exit only**

Table 1. Labels (Continued)

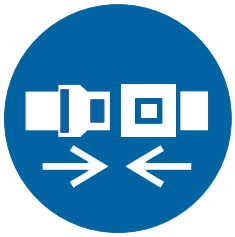
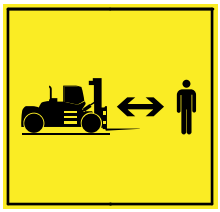
	**6. Seat belt**
	**7. In case of rollover** This sticker shows what the operator must do in case of rollover. Do not jump out of the cabin in case of rollover. Brace feet against the floor and hold on tightly to the steering wheel. Climb out of the machine when it has stopped moving.
	**8. Working zone**
	**9. Crush injury risk**

Table 1. Labels (Continued)

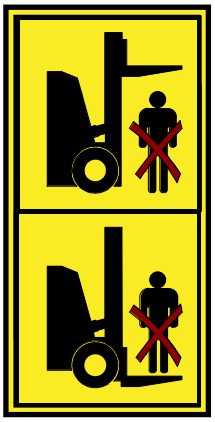
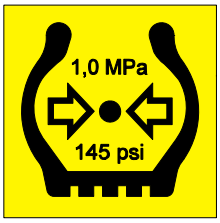
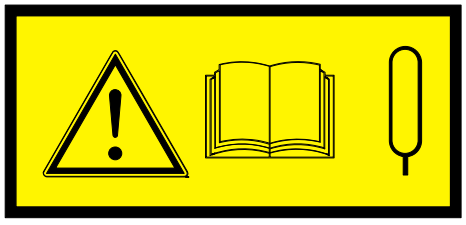
	**10. Injection hazard**
	**11. Do not stand under or on lifted load.**
	**12. Tire pressure 10 bar (1.0 MPa)**
	**13. Tie down point for loading the machine for transport** Secure the machine here when loading it for transport.
	**14. Accumulator pressure** Warning, read instructions in the manual.

Table 1. Labels (Continued)

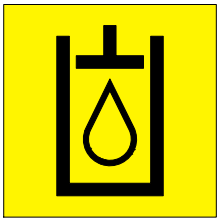
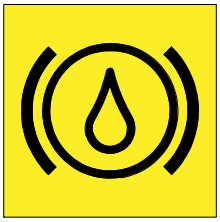
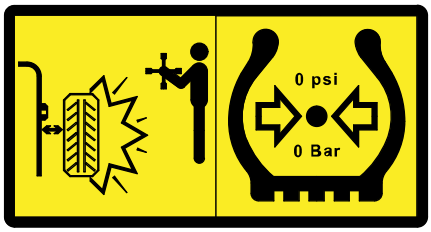
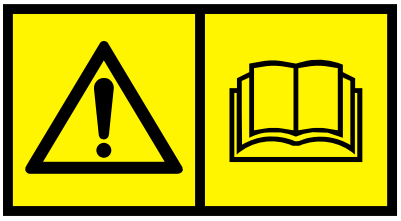
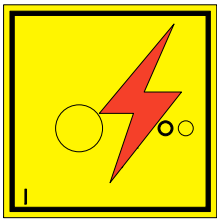
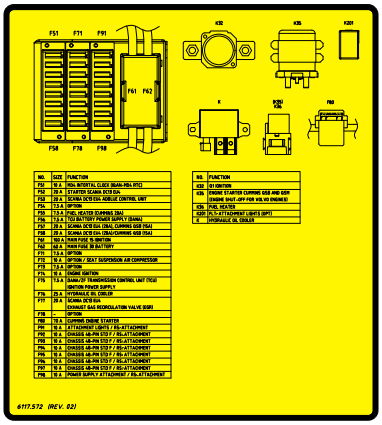
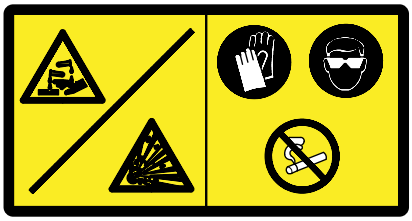
	**15. Hydraulic oil**
	**16. Diesel fuel**
	**17. Brake cooling oil**
	**18. Do not step here**
	**19. Remove pressure before demounting tire**
	**20. Warning - Read operating instructions first**
	**21. Battery main switch**

Table 1. Labels (Continued)

	**22. Cab tilting**
	**23. Fuses and relays, battery compartment**
	**24. Warning - Acid and explosion risk**
	**25. Crushing risk by tire**
	**26. Machine working zone**

2.2 Responsibilities of the operational manager

2.2.1 Preventing work-related hazards

The operational manager must ensure that operators, and maintenance personnel have sufficient knowledge of the work-related hazards, and the ways to avoid the hazards.

The operational manager must ensure to inform the operator that a local risk assessment always must be performed before every work phase or shift. The assessment ensures that the operator stops and thinks about what to do before starting to work.

- Identify potential hazards that could affect the operator, other personnel, the environment, the product, or work methods while performing the task
- Assess the risks and implement the actions that are required to eliminate or reduce the risks

Only personnel with sufficient competence are allowed to operate the machine, and carry out other tasks on the machine.

The responsibilities of the operational manager are, for example, to:

- Provide training and orientation.
- Validate training methods.
- Verify competence and skills.
- Monitor and evaluate user performance regularly.
- Provide fire-fighting equipment.
- Make sure that the working site has guidelines on how to prevent fires.
- Make sure that the working site has guidelines to follow concerning fire-fighting.
- Make sure that the working site has guidelines on how to operate the machine during strong wind.
- Make sure that the instructions from Konecranes Lift Trucks are accessible and up to date.
- Make a risk assessment of the work site, for example, regarding height limitations, door openings, overhead powerlines, and ground conditions.
- Make sure that the work site follows all local rules and regulations.

2.2.2 Preventive maintenance

⚠ WARNING

MACHINE MALFUNCTION HAZARD

Failure to regularly and properly maintain the product can result in death, injury, or damage.

Do not allow the product to be used if it is not in proper condition or if it has not been maintained correctly. Contact an authorized service agent or manufacturer's representative immediately if there are doubts.

⚠ WARNING

MACHINE NON-COMPLIANCE

Replacing components with non-genuine components, or components not authorized by Konecranes Lift Trucks, can affect the safety of the machine. This is considered as a modification of the machine and therefore voids Konecranes' liability as manufacturer.

The party that performed the modification will thereafter legally be liable for the safety of the modified machine, and the related CE marking.

For any clarification always contact your authorized Konecranes Lift Trucks representative.

RISK OF PROPERTY DAMAGE

NOTICE

Only use genuine spare parts or materials and lubricants that are approved by the product manufacturer or manufacturer's representative. For more information, see the spare part catalogue and section Fuel and oil recommendations (page 249).

Scheduled inspections and preventive maintenance are essential for keeping the product in safe working condition. Here are some general guidelines for preventive maintenance.

- It is the responsibility of the **operational manager** to organize maintenance inspections regularly. These inspections are to ensure long-term safety, reliability, durability, operability, and warranty for the product.
- The operational manager must keep a record (log book) of all maintenance activities and usage relating to the product.
- Maintenance must be carried out at different intervals and by authorized personnel who are qualified for the individual task.
- Daily checks and minor lubrication must be carried out by operators or maintenance personnel. These checks are important for catching small faults before they become major faults and causes breakdowns.
- Other maintenance actions must be done by service personnel that are authorized by the operational manager.
- Replacement parts and materials must comply with the specifications that are defined by the product manufacturer. It is the responsibility of the operational manager to ensure that only genuine replacement parts, and components that are approved by the manufacturer are used.
- Keep this document in a safe, accessible location during the whole lifetime of the product.

2.2.3 Personal protective equipment

NOTE ***For safety, all personnel working in or near the machine are required to wear personal protective equipment (PPE).***

NOTE ***This section proposes personal protective equipment to ensure the safety of all personnel working in or near the machine. Follow the local regulations and requirements of the working environment. Use only approved and accepted personal protective equipment.***

Operators and anyone near and around the product **must** wear the following items:

- Safety shoes
- High-visibility clothing

Various types of PPE are available as listed, depending on the situation, other types of PPE than listed can be required. It is the responsibility of the operational manager to make sure that all local PPE requirements are followed.

- Hard hat
- Eye protection
- Ear protection
- Respirator
- Safety gloves
- Protective clothing
- Safety harness when working at heights

Do not wear loose clothing or jewelry that can get caught on controls or pulled into moving parts of the product.

Do not wear jewelry or metal accessories such as watches when working with or near the electrical system or the batteries.

Tie back long hair. Long hair can get entangled.

Select the appropriate clothing for each task, for example:

- Wear fire-resistant clothing when welding, flame cutting, or using an angle grinder.
- Tear-resistant clothing must resist damage from sharp edges in the steel structure.
- Wear anti-static clothing when working on electrical circuits so that components do not get damaged by a discharge of static electricity.
- Always use safety goggles when working with high voltage or pressurized fluids.
- When working with lubricants, clothing must prevent direct skin contact with the lubricant.
- Choose clothing with consideration to the temperature at the working site, and stay hydrated.

2.2.3.1 Fall protection

While personnel installs, inspects, or do maintenance work at heights, they must follow fall protection procedures as required by local regulations. Fall prevention practices and equipment aim at protecting personnel working on or around the equipment.

If the equipment does not have a service platform or guardrail, personnel must use a properly fitted safety harness. The safety harness is attached to the dedicated fixing points on a building or equipment to prevent falls.

If dedicated fall protection fixing points are missing, it is the operational manager's responsibility to make sure that suitable and secure fixing points are available. If not possible it is necessary for the operational manager to provide an appropriate manlift.

If ladders must be used, personnel must practice setting and securing the ladders before using them for actual work.

Fall protection system has four components:

- **Safety harness:** Safety harness helps to prevent employees to get hurt in a fall.
- **Lanyard belt:** Lanyard belt is connected to the anchor point and is attached to the safety harness. Lanyard belts are shock absorbing, which means that they slow down and eventually stop a fall.
- **Snap hook:** Snap hooks connect the D-ring to the safety harness. Snap hooks must be double locking. To connect only one snap hook to one D-ring, is the basic rule.
- **Anchorage point:** Anchorage point is the point to which personal fall protection equipment is attached. The point must be capable of supporting at least 2,268 kg (5,000 lb) for each employee. If there is any doubt about the strength of the attachment point, find an alternative point that can support the worker.

A typical fall protection program may include:

- Documented and established site policies and procedures
- Conducting site assessments for fall hazards
- Selection of the proper fall protection system and equipment
- Training on fall protection procedures and the proper use of fall protection systems
- Inspection and proper maintenance of fall protection equipment
- Measures to prevent falling objects
- Rescue plans

If necessary, contact your supplier or service organization for assistance with designing your fall protection program. For more information about lifting operations and equipment, see "Lifting Operations and Lifting Equipment Regulations" (LOLER).

2.2.4 Incident reporting

Product safety issues that you must report are events in which the manufacturer's product has been involved in an accident or near-miss incident. Contact your local manufacturer's representative immediately to report any safety-related feedback, such as unauthorized modifications, missing instructions and safety labels, neglected maintenance, or misuse.

Reporting is mandatory to ensure safe working conditions for employees, to provide information for the risk assessment process, and to initiate product and work procedure improvements.

2.3 Limitations of the product

2.3.1 Operating conditions

Thunderstorm

When in danger of being struck by lightning, operating or being close to the machine is strongly discouraged. Protection from lightning during work must be managed by the workplace risk assessment that is made by the operational manager.

Following a lightning strike (or if you suspect the machine has been struck) the machine must be checked by authorized personnel. The check must follow the instructions of the daily maintenance.

Surfaces

Do not operate the machine on uneven surfaces or in unstable conditions.

NOTE ***Do not drive on slopes that are greater than 15%.***

2.3.2 Inclination angles

⚠ WARNING

TIPPING AND COLLISION HAZARD

If you drive on slopes greater than 15%, the parking brake may fail and risk of tipping increases considerably. Risk of serious personal injury and damage to the machine.

Do not drive on slopes greater than 15%.

⚠ WARNING

RISK OF LOAD DROP

Driving downhill on slopes carrying a load, can lead to a load drop. This can damage the machine and can lead to serious personal injury.

If carrying a load, always drive downhill in reverse.

NOTE ***If you must drive the machine along greater slopes, contact your Konecranes Lift Trucks authorized dealer.***

NOTE ***Do not drive on slopes that are greater than 15%.***

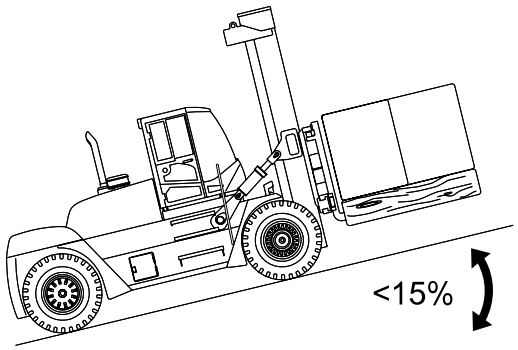


Figure 5. Do not drive on slopes greater than 15%

2.3.3 Lift truck danger zones, general

DANGER

MOVING MACHINERY HAZARD

The moving machine and its moving parts can cause death or serious injury.

While the machine operates, unauthorized personnel should never enter or be within the danger zone.

During operation, the authorized personnel working within the danger zone and the operator must constantly communicate verbally or visually to stay aware of each other.

The following images show the danger zones surrounding the machine and its parts.

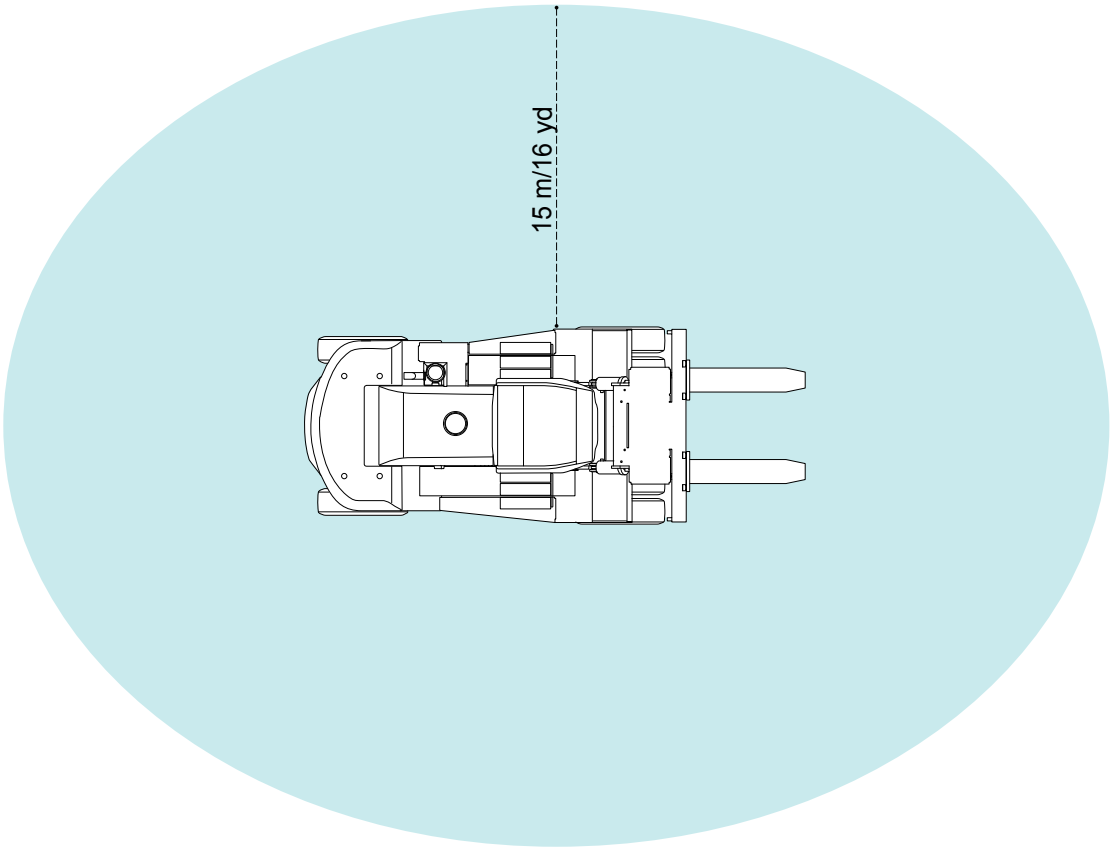


Figure 6. General danger zone

2.3.4 Tire explosion danger zone

DANGER

HIGH-PRESSURE HAZARD

The tires may explode when you inflate or deflate them, or in case of fire. Standing inside the tire explosion danger zone during a tire explosion can cause death or serious injury.

Always stand to the side of the wheel when deflating or inflating tires, see "tire explosion danger zone" illustration. Use safety glasses.

NOTE ***The tire explosion danger zone follows the positioning of the wheels. The illustration applies when the wheels are in line with the machine.***

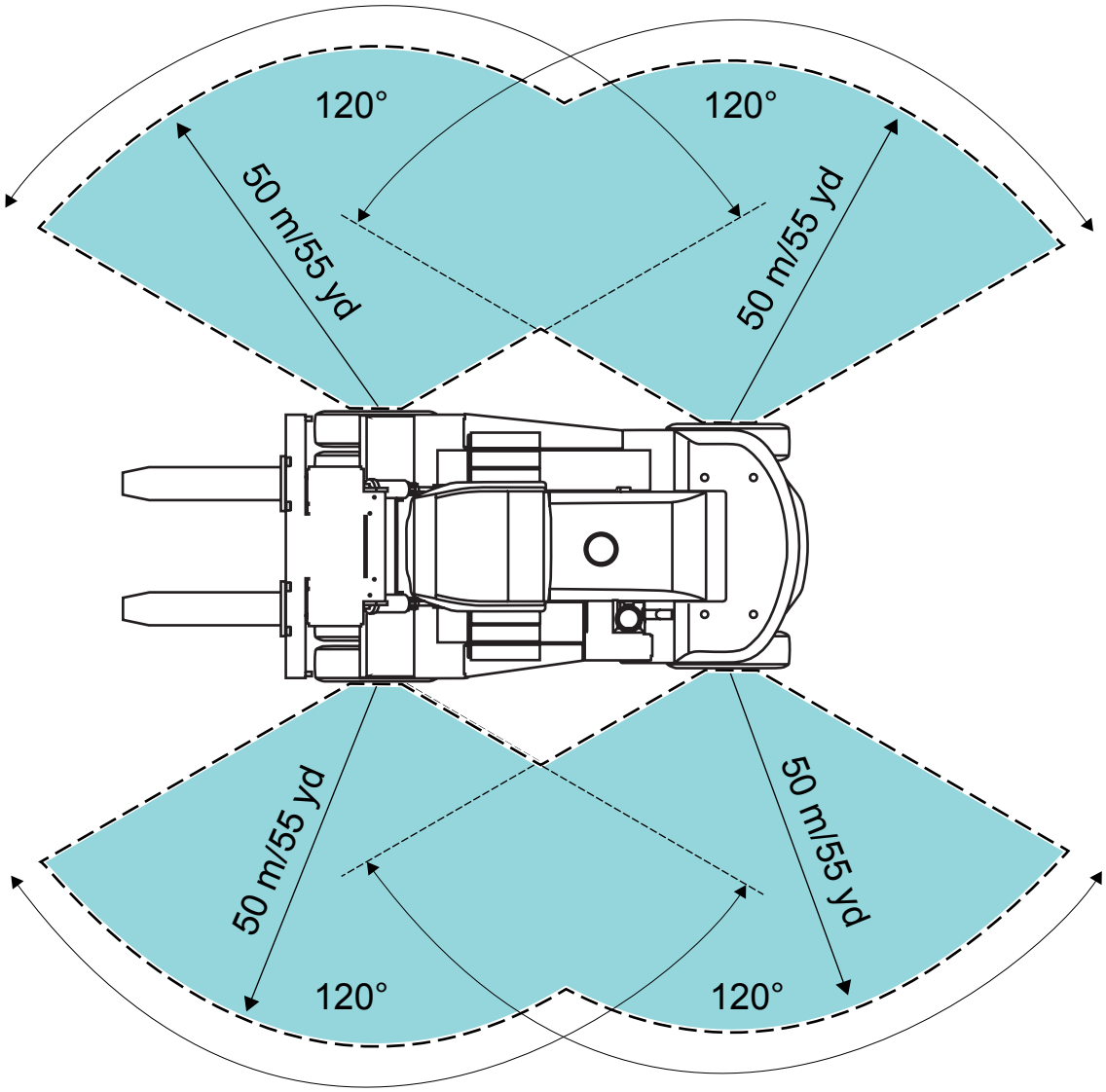


Figure 7. Tire explosion danger zones

2.3.5 Prohibited use

⚠ WARNING

MACHINE MALFUNCTION HAZARD

Using the machine outside the limits of its capacity or operating conditions could cause malfunction of the equipment. Unauthorized usage could lead to death, severe injury, or property damage.

Do not use the machine outside the limits of its capacity or operating conditions.

The misuse of the equipment includes, but is not limited to:

- Lifting or transporting people.
- Driving with the load above transport position.
- Driving with heavy loads in slings.
- Driving with swinging load.
- Having passengers in the cabin [1)]
- Driving on uneven terrain
- Exceeding the load limit, which is shown on the lifting capacity plate
- Adding extra counterweights
- Driving uphill and downhill on slopes with an inclination over 15%.
- Using tools that are not approved by the manufacturer.
- Using the low-voltage battery switch when the machine is in motion.
- Overriding any safety systems.
- Using the emergency stop in a none emergency situation.

NOTE ***Only use the emergency stop in an emergency situation.***

[1)] If a truck is equipped with an optional trainer's seat, another person is allowed to sit there, as long as the person uses the seat belt.

For more information, see the lifting capacity plate of the machine, and, if applicable, lifting capacity plates on attachments.

Contact the manufacturer or the representative for the manufacturer if there are any doubts.

2.3.6 Changes to the product

⚠ DANGER

MACHINE MALFUNCTION HAZARD

Unauthorized changes, or modifications to the product can lead to death, severe injury, or property damage.

Always contact Konecranes Lift Trucks, or an authorized representative to get a written approval in advance for any product change or modification.

⚠ DANGER

MACHINE MALFUNCTION HAZARD

Changes, and modifications without proper risk assessment, can lead to death, or serious personal injuries. It can also damage property, or the environment.

Unauthorized modifications void the warranty and responsibility of the manufacturer.

Perform a risk assessment, which eliminates, or reduces risks, and considers appropriate safety measures.

⚠ WARNING

MACHINE MISUSE HAZARD

Adding and using equipment that is not supplied with the machine, can cause the products to malfunction. Risk of serious personal injury and damage to the machine.

If using equipment that was not supplied with the machine, an authorized dealer must approve the combination and use of the equipment. The authorized dealer must ensure that safe operations can be guaranteed concerning lifting capacity, stability, and visibility.

⚠ WARNING

MACHINE NON-COMPLIANCE

Replacing components with non-genuine components, or components not authorized by Konecranes Lift Trucks, can affect the safety of the machine. This is considered as a modification of the machine and therefore voids the liability of Konecranes as a manufacturer.

The party that performed the modification will thereafter legally be liable for the safety of the modified machine, and the related CE marking.

For any clarification always contact your authorised Konecranes Lift Trucks representative.

All modifications and corrections that are not authorized in the product documents or which may affect the maintenance, operation, safety, and availability of the product must be approved in writing by **Konecranes Lift Trucks** before implementation. Approval requires a risk assessment which consider any new risks that the changes and modifications may bring.

All safety and information labels on the machine, must be updated to match the machine after any modifications.

To avoid using obsolete spare parts, always check the specific spare parts catalogue for the machine. For the latest version, contact Konecranes Lift Trucks spare parts department.

If a modification or correction has been implemented without the permission from **Konecranes Lift Trucks**, its effect on warranty liability is considered case-by-case. Thus, the warranty application may be rejected altogether. If a modification, or alteration is considered necessary, contact an authorized dealer, or the organization that manufactured, and designed the product. No modification is permitted, unless the written approval from the manufacturer is obtained.

Before doing any modifications, the following information must be sent to **Konecranes Lift Trucks**.

- Product model and type
- Serial number of product
- Description of the modification or correction

- Related blueprints
- Related photos
- And other material, if necessary

The manufacturer then approves, or rejects the modifications in writing.

2.4 Emissions

The noise and vibration levels are checked according to industry standards. This is to make sure that the operator's have a healthy environment while operating the machine.

2.4.1 Noise

Measured sound levels

⚠ WARNING

NOISE HAZARD

Continuous exposure to noise above 80 dB(A) can cause hearing impairment, and make the operator tired and unfocused.

Wear approved hearing protectors.

The noise values were measured according to the harmonized standard EN12053 – A1:2008, following the conditions described therein, by a notified body. The noise values are reported according to ISO4871:2009.

The specified equipment has been assessed in accordance with Directive 2000/14/EC (amended by Directive 2005/88/EC), annex VI by notified body 0404, RISE SMP Svensk Maskinprovning AB (The Swedish Machinery Testing Institute).

Declared dual-number noise emission values In accordance with ISO4871:2009				
	Lift mode	Idle mode	Drive mode	Total
Time proportion factors of the operating cycle (%) - ref. EN12053+A1:2008	0.18	0.58	0.24	1
A-weighted emission sound pressure level at the operator position LpAZ (dB)	75	74	76	76
Uncertainty (dB)	1	1	1	1
C-weighted peak emission sound pressure level	< 130	< 130	< 130	< 130
Measured sound power level in an operational cycle (A-weighted)	102			
Guaranteed sound power level in an operational cycle (A-weighted)	104			
Measured on 16-33 ton forklifts, for other sizes, the values may vary slightly.				

Where the time proportion factors are used in defining the operational cycle, they are as defined in EN12053+A1:2008.

2.4.2 Vibration

The whole-body vibration has been measured according to the harmonized standard EN13059:2008, following the conditions described therein, by a notified body.

- Measured whole body vibration: below 0.9 m/s²
- Overall uncertainty of the measurement: 1 m/s²

The reported expanded uncertainty is based on a standard uncertainty that is multiplied by a coverage factor K = 2. For a normal distribution, this value provides a level of confidence of approx. 95%.

The standard uncertainty has been determined in accordance with EA publication EA-4/16/2003.

2.5 Protective measures

2.5.1 Emergency stopping

⚠ DANGER

UNCONTROLLED MOVEMENT HAZARD

If the machine moves unexpectedly, it could result in personal injury, death, or damage to the equipment.

To stop any unexpected movement, press the emergency stop button.

⚠ WARNING

FORWARD TIPPING HAZARD

If the emergency stop is used when the machine moves, the machine may tip over. Risk of serious personal injury and damage to the machine.

Only use the emergency stop in an emergency.

NOTE ***Do not operate the equipment without knowing the location of the emergency stop buttons.***

After the emergency stop button (1) is pressed, all functions are cut out, the parking brake is activated and the engine stops. In normal operation, do not use the emergency stop button to stop the machine. Instead, use the brake pedal.

NOTE ***Only use the emergency stop button in an emergency situation. Routinely using the emergency stop button increases wear on the product and can cause a breakdown.***

After each time the emergency stop is used, a daily maintenance must be performed to check the overall function of the machine.

If the machine moves when pressing the emergency button, the condition of the parking brake disc and pads must also be checked. Contact authorized service personnel for the check-up.

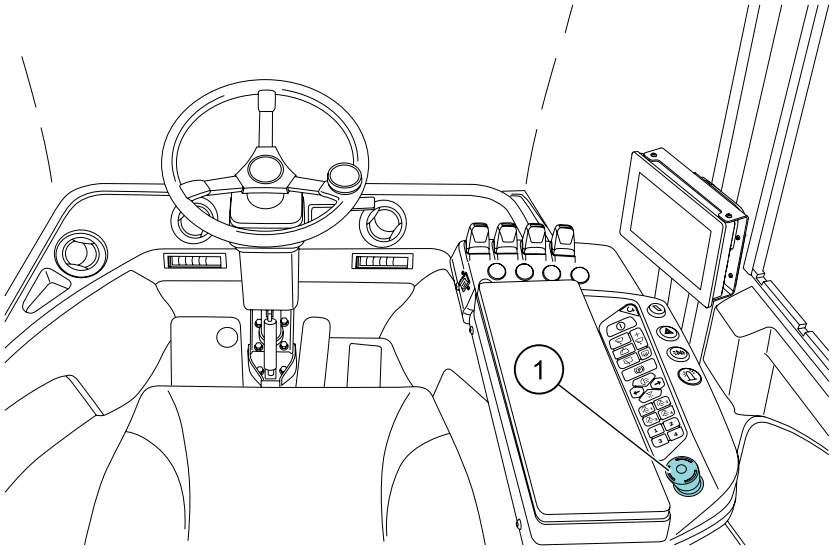
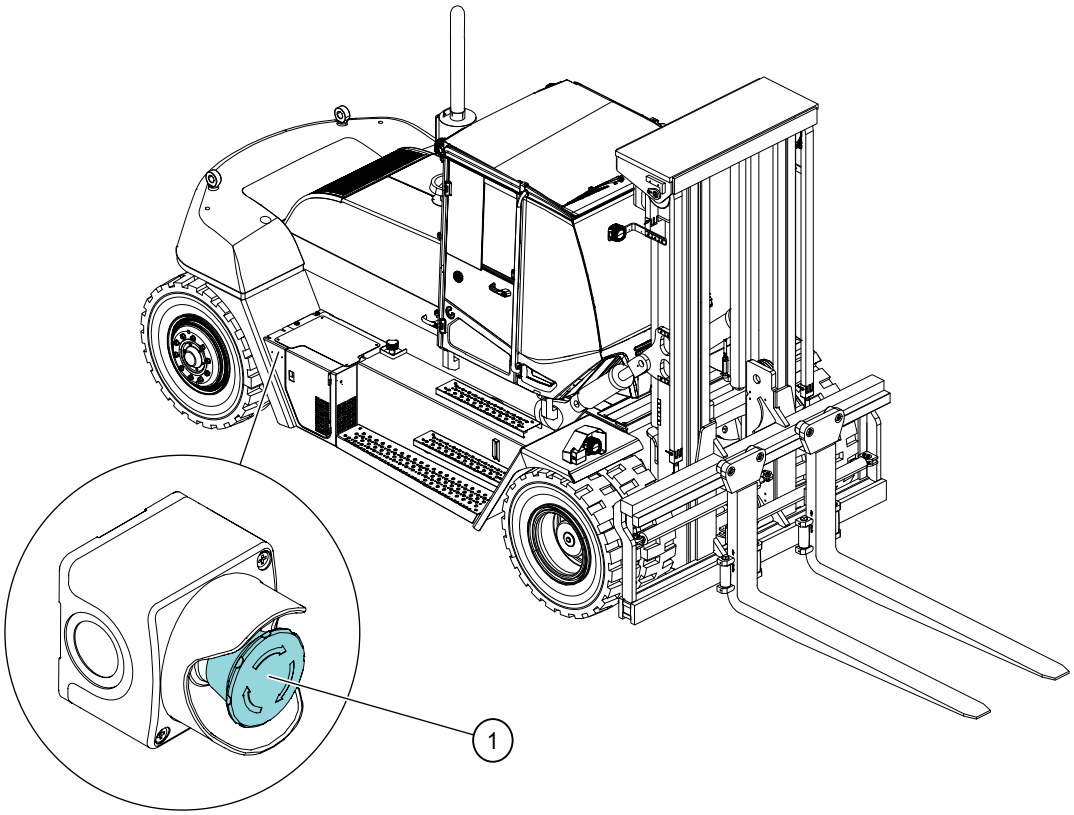


Figure 8. Emergency stop inside the cabin

Emergency stop on the outside of the machine



2.5.2 Battery main switch

DANGER	
	**EXPLOSION HAZARD** **Short-circuiting the battery may cause a fire or explosion, which can cause a risk of serious injury or death.** **To reduce the risks of fire, explosion, electric shock and personal injury, always remove jewelry and conductive material before working on the electrical system.**

DANGER	
	**EXPLOSION HAZARD** **Batteries generate explosive hydrogen when charged, which can cause a risk of serious injury or death.** **Always use the necessary protective equipment. Ensure that there is good ventilation and avoid sparking.**

⚠ DANGER

ELECTRIC SHOCK HAZARD

If the engine is on, there may still be voltage present in some parts, even when the battery main switch is turned off. The main switch does not cut the power from the alternator. This causes a risk of electric shocks, which can lead to death or serious personal injury.

To reduce the risks of electric shock and personal injury always remove jewelry and conductive material before working on the electrical system.

Always disconnect the ground (minus) cable at the battery when working near or on the alternator.

Be aware of the battery main switch functionality.

⚠ WARNING

TIPPING OVER HAZARD

If the battery main switch is turned off when the machine moves, the parking brake is activated. The machine may tip over, causing a risk of serious personal injury and damage to the machine.

Unless there is an emergency situation, do not turn off the battery main switch when the engine runs.

NOTE ***Do not operate the machine without knowing the location of the battery main switch (1).***

NOTE ***If the machine has an engine that uses diesel exhaust fluid (DEF) solution (for example AdBlue), turn off the engine, but do not turn off the battery main switch. Wait for the DEF pump to finish pumping back all the fluid from the hoses to the DEF tank before turning off the battery main switch (1). The required time varies slightly between different engine models.***

NOTE ***Remove the main switch handle when parking the machine.***

The battery main switch is found on the right-hand side of the machine, near the battery compartment. The machine can only be operated when the power is turned on.

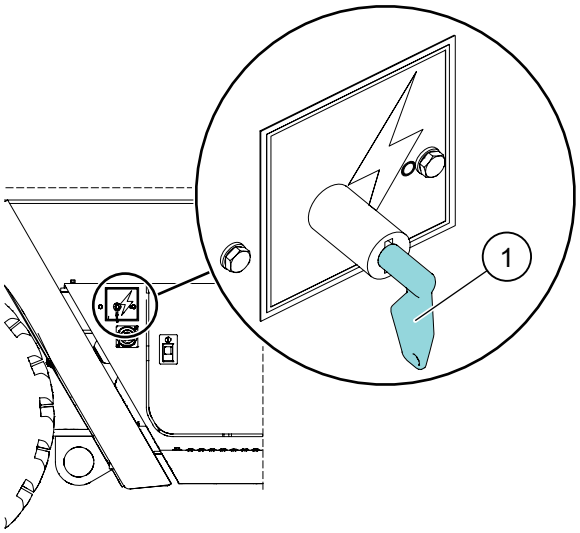


Figure 9. Battery main switch

2.5.3 Releasing the hydraulic pressure

⚠ WARNING

HIGH-PRESSURE HAZARD

The hydraulic system contains hydraulic accumulators to maintain the brake function during a possible engine failure. Risk of serious personal injury.

Only authorized maintenance personnel are permitted to loosen any hydraulic hoses.

Before maintaining or servicing the hydraulics of the machine:

- Always lower the mast and fork carriage to the bottom position.

- If maintaining the brake system, always ensure that the accumulator pressure for the hydraulics is released before loosening any hydraulic hoses in the brake circuit.

- Make sure that no other hydraulic hoses or components are pressurized before loosening any hoses.

For more information about releasing the hydraulic pressure, see Releasing the hydraulic accumulator pressure (page 73).

2.5.4 Fire safety

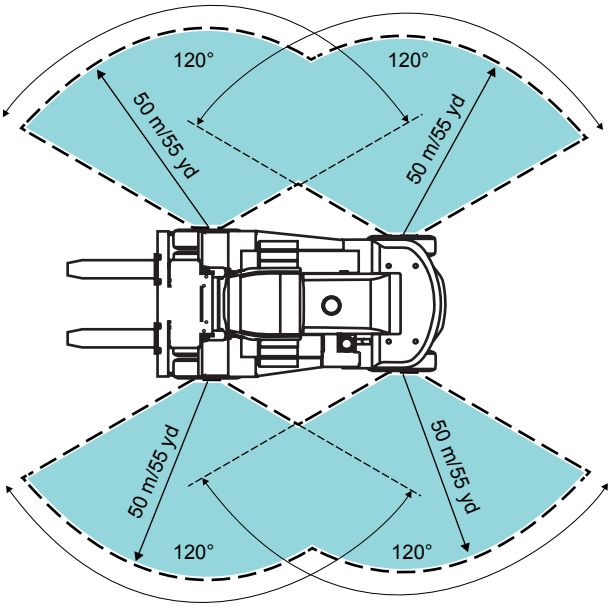
⚠ DANGER

FIRE AND EXPLOSION HAZARD

Ignition sources together with combustible materials can cause fire. If these risks are not avoided, they could lead to death or severe injury. Smoking, open flames, and sparks are examples of ignition sources. Fuel is an example of combustible material.

Ignition sources are prohibited near the machine.

During maintenance, follow appropriate fire prevention and protection measures. Measures include but are not limited to trained personnel and proper fire extinguishing equipment. Before starting any maintenance or repairs that require ignition sources, carry out a proper risk assessment to control the risk.



NOTE ***In case of fire, approach the machine from the front or the back. If possible, always avoid the tire explosion danger zones.***

- Smoking and open fire are prohibited near the product.
- Access to all fire-fighting equipment must be granted always, especially during maintenance and repair works.

NOTE ***Fire-fighting equipment is not a standard part of the machine. It is the responsibility of the operational manager to make sure that fire-fighting equipment is available.***

- All fire-fighting equipment must be inspected and serviced regularly, according to local regulations.
- Damaged fire-fighting equipment and used fire extinguishers must be replaced immediately.
- Know the various types of fires and the appropriate fire-fighting methods. Various fires must not be extinguished with water. Special extinguishing agents, dry powders, or deoxygenating agents are required.
- It is the responsibility of the operational manager to make sure that the working site has guidelines to follow concerning fire-fighting.
- All personnel must be aware of the guidelines and trained regularly in fire-fighting methods.

NOTE ***It is strongly suggested that guidelines, and training is performed in cooperation with local authorities, and rescue organizations.***

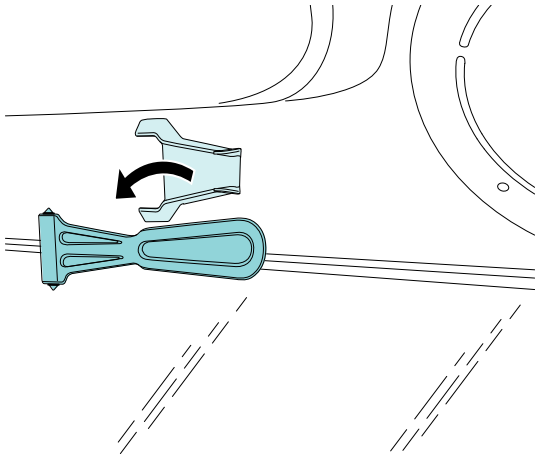
2.5.5 Emergency exits

The cabin door on the left-hand side is the main emergency exit.

If the left-hand side door is blocked, use the right-hand side door. If both the left and right doors are blocked, use the emergency hammer (option) to smash the rear window to exit the cabin.

Using the emergency hammer (Option)

1. Pull the emergency hammer from its mounting above the rear window.



⚠ WARNING

FLYING OBJECTS TO FACE HAZARD

Breaking glass may fly into your face and eyes.

Shield your eyes and face with your other arm while breaking the window with the hammer.

2. Smash the rear window with the hammer.
3. Use the hammer to scrape the remaining glass.
4. Exit the cabin through the rear window.

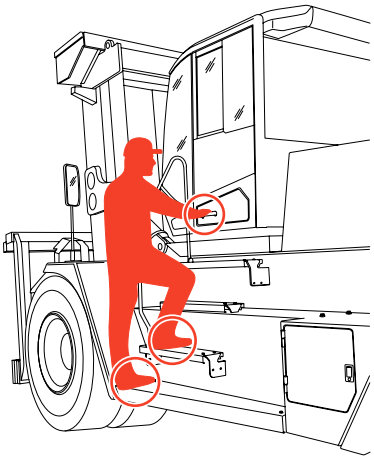
2.5.6 Mounting, and dismounting the machine

⚠ WARNING	
	**SLIPPING HAZARD** **Failing to maintain three points of contact can cause serious injury or death.** **Maintain three points of contact when mounting, or dismounting the machine. Three points of contact are either two hands, and one foot, or two feet, and one hand.**

NOTE ***Climb on and off only when the machine is stationary.***

NOTE ***Do not jump from the steps to the ground.***

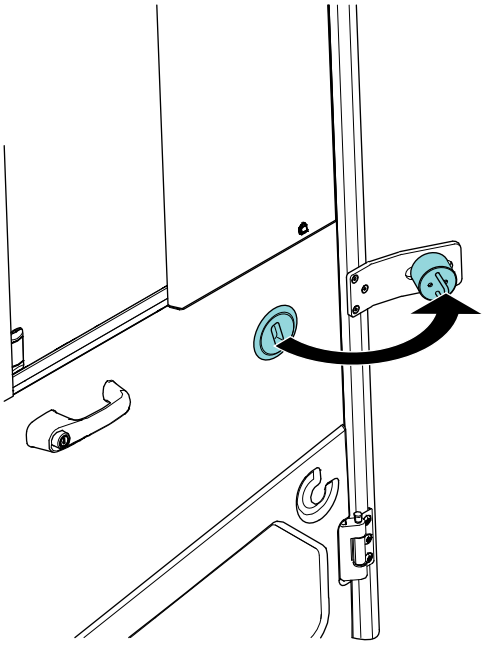
NOTE ***Following this procedure reduces the risk of falling, and decreases wear on back, and knees.***



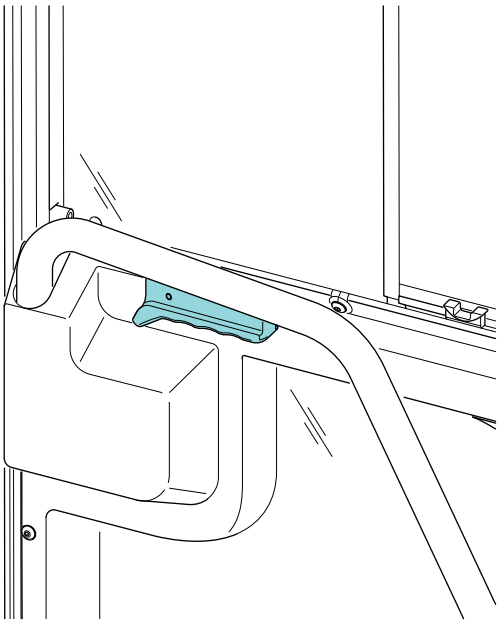
1. Face the steps, when mounting, or dismounting the machine.
   The cabin entrance is on the left side of the machine.
2. Maintain three points of contact until reaching the cabin, or ground.

2.5.7 Locking the cabin door in open position

1. To fasten the cabin door in open position, open the cabin door and push it into the lock.



2. To unlock the door from open position, press the handle on the inside of the cabin door.



2.5.8 Personnel requirements

⚠ DANGER

SPECIALIST SKILLS REQUIRED

Incompetent operation and maintenance could cause death or severe injuries.

Operation and maintenance procedures require professional skills and special training regarding the tasks and working methods.

Do not operate the equipment or do any maintenance tasks without proper training. Always follow the instructions. Use appropriate personal protective equipment, depending on the task.

To avoid hazardous situations and dangerous consequences, leave all operation and maintenance work to authorized personnel. Tasks that are mentioned are examples of tasks which are allowed only for authorized personnel. Instructions for safe handling and other risks that are related to the tasks, can be found in the following chapters. Tasks that require special technical skills and training include, but are not limited to:

1. Hydraulic system maintenance
2. Electric system maintenance
3. Battery maintenance
4. Tire maintenance
5. Changing parameters in the control system

2.6 Environmental information

Environmental impacts have been taken into account when designing and manufacturing this product. To prevent environmental risks during use, follow the instructions and local regulations for disposal of waste material. Proper use and maintenance improve the environmental performance of this product.

2.6.1 Energy consumption

Energy consumption during the use phase has the biggest environmental impact. Diesel fuel is needed for lifting, transporting, lighting, heating, cooling, and other optional components that are part of the machine. Konecranes machines minimize the use of fuel in the following ways:

- Engineering diesel engines with the best possible fuel efficiency and lowest emission levels.
- Engine downsizing.
- Fuel saving transmission features, like lock-up and continuously variable transmission.
- Using load-sensing hydraulic systems, so no hydraulic flow (with resulting energy losses) is created unless it is needed by an actual load command.
- ECO-driving supports the operators so they can minimize fuel consumption by reducing the harshness of operations.
- Connectivity for the operational managers to optimize the use and operational efficiency of their machine fleet by:
  - maximizing time driving with payload
  - minimizing travelling distances over the yard
  - select the most suitable machine capacity for specific lifting needs
  - monitoring the right tire pressure for the lowest rolling resistance in connected machines
- Eliminating idling time with:
  - automatic start and stop
- Means to optimize the preventive maintenance of the machines, to ensure long-term fuel efficiency.

2.6.2 Product lifecycle stages

The environmental impact of a Konecranes machine is taken into account for the whole lifecycle of the vehicle. “Lifecycle” refers to the extraction and processing of raw materials, the production of components, manufacturing, use, and maintenance. "Lifecycle" also refers to disposal of the product and the transportation that is involved from one stage to the next.

Each stage of the lifecycle has a different impact on the environment. The two most significant environmental impacts of the machines are the energy consumption during the use phase (in particular, the effects of diesel emissions) and the raw materials and component production (in particular, the effects of steel production). The significance of energy consumption depends on actual usage, including operating time, efficiency of operations, and load collective.

Product lifecycle stages include:

- Production of materials and components
- Equipment manufacturing and assembly
- Use phase, including maintenance, repairs, and modernization
- Dismantling and recycling of waste materials
- Transports between each stage

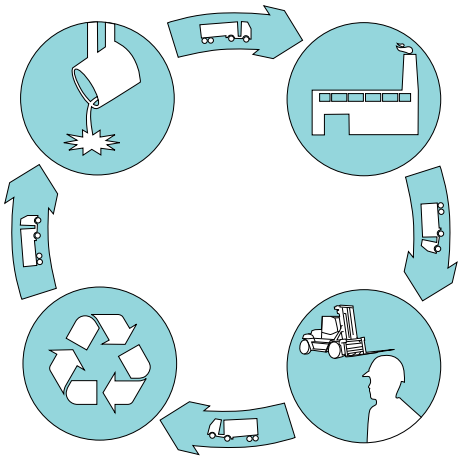


Figure 10. Product lifecycle stages

2.6.2.1 Production of materials and components

84%–92% of machine materials are metals, and rubber tires form 3%–9%. The rest of the materials include electrical and electromechanical components, fluids (hydraulic oil, diesel fuel, and grease), plastic, and glass.

The main raw material is steel. The most significant environmental impacts of steel production are the use of raw materials and energy, as well as carbon dioxide and particle emissions. More than 75% of the steel content can be manufactured from recycled steel scrap.

Lubricants, which are used from factory on the products, are industrial hydrocarbons.

Table 2. Materials used in Konecranes machines

	Konecranes Lift Trucks					Konecranes Liftace		
	Forklift	**Forklift, electric**	**Empty container handler**	**Laden container handler**	**Reach stacker**	**Forklift**	**Empty container handler**	**Reach stacker**
Steel	88%	84%	91%	90%	92%	88%	92%	92%
Rubber	6%	6%	4%	5%	3%	6%	3%	3%
Copper	<1%	<2%	<1%	<1%	<1%	<1%	<1%	<1%
Electronics	<1%	<4%	<1%	<1%	<1%	<1%	<1%	<1%
Fluids	<2%	<2%	<2%	<2%	<2%	<2%	<2%	<2%
Polymers	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%
Others	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%

2.6.2.2 Equipment manufacturing and assembly

Production mainly involves assembling of machines and some installations. Welding is only carried out for complementing or repair work. Surface treatment for reconditioning is conducted to a lesser extent.

Testing of machines is carried out outdoors after assembly, before delivery.

The most significant environmental impact is the energy consumption, and diesel emissions during test-driving. To decrease the impact, Konecranes Lift Trucks is using HVO100 bio diesel. It is recommended that HVO100 bio diesel is used generally to decrease the environmental footprint.

There are also some lower impacts from the chemicals that are used, like paints, oils and fuels. The waste from the production is disposed of, according to local regulations. Examples of waste are wood, plastic, and paper as well as hazardous waste such as residue of paint, and waste oil.

2.6.2.3 Use phase, including maintenance and modernization

Most significant environmental impacts of machines are the energy consumption during the use phase (in particular, the effects of diesel emissions). Konecranes machines minimize the use of fuel, as described in "Energy consumption".

Timely repairs and proper maintenance support each machine’s efficiency, safety and, performance which contributes to less environmental impact.

The optional hydraulic long-life (HLL) filter removes small particles, reduces the water in the oil, and extends the life of the hydraulic oil. This filter increases the amount of time between hydraulic oil replacements.

With the option TRUCONNECT® Smart Connected Lift Trucks the customer can plan service on real machine use, which in most situations extend service intervals. A sensor for monitoring the status of the hydraulic oil, and estimate the remaining life of the oil, can also be provided. The monitoring of the hydraulic oil status prevents unnecessary hydraulic oil replacement.

Certain major components like diesel engine, transmission, and some electronics can be restored to like-new condition. Konecranes Service offers restored spare parts, where the old part is requested back (as core unit for later renovation). This restoration process extends the useable machine life and reduced the environmental impact.

2.6.2.4 Dismantling and handling waste material

Konecranes Lifttrucks strive to optimize all packaging to minimize waste and to follow the EU waste hierarchy. The most preferable actions are: prevention, reuse, recycle, burning of material to recover the energy in the material, and as a final resort, safe disposal as landfills.

Waste material from dismantling shall be handled and disposed according to local regulations. As waste regulations and types of available recovery and disposal methods vary regionally, no general detailed guidance can be given.

Dismantling should always be planned and executed by authorized personnel. A local risk assessment must be performed in advance.

Depending on available recovery and disposal methods, wood can be recycled and reused but is the responsibility of the customer. Plastic waste is collected and, depending on the infrastructure, recycled, burned to recover the energy in the material, or as a final resort, safely disposed as landfills.

NOTE ***Always use licensed recycling companies.***

The following list provides proposals for adequate waste handling methods.

Table 3. Proposed waste handling methods (example for EU states)

Proposed waste handling methods (example of EU states)	
Material	**Handling method**
Metals	Material recycling, multi-metal scrap recycling.
Rubber tires	Recycle rubber according to local regulations. Whenever possible, return the used rubber tires to the tire supplier for recycling.
Electronics and electromechanical components	Some electrical parts may be treated as hazardous waste. Collect and recycle the electronics and electromechanical components separately. Use e-waste management.
Batteries	Batteries and other energy storage components may contain hazardous substances. Collect these items separately and recycle according to local regulations.
Fluids, accumulators, oil filters	Recycling, hazardous waste management
Plastics and polymers	Recycle plastic as material, burn to recover the energy in the material, or deliver it to a landfill site.
Chemicals	Never spill chemicals, such as oil, grease, and other liquids, onto the ground, soil, or sewage. Store waste oil and grease in containers that are indicated for the purpose. More detailed information on chemical handling as waste can be found in the chemical safety data sheet. The data sheet is available from the manufacturer of the chemical.
Packing materials	Reuse or recycle packing materials, such as plastics, wood, and cardboard.
Glass	Recycle glass according to local regulations.

2.6.2.5 Deliveries between each stage

Materials and components are provided by various suppliers worldwide, however steel structure is primarily sourced from local vendors to reduce the transportation need. It is an ethical, environmental, and employee-related principle that is applied.

Shipment of materials to the respective factories is primarily by road transport, and containerized whenever feasible.

Before shipment, each machine is partly dismantled, depending on dimensional and/or weight constraints for road transportation.

The shipment of a machine to local and regional customers is usually by road from the factory. When shipment is to more remote customers or the shipping route involves waterways, sea transport is often involved. By sea, Ro-Ro type ships are used (where the machine drives onto the ship).

2.6.3 Notice on the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH)

Konecranes is fully aware of its obligations under Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH), and under the UK REACH in the United Kingdom. Twice a year the EU publishes a Candidate list of Substances of Very High Concern (“SVHC”) for Authorization. Producers and EU importers/UK importers have the duty to inform their EU/UK customers when a product contains SVHCs in a concentration above 0.1 % weight by weight. Some Konecranes products do include small quantities of SVHCs, such as lead which is typically used in brass and in certain electric components. These cases are exemptions, as there are currently no satisfactory alternatives available for such substances. We are actively searching for alternatives to substitute articles including SVHCs.

For a list of SVHCs, please see
https://www.konecranes.com/about/corporate-responsibility/konecranes-reach-notice.

2.7 Storage information

2.7.1 Storage

The following chapter describes the recommended procedure for storage of machines. To preserve the condition of the stored machine, it must be driven regularly during storage.

Preparation before storage

NOTE ***Before storing the machine, make sure that all required services according to the maintenance schedule are performed.***

NOTE ***Be aware that some points in the storage handling process, must be performed by trained and authorized maintenance personnel.***

NOTE ***If using a pressure washer, never aim the water directly at radiators, air intakes, seals, rubber hoses, or electrical components.***

- Clean the machine
- Perform daily maintenance check, see section "Daily maintenance"
- Run all hydraulic functions and steer cylinders to end position and back again
- Fill the fuel tank before storing the machine
- Charge the battery
- Lubricate the machine, see section "Regular service"
- To prevent corrosion, apply a rust inhibitor to all the metallic surfaces
- To protect the coating from corrosion, touch up painted surfaces
- If possible, store the machine indoors or under a roof
- If stored outside, it is recommended to cover the whole machine

Maintenance during storage

NOTE ***When driving the machine, the engine temperature must reach at least 80 degrees and the transmission must reach at least 65 degrees.***

To preserve the condition of the machine during storage, the following steps must be performed at least once a month.

- Check the battery, charge if needed
- Check for visible leakage under the machine. If needed, tighten all connections before filling any fluid
- Bleed the fuel system, if needed, see section "Bleeding the fuel system"
- Start the machine, and idle to warm up the engine

- Drive the machine for a while, both forwards and in reverse
- Run all hydraulic functions and steer cylinders to end position and back again
- Before parking the machine again, check the guidelines for "Preparation before storage". Perform the steps, if needed.

Bringing out of storage

- Check for visible leakage under the machine and on the ground.
- Tighten all connections before filling any fluid, if needed
- Perform daily maintenance check, see section "Daily maintenance"
- Lubricate the machine, see section "Regular service"
- Check the battery, charge if needed
- Bleed the fuel system, if needed, see section "Bleeding the fuel system"
- Start the machine, and idle to warm up the engine
- When the engine has reached the required temperature, and while idling, check for visible oil, fuel, or coolant leakage
- Test drive the machine, to make sure all systems function properly

2.7.2 Alternative storage, up to two months

The following chapter describes the procedure for storage of machines that cannot be accessed or driven during storage.

NOTE ***This way of storing the machine should only be used if necessary. See section "Storage" for the recommended procedure.***

Preparation before storage

NOTE ***Before storing the machine, make sure that all required services according to the maintenance schedule are performed.***

NOTE ***Be aware that some points in the storage handling process, must be performed by trained and authorized maintenance personnel.***

NOTE ***If using a pressure washer, never aim the water directly at radiators, air intakes, seals, rubber hoses, or electrical components.***

- Clean the machine
- Perform daily maintenance check, see section "Daily maintenance"
- Run all hydraulic functions and steer cylinders to end position and back again
- Fill the fuel tank
- Fill up the windshield washer fluid
- Fill the AdBlue/DEF tank, if applicable
- Charge the battery
- Lubricate the machine, see section "Regular service"
- To prevent corrosion, apply a rust inhibitor to all the metallic surfaces
- To protect the coating from corrosion, touch up painted surfaces
- If possible, store the machine indoors or under a roof
- If stored outside, it is recommended to cover the whole machine

Bringing out of storage

- If applicable, remove the cover from the machine
- Check for visible leakage under the machine and on the ground.
- Tighten all connections before filling any fluid, if needed
- Perform daily maintenance check, see section "Daily maintenance"
- Lubricate the machine, see section "Regular service"
- Check the battery, charge if needed
- Bleed the fuel system, if needed, see section "Bleeding the fuel system"
- Check the condition of all rubber hoses, and retighten the hose clamps if necessary
- Check that no oil, fuel, or coolant leakage occurs
- Start the machine, and idle to warm up the engine

- When the engine has reached the required temperature, and while idling, check for visible oil, fuel, or coolant leakage
- Run all hydraulic functions and steer cylinders to end position and back again
- Check for visible leakage also when using the hydraulic functions after storage
- Test drive the machine, to make sure all systems function properly

2.7.3 Alternative storage, longer than two months

The following chapter describes the procedure for storage of machines that cannot be accessed or driven during storage.

NOTE ***This way of storing the machine should only be used if necessary. See section "Storage" for the recommended procedure.***

Preparation before storage

NOTE ***Before storing the machine, make sure that all required services according to the maintenance schedule are performed.***

NOTE ***Be aware that some points in the storage handling process, must be performed by trained and authorized maintenance personnel.***

NOTE ***If using a pressure washer, never aim the water directly at radiators, air intakes, seals, rubber hoses, or electrical components.***

NOTE ***When performing the regular service, also consider the procedure for conserving the machine.***

- Clean the machine
- Perform maintenance service according to the 500 hours schedule, see section "Regular service"
- Run all hydraulic functions and steer cylinders to end position and back again
- Apply a long-term rust inhibitor to the cylinder pistons
- Drain any water and contamination from the fuel filters and fuel tank
- Fill the fuel tank
- Fill up the windshield washer fluid
- Fill the hydraulic tank completely, to avoid corrosion above the maximum level
- Empty the AdBlue/DEF tank, if applicable, and rinse it with distilled water
- Disconnect, and charge the battery
- Store the battery in a safe way
- Loosen the fan belt
- To prevent corrosion, apply a long-term rust inhibitor to all the metallic surfaces
- To protect the coating from corrosion, touch up painted surfaces
- Conserve the machine, see section "Conservation of the lubrication and fuel system"
- Cover the air filter, exhaust pipe, and engine if necessary
- If possible, store the machine indoors or under a roof
- If stored outside, it is recommended to cover the whole machine

Conservation of the engine and fuel system

⚠ WARNING

RISK OF FIRE AND PERSONAL INJURY

Conservation oils are flammable and are dangerous to inhale.

Ensure good ventilation. Use a face mask when applying the conservation oil.

- Drain the engine oil and fill with conservation oil just over the MIN marking on the dipstick
- Connect the fuel suction and return hoses to a fuel can (app. 20 l) containing 1/3 conservation oil and 2/3 diesel fuel
- Bleed the fuel system, see section "Bleeding the fuel system"
- Start the engine and idle until about 2 l of the fluid in the fuel can have been used
- Stop the engine and reconnect the fuel suction and return lines to the machine
- Drain the excess fluid from the engine, see section "Cleaning and draining the fuel tank, all engines"
- Put a note on the machine with the date, type of conservation and the conservation oil used

Bringing out of storage

- If applicable, remove the cover from the machine
- Remove covers from air intake systems and exhaust systems
- Remove the rust inhibitor
- Check for visible leakage under the machine and on the ground.
- Tighten all connections before filling any fluid, if needed
- Check and adjust the hydraulic oil level, remove excess oil
- Charge and reconnect the battery
- Tighten the fan belt
- Fill the AdBlue/DEF tank, if applicable
- Perform maintenance service according to the 500 hours schedule, see section "Regular service"
- Lubricate the machine, see section "Regular service"
- Bleed the fuel system, if applicable, see section "Bleeding the fuel system"
- Check the condition of all rubber hoses, and retighten the hose clamps if necessary
- Check that no oil, fuel, or coolant leakage occurs
- Start the machine, and idle to warm up the engine
- When the engine has reached the required temperature, and while idling, check for visible oil, fuel, or coolant leakage
- Run all hydraulic functions and steer cylinders to end position and back again
- Check for visible leakage also when using the hydraulic functions after storage
- Test drive the machine, to make sure all systems function properly

3 TRANSPORT AND TOWING

3.1 Lifting the machine - General safety

⚠ DANGER

FALLING LOAD HAZARD

When the machine is lifted, the machine or parts from the machine could fall. There is a risk of serious personal injury or death to people who stands or walks near or under the machine.

Do not stand or walk near or under the machine when it is lifted.

⚠ WARNING

RISK OF DAMAGE TO THE MACHINE

When the machine is lifted, it could fall.

Visually check the lifting equipment and the lifting points for damages before lifting the machine.

Use only lifting equipment and cranes which have sufficient lifting capacity. See the information on the lifting capacity plate from the manufacturer, for the weight of the lifted machine. Follow local regulations for lifting procedures and equipment.

⚠ WARNING

RISK OF DAMAGE TO THE LIFT SLINGS

If the lift slings grind against the chassis, the lift slings can get damaged.

Lift the machine with the lift slings positioned as straight as possible.

The maximum allowed angle of the front lift slings for SMV 10-25 is 15 degrees.

The maximum allowed angle of the front lift slings for SMV 28-65 is 10 degrees.

The maximum allowed angles of the rear lift slings are:

- 15 degrees forwards and backwards for SMV 10-25

- 10 degrees to the left and to the right for SMV 10-25

- 10 degrees forwards and backwards for SMV 28-65

- 5 degrees to the left and to the right for SMV 28-65

When the machine is lifted, the lift slings must not grind against any part of the machine. Protect the lift slings with some appropriate protection if contact with the chassis cannot be avoided.

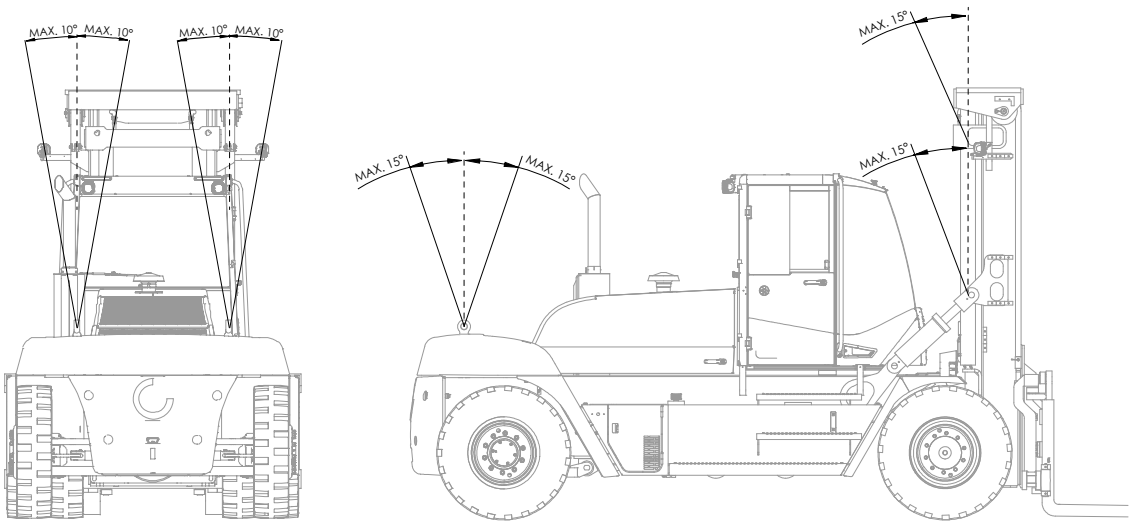


Figure 11. Maximum allowed angles of the slings SMV 10-25 (Rear lifting ears optional for SMV 10-25)

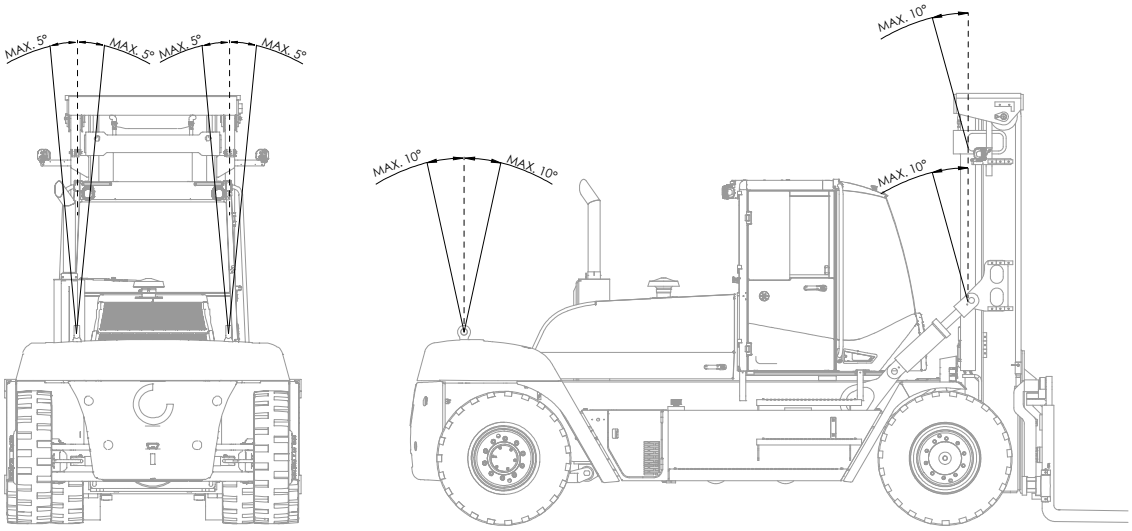


Figure 12. Maximum allowed angles of the slings SMV 28-65

3.2 Lifting points SMV 10-25

NOTE ***Always inspect the lifting ears before lifting the machine.***

NOTE ***When lifting the machine, the lift slings must always be as vertical as possible, never exceed the recommended angles. See Lifting the machine - General safety (page 53).***

NOTE ***If the machine is equipped with a high mast, always use the lower front lifting points.***

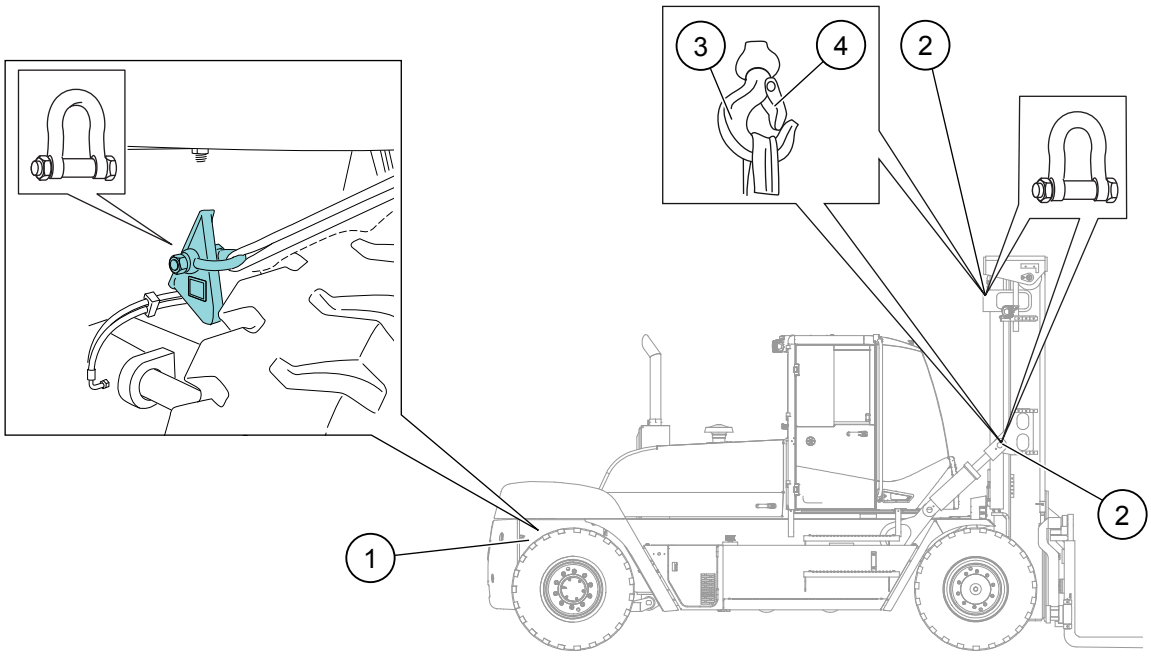


Figure 13. Lifting points SMV 10-25

1. Attach two shackles on the rear lifting ears (1) at the counterweight.
2. Attach two shackles to either the upper or the lower front lifting points (2).
3. Attach lift slings to the shackles in the front and the rear.
4. Attach the lift slings to the lifting hook (3) and secure the safety lock (4).

