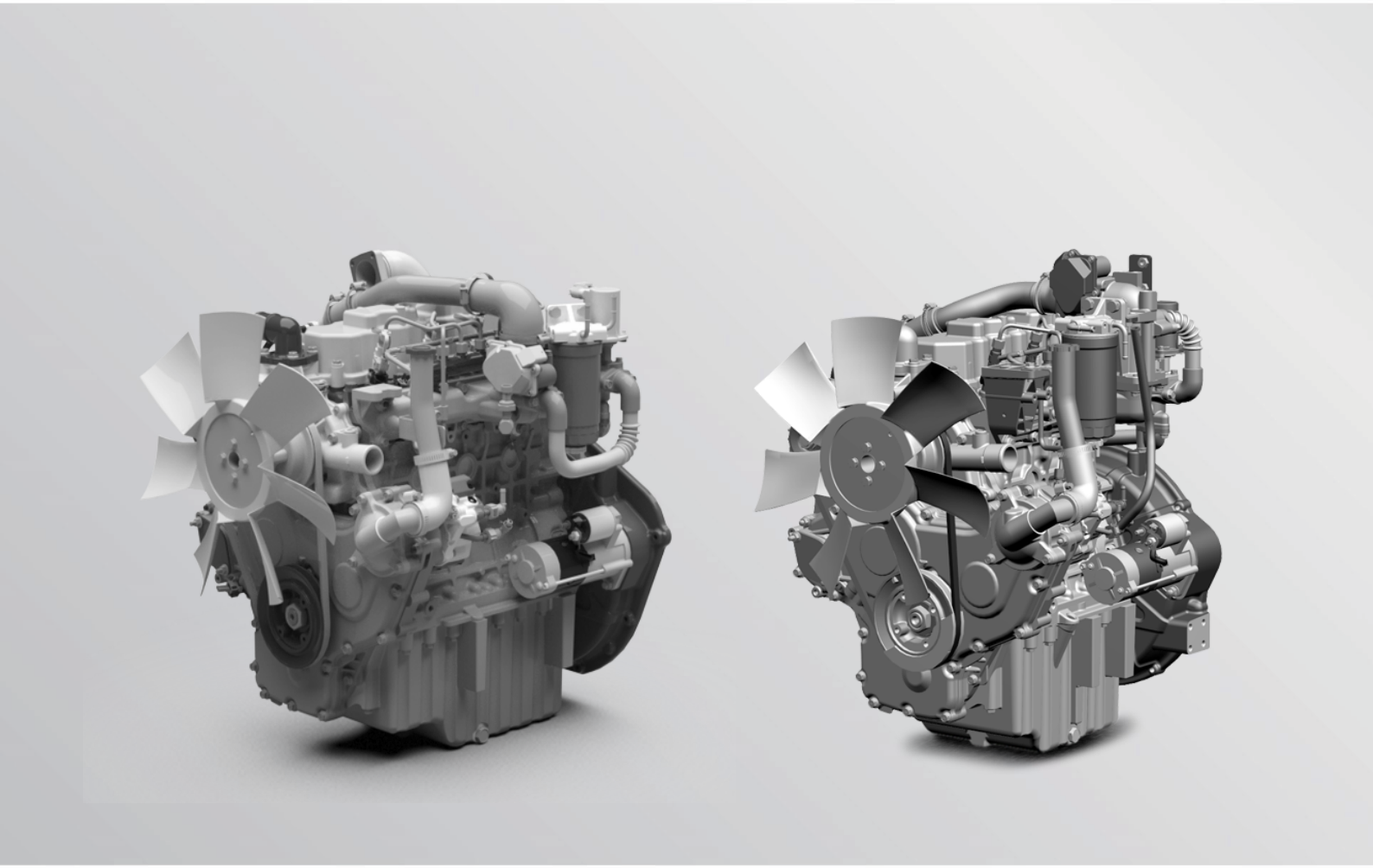
Be the ONE*

OPERATOR'S MANUAL

L4CRTV4/L3CRTV4/L3CRTV3
(INDUSTRIAL)



LS Tractor

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OPERATOR'S MANUAL

STAGE V CRDI DIESEL ENGINE

MODEL : L4CRTV4/L3CRTV4/L3CRTV3
(INDUSTRIAL)

LS Mtron

Introduction

We would like to thank you for choosing LS Engine.
Please read contents carefully of this manual before operating and maintaining the engine. Compliance with the instructions provided in the manual is the best way to guarantee trouble term operation of the engine.

The contents of this manual refer to the standard configuration of the engine
Please consult the instructions provided by the vehicle/equipment manufacturer or a specific any points that differ from the contents of this manual.

CALIFORNIA

PROPOSITION 65 WARNING

 **WARNING**: Breathing diesel engine exhaust exposes you to chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

- Always start and operate the engine in a well-ventilated area.
- If in an enclosed area, vent the exhaust to the outside.
- Do not modify or tamper with the exhaust system.
- Do not idle the engine except as necessary.

For more information, go to www.P65warnings.ca.gov/diesel

WASH YOUR HANDS AFTER HANDLING.

FEDERAL and CALIFORNIA EMISSION CONTROL SYSTEM WARRANTY STATEMENT

YOUR WARRANTY RIGHTS AND OBLIGATIONS

The California Air Resources Board (CARB), U.S. Environmental Protection Agency (EPA), and LS Mtron Ltd. (LS Mtron) are pleased to explain the emission control system warranty on your 2022 model year engine. New engines must be designed, built and equipped to meet stringent anti-smog standards. LS Mtron must warrant the emission control system on your engine for the periods of time listed below provided there has been no abuse, neglect or improper maintenance or usage of your engine. Additional conditions and responsibilities are further outlined below. Where a warrantable condition exists, LS Mtron will repair your engine at no cost to you including diagnosis, parts and labor.

MANUFACTURER'S LIMITED WARRANTY COVERAGE:

LS Mtron warrants to the original owner, and to each subsequent owner of a new diesel engine, that the emission control system of your engine:

1. Was designed, built and equipped so as to conform at the time of sale with all applicable regulations of CARB and EPA.

2. Is free from defects in material and workmanship which will cause such engine to fail to conform with applicable regulations for the following warranty period:

    - For engines rated at or above 19 kW (25 HP): five (5) years or 3,000 hours of operation, whichever occurs first.