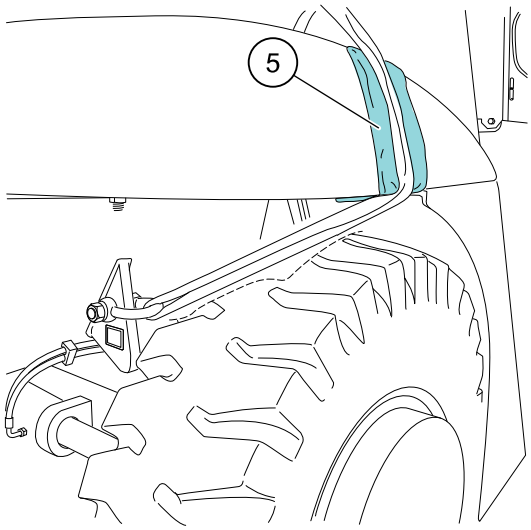


Figure 14. Rear lifting ears

5. To protect the slings when lifting the machine, place appropriate protection (5) between the lift slings and the chassis.

NOTE ***When lifting the machine, always use the rear lifting ears (1). The lifting ears on the removable counterweight (if applicable) must not be used for lifting the complete machine.***

3.3 Lifting points SMV 28-65

NOTE ***Always inspect the lifting ears before lifting the machine.***

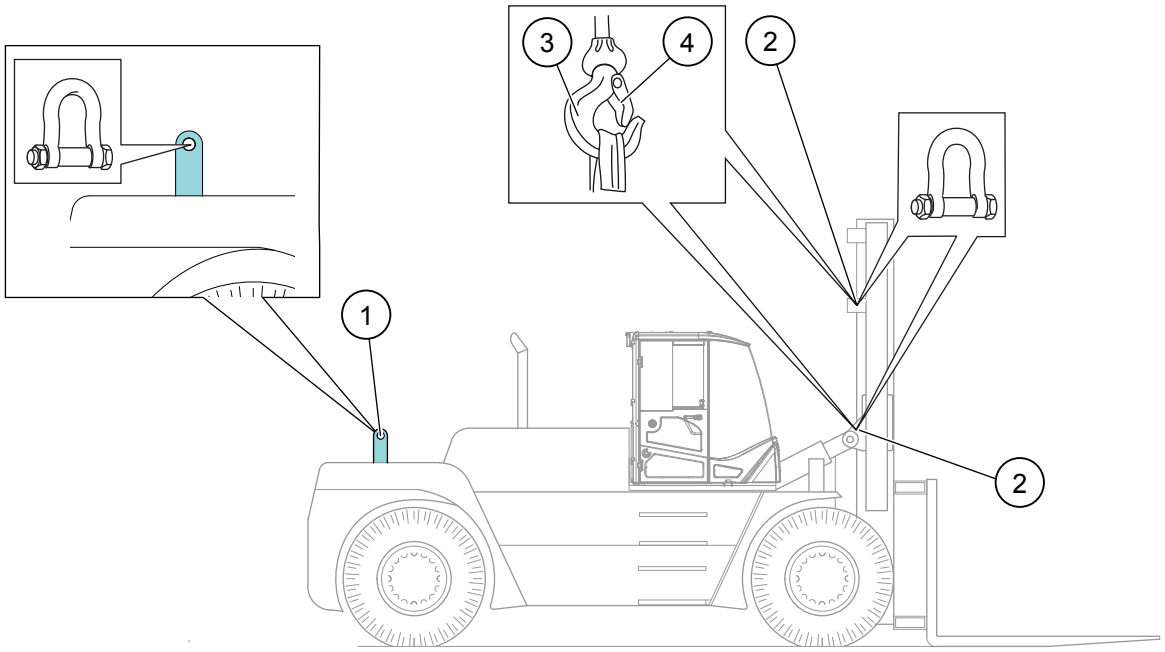


Figure 15. Lifting points SMV 28-65

1. Attach two shackles on the top rear lifting ears (1) at the counterweight.
2. Attach two shackles to either the upper or the lower front lifting points (2).
3. Attach lift slings to the shackles in the front and the rear.
4. Attach the lift slings to the lifting hook (3) and secure the safety lock (4).

NOTE ***When lifting the machine, always use the welded lifting ears (1), or the rear lifting ears. The lifting ears on the removable counterweight (if applicable) must not be used for lifting the complete machine.***

3.4 Rear top lifting ears SMV 10-25 (option)

⚠ WARNING	
⚠	**RISK OF DAMAGE TO THE MACHINE** **The machine can be dropped when lifted.** **Visually check the lifting ears and the bolts for the lifting ears for damages before lifting the machine. There should not be any visible damage on either the lifting ears or the bolts for the lifting ears.**

NOTE ***If the machine is equipped with a high mast, always use the lower front lifting points.***

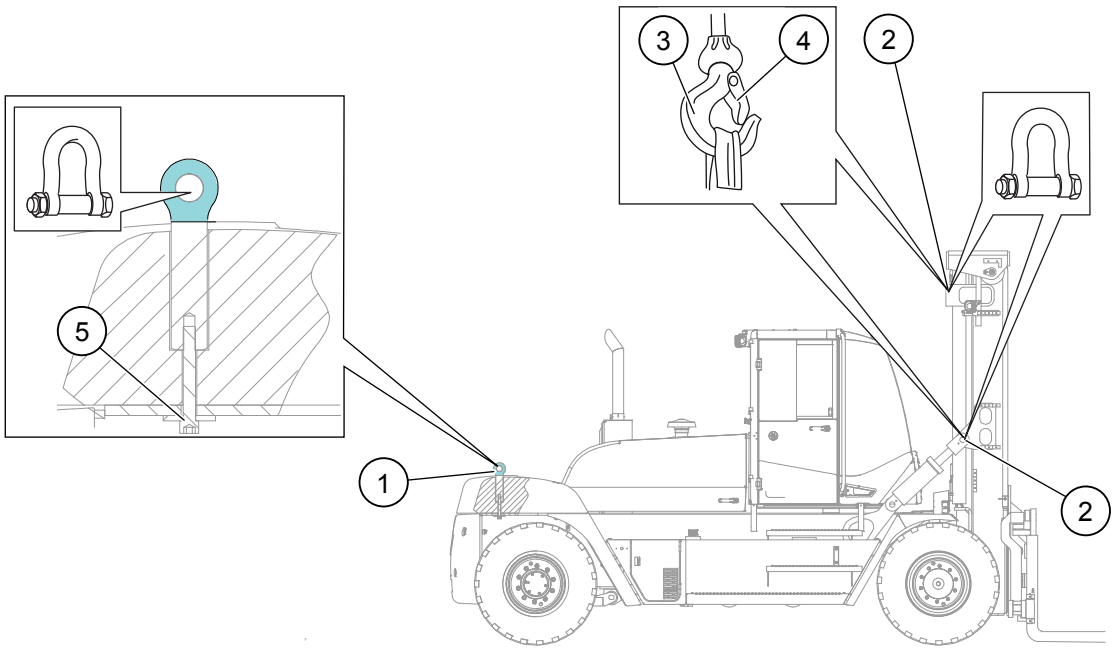


Figure 16. Lifting points when using optional lifting ears

NOTE ***The bolts for the lifting ears (5) are tightened with an appropriate locking glue when delivered. If the bolts are not loose, they do not need to be retightened.***

1. Attach two shackles on the top rear lifting ears (1) at the counterweight.
2. Attach two shackles to either the upper or the lower front lifting points (2).
3. Attach lift slings to the shackles in the front and the rear.
4. Attach the lift slings to the lifting hook (3) and secure the safety lock (4).

NOTE ***When lifting the machine, always use the rear lifting ears (1). The lifting ears on the removable counterweight (if applicable) must not be used for lifting the complete machine.***

3.5 Lifting the machine without the mast

⚠ WARNING

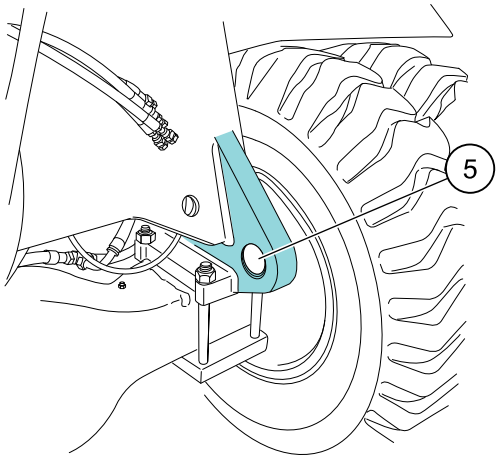
RISK OF DAMAGE TO THE MACHINE

Using shackles damages the bushings of the machine.

Do not use shackles to lift the machine when the mast is dismounted. Instead, use appropriate lifting equipment which does not damage the bushings.

NOTICE **Be careful not to damage the suspension ears when lifting the machine.**

When the mast is dismantled, it is possible to use the mast suspension ears (5) as lifting points.



1. To lift the machine without the mast, attach appropriate lifting equipment to the mast suspension ears (5).

3.6 Lifting the mast

When lifting only the mast, the lower lifting point must be used. This lifting point can also be used when lifting the complete machine, if needed.

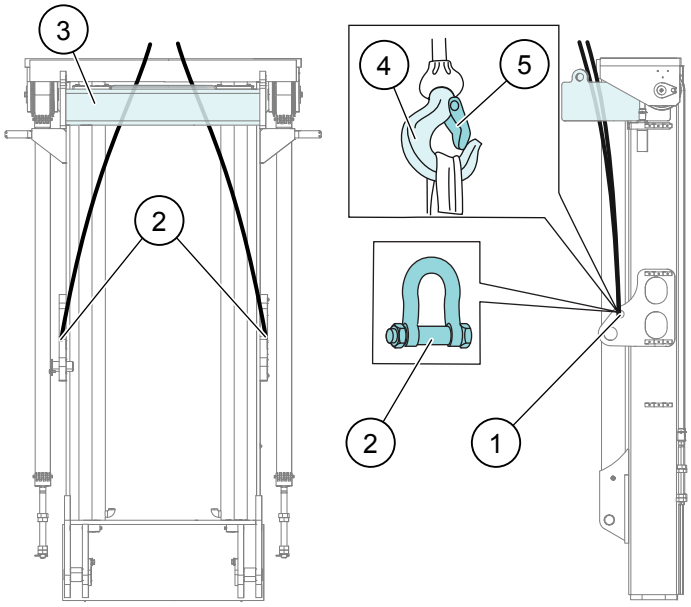


Figure 17. Lower lifting point - Mast

1. Attach two shackles on the lower front lifting points (1).
2. Attach lift slings to the shackles (2).
3. Thread the lift slings behind the top front beam (3).

NOTE ***When lifting the complete machine, the lift slings must be threaded between the top front beam (3), and the mast.***

4. Attach the lift slings to the lifting hook (4) and secure the safety lock (5).

3.7 Towing

⚠ WARNING

RUN OVER HAZARD

If the engine, the electrical system or the hydraulic system is broken, the parking brake may need to be released manually to tow the machine. In this situation, the machine has no brakes or steering capability, which may lead to serious personal injury and damage to the machine.

When towing the machine, the engine must idle, or a vehicle with sufficient braking capacity to stop both vehicles must be used.

⚠ WARNING

MOVING VEHICLE HAZARD

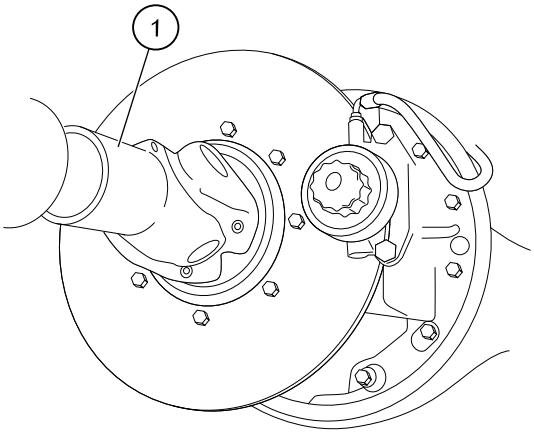
When towing the machine, there is a risk that the machine becomes unattached from the towing vehicle. It can lead to serious personal injury and damage to the machine.

Do not exceed the towing capacity of the transporting vehicle.

NOTE ***Only trained and authorized personnel are allowed to tow the machine.***

If possible, the engine should idle when being towed. If not, the hydraulic brake system, and servo-assisted steering system cannot be used.

If idling is not possible, release the hydraulic parking brake manually. After the hydraulic parking brake is released, the machine has no brakes. To stop both vehicles when towing the machine, use a vehicle with sufficient brake capacity. Use a towing bar if possible. For more information, see Manually releasing the parking brake (page 203).



1. Attach the towing bar to the machine.

NOTE ***Use the rear towing peg, if applicable, when fitting a sturdy towing bar on the machine. Otherwise use slings and secure them around the back counterweight when towing.***

2. Remove the propshaft (1).
3. Release the parking brake manually.

3.8 Transportation

NOTICE

RISK OF DAMAGE TO THE MACHINE

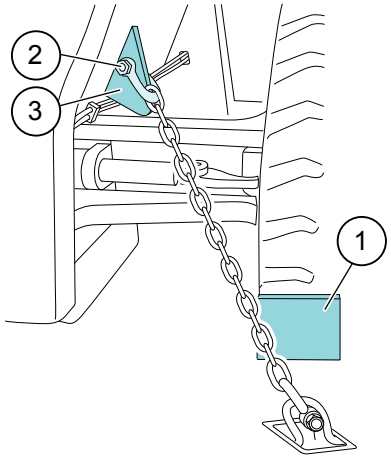
Do not exceed the load limits of the transporting vehicle. See the lifting capacity plate for the weight of the transported machine.

RISK OF DAMAGE TO THE MACHINE

NOTICE

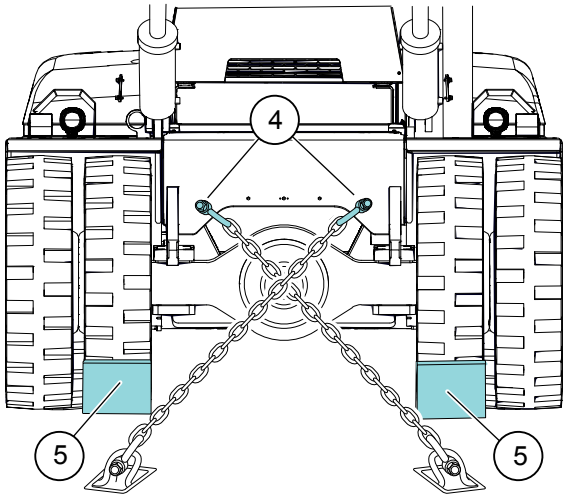
Check the total clearance height of the transporting vehicle and the transported machine. There can be low overpasses along the transportation route.

3.8.1 Securing the rear end



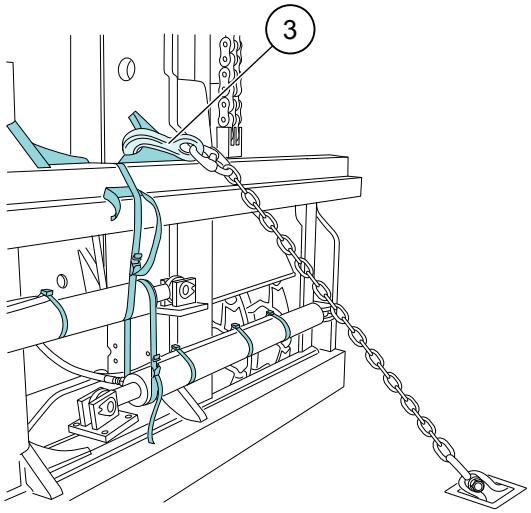
1. Engage the parking brake.
2. Place blocks (1) in front of and behind the wheels to prevent the truck from moving.
3. Hold the truck in place with two chains that are attached with shackles (2) to the eyes (3) beneath the counterweight.

3.8.2 Securing the front end - machines without mast



1. Attach two shackles to the front lifting eyes (4) positioned on the chassis.
2. Place blocks (5) in front of and behind the wheels to prevent the truck from moving.

3.8.3 Securing the front end - machines with mast



1. Lower the mast and fork carriage.
2. Attach two lifting hooks (3) to the fork carriage to hold the truck in place.
3. Secure the cylinders with straps and cable ties.

4 SERVICE AND MAINTENANCE INSTRUCTIONS

4.1 Maintenance safety information

⚠ WARNING

IRRITATING SUBSTANCE HAZARD

The machine contains several chemical substances, which can cause skin irritation and allergies. Personal injury hazard when in prolonged contact with skin.

When handling chemical substances, such as oils, hydraulic oils, fuel, grease, paint, avoid direct contact with the skin. Use safety gloves. Immediately wash skin that comes in contact with chemical substances.

⚠ WARNING

BODY INJURY HAZARD

Lifting or moving heavy components could cause musculoskeletal disorders and back strains.

Use appropriate lifting equipment. Use power tools when possible instead of manual tools.

⚠ WARNING

TIPPING AND COLLISION HAZARD

If a collision occurs, the machine can tip over. Risk of personal injury, and or damage to the machine.

Evaluate the height of overhead structures concerning the mast position when driving and before entering maintenance buildings with the machine.

Preventive maintenance and service must be carried out regularly and in accordance with the regulations that are supplied in the maintenance schedule.

Maintenance must only be carried out by trained staff, dealers, or service technicians authorized by the operational manager, or Konecranes Lift Trucks.

During the warranty period, maintenance must always be carried out by personnel authorized by Konecranes Lift Trucks.

Maintenance must be carried out in accordance with the maintenance schedule.

Before any service work, check that:

- The machine is parked on firm, level ground.
- The mast, and carriage are fully lowered, and the mast is tilted to vertical position.
- The machine is blocked, so that it cannot move.
- The engine is turned off and the ignition key removed.
- The battery main switch is turned off, and the handle is removed.
- The mast, and fork carriage have been secured, if they are in a raised position.
- The machine is firmly secured if work must be carried out underneath when the machine is lifted.

NOTE ***Make sure to use appropriate lifting equipment when handling heavy components.***

After every service, check the machine for leakage and carry out a test drive and an operational test on the machine. If applicable, check that TRUCONNECT® functions properly. Perform a daily maintenance check.

RISK OF DAMAGE TO THE MACHINE

NOTICE

When the machine is used in extremely warm, cold, or dusty environments or in other unfavorable conditions, it is more exposed. If so, the service must be carried out more frequently than the service and maintenance schedule recommends.

Clean the area around each component before lubricating, changing filters, or repairing the hydraulic system. Use only clean receptacles when topping up lubricants, and other fluids.

4.2 Reset service hour counter

⚠ WARNING

RISK OF DAMAGE TO THE MACHINE

If service is not performed according to the maintenance schedule, there is a risk of degradation and damage to the machine.

Reset of the service hours must only be performed by trained maintenance personnel.

Reset of the service hours must only be performed after each completed service of the machine.

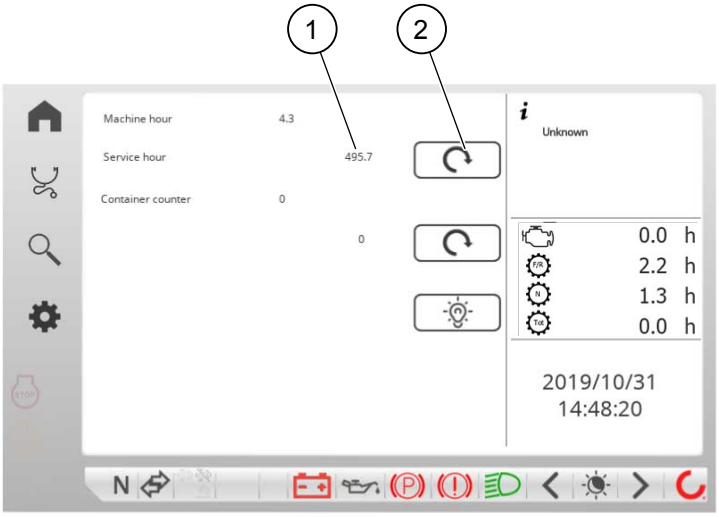


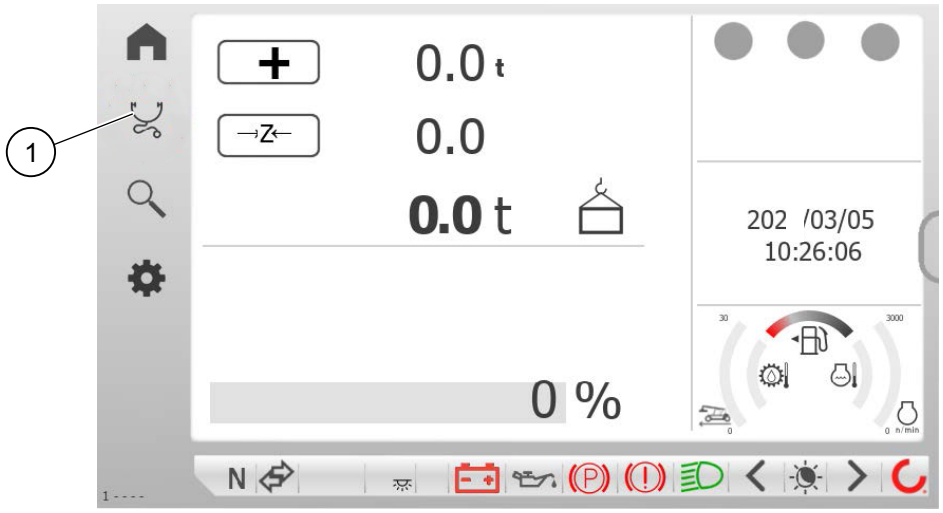
Figure 18. Reset service hours

After service is performed, the service hours (1) can be reset. The reset restarts the counter to the next service interval and removes all service reminders until the next interval is reached.

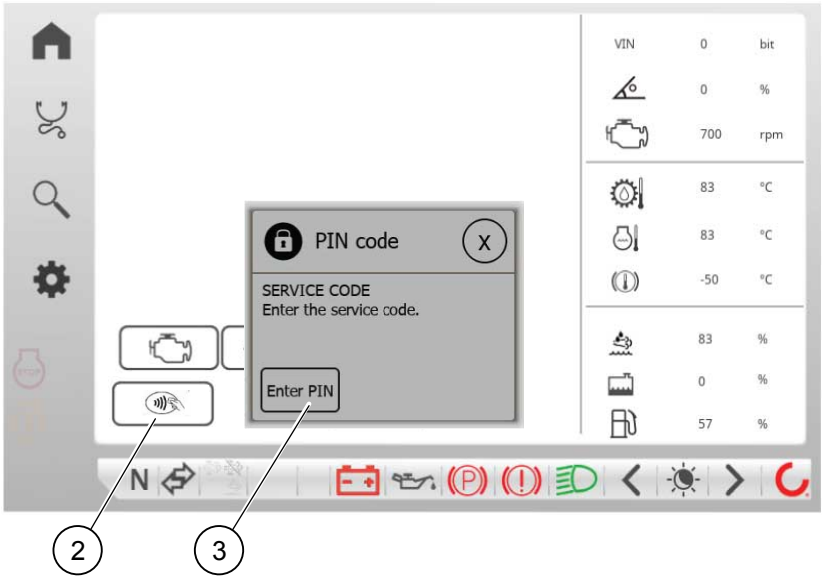
1. Perform service of the machine.
2. Press the reset button (2).
3. Enter the requested service code.
4. Press the reset button (2) for 5 s.

4.3 RFID - Adding an operator (option)

1. Start the ignition.

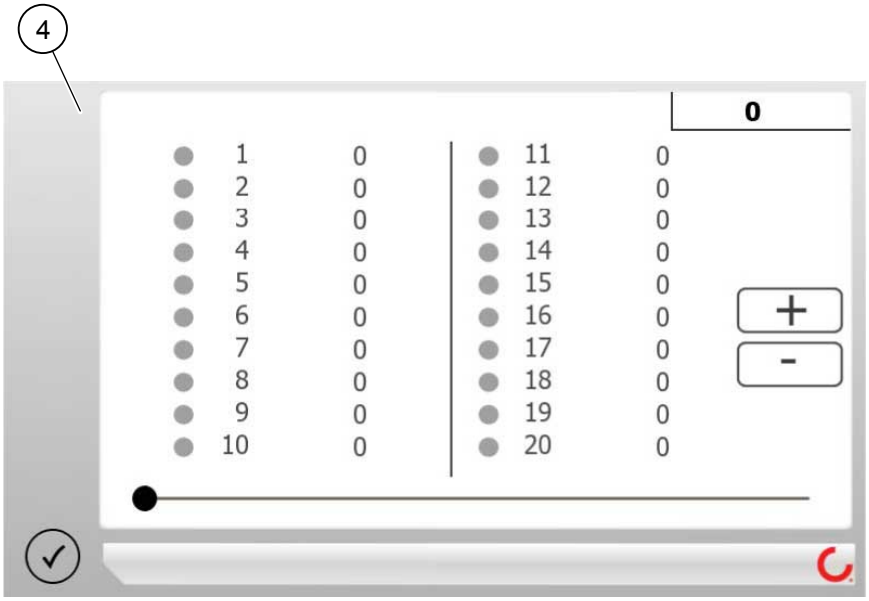


2. Go to the **Machine overview** page (1).

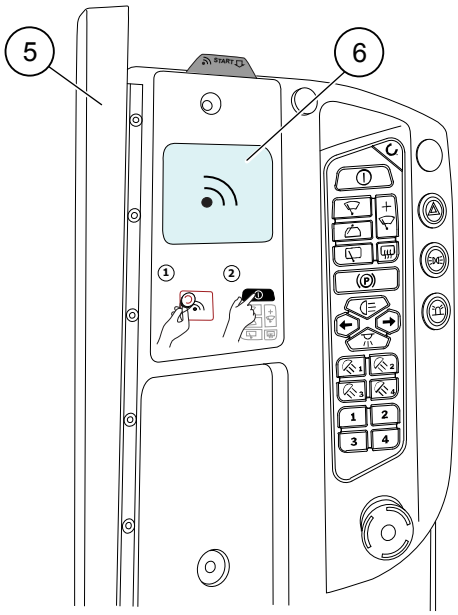


3. Press the RFID selection button (2).

4. Enter the service code (3).

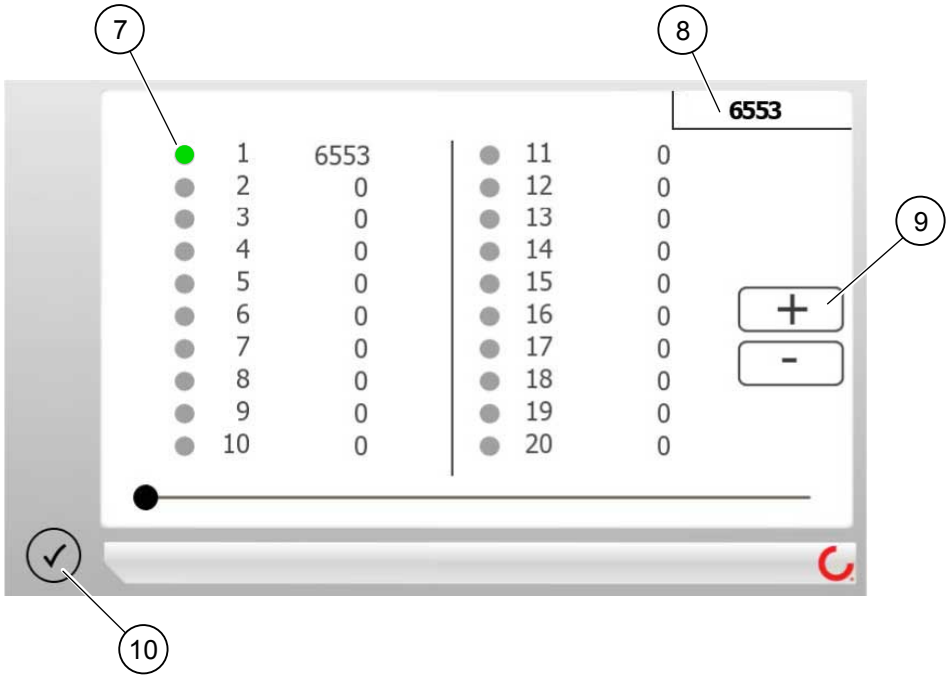


5. The **Access card** page (4) appears.



6. Lift the cover of the armrest (5).

7. Swipe the RFID tag over the RFID reader (6).

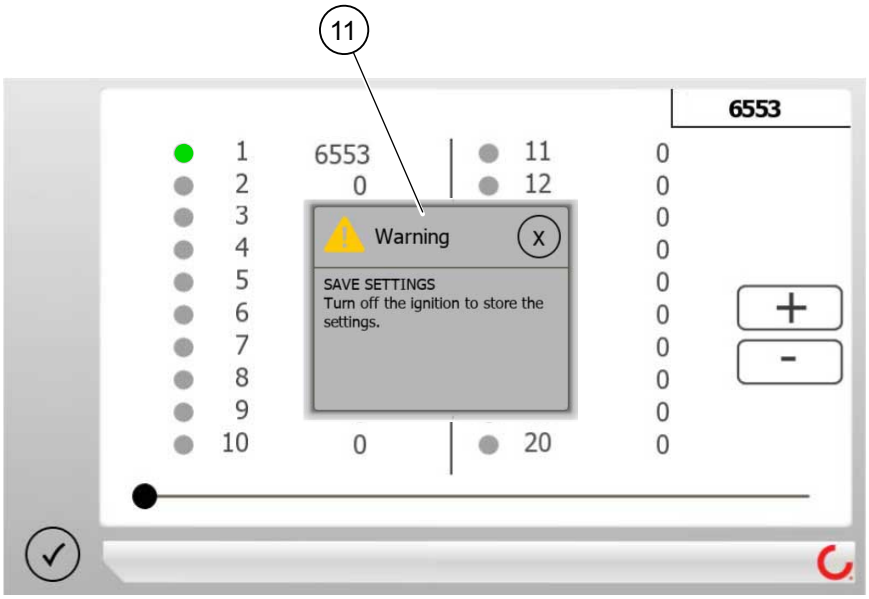


NOTE ***The ID-number of the operator appears in the top right corner (8).***

8. Choose a number in the list (7), the colour changes to green.
9. Press the "plus" button (9) to add the ID-number (8) to the operator number (7)

NOTE ***Press the "minus" button to remove an operator.***

10. Press "confirm" (10).



11. If the warning message (11) appears, turn off the ignition to store the new settings.

4.4 Electric welding

⚠ WARNING

RISK OF FIRE

While welding, molten particles can be projected and set fire to surrounding materials.

Keep the working area clean and use appropriate protective gear.

⚠ WARNING

TOXIC FUMES HAZARD

Breathing in the toxic fumes from welding can cause breathing difficulties and suffocation.

Do not inhale the welding fumes. Use appropriate protection gear such as breathing mask. Only qualified and trained personnel may perform this action.

RISK OF DAMAGE TO THE MACHINE

NOTICE

Follow these instructions when doing electric welding on the machine. Disconnect all battery connections, alternator connections, and all control units.

NOTE ***All welding work must be performed by authorized welders.***

1. Remove the battery connections.
2. Remove the connections to the alternator.
3. Disconnect all control units in, and on the machine.
4. Connect the welding clamp, close to the welding point.

NOTE ***Never attach the welding clamp to the engine, or anywhere that enables the current to pass over a bearing, or a vibration damper.***

5. When the welding is done, connect the alternator, and control units before connecting the batteries.
6. Perform a daily maintenance check.

NOTE ***To ensure that everything works properly, test all functions before returning the machine to operation.***

4.5 Jump-starting

⚠ DANGER

RISK OF ARCING AND EXPLOSION

Touching the connections during a jump-start attempt can cause arcing and lead to serious personal injury or death.

Do not touch the connections during a jump-start attempt.

⚠ WARNING

RISK OF EXPLOSIVE GAS

When jump-starting the machine with a new battery, the empty battery is charged with a high effect. The high-effect charging causes the empty battery to release explosive gas.

Always connect the black cable from the negative pole on the new battery to the chassis, as far away as possible from the empty battery.

NOTICE

RISK OF DAMAGE TO THE MACHINE

Jump-starting the machine with a quick charger, booster, power pack, or similar, can cause a current surge and serious damage to the control units.

Do not jump-start the machine with a quick charger, booster, power pack, or similar.

NOTE ***To avoid risk of fire, keep the working area clean when performing a jump-start attempt.***

1. Connect the red cable on the positive pole of the two auxiliary batteries to the positive pole of the discharged battery.
2. Connect the black cable that is on the negative pole of the two auxiliary batteries to a chassis point, away from the discharged battery.
3. When the engine starts, remove the cables in the reverse order.

4.6 Tilting the cabin

⚠ WARNING

FLYING OBJECTS HAZARD

Loose objects can fall out of the cabin. If left open when tilting the cabin, the cabin doors may come off their hinges. Risk of serious injury and damage to the machine.

Before the cabin is tilted, both cabin doors must be shut. Loose objects should be removed from the cabin. The mast should be vertical and the fork carriage in its lowest position.

⚠ WARNING

FALLING LOAD HAZARD

If the cabin is not fully tilted, the cabin may fall and cause serious injury.

If the cabin is not fully tilted, secure the cabin to prevent it from falling down. Take care if you must work underneath the cabin.

⚠ WARNING

MACHINE MISUSE HAZARD

Risk of serious injury and damage to the machine.

Do not drive the machine with the cabin partially or fully tilted.

⚠ WARNING

RISK OF DAMAGE TO THE MACHINE

When tilting the cabin, it collides with the mast if the mast is tilted backwards. This can cause damage to the cabin.

Do not tilt the cabin if the mast is tilted backwards.

All standard machines are equipped with manual cabin tilting (electrical cabin tilting is available as an option).

4.6.1 Manual cabin tilting

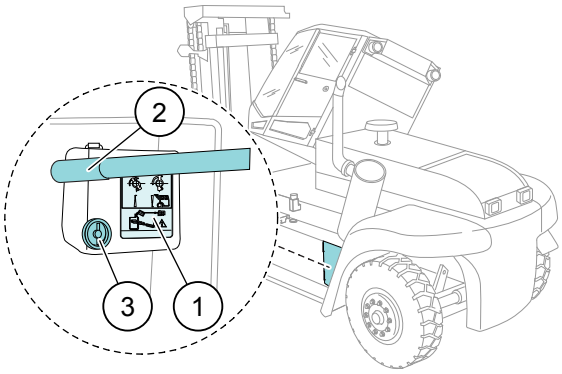


Figure 19. Manual cabin tilting

1. Warning sticker
2. Pump handle
3. Direction valve

A warning sticker (1) is attached to the pump.

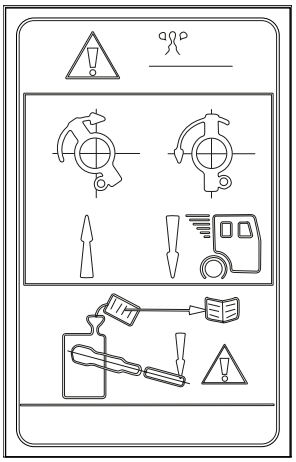
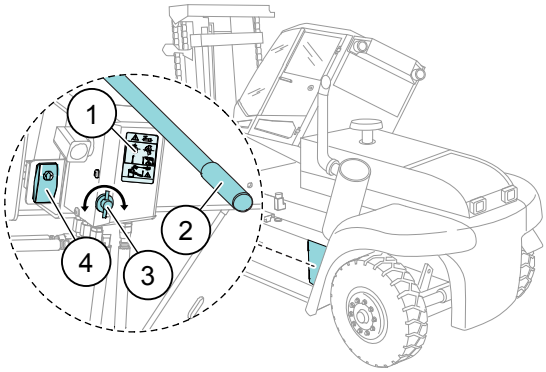


Figure 20. Pump warning sticker

1. Open the hatch by using a special key.
   Hatch is found on the left side of the machine.
2. Fit the pump handle (2) in the direction valve (3).
3. To tilt the cabin upwards, turn the direction valve (3) clockwise.
   To turn the valve (3), use the bottom end of the pump handle (2).
4. Pump to tilt the cabin.
5. To tilt the cabin downwards, turn the direction valve (3) counter-clockwise.
6. Pump to tilt the cabin.

4.6.2 Electrical cabin tilting (option)



1. Warning sticker
2. Pump handle
3. Direction valve
4. Electrical tilt button

A warning sticker (1) is attached to the pump.

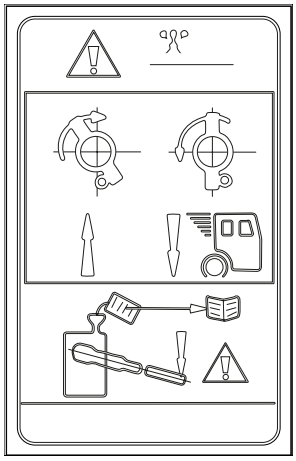


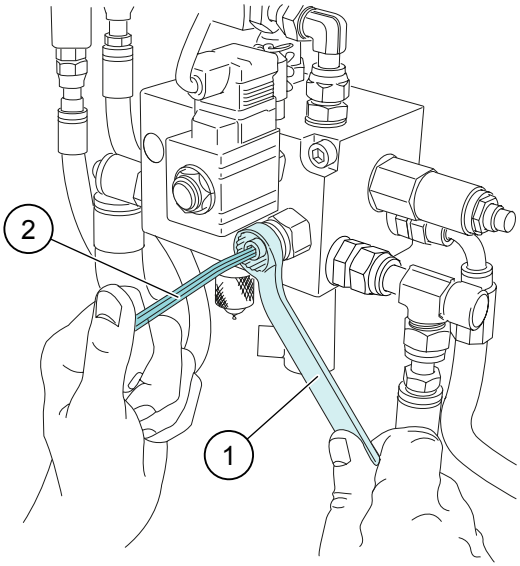
Figure 21. Pump warning sticker

1. Open the hatch by using a special key.
   Hatch is found on the left side of the machine.
2. Fit the pump handle (2) in the direction valve (3).
3. To tilt the cabin upwards, turn the direction valve (3) clockwise.
   To turn the valve (3), use the bottom end of the pump handle (2).
4. Press the electrical tilt button (4).
5. To tilt the cabin downwards, turn the direction valve (3) counter-clockwise.
6. Press the electrical tilt button (4).

4.7 Releasing the hydraulic accumulator pressure

⚠ WARNING	
	**HIGH-PRESSURE HAZARD** **The hydraulic system contains a hydraulic accumulator to maintain the brake function during a possible machine failure. Risk of serious personal injury.** **Before performing maintenance or service on the hydraulics of the machine:** **- Always lower the mast to the bottom position.** **- Always ensure that the accumulator pressure for the hydraulic brake system is released before loosening any hydraulic hoses in the brake circuit.** **Be careful as high nitrogen pressure remain in the accumulator even after the oil pressure is released.**

1. Locate the accumulator charging block.
2. Loosen the locknut using a wrench (1).



3. Loosen the drainage screw using an Allen key (2).

NOTE ***After performing maintenance on the machine, make sure to tighten the drainage screw and locknut.***

4.8 Changing the wheels

⚠ DANGER

HIGH-PRESSURE HAZARD

The tires may explode when you deflate or inflate them, or in case of fire. Standing inside the tire explosion danger zone during a tire explosion can cause death or serious injury.

Always stand to the side of the wheel when deflating or inflating tires, see "tire explosion danger zone" illustration. Use safety glasses.

⚠ WARNING

HIGH-PRESSURE HAZARD

If the valve is broken, air cannot come out of the tire while deflating.

If there is visual damage to the tire or rim, it may cause the tire to explode.

To deflate the tire, drill a hole into the thread, as shown in the illustration.

NOTICE **Only authorized and properly trained personnel are allowed to maintain and change the wheels.**

NOTE ***When changing tires, always perform a dye penetration test on the rims.***

4.8.1 Before changing the wheels

Changing a wheel is a two-man operation.

A support truck that is fitted with an attachment for the wheel (1) facilitates the work.

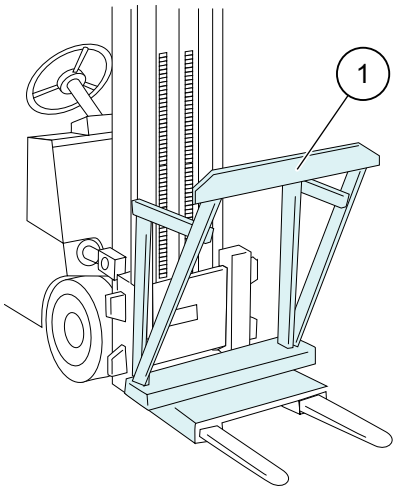


Figure 22. Support truck

1. Position the machine on even ground.
2. Lift the side of the machine and support the underside of the chassis according to recommendations.

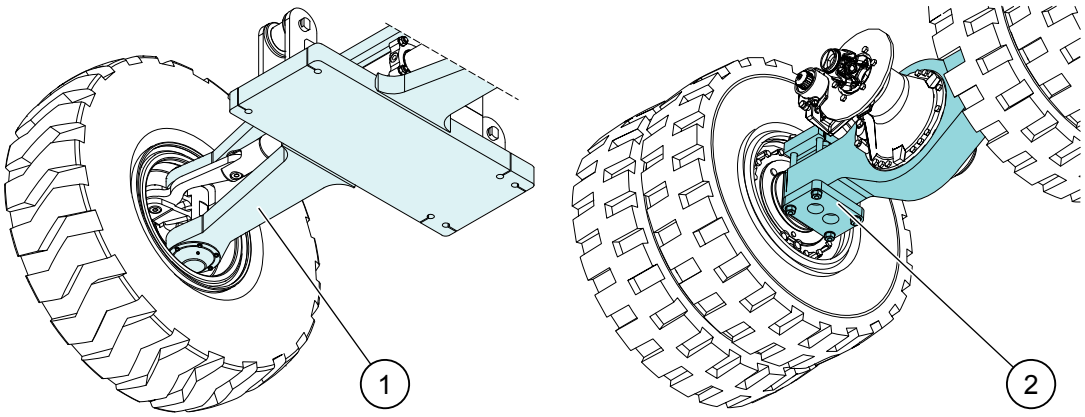
4.8.2 Positioning the jack

⚠ WARNING	
	**MOVING VEHICLE HAZARD.** **The machine can move if not parked on level ground and with the wheels firmly secured. If the machine moves, there is a risk of serious injury or death.** **Park the machine on level ground and firmly secure the wheels before jacking up the machine.**

Observe the following regulations before lifting the machine.

- Specifications for tires: See machine card.
- Specifications for rims: Use only rims that are approved by the manufacturer of the machine.
- Other type of tires: The machine is designed to use pneumatic tires. Solid tires are used only in consultation with the manufacturer of the machine.

NOTE ***Changing wheels is a two-man operation.***



1. Block the drive wheels and position the jack underneath the steer axle (1) to lift the steer axle of the machine.
2. Block the steer wheels and position the jack underneath the drive axle (2) to lift the drive axle of the machine.

4.8.3 Deflating the tire

⚠ DANGER

HIGH-PRESSURE HAZARD

The tires may explode when you deflate them. Standing inside the danger zone during a tire explosion causes death.

Always stand beside the wheel when deflating or inflating tires, see "tire explosion danger zone" illustration. Wear appropriate safety glasses.

⚠ DANGER

HIGH-PRESSURE HAZARD

If the valve mechanism shoots out at high pressure, it may cause serious personal injury or death.

Make sure that no part of the body is in the trajectory of the valve mechanism. Wear appropriate safety glasses.

⚠ WARNING

HIGH-PRESSURE HAZARD

If the valve is broken, air cannot come out of the tire while deflating.

If there are visual damages on the tire or the rim, it may cause the tire to explode.

To deflate the tire, drill a hole into the tread, as shown in the illustration.

NOTICE

RISK OF PROPERTY DAMAGE

When you deflate the tire, the high pressure and moisture of the air may cause the valve to get covered with ice.

Heat the valve with a heat gun.

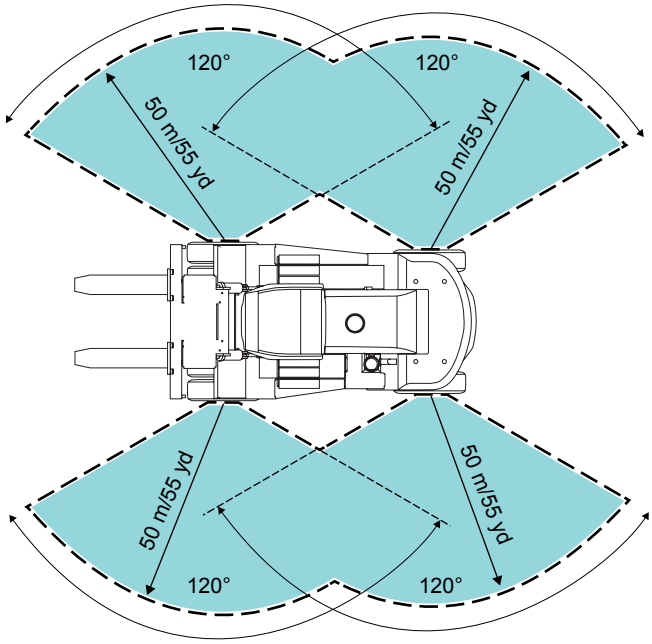


Figure 23. Tire explosion danger zone

NOTE ***Only drill if the valve is broken and does not release air. It is only allowed to drill in the surface of the tread that has contact with the ground (shown in the picture). If only drilling in the contact surface of the tread, it is possible to reuse the tire when it has been repaired.***

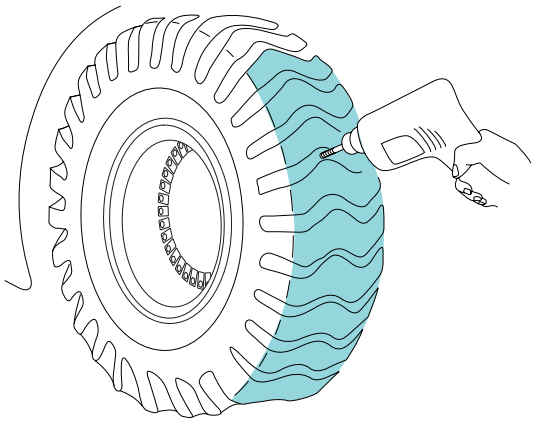


Figure 24. Drilling a hole into the tread

NOTE ***Recommended size of the drill bit, approximately 7-8 mm.***

Deflate as follows:

1. Unscrew the valve cap.
2. Unscrew the valve plug. Ensure that no part of the body is in the possible trajectory of the valve mechanism.

4.8.4 Inflating the tire

⚠ DANGER

HIGH-PRESSURE HAZARD

The tires may explode while being inflated or if the maximum tire pressure is exceeded. Standing inside the danger zone during a tire explosion can cause death or serious injury.

Never exceed the maximum tire pressure.

Always stand aside the wheel when deflating or inflating tires, outside the tire explosion danger zone. Use safety glasses.

NOTICE **Only authorized and properly trained personnel are allowed to maintain and change the wheels.**

The recommended tire pressure is 10 bar at 20° Celsius. When checking the tire pressure, consider the temperature. The recommended tire pressure can vary depending on the temperature.

If the machine is equipped with tire pressure monitoring system (TPMS), the 10-bar recommendation is monitored. Should the pressure drop too far or get too high, the operator gets a notification in the display unit.

NOTE ***Always contact the manufacturer of the machine in advance for a written approval to use other tires.***

NOTE ***The maximum pressures that are specified by the tire manufacturer must never be exceeded. If using another rim or tire than the ones delivered with the machine, other pressure values could be valid. It is the responsibility of the operational manager to make sure that the machine has the correct safety labels if using other tires.***

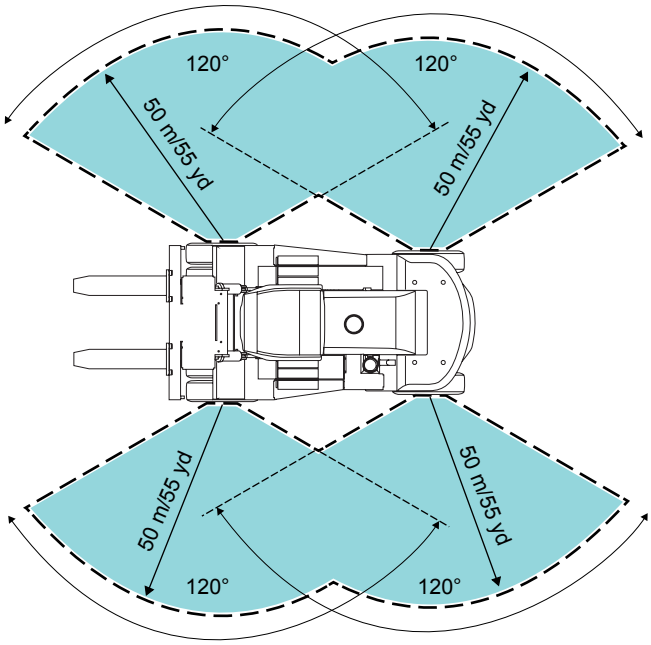


Figure 25. Tire explosion danger zone

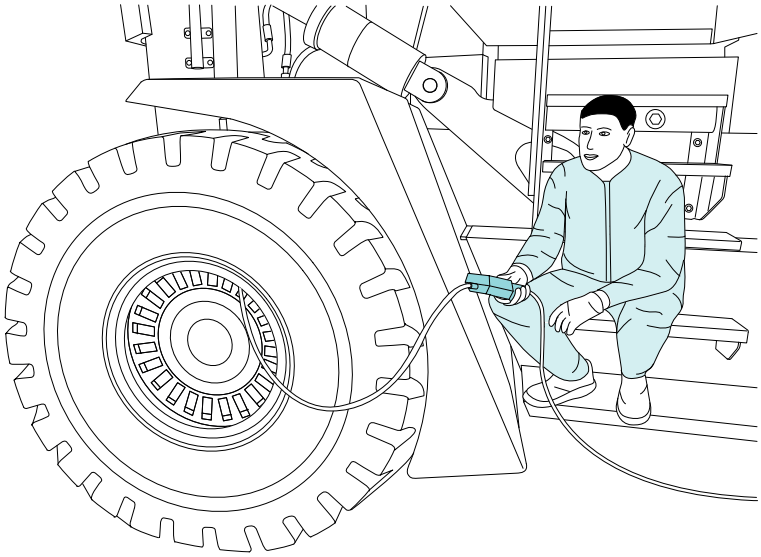


Figure 26. Example of staying out of the tire explosion danger zone when inflating or deflating a tire

- If using rims with clamps, never fit a tire or rim which is fully or partly inflated. All parts must be assembled before inflating the tire.
- Rim components must never be assembled with hammer blows.
- When the tire is deflated, disassemble the tire and check the rim for wear, cracks, and damage. Perform a dye penetration test on the rim.
- It is important that all rim components comply with each other and are certified and approved for use on heavy-duty machines.
- Check that all components are in place when bead seating pressure is achieved.
- Final inflation adjustment to service pressure is performed with the wheel mounted to the machine.
- If a safety cage is used, the tire can be inflated to maximum pressure. Otherwise the tire must be inflated until the bead is seated to the rim.
- Never exceed the maximum pressures that are specified by the tire manufacturer. If using another rim or tire than the ones delivered with the machine, other pressure values could be valid. Contact Konecranes Lift Trucks for advice.

Inflate the tire as follows:

NOTE ***If using rims with clamps, always mount the tire to the machine before inflating the tires.***

1. Check that locking rings and locking lugs (if applicable) are in place, and tightened with correct torque, before inflating the tire.
2. Connect the compressor line to the tire air valve.

NOTE ***To prevent the entry of humidity which leads to corrosion, use a dryer filter on the compressor air line.***

3. Check that all components are in place when bead seating pressure is achieved.

NOTE ***Always stand beside the wheel when inflating the tire.***

4. If using rims without clamps, mount the tire to the machine according to instructions.
5. Stand beside the wheel, inflate the tire to the maximum pressures specified by the tire manufacturer.

NOTE ***The recommended tire pressure varies depending on the temperature.***

4.8.5 Dismantling the outer drive wheel, general

DANGER

HIGH-PRESSURE HAZARD

Fitting tires that are not approved by the manufacturer may cause a tire explosion, which can cause serious personal injury or death.

When changing tires, only use tires which are approved by the manufacturer.

DANGER

HIGH-PRESSURE HAZARD

The bead seat bands (2) and locking rings (3) may release and shoot off when the pressure changes. Risk of serious personal injury and death.

Always release the air from both tires, before loosening or removing any wheel nuts or clamp units (if applicable).

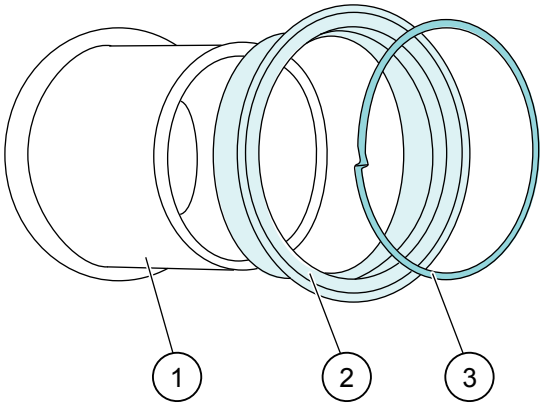
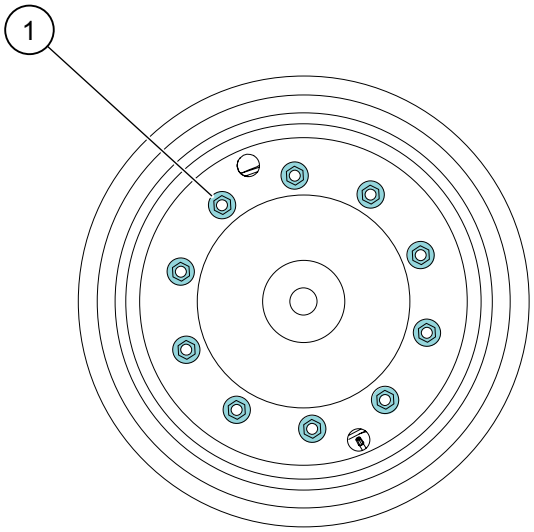


Figure 27. Parts of the rim

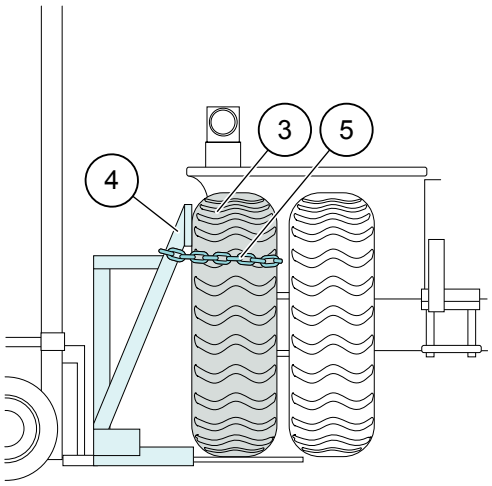
1. Rim base
2. Bead seat band
3. Locking ring

4.8.5.1 Dismantling the outer drive wheel, wheels without clamp units

1. Jack up the drive axle. See: Positioning the jack (page 75)
2. Deflate both outer and inner wheel (if applicable).
3. Remove all but two of the nuts (1).



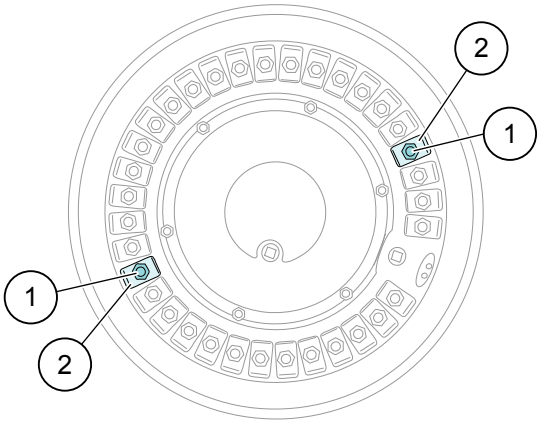
4. Use the support truck to support the weight of the outer wheel (3) on its forks.
5. Remove the two remaining nuts (1).
6. Lean the outer wheel (3) against the wheel support of the support truck (4).
7. Secure the wheel with a chain (5).



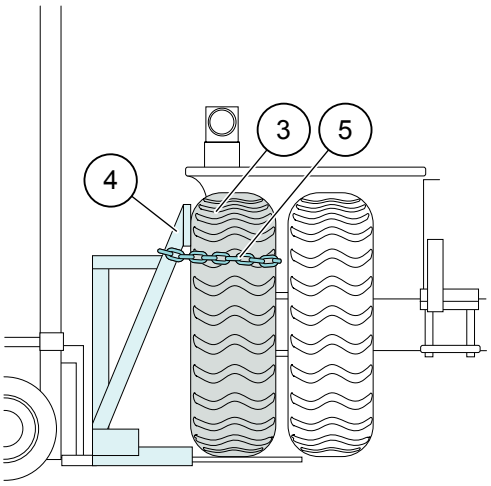
8. Reverse the support truck carefully and unload the outer wheel (3).

4.8.5.2 Dismantling the outer drive wheel, wheels with clamp units

1. Jack up the drive axle. See: Positioning the jack (page 75)
2. Deflate both outer and inner wheel (if applicable).
3. Remove all but two of the nuts (1) and clamp units (2).

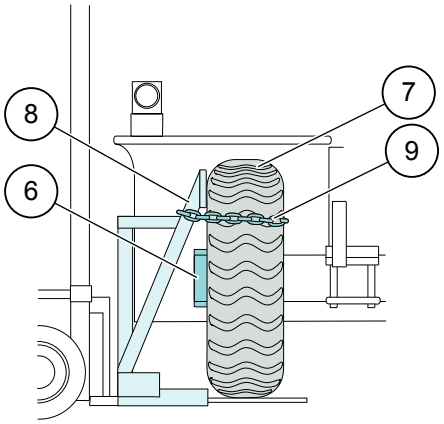


4. Use the support truck to support the weight of the outer wheel (3) on its forks.
5. Remove the two remaining nuts (1) and clamp units (2).
6. Remove the outer clamp unit ring.
7. Lean the outer wheel (3) against the wheel support of the support truck (4).
8. Secure the wheel with a chain (5) to the support truck.



9. Reverse the support truck carefully and unload the outer wheel (3).

4.8.6 Dismantling the inner drive wheel

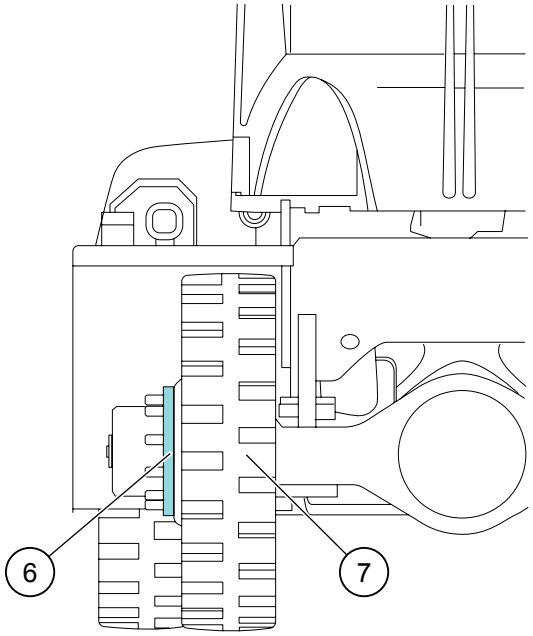


1. Remove the outer drive wheel.
2. Remove the spacer (6).

3. Make sure that the inner drive wheel (7) is deflated.
4. Use the forks of the support truck to support the weight of the inner drive wheel (7).
5. Lean the inner drive wheel (7) against the wheel support (8) and secure it with a chain (9).
6. Carefully reverse the support truck and unload the inner drive wheel (7).

4.8.7 Mounting the inner drive wheels

1. Load the inner drive wheel (7) onto the support truck and fasten it to the support.

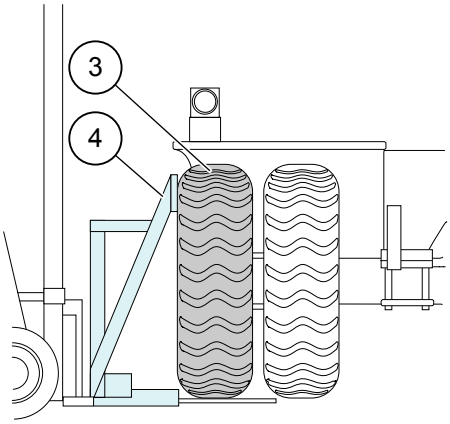


2. Clean the contact surfaces.
3. Carefully drive the support truck to the required position and place the inner drive wheel (7) over the drive axle and the hub.
4. Straighten the wheel (7).
5. Lower the forks of the support truck until the inner drive wheel (7) is resting on the hub.
6. Carefully reverse the support truck.
7. Mount the spacer (6).

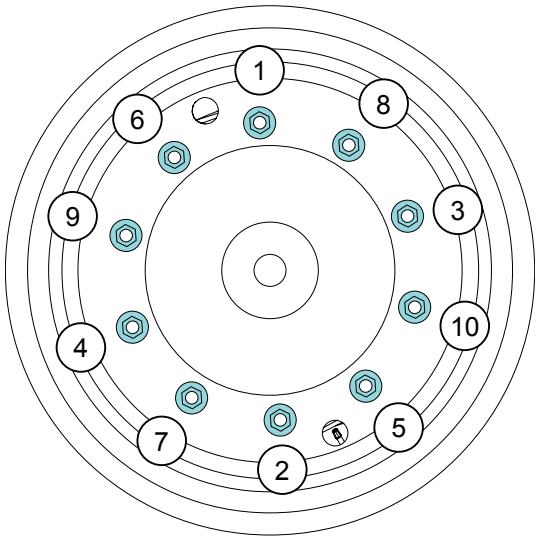
4.8.8 Mounting the outer drive wheel

4.8.8.1 Mounting the outer drive wheel, wheels without clamp units

1. Secure the wheel support (4) to the support truck.
2. Load the outer wheel (3) onto the wheel support (4).
3. Secure the wheel to the wheel support (4).
4. Carefully drive the support truck into position.
5. Place the outer wheel (3) over the hub.



6. Straighten the wheel (3).
7. To avoid putting too much weight on the drive axle, continue supporting the outer wheel (3).
8. To keep the rim in place, fasten two wheel nuts placed diagonally to each other.
9. Carefully reverse the support truck.
10. Tighten the wheel nuts crosswise, in the order 1-10 as shown in the figure.

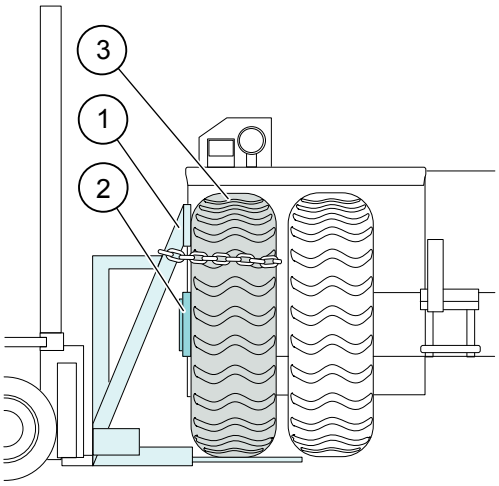


For the required torque, see Tightening the wheel nuts (page 91).

11. Pump the tires according to the recommendations from the tire manufacturer.

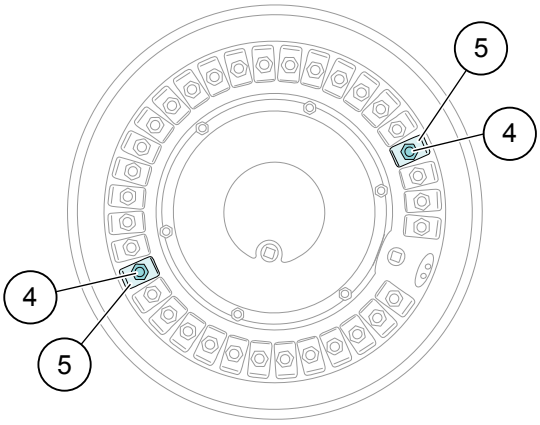
4.8.8.2 Mounting the outer drive wheel, wheels with clamp units

1. Secure the wheel support (1) to the support truck.
2. Load the outer wheel (3) onto the wheel support (1).
3. Secure the wheel (3) to the wheel support (1).
4. Carefully drive the support truck into position.
5. Place the outer wheel (3) over the hub.

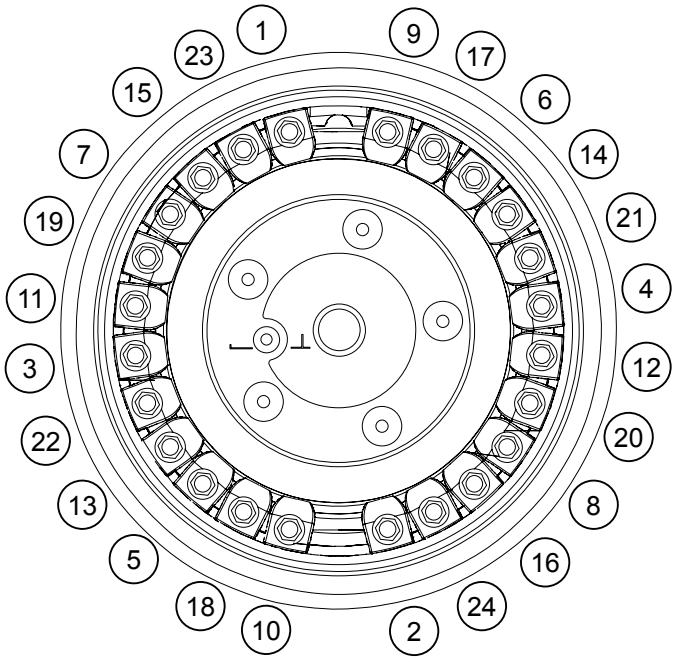


6. Straighten the wheel (3).
7. To avoid putting too much weight on the drive axle, continue supporting the outer wheel (3).
8. Fit the outer clamp unit ring (2).
9. To keep the rim in place, fasten two clamp units (5) and two wheel nuts (4).

NOTE ***Place the clamp units (5) and the wheel nuts (4) diagonally to each other.***



10. Carefully reverse the support truck.
11. Fasten the remaining clamp units (5).
12. Tighten the wheel nuts crosswise, in the order 1-24 as shown in the figure.



For required torque, see Tightening the wheel nuts (page 91).

13. Pump the tires according to the recommendations from the tire manufacturer.

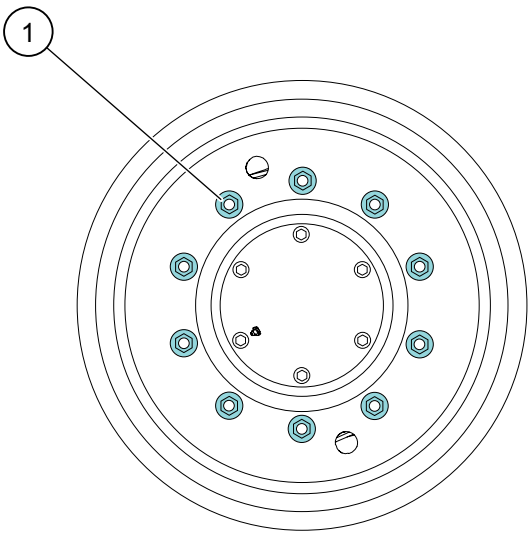
4.8.9 Dismantling the steer wheel, general

⚠ DANGER

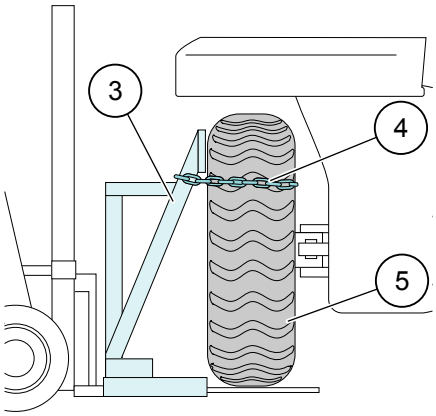
HIGH AIR PRESSURE
If the air is not released from the tire, it can explode. Risk of serious injury or death.
Release the air from the tire before dismantling.

4.8.9.1 Dismantling the steer wheels, wheels without clamp units

1. Jack up the steer axle. See Positioning the jack (page 75)
2. Deflate the tires.
3. Remove all but two of the nuts (1).



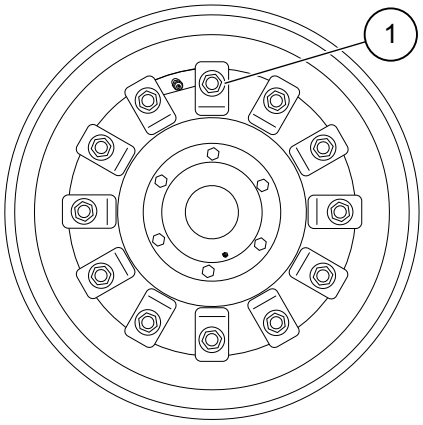
4. To support the weight of the steer wheel (5), use the forks of the support truck.
5. Remove the remaining nuts.
6. Lean the steer wheel (5) against the wheel support (3).
7. Fasten the steer wheel with a chain (4).



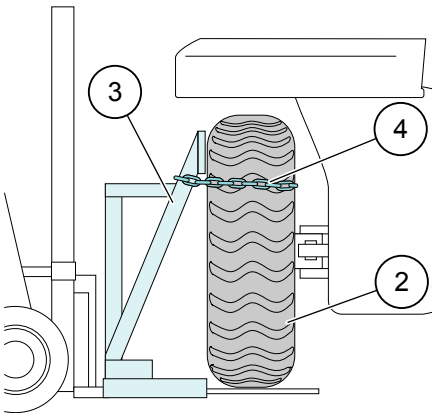
8. Carefully reverse the support truck and unload the steer wheel (5).

4.8.9.2 Dismantling the steer wheels, wheels with clamp units

1. Jack up the steer axle. See: Positioning the jack (page 75)
2. Deflate the tire.



3. Remove all but two of the nuts (1) and clamp units.

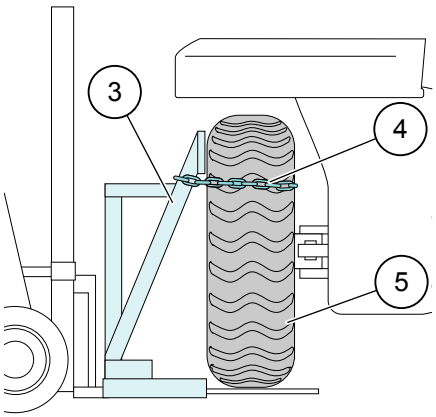


4. To support the weight of the steer wheel (2), use the forks of the support truck.

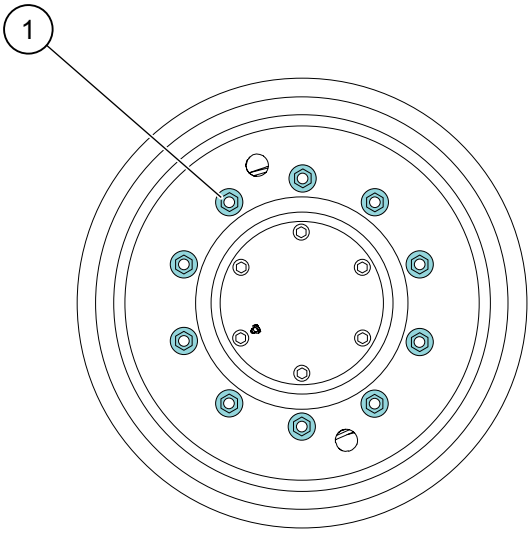
5. Remove the remaining nuts and clamp units.
6. Lean the steer wheel (2) against the wheel support (3).
7. Fasten the steer wheel with a chain (4).
8. Carefully reverse the support truck and unload the steer wheel (2).

4.8.10 Mounting the steer wheels

4.8.10.1 Mounting the steer wheels, wheels without clamp units

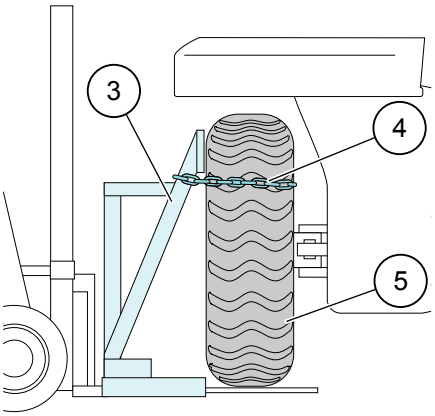


1. Load the steer wheel (5) onto the support truck.
2. Secure the steer wheel (5) to the wheel support (3) with a chain (4).
3. Clean the contact surfaces.
4. Carefully drive the support truck into position.
5. Place the steer wheel (5) against the hub.
6. To support the weight of the steer wheel (5), use the forks of the support truck.
7. Fix and tighten two of the nuts (1) diagonal to each other.

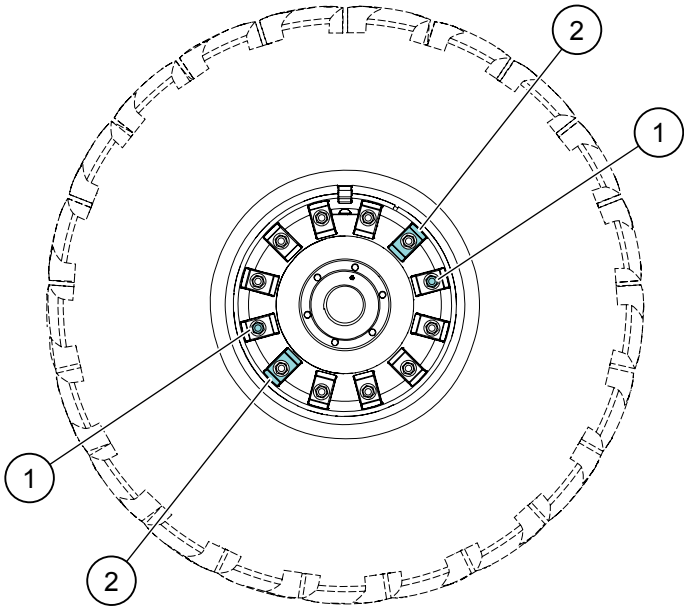


8. Carefully reverse the support truck.
9. Fasten and tighten the remaining nuts (1) crosswise. For the required torque, see Tightening torque (page 90).
10. Pump the tires according to the recommendations of the tire manufacturer.

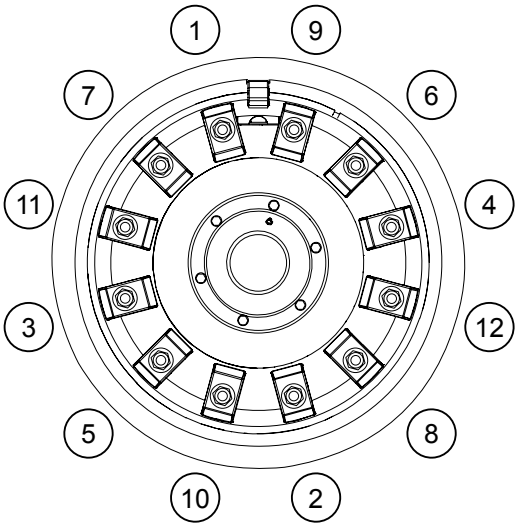
4.8.10.2 Mounting the steer wheels, wheels with clamp units



1. Load the steer wheel (5) onto the support truck.
2. Secure the steer wheel (5) to the wheel support (3) with a chain (4).
3. Clean the contact surfaces.
4. Carefully drive the support truck into position.
5. Place the steer wheel (5) against the hub.
6. To support the weight of the steer wheel (5), use the forks of the support truck.
7. Fix and tighten two of the clamp units (2) and nuts (1) diagonal to each other.



8. Carefully reverse the support truck.
9. Fasten and tighten the remaining clamp units (2) and nuts (1) in the correct sequence. For the required torque, see Tightening torque (page 90).



10. Pump the tires according to the recommendations of the tire manufacturer.

4.9 Tightening the bolted joints

This chapter gives general informaton about the tightening torques for nuts and bolts, as well as more precise information about tightening torques for the nuts and bolts that are used in specific parts of the truck.

4.9.1 Tightening torque

DANGER

MACHINE MALFUNCTION HAZARD

Failure to check the torque, can result in death, injury, or damage.

Check the torque of the bolted joints during first service and on regular intervals.

DANGER

MACHINE MALFUNCTION HAZARD

If lubricating the bolts before tightening them, the bolts are not properly fixated. Bolts which are not properly fixated, can cause accidents which can result in death, injury, or damage.

The torques which are presented in the table apply only for dry bolts. Do not lubricate the bolts before tightening.

The following table contains general tightening torque information for nuts and bolts in the truck.

NOTE ***Check the following chapters for more precise information about tightening torques for the nuts and bolts of specific parts.***

Table 4. Tightening torques for untreated, unoiled, steel screw joints

Millimeter bolts				Inch bolts			
Thread M	Tensile strength class			Thread UNC	Tensile strength class		
	8.8	10.9	12.9		8.8	10.9	12.9
6	9.8 Nm	14 Nm	17 Nm	1/4”	11 Nm	15 Nm	19 Nm
8	24 Nm	33 Nm	40 Nm	5/16”	22 Nm	31 Nm	38 Nm

Table 4. Tightening torques for untreated, unoiled, steel screw joints (Continued)

Millimeter bolts				Inch bolts			
10	47 Nm	65 Nm	79 Nm	3/8”	38 Nm	54 Nm	68 Nm
12	81 Nm	114 Nm	136 Nm	7/16”	61 Nm	87 Nm	108 Nm
14	128 Nm	181 Nm	217 Nm	1/2”	93 Nm	131 Nm	163 Nm
16	197 Nm	277 Nm	333 Nm	9/16”	133 Nm	187 Nm	234 Nm
18	275 Nm	386 Nm	463 Nm	5/8”	183 Nm	259 Nm	323 Nm
20	385 Nm	541 Nm	649 Nm	3/4”	322 Nm	455 Nm	568 Nm
22	518 Nm	728 Nm	874 Nm	7/8”	516 Nm	729 Nm	909 Nm
24	665 Nm	935 Nm	1120 Nm	1”	772 Nm	1090 Nm	1360 Nm
27	961 Nm	1350 Nm	1620 Nm	1 1/8”	1090 Nm	1550 Nm	1930 Nm
30	1310 Nm	1840 Nm	2210 Nm	1 1/4”	1530 Nm	2160 Nm	2690 Nm
33	1770 Nm	2480 Nm	2980 Nm	1 3/8”	2020 Nm	2850 Nm	3550 Nm
36	2280 Nm	3210 Nm	3850 Nm	1 1/2”	2650 Nm	3750 Nm	4680 Nm

4.9.2 Tightening the wheel nuts

DANGER

MACHINE MALFUNCTION HAZARD

Failure to check the torque, can cause the wheel nuts, and the rim to loosen, and destroy the hub. This can result in death, injury or damage.

Check the torque of the wheels nuts as described.

Check the torque of the wheel nuts daily for 14 days, or until the rim, clamp units, and nuts have settled in, and no more tightening is obtained.

Perform these checks:

- After a new delivery of machine
- After the machine has been taken into use
- After a wheel has been removed or replaced

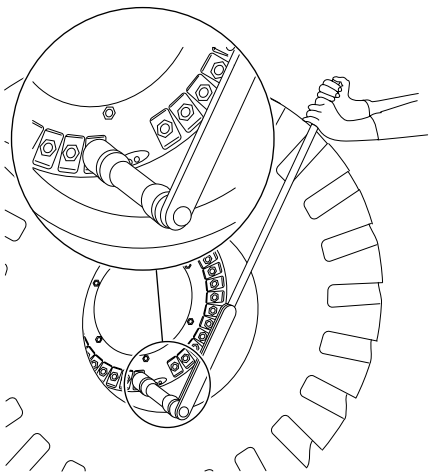


Figure 28. Drive wheel nuts

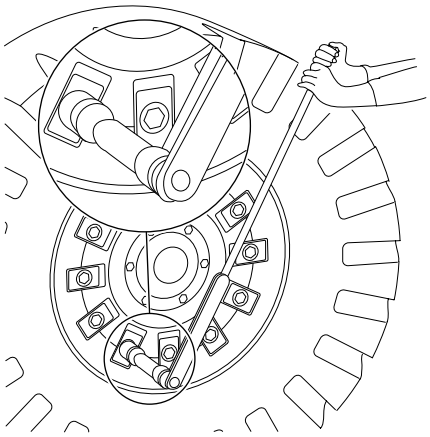


Figure 29. Steer wheel nuts

Tighten the nuts crosswise according to the following table.

Table 5. Drive wheel and steer wheel nuts torque

Position	Size	Strength class	Torque	Clamps
Drive axle	M18x2	10.9	400 Nm (295 lbf ft)	Yes
Drive axle	M22x1.5	10.9	768 Nm (566.4 lbf ft)	No (disc rim)
Steer axle	M22x1.5	10.9	400 Nm (295 lbf ft)	Yes
Steer axle	M22x1.5	10.9	700 Nm (516.3 lbf ft)	No (disc rim)

4.9.3 Tightening the bolts in the propshaft

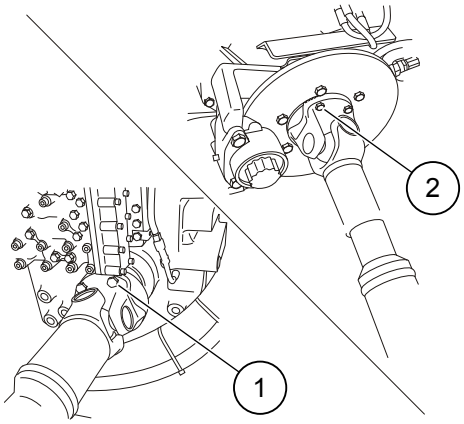


Figure 30. Propshaft SMV 10-18

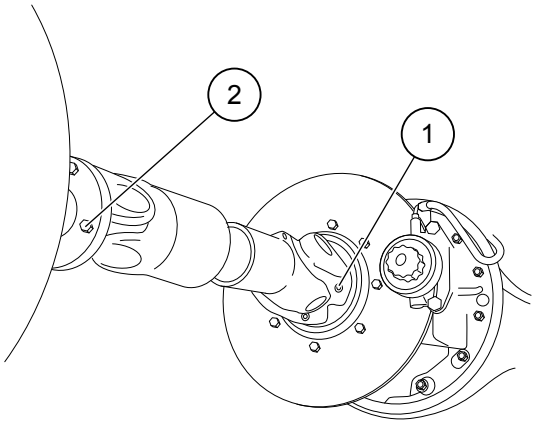


Figure 31. Propshaft SMV 32-60

Select the correct torque according to the bolt size on the drive axle side (1) and the transmission side (2).

Table 6. Propshaft torque

Size	Strength class	Torque
M14	8.8	128 Nm (94.4 lbf ft)
M12	8.8	81 Nm (59.7 lbf ft)

4.9.4 Tightening the bolts in the engine and transmission mounting

Check the condition of the rubber suspensions. If any wear and tear is discovered, replace the damaged parts.

The engine mountings are accessible from the engine compartment, one on each side of the rear part of the engine.

The transmission mountings are accessible from the engine compartment, one on each side of the transmission.

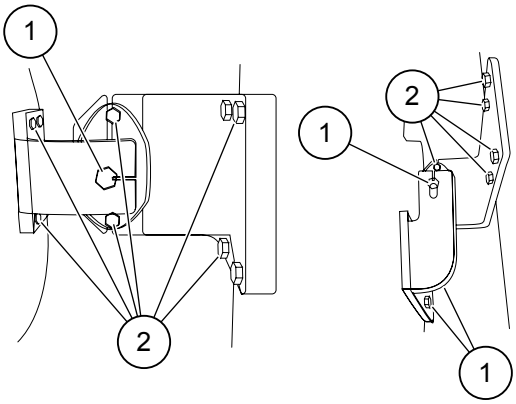


Figure 32. Engine mounting (left) and transmission mounting (right)

Table 7. Engine and transmission mounting torque

Size	Strength class	Torque
M20	8.8	385 Nm (284 lbf ft)
M16	8.8	197 Nm (145.3 lbf ft)
M16	10.9	277 Nm (204.3 lbf ft)

4.9.5 Tightening the bolts in the drive axle suspension

⚠ WARNING

RISK OF PROPERTY DAMAGE

The bolts must be tightened in the order that is shown in the figure.

There are four bolts on each side of the drive axle suspension. Select the correct torque from the table according to the bolt size.

NOTE ***The screws, nuts, and washers must be installed dry. Do not use lubricants on the threads, or contact surfaces of the screws, nuts, or washers.***

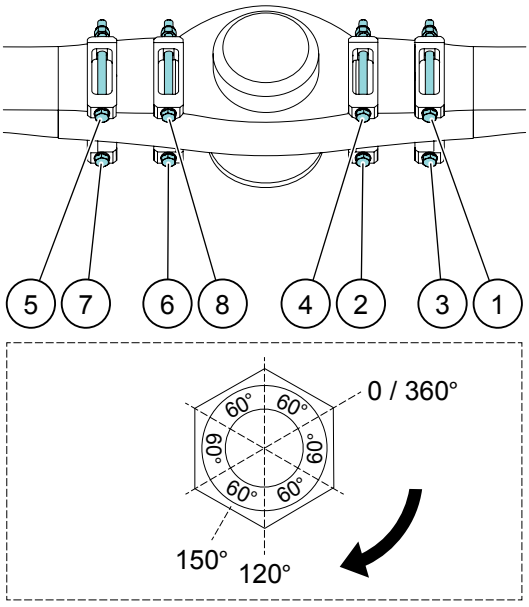


Figure 33. Order to tighten bolts, including bolt angle torque

NOTE ***The torque values in this table do not correspond to the standard torque values presented in the table in Tightening the bolted joints (page 90).***

Table 8. Drive axle suspension torque

Size	Method	Strength class	Torque
M24	1	10.9	900 Nm (663.8 lbf ft)
M30	1	10.9	1,550 Nm (1,143.2 lbf ft)
M30	2	10.9	750 Nm (553.2 lbf ft) + 120°

Table 8. Drive axle suspension torque (Continued)

Size	Method	Strength class	Torque
M36	1	10.9	3,000 Nm (2,212.7 lbf ft)
M36	2	10.9	1,500 Nm (1,106.3) + 150°

4.9.6 Tightening the bolts in the hydraulic pumps

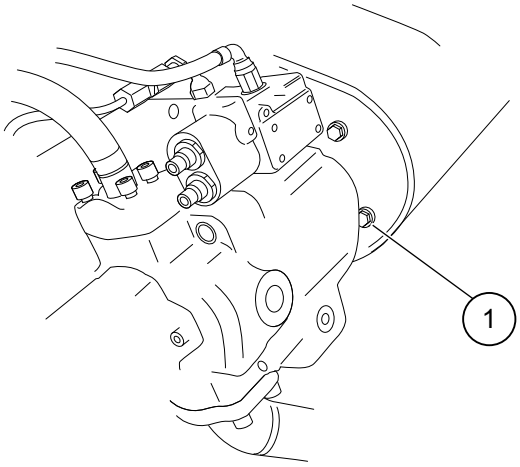


Figure 34. Hydraulic pumps

Table 9. Hydraulic pumps torque

Size	Strength class	Torque
M12x40	8.8	81 Nm (59.7 lbf ft)

4.9.7 Tightening the bolts in the cabin suspension

⚠ WARNING

RISK OF DAMAGE TO THE MACHINE

The suspension ears can get scrunched and damage the mounting brackets.

When tightening the bolts, do not exceed the recommended torque values.

⚠ WARNING

RISK OF DAMAGE TO THE MACHINE

When using the machine, the nuts and bolts of the front cabin suspension can come loose due to vibrations.

The threads on the bolt must pass through the entire locking part of the nut.

NOTE ***The torque value does not correspond to the standard torque value presented in the table at the beginning of the chapter.***

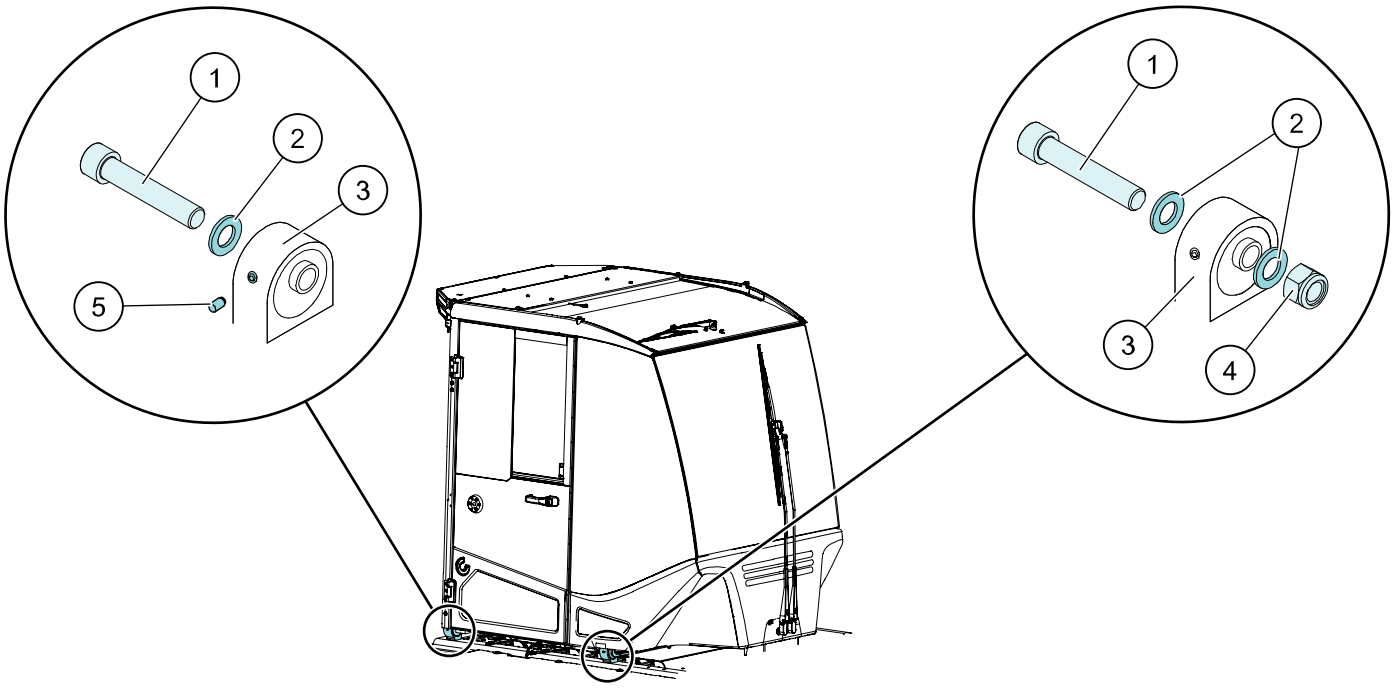


Figure 35. Cabin suspension

Cabin suspension - front

1. Place the bolt (1) with washers (2) in the suspension ears (3) and the mounting brackets.
2. Secure the bolt (1) with the locknut (4).

NOTE ***The threads on the bolt (1) must pass through the entire locking part of the nut (4).***

3. Tighten according to the recommended torque.

Cabin suspension - rear

1. Apply Loctite to the bolt (1).
2. Thread the bolt (1) with washer (2) through the suspension ears (3) and the mounting brackets.
3. Secure the bolt (1) with the locking screw (5).
4. Tighten according to the recommended torque.

Table 10. Cabin suspension torque

Size	Strength class	Torque
M24	12.9	100 Nm (73.8 lbf ft)

4.9.8 Tightening the bolts in the counterweights

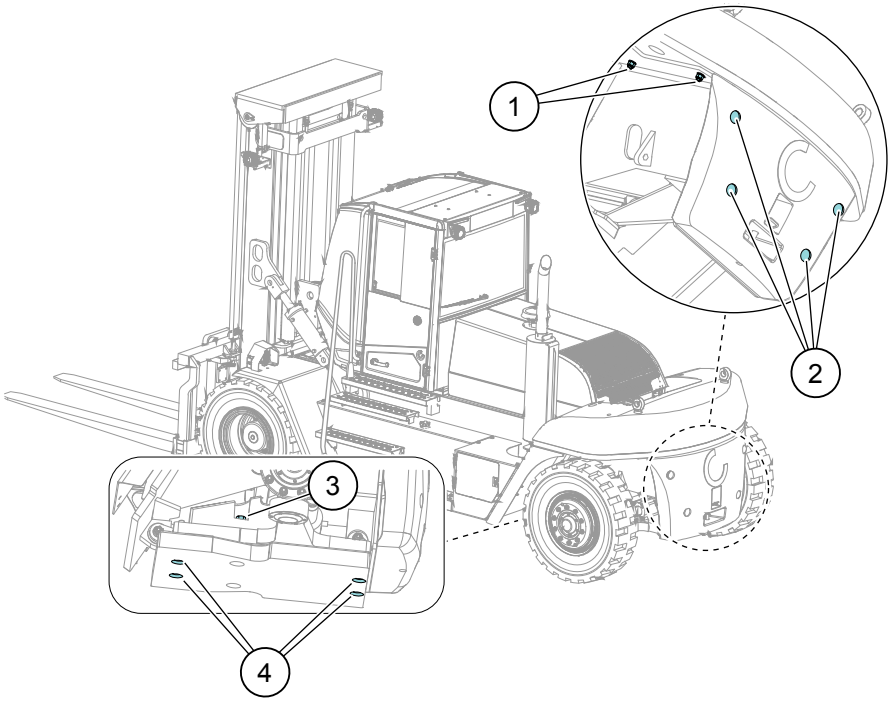


Figure 36. Counterweights

Select the right torque from the table according to the bolt size for the bolts of the counterweights (1), and (2). If equipped with counterweights on the steer axle, also check (3), and (4).

Table 11. Counterweights torque

Size	Strength class	Torque
M24	8.8	665 Nm (490.5 lbf ft)
M30	8.8	1,310 Nm (966.21 lbf ft)
M36	8.8	2,280 Nm (1,682 lbf ft)

4.9.9 Tightening the bolts in the steer axle

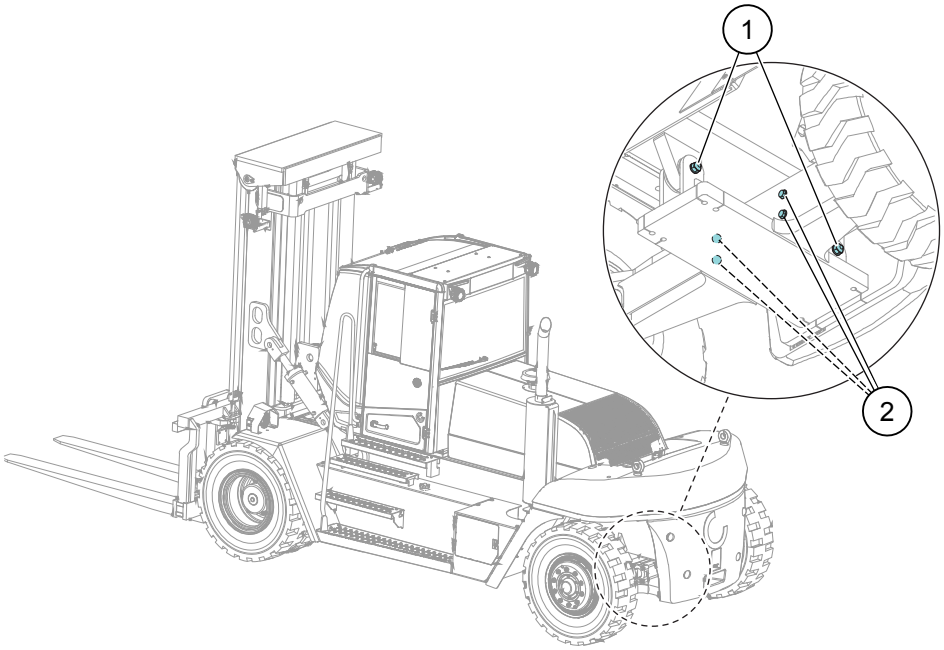


Figure 37. Steer axle

Tightening the bolts in the steer axle (1), and (2).

Table 12. Steer axle torque

Size	Strength class	Torque
M36	8.8	2,280 Nm (1,682 lbf ft)
M20	8.8	385 Nm (284 lbf ft)
M30	8.8	1,310 Nm (966.2 lbf ft)

4.10 Lubricating the machine

4.10.1 General lubrication rules

Follow these rules during lubrication:

- Clean off old grease and clean grease nipples.
- Lubricate until fresh grease protrudes.
- Use only recommended grease.
- All wear pads must be free of pressure for the grease to be able to penetrate.
- Wear pads require frequent lubrication with a small amount of grease. Roller bearings require more grease less often.
- Check the function and bearing slackness when lubricating.
- Specified lubrication intervals apply in favorable conditions. More frequent lubrication is recommended in more demanding conditions, particularly of the wear pads. Examples of more demanding conditions can be dusty environments and heavy handling.

For more information, see Recommended fluids and lubricants (page 250).

4.10.2 Lubricating the steer axle

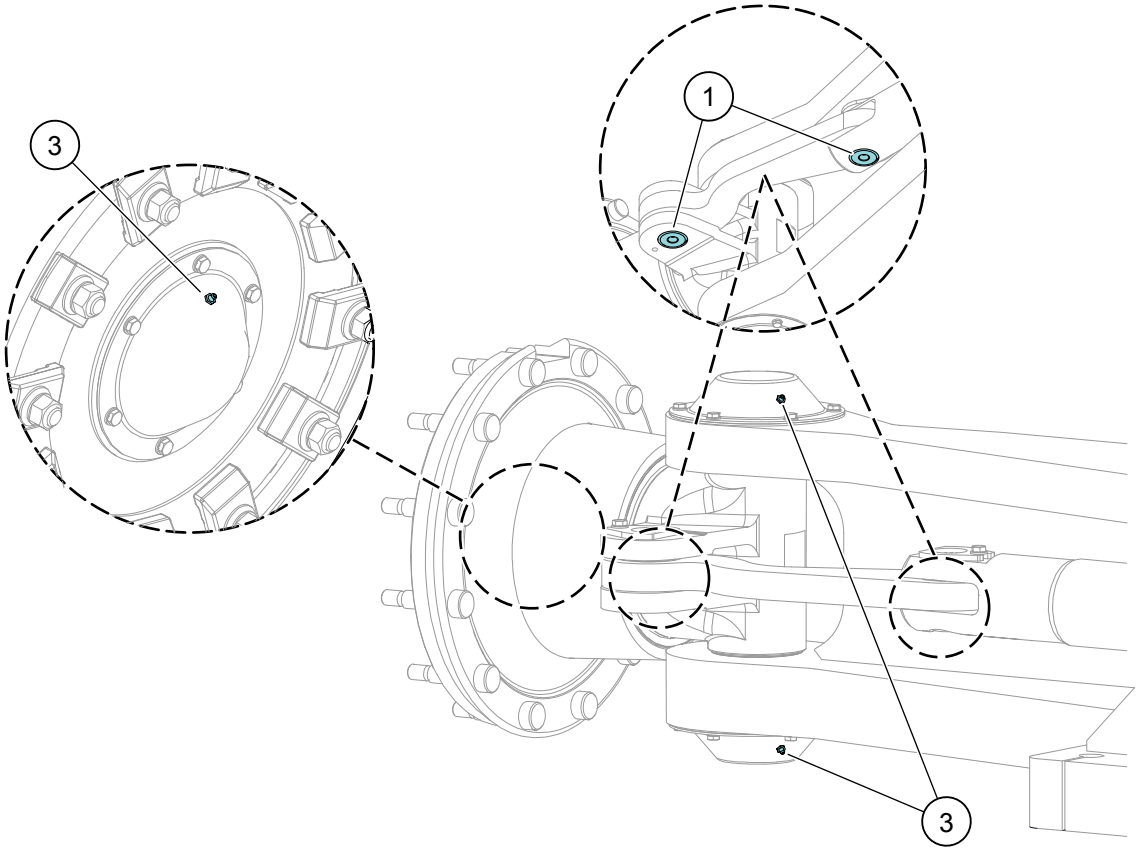


Figure 38. Lubrication points

1. Remove any old grease and clean the grease nipples.
2. Lubricate the steering links (1), four points - two points on each steer link.
3. Lubricate the spindle bolts (2), one upper and one lower on each side.
4. Lubricate the wheel bearings (3), one on each side.
   Grease penetrates onto the inside.

4.10.3 Lubricating the hinges

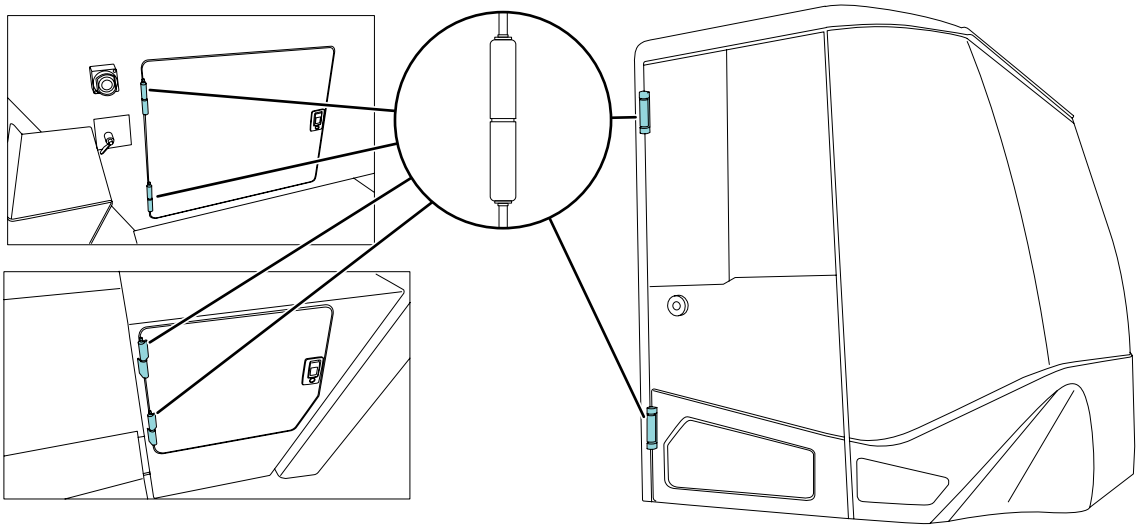


Figure 39. Lubrication points

1. Check and clean the hinges of the cabin door, battery hatch, and the hatch for the cabin tilting equipment.
2. Lubricate the hinges.
   To check that all parts of the hinges have been lubricated, open and close the hatches.

4.11 Lubricating the mast

DANGER

FALLING LOAD HAZARD

Certain tasks require that the inner mast and carriage are raised. If you do not secure them, they may fall and cause serious injury or death.

Secure the inner mast and carriage with a wooden block before starting work.

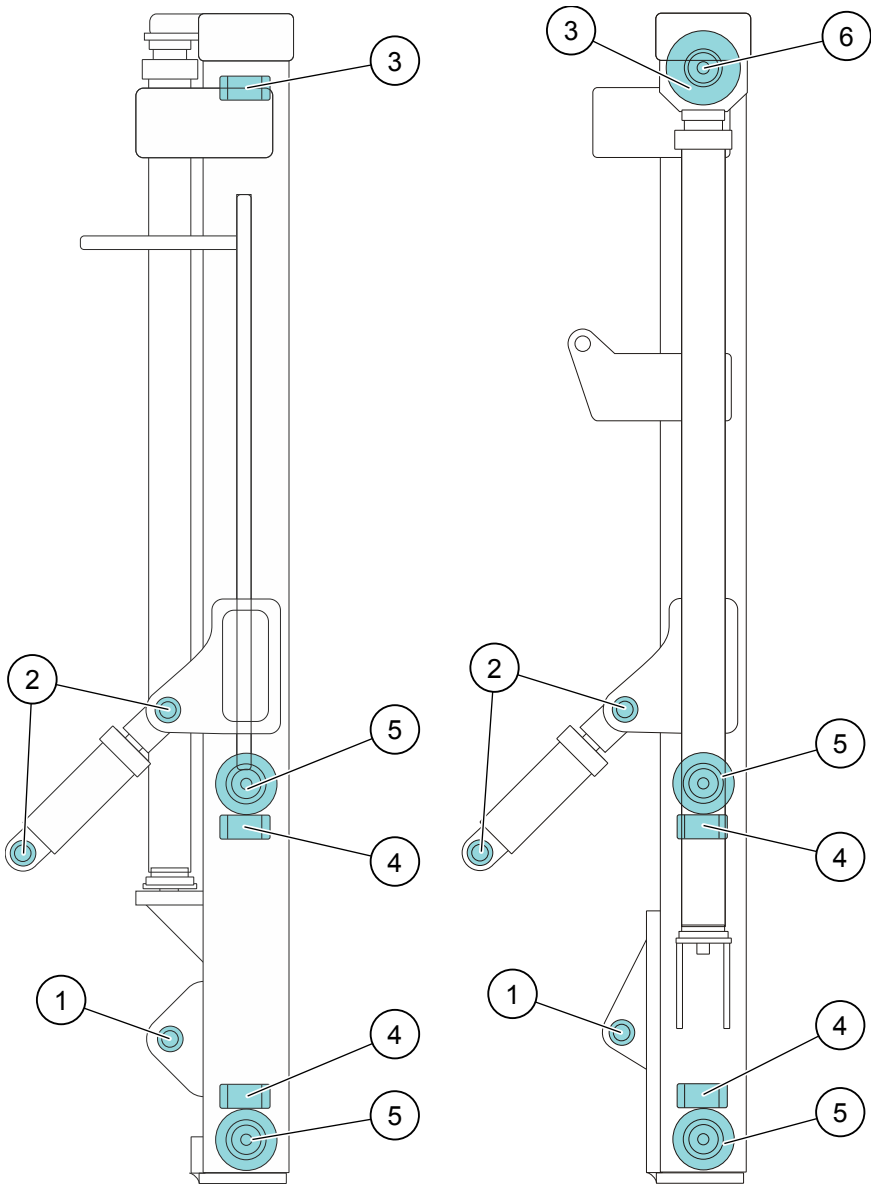


Figure 40. SMV 10-16 (left) and SMV 18-60 (right) mast lubrication points

1. Suspension shaft grease nipples
2. Tilt cylinder shafts
3. Top support rollers
4. Side support reels
5. Mast wheels
6. Chain wheels

NOTE ***Do not use to much grease. Grease in the mast beams cause the rollers and wheels to slide instead of roll.***

NOTE ***Apply grease only to the bearings, not to the support rollers and mast wheels. Remember to lubricate on both sides of the mast.***

1. Apply grease to the suspension shaft grease nipples (1).

The suspension shaft grease nipples (1) are accessible through the mast. Offload the shaft pins by lifting the mast either using a jack or a bench trestle and tilting it forwards.

2. Apply grease to the center of the tilt cylinder shafts (2).
   To offload the tilt cylinders, tilt the mast backwards.
3. Apply grease to the grease nipples of the top support rollers (3) on the outer mast.
   To reach the top support rollers (3), raise the mast.
4. Apply grease to the bearings of the side support reels (4) on the inner mast and the fork carriage.
   To reach the rollers, raise the carriage.
   The side support reels (4) of the fork carriage can be reached from the backside of the carriage.
   The side support reels (4) of the inner mast can be reached from the backside of the inner mast.
5. Apply grease to the bearings of the mast wheels (5) on the inner mast and the carriage.
   To reach the wheels, raise the carriage.
   The mast wheels (5) can be reached from the backside of the inner mast and carriage.
6. **For SMV18-60:** Apply grease to the chain wheels (6) through the grease nipples.

4.12 Lubricating the fork rollers

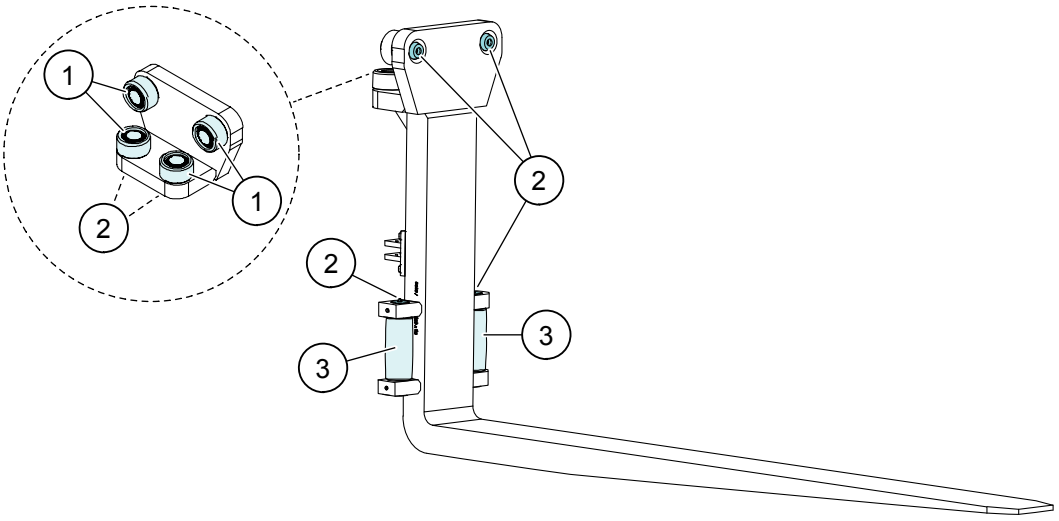


Figure 41. Fork rollers - lubrication points

1. Upper support rollers
2. Grease nipples
3. Lower support rollers

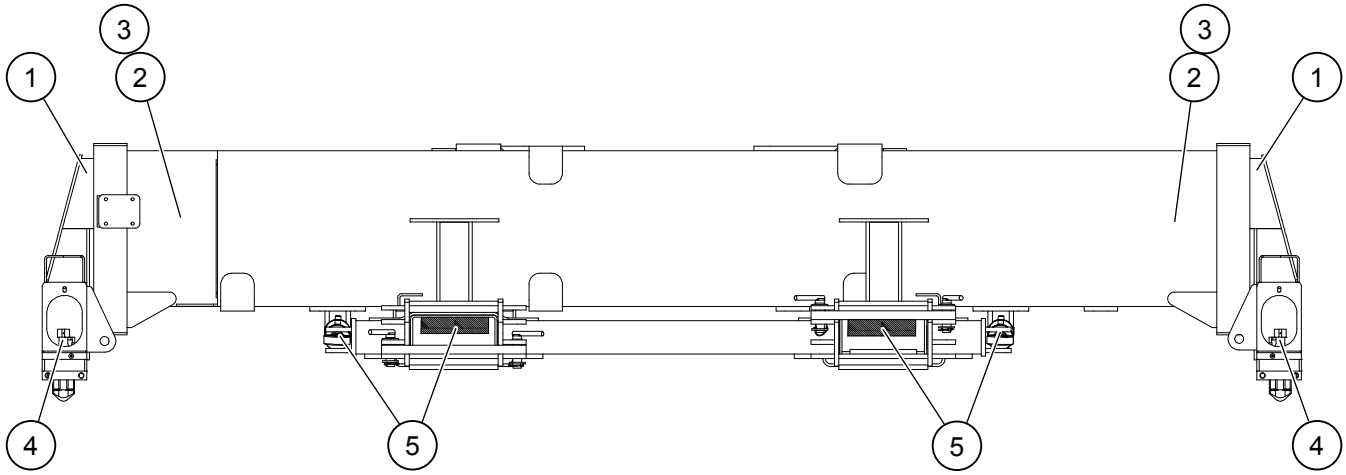
NOTE ***Do not use too much grease. Grease in the carriage beams cause the rollers and wheels to slide instead of roll.***

NOTE ***Only apply grease through the grease nipples (2) to the bearings, not directly on the support rollers (1, and 3).***

1. Apply grease through the grease nipples (2) for the upper support rollers (1).
   There are four upper support rollers (1) on each fork.
2. Apply grease through the grease nipples (2) for the lower support rollers (3).
   There are two lower support rollers (3) on each fork.

4.13 Lubricating the attachment

4.13.1 Attachment lubrication points - ELME 815 Toplift



1. Wear pads for main beams and extension beams
2. Extension cylinders
3. Stop cylinders
4. End beams and twistlocks
5. Fork frame and slew cylinders

4.13.2 Lubricating the wear pads for main beams and extending beams

There are 20 or 24 lubrication points depending on model:

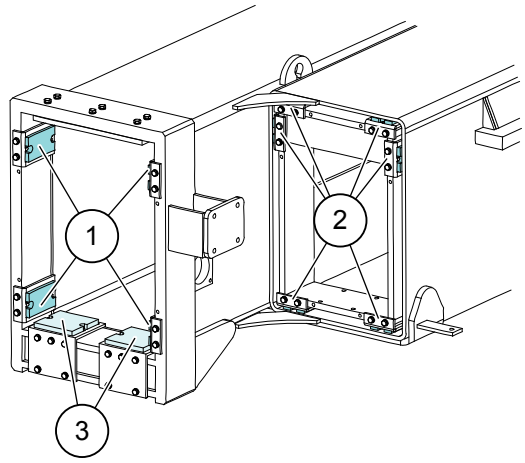


Figure 42. Lubrication points

- Four tracks (1) on the inside of each main beam
- Six tracks (2) on each extending beam
- Two tracks (3) on the inside of each main beam

4.13.3 Lubricating extension beams and twistlocks

NOTE ***Twistlocks on ELME New Generation (NG) are lubrication free.***

There are eight lubrication points:
- One grease nipple in each end box (1)
- One grease nipple in each sleeve (2)

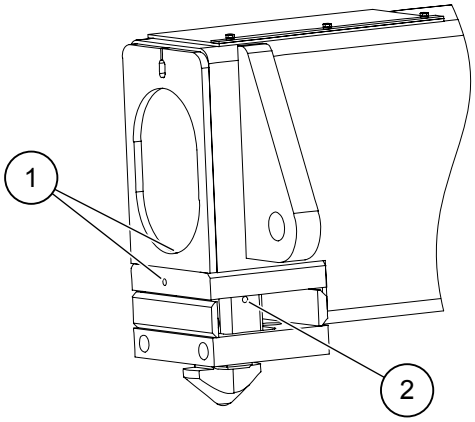


Figure 43. Lubrication points

4.13.4 Lubricating extension cylinder support wear pads and tracks

There are four lubrication points, two tracks in each extension beam.

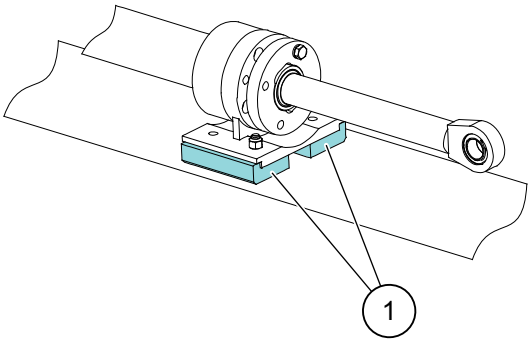


Figure 44. Lubrication points

4.13.5 Lubricating the fork frame - ELME 815

There are 6 lubrication points:

- Two greasing points on each slew cylinder, and one greasing point in the surface of the fork frame (4).

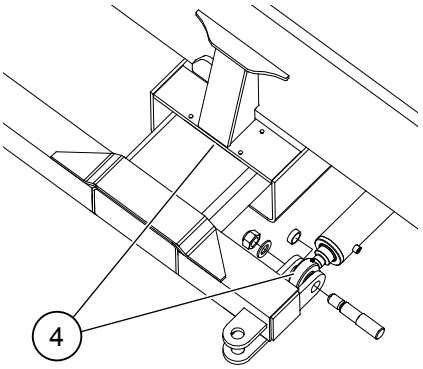


Figure 45. Lubrication points

4.13.6 Lubricating stop cylinders - ELME 815 (option)

One grease nipple (1) on each stop cylinder.

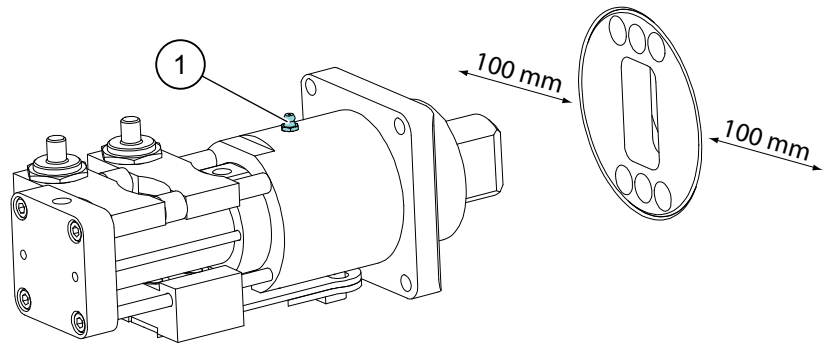


Figure 46. Lubrication points *

* Locking plate shown in illustration.

4.14 Maintenance common to all engines

4.14.1 Cleaning and draining the fuel tank, all engines

NOTE ***To collect the fuel, put a receptacle underneath the drain plug, and dispose of it in an environmentally responsible way.***

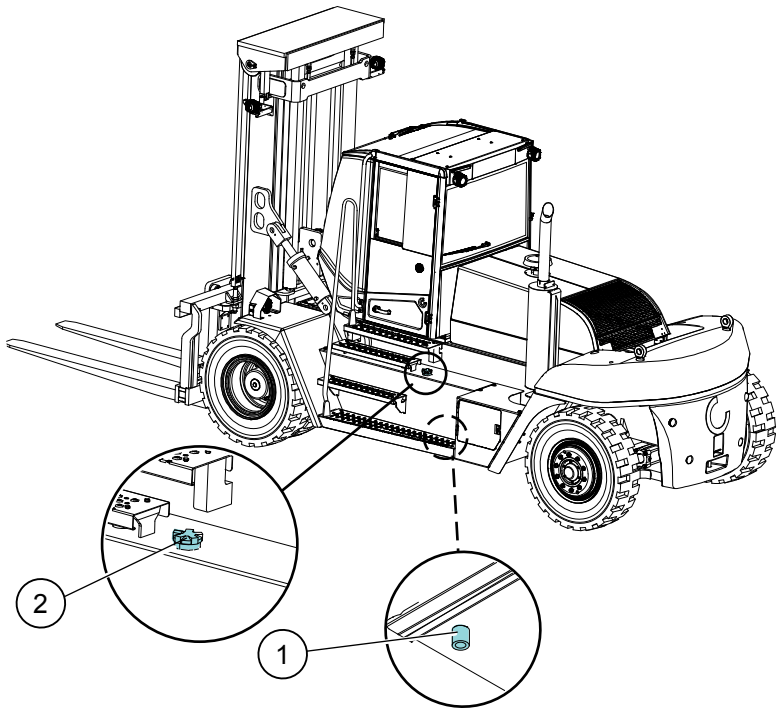


Figure 47. Fuel tank

1. Check the tank for any leaks.
2. Place a receptacle underneath the tank.
3. Loosen the drain plug (1).
4. Drain the tank of any dirt and water through the drain plug (1).
5. When clear fuel comes through, refit the drain plug (1).
   Before refitting the drain plug, check the seal and change if needed.

6. Check the seal around the fuel cap (2), and change if needed.

4.14.2 Cleaning the engine air filter's coarse separator

⚠ WARNING

TOXIC SUBSTANCE HAZARD

The engine air filter contains a significant number of dust particles, which may lead to breathing problems. If the filter element is damaged, the dust particles are also a major risk factor for engine damage.

Always wear a face mask when servicing the air intake system. Do not inhale the dust particles. Consider the environment when carrying out this work.

NOTE ***In sandy or dusty environments with many particles, clean the coarse separator more frequently.***

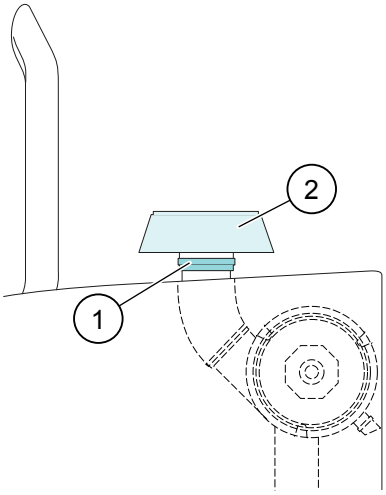


Figure 48. Coarse separator, standard

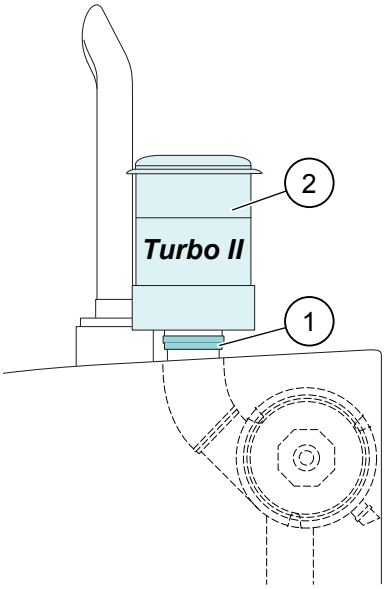


Figure 49. Coarse separator, Turbo II (option)

1. Clean around the coarse separator (2).
2. Clean the clamp (1).

3. Remove the clamp (1) from the coarse separator (2).
4. Remove the coarse separator (2).
5. Clean the coarse separator (2) with air and remove the particles.
6. Dry the coarse separator (2) with a cloth.
7. Refit the coarse separator (2) and screw the clamp (1) in place.

4.14.3 Cleaning and changing the engine air filter, all engines

⚠ WARNING

TOXIC SUBSTANCE HAZARD

The engine air filter contains a significant number of dust particles. If the filter element is damaged, it may lead to breathing problems.

Always wear a protective mask when servicing the air intake system. Do not inhale the dust particles. Consider the environment when carrying out this work.

⚠ WARNING

RISK OF PROPERTY DAMAGE

The engine air filter contains a significant number of dust particles. If the filter element is damaged, it causes a risk of damage to the engine.

Always make sure that the engine air filter is cleaned and undamaged. Follow the "daily maintenance" instructions, and the maintenance schedule.

RISK OF PROPERTY DAMAGE

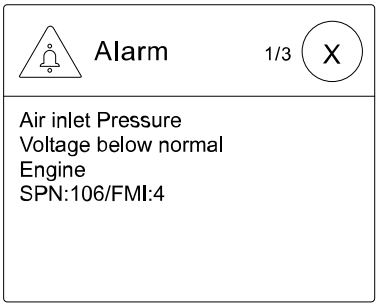
NOTICE

Do not clean the inside of the filter housing with compressed air. All maintenance on the air intake system must be carried out while the engine is turned off. Do not use any liquids to clean the engine air filter, as it is a dry filter element.

NOTE

Cleaning the engine air filter always induce a risk of damaging it. After cleaning, the engine air filter has lower dust capacity than a new element.

Clean or change the filter element when a warning about air inlet pressure appears on the MD4 display.



Clean the area around the filter before opening the clamp units.

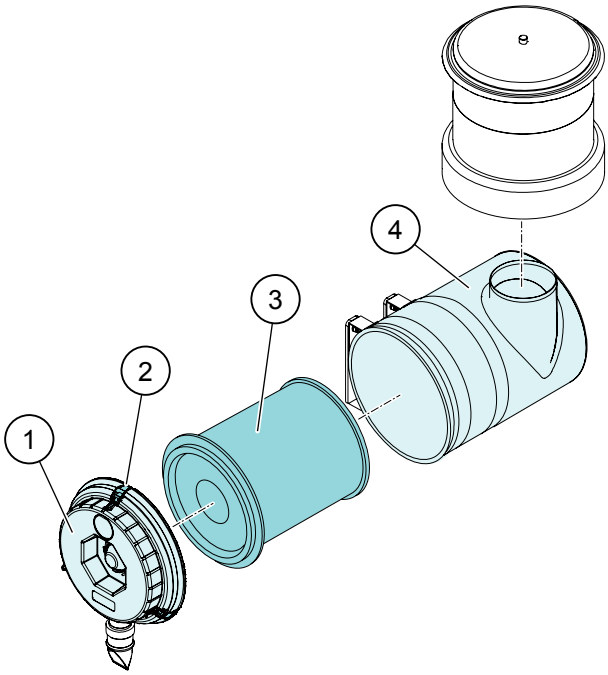


Figure 50. Main filter element

1. Open all the clamp units (2) and remove the air filter cover (1).
2. Empty out the dust which has collected in the air filter cover (1).
3. Dry the air filter cover (1) using a damp cloth.
4. Remove the element (3) carefully.

NOTE ***The safety cartridge inside the filter element (3), must stay in place.***

5. Clean inside the filter housing (4) using a damp cloth.
6. Use a flashlight to check from the outside that there are no holes or cracks in the filter paper.
7. To clean the filter element (3), carefully blow compressed air of maximum 5 bar (72.5 psi) from the inside. Continue to blow until no more dust comes out.

NOTE ***Do not use any liquids to clean the engine air filter, as it is a dry filter element (5).***

8. After cleaning, write the date of cleaning on the filter element (3).
9. Discard the filter element (3) if it is damaged, or when it has been cleaned four times.
10. Put back the filter element (3) and close the air filter cover (1).
11. On the MD4 display, push (X) on the error message to close it.

4.14.4 Changing the safety cartridge, all engines

NOTE ***Never clean the safety cartridge. Do not remove the safety cartridge unnecessarily.***

Replace the safety cartridge (1) if there has been any damage to the main filter.

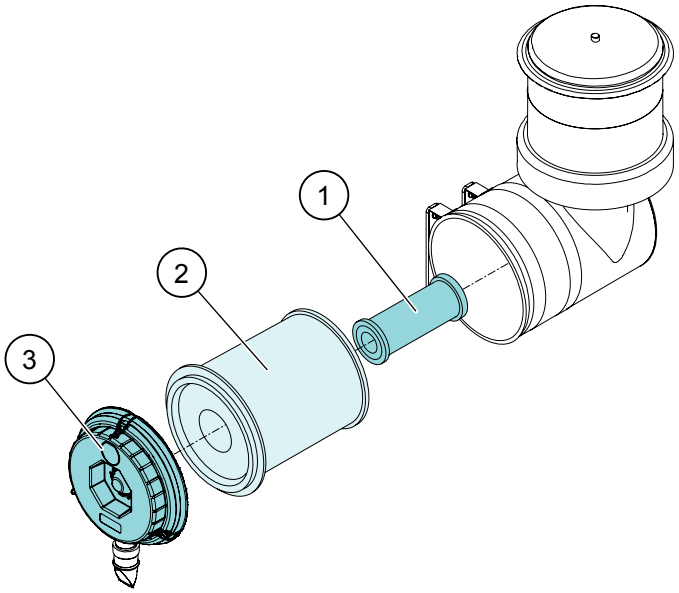


Figure 51. Safety cartridge

1. Disassemble the filter element (2) as in Cleaning and changing the engine air filter, all engines (page 109).
2. Fit in a new safety cartridge (1).
3. Put back the filter element (2) and close the air filter cover (3).

4.14.5 Checking the air intake system, all engines

The air intake system must be intact. Broken and leaking pipes shorten the life of the engine.

Check the system regularly.

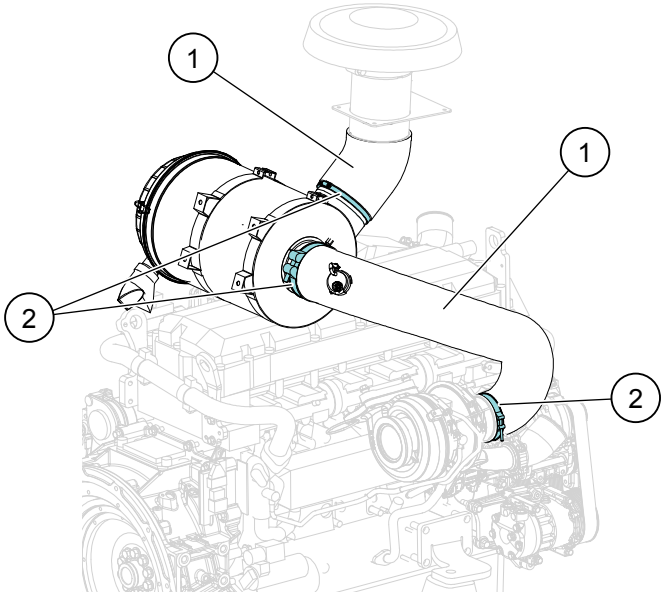


Figure 52. Air intake system

1. Check the hoses (1) for fissures and damage. If necessary, replace them.
2. Make sure that all hose clamps (2) are fit well.
3. Check that the filter housing is intact.

4.14.6 Checking the coolant system, Volvo engines

NOTE ***For Volvo engines, there is a cover on the coolant tank. Turn the hand wheel (1) of the coolant tank cover anti-clockwise. Slide the cover back to gain access to the Volvo coolant tank.***

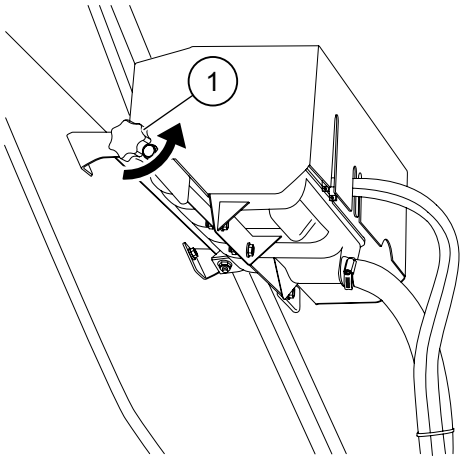


Figure 53. Cover on Volvo cooling tank

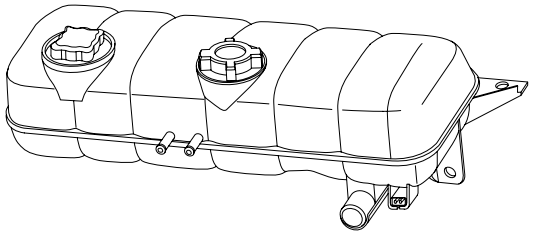
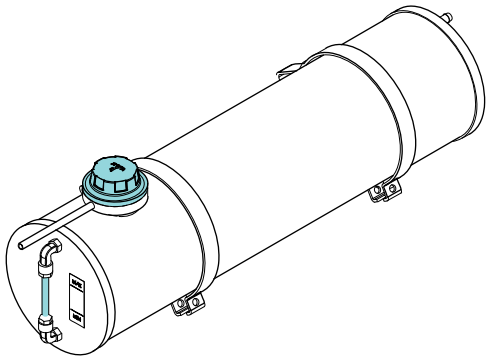


Figure 54. Cooling system, Volvo

1. To discover leaks and cracks, check all the hoses by pressing them. When in doubt, replace the hoses.
2. Check the radiator for damage and leaks, and that there are no deposits.
3. Check the functioning of the cabin heater.
4. Check the coolant in terms of:
   - Level
   - Freezing points
   - Any contaminations
5. Replace the coolant if it is not clean and clear.
6. If the coolant level is below minimum mark, top it up.
7. Check the rubber suspensions in the radiator mounting brackets at the bottom of the radiator. Replace the rubber mounts as necessary.
8. Make sure to tighten the fixing bolts.