The warranty period shall begin:

- On the date the equipment is first delivered to the first retail purchaser, or;

- If the equipment is placed in service for demonstration purposes prior to sale at retail, on the date the engine is first placed in service.

The emission control systems of your new LS Mtron engine were designed, built and tested using genuine LS Mtron parts, and the engine is certified as being in conformity with CARB and EPA emission control regulations. Accordingly, it is recommended that any replacement parts used for maintenance, repair, or replacement of emission control systems must be LS Mtron parts. Any replacement part may be used in the performance of any maintenance or repairs and will be provided without charge to the owner, although LS Mtron recommends that the owner obtain assurance that such parts are warranted by their manufacturer and LS Mtron to be equivalent to genuine LS Mtron parts. Such use shall not reduce the warranty obligations of LS Mtron, provided they are warranted to be equivalent to genuine LS Mtron parts.

Any warranted part which is not scheduled for replacement as required maintenance shall be warranted for the warranty period defined above. If any such part fails during the period of warranty coverage, and provided that there has been no abuse, neglect or improper maintenance or usage of your engine, it will be repaired or replaced under warranty. Any such part repaired or replaced under the warranty shall be warranted for the remaining warranty period.

Any warranted part which is scheduled only for regular inspection in the written instructions shall be warranted for the warranty period defined above, provided that there has been no abuse, neglect or improper maintenance or usage of your engine. A statement in the written instructions to the effect of "repair or replace as necessary" shall not reduce the period of warranty coverage. Any such part repaired or replaced under warranty shall be warranted for the remaining warranty period.

Any warranted part which is scheduled for replacement as required maintenance shall be warranted for the period of time prior to the first scheduled replacement point for that part. If the part fails prior to the first scheduled replacement, the part shall be repaired or replaced by LS Mtron under warranty, provided that there has been no abuse, neglect or improper maintenance or usage of your engine. Any such part repaired or replaced under warranty shall be warranted for the remainder of the period prior to the first scheduled replacement point for the part.

LS Mtron provides warranty services or repairs at all manufacturer distribution centers (warranty stations) that are franchised to service the subject engines. Please see the Customer Assistance section of this statement for help in locating such service centers. Repair or replacement of any warranted part under warranty shall be performed at no charge to the owner at a warranty station.

The owner will not be charged for diagnostic labor that leads to the determination that a warranted part is in fact defective, provided that such diagnostic work is performed at a warranty station.

LS Mtron is liable for damages to other engine components proximately caused by a failure under warranty of any warranted part.

LS Mtron is required by California regulations to maintain a supply of warranted parts sufficient to meet the expected demand for such parts during the warranty period for the engines covered by this warranty.

OWNER’S WARRANTY RESPONSIBILITIES:

This engine is designed to operate on ultra low sulfur diesel fuel only. Use of any other fuel may result in this engine no longer operating in compliance with CARB or EPA’s emissions requirements.

The purchaser is responsible for initiating the warranty process. You must present the engine to a LS Mtron dealer as soon as a problem exists. The warranty repairs should be completed by the dealer as expeditiously as possible.

Use of any add-on or modified parts that are not exempted from anti-tampering laws by CARB or EPA may reduce or eliminate your warranty coverage. The use of any non-exempted add-on or modified parts shall be grounds for disallowing a warranty claim. LS Mtron is not liable for failures of warranted parts caused by the use of a non-exempted add-on or modified part.

The emissions control parts covered by this Limited Emission Control System Warranty are listed under “What is covered by the Limited Emission Control System Warranty.” You are

responsible for the performance of all scheduled maintenance or repairs on your new LS Mtron engine. LS Mtron may deny a warranty claim if failure to perform maintenance results in the failure of a warranted part. Receipts covering the performance of regular maintenance should be retained in the event of questions arise concerning maintenance. The receipts should be transferred to each subsequent owner of the equipment with the emission warranted engines.

Customer Assistance

In the event that you do not receive the warranty service to which you believe you are entitled under the Limited Emission Control Systems Warranty, you should contact LS Mtron at the address below for assistance. If you need additional assistance or information concerning the Limited Emission Control System Warranty, contact:

1. LS Mtron Ltd.
   886, Gwahak-Ro, Bongdong-Eup
   Wanju-gun, Jeollabuk-Do, Korea
   Phone: 82-63-279-5824
   Fax: 82-63-279-5933

2. LS tractor USA LLC Ricky
   Mark
   Service Department 6900
   Corporation Parkway
   Battleboro, NC 27809
   Phone: 1-252-984-0700
   Fax: 1-252-984-0701

3. Big B Sales, Inc.
   Travis Bowlin
   674 Hwy 8,
   Sicily Island, LA 71368
   Phone: 1-318-389-5349
   Fax: 1-318-389-5181

4. Lane Tractor Sales
   Michael Lane
   7980 Hwy 99 East;
   Los Molinos, CA 96055
   Phone: 1-530-384-1016
   Fax: 1-530-384-0305

What is not covered by the Limited Emission Control System Warranty
This warranty does not cover:

1. Malfunctions in any part caused by any of the following: misuse, abuse, improper adjustments, modifications, alteration, tampering, disconnection, improper or inadequate maintenance, or use of fuels not recommended for the engine as described in the Maintenance Manual.

2. Damage resulting from accident, acts of nature or other events beyond the control of LS Mtron.

3. The replacement of expendable maintenance items such as exhaust system, filters, hoses, belts, oil, thermostat, and coolant made in connection with scheduled maintenance services once these parts have been replaced.

4. Replacement items which are not genuine LS Mtron parts or not authorized by LS Mtron.

5. Loss of time, inconvenience, loss of use of equipment, engine or commercial loss.

What is covered by the Limited Emission Control System Warranty

The following is a list of systems and parts that are considered a part of the Emission Control System and are covered by the Limited Emission Control System Warranty for engines which were built to conform to CARB and EPA regulations:

IMPORTANT! This may not include expendable maintenance items such as nozzle assemblies and rubber flanges. Emission related parts requiring scheduled maintenance are warranted until their first scheduled replacement point only.

This Limited Emission Control System Warranty applies to the following emission control parts:

(1) Fuel System
- (A) Fuel injection pump.
- (B) Fuel Injectors.