4.14.7 Checking the coolant system, Cummins engines



1. To discover leaks and cracks, check all the hoses by pressing them. When in doubt, replace the hoses.
2. Check the radiator for damages and leaks, and that there are no deposits.
3. Check the functioning of the cabin heater.
4. Check the coolant in terms of:
   - Level
   - Freezing points
   - Any contaminations
5. Replace the coolant if it is not clean and clear.
6. If the coolant level is below minimum mark, top it up.
7. Check the rubber suspensions in the radiator mounting brackets at the bottom of the radiator. Replace the rubber mounts as necessary.
8. Ensure that the fixing bolts are tightened.

4.14.8 Changing the coolant, Volvo engines

⚠ WARNING

HOT FLUID HAZARD

Hot coolant may spray from the refill, which may cause a risk of serious injury.

Allow engine to cool and release pressure before opening the filler cap.

Only authorized and trained service personnel is allowed to fill the coolant.

⚠ WARNING

HIGH-PRESSURE HAZARD

The system may be under pressure even if it is not of the high-pressure type. The coolant may be under pressure and hot, which may cause serious injury.

Open the filler cap slowly.

⚠ WARNING

HARMFUL SUBSTANCE HAZARD

Using wrong coolant may damage the machine.

Use the recommended coolant and never mix different coolants.

For recommended coolants, see Fuel and oil recommendations (page 249).

⚠ WARNING

TOXIC SUBSTANCE HAZARD

It is highly dangerous to drink ethylene glycol. Contact with skin or spray from the refill can cause skin irritation and eye damage.

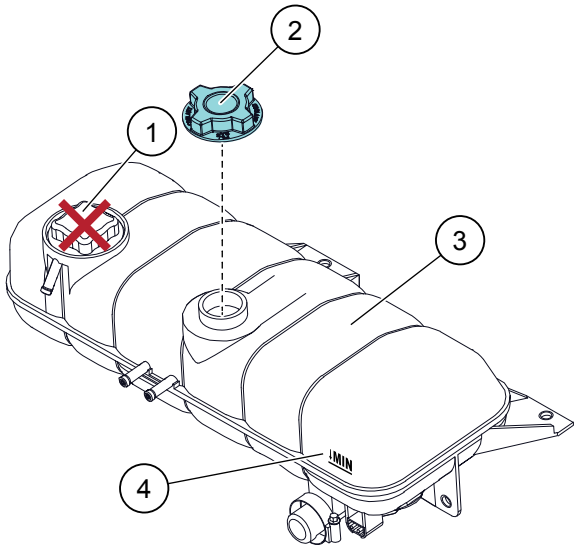
Do not drink ethylene glycol, and avoid contact with skin.

⚠ WARNING

HOT COOLANT HAZARD

Opening the pressure chamber cap (1) can cause serious personal injury.

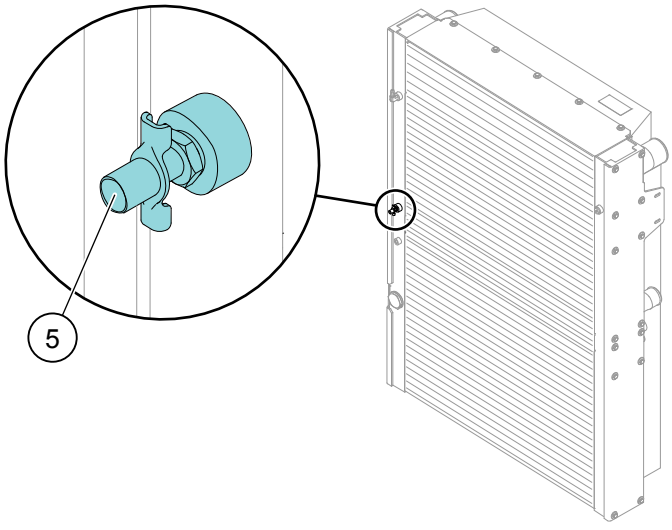
Never open the pressure chamber cap (1) when checking, or refilling coolant.



1. Remove the filler cap (2) on the expansion tank (3).

NOTE ***To ensure that the system is not pressurized when removing the filler cap (2) , only open 1/4 of a turn first.***

2. Switch on the ignition to adjust the temperature for the cabin heater to maximum.
3. After adjusting the temperature, switch off the ignition again.



4. Place a receptacle under the drain valve (5).
5. To lead the coolant to the receptacle, connect a hose to the drain valve (5).
6. Open the drain valve (5).

NOTE ***Be careful, risk of burning when opening the valve (5).***

7. Drain the whole system, using the drain valve (5) on the side of the radiator.

NOTE ***Drain the whole system, when replacing hoses and components in the system.***

8. Close the drain valve (5).
9. Remove the hose from the drain valve (5).
10. Fill to the maximum level through the filler cap (2) on the expansion tank (3).

11. Start the engine, let it idle, and check for leaks.
12. Observe the level and fill as necessary.
    - When the operating temperature has been reached, the level stabilizes.
    - The tank (3) should be filled to the maximum.
13. Refit the filler cap (2).

4.14.9 Changing the coolant, Cummins engines

⚠ WARNING

HOT FLUID HAZARD

Hot coolant may spray from the refill, which may cause a risk of serious injury.

Allow engine to cool and release pressure before opening the filler cap.

⚠ WARNING

HIGH-PRESSURE HAZARD

The system may be under pressure even if it is not of the high-pressure type. The coolant may be under pressure and hot, which may cause serious injury.

Open the filler cap slowly.

⚠ WARNING

HARMFUL SUBSTANCE HAZARD

Using wrong coolant may damage the machine.

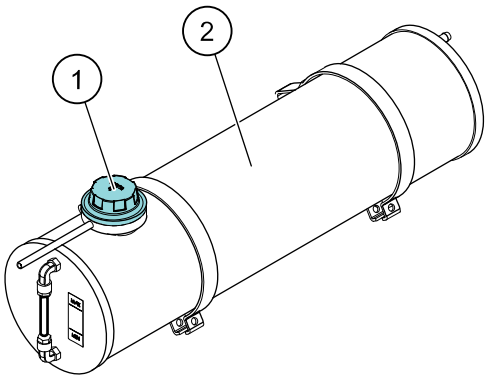
Use the recommended coolant and never mix different coolants.

⚠ WARNING

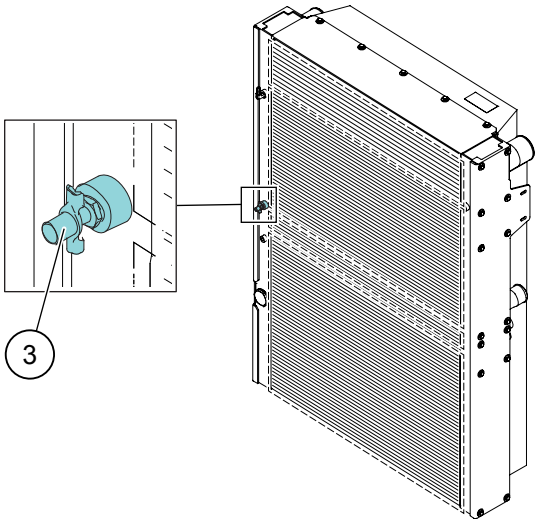
TOXIC SUBSTANCE HAZARD

It is highly dangerous to drink ethylene glycol. Contact with skin or spray from the refill can cause skin irritation and eye damage.

Do not drink ethylene glycol and avoid contact with skin.



1. Remove the filler cap (1) on the expansion tank (2).
   To ensure that the system is not pressurized when removing the filler cap (1), only open 1/4 of a turn first.
2. Switch on the ignition to adjust the temperature for the cabin heater to maximum. After adjusting the temperature, switch off the ignition.



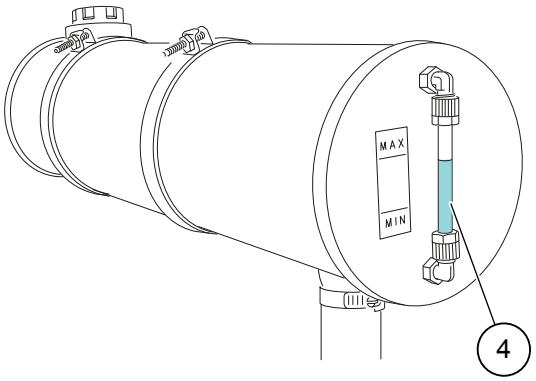
3. Place a receptacle under the drain valve (3).
4. To lead the coolant to the receptacle, connect a hose to the drain valve (3).
5. Open the drain valve (3).

NOTE ***Be careful, risk of burning when opening the valve.***

6. Drain the whole system.

NOTE ***Drain the whole system using the drain valve on the side of the radiator when replacing hoses and components in the system.***

7. Close drain valve (3).
8. Remove the hose from the drain valve (3).
9. Fill through the filler cap (1) on the expansion tank (2) to the maximum level.
10. Start the engine, run on idle, and check for leaks.
11. Observe the level and fill as necessary.
    - When the operating temperature has been reached, the level stabilizes.
    - Level should be at the maximum level indicator (4) on the side of the expansion tank.



12. Refit the filler cap (1).

4.14.10 Cleaning the radiator, intercooler, and oil coolers, all engines

⚠ WARNING

HOT SURFACE HAZARD

If you touch the radiator and coolers when they are hot, the heat may cause serious injury.

Only clean the radiator and coolers when the engine has been turned off and cooled down. Do not apply cold water on hot surface.

NOTICE

RISK OF PROPERTY DAMAGE

If you use a high-pressure steam cleaner, it may damage the fins of the radiator, intercooler, and oil coolers.

Use compressed air.

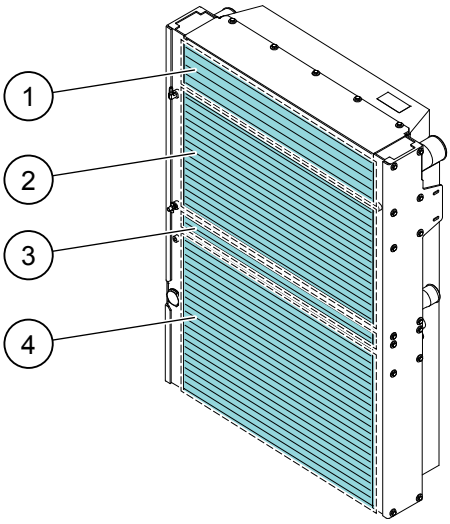


Figure 55. Radiator

1. Intercooler (contains air from the turbo to the engine)
2. Engine radiator (contains engine coolant)
3. Oil cooler for brakes(not applicable for all models and sizes)
4. Transmission oil cooler

To clean the radiator (2), intercooler (1), and oil coolers (3 and 4), use compressed air.

1. Blow against the direction of the fan.
   The radiator (2), intercooler (1), and oil coolers (3 and 4) must not be cleaned with high-pressure water. In extreme cases, solvents or a jet of steam can be used with great care.
2. Allow the solvent time to penetrate. Rinse off with water.
3. Run the engine warm so that surplus water evaporates and does not cause corrosion.

4.14.11 Checking the valve clearance, all engines

NOTICE

The valve clearance must be checked and adjusted by a service technician who has the necessary special equipment. The technician must be authorized by Konecranes Lift Trucks or by the engine manufacturer.

NOTE ***Check the valve clearance when the engine is cold. Follow the instructions in the engine manufacturer's instruction book.***

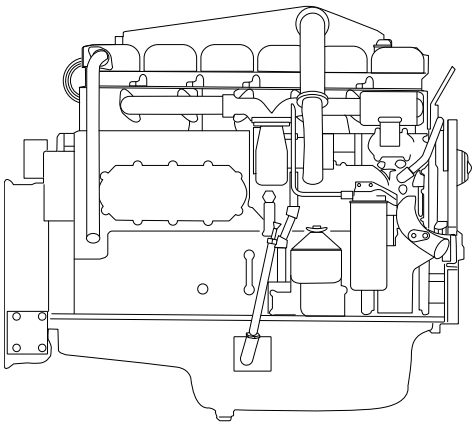


Figure 56. Valve clearance

4.14.12 Checking the fuel system and fuel injectors, all engines

⚠ WARNING

SKIN INJECTION HAZARD

If the high-pressure fluid from the fuel injectors penetrates the skin, it may cause serious bodily injury or death.

Never check leakage of the fuel system when the engine runs. Use protective gear such as safety gloves and protective wear.

RISK OF DAMAGE TO THE MACHINE

NOTICE

The fuel injectors must be checked and adjusted by a service technician who has the necessary special equipment. The technician must be authorized by Konecranes Lifttrucks or by the engine manufacturer.

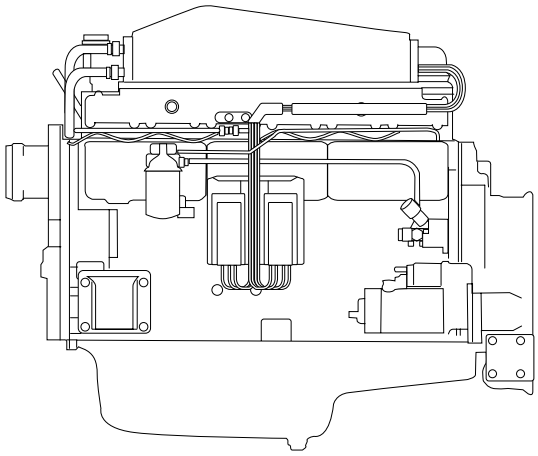


Figure 57. Fuel system and fuel injectors

1. Check the fuel system for leakage.

4.14.13 Checking the exhaust system, all engines

⚠ WARNING

HOT SURFACE HAZARD

Touching the exhaust system while it is hot may cause serious injury.

Wait until the exhaust system has cooled down before starting any maintenance work.

NOTE ***Always check the exhaust system, if the engine or machine sounds changes.***

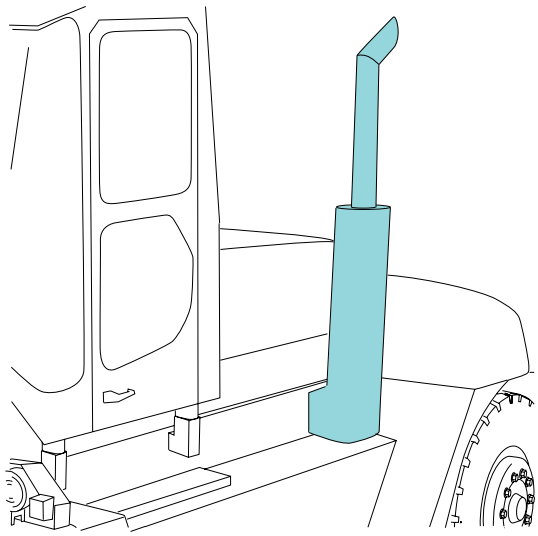


Figure 58. Exhaust system

1. Check the overall condition of the exhaust system. If leaking, replace the pipes or the muffler.
2. Check all joints.
3. Check the exhaust manifold.
4. Check the suspension of the muffler. Replace if necessary.

5. Start the engine.
6. Check for any leaks in the exhaust system.

4.15 Maintaining the Volvo engines

This chapter includes the instructions specific to Volvo engines.

4.15.1 Bleeding the fuel system: Volvo 5- and 8-liter engines

⚠ WARNING	
	**HIGH-PRESSURE HAZARD** **High-pressure fuel may cause serious personal injury.** **Never disconnect a fuel line or a component from a fuel pump that is to be bled. The fuel is highly pressurized and can penetrate the skin.**

NOTE ***Working with the fuel system requires special cleanliness.***

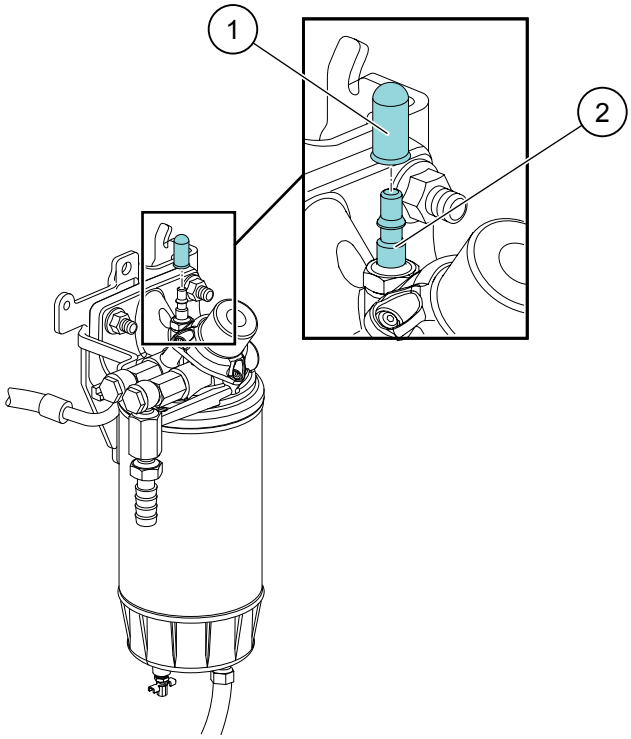
NOTE ***Check that there is sufficient fuel in the tank, and that the fuel taps are open (if applicable).***

NOTE ***To collect fuel, put a receptacle under the fuel filter.***

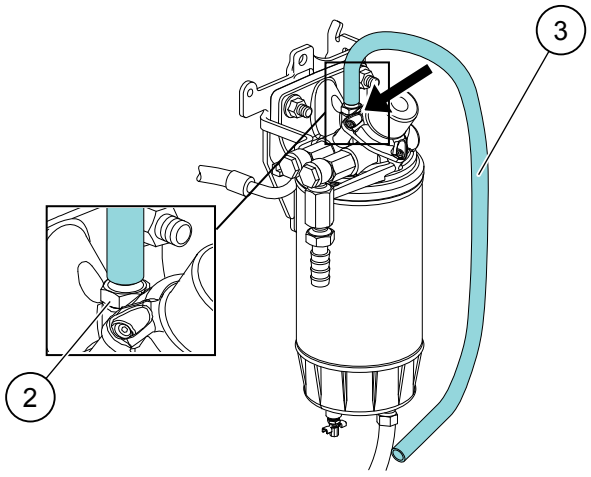
NOTE ***Take care of the excess fuel and store the used filter in a suitable container. Dispose of both in an environmentally responsible way.***

NOTE ***Bleed the system if it has run dry or after filter change. Bleed the fuel system with the hand pump on the fuel filter bracket.***

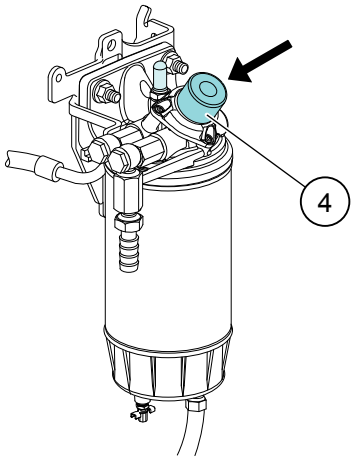
1. Clean thoroughly around the bleeder nipple (2) and cap (1).
2. Remove the protective cap (1) on the bleeder nipple (2).



3. Connect a transparent hose (3) to the nipple (2). To collect the excess fuel, place the loose end of the hose (3) in a receptacle.
4. Loosen the nipple (2), at least two turns.



5. Bleed the fuel system by pumping up fuel with the hand pump (4) until air-free fuel flows out. Pump rapidly, to maintain pressure in the pump.



6. Tighten the bleeder nipple with torque 3.5 Nm, while air-free fuel flows out.
7. Wait for 15 s. and then repeat step 4 to 6.
8. Remove the hose (3).
9. Fit the protective cap (1) on the bleeder nipple (2).
10. Start the engine.

NOTE ***If the engine does not run smoothly, repeat the procedure.***

4.15.2 Bleeding the fuel system: Volvo 11 and 13-liter engines

⚠ WARNING

HIGH-PRESSURE HAZARD

High-pressure fuel may cause serious personal injury.

Never disconnect a fuel line or a component from a fuel pump that is to be bled. The fuel is highly pressurized and can penetrate the skin.

NOTE ***Working with the fuel system requires special cleanliness.***

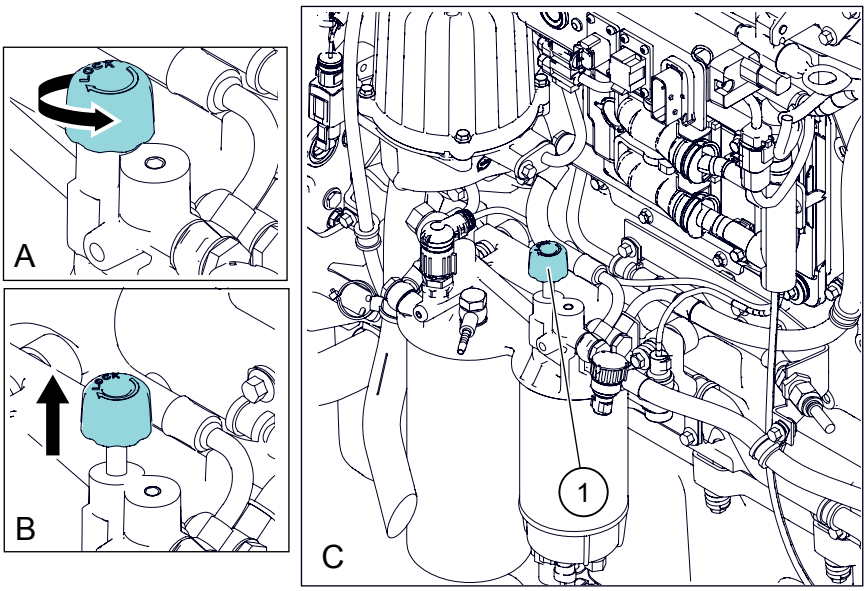
NOTE ***Check that there is sufficient fuel in the tank, and that the fuel taps are open (if applicable).***

NOTE ***To collect fuel, put a receptacle under the fuel filter.***

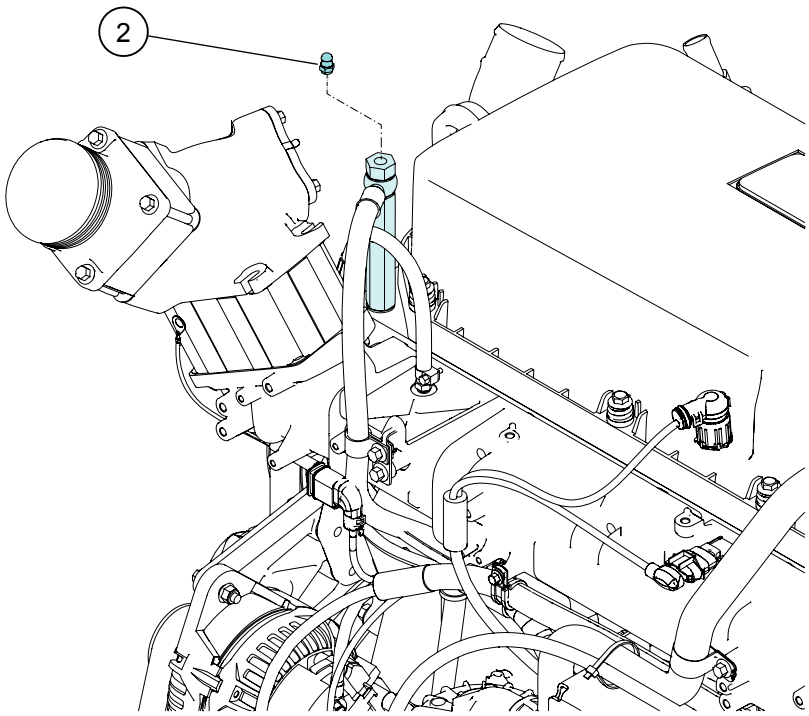
NOTE ***Take care of the excess fuel and store the used filter in a suitable container. Dispose of both in an environmentally responsible way.***

NOTE ***Bleed the system if it has run dry, if the filter is changed, or after a longer downtime. In such a case, bleed the system with the hand pump on the fuel filter bracket.***

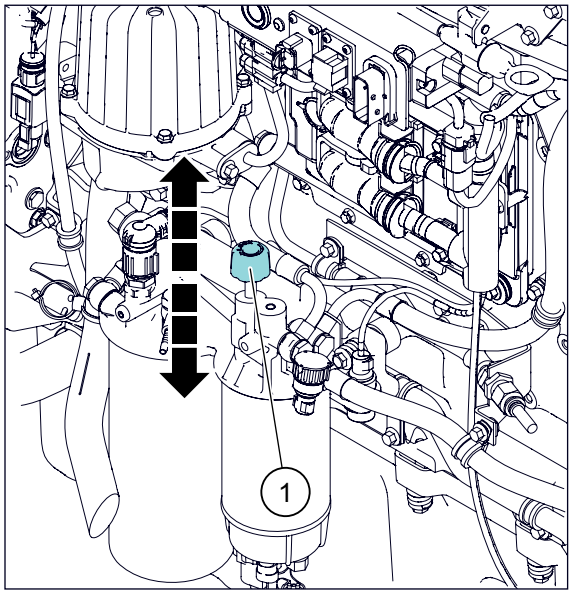
1. Clean thoroughly around the filter before starting to bleed the filter.
2. Free the hand pump (1) from the fuel filter bracket.
   2.1 Turn the fuel pump handle (1) counter-clockwise.
   2.2 Pull upwards.
   2.3 The hand pump (1) is now open.



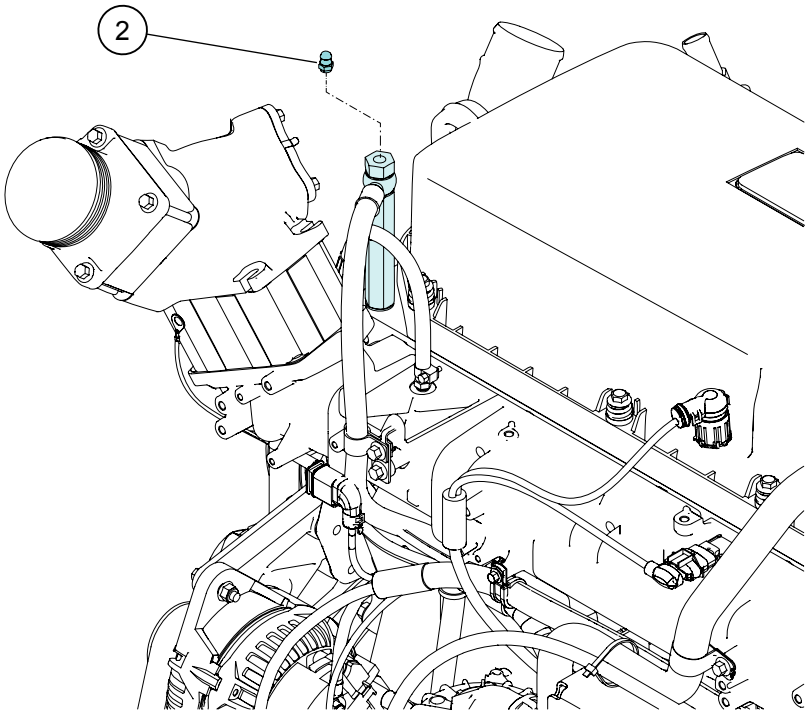
3. Open the bleeder nipple (2).
4. To collect fuel, connect a hose and a receptacle to the other end of the hose.



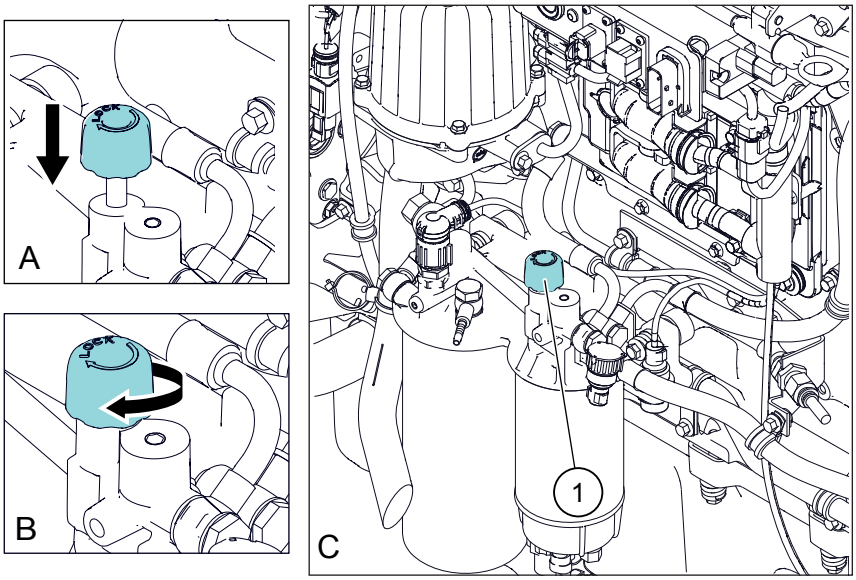
5. Bleed the fuel system by pumping with the hand pump (1) until the fuel flows without air bubbles.



6. Close the nipple (2).
   Tightening torque: 3.5 Nm (2.6-lbf ft).



7. Remove the hose.
8. Replace the rubber cap.
9. Tighten the fuel pump handle (1).
   9.1 Press the pump handle (1) downwards.
   9.2 Turn the pump handle (1) clockwise.
   9.3 The hand pump (1) is now closed.



10. Wipe dry any spilled fuel.
11. Check that there is no leakage.
12. Start the engine.

NOTE ***If the engine does not run smoothly, repeat the procedure.***

4.15.3 Draining the fuel prefilter: Volvo 5- and 8-liter engines

⚠ WARNING

HARMFUL SUBSTANCE HAZARD

The machine contains several chemical substances, which may cause skin irritation and allergies. Risk of injury when in prolonged contact with skin.

When handling lubricants and oils, avoid direct contact with the skin. Use safety gloves. Immediately wash skin that comes in contact with chemical substances.

NOTE ***Working with the fuel system requires special cleanliness.***

NOTE ***To avoid fuel spillage, place a receptacle underneath the filter.***

NOTE ***Take care of the excess fuel and dispose of it in an environmentally responsible way.***

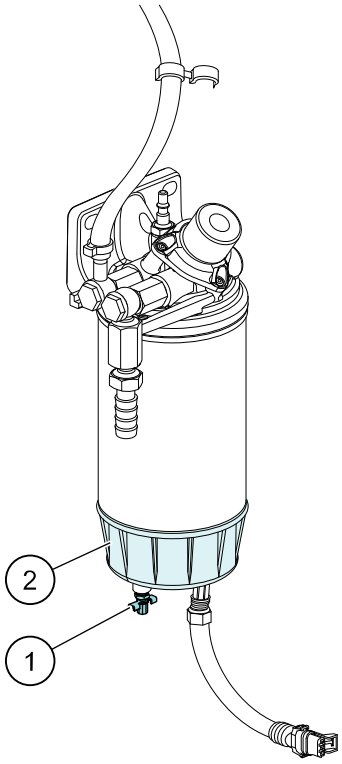


Figure 59. Fuel prefilter

1. Stop the engine.
2. Close the fuel tap if applicable.
3. To collect the water and fuel, put a receptacle under the fuel prefilter.
4. Open the drain valve (1) at the bottom of the water separator (2).
5. Drain the water contained in the water separator (2) into the receptacle.

NOTE ***Do not drain the water separator (2) completely.***

6. Tighten the drain valve (1) and open the fuel tap if applicable.
7. Start the engine.
8. Check that there is no leakage from fuel prefilter.

NOTE ***If the engine is not working properly, bleed the system. For more information, see "Bleeding the fuel system" for Volvo engines.***

4.15.4 Draining the fuel prefilter: Volvo 11- and 13-liter engines

⚠ WARNING

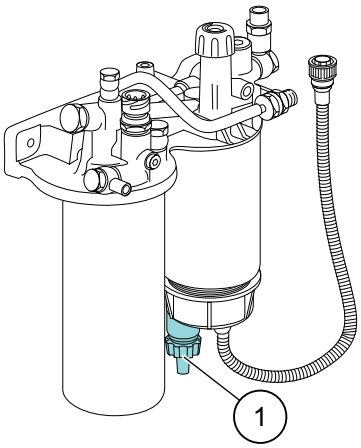
HARMFUL SUBSTANCE HAZARD

The machine contains several chemical substances, which may cause skin irritation and allergies. Risk of injury when in prolonged contact with skin.

When handling lubricants and oils, avoid direct contact with the skin. Use safety gloves. Immediately wash skin that comes in contact with chemical substances.

NOTE ***Working with the fuel system requires special cleanliness.***

NOTE ***Take care of the water and fuel and dispose of it in a safe, controlled, and environmentally responsible way.***



1. To collect the water and fuel, put a receptacle under the fuel prefilter.
2. Open the drain valve (1) in the base of the fuel prefilter.
3. Tighten the drain valve (1) when fuel without water starts to run out.

4.15.5 Changing the fuel prefilter: Volvo 5- and 8-liter engines

⚠ WARNING

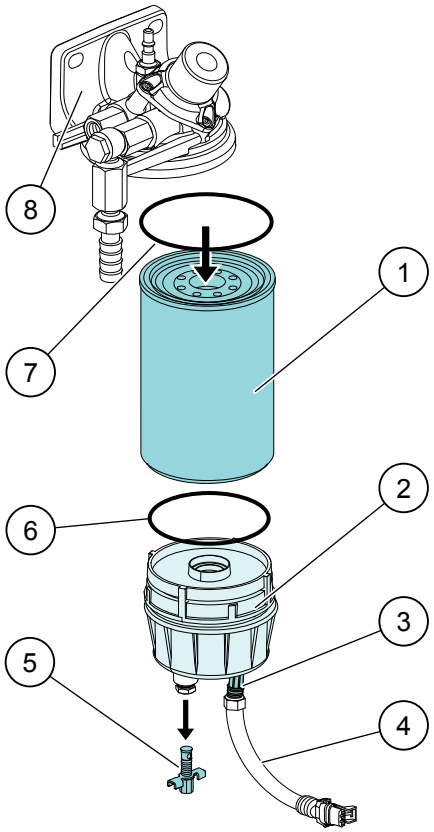
HARMFUL SUBSTANCE HAZARD

The machine contains several chemical substances, which may cause skin irritation and allergies. Risk of injury when in prolonged contact with skin.

When handling lubricants and oils, avoid direct contact with the skin. Use safety gloves. Immediately wash skin that comes in contact with chemical substances.

NOTE ***If the machine is equipped with a fuel tap (option), close tap before proceeding with the change of the fuel filter.***

NOTE ***To collect the water and fuel, put a receptacle under the fuel filter. Store the used filter in a suitable container and dispose of it in an environmentally responsible way.***



1. Clean thoroughly around the fuel prefilter (1) and water separator (2).
2. Disconnect the cable (4) from the water trap sensor (3).
3. To drain the filter, open the drain valve (5) at the bottom of the water separator (2).
4. Tighten the drain valve (5) again.
5. Remove the fuel prefilter (1) and the water separator (2).
   Put the used filter in a suitable container and dispose of it in an environmentally responsible way.
6. Lubricate the new O-ring (7) with diesel.
7. Screw the new filter (1) onto the mounting bracket (8) by hand, until it bottoms.

Tighten a further 1/2–2/3 turns.

8. Remove the water separator (2) from the old fuel prefilter (1).
9. Clean the upper section of the water separator (2) and the contact surfaces.
10. Lubricate the new rubber seal (6) with diesel.
11. Reattach the water separator (2) to the new filter (1).
12. Reconnect the cable (4) to the water trap sensor (3).
13. Open fuel taps, if applicable, and bleed the fuel system. For more information, see *Bleeding the Volvo fuel system*.
14. Start the engine and make sure that there is no leakage.

NOTE ***If the engine is not working properly, bleed the system. For more information, see "Bleeding the fuel system" for Volvo engines.***

4.15.6 Changing the fuel prefilter: Volvo 11- and 13-liter engines

⚠ WARNING

HARMFUL SUBSTANCE HAZARD

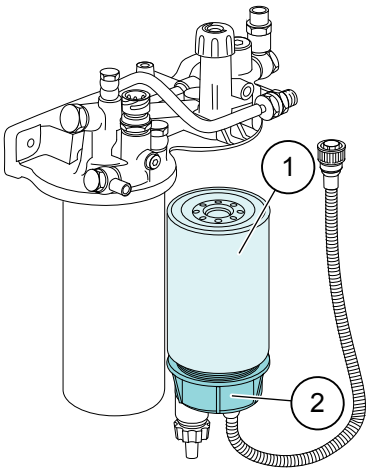
The machine contains several chemical substances, which may cause skin irritation and allergies. Risk of injury when in prolonged contact with skin.

When handling lubricants and oils, avoid direct contact with the skin. Use safety gloves. Immediately wash skin that comes in contact with chemical substances.

NOTE ***Working with the fuel system requires special cleanliness.***

NOTE ***To collect the water and fuel, put a receptacle under the fuel filter.***

NOTE ***Take care of the water and fuel and dispose of it in a safe controlled manner. Store the used filter in a suitable container, and dispose of it in an environmentally responsible way.***



1. Clean thoroughly around the fuel prefilter (1) and water separator (2).
2. Disconnect the cable from the water separator sensor.
3. Remove the fuel prefilter (1) from the mounting bracket. Collect any spilled fuel in a receptacle.

4. Remove the water separator (2) from the fuel prefilter (1).
5. Clean the upper part of the water separator (2) with a soft rag.
6. Check that the drain hole in the water separator (2) is not clogged.
7. Install a new seal on the water separator (2).
8. Lubricate the seal with diesel fuel.
9. Reinstall the water separator (2) to the new filter.
10. Screw the new filter onto the mounting bracket by hand. The rubber seal should touch the mating surface.
11. Tighten another half turn, no more.
12. Reconnect the cable to the water separator sensor.
13. If necessary, bleed the fuel system.
    For more information, see *Bleeding the Volvo fuel system*.
14. Start the engine, check that there is no leakage.

4.15.7 Changing the fuel filter: Volvo 5- and 8-liter engines

⚠ WARNING

HARMFUL SUBSTANCE HAZARD

The machine contains several chemical substances, which may cause skin irritation and allergies. Risk of injury when in prolonged contact with skin.

When handling lubricants and oils, avoid direct contact with the skin. Use safety gloves. Immediately wash skin that comes in contact with chemical substances.

⚠ WARNING

IGNITION HAZARD

Fuel spill onto a hot surface or an electrical component can cause a fire. Causing a risk of personal injury or death.

When carrying out work on the fuel system, make sure that the engine is cold. Store the fuel soaked rags in a suitable container, so that they cannot cause fire. Dispose of them in an environmentally responsible way.

RISK OF MATERIAL DAMAGE

NOTICE

A leaking seal allows air to enter the system and thus prevent the flow of fuel from the tank to the fuel pump. The wrong type of fuel filter may damage the fuel injection circuit.

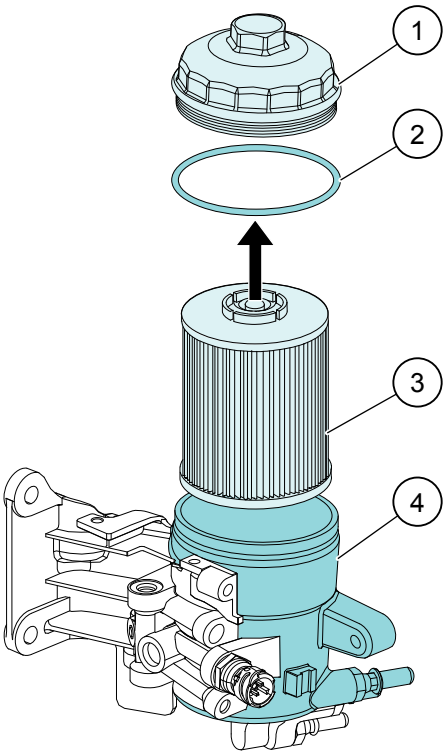
Always use original parts when replacing the filters.

NOTE ***Replace the fuel filter when the engine is cold.***

NOTE ***Working with the fuel system requires special cleanliness.***

NOTE ***To avoid spillage, place a receptacle underneath the filter.***

NOTE ***Take care of the excess fuel and dispose of it in a safe controlled manner. Store the used filter in a suitable container, dispose of it in an environmentally responsible way.***



1. Clean around the filter cover (1) and filter housing (4).
2. Carefully remove the fuel filter cover (1).

NOTE ***Be prepared to gather up fluid. The filter is still full of fuel and there is a risk of spillage when the cover is removed.***

3. Remove the O-ring (2) and filter (3). Let the fuel drip off into a receptacle.
4. If the filter housing is empty, lubricate with diesel around the inner section of the filter sealing surface.
5. Lubricate the O-ring (2) with diesel before installing the filter cover.
6. Install the filter (3) in the filter cover. Make sure that the filter fits properly in the cover.
7. Install the filter cover (1) and filter (3) in the bracket.
8. Carefully screw in the cover (1) and check that the O-ring (2) does not get twisted. Relubricate the seal as necessary. Tighten the cover to: 25 Nm (18.4 lbf. ft.)
9. Bleed the fuel system. See *Bleeding the fuel system* for Volvo engines.
10. Start the engine, check that there is no leakage.

NOTE ***If the engine is not working properly, bleed the system again.***

4.15.8 Changing the fuel filter: Volvo 11- and 13-liter engines

⚠ WARNING

HARMFUL SUBSTANCE HAZARD

The machine contains several chemical substances, which may cause skin irritation and allergies. Risk of injury when in prolonged contact with skin.

When handling lubricants and oils, avoid direct contact with the skin. Use safety gloves. Immediately wash skin that comes in contact with chemical substances.

⚠ WARNING

IGNITION HAZARD

Fuel spill onto a hot surface or an electrical component can cause a fire. Causing a risk of personal injury or death.

When carrying out work on the fuel system, make sure that the engine is cold. Store fuel soaked rags so that they cannot cause fire.

RISK OF MATERIAL DAMAGE

NOTICE

A leaking seal allows air to enter the system and thus prevent the flow of fuel from the tank to the fuel pump. The wrong type of fuel filter may damage the fuel injection circuit.

Always use original parts when replacing the filters.

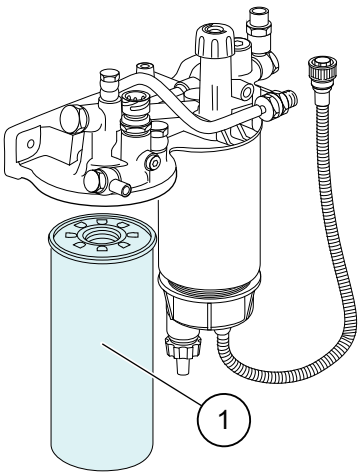
NOTICE

Do not fill the new fuel filter with fuel before assembly. There is a risk that contamination could get into the system and cause malfunctions or damage.

NOTE ***Replace the fuel filter when the engine is cold.***

NOTE ***To avoid fuel spillage, place a receptacle underneath the filter.***

NOTE ***Take care of the excess fuel and dispose of it in a safe controlled manner. Store the used filter in a suitable container, dispose of it in an environmentally responsible way.***



1. Clean around the fuel filter (1).
2. Remove the filter (1) with a suitable filter remover. Collect any spilled fuel in a receptacle.
3. Clean the filter mating surface on the mounting bracket.
4. Lubricate the seal with diesel fuel.

5. Install the new fuel filter.
6. Tighten the fuel filter in accordance with the instructions on the fuel filter.
7. If necessary, bleed the fuel system. For more information, see *Bleeding the Volvo fuel system*.
8. If a water separator is installed, change the water separator filter at the same time as the fuel filter.
   Clean inside the water separator with a soft rag.

4.15.9 Changing the AdBlue filters, Volvo

4.15.9.1 Changing the AdBlue pump filter

This section is applicable for machines that are equipped with Volvo or Cummins QSB 6.7 engines.

⚠ WARNING

CORROSIVE SUBSTANCE HAZARD

The AdBlue solution may cause skin and eye damage. It is corrosive towards certain metals such as copper and aluminum.

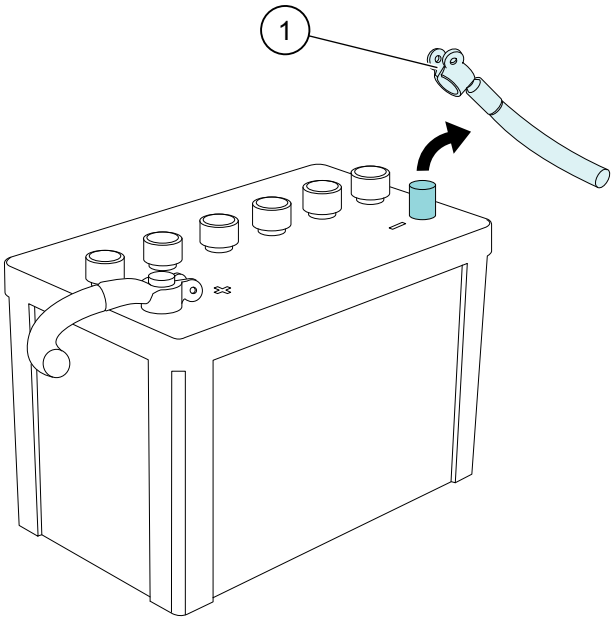
Do not allow AdBlue solution to come in contact with other chemicals. Use safety gloves. If the AdBlue solution comes in contact with the skin or eyes, quickly wash it off with soap and water.

NOTE ***Wait at least 2-5 min after the engine has been turned off to disconnect the battery negative terminal. By doing so, the automatic drainage and depressurization of the selective catalytic reduction system can take place.***

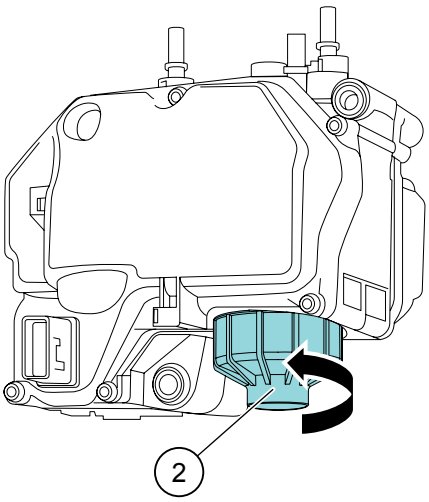
NOTE ***To avoid spillage, place a receptacle underneath the filter.***

NOTE ***Take care of the excess fluid and dispose of it in a safe controlled manner. Store the used filter in a suitable container, dispose of it in an environmentally responsible way.***

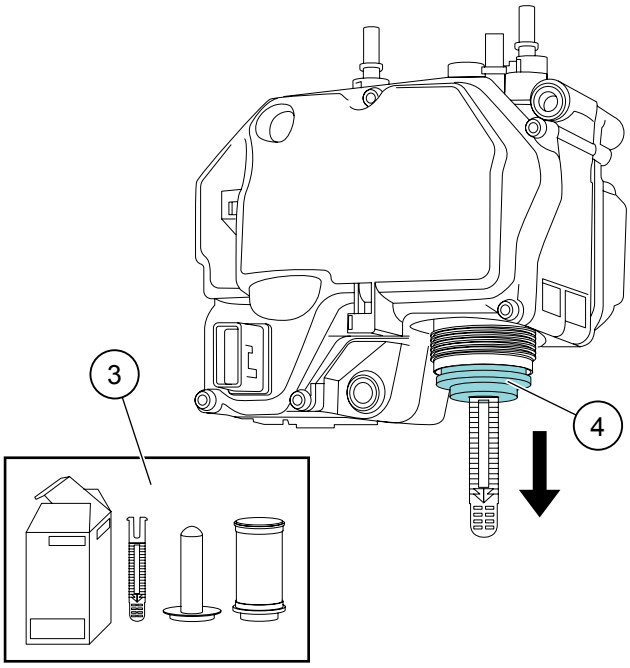
1. Switch off the engine.



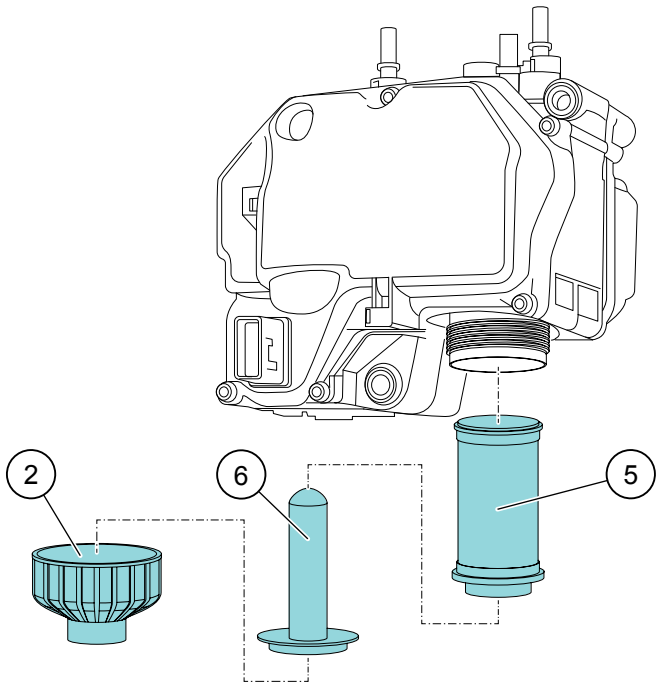
2. After 2-5 min, disconnect the battery negative terminal (1).



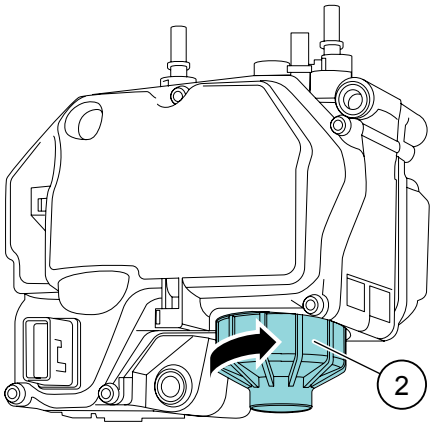
3. Place a receptacle under the filter cover (2).
4. Remove the filter cover (2), let AdBlue run into the receptacle.



5. Press the puller, which is supplied with the filter kit (3), into the filter hole until a click is heard.
6. Pull out the old filter (4).
7. Put the used filter (4) in a suitable container, and dispose of it in an environmentally responsible way.



8. Install the new filter (5).
9. Install the rubber gasket (6).



10. Reattach the filter cover (2).
11. Tighten the filter cover (2) using a torque wrench.

NOTE ***Tightening torque is 20 + 5 Nm (14.8 + 3.68-lbf ft).***

12. Reconnect the battery negative terminal (1).
13. Start the engine.
14. Check that there are no leaks.
15. Delete any error codes.

4.15.9.2 Changing the AdBlue breather filter

⚠ WARNING

CORROSIVE SUBSTANCE HAZARD

The AdBlue solution may cause skin and eye damage. It is corrosive towards certain metals such as copper and aluminum.

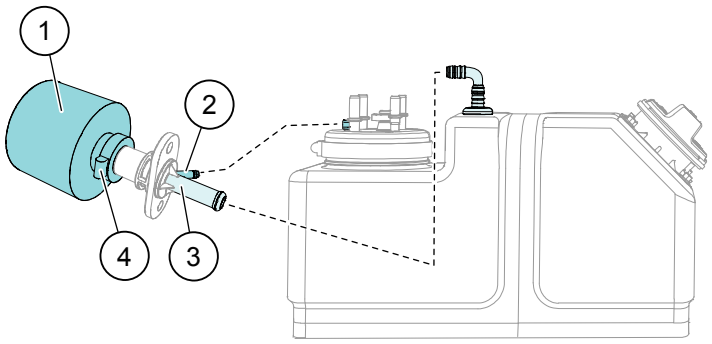
Do not allow AdBlue solution to come in contact with other chemicals. Use safety gloves. If the AdBlue solution comes in contact with the skin or eyes, quickly wash it off with soap and water.

NOTE ***Wait at least 2-5 min after the engine has been turned off to disconnect the battery negative terminal. By doing so, the automatic drainage and depressurization of the selective catalytic reduction system can take place.***

NOTE ***To avoid spillage, place a receptacle underneath the filter.***

NOTE ***Take care of the excess fluid and dispose of it in a safe controlled manner. Store the used filter in a suitable container, dispose of it in an environmentally responsible way.***

NOTE ***The size and appearance of the tank can vary depending on machine model and size.***



1. Breather filter
2. From sensor
3. From tank
4. Hose clamp

How to replace the breather filter

1. Switch off the engine.
2. Disconnect the battery negative terminal (after 2-5 min).
3. Clean around the filter area.
4. Loosen the hose clamp (4).
5. Remove the breather filter (1) from the AdBlue tank.
6. Put the used filter in a suitable container and dispose of it in an environmentally responsible way.
7. Reverse the procedure to install the new breather filter.

NOTE ***It is important that the new filter is installed in the exact same position as the removed filter.***

4.15.9.3 Changing the AdBlue armature (level) filter

⚠ WARNING

CORROSIVE SUBSTANCE HAZARD

The AdBlue solution may cause skin and eye damage. It is corrosive towards certain metals such as copper and aluminum.

Do not allow AdBlue solution to come in contact with other chemicals. Use safety gloves. If the AdBlue solution comes in contact with the skin or eyes, quickly wash it off with soap and water.

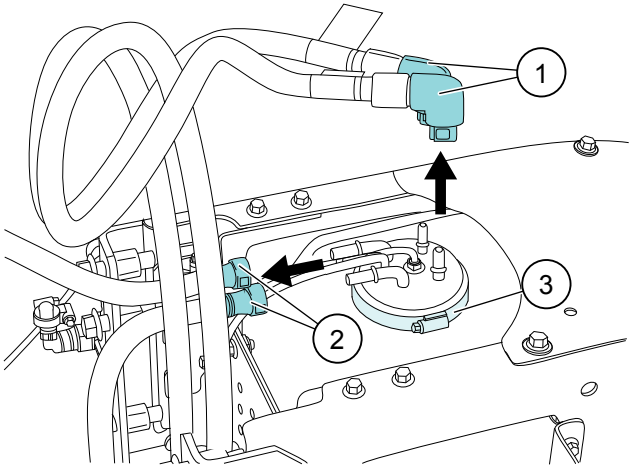
NOTE ***Wait at least 2-5 min after the engine has been turned off to disconnect the battery negative terminal. By doing so, the automatic drainage and depressurization of the selective catalytic reduction system can take place.***

NOTE ***To avoid spillage, place a receptacle underneath the filter.***

NOTE ***Take care of the excess fluid and dispose of it in a safe controlled manner. Store the used filter in a suitable container, dispose of it in an environmentally responsible way.***

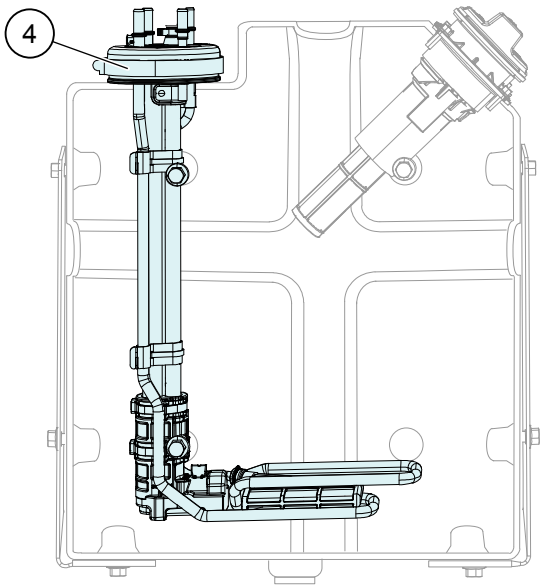
NOTE ***The size and appearance of the armature filter can vary depending on machine model and size.***

1. Switch off the engine.
2. Disconnect the battery negative terminal (after 2-5 min).
3. Clean around the hose connection area.

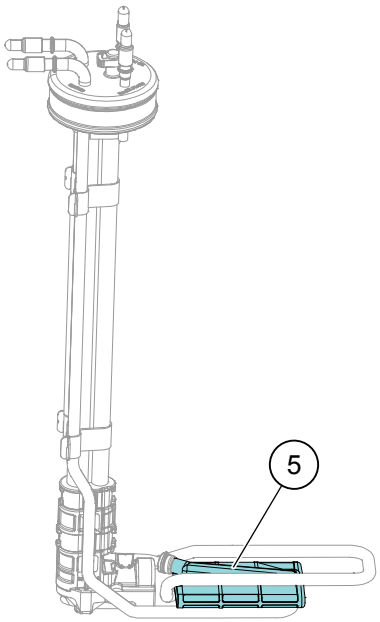


4. Remove the connector hoses (1).
5. Wrap a plastic bag around the connectors to protect them.
6. Remove the coolant hoses (2).

7. Remove the hose clamp (3).



8. Lift out the armature (4).



9. Remove the armature (level) filter (5).
10. Flush warm water through the armature to clean it.
11. Reverse the procedure to reinstall the new armature (level) filter.

NOTE ***After reinstalling the new armature (level) filter (5), check the coolant level.***

4.15.10 Changing the Volvo engine oil

⚠ WARNING

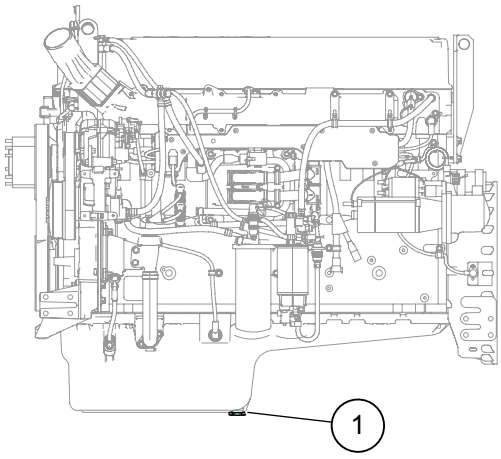
HOT FLUID HAZARD
Hot engine oil may cause serious personal injury.
To avoid burns, use care when opening the drain plug.

NOTE ***Drain the oil when the engine is at the operating temperature, at least 65°C (149°F).***

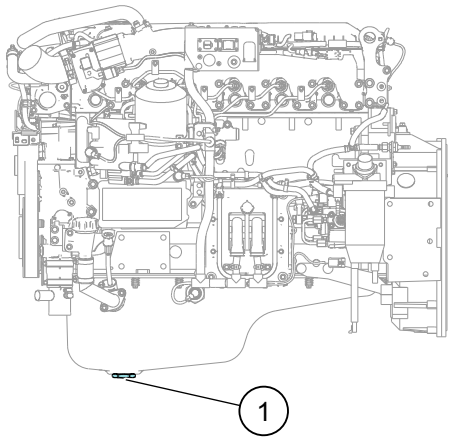
NOTE ***To avoid spillage, place a receptacle under the filter.***

NOTE ***Take care of the excess oil and dispose of it in an environmentally responsible way.***

1. Place a receptacle underneath the drain plug (1).

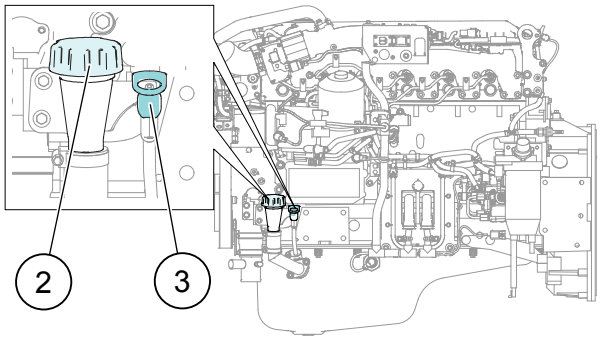


EU stage 3a/4 / US tier 3/4i/4f



EU stage 5

2. Unscrew the drain plug (1).
3. Allow the oil to run out.
4. Check the seal for damage or deformation.
   If necessary, renew the seal.
5. Refit the drain plug (1).
6. Tighten up the drain plug (1).
7. Remove the filler cap (2).



8. Fill oil through the opening, use the recommended oil.
9. Check the oil level using the dipstick (3). Make sure that the oil level is between the minimum and maximum marks on the dipstick (3). Do not fill above the maximum oil level.

10. Refit the filler cap (2).
11. Check that there are no leaks from the drain plug (1) or the oil filter.
12. Start the engine.
    Check that there is no warning symbol for low oil pressure on the display.
13. Turn off the engine.
    Check the oil level after 5 min.

4.15.11 Changing the engine oil filter: Volvo 5- and 8-liter engines

⚠ WARNING

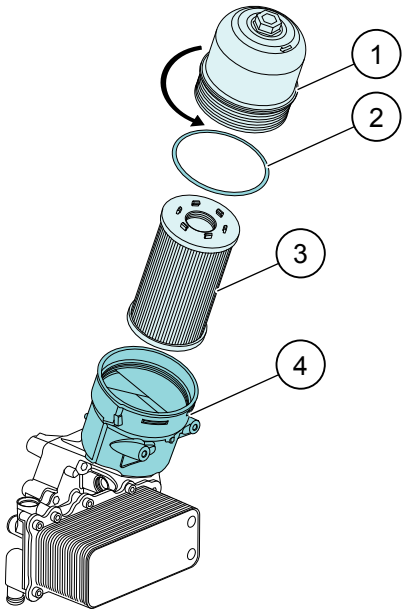
HOT OIL AND HOT SURFACES HAZARD
Risk of personal injury.
Use protective gloves.

NOTE ***Working with the fuel system requires special cleanliness.***

NOTE ***To avoid spillage, place a receptacle under the filter.***

NOTE ***Take care of the excess oil and dispose of it in a safe controlled manner. Put the filter in a suitable container, dispose of it in an environmentally responsible way.***

Drain the oil according to the instructions in *Changing the engine oil*.



1. Before opening the oil filter, clean around the filter cover (1) and the filter housing (4).
2. Clean around the oil filter (3).
3. Carefully remove the filter cover (1) together with the filter (3).
4. Remove the O-ring (2) and filter (3) from the cover (1).
5. Let the oil drip off into a receptacle.
6. Lubricate the new O-ring (2) and the gasket of the new filter (3) with new oil before installation.

7. Install the new filter (3) and new O-ring (2) in the filter cover (1). Make sure to install the filter correctly in the cover.
8. Install the filter cover (1) and filter (3) in the filter housing (4).
9. Tighten the cover to 40 Nm (29.5-lbf. ft.).
10. Fill with required volume of oil. See Fuel and oil recommendations (page 249).
11. Start the engine.
    Check that there is no oil leakage from the oil filter or drain plug.
12. Switch off the engine and check the oil level after a few minutes.
13. If necessary, top up with oil.

4.15.12 Changing the engine oil filter: Volvo 11- and 13-liter engines

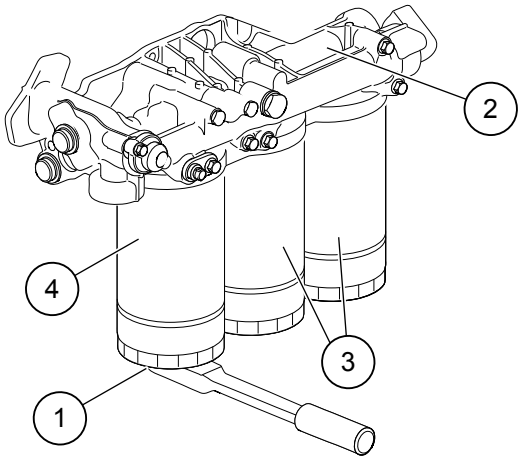
⚠ WARNING

HOT OIL AND HOT SURFACES HAZARD
Risk of personal injury.
Use protective gloves.

NOTE ***Working with the oil system requires special cleanliness.***

NOTE ***To avoid spillage, place a receptacle underneath the filter.***

NOTE ***Take care of the excess oil and dispose of it in a safe controlled manner. Put the used filter in a suitable container, and dispose of it in an environmentally responsible way.***



1. Clean the oil filter bracket (2).
2. Remove all oil filters with a suitable oil filter extractor (1).
3. Clean the mating surface of the oil filter bracket.
   3.1 Make sure to not leave any old oil seal remnants behind.
   3.2 Carefully clean inside the protective rim on the oil filter bracket (2).
4. Put a thin layer of new engine oil on the seals of the new oil filters.
5. Install the new oil filters.
   5.1 Tighten the two full-flow filters (3) 1/2–3/4 of a turn after they bottom.
   5.2 Tighten the bypass filter (4) 3/4–1 turn after it bottoms.

6. Top up with engine oil, start the engine, and let it run for 20–30 s. See Fuel and oil recommendations (page 249).
7. Turn off the engine.
8. Check the oil level, and top up as required.
9. Check the seals around the oil filters.