(2) Air Induction System
- (A) Intake manifold.
- (B) Turbocharger
- (C) Air Control Valve
- (D) Exhaust Manifold

(3) Exhaust Gas Recirculation (EGR) System
- (A) EGR valve body

(4) Aftertreatment Devices
- (A) DOC
- (B) DPF

(5) Positive Crankcase Ventilation (PCV) System.
- (A) PCV Valve.
- (B) Oil Filler Cap.

(6) Miscellaneous items Used in Above Systems
- (A) Vacuum, temperature, and time sensitive valves and switches.
- (B) Electronic control units, sensors, solenoids, and wiring harnesses.
- (C) Hoses, belts, connectors, assemblies, clamps, fittings, tubing, sealing gaskets or devices, and mounting hardware.
- (D) Pulleys, belts and idlers.
- (E) Emission Control Information Labels.
- (F) Any other part with the primary purpose of reducing emissions or that can increase emissions during failure without significantly degrading engine performance.

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GENERAL INFORMATION

1.GENERAL INFORMATION

1.1 ASSURANCE

To ensure the best performance of your engine and to obtain an LS warranty, you must carefully follow the instructions provided in this manual. Otherwise, the warranty may be invalidated.

1.2 GENUINE PARTS

Only genuine parts must be used, otherwise the life of the product may be shortened and the risk of safety accident may occur.

1.3 RESPONDINILITY

The manufacturer is responsible only for the operations specified in this manual. Exceptions not mentioned in this manual must be carried out in LS and approved dealer workshops.

1.4 SAFETY CAUTION

1.4.1 FIRE AND EXPLOSINS

Warning

KEEP FLAMES AWAY

Do not use flames near the engine (in the engine room). Spilled fuel, oil and LLC may ignite and cause a fire. Wipe off spilled fuel, oil and LLC immediately and thoroughly. Spilled fuel, oil and LLC may ignite and cause a fire.

Store fuel and engine oil in a well ventilated designated area. Make sure that the fuel and engine oil container caps are tightly closed.

KEEP ENGINE SURROUNDING AREA TIDY AND CLEAN

Do not leave combustible or explosive materials, such as fuel, engine oil and LLC, near the engine. Such substances can cause fire or explosion. Thoroughly remove dust, dirt and other foreign materials which are accumulated on the engine and the area around the engine. Such materials can cause fire or the engine to overheat. In particular, clean the top surface of the battery thoroughly. Dust can cause a short-circuit. Always place the engine at a position at least 1 m (3.28 ft.) away from buildings and other equipment to prevent possible fire caused by engine heat.

AVOID ACCESSING CRANKCASE UNTIL ENGINE COOLS

Do not attempt to open the crankcase before the engine cools down. Wait at least 10 minutes after stopping the engine. Opening the cover when the engine is hot allows fresh air to flow into the crankcase, which can cause oil mist to ignite and explode. Avoid inspecting.

CARE ABOUT FUEL, OIL AND EXHAUST GAS LEAKAGE

If any fuel, oil or exhaust gas leakage is found, immediately take corrective measures to stop it. Such leakages, if left uncorrected, can cause fuel or engine oil to reach hot engine surfaces or hot exhaust gas to contact flammable materials, possibly leading to personal injury and/or damage to equipment.

USE EXPLOSION-PROOF LIGHTING APPARATUS

When inspecting fuel, engine oil, coolant, battery electrolyte, etc., use a flameproof light. An ordinary light, if accidentally broken, may ignite and cause an explosion.

PREVENT ELECTRICAL WIRES FROM SHORT-CIRCUITING

Avoid inspecting or servicing the electrical system with the ground cable connected to the battery. Otherwise, a fire could result from short-circuiting. Be sure to disconnect the battery cable from the negative (-) terminal before beginning with the work procedure. Short circuits, possibly resulting in fire, may be caused by a loose terminal or damaged cable/wire. Inspect the terminals, cables and wires, and repair or replace the faulty parts before beginning with the service procedure.

KEEP FIRE EXTINGUISHERS AND FIRST-AID KIT HANDY

Keep fire extinguishers handy, and become familiar with their usage. Keep a first-aid kit at the designated place where it is easily accessible by anyone at any time. Establish response procedures to follow in the event of fire or accident. Provide an emergency evacuation route, contact points, and means of communication in case of emergency.

1.4.2 STAY CLEAR OF ALL ROTATING AND MOVING PARTS

Warning

INSTALL PROTECTIVE COVERS IN ROTATING PARTS

Make sure the protective covers for engine rotating parts are properly installed as intended. Repair loose or damaged protective covers as necessary. Never remove the covers guarding personnel from rotating parts, when the engine is operating. When combining the engine with the engine-driven machine or radiator, always provide a cover on every exposed moving part such as driving belt and coupling. Never remove protective covers.

ENSURE SAFETY OF NEIGHBORING PEOPLE BEFORE STARTING ENGINE

Before starting the engine, ensure that there is nobody in the neighborhood and that no tools are left on or near the engine. Verbally notify people around the engine or in the work area when starting the engine. When the starter device is posted with a sign that prohibits startup operation, do not operate the engine.

STAY CLEAR OF MOVING PARTS DURING ENGINE RUNNING

Do not approach rotating or sliding parts of the engine when the engine is in operation. Keep objects likely to be caught by rotating parts away from such parts. If any part of the clothing or outfitting is caught by a rotating part, serious bodily injuries could result.

LOCK OUT AND TAGOUT

Be sure to lockout and tagout before starting inspection and maintenance. Lockout and tagout are effective methods of cutting off machines and equipment from energy sources. To accomplish the lockout/tagout, remove the starter switch key, set the battery switch to OFF and attach a "Do Not Run" or similar CAUTION tag to the starter switch. The starter switch key must be kept by the person who performs inspection and maintenance during the work.

KEEP ENGINE STOPPED DURING SERVICING

Be sure to stop the engine before proceeding to inspection and service procedure. Never attempt to make adjustments on the engine parts while the engine is running. Rotating parts such as belt can entangle your body and cause serious injuries.

ALWARYS RESTORE ENGINE TURNING TOOLS AFTER USE

Do not forget to remove the tools which have been used for turning the engine during inspection or servicing, after the procedure is finished. Remember also that the turning gear must be returned to the operating condition before starting the engine. Starting the engine with the turning tools inserted or with the turning gear in engagement can lead to not only engine damage but also personal injuries.

1.4.3 BE CAREFUL OF EXHAUST FUME POISONING

Warning

OPERATE ENGINE IN WELL-VENTILATED AREA

Ensure that there is no exhaust gas leak from duct joints. Exhaust gas from the engine contains carbon monoxide and other harmful substances. Operating the engine in an ill-ventilated area can produce gas poisoning.

1.4.4 BE CAREFUL OF FALLING DOWN

Warning

LIFT ENGINE CAREFULLY

To lift the engine, always use a correct wire rope capable of withstanding the engine weight. Attach the wire rope to the lifting hangers provided on the engine using a correct sling. During lifting process, keep the engine in a well-balanced position by taking the center of gravity of the engine into consideration. If the wire rope contacts the engine directly, place a cloth or other soft padding to avoid damage to the engine and wire rope.

DO NOT CLIMB ONTO THE ENGINE

Do not climb onto the engine, nor step on any engine parts located on the lateral sides. To work on parts located on the upper section of engine, use a ladder, stool, etc., that is firmly secured. Climbing on the engine may not only damage engine parts but also cause parts to fall off and result in personal injuries.

ESTABLISH FIRM SCAFFOLD DURING WORK

When working on the upper part of the engine and other hard-to-reach places, use a stable work platform. Standing on a decrepit stool or parts box may result in personal injury. Do not place any unnecessary objects on a work platform.

1.4.5 BE CAREFUL OF HANDLING FUEL, ENGINE OIL, AND LLC

Warning

USE ONLY SPECIFIED FUEL, ENGINE OIL AND LONG LIFE COOLANT(LLC)

Use only the fuel, oil and LLC specified in this manual, and handle them carefully. Use of any other fuel, oil or LLC, or improper handling may cause various engine problems and malfunctions. Obtain the Material Safety Data Sheets (MSDS) issued by the fuel, oil and LLC suppliers, and follow the directions in the MSDSs for proper handling.

HANDLE LLC (LONG LIFE COOLANT) CAREFULLY

When handling LLC, always wear rubber gloves and protective face mask. If LLC or cooling water containing LLC comes into contact with your skin or eyes, or if it is swallowed, you would suffer from inflammation, irritation or poisoning. Should LLC be accidentally swallowed, induce vomiting immediately and seek medical attention. Should LLC enter your eyes, flush them immediately with plenty of water and seek medical attention. If LLC splashes onto your skin or clothing, wash it away immediately with plenty of water. Keep flames away from LLC. The LLC can catch flames, causing a fire. Coolant containing LLC is a hazardous material. Do not dispose of it in unauthorized manner. Abide by the applicable law and regulations when discarding drained coolant.

PROPER DISPOSAL OF WASTE OIL AND COOLANT(LLC)

Do not discharge waste engine oil or coolant into sewerage, river, lake or other similar places. Such a way of disposal is strictly prohibited by laws and regulations. Dispose of waste oil, coolant and other environmentally hazardous waste in accordance with the applicable law and regulations.

1.4.6 BE CAREFUL OF BURNS

Warning

DO NOT TOUCH THE ENGINE DURING OR IMMEDIATELY AFTER OPERATION

Do not touch the engine during or immediately after operation to avoid risk of burns. To conduct maintenance and inspection work, wait until the engine has cooled sufficiently, checking the water temperature gauge.

DO NOT OPEN THE RADIATOR FILLER CAP WHEN THE ENGINE IS HOT

Never open the radiator filler cap while the engine is running or immediately after the engine is stopped. Give a sufficient cooling time to the engine coolant before opening the cap. When opening the radiator filler cap, slowly turn the cap to release internal pressure. To prevent scalds with steam gushing out, wear thick rubber gloves or cover the cap with a cloth. Close the radiator cap tightly without fail. The coolant is very hot and under pressure during engine running or just after the engine stops. If the radiator cap is not closed tightly, steam and hot coolant may gush out and can cause scalds.

ADD COOLANT ONLY AFTER THE COOLANT TEMPERATURE DROPPED

Do not add coolant immediately after the engine stops. Wait until the coolant temperature lowers sufficiently to avoid a risk of burns.

1.4.7 SERVICE BATTERY

CAUTION

HANDLE THE BATTERY CORRECTLY

• Never use flames or allow sparks to generate near the battery. The battery releases flammable hydrogen gas and oxygen gas. Any flames or sparks in the vicinity could cause an explosion.

• Do not use the battery the fluid level of which is lowered below the lower limit line. Sustained use of the battery could result in an explosion.

• Do not short the battery terminals with a tool or other metal object.

• When disconnecting battery cables, always remove the cable from the negative (-) terminal first. When reconnecting the cables, attach the cable to the positive (+) terminal first.
• Charge the battery in a well-ventilated area, with all filling hole plugs removed.

• Make sure the cable clamps are securely installed on the battery terminals. A loose cable clamp can cause sparks that may result in an explosion.

• Before servicing electrical components or conducting electric welding, set the battery switch to the (Open/OFF) position or disconnect the cable from the negative (-) battery terminal to cut off the electrical current.

• Electrolyte (battery fluid) contains dilute sulfuric acid. Careless handling of the battery can lead to the loss of sight and/or skin burns. Also, keep the battery fluid off the mouth.

• Wear protective goggles and rubber gloves when working with the battery. (when adding water, charging, etc.)

• If electrolyte is spilled onto the skin or clothing, immediately wash it away with lots of water. Use soap to thoroughly clean.

• The battery fluid can cause blindness if splashing into eyes. If it gets into eyes, immediately flush it away with plenty of clean fresh water, and seek immediate medical attention.

• If the battery fluid is accidentally swallowed, gargle with plenty of water, then drink lots of water, and seek immediate medical attention.

1.4.8 WHEN ABNORMALITY OCCURS

CAUTION

STOP OVERHEATED ENGINE AFTER COOLING RUN

Even if the engine is about to overheat, do not stop the engine immediately. Abrupt stopping of an overheated engine can cause the coolant temperature to rise, resulting in seized engine parts. If the engine is about to overheat, run the engine at low idling speed (cooling operation), and stop the engine after the coolant temperature lowers sufficiently. Do not add coolant immediately after stopping the engine. Adding coolant to a hot engine can cause the cylinder heads to crack due to sudden change in temperature. Add coolant little by little after the engine cools down to room temperature.