4.15.13 Changing the crankcase breather filter

NOTE ***The crankcase breather filter (1) is used on 5- and 8-liter Volvo engines (EU stage 4 and below).***

NOTE ***Always change the crankcase breather filter (1), it must not be cleaned and reused.***

NOTE ***Store the used filter in a suitable receptacle, and dispose of it in an environmentally responsible way.***

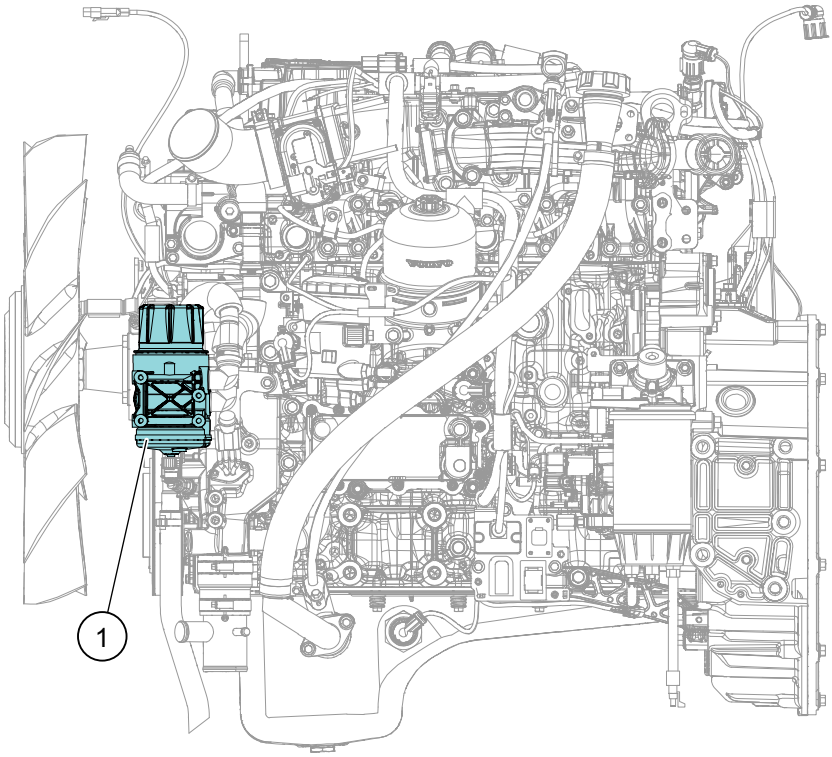
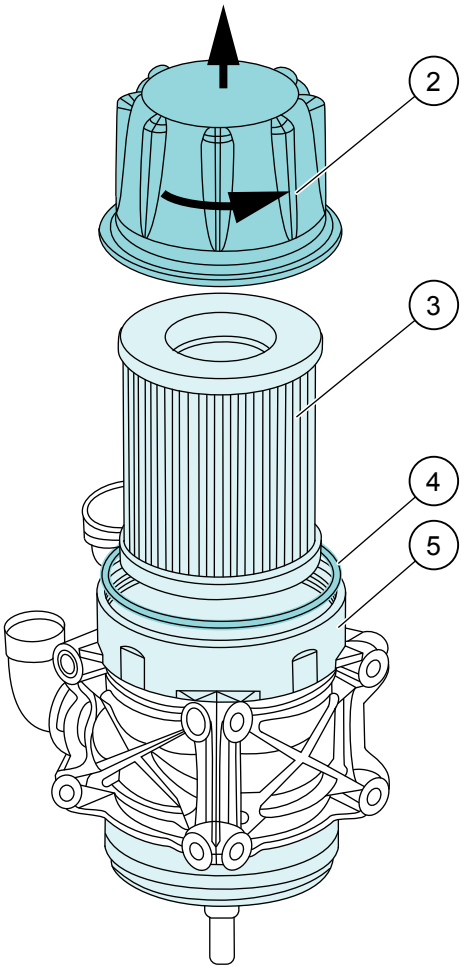


Figure 60. Placement of crankcase breather filter (1) - Volvo TAD 571 VE

Changing the crankcase breather filter



1. Clean around the filter cover (2) and the filter housing (5).
2. Remove the filter cover (2), using a suitable tool.
3. Remove the filter element (3) from the filter housing (5).
4. Remove the O-ring (4).
5. Clean inside the filter cover (2) and filter housing (5) with a lint free cloth.
6. Lubricate the new O-ring, using clean engine oil.
7. Fit the new O-ring to the filter cover (2).
8. Insert the new filter element in the filter housing (5).
9. Reattach the filter cover (2) on to the filter housing (5).

4.15.14 Checking the Volvo drive belt

NOTE ***If the drive belt is oily, worn, or damaged, it must be replaced.***

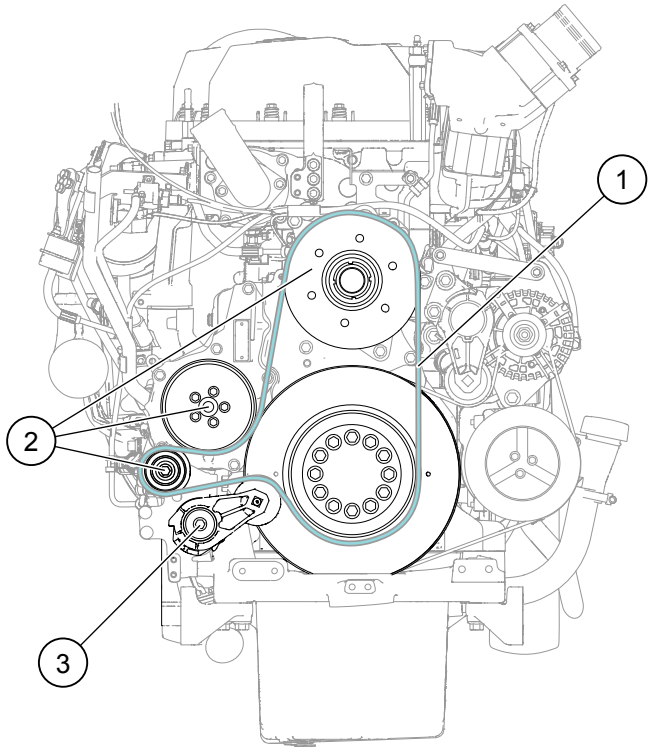


Figure 61. EU stage 3a/4 / US tier 3/4i/4f

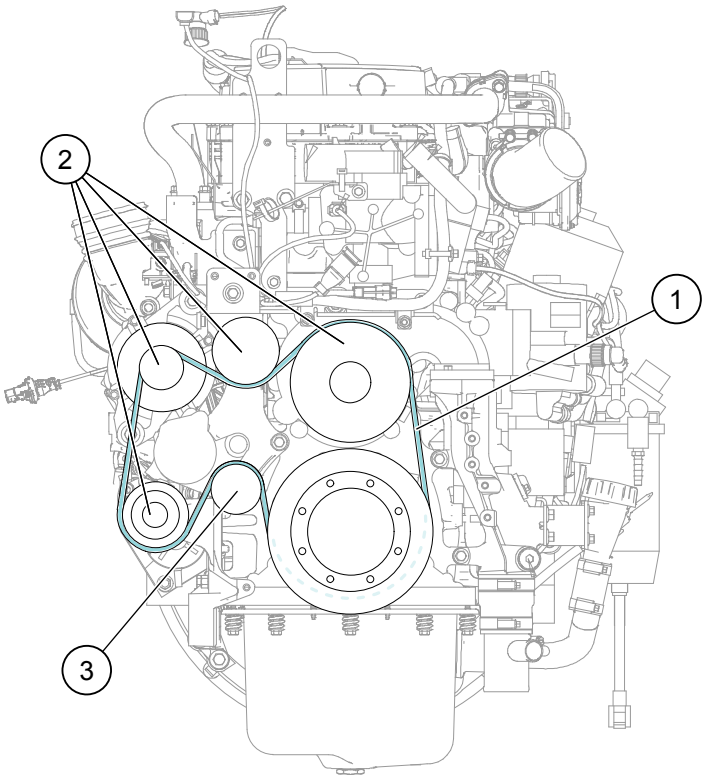


Figure 62. EU stage 5 - TAD 581, 583 VE

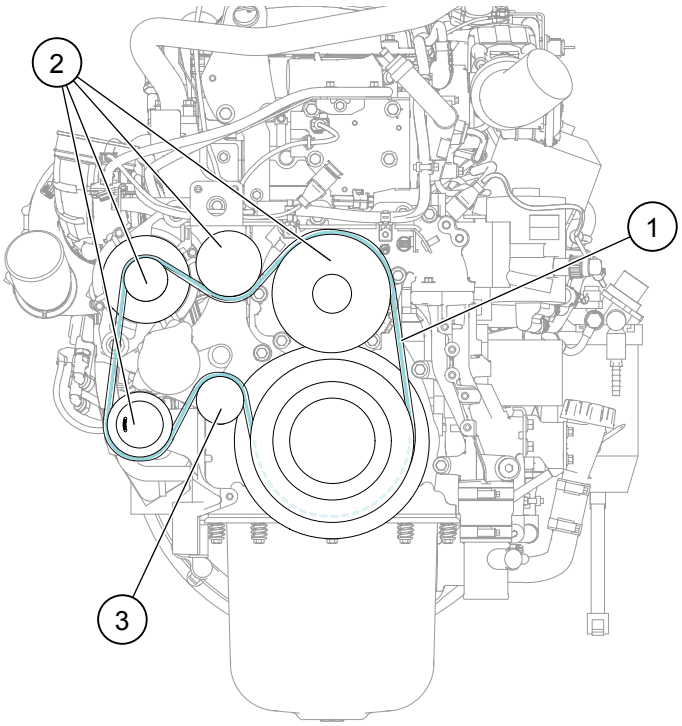


Figure 63. EU stage 5 - TAD 881, 883 VE

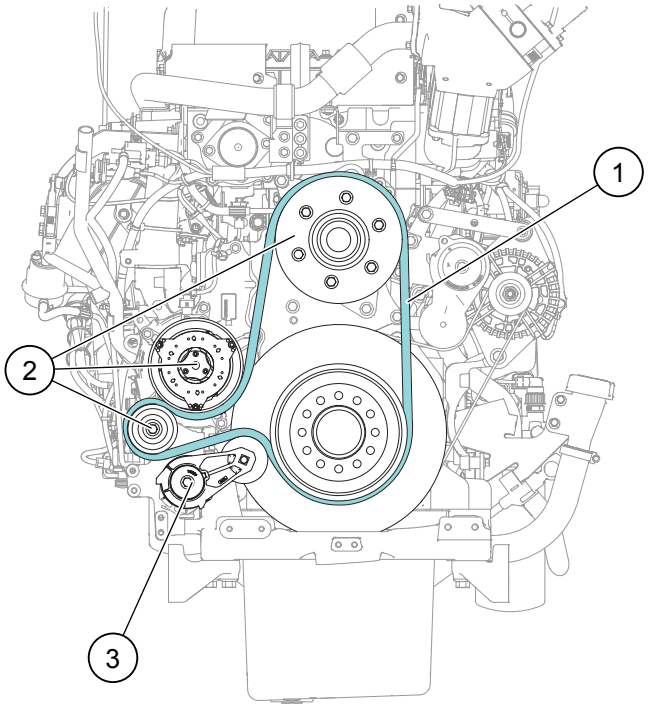


Figure 64. EU stage 5 - TAD 1181, 1183 VE

1. Check the belt (1) for cracks and wear.
   The belt (1) should be checked after operation, when it is hot.
   It should be possible to depress the belt (1) 3–4 mm (0.12–0.16 in) between the pulleys (2).
2. Check that the automatic belt tensioners (3) function and maintains the tension in the belt (1).
3. Check the idler pulleys (2) for damage.

4.15.15 Checking the Volvo vibration damper

⚠ WARNING

RISK OF DAMAGE TO THE MACHINE

If the vibration damper does not function properly, it can lead to serious engine or drive line failure.

Check the condition of the vibration damper regularly, follow the regular service schedule.

Service must be performed by an authorized service technician. If service or replacement of parts is needed, contact your local dealer for more information.

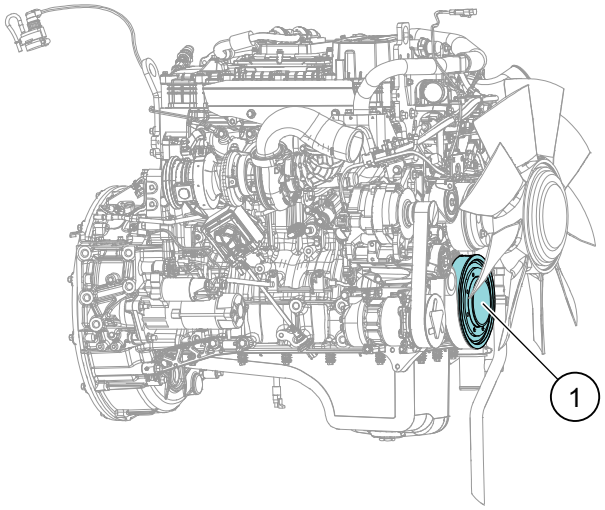


Figure 65. Vibration damper

1. Check the vibration damper (1) for wear and damage.

4.15.16 Checking the Volvo water pump

⚠ WARNING

RISK OF DAMAGE TO THE MACHINE

A leaking or damaged water pump can lead to serious engine or drive line failure.

Check the condition of the water pump regularly, follow the regular service schedule.

Service must be performed by an authorized service technician. If service or replacement of the water pump is needed, contact your local dealer for more information.

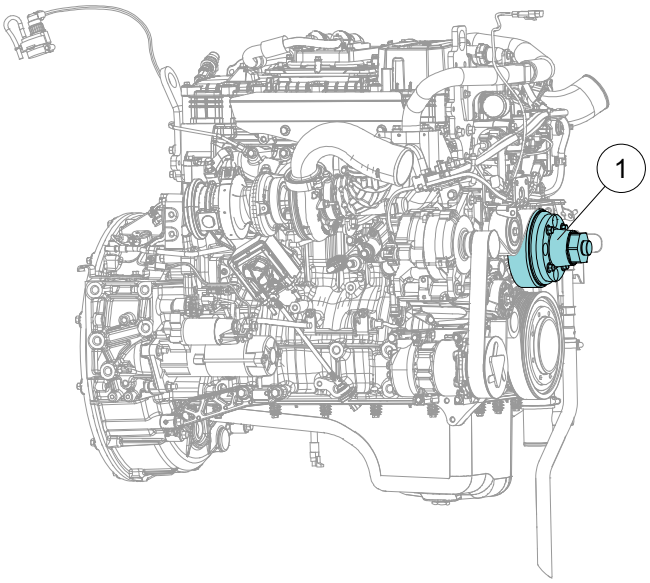


Figure 66. Water pump

NOTE ***Location, and appearance can vary depending on size and model of the motor.***

1. Check the water pump (1) for leaks, and wear.

NOTE ***If dripping, or a steady flow of coolant or oil is found, the water pump (1) must be replaced. Contact your local authorized dealer for more information.***

4.16 Maintaining the Cummins engines

This chapter includes the maintenance instructions for the Cummins engines.

4.16.1 Bleeding the fuel system - QSB 6.7

4.16.1.1 Bleeding the fuel prefilter - QSB 6.7 and B 6.7

⚠ WARNING

HIGH-PRESSURE HAZARD

High-pressure fuel may cause serious personal injury.

Never disconnect a fuel line or a component from a fuel pump that is to be bled. The fuel is highly pressurized and can penetrate the skin.

NOTE ***Working with the fuel system requires special cleanliness.***

NOTE ***To avoid fuel spillage, place a receptacle underneath the filter.***

NOTE ***Take care of the excess fuel, and dispose of it in an environmentally responsible way.***

NOTE ***Bleed the fuel system if it has run dry or after filter change. Bleed the fuel system with the hand pump on the fuel filter bracket.***

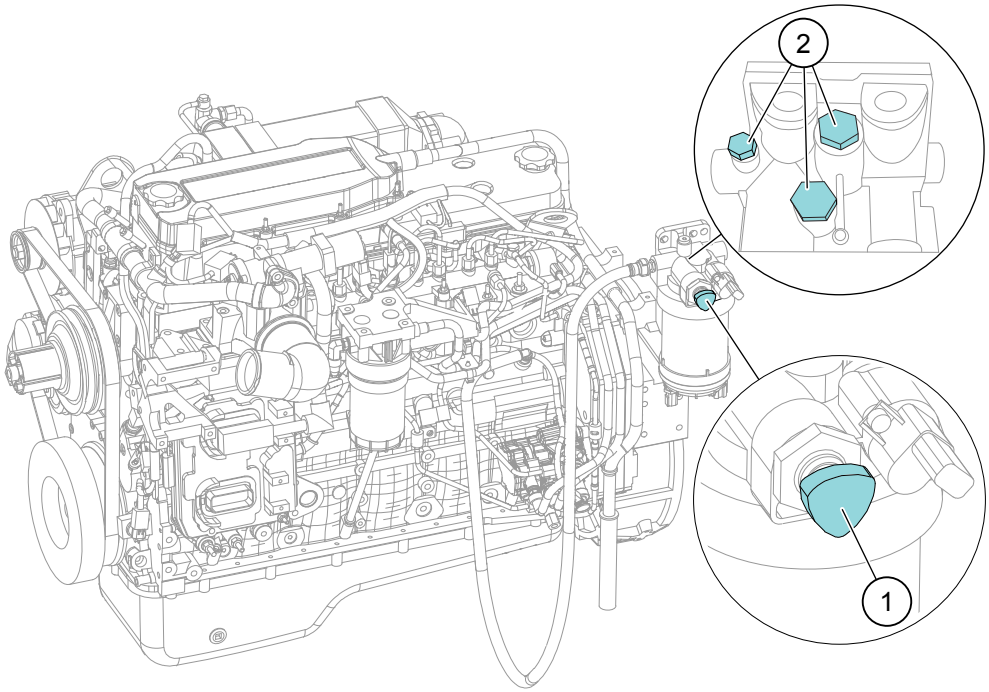


Figure 67. Bleeding the fuel prefilter - QSB 6.7

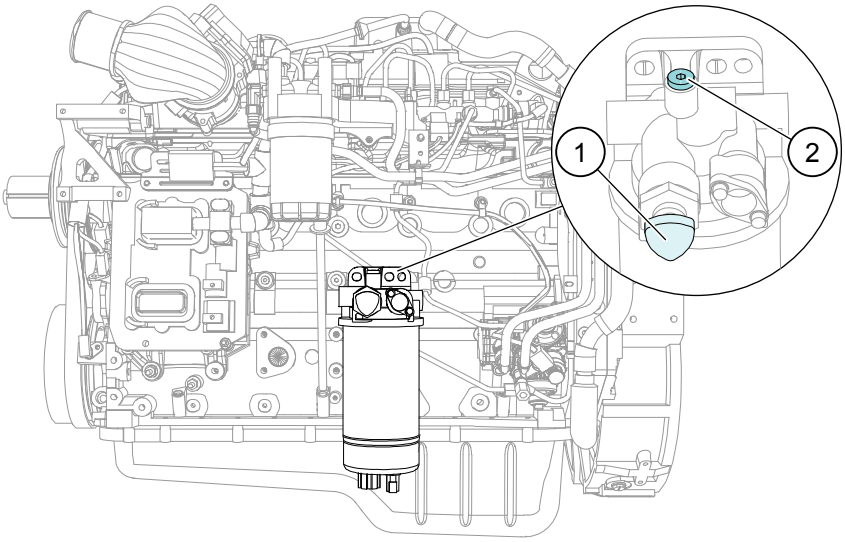


Figure 68. Bleeding the fuel prefilter - B 6.7

1. Clean thoroughly around the bleeder nipples (2) and the fuel prefilter.
2. Open the bleeder nipples (2).
3. Place a receptacle underneath the fuel prefilter.
4. Bleed the fuel system by pumping up fuel with the hand pump (1) until air-free fuel flows out.

NOTE ***Pump rapidly, to maintain pressure in the pump.***

5. Close the nipples (2).

NOTE ***Tightening torque 3.5 Nm (2.6-lbf ft).***

6. Wipe dry any spilled fuel.
7. Start the engine and make sure that there is no leakage.

NOTE ***If the engine does not run smoothly, repeat the procedure.***

4.16.1.2 Bleeding the distributor pump - QSB 6.7

⚠ WARNING	
	**HIGH-PRESSURE HAZARD** **High-pressure fuel may cause serious personal injury.** **Never disconnect a fuel line or a component from a fuel pump that is to be bled. The fuel is highly pressurized and can penetrate the skin.**

NOTE ***Working with the fuel system requires special cleanliness.***

NOTE ***To avoid fuel spillage, place a receptacle underneath the filter.***

NOTE ***Take care of the excess fuel, and dispose of it in an environmentally responsible way.***

NOTE ***Bleed the system if it has run dry or after filter change. Bleed the fuel system with the hand pump on the fuel filter bracket.***

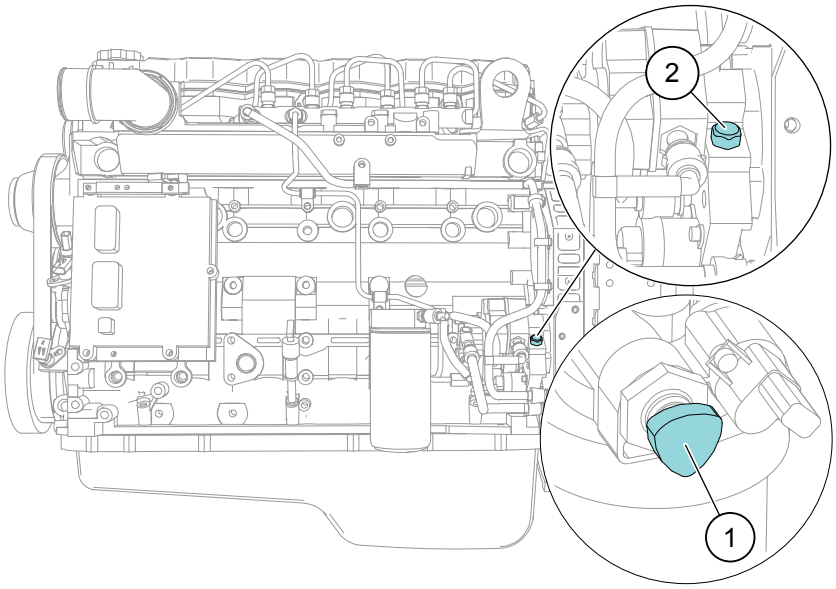


Figure 69. Bleeding the distributor pump - QSB 6.7

1. Clean thoroughly around the bleeder nipple (2) and the distributor pump.
2. Open the bleeder nipple (2).
3. Place a receptacle underneath the distributor pump.
4. Bleed the fuel system by pumping up fuel with the hand pump (1) until air-free fuel flows out.

NOTE ***Pump rapidly, to maintain pressure in the pump.***

5. Close the nipple (2).

NOTE ***Tightening torque: 3.5 Nm (2.6-lbf ft).***

6. Wipe dry any spilled fuel.
7. Start the engine and make sure that there is no leakage.

NOTE ***If the engine does not run smoothly, repeat the procedure.***

4.16.1.3 Bleeding the fuel filter - QSB 6.7 and B 6.7

⚠ WARNING

HIGH-PRESSURE HAZARD

High-pressure fuel may cause serious personal injury.

Never disconnect a fuel line or a component from a fuel pump that is to be bled. The fuel is highly pressurized and can penetrate the skin.

NOTE ***Working with the fuel system requires special cleanliness.***

NOTE ***To avoid fuel spillage, place a receptacle underneath the filter.***

NOTE ***Take care of the excess fuel, and dispose of it in an environmentally responsible way.***

NOTE ***Bleed the system if it has run dry or after filter change. Bleed the fuel system with the hand pump on the fuel filter bracket.***

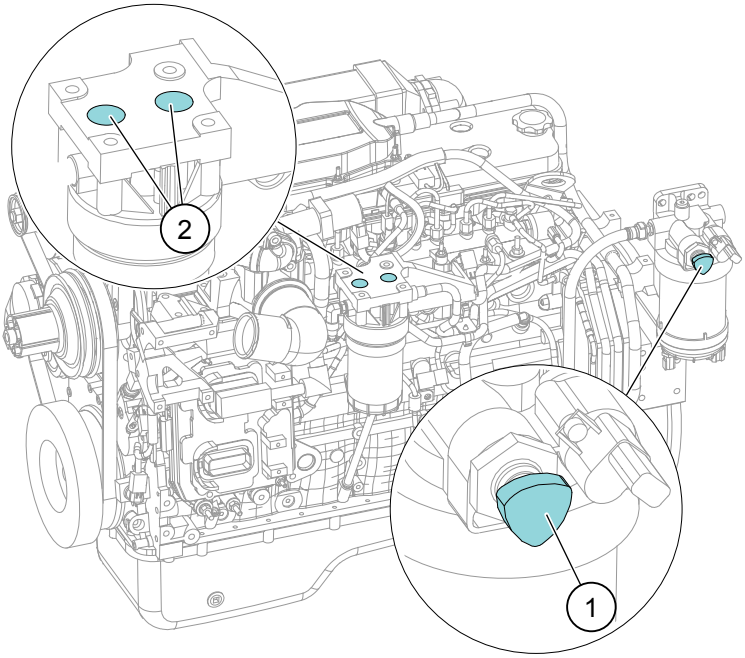


Figure 70. Bleeding the fuel filter - QSB 6.7

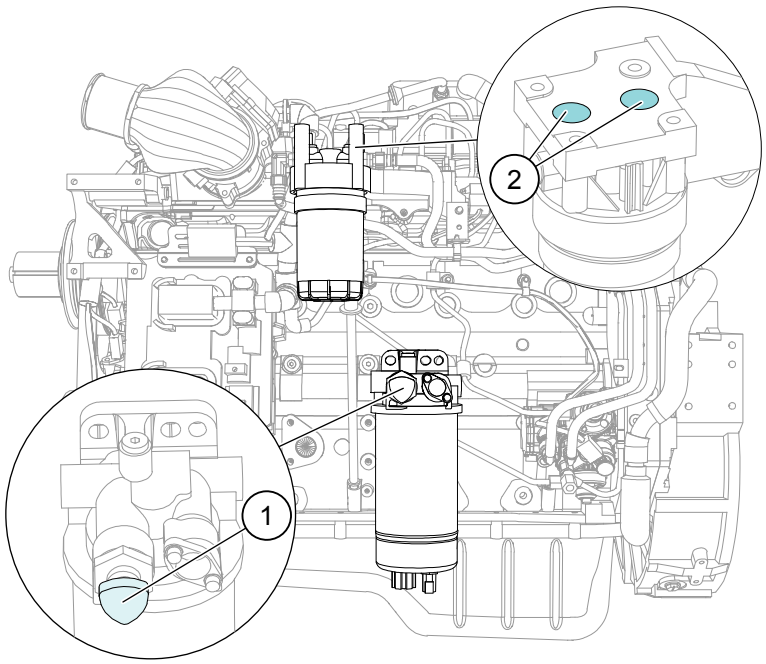


Figure 71. Bleeding the fuel filter - B 6.7

1. Clean thoroughly around the bleeder nipples (2) and the fuel filter.
2. Open the bleeder nipples (2).
3. Place a receptacle underneath the fuel filter.
4. Bleed the fuel system by pumping up fuel with the hand pump (1) until air-free fuel flows out.

NOTE ***Pump rapidly, to maintain pressure in the pump.***

5. Close the nipples (2).

NOTE ***Tightening torque 3.5 Nm (2.6-lbf ft).***

6. Wipe dry any spilled fuel.
7. Start the engine and make sure that there is no leakage.

NOTE ***If the engine does not run smoothly, repeat the procedure.***

4.16.2 Bleeding the fuel system - QSM 11

⚠ WARNING

HIGH-PRESSURE HAZARD

High-pressure fuel may cause serious personal injury.

Never disconnect a fuel line or a component from a fuel pump that is to be bled. The fuel is highly pressurized and can penetrate the skin.

NOTE ***Working with the fuel system requires special cleanliness.***

NOTE ***To avoid fuel spillage, place a receptacle underneath the filter.***

NOTE ***Take care of the excess fuel, and dispose of it in an environmentally responsible way.***

NOTE ***Bleed the system if it has run dry, if the filter is changed, or after a longer downtime.***

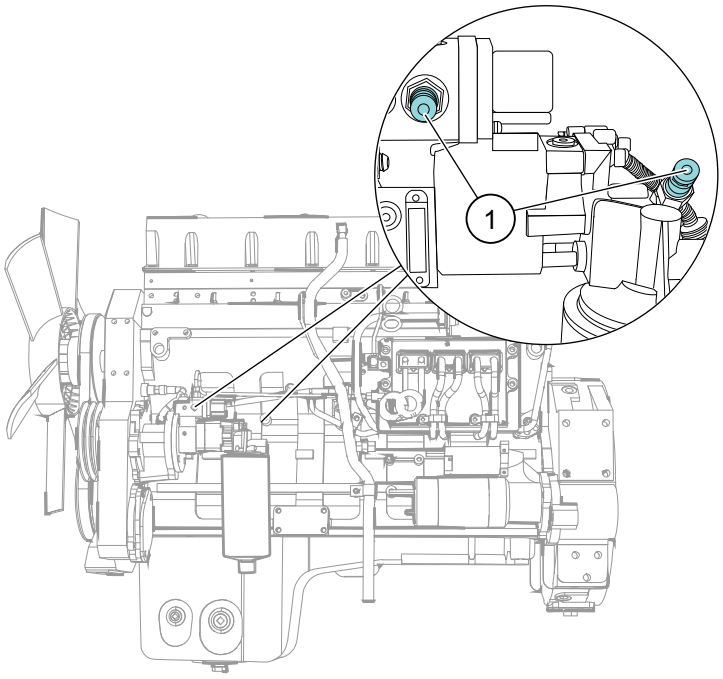


Figure 72. Bleeding fuel filter - QSM 11

1. Clean thoroughly around the bleeder nipples (1).
2. Connect draining hoses to the bleeder nipples (1).

NOTE ***To open the bleeder nipples (1), select a hose with a suitable connection.***

3. To collect any excess fluid, place the opposite ends of the hoses in a receptacle.
4. Start the engine.
5. Bleed the fuel system until air-free fuel flows out.
6. Close the nipples (1).

NOTE ***Tightening torque: 3.5 Nm (2.6-lbf ft).***

7. Stop the engine.

8. Check that there is no leakage from the fuel filter.

NOTE ***If the engine does not run smoothly, repeat the procedure.***

4.16.3 Bleeding the fuel system - X12

4.16.3.1 Bleeding the fuel prefilter - X12

⚠ WARNING

HIGH-PRESSURE HAZARD

High-pressure fuel may cause serious personal injury.

Never disconnect a fuel line or a component from a fuel pump that is to be bled. The fuel is highly pressurized and can penetrate the skin.

NOTE ***Working with the fuel system requires special cleanliness.***

NOTE ***To avoid fuel spillage, place a receptacle underneath the filter.***

NOTE ***Take care of the excess fuel, and dispose of it in an environmentally responsible way.***

NOTE ***Bleed the system if it has run dry or after filter change. Bleed the fuel system with the hand pump on the fuel filter bracket.***

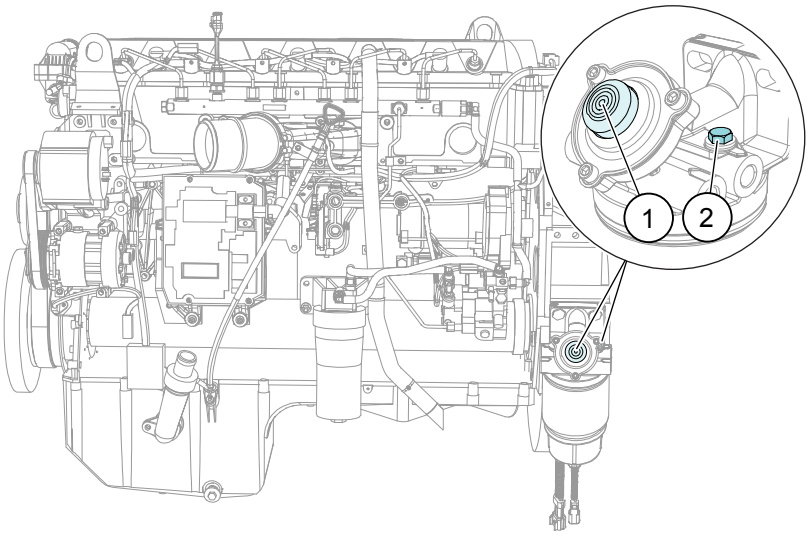


Figure 73. Bleeding the fuel prefilter - X12

1. Clean thoroughly around the bleeder nipple (2) and hand pump (1).
2. Open the bleeder nipple (2).
3. Place a receptacle underneath the fuel prefilter.
4. Bleed the fuel system by pumping up fuel with the hand pump (1) until air-free fuel flows out.

NOTE ***Pump rapidly, to maintain pressure in the pump.***

5. Close the nipple (2).

NOTE ***Tightening torque: 3.5 Nm (2.6-lbf ft).***

6. Remove the hose.
7. Wipe dry any spilled fuel.
8. Start the engine and make sure that there is no leakage.

NOTE ***If the engine does not run smoothly, repeat the procedure.***

4.16.3.2 Bleeding the fuel filter - X12

⚠ WARNING

HIGH-PRESSURE HAZARD

High-pressure fuel may cause serious personal injury.

Never disconnect a fuel line or a component from a fuel pump that is to be bled. The fuel is highly pressurized and can penetrate the skin.

NOTE ***Working with the fuel system requires special cleanliness.***

NOTE ***To avoid fuel spillage, place a receptacle underneath the filter.***

NOTE ***Take care of the excess fuel, and dispose of it in an environmentally responsible way.***

NOTE ***Bleed the system if it has run dry or after filter change. Bleed the fuel system with the hand pump on the fuel filter bracket.***

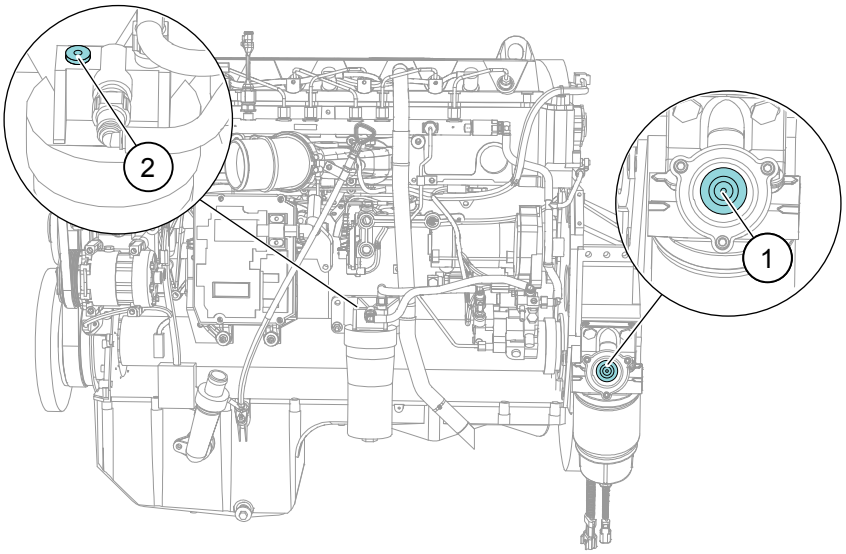


Figure 74. Bleeding the fuel filter - X12

1. Clean thoroughly around the bleeder nipple (2) and hand pump (1).
2. Open the bleeder nipple (2).
3. Place a receptacle underneath the fuel filter.
4. Bleed the fuel system by pumping up fuel with the hand pump (1) until air-free fuel flows out.

NOTE ***Pump rapidly, to maintain pressure in the pump.***

5. Close the nipple (2).

NOTE ***Tightening torque: 3.5 Nm (2.6-lbf ft).***

6. Remove the hose.
7. Wipe dry any spilled fuel.
8. Start the engine and make sure that there is no leakage.

NOTE ***If the engine does not run smoothly, repeat the procedure.***

4.16.4 Draining the fuel prefilter - X12

⚠ WARNING

HARMFUL SUBSTANCE HAZARD

The machine contains several chemical substances, which may cause skin irritation and allergies. Risk of injury when in prolonged contact with skin.

When handling lubricants and oils, avoid direct contact with the skin. Use safety gloves. Immediately wash skin that comes in contact with chemical substances.

NOTE ***Working with the fuel system requires special cleanliness.***

NOTE ***To avoid fuel spillage, place a receptacle underneath the filter.***

NOTE ***Take care of the excess fuel, and dispose of it in an environmentally responsible way.***

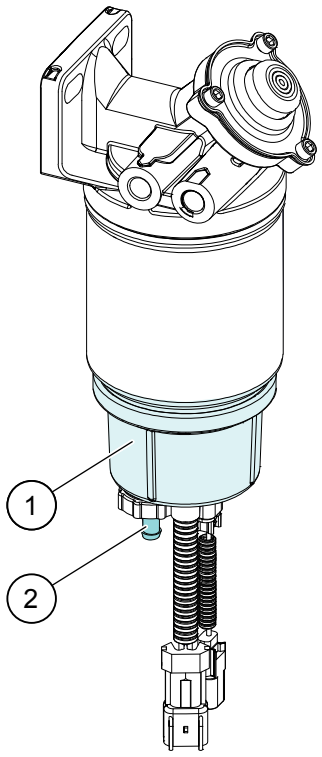


Figure 75. Fuel prefilter - X12

1. Stop the engine.
2. Close the fuel tap, if applicable.

3. To collect the water and fuel, put a receptacle under the fuel prefilter.
4. Open the drain valve (2) at the bottom of the water separator (1).
5. Drain the water contained in the water separator (1) into the receptacle.

NOTE ***Do not drain the water separator (1) completely.***

6. Tighten the drain valve (2) and open the fuel tap, if applicable.
7. If needed, bleed the system. For more information, see sections about "Bleeding the fuel system".
8. Start the engine.
9. Check that there is no leakage from the fuel prefilter.

4.16.5 Changing the fuel prefilter - QSB 6.7 and B 6.7

⚠ WARNING

HARMFUL SUBSTANCE HAZARD

The machine contains several chemical substances, which may cause skin irritation and allergies. Risk of injury when in prolonged contact with skin.

When handling lubricants and oils, avoid direct contact with the skin. Use safety gloves. Immediately wash skin that comes in contact with chemical substances.

NOTE ***To collect the water and fuel, put a receptacle under the fuel prefilter. Store the used filter in a suitable container and dispose of it in an environmentally responsible way.***

NOTE ***Working with the fuel system requires special cleanliness.***

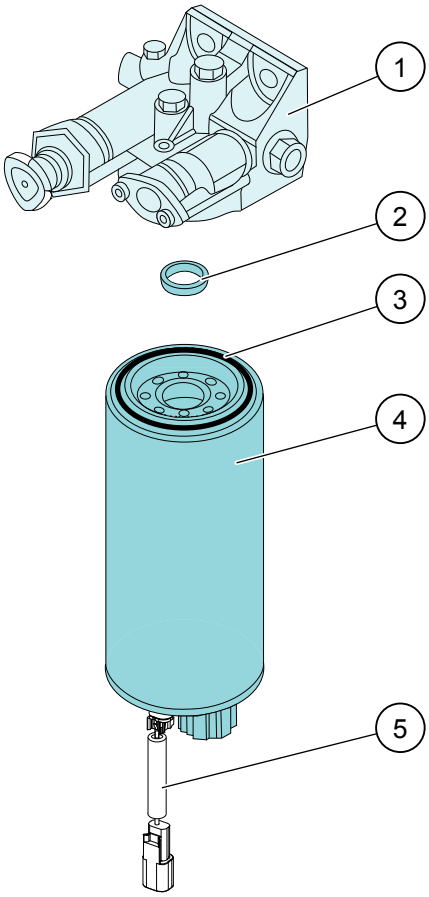


Figure 76. Fuel prefilter - QSB 6.7 and B 6.7

1. Close fuel taps, if applicable.
2. Clean thoroughly around the fuel prefilter (4) and the mounting bracket (1).
3. Disconnect the cable (5) from the fuel prefilter (4).
4. Remove the filter (4) from the mounting bracket (1).
   Put the used filter (4) in a suitable container and dispose of it in an environmentally responsible way.
5. Install a new seal (2) to the new filter.
6. Lubricate the new seal (2) with diesel fuel.

7. Lubricate the seal (3) on the new filter with diesel fuel.
8. Screw the new filter onto the mounting bracket (1) by hand, until it bottoms. Tighten a further 1/2–2/3 turns.
9. Reconnect the cable (5) to the fuel prefilter (4).
10. Open fuel taps, if applicable, and bleed the fuel system. For more information, see sections about "Bleeding the fuel system".
11. Start the engine and make sure that there is no leakage.

4.16.6 Changing the fuel prefilter - X12

⚠ WARNING

HARMFUL SUBSTANCE HAZARD

The machine contains several chemical substances, which may cause skin irritation and allergies. Risk of injury when in prolonged contact with skin.

When handling lubricants and oils, avoid direct contact with the skin. Use safety gloves. Immediately wash skin that comes in contact with chemical substances.

NOTE ***To collect the water and fuel, put a receptacle under the fuel prefilter. Store the used filter in a suitable container and dispose of it in an environmentally responsible way.***

NOTE ***Working with the fuel system requires special cleanliness.***

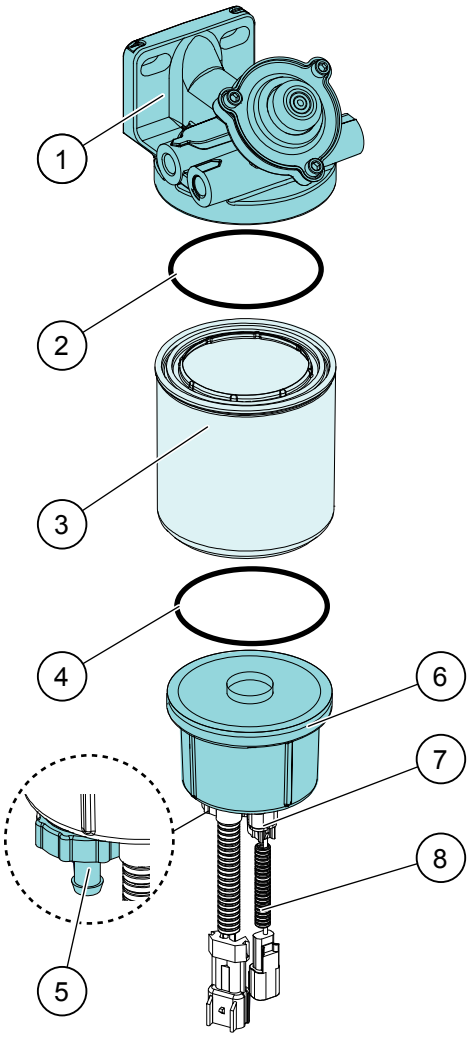


Figure 77. Fuel prefilter - X12

1. Close fuel taps, if applicable.
2. Clean thoroughly around the fuel prefilter (3) and the water separator (6).
3. Disconnect the cables (8) from the water trap sensors (7).

4. Remove the fuel prefilter (3) from the mounting bracket (1).
5. Remove the the water trap (6) from the filter (3).
   Put the used filter in a suitable container and dispose of it in an environmentally responsible way.
6. Clean the water trap (6) with a soft rag.
   Check that the drain hole (5) in the water trap (6) is not blocked.
7. Install a new O-ring (4) on the water separator (6).
8. Lubricate the O-ring (4) with diesel fuel.
9. Reinstall the water trap (6) to the new filter (3).
10. Lubricate the O-ring (2) with diesel fuel.
11. Screw the new filter (3) onto the mounting bracket (1) by hand, until it bottoms.
    Tighten a further 1/2–2/3 turns.
12. Reconnect the cables (8) to the water trap sensors (7).
13. Open fuel taps, if applicable, and bleed the fuel system. For more information, see sections about "Bleeding the fuel system".
14. Start the engine and make sure that there is no leakage.

4.16.7 Changing the AdBlue filters, Cummins

4.16.7.1 Changing the AdBlue pump filter

This section is applicable for machines that are equipped with Volvo or Cummins QSB 6.7 engines.

⚠ WARNING

CORROSIVE SUBSTANCE HAZARD

The AdBlue solution may cause skin and eye damage. It is corrosive towards certain metals such as copper and aluminum.

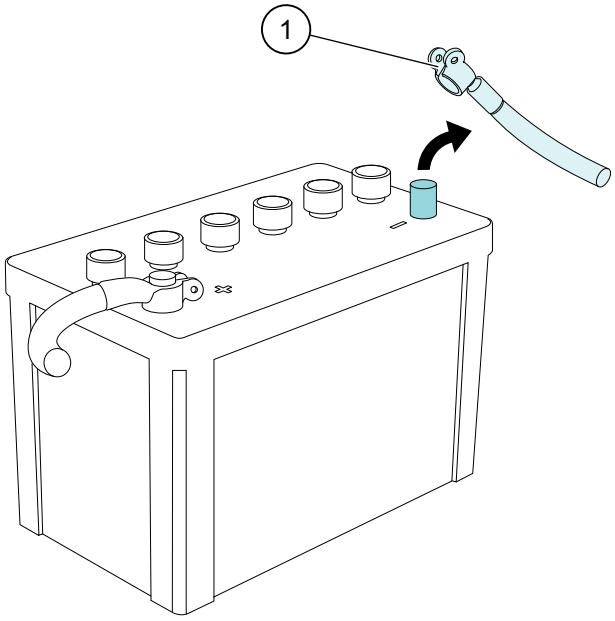
Do not allow AdBlue solution to come in contact with other chemicals. Use safety gloves. If the AdBlue solution comes in contact with the skin or eyes, quickly wash it off with soap and water.

NOTE ***Wait at least 2-5 min after the engine has been turned off to disconnect the battery negative terminal. By doing so, the automatic drainage and depressurization of the selective catalytic reduction system can take place.***

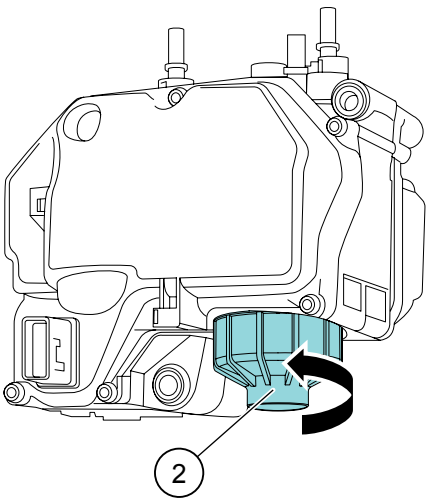
NOTE ***To avoid spillage, place a receptacle underneath the filter.***

NOTE ***Take care of the excess fluid and dispose of it in a safe controlled manner. Store the used filter in a suitable container, dispose of it in an environmentally responsible way.***

1. Switch off the engine.

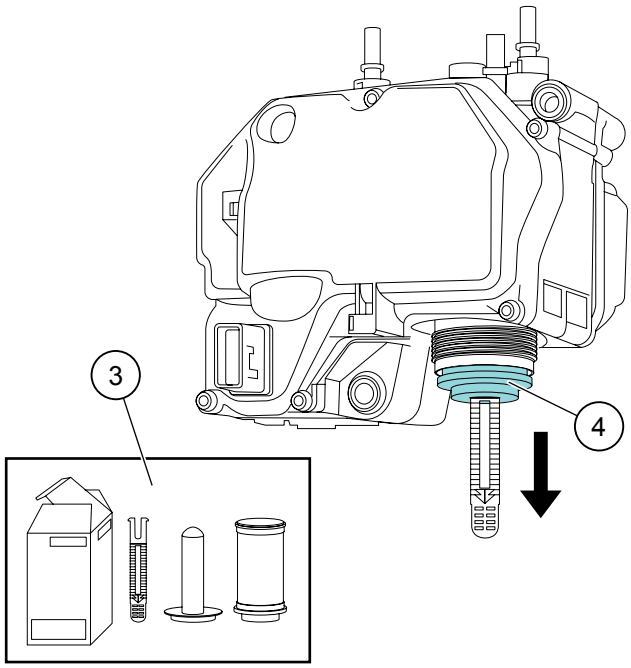


2. After 2-5 min, disconnect the battery negative terminal (1).

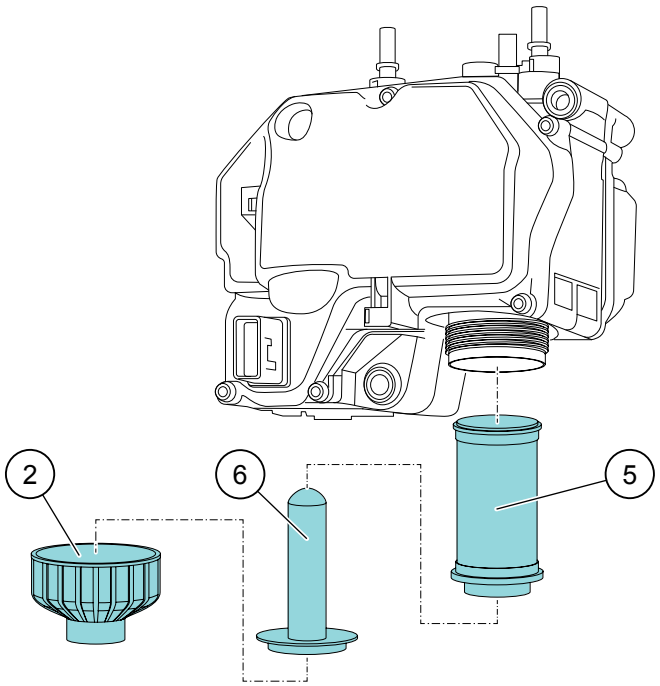


3. Place a receptacle under the filter cover (2).

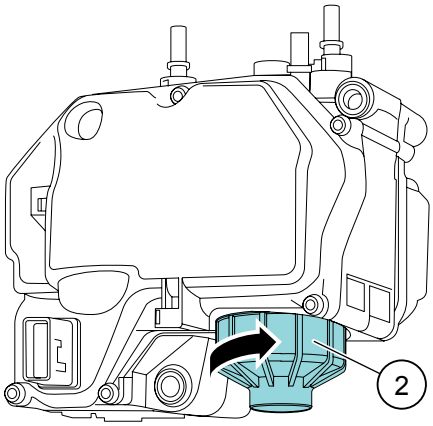
4. Remove the filter cover (2), let AdBlue run into the receptacle.



5. Press the puller, which is supplied with the filter kit (3), into the filter hole until a click is heard.
6. Pull out the old filter (4).
7. Put the used filter (4) in a suitable container, and dispose of it in an environmentally responsible way.



8. Install the new filter (5).
9. Install the rubber gasket (6).



10. Reattach the filter cover (2).
11. Tighten the filter cover (2) using a torque wrench.

NOTE ***Tightening torque is 20 + 5 Nm (14.8 + 3.68-lbf ft).***

12. Reconnect the battery negative terminal (1).
13. Start the engine.
14. Check that there are no leaks.
15. Delete any error codes.

4.16.7.2 Changing the AdBlue pump filter, B 6.7 and X12

⚠ WARNING

CORROSIVE SUBSTANCE HAZARD

The AdBlue solution may cause skin and eye damage. It is corrosive towards certain metals such as copper and aluminum.

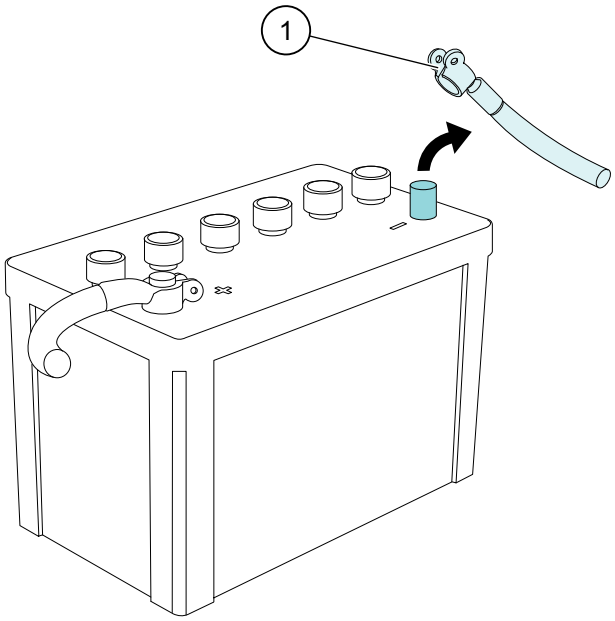
Do not allow AdBlue solution to come in contact with other chemicals. Use safety gloves. If the AdBlue solution comes in contact with the skin or eyes, quickly wash it off with soap and water.

NOTE ***Wait at least 2-5 min after the engine has been turned off to disconnect the battery negative terminal. By doing so, the automatic drainage and depressurization of the selective catalytic reduction system can take place.***

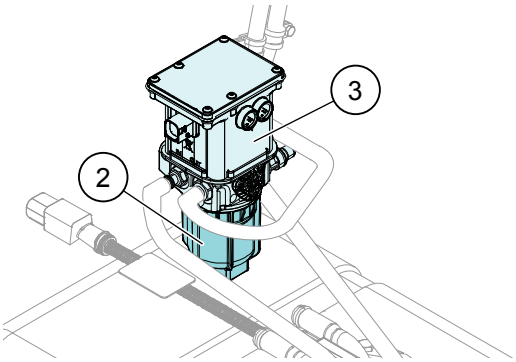
NOTE ***To avoid spillage, place a receptacle underneath the filter.***

NOTE ***Take care of the excess fluid and dispose of it in a safe controlled manner. Store the used filter in a suitable container, dispose of it in an environmentally responsible way.***

1. Switch off the engine.

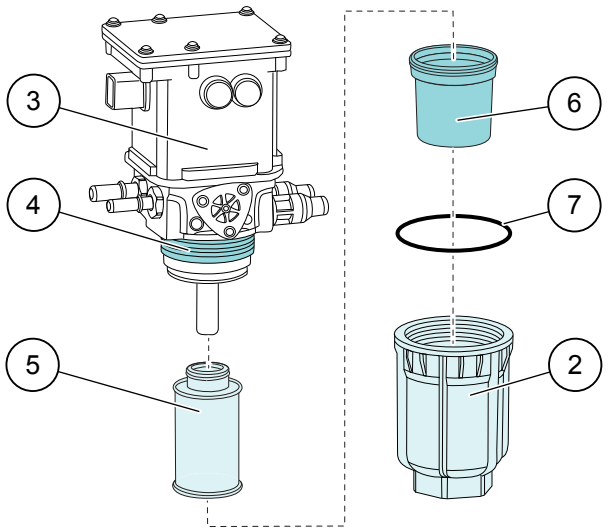


2. After 2-5 min, disconnect the battery negative terminal (1).



3. Place a suitable receptacle under the pump (3).

4. Clean around the filter cover (2) and the pump (3).
5. Unscrew the filter cover (2).
   Use a 46-mm socket.



6. Remove the O-ring (7).
7. Remove the frost protection device (6) and the filter (5).
8. Put the used filter (5) in a suitable container and dispose of it in an environmentally responsible way.
9. Wipe the pump (3) and threads (4) clean.
10. Fit the new filter.
11. Fit the new frost protection device.
12. Lubricate the threads (4).
13. Lubricate the new O-ring with AdBlue.
14. Fit the new O-ring in the filter cover (2).
15. Check that the frost protection device and O-ring are correctly fitted.
16. Reattach the filter cover (2) on the pump (3) and tighten to 80 Nm (59 lbf ft).
17. Reconnect the battery negative terminal (1).

4.16.7.3 Changing the AdBlue tank filter

⚠ WARNING

CORROSIVE SUBSTANCE HAZARD

The AdBlue solution may cause skin and eye damage. It is corrosive towards certain metals such as copper and aluminum.

Do not allow AdBlue solution to come in contact with other chemicals. Use safety gloves. If the AdBlue solution comes in contact with the skin or eyes, quickly wash it off with soap and water.

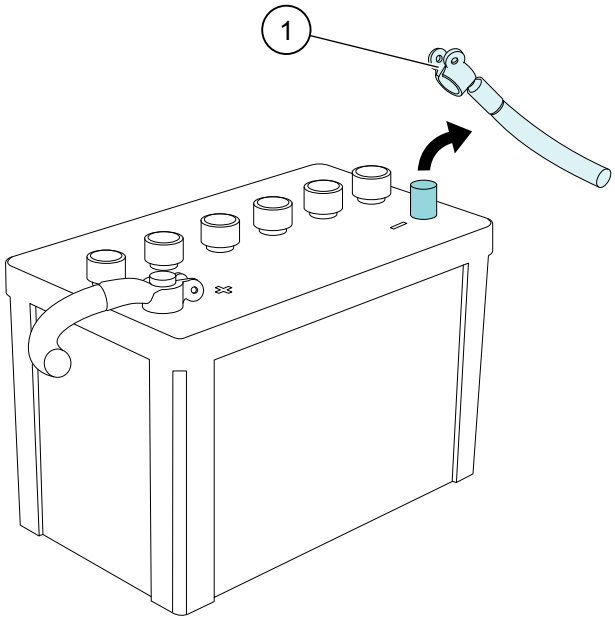
NOTE

Wait at least 2-5 min after the engine has been turned off to disconnect the battery negative terminal. By doing so, the automatic drainage and depressurization of the selective catalytic reduction system can take place.

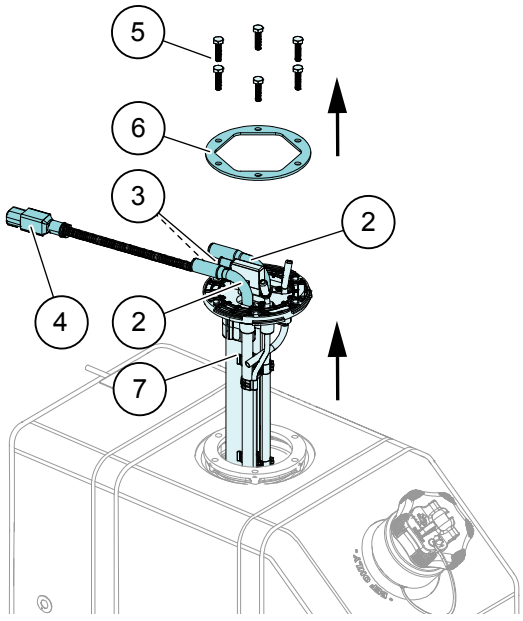
NOTE ***To avoid spillage, place a receptacle underneath the filter.***

NOTE ***Take care of the excess fluid and dispose of it in a safe controlled manner. Store the used filter in a suitable container, dispose of it in an environmentally responsible way.***

1. Switch off the engine.



2. Disconnect the battery negative terminal (1) after 2-5 min.



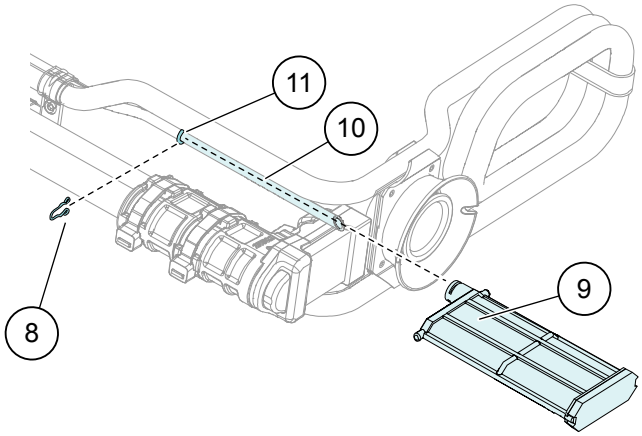
3. Disconnect the coolant supply and return (2).
4. Disconnect the AdBlue supply and return (3).
5. Disconnect the electrical connector (4).

NOTE ***To prevent contamination, disconnect the connector (4) last.***

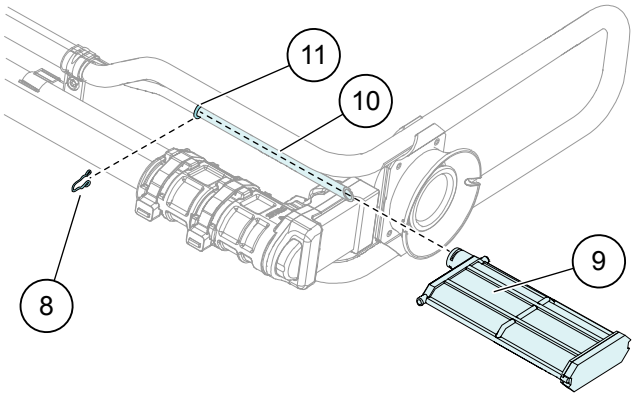
6. To avoid contamination, cover the connector (4) and the exposed inlets and outlets (2 and 3) on the AdBlue tank assembly.
7. Loosen and remove the screws (5).
8. Remove the attachment plate (6).

9. Lift out the AdBlue tank assembly (7) from the tank.

AdBlue tank assembly and filter - X12



AdBlue tank assembly and filter - QSB 6.7 and B 6.7



10. Remove the clip (8) from the inlet port.
11. Remove the AdBlue tank filter (9) from the inlet pipe (10).
12. Remove the O-ring (11).
13. Reverse the procedure to install the new AdBlue tank filter and O-ring.

4.16.8 Changing the Cummins engine oil

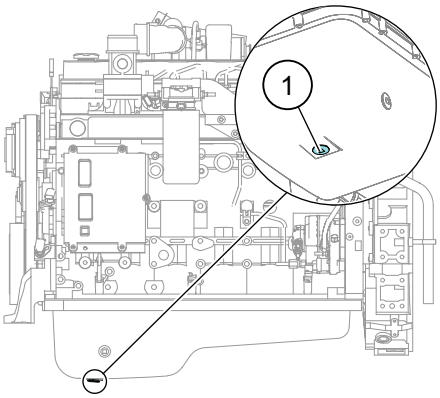
⚠ WARNING

HOT FLUID HAZARD
Hot engine oil may cause serious personal injury.
To avoid burns, be careful when opening the drain plug.

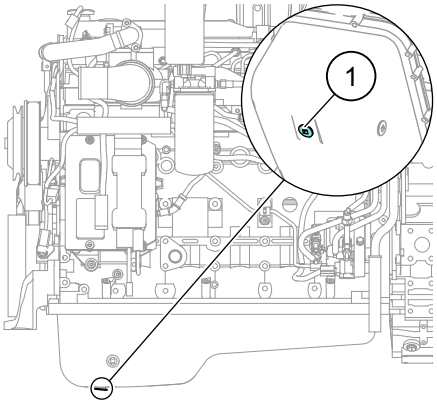
NOTE ***Drain the oil when the engine is at the operating temperature, at least 65°C (149°F).***

NOTE ***Working with the oil system requires special cleanliness.***

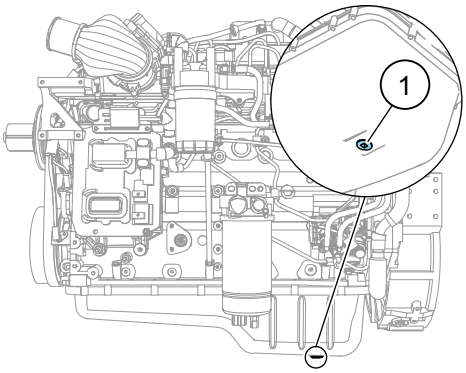
NOTE ***Put the used filter in a suitable container, and dispose of it in an environmentally responsible way.***



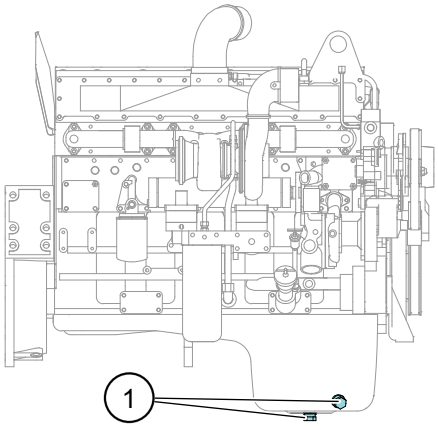
QSB 6.7 - EU stage 3a / US tier 3



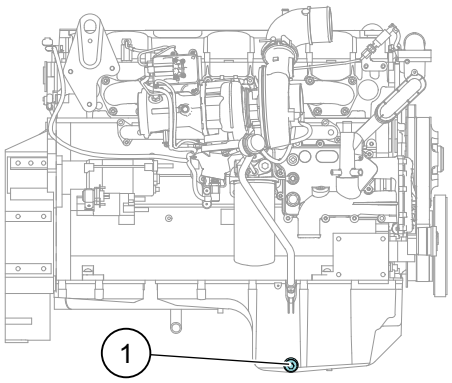
QSB 6.7 - EU stage 4 / US tier 4f



B 6.7 - EU stage 5 / US tier 4f

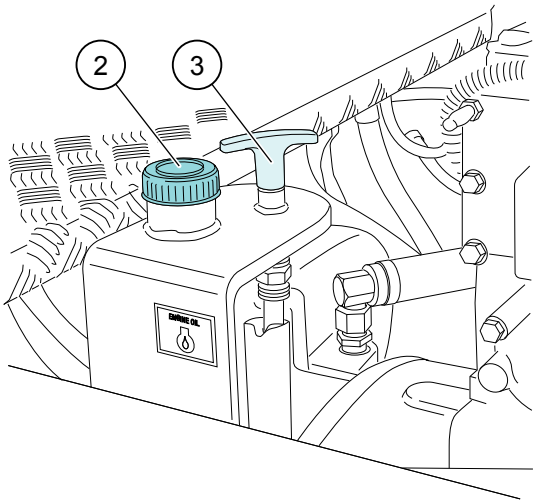


QSM 11



X12

1. To avoid spillage, place a receptacle underneath the drain hole.
2. Unscrew the drain plug (1).
3. Allow the oil to run out.
4. Check that the seal is undamaged. If necessary, renew the seal.
5. Fit the drain plug.
6. Tighten up the drain plug (1).
7. Remove the filler cap (2).



8. Pour oil through the opening.
9. Check the oil level using the dipstick (3).
10. Fill up to the maximum indicator level.
11. Refit the filler cap (2).
12. Start the engine.
13. Check that there is no warning symbol for low oil pressure on the display.
14. Check that there are no leaks from the drain plug or the oil filter.
15. Turn off the engine and check the oil level again after 5 min.

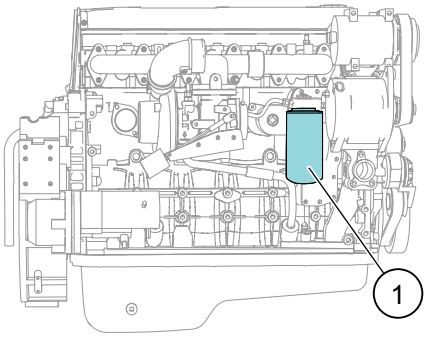
4.16.9 Changing the Cummins engine oil filter

⚠ WARNING

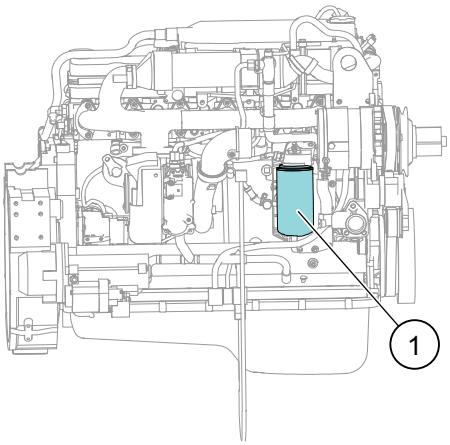
HOT OIL AND HOT SURFACES HAZARD
Risk of personal injury.
Use protective gloves.