AVOID IMMEDIATE RESTART AFTER ABNORMAL STOP

If the engine stops abnormally, do not restart the engine immediately. If the engine stops with an alarm, check and remedy the cause of the problem before restarting. Sustained use of the engine without any remedy could result in serious engine problems.

AVOID CONTINUOUS ENGINE OPERATION WITH TOO LOW OIL PRESSURE

If an abnormal engine oil pressure drop is indicated, stop the engine immediately, and inspect the lubrication system to locate the cause. Continuous engine operation with low oil pressure may cause bearings and other parts to seize.

STOP THE ENGINE IMMEDIATELY IF FAN BELT IS BROKEN

If fan belt is broken, stop the engine immediately. Continued operation of the engine with V-belt broken could cause the engine to overheat and thereby the coolant to boil into steam, which may gush out from the reserve tank or radiator, and cause personal injuries.

1.4.9 OTHER CAUTIONS

CAUTION

WEAR EAR PLUGS

Always wear ear plugs when entering the machine room (engine room). Combustion sound and mechanical noise generated by the engine can cause hearing problems.

MODIFICATION OF ENGINE PROHIBITED

Unauthorized modification of the engine will void the manufacturer's warranty. Modification of the engine may not only cause engine damage but also produce personal injuries.

BREAK-IN OPERATION

A new engine needs to be broken in for the first 50 hours of operation. During this period, do not subject the engine to heavy loads. Operating a new engine under high loads or severe conditions during the break-in period can shorten the service life of the engine.

WARMING-UP OPERATION

After starting the engine, run the engine at low idling speeds for 3 minutes for warming-up. Start the work after this operation is completed. Warm-up operation circulates the lubricant through the engine. Therefore, individual engine parts are well lubricated before they are subjected to heavy loads. This is very important for longer service life, high performance and economical operation. Do not conduct warm-up operation for a longer time than necessary. Prolonged warm-up operation causes carbon build-up in the cylinders that leads to incomplete combustion.

AVOID ENGINE OPERATIONS IN A OVERLOAD CONDITION

If the engine is considered to be in an overloaded condition which is identified by too much black smoke, etc., immediately reduce the load on the engine so that the correct output and load conditions may be achieved. Overloading the engine causes not only high fuel consumption but also excessive carbon deposits inside the engine. Excessive carbon deposits can cause various engine problems and shorten the service life of the engine remarkably.

COOLING OPERATION BEFORE STOPPING ENGINE

Always conduct the cooling operation (low speed idling) for 3 minutes before stopping the engine. Abruptly stopping the engine immediately after high-load operation can cause partial overheating and shorten the service life of the engine. During cooling operation, check the engine for abnormalities.

PROTECTION OF ENGINE AGAINST WATER ENTRY

Do not allow rainwater, etc. to enter the engine through the air inlet or exhaust openings.

CAUTION

As the CRDI engine consists of many electronic components, do not clean it with a high-pressure water jet. Detergent or water can damage the engine's electronic parts, leading to a serious accident.

CONDUCT PROPER MAINTENANCE OF AIR CLEANER OR PRE-CLEANER

The major cause of abnormal wear on engine parts is dust from intake air. Worn parts result in an increase of oil consumption, decrease of output, and starting difficulties. Maintain the air filter or pre-filter as described below to ensure optimum air filtering performance.

- Do not maintain the air filter or pre-filter while the engine is in operation. Operating the engine without the pre-filter can suck particles of foreign matter into the engine and could result in serious accidents.
- When removing the air filter or pre-filter, use care to prevent dust trapped in the air filter or pre-filter from entering the engine. After removing the air filter or pre-filter, immediately cover the opening (inlet port of air cleaner; port in body for pre-cleaner) with plastic sheet or similar means to prevent dust from entering the engine.

OBSERV SAFETY RULES AT WORK SITE

Observe the safety rules established at your workplace when operating and maintaining the engine. Do not operate the engine if you are feeling ill. Operation of the engine with reduced awareness may cause improper operation that could result in accidents. In such a case, inform your supervisor of your condition. When working in a team of two or more people, use specified hand signals to communicate among workers.

WORK CLOSTHING AND PROTECTIBE GEAR

Wear a hardhat, face shield, safety shoes, dust mask, gloves and other protective gear as needed. When handling compressed air, wear safety goggles, hardhat, gloves and other necessary protective gear. Works without wearing proper protective gear could result in serious injuries.

USE OF TOOLS OPTIMUM FOR EACH WORK

Always keep in mind to select most appropriate tools for the work to be performed and use them correctly. If tools are damaged, replace with new tools.

AVOIDANCE OF PROLONGED TIME OF STARTER OPERATION

Do not operate the starter for more than 20 seconds at a time even if the engine does not start. Wait for at least 30 seconds before next engine cranking. Continuous operation of the starter will drain the battery power and cause the starter to seize.

DO NOT TURN OFF BATTERY SWITCH DURING OPERATION

Do not turn off battery switch during operation. If the battery switch is turned OFF when the engine is running, not only various meters will stop working but also the alternator may have its diode and transistor deteriorated.

CAUTIONARY INSTRUCTIONS FOR TRANS PORTING ENGINE

When transporting the engine on a truck, consider the engine weight, width and height to ensure safety. Abide by road traffic laws, vehicle road acts, vehicle restriction ordinances and other pertinent laws.

VENTILATION OF ENGINE ROOM

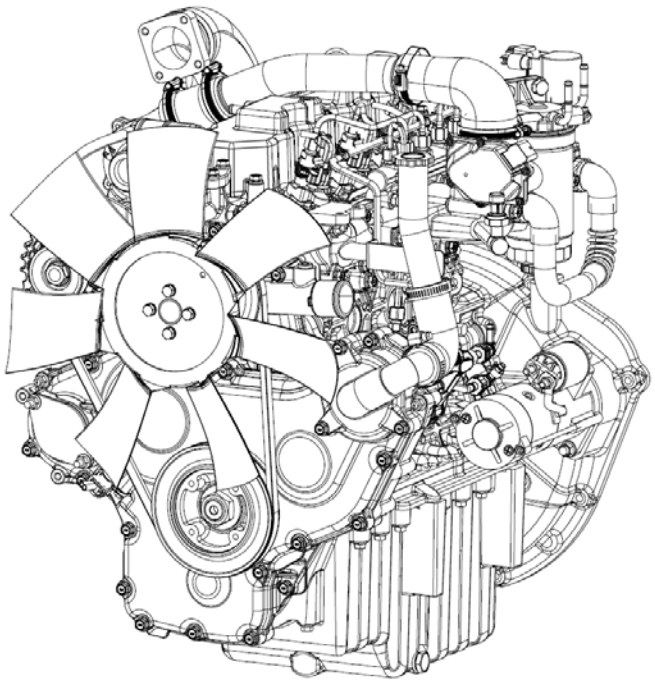
Always provide adequate ventilation in the engine room. Insufficient air in the room can cause an increase in the engine temperature and a decrease in the output power and performance.