NOTE ***Working with the oil system requires special cleanliness.***

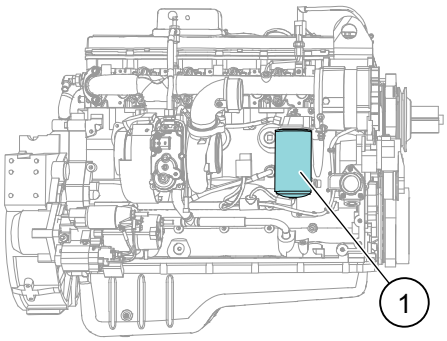
NOTE ***Put the used filter in a suitable container, dispose of it in an environmentally responsible way.***



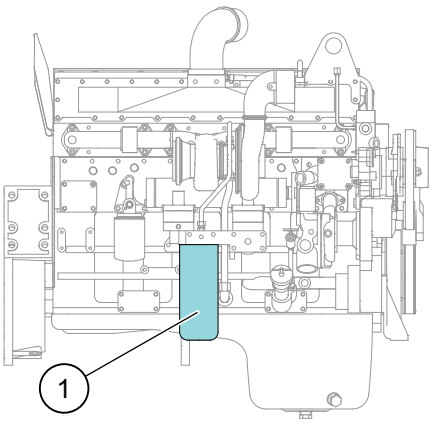
QSB 6.7 - EU stage 3a / US tier 3



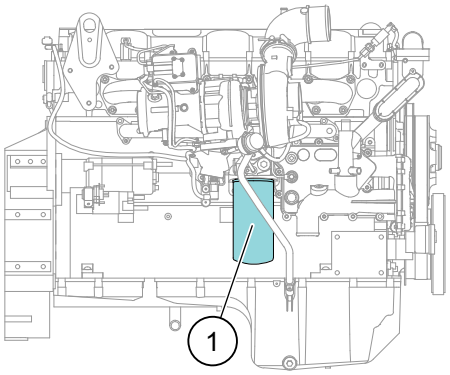
QSB 6.7 - EU stage 4 / US tier 4f



B 6.7 - EU stage 5 / US tier 4f



QSM 11



X 12

1. To avoid spillage, place a receptacle underneath the filter (1).
2. Clean around filter on the outside of the filter.
3. Remove and dispose of the old filter (1).
4. Clean the mating surface of the filter housing.
5. Lubricate the rubber seal with new oil and fit a new filter.
6. Secure the filter by hand.

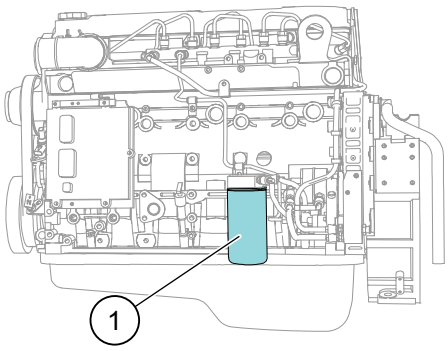
NOTE ***Never use tools. The filter could get damaged and the circulation obstructed.***

7. Top up with engine oil, start the engine, and let it run for 20–30 s.
8. Turn off the engine, check the oil level, and top up as required. See Fuel and oil recommendations (page 249).
9. Check the seal around the oil filters.

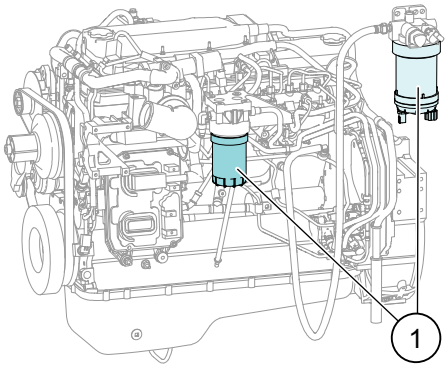
4.16.10 Changing the Cummins fuel filter

NOTE ***Working with the fuel system requires special cleanliness.***

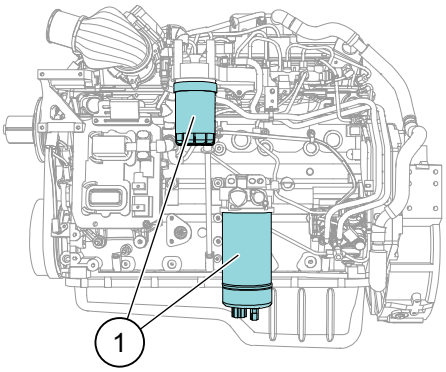
NOTE ***Put the used filter in a suitable container, dispose of it in an environmentally responsible way.***



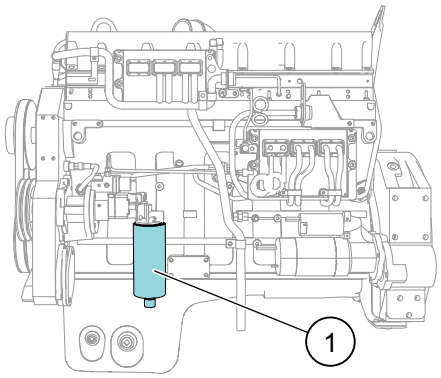
QSB 6.7 - EU stage 3a / US tier 3



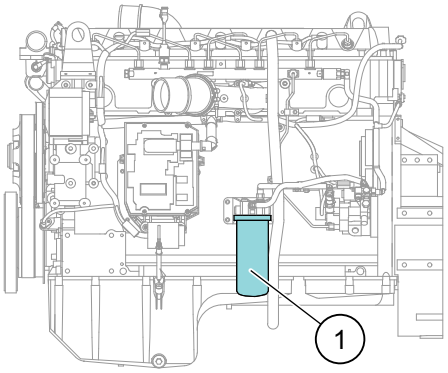
QSB 6.7 - EU stage 4 / US tier 4f



B 6.7 - EU stage 5 / US tier 4f



QSM 11



X12

1. To collect any spilled fuel, place a receptacle under the fuel filter (1).
2. Clean around the fuel filter (1).
3. Remove the fuel filter (1) with a suitable filter remover.
4. Remove the thread adapter seal.
   Clean the gasket surface on the fuel filter head.

5. Lubricate the fuel filter gasket with clean engine oil.
6. Fill the new fuel filter (1) with clean diesel fuel.
7. Install the new thread adapter seal (included in the filter kit).
8. Install the filter (1) on the filter head.
9. Turn the filter (1) until the gasket contacts the filter head surface.
10. Tighten the fuel filter (1) in accordance with the instructions of the filter manufacturer.
11. Bleed the fuel system. See *"Bleeding the Cummins fuel system"*.
12. Start the engine, check that there is no leakage.

NOTE ***If the engine is not working properly, bleed the system again.***

4.16.11 Checking the Cummins drive belt

NOTE ***If the drive belt is oily, worn, or damaged, it must be replaced.***

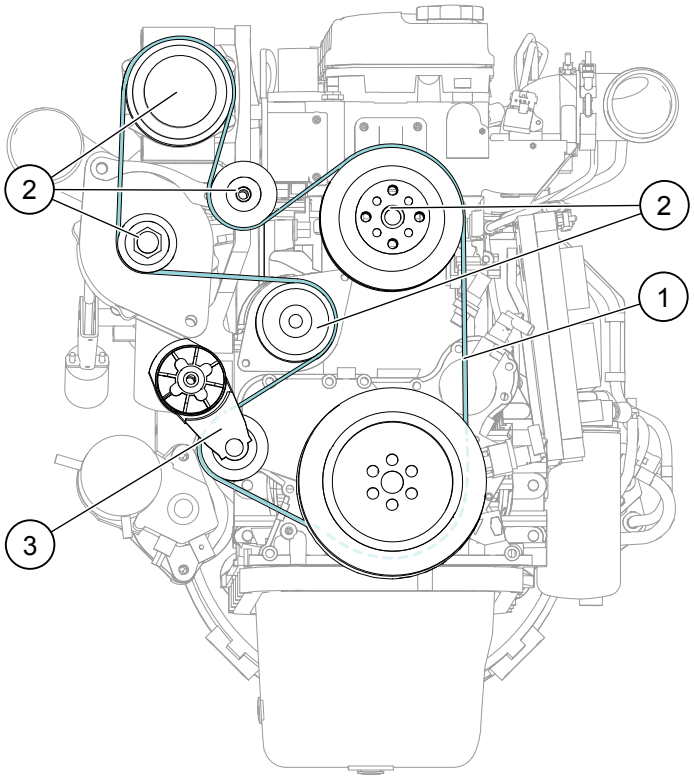


Figure 78. QSB 6.7 - EU stage 3a / US tier 3

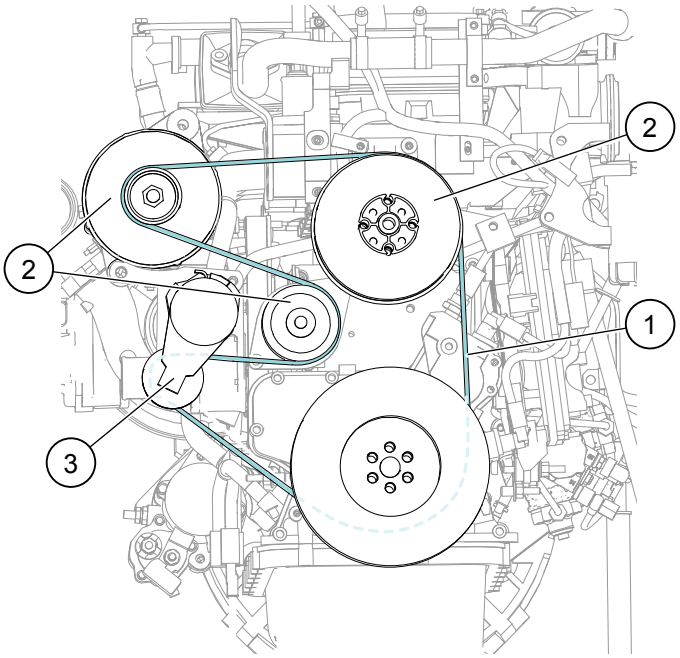


Figure 79. QSB 6.7 - EU stage 4 / US tier 4f

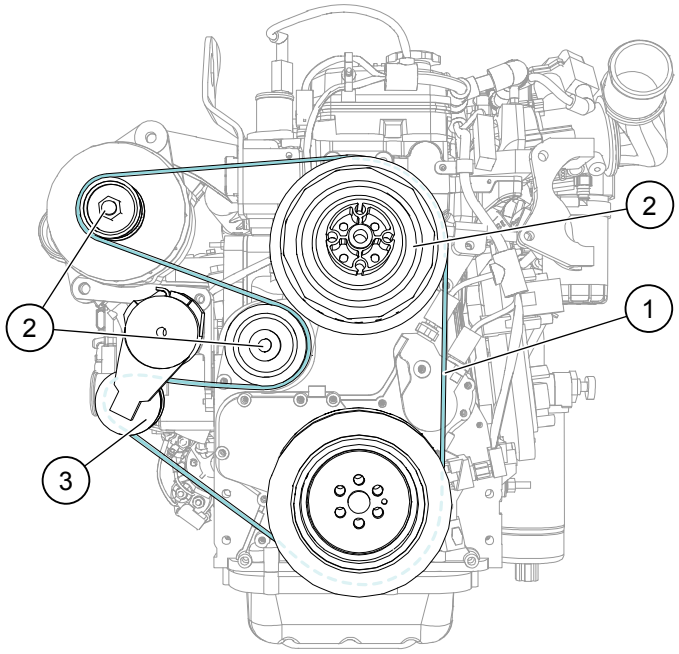


Figure 80. B 6.7 - EU stage 5 / US tier 4f

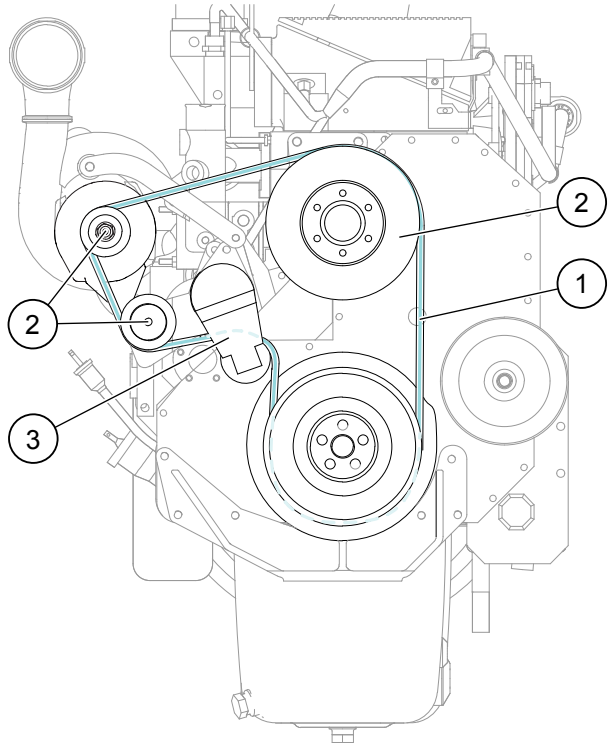


Figure 81. QSM 11

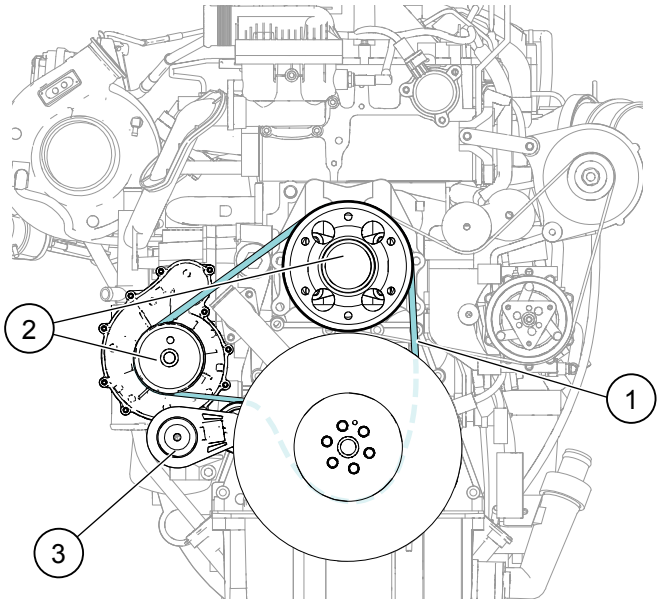


Figure 82. X12

1. Check the belt (1) for cracks and wear.
2. Check that the automatic belt tensioners (3) function and maintain the tension in the belt.
3. Check the idler pulleys (2) for damage.

4.16.12 Checking the Cummins cooling fan

⚠ WARNING

EQUIPMENT: FAN DAMAGE HAZARD

Risk of personal injury or equipment damage

If a fan blade is damaged, it can cause the fan to fail, which can cause personal injury or property damage.

Do not rotate the engine by pulling or prying on the fan. Use the accessory drive shaft or the crankshaft barring tool to rotate the crankshaft.

⚠ WARNING

EQUIPMENT: BENT FAN BLADE HAZARD

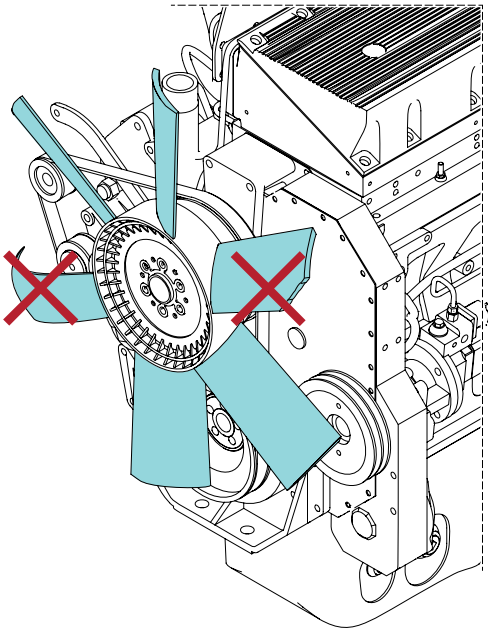
Risk of personal injury or equipment damage

A bent fan blade can cause the fan to fail, which can cause personal injury or property damage.

Do not straighten a bent fan blade or continue to use a damaged fan.

NOTE ***The fan must be visually inspected daily.***

NOTE ***Replace a damaged fan with a fan that has an identical part number. Any other fan must be approved by Cummins to be covered under warranty.***



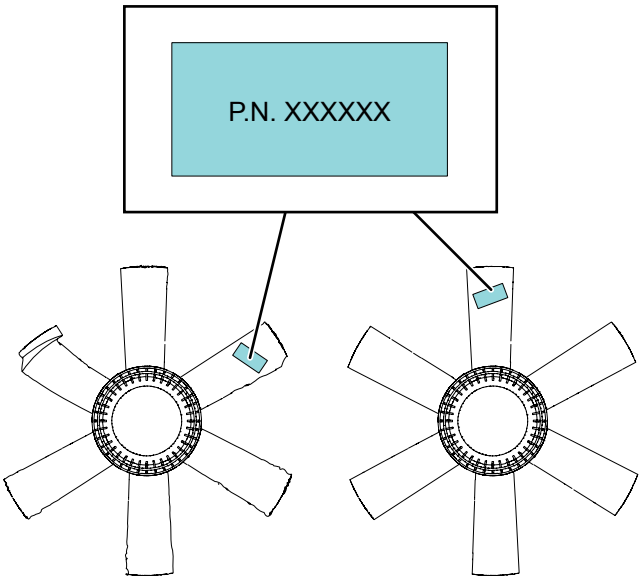
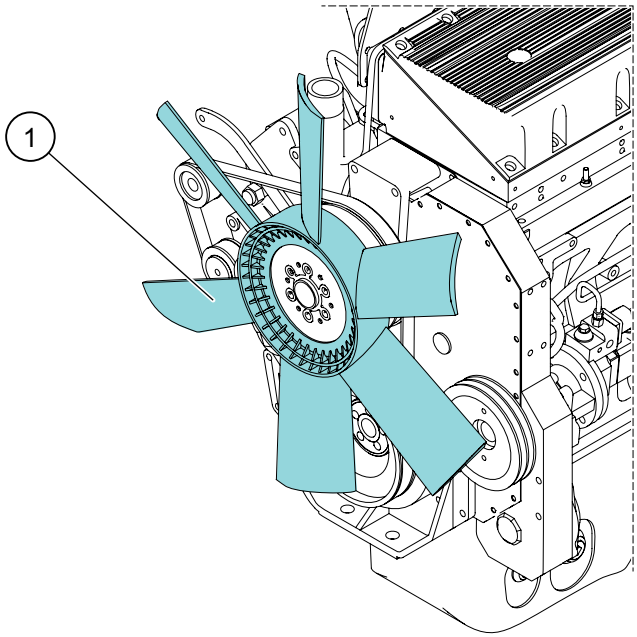


Figure 83. Original fan part number, Cummins

1. Check for cracks, loose rivets.
2. Check for bent or loose blades (1).



3. Check that the fan is securely mounted.
4. Tighten the capscrews if necessary.

NOTE ***Refer to the engine manufacturer's specifications for capscrew torque.***

4.16.13 Checking the Cummins vibration damper

⚠ WARNING

RISK OF DAMAGE TO THE MACHINE

The silicone fluid in the vibration damper will harden after an extended operating time, and will cause the damper to not function properly. This can lead to serious engine or drive line failure.

Check the condition of the vibration damper regularly, follow the regular service schedule.

Service must be performed by an authorized service technician. If service or replacement of parts is needed, contact your local dealer for more information.

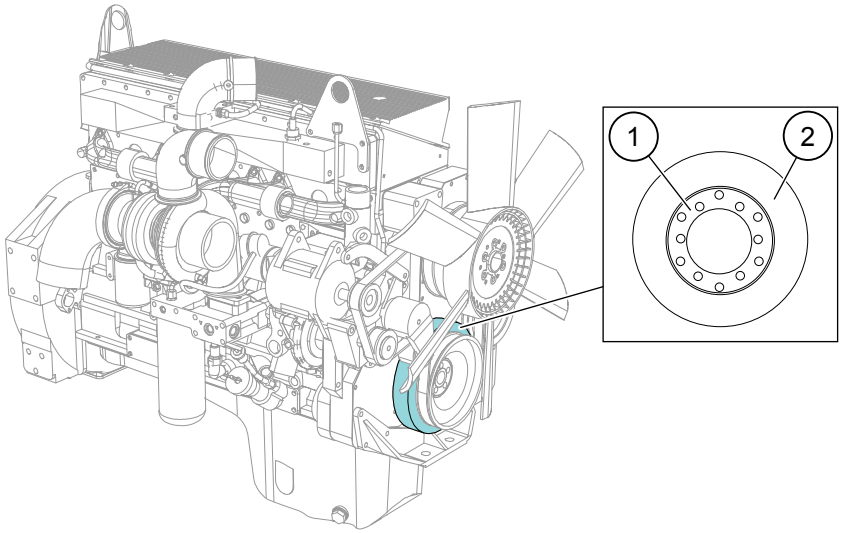


Figure 84. Vibration damper

1. Check the inner part (1) of the vibration damper for cracks, dents, or silicone fluid loss.
2. Check the outer part (2) of the vibration damper for cracks, deformations, or raising of the damper cover plate.

4.16.14 Checking the Cummins water pump

⚠ WARNING

RISK OF DAMAGE TO THE MACHINE

A leaking or damaged water pump can lead to serious engine or drive line failure.

Check the condition of the water pump regularly, follow the regular service schedule.

Service must be performed by an authorized service technician. If service or replacement of the water pump is needed, contact your local dealer.

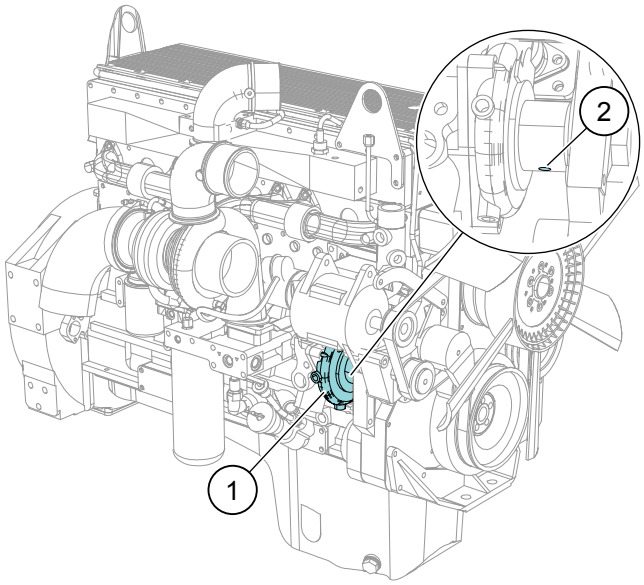


Figure 85. Water pump

Check the drainage hole (2) on the water pump (1) for leakage of coolant or oil.

NOTE ***If dripping or a steady flow of coolant or oil is found, the water pump (1) must be replaced. Contact your local authorized dealer for more information.***

If the drainage hole (2) is clogged, a small screwdriver or similar tool can be used to remove any debris.

NOTE ***Always make sure that the drainage hole (2) on the water pump (1) is clear.***

4.17 Maintaining the DANA transmissions

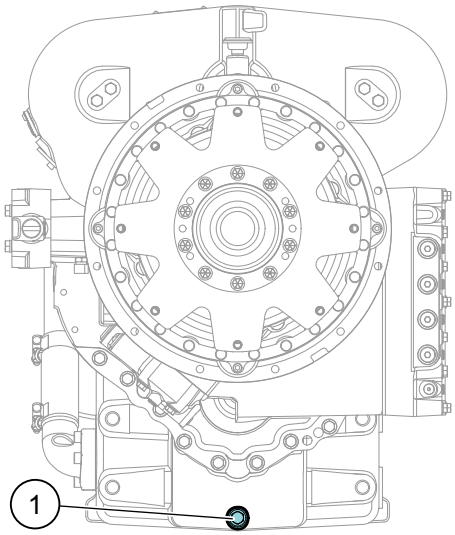
4.17.1 Changing the DANA transmission oil

⚠ WARNING	
	**HOT OIL HAZARD** **Risk of serious personal injury.** **To avoid burns, use care in opening the drain plug.**

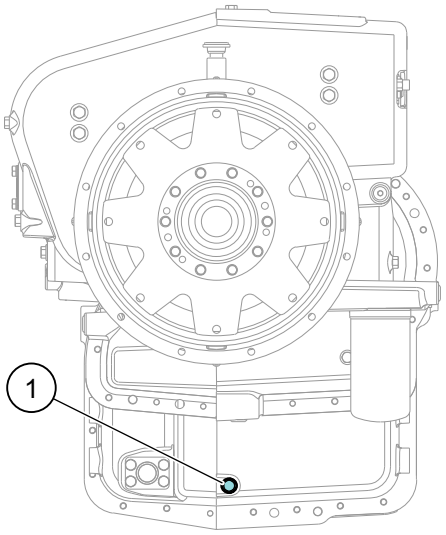
NOTE ***Replace the oil when it is at the operating temperature, 82–93° C (180–200° F).***

NOTE ***Working with the oil system requires special cleanliness.***

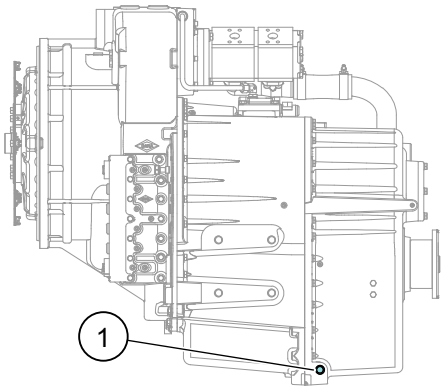
NOTE ***Take care of the excessive oil and dispose of it in an environmentally responsible way.***



DANA TE14



DANA TE17



DANA TE30 (not available for all models)

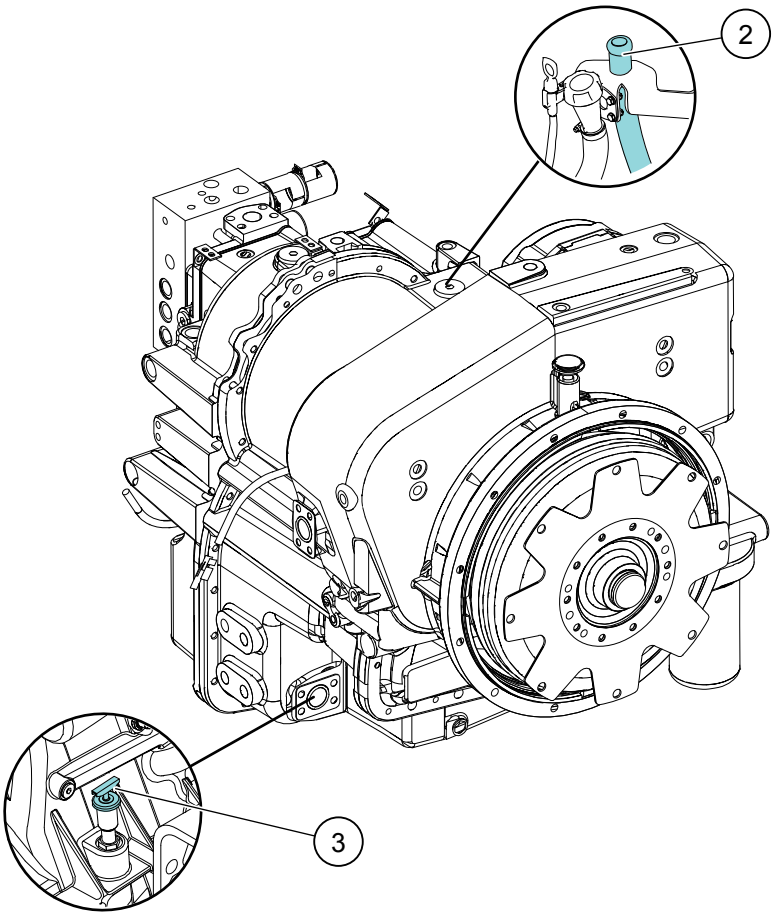


Figure 86. DANA TE17

1. Place a receptacle underneath the drain plug (1).
2. Clean around the drain plug (1).
3. Remove the drain plug (1) and allow the oil to run out.
4. Check the seal on the drain plug (1).
5. Refit the drain plug (1).
6. Remove the filler cap (2).
7. Fill with the recommended oil to the maximum level indicator on the dipstick (3). For more information, see Recommended fluids and lubricants (page 250).
8. To fill the torque converter and pipes, turn on the engine. Let it idle for 1 min.
9. Check the level of the oil while the engine runs.
10. Fill up with oil to the minimum indicator.
11. Check the oil level again when the engines operating temperature has reached 82-93° C (180-200° F). Fill to the maximum level indicator.

4.17.2 Changing the DANA transmission oil filter

RISK OF PROPERTY DAMAGE

NOTICE **Handle the filter with care. Do not fit a damaged filter. Make sure that no dirt or sludge penetrates into the transmission.**

NOTE ***Working with the oil system requires special cleanliness.***

NOTE ***To avoid spillage, place a receptacle under the filter.***

NOTE ***Take care of the excessive oil and dispose of it in a safe controlled manner. Put the used filter in a suitable container, and dispose of it in an environmentally responsible way.***

4.17.2.1 DANA TE17 transmission oil filter

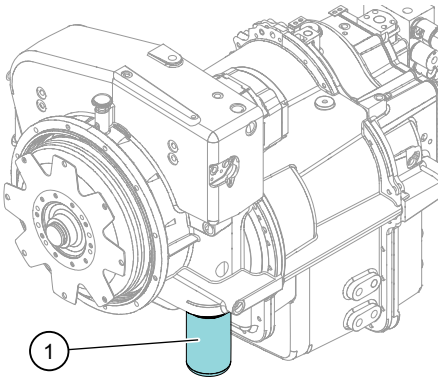


Figure 87. DANA TE17

1. Clean the outside of the filter unit.
2. Loosen the filters by hand or with a filter wrench.
3. Remove the filters.
4. Check the new filters and the seals.
5. Lightly lubricate the seals with oil.
6. Clean the mating surface of the filter housing (1).
7. Screw on the filters until the seal is in contact with the filter housing (1). Tighten another half turn, no more.
8. Start the engine, check that there are no leaks.
9. Check the oil level with the dipstick.
10. Switch off the engine.

4.17.2.2 DANA TE14 and TE30 transmission oil filter

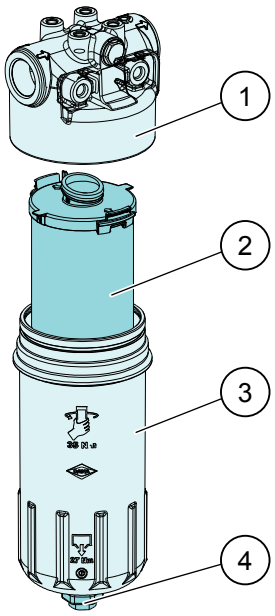
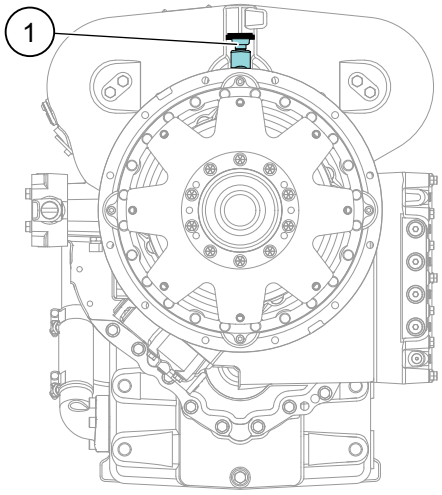


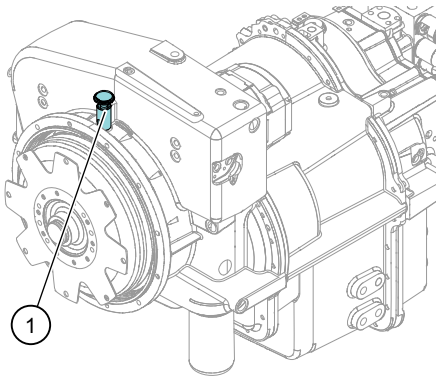
Figure 88. DANA TE14 and TE30

1. Clean around the filter cover (1) and filter housing (3).
2. Remove the drain plug (4).
3. Remove the filter cover (1) with a suitable filter remover.
4. To collect any excess oil, place the filter (2) and the cover (1) in a suitable container.
5. Clean inside the filter (2) with a lint free cloth.
6. Inspect and lubricate the O-ring on the drain plug (4).
7. Insert the drain plug (4) again.
8. Insert the new filter into the filter cover (1).
9. Lubricate the O-ring on the filter cover (1) with clean transmission oil.
10. Screw the filter cover (1) back onto the filter housing (3).
11. Tighten the cover (1) with 35 Nm.
12. Start the engine.
13. Check that there are no leaks.
14. Check the oil level with the dipstick.
15. Switch off the engine.

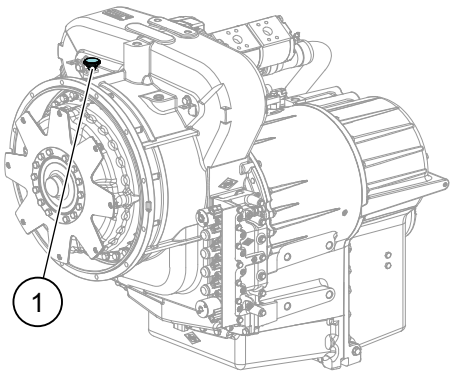
4.17.3 Checking the DANA transmission breather



DANA TE14 (not available for all models)



DANA TE17



DANA TE30 (not available for all models)

1. Clean the transmission breather (1) with a cloth.
2. Check that the transmission breather (1) is not clogged.
3. Replace if necessary.
   Unscrew the transmission breather (1) and replace with a new transmission breather.

4.17.4 Calibrating the DANA transmission

4.17.4.1 Heating up the DANA transmission

⚠ WARNING

RUN OVER HAZARD

If the parking brake fails, the machine can start moving. If so, it can cause death, severe injury, and property damage.

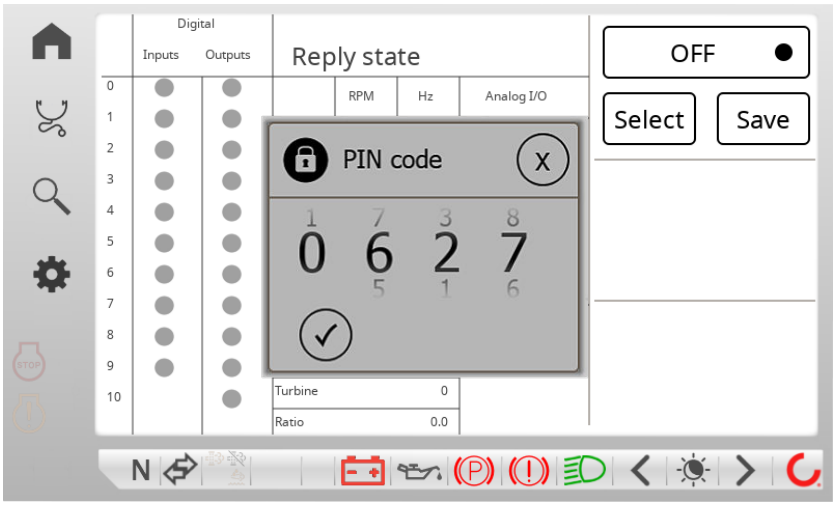
Check the parking brake and replace worn disk pads before heating and calibration.

Heat up the transmission before the calibration procedure.

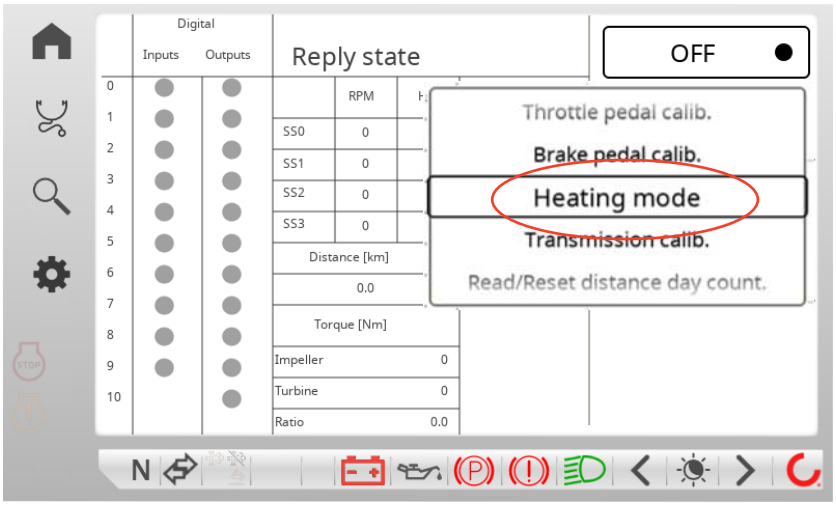
When the heating mode is selected, the following functions are possible:

- Forward or reverse can be selected when the parking brake is activated
- Highest gear is selected automatically

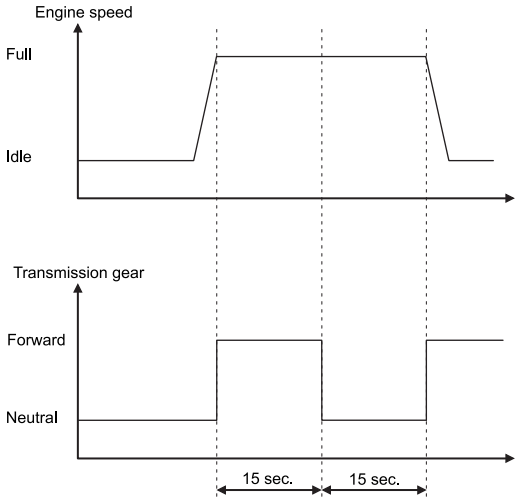
1. Go to **Machine overview > DANA transmission**.



2. From the top-right panel, select **Heating mode**.



3. Make sure that you activate the parking brake and that it works properly.
4. If the parking brake fails, use the foot brake.
5. Select driving direction forward.
6. Run the engine at maximum RPM.
7. After about 15 s at maximum RPM, select neutral.
8. Continue at maximum RPM.
9. Keep the transmission in neutral at maximum RPM for another 15 s.
   The figure shows the heating cycle for the transmission.



10. Release the speed pedal and allow the engine to slow down to idle.
11. Repeat the procedure from step 3 until the transmission has reached a temperature of 80°C...90°C (176°F...190°F).
12. You can now calibrate the transmission.

NOTE ***When the converter output temperature exceeds 120°C (248°F), the engine is reduced to half RPM.***

4.17.4.2 Activating the DANA transmission calibration

⚠ WARNING

RUN OVER HAZARD

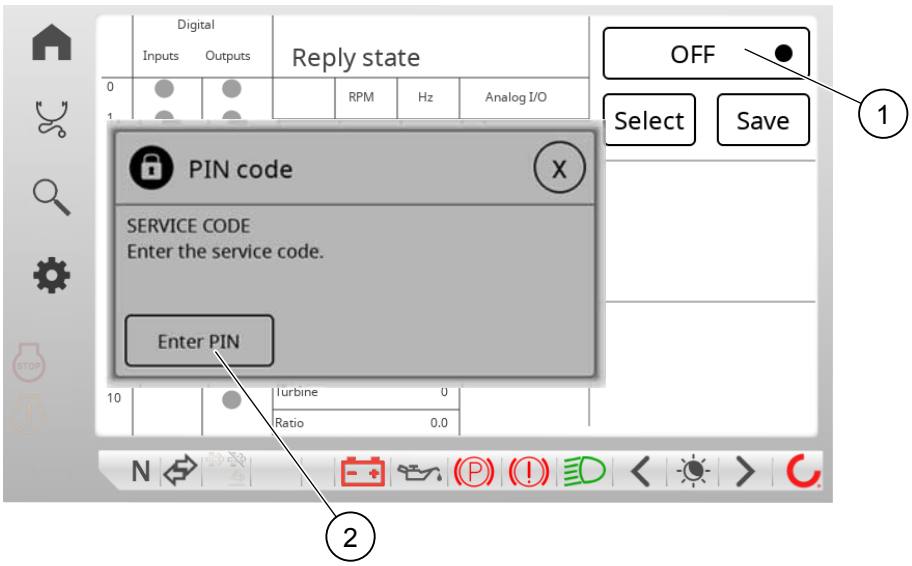
If the parking brake fails, the machine can start moving.

Never leave your seat during calibration. If the parking brake fails, you can use the foot brake.

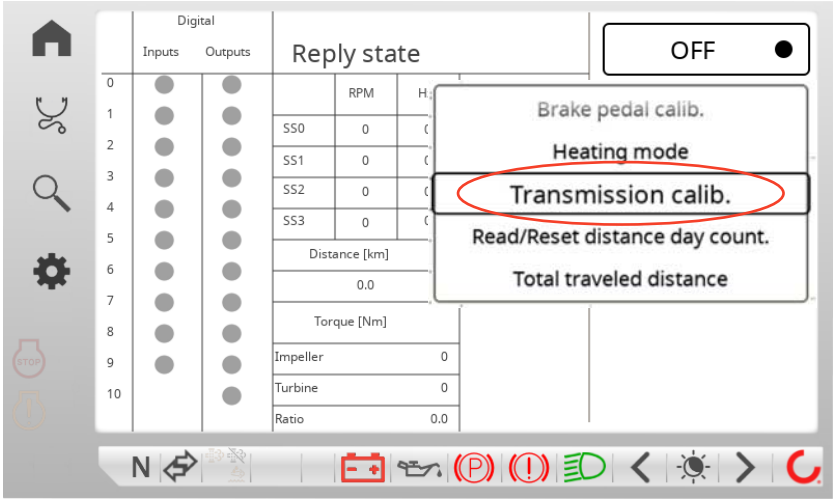
The transmission calibration determines the amount of oil that is required to fill the clutch until the clutch starts to transfer torque.

To activate the transmission calibration, the following conditions must be met:
- Parking brake must be activated and work properly
- Transmission oil temperature must exceed 70°C (150°F)
- Engine RPM must be 800 RPM ± 200 RPM

1. Go to **Machine overview > DANA transmission**.
2. To enter the PIN code (2), press the panel (1).



3. Enter the service PIN code.
4. From the drop-down list, select **Transmission calibration**.



5. To start calibration, tap on **Select**.
   The calibration automatically calibrates all the clutches in the transmission.
   The calibration takes about 20 min to perform.
   If any problems occur during calibration, an error code appears on the display.
6. After finishing the calibration, turn off the ignition.
7. Wait for 5–10 s.
8. Turn on the ignition.
   After the restart, the new settings for gear shifting are in use.

NOTE ***Remember to select "OFF" in the request code menu when you are finished with the calibration.***

4.18 Maintaining the ZF transmissions

This chapter includes the maintenance instructions for the ZF transmissions.

4.18.1 Changing the ZF transmission oil

⚠ WARNING

HOT FLUID HAZARD
Risk of serious personal injury.
Avoid spilling hot oil and do not touch hot surfaces.

NOTE ***Replace the oil when it is at the operating temperature.***

NOTE ***Working with the oil system requires special cleanliness.***

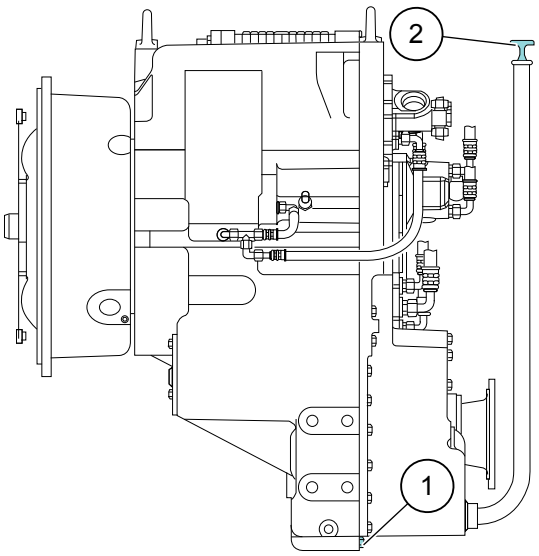


Figure 89. Changing the transmission oil

1. Place a suitable container under the drain plug.
2. Clean around the drain plug (1).
3. Remove the drain plug.
4. Allow the oil to drain.
5. Clean the drain plug.
6. Replace the O-ring on the drain plug.
7. Remove the filler cap (2).
8. Fill with the recommended oil to the maximum level indicator on the dipstick (2).
9. Run the engine on idle for 1 min to fill the torque converter and pipes.
10. Check the oil level when the engine has run for 1 min and then refill to the minimum indicator level.
11. Check the oil level again when the transmission has reached operating temperature. Fill to the maximum indicator level.
    See maintenance data for volume.
12. Put the dipstick and the filler cap (2) back again.

4.18.2 Changing the ZF transmission oil filter

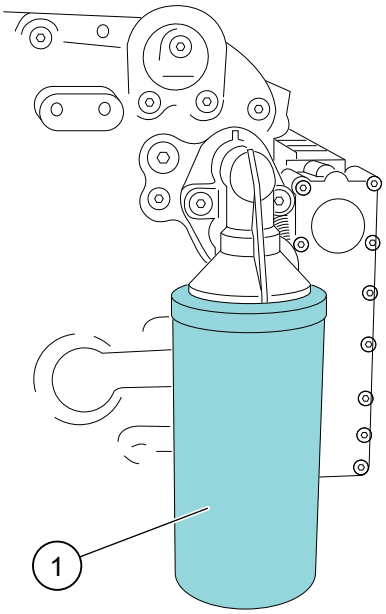
RISK OF PROPERTY DAMAGE

NOTICE **Handle the filter with care. Do not fit a damaged filter. Make sure that no dirt or sludge penetrates into the transmission.**

NOTE ***Working with the oil system requires special cleanliness.***

4.18.2.1 Changing the ZF 191 transmission oil filter

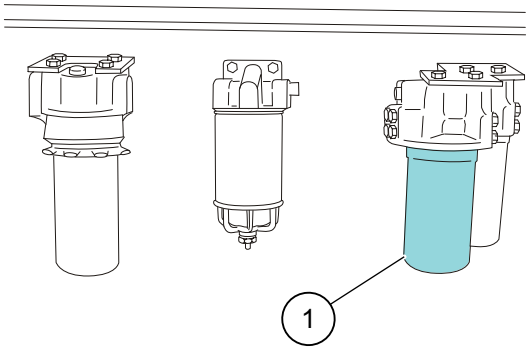
1. Clean the outside of the filter unit.
2. To collect any excess oil, place a receptacle underneath the filters (1).



3. Loosen the filters (1) by hand or with a filter wrench.
4. Remove the filters (1).
5. Check the new filters (1) and the seals.
6. Lightly lubricate the seals with oil.
7. Screw on the filters (1) until the seal is in contact with the filter housing. Tighten another half turn, no more.
8. Start the engine, check that there are no leaks.
9. Check the oil level with the dipstick.
10. Switch off the engine.

4.18.2.2 Changing the ZF 261/311 transmission oil filter

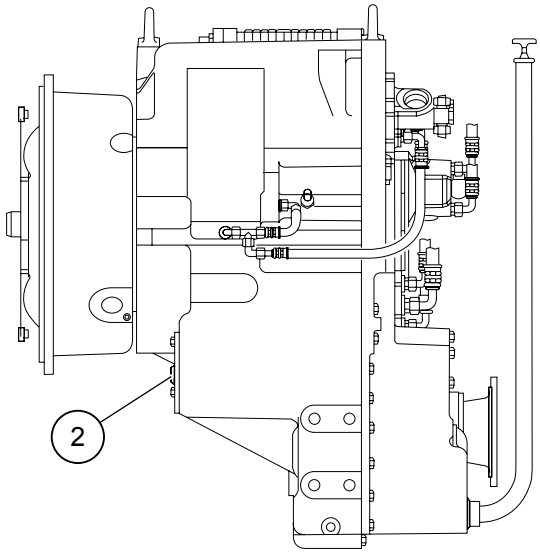
1. Clean the outside of the filter unit.
2. Place a receptacle underneath the filters (1) to collect any oil.



3. Loosen the filters (1) by hand or with a filter wrench.
4. Remove the filters (1).
5. Check the new filters (1) and the seals.
6. Lightly lubricate the seals with oil.
7. Screw on the filters (1) until the seal is in contact with the filter housing, tighten the filter (1) one half turn by hand at the most.

Cleaning the ZF 261/311 transmission oil strainer

8. Clean the transmission oil strainer (2), if available.
9. Carefully clean the outside of the oil strainer unit.
10. Place a receptacle under the oil strainer (2) to collect any oil.



11. Loosen the oil strainer (2).

NOTE ***Make sure that no larger particles (metal pieces or similar) are stuck to the oil strainer (2).***

12. Clean the oil strainer (2).
13. Slightly lubricate the oil strainer (2).
14. Fit the oil strainer (2).
15. Start the engine and check that there are no leaks.
16. Check the oil level with the dipstick.
17. Switch off the engine.

4.18.3 Checking the ZF transmission breather

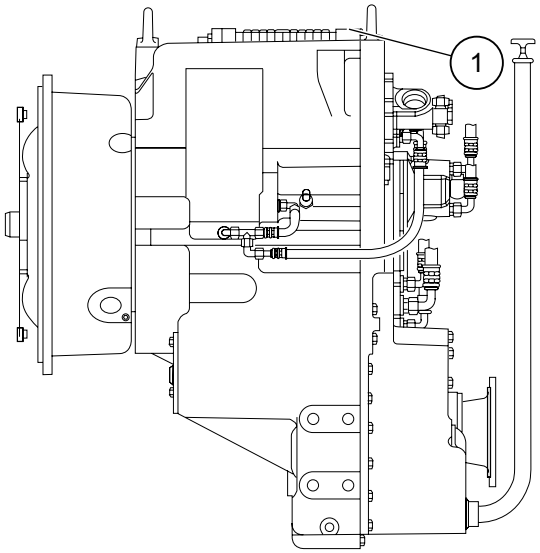


Figure 90. ZF transmission breather

1. Clean the transmission breather (1) with a cloth.
2. Check that the transmission breather (1) is not clogged.
3. Replace if necessary.

4.18.4 Calibrating the ZF transmission

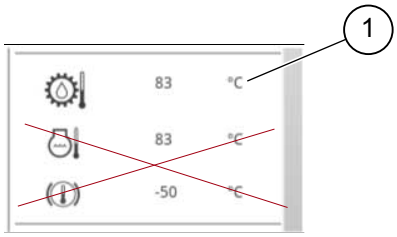
4.18.4.1 Heating up the ZF transmission

⚠ WARNING

UNCONTROLLED MOVEMENT HAZARD
Risk of personal injury or damage to the machine. Only the service brake is in use.
Use chocks to block the wheels.

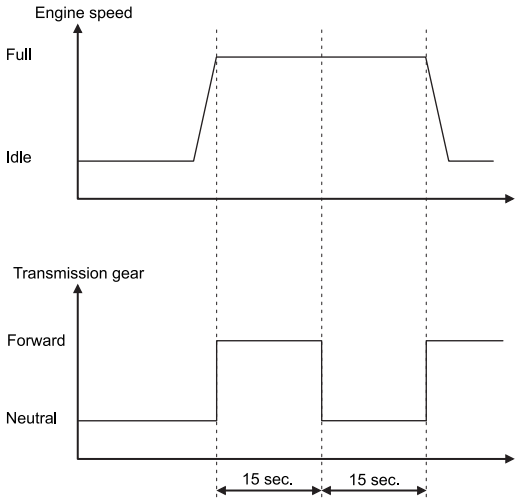
Heat up the transmission before the calibration procedure.

1. To monitor the transmission temperature, go to the **Machine overview> Transmission** page. The transmission temperature displays on the right on the MD4 display (1).



2. Select manual gear shifting.
3. Select the highest gear.
4. Apply the service brake by using the brake pedal in the cabin.
5. Release the parking brake.
6. Select driving direction forward.
7. Run the engine at maximum RPM.
8. After about 15 s at maximum RPM, select neutral.

9. Continue at maximum RPM.
10. Keep the transmission in neutral at maximum RPM for another 15 s.
    The figure shows the heating cycle for the transmission.



11. Release the speed pedal and allow the engine to slow down to idle.
12. Repeat the procedure from step 6 until the transmission has reached a temperature of 80°C...90°C (176°F...190°F).
13. You can now calibrate the transmission.

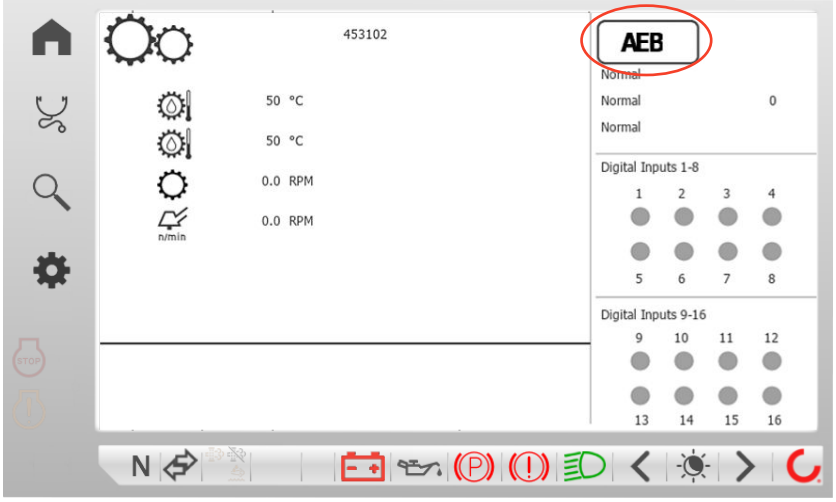
NOTE ***When the converter output temperature exceeds 125°C (257°F), the engine is reduced to half RPM.***

4.18.4.2 Activating the ZF transmission calibration

The transmission calibration determines the amount of oil that is required to fill the clutch until the clutch starts to transfer torque.

To activate the transmission calibration, the following conditions are required:
- Parking brake must be activated and work properly
- Transmission oil temperature must exceed 70°C (158°F)

1. Start the calibration by pressing AEB on the **Transmission page**.
   AEB = Automatisiertes Ermitteln der Befüllparameter (Automated determination of the filling parameters).



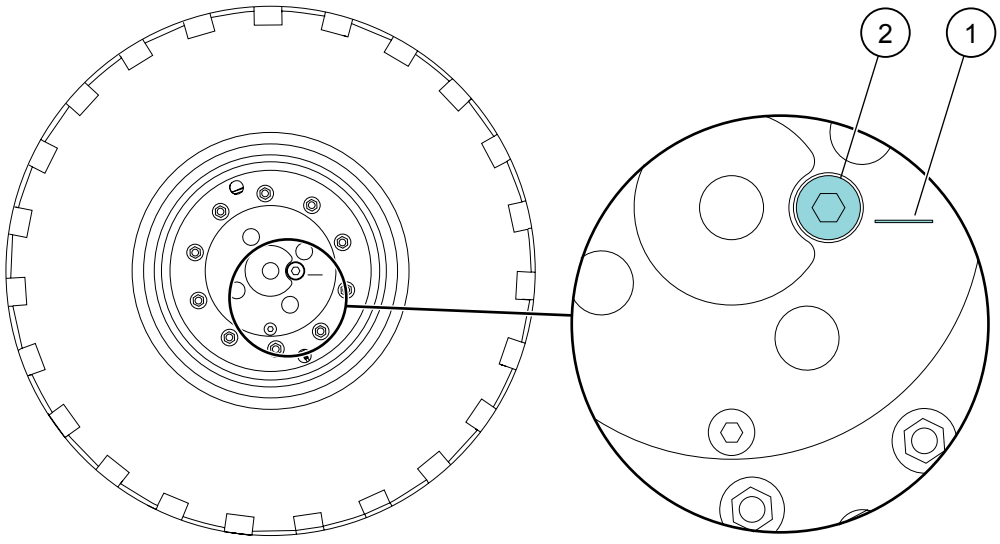
2. The calibration takes 15–20 min. The grey progress bar shows when the calibration is complete. Click OK.
3. Switch off ignition.
4. Wait 5–10 s. before turning on the machine again.
5. Switch the machine back on.
   The new values are in use now.

4.19 Maintaining the drive axle

4.19.1 Checking the drive axle oil level

NOTE ***Check the oil level in both hubs and the differential.***

1. Park the machine on level ground.
2. Make sure the hub level mark (1) is horizontal and you can read the text "oil" on the hub.



3. Open the filling and level plugs (2) and check the oil level.

- If oil seeps out of the filling and level plug, there is enough oil.

NOTE ***If a large amount of oil comes out, check for internal leakage.***

- If no oil seeps out, the oil level must be checked.

NOTE ***Minimum oil level is at least 1 cm from the edge of the filling and level hole.***

4. If there is not enough oil, refill oil to at least the minimum level.
5. Tighten the filling and level plug (2).

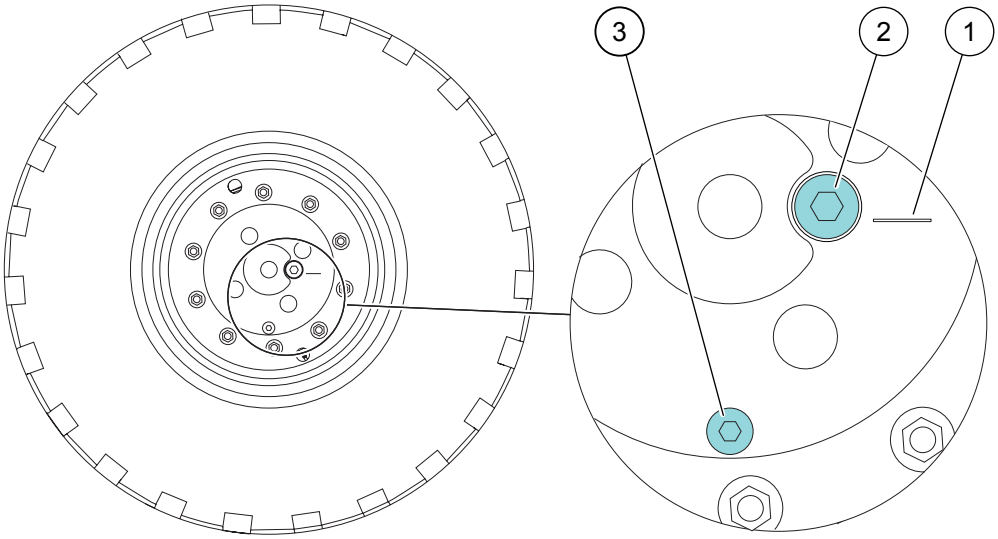
4.19.2 Changing the drive axle oil

NOTE ***Change the oil in both hubs and the differential.***

NOTE ***Take care of the excess oil and dispose of it in an environmentally responsible way.***

Park the machine on level ground.

4.19.2.1 Changing the drive axle oil - hub

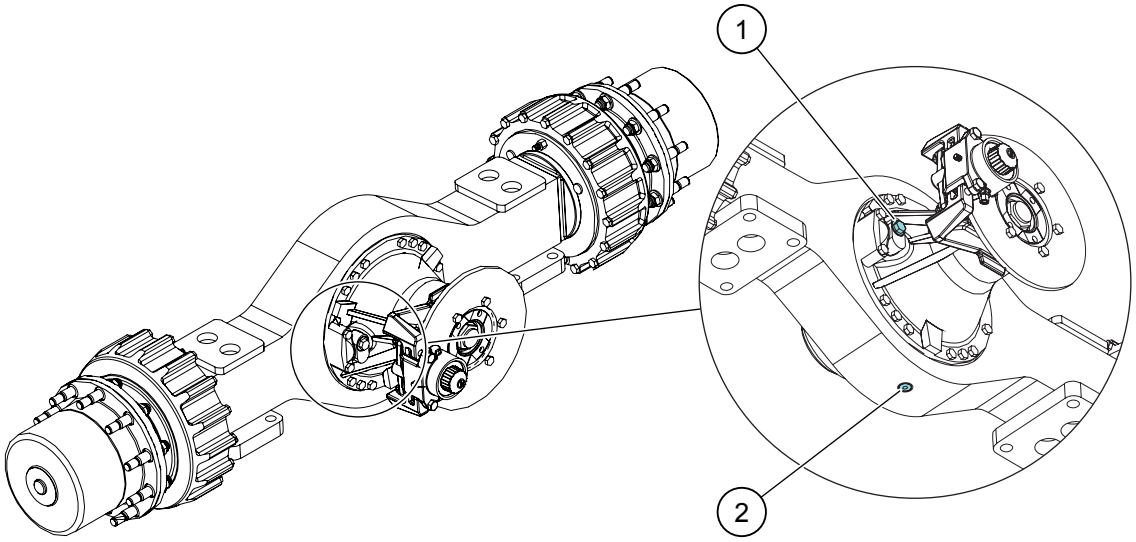


1. Make sure that the drain hole (3) is located in the highest position on the wheel.
2. Clean around the drain hole (3) and plug.
3. Remove the plug from the drain hole (3).
4. Fix a suitable hose in the drain hole (3).
   Use a hose that fits the threads in the the drain hole (3).
5. To reposition the drain hole (3), carefully drive the machine in any direction.
   Make sure that the drain hole (3) is located in the lowest position on the wheel.
6. Drain the oil through the hose into a receptacle.
7. Refit the plug into the drain hole (3).
8. Place the machine with the level mark (1) and the text "oil" in horizontal position on the hub.
9. Open the filling and level plug (2).
10. Fill the drive axle through the filling and level plug (2).

NOTE ***Minimum oil level is at least 1 cm from the edge of the filling and level hole.***

11. Close the filling and level plug (2).
12. Repeat the procedure on the opposite side.

4.19.2.2 Changing the drive axle oil - differential

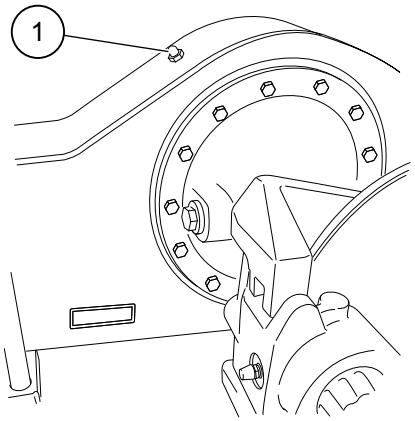


1. Clean around the drain plug (2).
2. Remove the drain plug (2).
3. Drain the differential through the drain plug (2).
   Drain the oil at operating temperature or overnight, as the oil is of high viscosity.
4. Refit the drain plug (2).
5. Open the filling and level plug (1).
6. Fill the drive axle through the filling and level plug (1).

NOTE ***Minimum oil level is at least 1 cm from the edge of the filling and level hole.***

7. Close the filling and level plug (1).

4.19.3 Checking the drive axle breather

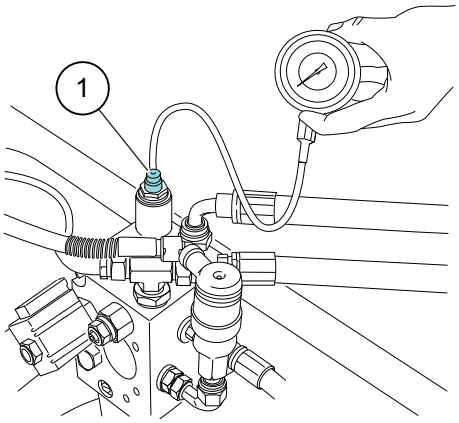


1. Check that the drive axle breather is not clogged.
2. Replace if necessary.

Unscrew the drive axle breather (1) and replace with a new drive axle breather.

4.19.4 Measuring the parking brake pressure

1. Connect a pressure gauge (0–300 bar or 0–5000 psi) to the measuring point (1) marked PRM on the accumulator charging valve.



2. Start the engine and let it idle.
3. Release the parking brake.
4. Read the pressure. Check according to the machine card.

4.19.5 Adjusting the parking brake

⚠ WARNING

MOVING VEHICLE HAZARD.

The machine can move if not parked on level ground and with the wheels firmly secured. If the machine moves, there is a risk of serious injury or death.

Park the machine on level ground and firmly secure the wheels.

Adjusting the parking brake is required after installing new brake pads or brake disc, after all repairs, and to improve braking performance. Adjust the parking brake when it is cold. The parking brake must be in the released condition while adjusting.

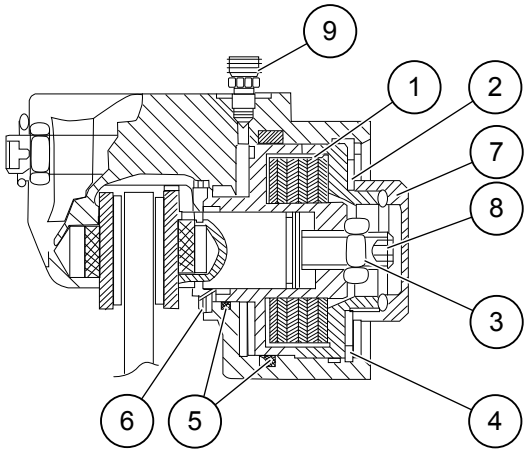


Figure 91. Parking brake

1. Spring
2. Lock ring
3. Locknut
4. Seal
5. Piston sealing
6. Dust cap
7. Screw cap
8. Adjusting screw
9. Bleeder screw

1. Park the machine on a level surface.

NOTE ***To prevent the vehicle from moving, block the wheels.***

2. To release the parking brake, press the parking brake switch.

NOTE ***The parking brake pressure must be correct and the ignition must be on.***

3. Remove the screw cap (7).
4. Loosen the locknut (3). Turn the adjusting screw (8) clockwise until both brake pads contact the brake disc.
5. Turn the adjusting screw counterclockwise to set the total clearance to 1–0.5 mm (0.04–0.02 in).
6. Tighten the locknut (3).
7. Recheck the clearance.

4.19.6 Manually releasing the parking brake

DANGER

RUN OVER HAZARD

If the engine is running, the service brake is working. If the engine is not running, only the parking brake is working. If it is released, the machine has no brakes. Risk of serious personal injury or death.

To prevent the machine from moving, block the wheels.