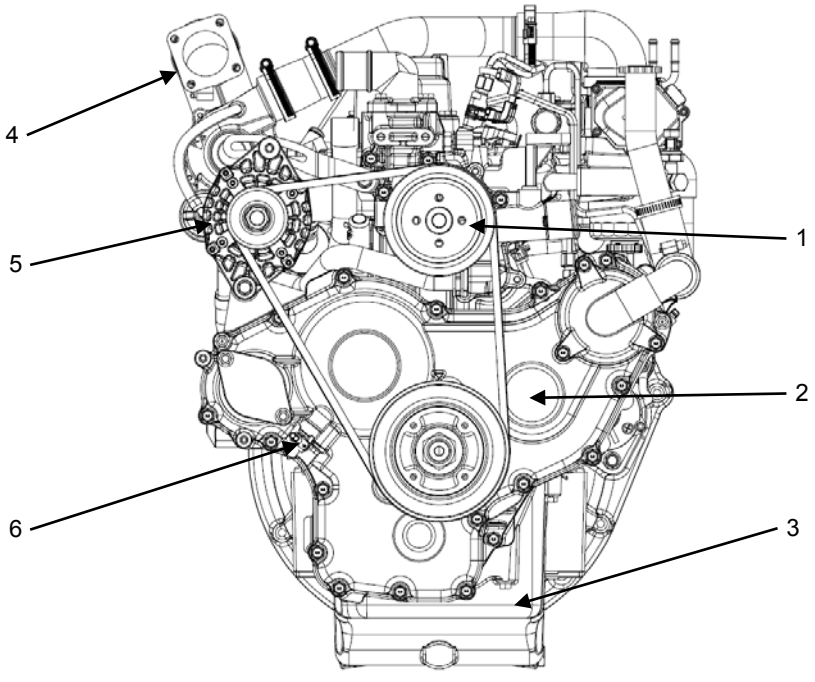
DO NOT TOUCH HIGN-PRESSURE INJECTION FUEL

If fuel leaks or sprays out from the high pressure injection pipe, do not touch the fuel. Fuel in the fuel injection pipes is under high pressure and if the fuel contact your skin, it goes into deep tissues and may result gangrene.