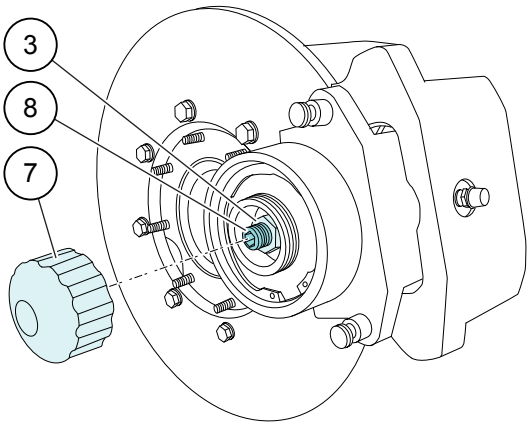


Figure 92. Manually releasing the parking brake

If hydraulic pressure is not available, the parking brake can be manually released as follows:

1. To prevent the machine from moving, block the wheels.
2. Remove the screw cap (7).
3. Loosen the locknut (3).
4. Turn the adjusting bolt (8) counterclockwise until the brake is released.
5. Tighten the locknut (3). Install and hand-tighten the screw cap.

NOTE ***Before you return the machine to operation, adjust the parking brake, see Adjusting the parking brake (page 202).***

4.19.7 Bleeding the parking brake

When you loosen the hydraulic hose of the parking brake, bleed the parking brake to remove the air from the system. To obtain the correct functionality, all air in the brake cylinder must be vented out.

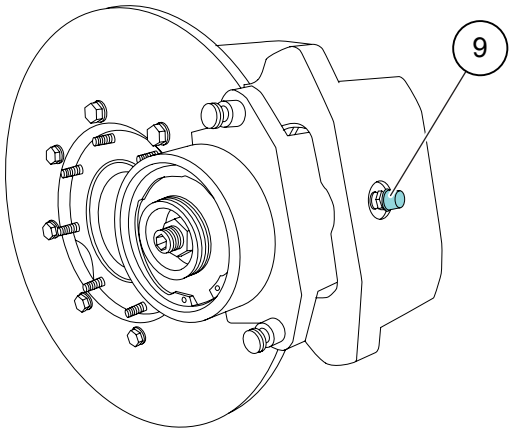


Figure 93. Bleeding the parking brake

1. Attach a clear tube to the bleeder screw (9). Insert the other end of the tube in a receptacle.
2. Apply hydraulic pressure to the parking brake.
3. Loosen the bleeder screw (9).
4. Continue to apply pressure until no air bubbles appear in the hydraulic oil in the receptacle.
5. Tighten the bleeder screw and release the pressure.

4.20 Maintaining the steer axle

4.20.1 Checking the steer axle bearings

Check the wheel and spindle bearings regularly and always when the tires are replaced. It is important to check the steer axle bearing during running in.

It is important that there is no play in the steer axle bearings, as they are exposed to heavy loads and shocks. Any play results sooner or later in bearing breakdown. Bearings are adjustable.

For more information, see Adjusting the wheel bearings (page 206).

NOTE ***Play in link bearings are acceptable to 1–2 mm (0.04–0.08 in) for each bearing. Link bearings are not adjustable.***

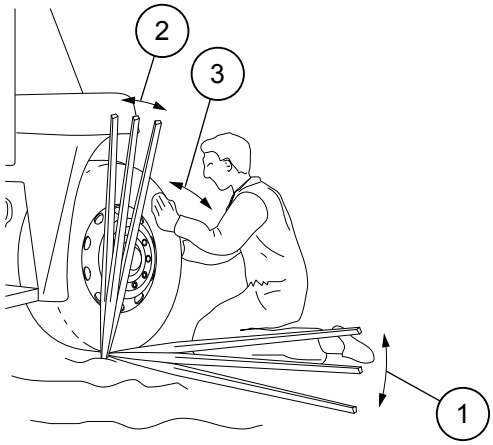
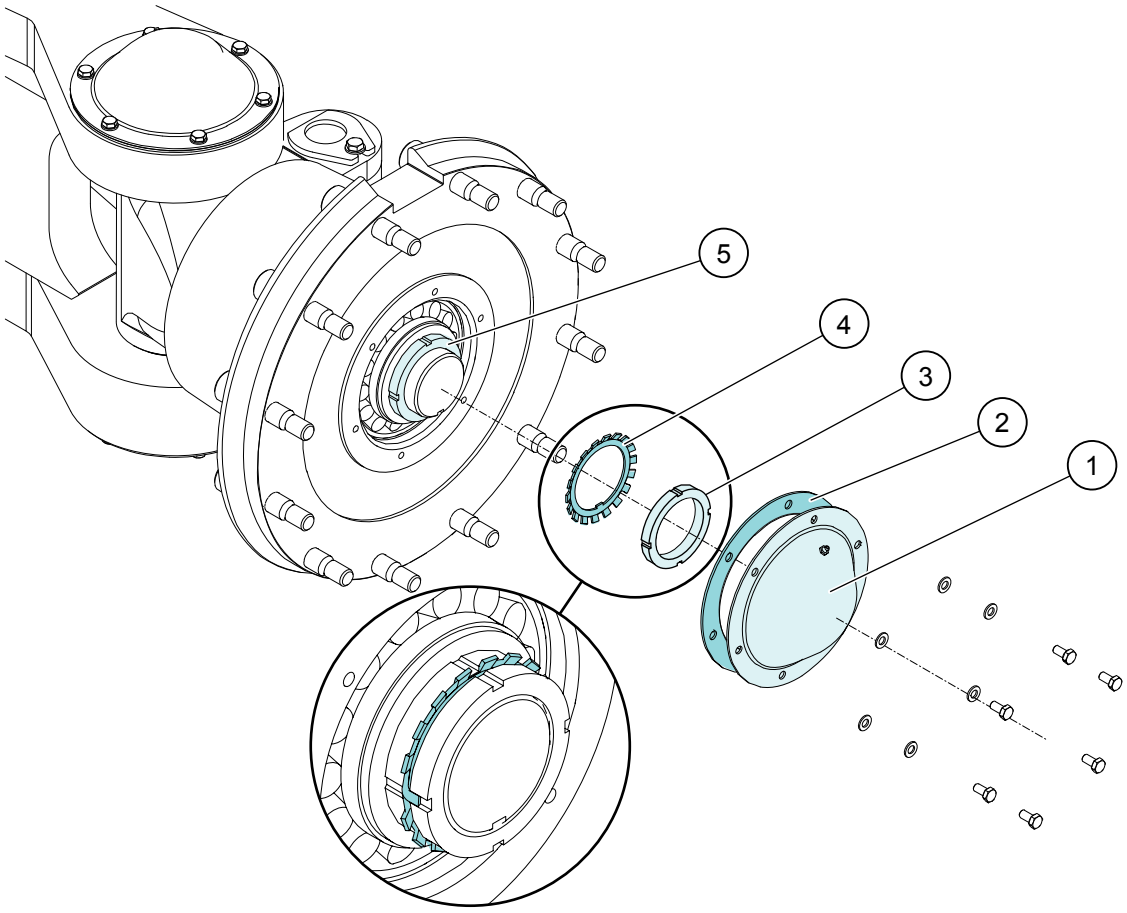


Figure 94. Checking the steer axle bearings

1. To lift each side, use a jack. See Positioning the jack (page 75).
2. Check the plays when the wheel rises from the ground.
3. Check the spindle bearings by lifting the wheel with a crowbar (1). See Adjusting the spindle bearings (page 207).
4. Check the wheel bearings by prying the wheel vertically (2). See Adjusting the wheel bearings (page 206).
5. Check the link bearings by turning the wheels in the steering direction (3).

4.20.2 Adjusting the wheel bearings



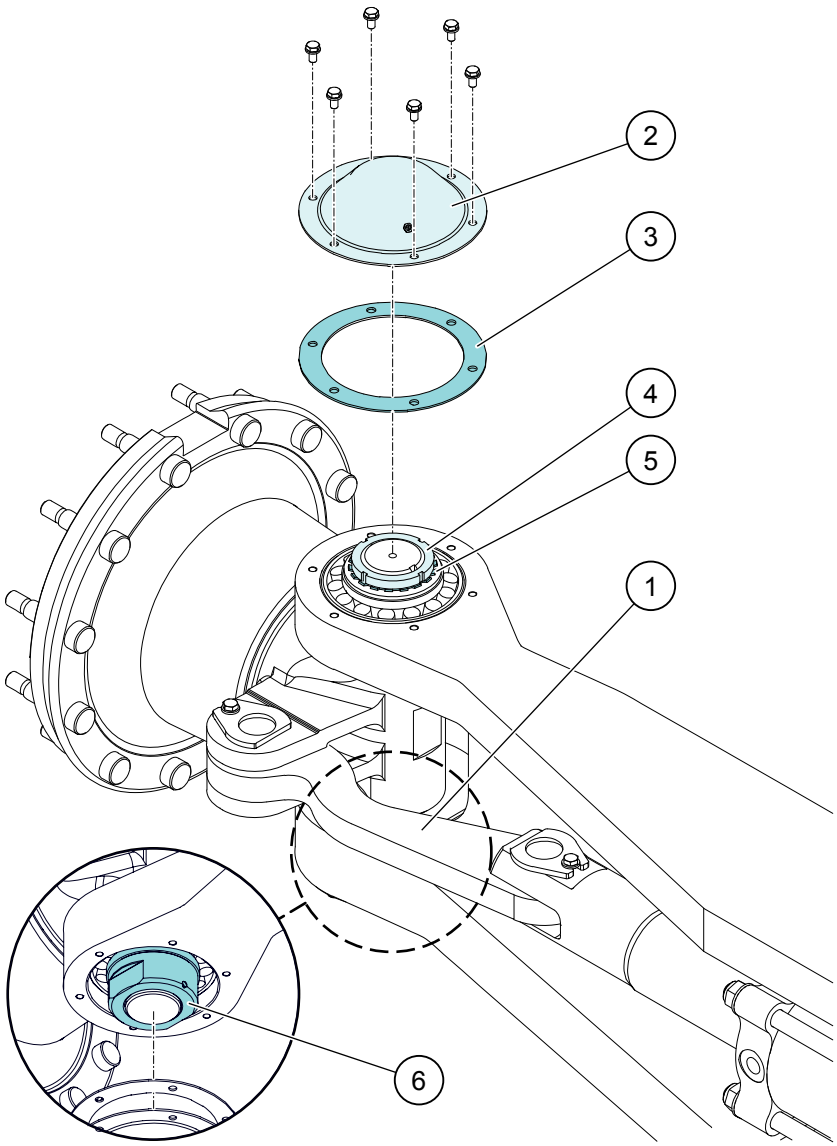
NOTE ***For instructions on how to jack up the machine, see Positioning the jack (page 75).***

1. Remove bearing cover (1) and gasket (2).
2. Check that the grease is clean and free from particles.
   If the the grease is not clean or free from particles, the reason for the play may be a damaged bearing.
3. Loosen the outer nut (3) and remove the lock washer (4).
4. Tighten the inner nut (5).
   First tighten the nut to 500 Nm (368. 78-lbf ft).
5. Rotate the hub ten revs anti-clockwise.

NOTE ***The hub should only offer light resistance when rotating. A noise or irregular rotation means that the bearings are damaged. If so, the bearings must be replaced.***

6. Repeat steps 4 and 5 once.
7. Tighten the inner nut (5) again to achieve the correct torque of 500 Nm (368. 78-lbf ft).
8. Mount the lock washer (4).
9. Tighten the outer nut (3) to achieve the correct torque of 300 Nm (162.3-lbf ft).
10. Lock the outer nut (3) using the lock washer (4).
11. Refit the gasket (2) and bearing cover (1).

4.20.3 Adjusting the spindle bearings



NOTE ***For instructions on how to jack up the machine, see Positioning the jack (page 75).***

NOTE ***The steer wheel may have to be removed to access the spindle and bearing. For instructions on how to remove the steer wheel, see Dismantling the steer wheels, wheels with clamp units (page 87).***

1. Remove the steering link (1).
2. Remove the bearing cover (2) and gasket (3).
3. Check that the grease is clean and free from particles.
   If the the grease is not clean or free from particles, the reason for the play may be a damaged bearing.
4. Unscrew the upper nut (4) completely. Otherwise, you cannot reach 1000 Nm (737.6-lbf ft) with the lower nut.
5. Loosen the lock washer (5).
6. Check that the lower nut (6) is tightened. Tighten the stop screw with 35 Nm and Loctite. The correct torque is 1000 Nm (737.6-lbf ft).

NOTE ***The lower nut (6) is not used to preload the bearing. All bearing preload is adjusted with the upper nut (3).***

7. Tighten the upper nut (4).
   The correct torque for KM12 and KM17 is 300 Nm (221.3-lbf ft), and for KM22 is 350 Nm (258.1-lbf ft).
8. Rotate or swing the spindle ten times to the end positions (left-right-left-right, and so on).
9. Tighten the upper nut (4) again. The spindle should only offer light resistance when turning.

NOTE ***A noise or irregular rotation means that the bearing is broken. Replace the bearing.***

10. Lock the upper nut (4) with the lock washer (5).
11. Refit a new gasket (3).
12. Refit the bearing cover (2).
13. Fill the bearing house with grease.

4.21 Maintaining the hydraulic system

4.21.1 Changing the hydraulic oil

The filter should be changed when the hydraulic oil is changed.

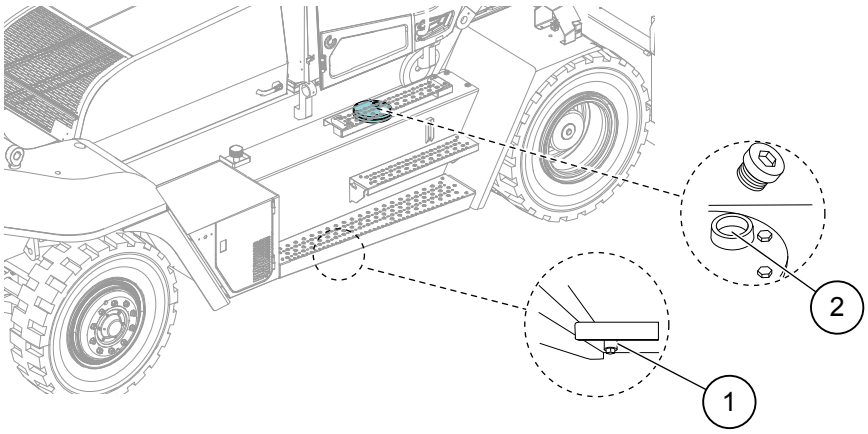


Figure 95. Changing the hydraulic oil

1. Drain out the oil through the drain plug (1), using a receptacle.

NOTE ***If the filters have been removed, soak up the oil through the filter housings.***

2. Check the tank for cracks and signs of leakage.
3. Inspect the bottom of the tank through the inspection hatches for any deposits.
4. Clean the tank if needed.
5. Assemble the filters and covers if removed.
6. Fill up the hydraulic oil through the filling cap (2) in the filter cover, the oil flows through the filters.

NOTE ***To make sure that the oil goes through the filters quickly, connect the oil pump to the filling cap (2).***

4.21.2 Starting the hydraulic pumps

NOTICE

RISK OF DAMAGE TO THE MACHINE

Air in the system may damage the hydraulic system.

Never start the machine if the pumps are not air-bled.

The machine is equipped with variable pumps. After servicing pumps or other parts of the hydraulic system, the pumps are started as follows.

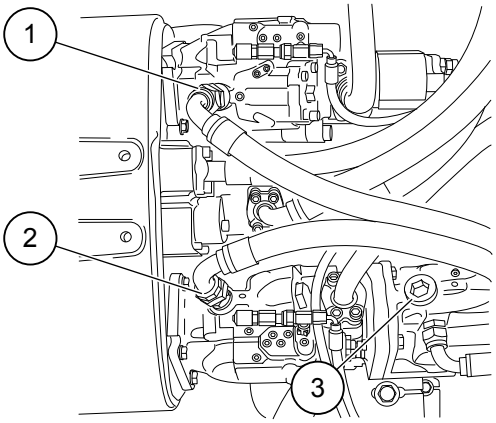


Figure 96. Hydraulic pump

1. Disconnect hoses (1) and (2).
2. Unscrew pump plug (3).
3. Fill the three pump housings with the recommended hydraulic oil.
4. Refit the hoses (1), (2) and the pump plug (3).
5. Start the machine and raise the forks slowly.

NOTE

Any noise should disappear after a few seconds. If there is a consistent noise, which does not disappear after a few seconds, turn of the machine and check the hydraulic system.

4.21.3 Changing the hydraulic oil filter

RISK OF DAMAGE TO THE MACHINE

NOTICE

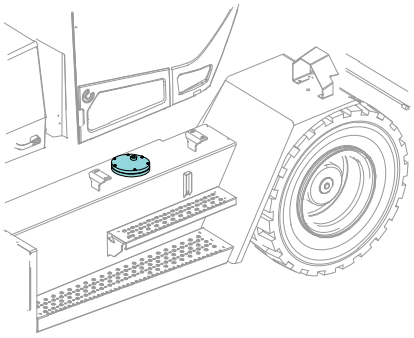
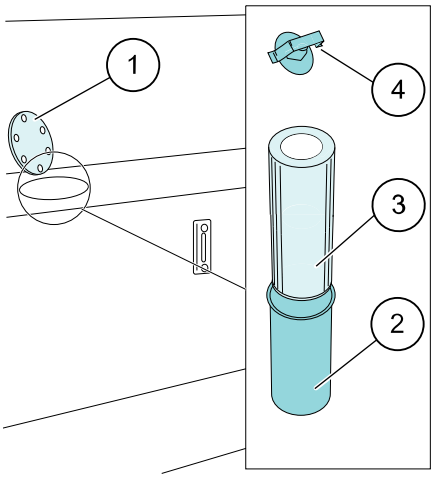
Changing the hydraulic oil filter without following these instructions may damage the hydraulic system.

Always follow these instructions when changing the hydraulic oil filter.

NOTE ***To be able to check the oil, the forks must be lowered to ground level.***

The hydraulic oil filters are in the hydraulic tank. In smaller forklifts, the tank is located under the steps, in bigger ones, the tank is next to the steps.

Table 13. Location of hydraulic tank and filter - smaller forklifts (SMV 10-16)

	
Location of hydraulic tank	**Hydraulic oil filter components**

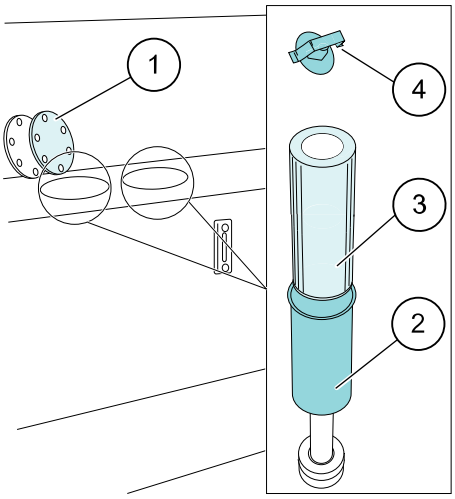
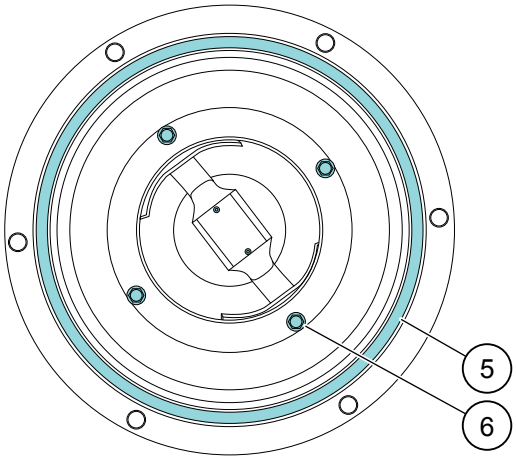


Figure 97. Hydraulic oil filter components

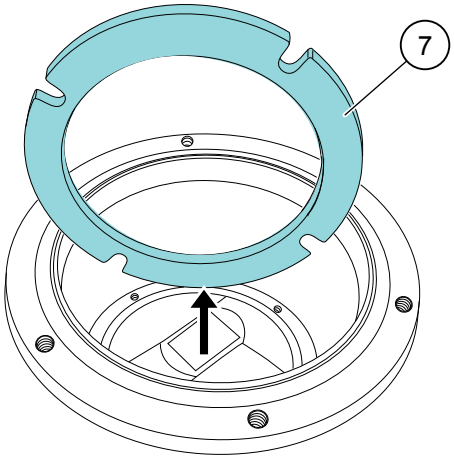
1. Filter cover
2. Filter housing
3. Hydraulic oil filter
4. Overflow valve

1. With smaller forklifts, remove the top step to access the hydraulic tank.
2. Clean around the filter cover (1).

3. Remove the filter cover (1).
4. Check the condition of the seal (5).
5. Remove the four screws (6) of the filter housing in the return chamber.

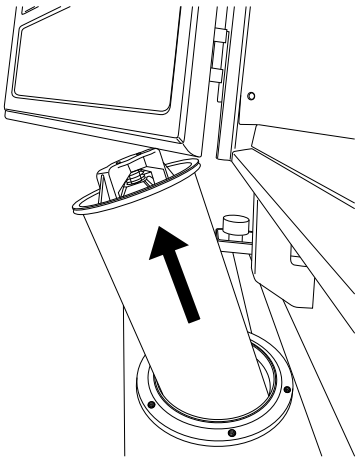


6. Remove the rim (7) of the filter housing.



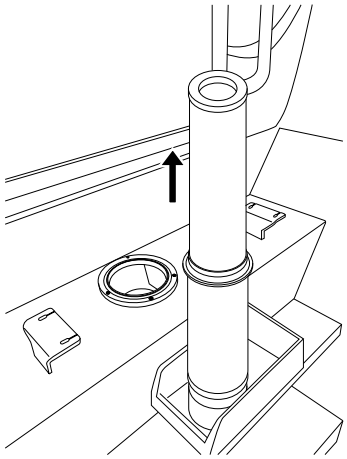
7. Lift the complete filter housing from the hydraulic tank. Let it drain before disassembling it.

NOTE ***With smaller forklifts, open the cabin door before you remove the filter housing.***

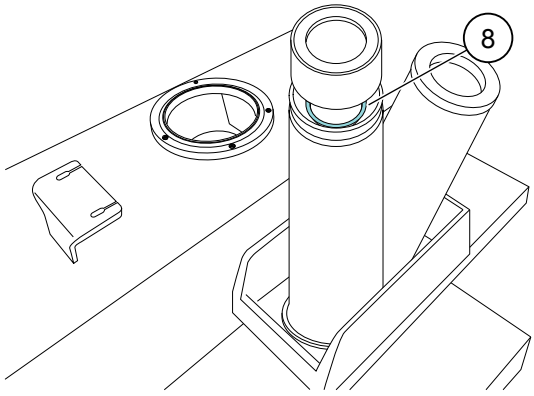


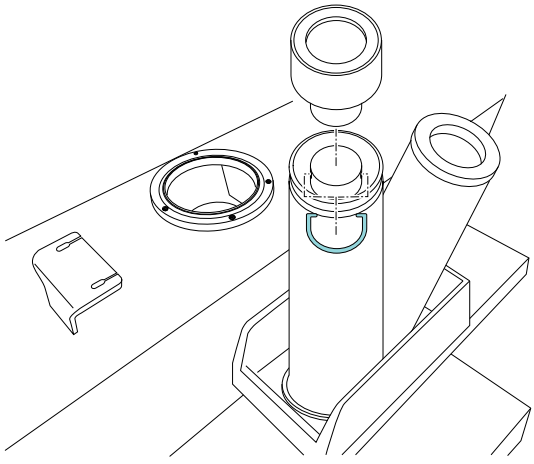
8. After you have removed the filter housing, check the filter area for any deposits.
9. Remove the overflow valve (4) by pressing and turning it.

10. Take the filter from the filter housing.

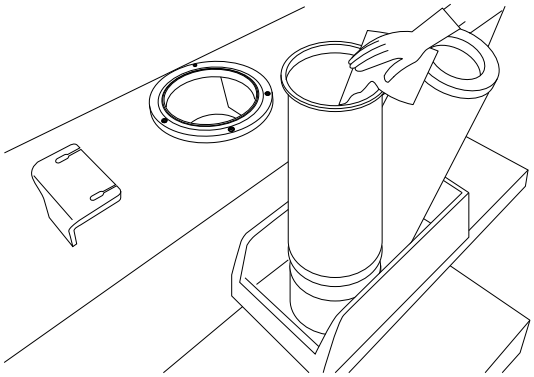


11. Remove the hydraulic filter spring (8).





12. Remove the filters.
13. Check the filters for any deposits. Remove the deposits.
14. Clean the filter housing, using a lint free cloth.



15. Fit new filters, close with the overflow valve (4).
    Press and turn to the correct position.
16. Fit the filter housing in the tank.
17. Fit rim (7) and then put back the screws in the filter housing.
18. Fit the filter covers using new O-rings.
19. Fill with oil if the oil has been drained.
20. Start the machine and check for leakage.
21. Turn off the machine and check the oil level.
    For more information, see Starting the hydraulic pumps (page 209).

4.21.4 Hydraulic long life (HLL) filter (option)

NOTE ***Working with the oil system requires special cleanliness.***

NOTE ***To avoid spillage, place a receptacle under the filter.***

NOTE ***Take care of the excessive oil and dispose of it in a safe controlled manner. Put the used filter in a suitable receptacle, and dispose of it in an environmentally responsible way.***

4.21.4.1 Placement of the hydraulic long life (HLL) filter

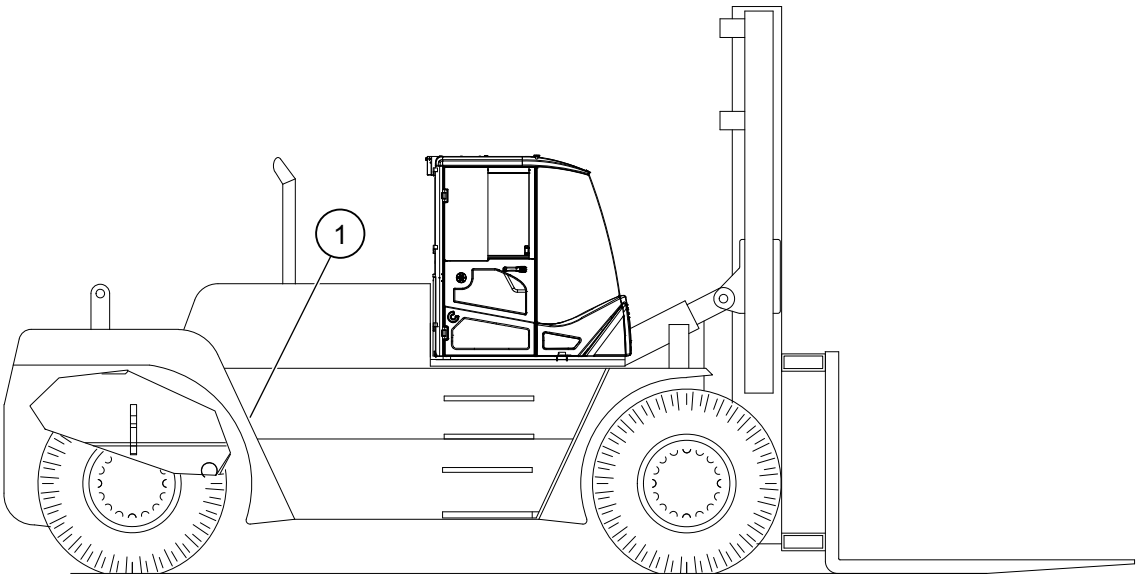


Figure 98. Placement of filter, SMV 10-16

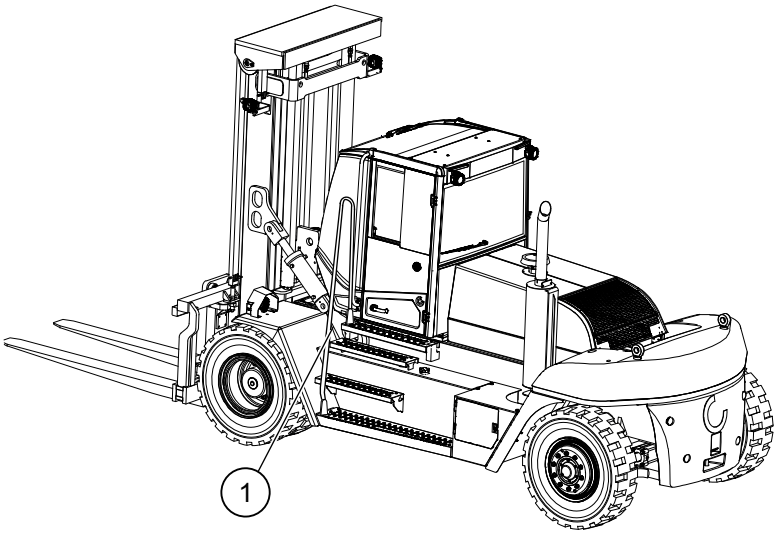


Figure 99. Placement of filter, SMV 18-60

1. Placement of the HLL filter

4.21.4.2 Checking the HLL filter

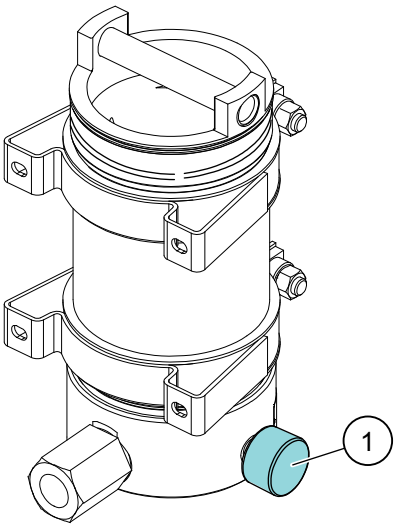


Figure 100. Pressure indicator

The pressure indicator (1) shows the status of the HLL filter, when the machine is on. If the indicator points towards the red area between service intervals, the HLL filter must be changed. For more information, see Changing the hydraulic long life (HLL) filter (option) (page 214).

4.21.4.3 Changing the hydraulic long life (HLL) filter (option)

NOTE ***If the pressure indicator (5) points towards the red area between service intervals, the filter must be changed. Otherwise, follow the regular service recommendations. See Regular service (page 236)***

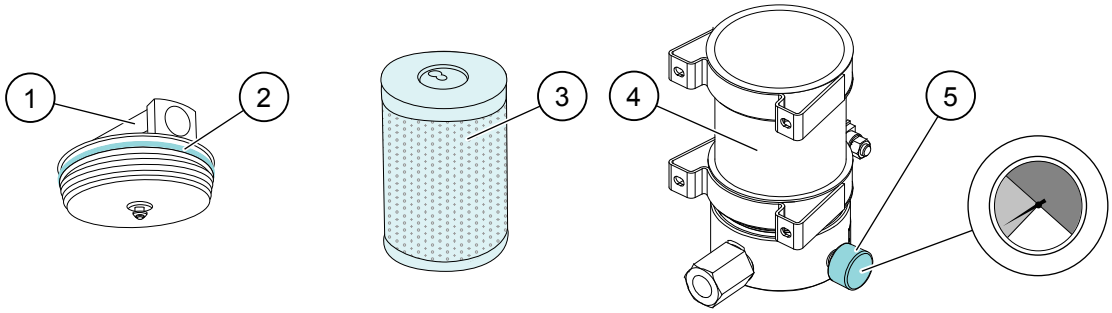
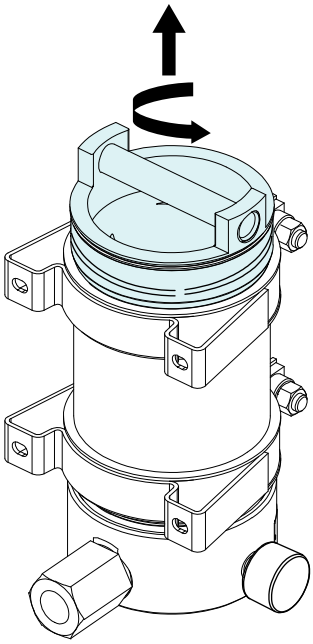


Figure 101. Parts of the HLL filter

1. Filter cover
2. Seal (O-ring)
3. Filter
4. Filter housing
5. Pressure indicator

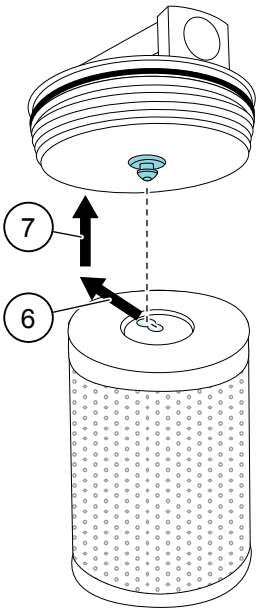
1. Clean the surface around and on the filter housing (4) and cover (1).



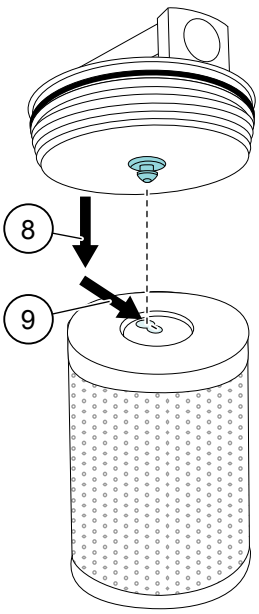
2. To open the cover (1), turn it counterclockwise.

3. Lift the cover (1) and filter (3) slowly.

NOTE ***Let the excess oil drip into the filter housing (4).***

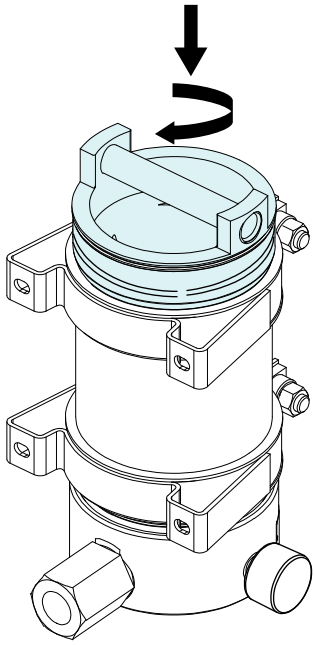


4. To collect any remaining oil, place the filter (3) and the cover (1) in a suitable container.
5. To remove the cover (1) from the filter (3), slide the cover outwards (6) and pull upwards (7).
6. Dispose of the filter (3) in a responsible way.
7. Remove and change the seal (2).



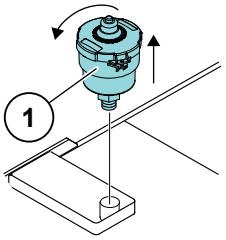
8. To attach the cover (1) to the new filter, move the filter downwards (8), and fit the pin in the filter.

9. Slide the cover (1) towards the middle (9).

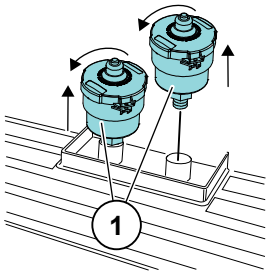


10. Insert the new filter with the attached cover (1) into the filter housing (4).
11. To fixate the cover (1), turn it clockwise in the filter housing (4).

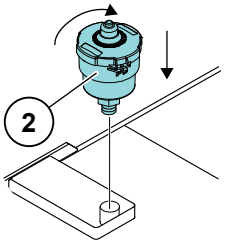
4.21.5 Changing the hydraulic tank breather filter



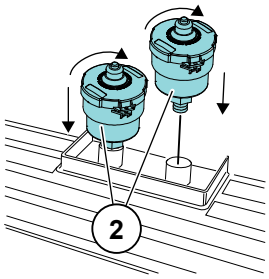
Remove breather filter, single



Remove breather filter, double



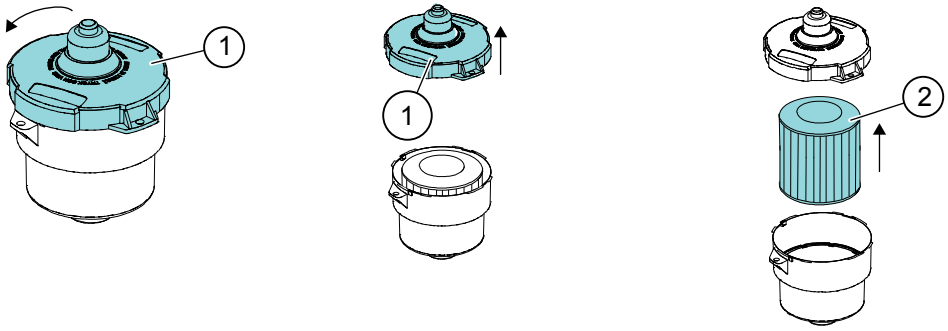
Replace breather filter, single



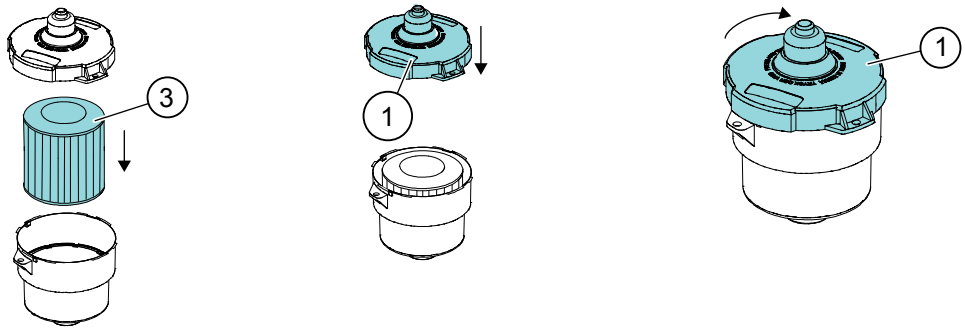
Replace breather filter, double

1. Clean around the breather filter housing.
2. Unscrew the breather filter (1).
3. Replace with a new breather filter (2).

4.21.5.1 Replace filter element in the breather filter housing



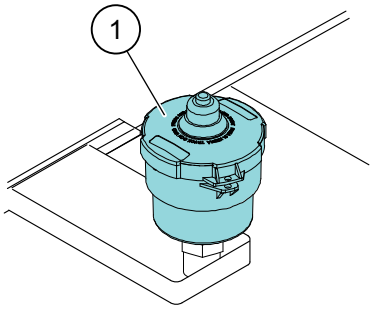
1. Clean around the filter cap (1).
2. Unscrew the filter cap (1).
3. Remove the filter cap (1).
4. Remove the filter element (2).



5. Add the new filter element (3).
6. Screw the filter cap (1) back on.

4.21.6 Changing the brake cooling oil

NOTE ***Working on the oil system requires special cleanliness.***

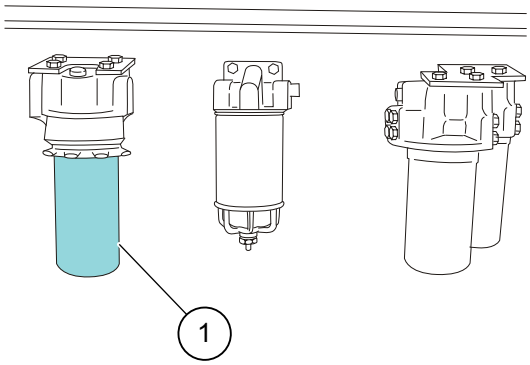


1. Clean around the breather filter (1).
2. Drain out the oil through the drain plug, using a receptacle placed underneath. Drain plug is found in the bottom of the tank.
3. To speed up the draining of the oil, remove the filler cap.
4. Fill up the brake cooling oil through the breather filter (1).

4.21.7 Changing the brake cooling oil filter

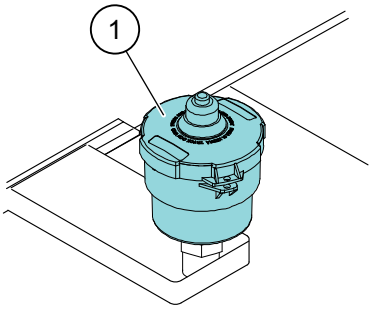
NOTE ***Working on the oil system requires special cleanliness.***

NOTE ***To avoid spillage, place a receptacle underneath the filter. Store the used filter in a suitable container and dispose of it in an environmentally responsible way.***



1. Clean around the filter (1).
2. Remove the old filter (1).
3. Clean the mating surface of the filter housing.
4. Lubricate the rubber seal and fit a new filter.
5. Secure the filter by hand.

4.21.8 Changing the breather filter for the brake cooling oil tank



1. Clean around the breather filter (1).
2. Unscrew the breather filter (1).
3. Replace with a new breather filter (1).

4.22 Maintaining the mast and fork carriage

4.22.1 Checking the mast and fork carriage

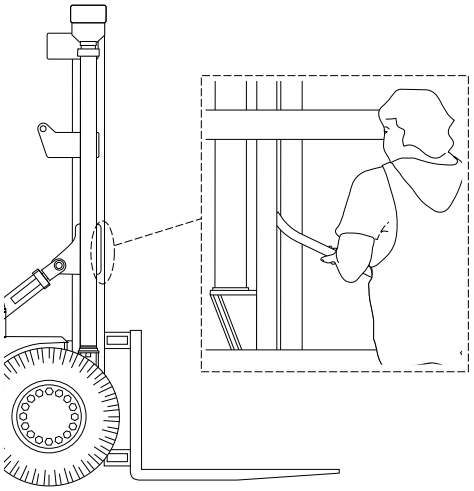


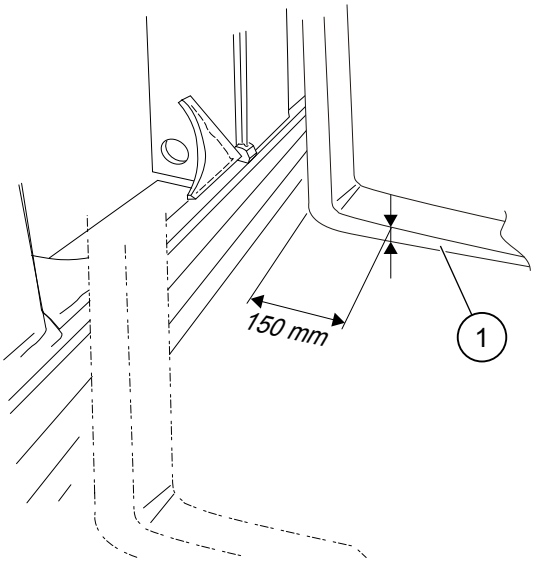
Figure 102. Checking the mast and fork carriage

Using a crowbar or a lever:

1. Check the play between the carriage and the inner mast.
2. Check the play between the inner and the outer mast.
   If there is a play exceeding 5 mm (0.2 in), seek the advice of the nearest authorized dealer.

4.22.2 Checking the fork arms

⚠ WARNING	
	**RISK OF PROPERTY DAMAGE** **The forks can crack, become deformed, or break.** **Only specially trained personnel can inspect the forks for cracks. The inspection interval is one year.** **Only a company that is certified can do fork inspections.** **Do not rectify surface cracks and wear by welding, only an authorized dealer can evaluate if the forks can be repaired.**



1. Check the fork arms for the thickness of the fork blade, crack formation, and deformation. The wear on the fork blade must not exceed 10%, based on the stamped dimension on the fork (1). The wear on the fork blade is measured 150 mm (6 in) from the heal of the fork (1).

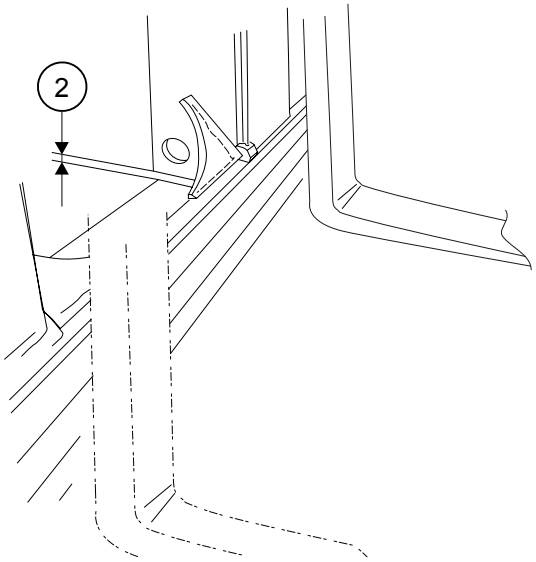
NOTE ***Do not use the fork if it has any visible cracks.***

2. Check for crack formations in the fork heal.
   Surface cracks are usually not longer than 5 mm (0.2 in).
3. If surface cracks are found, grind off about 0.5 mm (0.02 in). Use magnetic powder to check if the crack is still visible.

NOTE ***Only a company that is certified to do fork inspections are allowed to perform this step.***

4. Check the fork suspension for play.
   If the forks are in need of repair, contact an authorized dealer, that can evaluate if it is possible to repair the forks.

4.22.3 Checking the clearance between the mast and fork carriage



Between base plate on the outer mast and the fork carriage.

1. Lower the mast and carriage to their lowest position. Keep the mast in vertical position.
2. Check the space between the base plate on the outer mast and the fork carriage (2).

NOTE ***The space must be 10 mm (0.4 in).***

3. If the space is not 10 mm (0.4 in), readjust the lift chains equally.

4.22.4 Checking the fork shaft system (option)

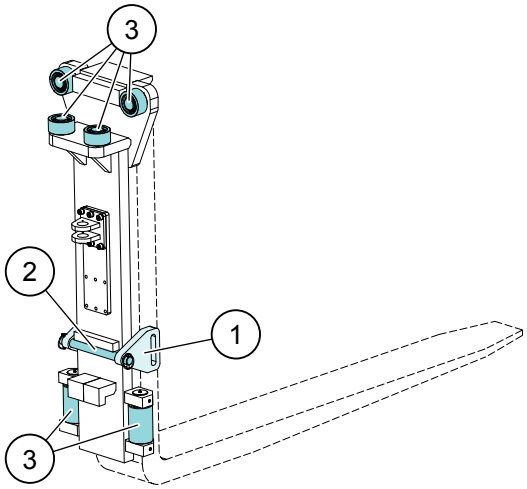


Figure 103. Fork shaft system

Check the fork shaft system as follows:

1. Check that the welding on the locking mechanism (1) is undamaged.
2. Check that the locking pin (2) is undamaged.
3. Check that the ball bearings, and rollers (3) are undamaged.

4.22.5 Checking the lift chains

DANGER

FALLING LOAD HAZARD

If a chain breaks, the load can fall, and cause death, personal injury or damage to the machine.

If in doubt, replace the chain. Always replace the full chain, do not join, or restore broken lift chains.

Before inspection, clean the chains in their entire length. Always check the chains when without a load.

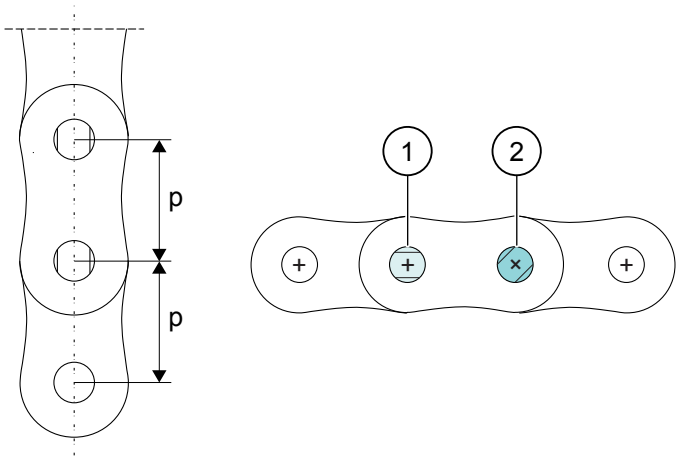


Figure 104. Lift chains

For inspection intervals, see Regular service (page 236).

1. Check that the length of the chain has not increased by more than 3% compared to its original length.
   Measure the 25 links that are lifted first, counting from the chain wheel down towards the carriage. These 25 links are the part of the chain where the extension is the greatest and most often brake.
2. Compare with the value for the given chain sizes in the following table.
3. If the 3% limit is exceeded, replace the chain.

NOTE ***Local regulations may require that the chain must be replaced when the length increases by 2%.***

Table 14. Length of 25 links of chain

Parting (p)	Length of 25 links for new chain	Length of 25 links at 2% extension	Length of 25 links at 3% extension
38.1 mm (1.5 in)	952.5 mm (37.5 in)	971 mm (38.2 in)	981 mm (38.6 in)
50.8 mm (2 in)	1270 mm (50 in)	1295 mm (51 in)	1308 mm (51.5 in)
63.5 mm (2.5 in)	1587.5 mm (62.5 in)	1619 mm (63.7 in)	1635 mm (64.37 in)
76.2 mm (3 in)	1905 mm (75 in)	1943 mm (76.5 in)	1962 mm (77.2 in)

4. Check the state of the lift chains, make sure that there are:

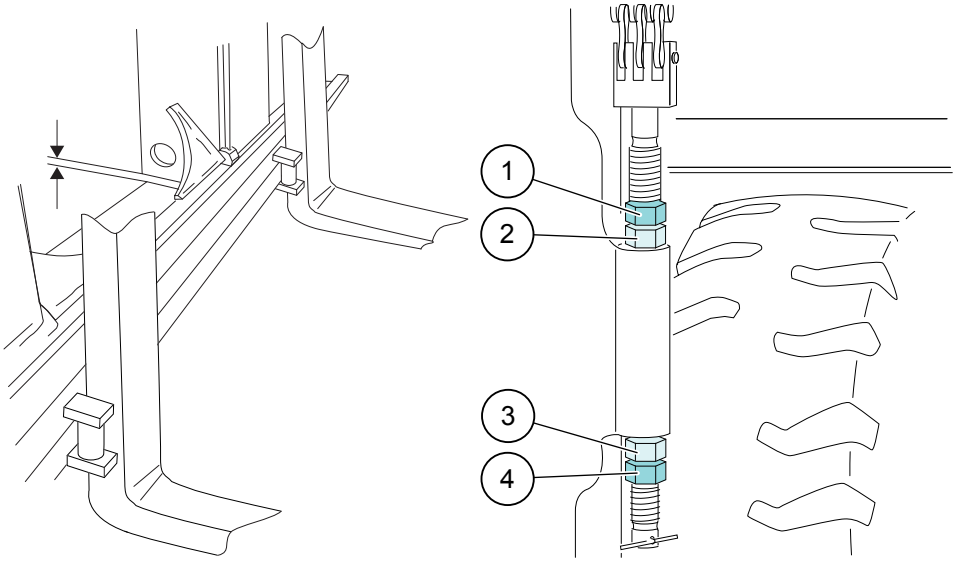
- No twisted pins. Normal pin position (1), and twisted pin postion (2).
- No loose pins in the outside washers
- No visible cracks in any washer (link section)
- No visible mechanical damage
- No visible cracks or damages on the chain attachments on mast and carriage
- No jarring noise when the chain moves
- No corrosion in the chain
- No resistance when the chain bends over the chain wheel

NOTE ***If any of these deviations are found, always replace the chains.***

5. Lubricate the chains after inspection using a thin oil or lubrication spray.

4.22.6 Adjusting the lift chains

NOTE ***Follow the same procedure, and adjust both lift chains simultaneously.***



1. Adjust the lift chains with the adjusting nuts (1-4).

NOTE ***When the mast is in the lowest position, the distance between the base plate of the outer mast, and the bottom of the carriage should be 10 mm.***

2. Raise the carriage to 50 mm.
3. Place a 10 mm spacer on both sides, under the carriage.
4. Lower the carriage until it rests on the spacer.
5. Loosen the upper adjusting nut (2), and the upper locking nut (1).
6. Adjust both the lift chains with the lower adjusting nut (3), until both have the same tension.
7. Lock the lower locking nut (4), on both lift chains.
8. Raise the carriage with load.
9. Tighten the upper adjusting nut (2).
10. Lock the upper locking nut (1).

4.23 Maintaining the machine

4.23.1 Cleaning the machine

⚠ WARNING

HARMFUL SUBSTANCE HAZARD

Risk of serious injury.

Hot steam or aggressive degreasing agents must be used with great care. Protective clothing and eye protection must be worn.

Figure 105. Cleaning the machine

The length of time between cleaning sessions depends on the type of work that the machine carries out.

NOTE

If the machine is used in aggressive environments, it must be cleaned after it has been used. Examples of aggressive environments are:

- ***salt water***
- ***fertilizers***
- ***chemicals***
- ***cement***

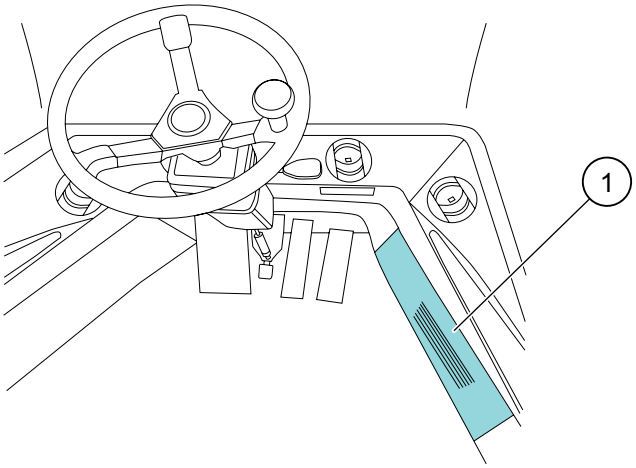
1. Protect all electrical components and the air intake filter from steam, water, and so on, during cleaning.
2. Clean the areas around the oil filling and lubrication areas before servicing.
3. If using a degreasing agent when cleaning, allow sufficient time for it to penetrate. Rinse with a powerful jet of water afterwards.
4. After cleaning the engine, run the engine warm so that it dries. Check that no water that has penetrated has caused any faults.
5. Dispose of all used cleaning materials in an environmentally responsible way.
6. Always lubricate the machine after cleaning. For more information, see Lubricating the machine (page 98).

4.23.2 Changing the internal cabin air filter

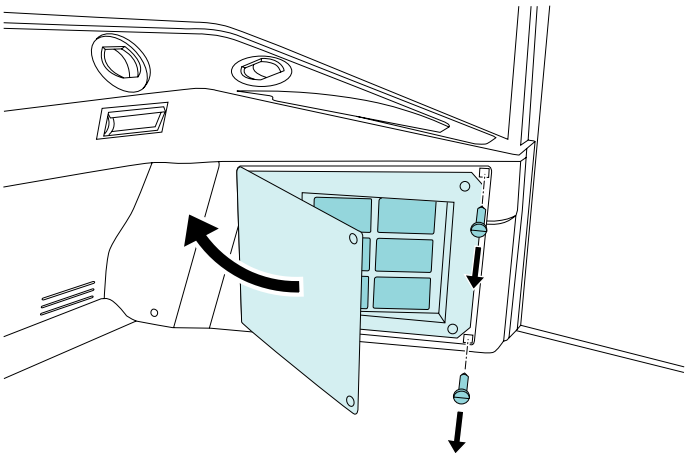
NOTE ***Take care when changing the air filter, the filter may contain unhealthy particles. Dispose of the old filter in an environmentally responsible way.***

The internal and external cabin air filters are under the dashboard on the right side of the cabin.

1. Loosen the screws to open the cabin ventilation system cover (1). The filter frame with the blue cabin air filter is revealed.



2. Loosen the screws on the filter frame and open it.



3. Pull out the filter gently to avoid dust in the climate unit and cabin.
4. Replace the filter in the frame.
5. Put back the filter frame and tighten the screws.
6. Close the cover on the cabin ventilation system and tighten the cover screws.

4.23.3 Changing the external cabin air filter

NOTE ***Take care when changing the air filter, the filter may contain unhealthy particles. Dispose of the old filter in an environmentally responsible way.***

The internal and external cabin air filters are under the right-hand dashboard.

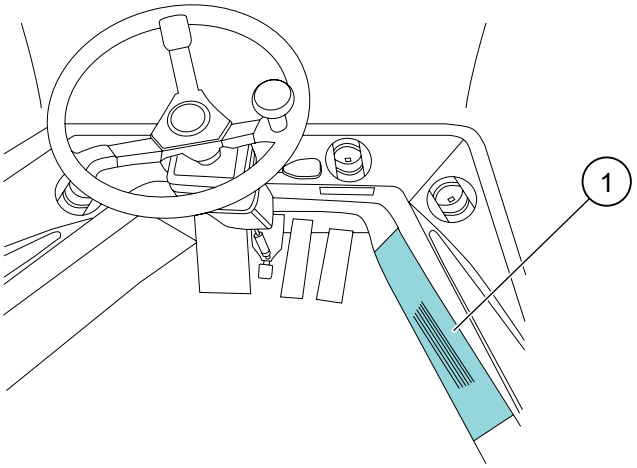
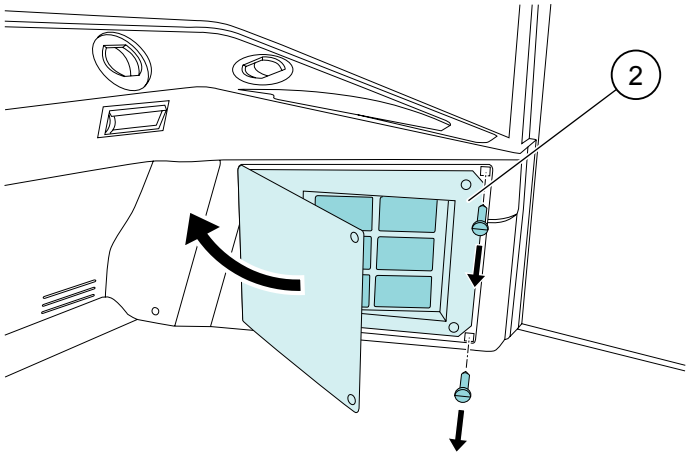
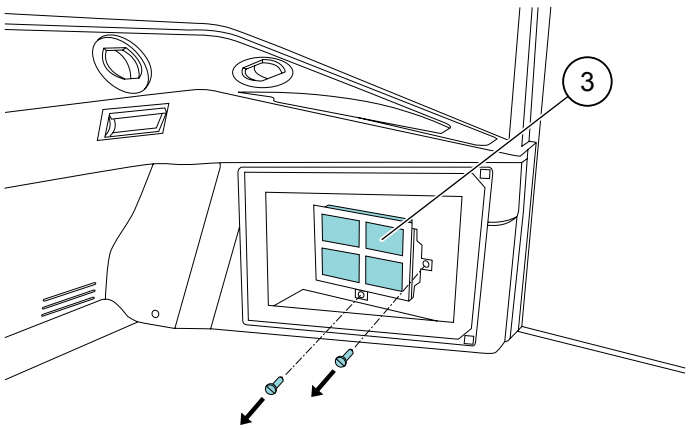


Figure 106. Replacing the external cabin air filter

1. To open the "cabin ventilation" system cover (1), loosen the screws. The filter frame with the blue cabin air filter is revealed.



2. Loosen the screws on the filter frame (2).
3. To reveal the beige external air filter, remove the frame and the internal filter.



4. Loosen the screws on the external air filter frame (3).

5. Replace the filter element.
6. Replace the covers and fasten the frame screws again.
7. Remount the internal filter.
8. Close the cover of the cabin ventilation system and fasten the screws.

4.23.4 Checking the battery

⚠ WARNING

CORROSIVE SUBSTANCE HAZARD

The battery contains corrosive acid that may cause a risk for serious injury or death.

Always use the necessary protective equipment.

⚠ WARNING

ELECTRICAL HAZARD

The main disconnect does not cut the power to the alternator.

To reduce the risks of electric shock and personal injury always remove jewelry and conductive material before working on the electrical system. Always disconnect the ground (minus) cable at the battery when working near or on the alternator.

⚠ WARNING

TIPPING OVER HAZARD

Turning off the battery main switch while the machine is moving applies the parking brake and the machine may tip over. The software in the control unit can get damaged.

Do not turn off the battery main switch while the engine is running.

The batteries are in the battery compartment.

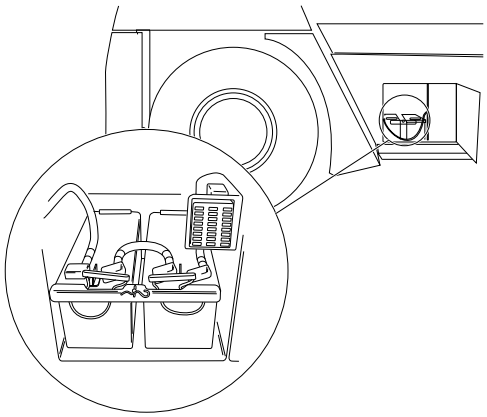


Figure 107. Battery compartment

1. Keep the batteries clean.
2. Remove corrosion from the battery connections and check that the cable connections are tightened.
3. Lubricate the battery terminals using acid-free grease.

4. Check the battery acid level. If necessary, fill with distilled battery water.

4.23.5 Changing the batteries

⚠ DANGER

RISK OF EXPLOSIVE GAS

There can be explosive gas around the batteries, which can cause serious personal injury or death.

Always disconnect the ground (minus) cable, when working with, or around the batteries.

Never smoke, or have flammable, or combustible material near, when working with or around the batteries.

⚠ DANGER

CORROSIVE SUBSTANCE HAZARD

The battery contains corrosive acid that can cause a risk for serious injury or death.

Always use necessary protective equipment, such as eye-protector, and safety gloves.

⚠ WARNING

RISK OF ARCING AND ELECTRIC SHOCK

Touching the connections during a battery change can cause arcing, and lead to serious personal injury or death.

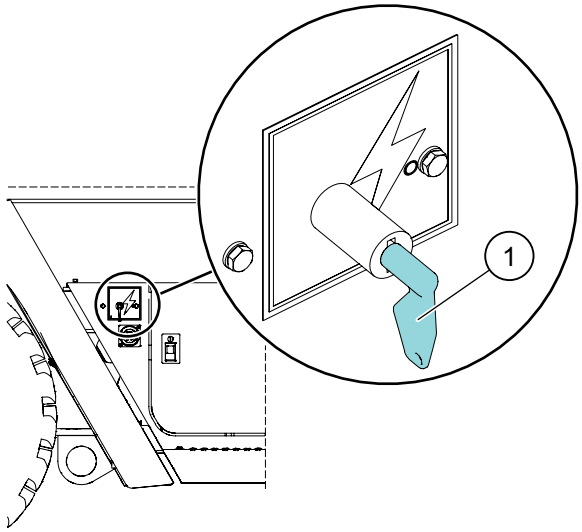
Do not touch the connections during the battery change.

Always remove jewlery, and conductive material before working on the electrical system.

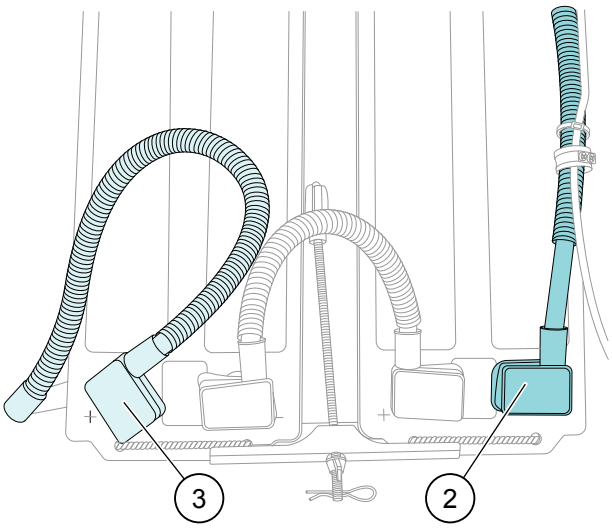
NOTE ***Take care of the old batteries, and dispose of them in an environmentally responsible way.***

NOTE ***Before installing new batteries, check for damages, or leakage. Make sure that the batteries are charged. Check the cables for damages, replace if needed. Clean, and lubricate the battery poles.***

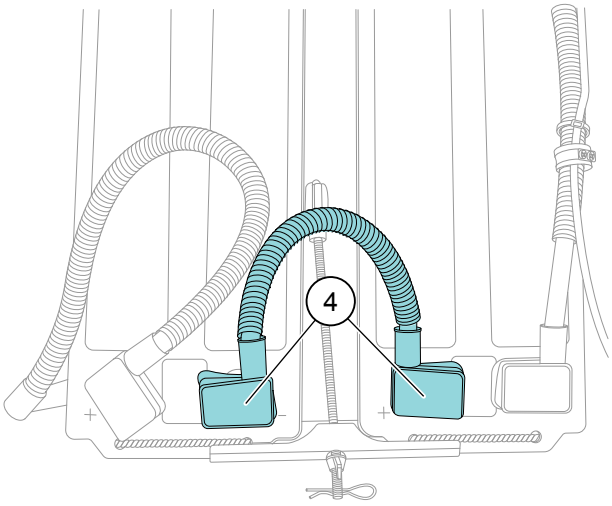
1. Turn off the machine, and the ignition.



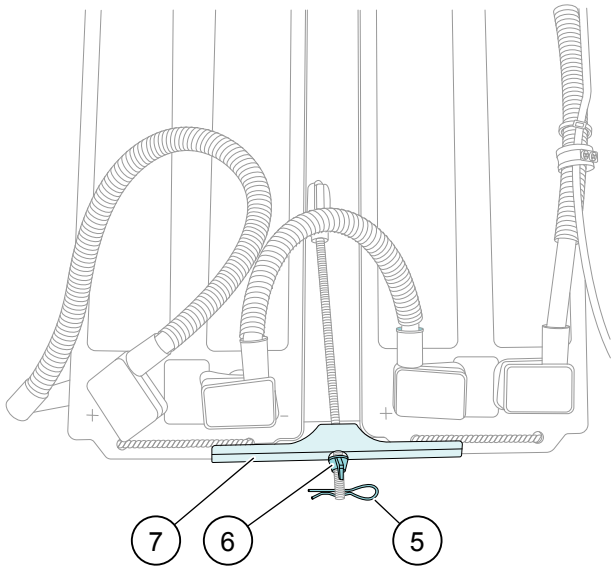
2. Turn off the battery main switch (1)
3. Clean the surface around the battery connections.



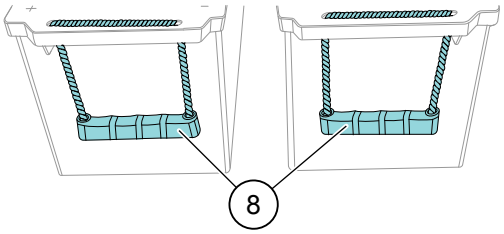
4. Disconnect the ground connection (2), the cable is marked with blue color.
5. Disconnect the "plus" connector (3), the cable is marked with red color.



6. Remove the connecting cable between the batteries (4).



7. Remove the locking pin for the battery attachment (5).
8. Remove the wing nut and the washer (6).
9. Remove the mounting bracket for the batteries (7).