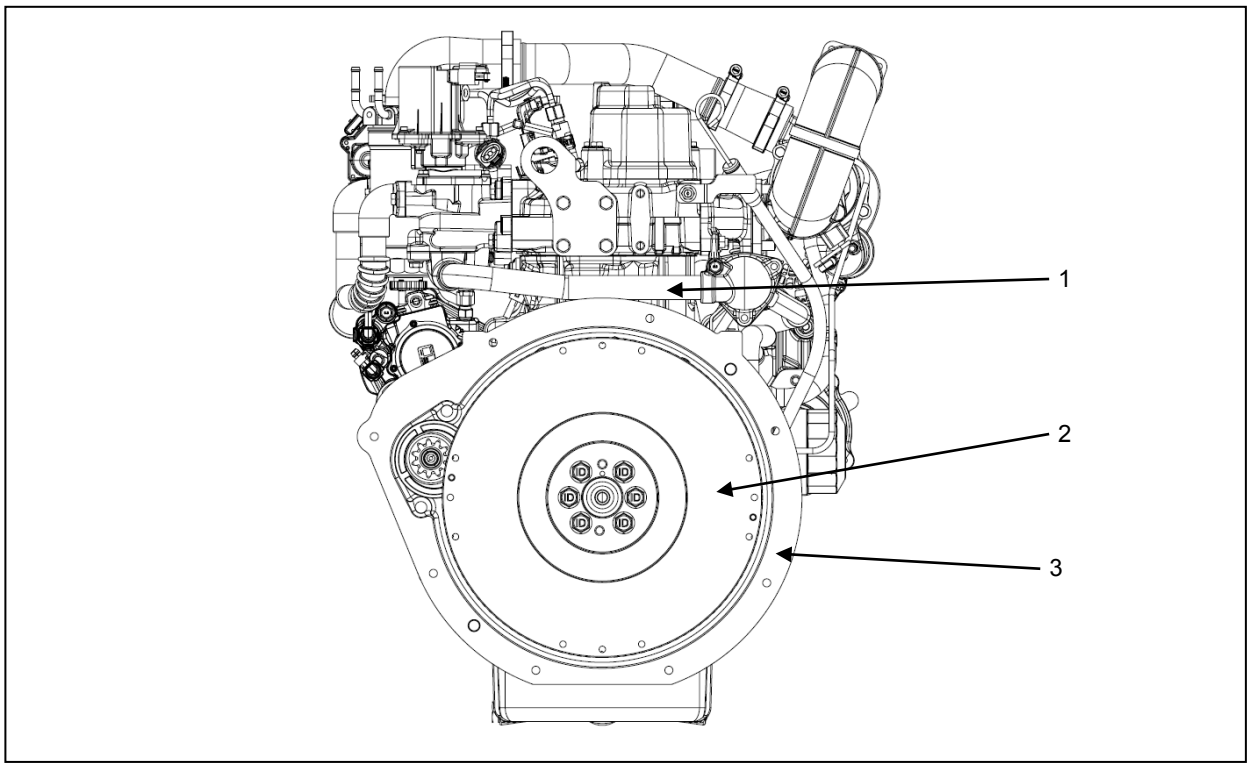
1.5 EXTERNAL STRUCTURE

L4CRTV4 ENGINE

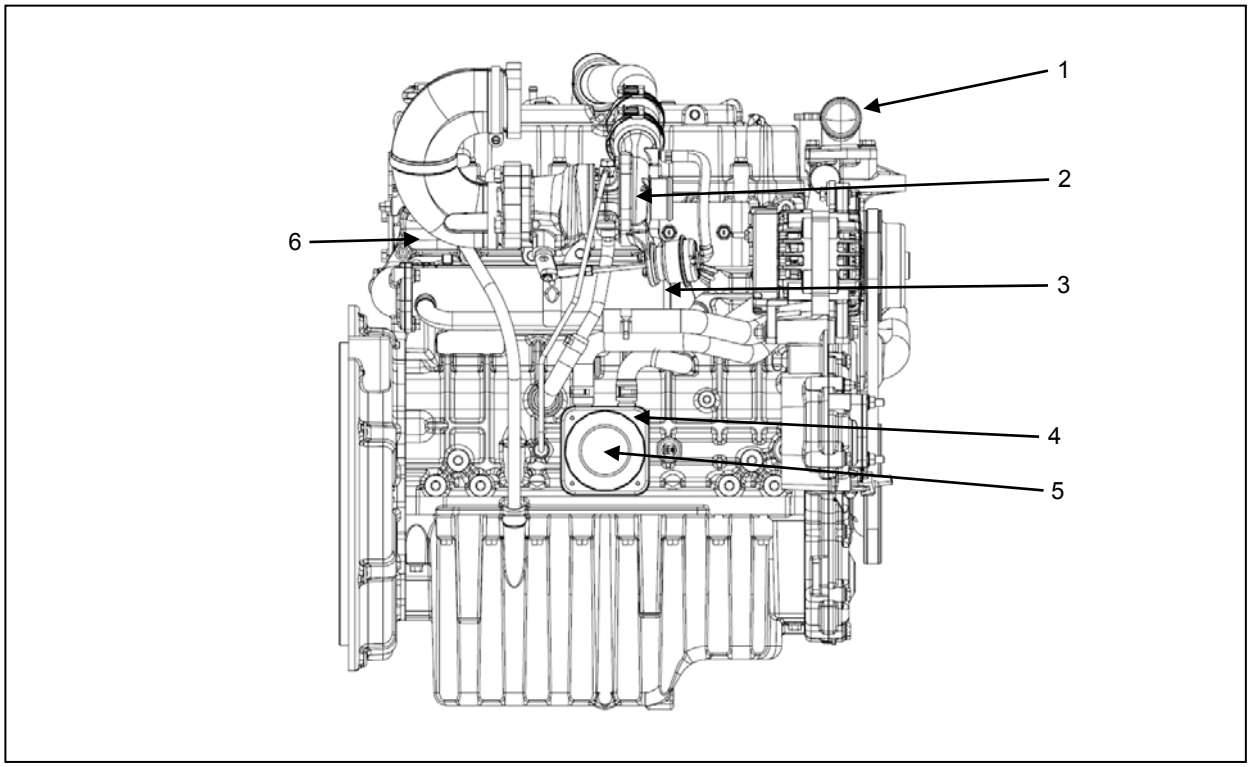




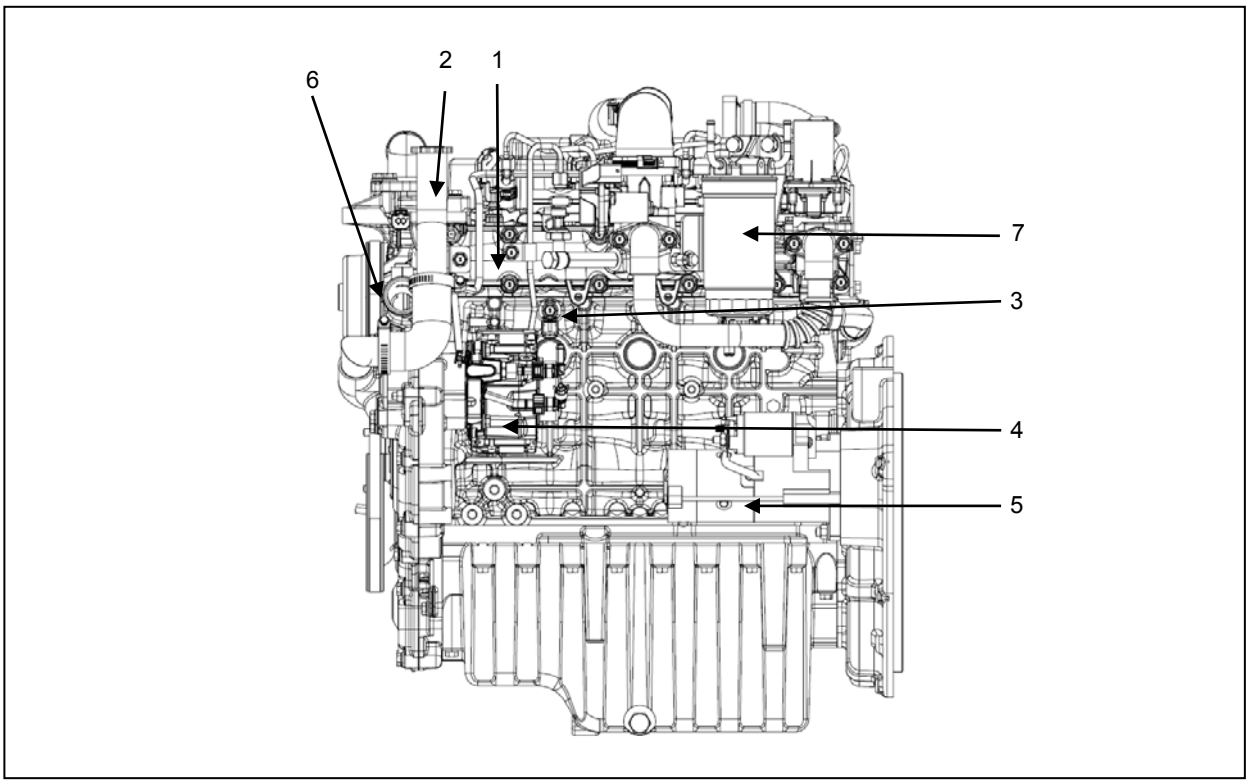
1. Cooling fan pulley
2. Gear case (FR)
3. Oil pan
4. Exhaust Connector
5. Alternator
6. Cam position sensor