10. Use the handles (8) to lift out the batteries from the battery compartment.

NOTE ***When installing the new batteries, reverse the procedure.***

4.23.6 Checking the weld constructions

To see if there are any visible signs of damage, deformation, metal fatigue, and so on, check the mast, chassis, and all welded parts. Check them at least once a year, more often if the machine is used in shift work or in tough environments with a frequent heavy load. If you have any doubts, contact your Konecranes Lift Trucks authorized dealer.

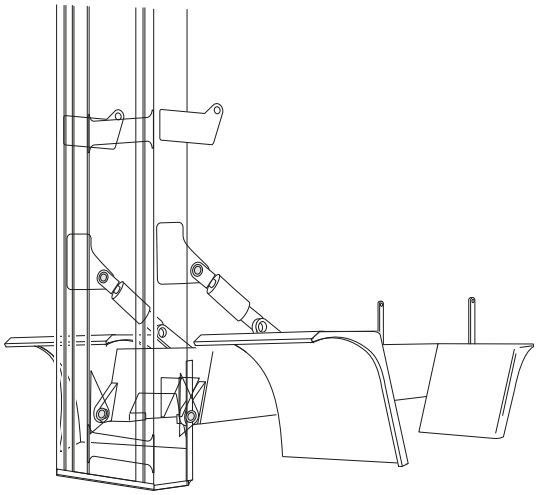


Figure 108. Weld constructions

4.23.7 Changing the windshield wipers

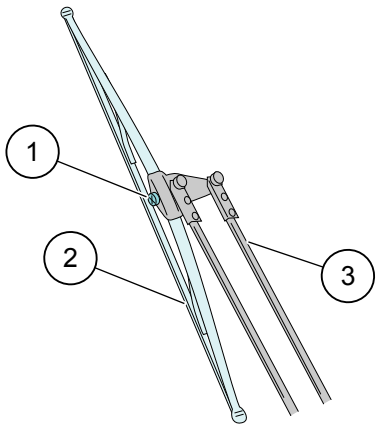


Figure 109. Windshield wipers

1. Raise the wiper from the windshield.
2. Remove the nut (1).
3. Remove the blade (2) from the arm (3).
4. Insert the new blade (2) into the arm (3).
5. Refit the nut.
6. Lower the wiper back onto the windshield.

5 MAINTENANCE SCHEDULE

5.1 Commissioning inspection

Always perform maintenance, lubrication, inspection, and daily maintenance according to the instructions in this document. Before starting up the machine for the first time, check the inspection points according to the warranty commissioning report.

The warranty commissioning report must be filled in and returned to Konecranes Lifttrucks within one week from starting up the machine to make the warranty valid from the commissioning date.

If the warranty commissioning report is not returned within one week, the warranty is valid from the day the machine was delivered by Konecranes Lifttrucks.

5.2 Commissioning service

1. Clean the machine.
2. Tighten the wheel nuts according to correct torque.
3. Check the pressure and condition of the tires.
4. Check the windshield washer level.
5. Check the fuel level.
6. Check the coolant level.
7. Check the transmission oil level.
8. Check the engine oil level.
9. Check the hydraulic oil level.
10. Check the functioning of the service and parking brake.
11. Check the functioning of the steering system.
12. Lubricate according to the lubrication chart
13. Check the functioning and the condition of the electrical system, lighting, instruments, switches, and safety system.
14. Check the functioning of the hydraulic system.
15. Check the drive axle oil level.
16. Check the condition of batteries.
17. Check the safety and condition of the operator's cabin, fuel and oil tanks, chassis, counterweights, lifting equipment, and attachment.
18. Check the condition of the paintwork and windows.
19. Compare the specifications with the customer's acceptance of order.
20. Check the ID and warning signs, compare against available documentation.
21. Check that the operating instruction is delivered with the machine.
22. If applicable, activate TRUCONNECT® with customer information in the portal.

5.3 Daily maintenance

⚠ DANGER

UNCONTROLLED MOVEMENT HAZARD

If the machine moves unexpectedly, it could result in personal injury, death, or damage to the equipment.

To stop any unexpected movement, press the emergency stop button.

⚠ WARNING

MOVING PARTS HAZARD

There is a risk of getting trapped by moving parts of the engine. There is also a cutting risk from moving parts of the engine.

Do not open the hood or perform maintenance work while the engine runs.

⚠ WARNING

TOXIC SUBSTANCE HAZARD

Breathing diesel engine exhaust exposes you to chemicals that may cause cancer, birth defects, or other reproductive harm.

Never run the engine in unventilated places. Use fume extraction.

Do not keep the engine idling, except when necessary.

Do not modify or tamper with the exhaust system.

⚠ WARNING

IGNITION HAZARD

During operation, parts of the machine can become very hot. If there are flammable or combustible materials, on or near any hot surfaces on the machine, there is a risk of fire. Examples of such materials are paper, or saw dust.

Before taking the machine into operation, make sure that there are no flammable or combustible materials on or around any hot surfaces. Examples of hot surfaces can be the turbo, exhaust pipe, DPF, and so on.

NOTE ***Visually inspect the machine for damage while going through the checklist during daily maintenance.***

NOTE ***Check the condition of the safety and information labels, replace if needed.***

NOTE ***After performing the daily maintenance tasks, start the machine and listen for any abnormal noise from the engine and transmission. If any abnormal noise is heard, contact maintenance personnel.***

NOTE ***Separate instructions on how to perform each task, can be found in the Operating Instructions.***

1. Check the battery main switch
2. Check the wheel nuts and clamps.
3. Check the tire pressure and the condition of tires and rims (visible cracks and damages).
4. Check the engine oil level.
5. Check the transmission oil level.
6. Check the coolant level in all tanks.
7. Check the hydraulic oil level.
8. Check the brake cooling oil level (option, not available for all models).
9. Check the grease level in the two reservoirs for the automatic lubrication system (option).

NOTE ***If automatic lubrication is installed (optional), there can be one or two tanks.***

10. Check the MD4 warnings for clogging of engine air filter.
11. Check the windshield washer fluid level.
12. Check the fuel level.
13. Check the AdBlue level (when applicable).
14. Check the soot level (when applicable).

15. Check that the mirrors are clean and adjust them to make sure of good visibility.
16. Check that the windows are clean.
17. Clean the rearview camera (option).
18. Check for visual signs of leakage, around and under the machine
19. Check the seat adjustments and adjust if needed.
20. Check the steering wheel adjustments.
21. Check the service brake functionality.
22. Check the parking brake functionality.
23. Check the functionality of the steering system.
24. Check the hydraulic functions.
25. Check the electrical functions.
26. Check the climate unit (option) settings.

5.4 Maintenance points after the first 150 operating hours

1. Change the engine oil.
2. Change the engine oil filter.
3. Change the transmission oil.
4. Change the transmission oil filter.
5. Lubricate the machine.
6. Check the drive axle oil level.
7. Check the coolant level.
8. Check the coolant freezing point.
9. Check the engine drive belt.
10. Check the hydraulic oil level.
11. Check the battery condition.
12. Check the exhaust system.
13. Check (clean if necessary) the engine air filter and air intake.
14. Check the mast and carriage.
15. Check pressure and condition of the tires.
16. Tighten the wheel nuts to the correct torque.
17. Check the steer axle bearings.
18. Check and tighten the bolted joints.
19. Check the condition and functioning of the electrical system, lighting, instrumentation, switches, and safety system.
20. Check the safety and condition of the cabin, tanks, chassis, counterweights, lifting equipment, and attachments.
21. Check the condition of the paintwork and windows.
22. Check the functioning of the service and parking brake.
23. Check the functioning of the steering system.
24. Check the functioning of the hydraulic system.
25. If applicable, check that TRUCONNECT® functions properly.

5.5 Regular service

Table 15. Machine maintenance

Maintenance points	As necessary	Every 500 h	Every 1000 h	Every 2000 h	Every 4000 h
Contact your local authorized dealer for updates about the latest changes and service information		X	X	X	X
Cleaning the machine	X				
Lubricating hinges		X	X	X	X
Changing the cabin air filters	X		X	X	X
Tightening the bolted joints	X	X	X	X	X
Checking the battery		X	X	X	X
Checking the condition of paintwork and windows		X	X	X	X
Checking the safety and condition of the cabin, tanks, body, counterweights, lifting equipment, and attachment		X	X	X	X
Checking the machine plate and the warning stickers		X	X	X	X
Checking the weld constructions				X	X
Checking for leaks		X	X	X	X

Table 16. Engine maintenance Volvo TAD 581, 881, 883 VE

Maintenance points	As necessary	Every 500 h	Every 1000 h	Every 2000 h	Every 4000 h
Changing the engine oil [1)]			X	X	X
Changing the engine oil filter [1)]			X	X	X
Draining the fuel prefilter	X	X	X	X	X
Draining the extra fuel prefilter (if applicable	X	X	X	X	X
Changing the fuel filter			X	X	X
Changing the fuel prefilter			X	X	X
Changing the extra fuel prefilter (if applicable			X	X	X
Changing the AdBlue-pump filter				X	X
Changing the AdBlue breather filter				X	X
Changing the AdBlue armature (level) filter				X	X
Cleaning and draining the fuel tank 1)	X				X
Cleaning the engine air filter	X	X	X	X	X
Changing the engine air filter [1)]	X			X	X
Changing the safety filter [1)]	X			X	X
Checking the coolant level		X	X	X	X
Checking the freezing point of the coolant 1)	X		X	X	X
Cleaning the radiator, intercooler, and oil coolers		X	X	X	X
Cleaning the coolant system and changing the coolant	At 5000 hours or at least every two years				
Checking the air intake system	X	X	X	X	X
Checking the drive belts		X	X	X	X
Checking the belt tensioner and idler pulleys			X	X	X
Checking the cooling fan and fan hub			X	X	X
Checking the water pump for wear and leaks			X	X	X
Checking the vibration damper on the front pulley			X	X	X
Checking the coolant hoses			X	X	X
Replacing the drive belts				X	X

Table 16. Engine maintenance Volvo TAD 581, 881, 883 VE (Continued)

Maintenance points	As necessary	Every 500 h	Every 1000 h	Every 2000 h	Every 4000 h
Checking for leaks		X	X	X	X
Checking and adjusting the valve clearance				X	X
Checking the cable clamping				X	X
Checking the exhaust system		X	X	X	X
Checking the engine and transmission mountings				X	X
Checking the engine and transmission for abnormal noise				X	X

Use minimum oil quality of VDS4.5

1) More often if necessary.

Table 17. Engine maintenance Volvo TAD 1181 VE

Maintenance points	As necessary	Every 500 h	Every 1000 h	Every 2000 h	Every 4000 h
Changing the engine oil 1)			X	X	X
Changing the engine oil filter 1)			X	X	X
Draining the fuel prefilter	X	X	X	X	X
Draining the extra fuel prefilter (if applicable	X	X	X	X	X
Changing the fuel filter			X	X	X
Changing the fuel prefilter			X	X	X
Changing the extra fuel prefilter (if applicable			X	X	X
Changing the AdBlue-pump filter				X	X
Changing the AdBlue breather filter				X	X
Changing the AdBlue armature (level) filter				X	X
Cleaning and draining the fuel tank 1)	X				X
Cleaning the engine air filter	X	X	X	X	X
Changing the engine air filter 1)	X			X	X
Changing the safety filter 1)	X			X	X
Checking the coolant level		X	X	X	X
Checking the freezing point of the coolant 1)	X		X	X	X
Cleaning the radiator, intercooler, and oil coolers		X	X	X	X
Cleaning the coolant system and changing the coolant	At 5000 hours or at least every two years				
Checking the air intake system	X	X	X	X	X
Checking the drive belts		X	X	X	X
Checking the belt tensioner and idler pulleys			X	X	X
Checking the cooling fan and fan hub			X	X	X
Checking the water pump for wear and leaks			X	X	X
Checking the vibration damper on the front pulley			X	X	X
Checking the coolant hoses			X	X	X
Replacing the drive belts				X	X
Checking for leaks		X	X	X	X
Checking and adjusting the valve clearance				X	X
Checking the cable clamping				X	X
Checking the exhaust system		X	X	X	X

Table 17. Engine maintenance Volvo TAD 1181 VE (Continued)

Maintenance points	As necessary	Every 500 h	Every 1000 h	Every 2000 h	Every 4000 h
Checking the engine and transmission mountings				X	X
Checking the engine and transmission for abnormal noise				X	X

Use minimum oil quality of VDS4.5

1) More often if necessary.

Table 18. Engine maintenance Volvo TAD 571, 871, 873 VE

Maintenance points	As necessary	Every 500 h	Every 1000 h	Every 2000 h	Every 4000 h
Changing the engine oil 1), 2)		X	X	X	X
Changing the engine oil filter 1), 2)		X	X	X	X
Draining the fuel prefilter	X	X	X	X	X
Changing the fuel filter			X	X	X
Changing the fuel prefilter			X	X	X
Changing the crankcase filter			X	X	X
Changing the AdBlue-pump filter (AdBlue engines)				X	X
Changing the AdBlue breather filter (AdBlue engines)				X	X
Cleaning and draining the fuel tank 1)	X				X
Cleaning the engine air filter 1)	X	X	X	X	X
Changing the engine air filter 1)	X			X	X
Changing the safety filter	X			X	X
Checking the coolant level		X	X	X	X
Checking the freezing point of the coolant 1)	X		X	X	X
Cleaning the radiator, intercooler, and oil coolers		X	X	X	X
Cleaning the coolant system and changing the coolant	At 5000 hours or at least every two years				
Checking the air intake system	X	X	X	X	X
Checking the drive belts		X	X	X	X
Checking the belt tensioner and idler pulleys			X	X	X
Checking the cooling fan and hub			X	X	X
Checking the water pump for wear and leaks			X	X	X
Check the vibration damper on the front pulley			X	X	X
Check the cooling hoses			X	X	X
Replacing the drive belts				X	X
Checking for leaks		X	X	X	X
Checking and adjusting the valve clearance				X	X
Checking cable clamping				X	X
Checking the exhaust system		X	X	X	X
Checking the engine and transmission mountings				X	X
Checking the engine and transmission for abnormal noise				X	X

Use minimum oil quality of VDS4

1) More often if necessary.

2) 1000-hour service intervals require an approved oil analysis

Table 19. Engine maintenance Volvo TAD 1171, 1371 VE

Maintenance points	As necessary	Every 500 h	Every 1000 h	Every 2000 h	Every 4000 h
Changing the engine oil [1), 2)]			X	X	X
Changing the engine oil filter [1), 2)]			X	X	X
Changing the engine by-pass filter		X	X	X	X
Draining the fuel prefilter	X	X	X	X	X
Changing the fuel filter			X	X	X
Changing the fuel prefilter			X	X	X
Changing the AdBlue-pump filter (AdBlue engines)				X	X
Changing the AdBlue breather filter (AdBlue engines)				X	X
Cleaning and draining the fuel tank [1)]	X				X
Cleaning the engine air filter [1)]	X	X	X	X	X
Changing the engine air filter [1)]	X			X	X
Changing the safety filter [1)]	X			X	X
Checking the coolant level		X	X	X	X
Change the coolant [3)]			X	X	X
Checking the freezing point of the coolant [1)]	X		X	X	X
Cleaning the radiator, intercooler, and oil coolers		X	X	X	X
Cleaning the coolant system and changing the coolant	At 5000 hours or at least every two years				
Checking the air intake system	X	X	X	X	X
Checking the drive belts		X	X	X	X
Checking the belt tensioner and idler pulleys			X	X	X
Checking the cooling fan and hub			X	X	X
Checking the water pump for wear and leaks			X	X	X
Check the vibration damper on the front pulley			X	X	X
Check the cooling hoses			X	X	X
Replacing the drive belts				X	X
Checking for leaks		X	X	X	X
Checking and adjusting the valve clearance				X	X
Checking cable clamping				X	X
Checking the exhaust system		X	X	X	X
Checking the engine and transmission mountings				X	X
Checking the engine and transmission for abnormal noise				X	X

Use minimum oil quality of VDS4

1) More often if necessary.

2) 1000-hour service intervals require an approved oil analysis

3) Only valid for Volvo TAD 1371 VE

Table 20. Engine maintenance Volvo TAD 541, 551 VE

Maintenance points	As necessary	Every 500 h	Every 1000 h	Every 2000 h	Every 4000 h
Changing the engine oil [1), 2)]		X	X	X	X
Changing the engine oil filter [1), 2)]		X	X	X	X
Draining the fuel prefilter	X	X	X	X	X

Table 20. Engine maintenance Volvo TAD 541, 551 VE (Continued)

Maintenance points	As necessary	Every 500 h	Every 1000 h	Every 2000 h	Every 4000 h
Draining the extra fuel prefilter	X	X	X	X	X
Changing the fuel filter			X	X	X
Changing the fuel prefilter			X	X	X
Changing the extra fuel prefilter			X	X	X
Changing the crankcase filter			X	X	X
Cleaning and draining the fuel tank [1)]	X				X
Cleaning the engine air filter	X	X	X	X	X
Changing the engine air filter [1)]	X			X	X
Changing the safety filter [1)]	X				X
Checking the coolant level		X	X	X	X
Checking the freezing point of the coolant [1)]	X		X	X	X
Cleaning the radiator, intercooler, and oil coolers		X	X	X	X
Cleaning the coolant system and changing the coolant	At 5000 hours or at least every two years				
Checking the air intake system	X	X	X	X	X
Checking the drive belts		X	X	X	X
Checking the belt tensioner and idler pulleys			X	X	X
Checking the cooling fan and fan hub			X	X	X
Checking the water pump for wear and leaks			X	X	X
Checking the vibration damper on the front pulley			X	X	X
Checking the cooling hoses			X	X	X
Replacing the drive belts				X	X
Checking for leaks		X	X	X	X
Checking and adjusting the valve clearance				X	X
Checking the cable clamping				X	X
Checking the exhaust system		X	X	X	X
Checking the engine and transmission mountings				X	X
Checking the engine and transmission for abnormal noise				X	X

Use minimum oil quality of VDS3.

[1)] More often if necessary.

[2)] 1000-hour service intervals require an approved oil analysis.

Table 21. Engine maintenance Volvo TAD 841, 851, 853 VE

Maintenance points	As necessary	Every 500 h	Every 1000 h	Every 2000 h	Every 4000 h
Changing the engine oil [1), 2)]		X	X	X	X
Changing the engine oil filter [1), 2)]		X	X	X	X
Draining the fuel prefilter	X	X	X	X	X
Draining the extra fuel prefilter	X	X	X	X	X
Changing the fuel filter			X	X	X
Changing the fuel prefilter			X	X	X
Changing the extra fuel prefilter			X	X	X
Cleaning and draining the fuel tank [1)]	X				X

Table 21. Engine maintenance Volvo TAD 841, 851, 853 VE (Continued)

Maintenance points	As necessary	Every 500 h	Every 1000 h	Every 2000 h	Every 4000 h
Cleaning the engine air filter	X	X	X	X	X
Changing the engine air filter 1)	X			X	X
Changing the safety filter 1)	X			X	X
Checking the coolant level		X	X	X	X
Checking the freezing point of the coolant 1)	X		X	X	X
Cleaning the radiator, intercooler, and oil coolers		X	X	X	X
Cleaning the coolant system and changing the coolant	At 5000 hours or at least every two years				
Checking the air intake system	X	X	X	X	X
Checking the drive belts		X	X	X	X
Checking the belt tensioner and idler pulleys			X	X	X
Checking the cooling fan and fan hub			X	X	X
Checking the water pump for wear and leaks			X	X	X
Checking the vibration damper on the front pulley			X	X	X
Checking the cooling hoses			X	X	X
Replacing the drive belts				X	X
Checking for leaks		X	X	X	X
Checking and adjusting the valve clearance				X	X
Checking the cable clamping				X	X
Checking the exhaust system		X	X	X	X
Checking the engine and transmission mountings				X	X
Checking the engine and transmission for abnormal noise				X	X

Use minimum oil quality of VDS3.

1) More often if necessary..

2) 1000-hour service intervals require an approved oil analysis.

Table 22. Engine maintenance Volvo TAD 1141, 1151 VE

Maintenance points	As necessary	Every 500 h	Every 1000 h	Every 2000 h	Every 4000 h
Changing the engine oil 1), 2)		X	X	X	X
Changing the engine oil filter 1), 2)		X	X	X	X
Changing the engine by-pass filter		X	X	X	X
Draining the fuel prefilter	X	X	X	X	X
Draining the extra fuel prefilter	X	X	X	X	X
Changing the fuel filter			X	X	X
Changing the fuel prefilter			X	X	X
Changing the extra fuel prefilter			X	X	X
Cleaning and draining the fuel tank 1)	X				X
Cleaning the engine air filter	X	X	X	X	X
Changing the engine air filter 1)	X			X	X
Changing the safety filter 1)	X			X	X
Checking the coolant level		X	X	X	X
Checking the freezing point of the coolant 1)	X		X	X	X

Table 22. Engine maintenance Volvo TAD 1141, 1151 VE (Continued)

Maintenance points	As necessary	Every 500 h	Every 1000 h	Every 2000 h	Every 4000 h
Cleaning the radiator, intercooler, and oil coolers		X	X	X	X
Cleaning the coolant system and changing the coolant	At 5000 hours or at least every two years				
Checking the air intake system	X	X	X	X	X
Checking the drive belts		X	X	X	X
Checking the belt tensioner and idler pulleys			X	X	X
Checking the cooling fan and fan hub			X	X	X
Checking the water pump for wear and leaks			X	X	X
Checking the vibration damper on the front pulley			X	X	X
Checking the cooling hoses			X	X	X
Replacing the drive belts				X	X
Checking for leaks		X	X	X	X
Checking and adjusting the valve clearance				X	X
Checking the cable clamping				X	X
Checking the exhaust system		X	X	X	X
Checking the engine and transmission mountings				X	X
Checking the engine and transmission for abnormal noise				X	X

Use minimum oil quality of VDS3.

1) More often if necessary..

2) 1000-hour service intervals require an approved oil analysis.

Table 23. Engine maintenance Cummins X12

Maintenance points	As necessary	Every 500 h	Every 1000 h	Every 2000 h	Every 4000 h
Changing the engine oil 1)		X	X	X	X
Changing the engine oil filter 1)		X	X	X	X
Changing the fuel filter		X	X	X	X
Changing the water separator		X	X	X	X
Changing the Ad-Blue pump filter					X
Changing the Ad-Blue tank filter				X	X
Cleaning and draining the fuel tank 1)	X				X
Cleaning the engine air filter	X	X	X	X	X
Changing the engine air filter 1)	X			X	X
Changing the safety filter 1)	X			X	X
Checking the coolant level		X	X	X	X
Checking the freezing point of coolant 1)	X		X	X	X
Checking the supplemental coolant additive (SCA)		X	X	X	X
Cleaning the radiator, intercooler, and oil coolers		X	X	X	X
Cleaning the coolant system and changing the coolant	At 5000 hours or at least every two years				
Checking the air intake system	X	X	X	X	X
Checking the drive belts		X	X	X	X
Checking the belt tensioner and idler pulleys			X	X	X
Checking the cooling fan and fan hub			X	X	X
Checking the water pump for wear and leaks			X	X	X

Table 23. Engine maintenance Cummins X12 (Continued)

Maintenance points	As necessary	Every 500 h	Every 1000 h	Every 2000 h	Every 4000 h
Checking the vibration damper on the front pulley			X	X	X
Checking the cooling hoses			X	X	X
Checking for leaks		X	X	X	X
Checking and adjusting the valve clearance 2)				X	X
Checking the cable clamping				X	X
Checking the exhaust system		X	X	X	X
Checking the engine and transmission mountings				X	X
Checking the engine and transmission for abnormal noise				X	X

Use minimum oil quality of CES20081 / ACEA E9 / API CJ-4

1) More often if necessary..

2) If using **HVO 100** diesel fuel, valve clearance should be checked every 1000 hours.

Table 24. Engine maintenance Cummins B 6.7 - EU stage 5 / US tier 4f

Maintenance points	As necessary	Every 500 h	Every 1000 h	Every 2000 h	Every 4000 h
Changing the engine oil 1)		X	X	X	X
Changing the engine oil filter 1)		X	X	X	X
Changing the fuel filter		X	X	X	X
Changing the water separator		X	X	X	X
Changing the Ad-Blue pump filter					X
Changing the Ad-Blue tank filter				X	X
Cleaning and draining the fuel tank 1)	X				X
Cleaning the engine air filter	X	X	X	X	X
Changing the engine air filter 1)	X			X	X
Changing the safety filter 1)	X			X	X
Changing the coolant filter		X	X	X	X
Checking the coolant level		X	X	X	X
Checking the freezing point of coolant 1)	X		X	X	X
Cleaning the radiator, intercooler, and oil coolers		X	X	X	X
Changing the coolant				X	X
Checking the air intake system	X	X	X	X	X
Checking the drive belts		X	X	X	X
Checking the belt tensioner and idler pulleys			X	X	X
Checking the cooling fan and fan hub			X	X	X
Checking the water pump for wear and leaks			X	X	X
Checking the vibration damper on the front pulley			X	X	X
Checking the cooling hoses			X	X	X
Checking for leaks		X	X	X	X
Checking and adjusting the valve clearance					X
Checking the cable clamping				X	X
Checking the exhaust system		X	X	X	X

Table 24. Engine maintenance Cummins B 6.7 - EU stage 5 / US tier 4f (Continued)

Maintenance points	As necessary	Every 500 h	Every 1000 h	Every 2000 h	Every 4000 h
Checking the engine and transmission mountings				X	X
Checking the engine and transmission for abnormal noise				X	X

Use minimum oil quality of CES20081 / ACEA E9 / API CJ-4

1) More often if necessary.

Table 25. Engine maintenance Cummins QSB 6.7 T4

Maintenance points	As necessary	Every 500 h	Every 1000 h	Every 2000 h	Every 4000 h
Changing the engine oil 1)		X	X	X	X
Changing the engine oil filter 1)		X	X	X	X
Changing the fuel filter		X	X	X	X
Changing the water separator		X	X	X	X
Changing the Ad-Blue pump filter					X
Changing the Ad-Blue tank filter				X	X
Cleaning and draining the fuel tank 1)	X				X
Cleaning the engine air filter	X	X	X	X	X
Changing the engine air filter 1)	X			X	X
Changing the safety filter 1)	X			X	X
Checking the coolant level		X	X	X	X
Checking the freezing point of coolant 1)	X		X	X	X
Cleaning the radiator, intercooler, and oil coolers		X	X	X	X
Cleaning the coolant system and changing the coolant	At 5000 hours or at least every two years				
Checking the air intake system	X	X	X	X	X
Checking the drive belts		X	X	X	X
Checking the belt tensioner and idler pulleys			X	X	X
Checking the cooling fan and fan hub			X	X	X
Checking the water pump for wear and leaks			X	X	X
Checking the vibration damper on the front pulley			X	X	X
Checking the cooling hoses			X	X	X
Checking for leaks		X	X	X	X
Checking and adjusting the valve clearance					X
Checking the cable clamping				X	X
Checking the exhaust system		X	X	X	X
Checking the engine and transmission mountings				X	X
Checking the engine and transmission for abnormal noise				X	X

Use minimum oil quality of CES20081 / ACEA E9 / API CJ-4

1) More often if necessary.

Table 26. Engine maintenance Cummins QSM 11-C335

Maintenance points	As necessary	Every 500 h	Every 1000 h	Every 2000 h	Every 4000 h
Changing the engine oil [1]		X	X	X	X
Changing the engine oil filter [1]		X	X	X	X
Changing the fuel filter		X	X	X	X
Cleaning and draining the fuel tank [1]	X				X
Cleaning the engine air filter	X	X	X	X	X
Changing the engine air filter [1]	X			X	X
Changing the safety filter [1]	X			X	X
Checking the coolant level		X	X	X	X
Checking the freezing point of coolant [1]	X		X	X	X
Checking the supplemental coolant additive (SCA)		X	X	X	X
Replacing the coolant filter [2]		X	X	X	X
Cleaning the radiator, intercooler, and oil coolers		X	X	X	X
Cleaning the coolant system and changing the coolant	At 5000 hours or at least every two years				
Checking the air intake system	X	X	X	X	X
Checking the drive belts		X	X	X	X
Checking the belt tensioner and idler pulleys			X	X	X
Checking the cooling fan and fan hub			X	X	X
Checking the water pump for wear and leaks			X	X	X
Checking the vibration damper on the front pulley			X	X	X
Checking the cooling hoses			X	X	X
Checking for leaks		X	X	X	X
Checking and adjusting the valve clearance				X	X
Checking the cable clamping				X	X
Checking the exhaust system		X	X	X	X
Checking the engine and transmission mountings				X	X
Checking the engine and transmission for abnormal noise				X	X

Use minimum oil quality of CES20071 / ACEA E5 / API CH-4

[1] More often if necessary.

[2] Do not replace the coolant filter if the SCA concentration level is over three units.

Table 27. Engine maintenance Cummins QSB 6.7-C260

Maintenance points	As necessary	Every 500 h	Every 1000 h	Every 2000 h	Every 4000 h
Changing the engine oil [1]		X	X	X	X
Changing the engine oil filter [1]		X	X	X	X
Changing the fuel filter		X	X	X	X
Changing the water separator		X	X	X	X
Cleaning and draining the fuel tank [1]	X				X
Cleaning the engine air filter	X	X	X	X	X
Changing the engine air filter [1]	X			X	X
Changing the safety filter [1]	X			X	X
Checking the coolant level		X	X	X	X

Table 27. Engine maintenance Cummins QSB 6.7-C260 (Continued)

Maintenance points	As necessary	Every 500 h	Every 1000 h	Every 2000 h	Every 4000 h
Checking the freezing point of coolant [1)]	X		X	X	X
Cleaning the radiator, intercooler, and oil coolers		X	X	X	X
Cleaning the coolant system and changing the coolant	At 5000 hours or at least every two years				
Checking the air intake system	X	X	X	X	X
Checking the drive belts		X	X	X	X
Checking the belt tensioner and idler pulleys			X	X	X
Checking the cooling fan and fan hub			X	X	X
Checking the water pump for wear and leaks			X	X	X
Checking the vibration damper on the front pulley			X	X	X
Checking the cooling hoses			X	X	X
Checking for leaks		X	X	X	X
Checking and adjusting the valve clearance					X
Checking the cable clamping				X	X
Checking the exhaust system		X	X	X	X
Checking the engine and transmission mountings				X	X
Checking the engine and transmission for abnormal noise				X	X

Use minimum oil quality of CES20071 / ACEA E5 / API CH-4

[1)] More often if necessary.

Table 28. Transmission maintenance

Maintenance points	As necessary	Every 500 h	Every 1000 h	Every 2000 h	Every 4000 h
Changing the transmission oil [1)]			X	X	X
Changing the transmission oil filter			X	X	X
Cleaning the transmission oil cooler: Cleaning the radiator, intercooler, and oil coolers	X		X	X	X
Checking the transmission breather	X	X	X	X	X
Calibrating the transmission		X	X	X	X

[1)] Check oil level daily with engine idling, maintain oil level at full mark (temperature depending).

Table 29. Drive axle maintenance

Maintenance points	As necessary	Every 500 h	Every 1000 h	Every 2000 h	Every 4000 h
Changing the drive axle oil					X
Checking the drive axle oil level		X	X	X	X
Checking the drive axle breather	X	X	X	X	X
Checking the condition and pressure of the tires	X	X	X	X	X
Tightening the wheel nuts	X	X	X	X	X
Adjusting the parking brake		X	X	X	X

Table 30. Steer axle maintenance

Maintenance points	As necessary	Every 500 h	Every 1000 h	Every 2000 h	Every 4000 h
Lubricating the steer axle		X	X	X	X
Checking the steer axle bearings			X	X	X
Checking the condition and pressure of the tires	X	X	X	X	X
Tightening the wheel nuts	X	X	X	X	X

Table 31. Hydraulic system maintenance

Maintenance points	As necessary	Every 500 h	Every 1000 h	Every 2000 h	Every 4000 h
Changing the hydraulic oil [1)]	X				X
Changing the hydraulic oil filter	X			X	X
Changing the HLL (hydraulic long life) filter (machines with HLL filter) [2)]	X				X
Changing the hydraulic tank breathing filter	X				X
Changing the brake cooling oil (machines with brake cooling oil)	X				X
Changing the brake cooling oil filter (machines with brake cooling oil)	X				X
Changing the hydraulic high pressure oil filter [3)]	X				X
Changing the breathing filter for the brake cooling oil tank (machines with brake cooling oil)	X				X
Checking the hydraulic hoses		X			

[1)] If fitted with an HLL filter, the oil change interval can reach up to 12,000 hours. Oil analysis must be carried out every 1000 hours after the initial oil change at 4000 hours.

[2)] The filter element should be replaced as necessary when implied on the pressure indicator on the filter housing.

[3)] The high pressure filter is used on the Reachstacker, but is an option for all other models.

Table 32. Mast and forks maintenance

Maintenance points	As necessary	Every 500 h	Every 1000 h	Every 2000 h	Every 4000 h
Lubricating the mast		X	X	X	X
Lubricating the fork shaft system		X	X	X	X
Checking the mast and fork carriage		X	X	X	X
Checking the fork arms		X	X	X	X
Checking the fork shaft system		X	X	X	X

Table 33. Functional test

Testing points	As necessary	Every 500 h	Every 1000 h	Every 2000 h	Every 4000 h
Checking the function of the electrical system		X	X	X	X
Checking the function of the steering system		X	X	X	X
Checking the function of the hydraulic system		X	X	X	X
Checking the function of the service and parking brake		X	X	X	X

5.6 Maintenance data

Unit	Material/oil/lubricant	Volume
Engine	Engine oil	VOLVO 541 / 551: 16 l (4.23 US gal) VOLVO 571: 16 l (4.23 US gal) VOLVO 581 / 583: 16 l (4.23 US gal) VOLVO 841 / 851: 27 l (7.13 US gal) VOLVO 871 / 873: 27 l (7.13 US gal) VOLVO 881 / 883: 27 l (7.13 US gal) VOLVO 1141 / 1151: 37 l (9.77 US gal)) VOLVO 1171: 37 l (9.77 US gal) VOLVO 1181: 37 l (9.77 US gal) VOLVO 1371: 36 l (9.51 US gal) CUMMINS QSM 11-C335 / X12: 37 l (9.77 US gal) CUMMINS QSB 6.7 / B 6.7: 16,7 l (4.41 US gal) CUMMINS QSB 4.5 T3: 13 l (3.43 US gal)
Fuel tank	Diesel	130–700 l (114–184.9 US gal)
AdBlue tank	AdBlue	30–60 l (7.9–15.8 US gal)
Cooling system	Glycol and water mixture	50–60 l (13.2–15.9 US gal)
Hydraulic oil system (total volume)	Hydraulic oil	150–900 l (39–237.8 US gal)
Brake cooling oil tank (option)	Brake cooling oil	110 l (29 US gal)
Drive axle	Drive axle oil	See table *"Oil filling quantities"* in section *"Recommended fluids and lubricants"*.
Transmission	See fluid recommendations	DANA TE10: 25.6 l (6.8 US gal) DANA TE14: 27 l (7 US gal) DANA TE17: 25–30 l (6.6–7.9 US gal) DANA TE27 / TE32: 60–70 l (15.9–18.5 US gal) DANA TE30: 55 l (14.5 US gal) ZF 191: 25–30 l (6.6–7.9 US gal) ZF 261 / 311: 40–50 l (10.6–13.2 US gal) Always check with dipstick
Tires	Air	See manufacturer's recommendations.

APPENDIX I: FUEL AND OIL RECOMMENDATIONS

Quality of the engine oil

Depending on engine type, the engine oil must comply with one of the following oil classifications:

- Volvo VDS-4.5
- Volvo VDS-4
- Volvo VDS-3
- CES20081 / ACEA E9 / API CJ-4
- CES20071 / ACEA E5 / API CH-4
- ACEA E5 / API CI-4

Table 34. Oil classifications according to engine type

Engine	Oils					
	VDS-4.5	VDS-4	VDS-3	CES20081 / ACEA E9 / API CJ-4	CES20071 / ACEA E5 / API CH-4	ACEA E5 / API CI-4
Volvo TAD 581, 881, 883, 1181 VE	X					
Volvo TAD 571, 871, 873, 1171, 1371 VE		X				
Volvo TAD 541, 551, 841, 851, 853, 1141, 1151 VE			X			
Cummins QSB 6.7 T4, B 6.7, X12 1)				X		
Cummins QSB 6.7, QSM 11					X	

1) For Cummins B 6.7 and X12 engines, SAE 15W-40 must be used.

Check with your oil supplier that your oil meets these demands.

For engines that do not use fuel with low sulphur content, the TBN (Total Base Number) value should be at least 12 according to ASTM 2896. Check with your oil supplier that your oil meets these demands.

Depending on operating conditions, and the quality of the oil and fuel, the intervals between changing the oil may vary in length.

The engine oil must be replaced within a maximum operation time of one year.

If the machine is parked in cold weather, the viscosity of the oil can vary according to the temperature. Therefore the ambient temperature is vital to the choice of the engine oil viscosity range (see following figure).

NOTE ***If the machine is warm, the oil is also warm.***

Changing the oil due to a change in season may be avoided by using multi-grade oils. Specified intervals for changing the oil also apply to multi-grade oils.

NOTE ***No oil additives should be added to the recommended oils. Using such additives may invalidate the engine warranty.***

Avoid mixing different brands of oil.

The temperature ranges for adjacent SAE classes overlap, so you do not need to replace the oil when short-term temperature changes occur.

NOTE ***To ensure trouble-free cold starts, select the SAE class according to the ambient temperature.***

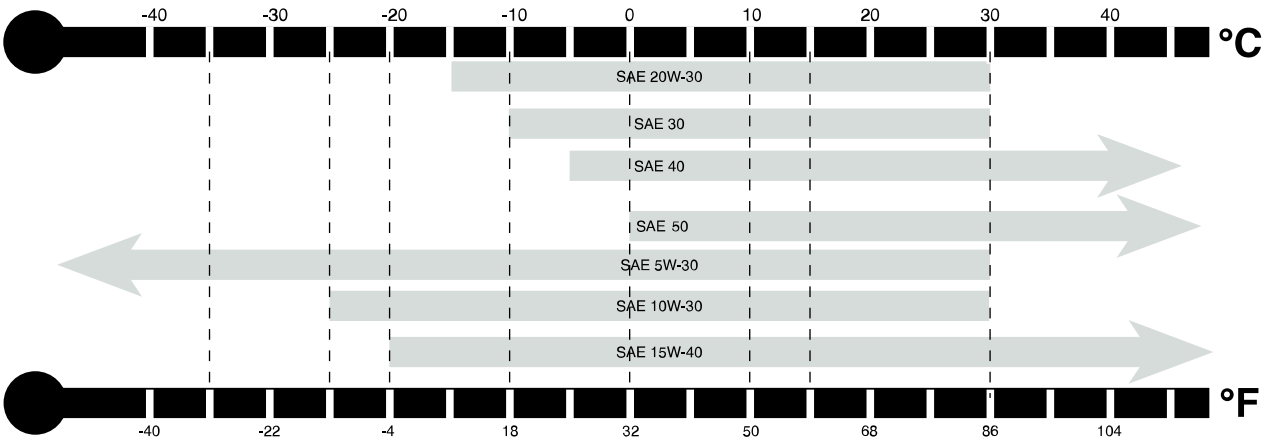


Figure 110. Oil temperature ranges

Extended oil change interval

Extended oil change interval may differ when using synthetic fluids. To determine a baseline, appropriate change intervals should be determined for each engine by measuring oil oxidation and wear metals over time. Wear metals analysis can provide useful information, but an engine should not be removed from service based solely on this analysis. For more information contact Konecranes Lift Trucks, an authorized dealer, or the engine supplier.

Recommended fluids and lubricants

Diesel fuel

It is recommended to use diesel fuel **HVO 100**, which complies with the following classification:

- EN 15940 Class A

If using other diesel fuels than **HVO 100**, they must comply with one of the following classifications:

- EN 590
- ASTM D 975 No 1-D or 2-D

For Tier 4F, stage 4 and stage 5 engines **ULSD** (**Ultra-Low Sulfur Diesel**) fuel must be used (sulphur content below 15 mg/kg).

For more information, contact the engine manufacturer, or an authorized representative.

NOTE ***As the ambient temperature falls, the flow characteristics of the diesel fuel are reduced and paraffin begins to precipitate, i.e the diesel is gelling in cold temperatures. Use the correct diesel quality according to the ambient temperature.***

NOTE ***Using additives to improve the flow is not recommended. Additives may reduce the capacity to start from cold.***

Biodiesel (FAME)

Vegetable oil esters (Fatty Acid Methyl Esters, FAME), also called "biodiesel", are increasingly available as a blending component in diesel fuels.

The engine manufacturer accepts the same FAME content as in major on-road fuels EN590 and ASTM D975. The maximum FAME content is 7%, without any specific extra service requirements. For more information, contact the engine manufacturer, or an authorized representative.

NOTE ***Higher FAME blends negatively impact performance, emissions, and fuel consumption. It also affects negatively the function of the SCR engines exhaust after treatment system.***

AdBlue solution

Only use an AdBlue solution that fulfills the ISO 22241 standard. The AdBlue solution consists of deionized water that is mixed with 32.5% urea.

Table 35. Engines using AdBlue solution

Engine family	Engine
VOLVO	TAD 571 VE
	TAD 871 / 873 VE
	TAD 1171 VE
	TAD 1371 VE
	TAD 581 VE
	TAD 881 / 883 VE
	TAD 1181 VE
CUMMINS	QSB 6.7 [1] / B 6.7 / X12

1) EU stage 4 / US tier 4f

Transmission oil

DANA transmission: ATF Dexron III

ZF transmission: Mineral oil -based engine oil (API CD/CE/CF-4/CF/CG-4/CH-4/ CI-4/SF/SG/SH/SJ/SL or ACEA, categories A, B, E). Viscosity degrees: SAE 20W-20 / 30 / 10W-30 / 10W-40 / 15W-30 / 15W-40 / 20W-40. For more information, see the ZF recommended oil list TE-ML 03.

Table 36. ZF Transmission: Approved and recommended oil types

Lubricant class	Oil type / viscosity	Temperature
03C, 03M	ATF (Automatic transmission fluids)	-40°C
03F	UTTO in accordance with JDM 20D / John Deere Low Viscosity Hy-Gard	-40°C
03E, 03G, 03H	UTTO	-30°C
03K	SAE 0W-30, 0W-40	-40°C
03B, 03C, 03K	SAE 5W-30, 5W-40	-35°C
03A, 03B, 03C, 03K	SAE 10 W, 10W-30, 10W-40	-30°C
03A, 03C, 03K	SAE 15W-30, 15W-40	-25°C
03A, 03C, 03K	SAE 20W-20, 20W-40	-20°C
03A, 03C, 03K	SAE 30	-10°C

Oil change interval

Drain and refill the system every 1000 h for average environmental and duty cycle conditions. Severe or sustained high operating temperature or dusty environments cause accelerated deterioration or contamination. Judgment must be used to determine the required change intervals for extreme conditions. For more information, contact your local authorized dealer.

Drive axle oil

Axle housing / Hub assembly / Drive Assembly

API GL.5 SAE 90

Table 37. Oil filling quantities

Model	Drive axle	Width (mm)	Planetary gear	Brake	Differential	Hub
FLT 10-16	D81	2274	PL478	NLB5340	19 l (5.02 US gal)	2.3 l (0.6 US gal)
FLT 18-25	D91	2717	PL488	NLB4460	31 l (8.2 US gal)	3.2 l (0.8 US gal)
FLT 28-33	D91	3015	PL408	NLB6460	36.5 l (9.6 US gal)	3.7 l (0.97 US gal)
FLT / LCH 37-50	D102	3807	PL341	NLB8460	72 l (19 US gal)	11 l (2.9 US gal)
FLT / LCH 37-50	D102	3431	PL341	NLB8460	58 l (15.3 US gal)	11 l (2.9 US gal)
LCH 52	D102	4549	PL341	NLB8460	121 l (31.9 US gal)	12.5 l (3.3 US gal)
FLT / LCH 52-55	D106	3807	PL341	NLB8460	85 l (22.4 US gal)	11 l (2.9 US gal)
FLT 60-55	D111	4188	PL545	NLB6650-1	108 l (28.5 US gal)	12.5 l (3.3 US gal)
ECH 80	D81	3218	PL478	NLB5340	39 l 10.3 US gal)	2.3 l (0.6 US gal)
ECH 90/100	D81	3713	PL488	NLB6340	45 l (11.9 US gal)	3.5 l (0.9 US gal)
ECH 90/100	D91	4218	PL488	NLB6340	45 l (11.9 US gal)	3.5 l (0.9 US gal)
ECH 90/100 *)	D91	4203	PL489	NLB4460	66 l (17.4 US gal)	3.2 l (0.8 US gal)
RST 108	D81	3713	PL488	NLB6340	45 l (11.9 US gal)	3.5 l (0.9 US gal)
RST 2518	D91	3015	PL408	NLB6460	36.5 l (9.6 US gal)	3.7 l (0.97 US gal)
RST 4127-4638	D102	3807	PL341	NLB8460	72 l (19 US gal)	11 l (2.9 US gal)
RST 4537-4644	D106	3807	PL341	NLB8460	85 l (22.4 US gal)	11 l (2.9 US gal)
RST 4646	D111	4188	PL545	NLB6650-1	108 l (28.5 US gal)	12.5 l (3.3 US gal)

*) = with clamped wheel rims

NOTE ***The volumes are strictly recommendations. If you have any doubts, contact your Konecranes Lift Trucks authorized dealer for advice.***

Hydraulic oil

For machines without separate brake cooling tank

Universal Tractor transmission oil (UTTO)

The oil must comply with one of the following classifications:

- John Deere: JD20C
- Massey Ferguson: MF1141/MF1135/ MF1143
- ZF: TE-ML 03E/TE-ML 05F/TE-ML 06K

For machines with separate brake cooling tank (option)

DIN 51524 Part 2 HLP and Part 3 HVLP

Use hydraulic oil from a well-known oil company for mobile applications.

Viscosity	Temperature range
SHS 32	-30°C...+10°C (-22°F...+50°F)
SHS 46	-20°C...+50°C (-4°F...+122°F)
SHS 68	±0°C...+50°C (+32°F...+122°F)

Brake cooling oil (option)

Universal Tractor transmission oil (UTTO)

The oil must comply with one of the following classifications:

- John Deere: JD20C
- Massey Ferguson: MF1141/MF1135/ MF1143
- ZF: TE-ML 03E/TE-ML 05F/TE-ML 06K

Grease

Multipurpose type E.P. according to NLGI Grade 2.

Coolant

⚠ WARNING

HARMFUL SUBSTANCE HAZARD

Using wrong coolant may damage the machine.

Use the recommended coolant and never mix different coolants.

⚠ WARNING

TOXIC SUBSTANCE HAZARD

It is highly dangerous to drink ethylene glycol. Contact with skin or spray from the refill can cause skin irritation and eye damage.

Do not drink ethylene glycol and avoid contact with skin.

Use only ethylene glycol-based coolants with an additive that prevents corrosion. Do not mix different coolant types with each other. Do not mix the coolant with antifreeze that contains ethanolamine.

Table 38. Coolants for Volvo engines

Engine	Coolant
VOLVO TAD 541, 551 VE	Volvo Penta Coolant VCS-2 and VCS-2 Ready Mixed
VOLVO TAD 571 VE	
VOLVO TAD 581 VE	
VOLVO TAD 841 VE	
VOLVO TAD 851 VE	
VOLVO TAD 871, 873 VE	
VOLVO TAD 881, 883 VE	
VOLVO TAD 1141, 1151 VE	
VOLVO TAD 1171 VE	
VOLVO TAD 1181 VE	
VOLVO TAD 1371 VE	

Table 39. Coolants for Cummins engines

Engine	Coolant
CUMMINS QSB 6.7-C240	To comply with Cummins CES 14603 Recommended: Cummins ES Compleat EG
CUMMINS B 6.7	
CUMMINS QSM 11-C335	
CUMMINS X12	

Liquid antifreeze at the lowest temperature	Percentage of volume mixture liquid antifreeze	Mixture of antifreeze and water
-12°C (10.4°F)	25	1:3
-18°C (-0.4°F)	30	1:2
-25°C (-13°F)	40	1:1.5
-37°C (-34.6°F)	50	1:1
-60°C (-76°F)	66	2:1

APPENDIX II: FUSES AND RELAYS

Fuses

Fuses are located behind the operator's seat in the cabin and in the battery compartment on the right side of the machine.

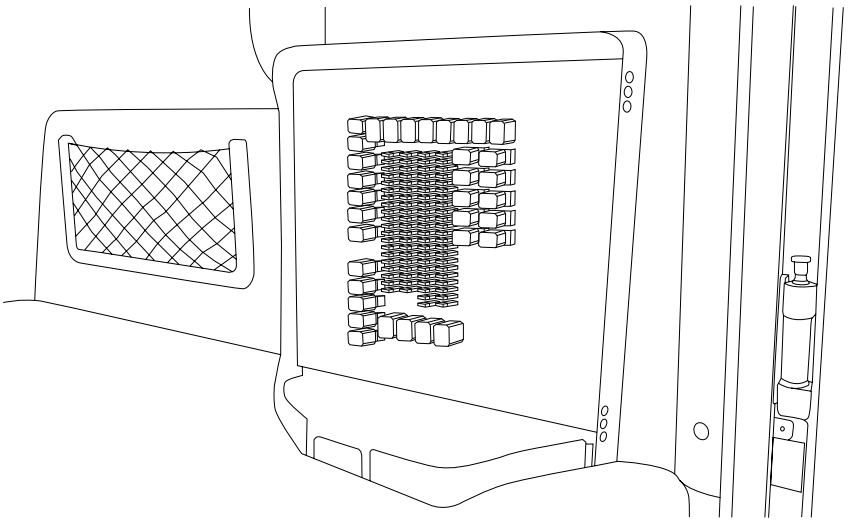


Figure 111. Location of fuses

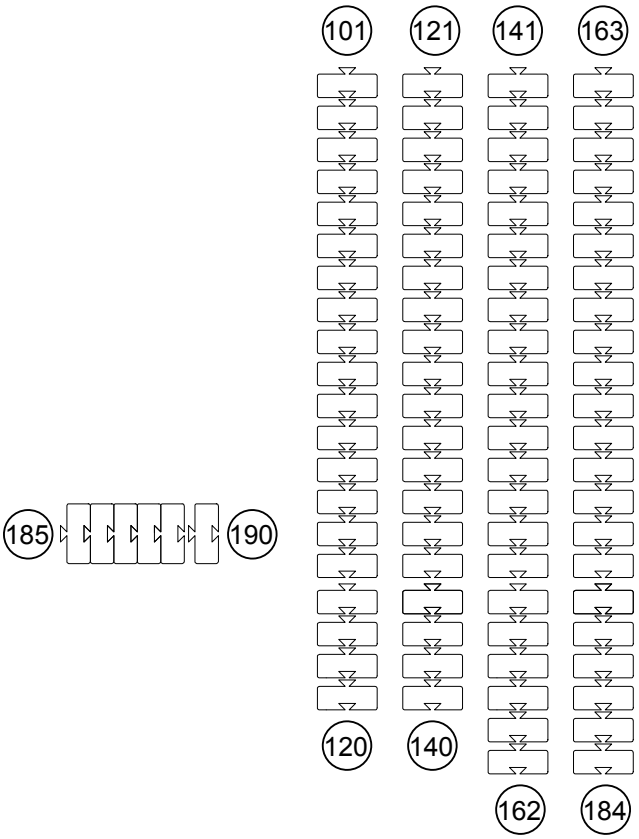


Figure 112. Numbering order of the fuses

Table 40. Fuses and their function (Functions may vary depending on machine model and chosen options)

Number	Size	Function
F101	7.5 A	Cabin heating
F102	7.5 A	Option
F103	7.5 A	Option
F104	7.5 A	Central lubr. pump chassis
F105	10 A	Converter 12-V option
F106	7.5 A	Reverse light
F107	7.5 A	Working light extra 2
F108	7.5 A	PCB 48-PIN STD D
F109	7.5 A	PCB 48-PIN STD D
F110	7.5 A	PCB 48-PIN STD D
F111	7.5 A	PCB 48-PIN STD D
F112	7.5 A	Clutch for HVAC compressor
F113	5 A	Position light right
F114	5 A	Position light left
F115	7.5 A	High beam
F116	7.5 A	Low beam
F117	15 A	Seat suspension air compressor
F118	7.5 A	Reverse alarm in the front
F119	7.5 A	Working lights extra 1
F120	10 A	Option
F121	7.5 A	Working light mast, right
F122	7.5 A	Working light mast, left
F123	10 A	Main fuse for the lights, F115 and F116
F124	5 A	ACR RFID keyless ignition
F125	5 A	Battery clock (RTC)
F126	7.5 A	Ignition
F127	7.5 A	Beacon
F128	7.5 A	Power supply controller
F129	7.5 A	Hazard
F130	10 A	HV/AC condensor blower 1
F131	10 A	HV/AC condensor blower 2
F132	10 A	HV/AC condensor blower 3
F133	7.5 A	K128 Door open switch
F134	5 A	Reading light
F135	15 A	Rear window heating
F136	7.5 A	RCU
F137	7.5 A	Diagnostic, PCB connector
F138	7.5 A	CAN extra, PCB connector
F139	5 A	Turn signal
F140	7.5 A	PCB 48-PIN STD D
F141	7.5 A	PCB 48-PIN STD D
F142	7.5 A	Rearview mirror heater
F143	5 A	I/O units in the armrest, XC21, XC21 OPT C1, XC21 OPT C2
F144	7.5 A	Seat heater
F145	7.5 A	MD4

Table 40. Fuses and their function (Functions may vary depending on machine model and chosen options) (Continued)

Number	Size	Function
F146	5 A	TRUCONNECT® modem
F147	5 A	RFID nearguard 2
F148	5 A	Tire pressure gateway
F149	10 A	Connection for computer
F150	5 A	RFID nearguard 1
F151	7.5 A	Main fuse for position light (F113, F114) and brake lights
F152	5 A	Alcohol ignition interlock
F153	10 A	24 V dashboard
F154	5 A	GSM G2 modem
F155	10 A	12 V reverse camera
F156	10 A	12 V dashboard
F157	10 A	24 V roof
F158	7.5 A	Converter roof
F159	10 A	12 V roof
F160	7.5 A	12 V radio
F161	15 A	Working light roof (option)
F162	15 A	Working light roof (option)
F163	10 A	Wiper rear/roof/front washer
F164	7.5 A	PCB 48-PIN STD E
F165	7.5 A	PCB 48-PIN STD E
F166	7.5 A	Converter
F167	7.5 A	Converter 2 rear wall
F168	15 A	Horn
F169	7.5 A	PCB 48-PIN STD E
F170	7.5 A	PCB 48-PIN STD E
F171	7.5 A	PCB 48-PIN STD E
F172	7.5 A	PCB 48-PIN STD E
F173	7.5 A	Fuel heater
F174	7.5 A	Option
F175	7.5 A	Option
F176	15 A	Electrical seat column
F177	7.5 A	Option
F178	7.5 A	Particle detecting monitor (PDM)
F179	10 A	XA2 OPT, external expansion unit in the chassis
F180	10 A	XA2-STD, external expansion unit in the chassis
F181	10 A	Connection for computer
F182	7.5 A	Reverse camera
F183	5 A	HVAC controller
F184	15 A	HVAC blower
F185	3 A	Spare fuse
F186	5 A	Spare fuse
F187	7.5 A	Spare fuse
F188	10 A	Spare fuse
F189	15 A	Spare fuse
F190	-	Fuse test

Fuses and relays in the battery compartment

DANGER

EXPLOSION HAZARD

Short-circuiting the battery may cause a fire or explosion, which can cause a risk for serious injury or death.

DANGER

CORROSIVE SUBSTANCE HAZARD

The battery contains corrosive acid that may cause a risk for serious injury or death.

Always use the necessary protective equipment.

DANGER

EXPLOSION HAZARD

Batteries generate explosive hydrogen when charged, or when being jump-started, which may cause a risk for serious injury or death.

Always use the necessary protective equipment. Ensure that there is good ventilation and avoid sparking.

WARNING

ELECTRICAL HAZARD

The battery main switch disconnect does not cut the power to the alternator.

To reduce the risks of electric shock and personal injury always remove jewelry and conductive material before working on the electrical system. Always disconnect the ground (minus) cable at the battery when working near or on the alternator.

WARNING

TIPPING OVER HAZARD

Turning off the battery main switch while the machine is moving applies the parking brake and the machine may tip over. The software in the control unit can get damaged.

Do not turn it off while the engine is running.

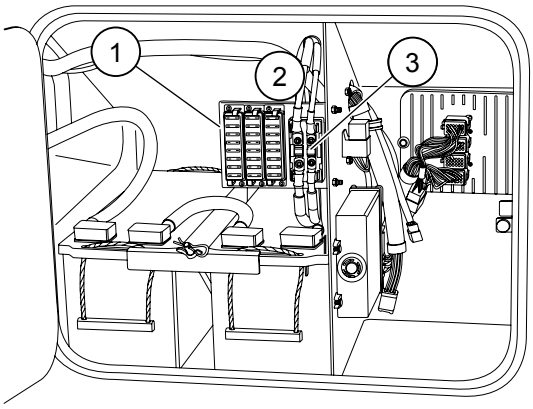


Figure 113. Fuses and relays in the battery compartment

1. Fuses F51–F58, F71-78, F92-F98 (1)
2. Relay K32 (2), behind the three fuse lines
3. Fuses F61-F62, F80

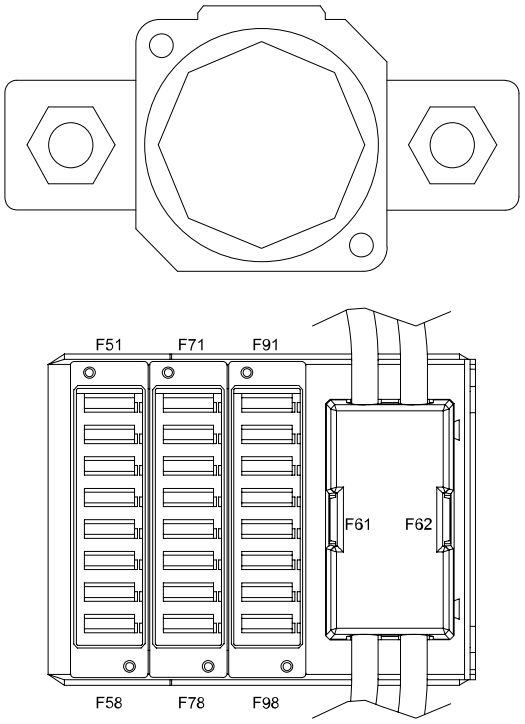


Figure 115. Numbering order of the fuses

Table 41. Fuses and their functions (Functions may vary depending on machine model and chosen options)

Number	Size	Function
F51	10 A	MD4 internal clock (IQAN-MD4 RTC)
F52	20 A	Starter for Scania DC13 EU4/Cummins QSB (15A)
F53	20 A	Scania DC13 EU4 AdBlue control unit/Cummins QSB (15 A)
F54	7.5 A	Cummins QSB (15 A)
F55	7.5 A	Fuel heater (Cummins 20A)
F56	7.5 A	TCU battery power supply (DANA)
F57	20 A	Scania DC13 EU4, VOLVO 660/760 (10A) /Cummins QSB (15A)
F58	20 A	Scania DC13 EU4/Cummins QSB (15A)

Table 41. Fuses and their functions (Functions may vary depending on machine model and chosen options) (Continued)

Number	Size	Function
F61	100 A	Main fuse 15 ignition
F62	60 A	Main fuse 30 battery
F71	7.5 A	Option
F72	7.5 A	Option (fuel shut-off) (seat suspension air compressor 15 A)
F73	7.5 A	Option
F74	10 A	Engine ignition
F75	7.5 A	DANA/ZF transmission control unit (TCU) ignition power supply
F76	25 A	Hydraulic oil cooler
F77	20 A	Scania DC13 EU4 exhaust gas recirculation valve (EGR)
F78	-	Option
F80	70 A	Cummins engine starter
F81	100 A	Cummins intake air heater
F91	10 A	Attachment lights
F92	10 A	Chassis 48-pin STD F
F93	10 A	Chassis 48-pin STD F
F94	10 A	Chassis 48-pin STD F
F95	10 A	Chassis 48-pin STD F
F96	10A	Chassis 48-pin STD F
F97	10A	Chassis 48-pin STD F
F98	10 A	Power supply, attachment

Relays

Relays K32, K35, and K36 are mounted next to the main fuses in the battery compartment. K101-K135 are mounted behind the operator seat in the cabin.

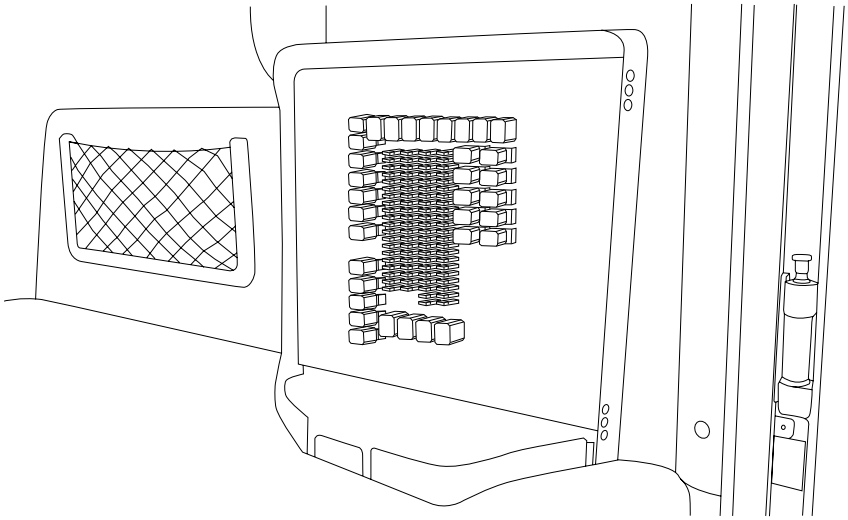


Figure 116. Relay location K101-K135

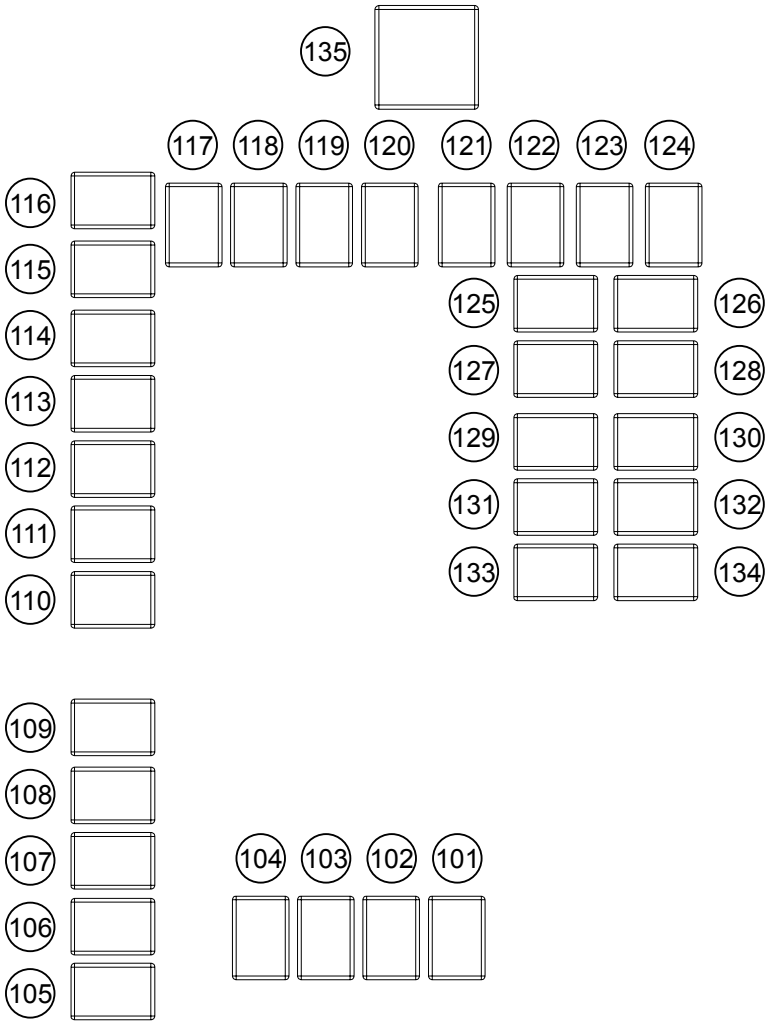


Figure 117. Relays K101-135

Table 42. Relay functions (Functions may vary depending on machine model and chosen options)

Number	Function
K31	Volvo 620, 722, Engine starter
K32	Q1 ignition
K33	Ground support for K31
K35	Engine shut-off for Volvo engines (Engine starter Cummins QSB and QSM)
K36	Fuel heater
K63	Starter lockout Cummins
K64	Intake air heater Cummins
K65	DEF hose heating 1 Cummins
K66	DEF hose heating 2 Cummins
K67	DEF hose heating 3 Cummins
K68	DEF heater relay
K101	Pre-heating power supply for HVAC (heating, ventilation, air-conditioning)
K102	Signal for HVAC (heating, ventilation, air-conditioning), engine running with cabin doors closed
K103	Brake lights
K104	Inverted road light (turnable seat)
K105	ACR RFID keyless ignition

Table 42. Relay functions (Functions may vary depending on machine model and chosen options) (Continued)

Number	Function
K106	Working light mast F121 and F122
K107	Working light extra 1
K108	Front alarm
K109	Door switch
K110	Low beam
K111	High beam
K112	Clutch for HVAC compressor
K113	Blinker right
K114	Blinker left
K115	Working light extra 2
K116	Backup Light/Right
K117	Central lubrication pump chassis
K118	Option
K119	Option
K120	RCU 3
K121	Working light roof F161, F162
K122	Windshield wiper motor roof
K123	Windshield wiper motor rear
K124	Rear/front window washer motor
K125	Rear window heating
K126	Windshield wiper motor front, 1st speed
K127	Rear/front window washer motor
K128	Windshield wiper motor front, 2nd speed
K129	Horn
K130	Fuel heater
K131	RCU 1
K132	RCU 2
K133	Option
K134	Communication radio
K135	Hazard
K201	Attachment lights (opt)