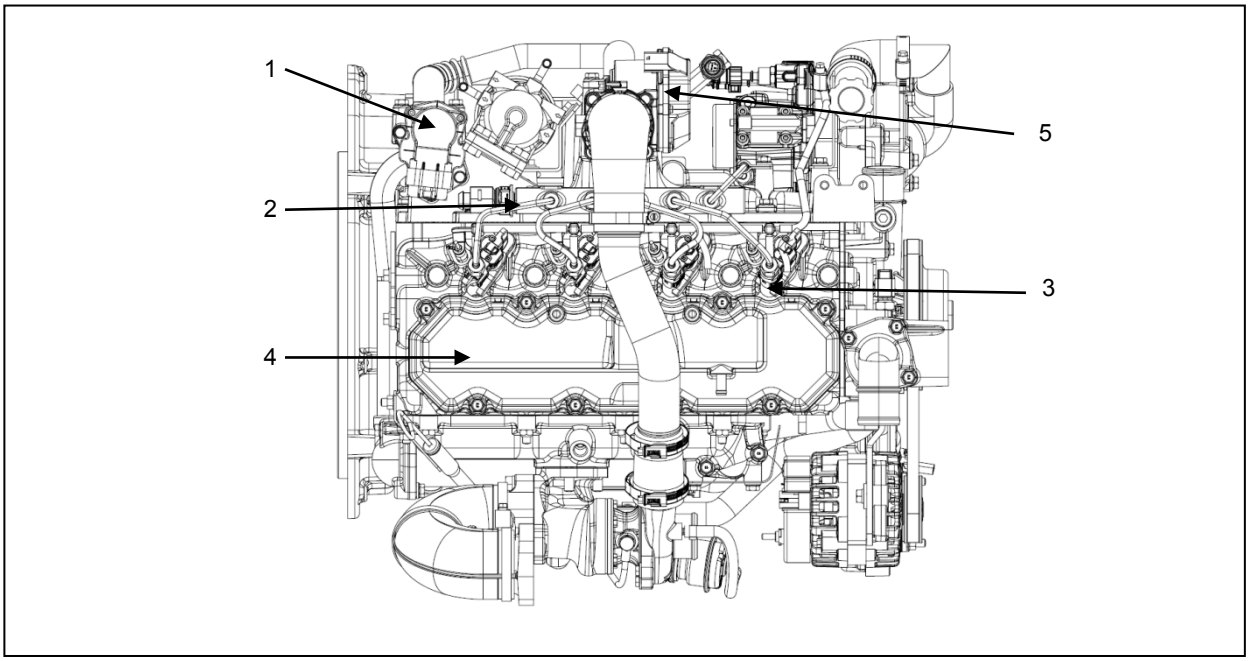
1. EGR Passage pipe 2. Flywheel 3. Flywheel housing



1. Water pump(Outlet) 2. Turbocharger 3. EGR cooler 4. Oil cooler 5. Oil filter
6. Exhaust manifold

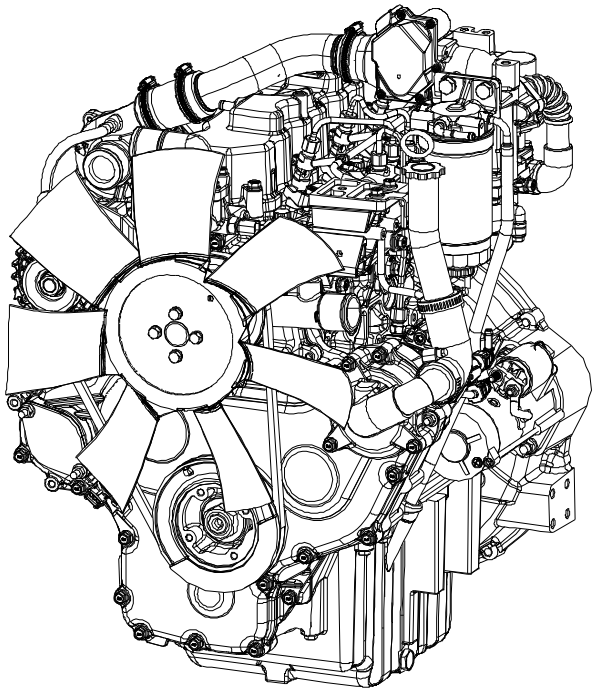


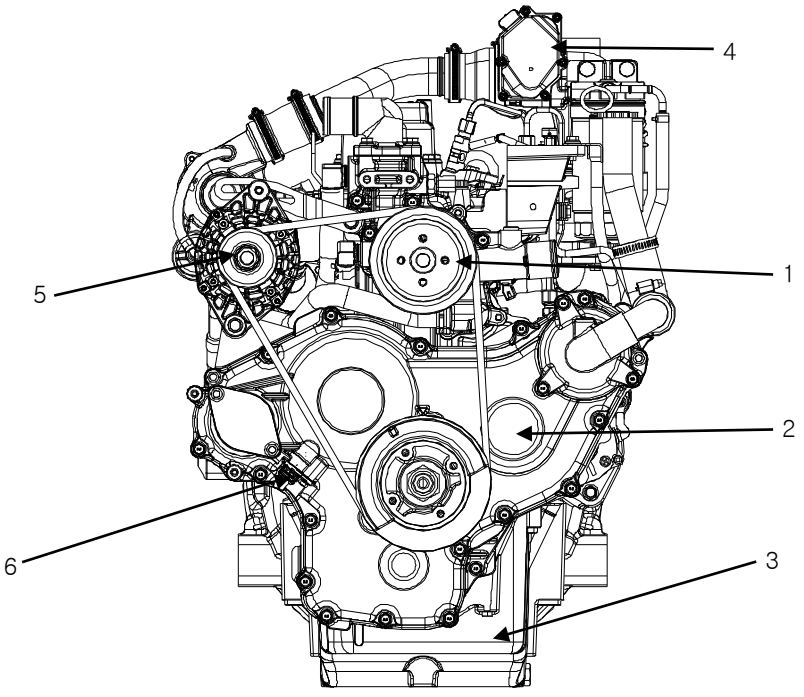
1. Intake manifold 2. Oil inlet 3. Knock sensor 4. High-pressure pump
5. Starter 6. Water pump (Inlet) 7. Main fuel filter



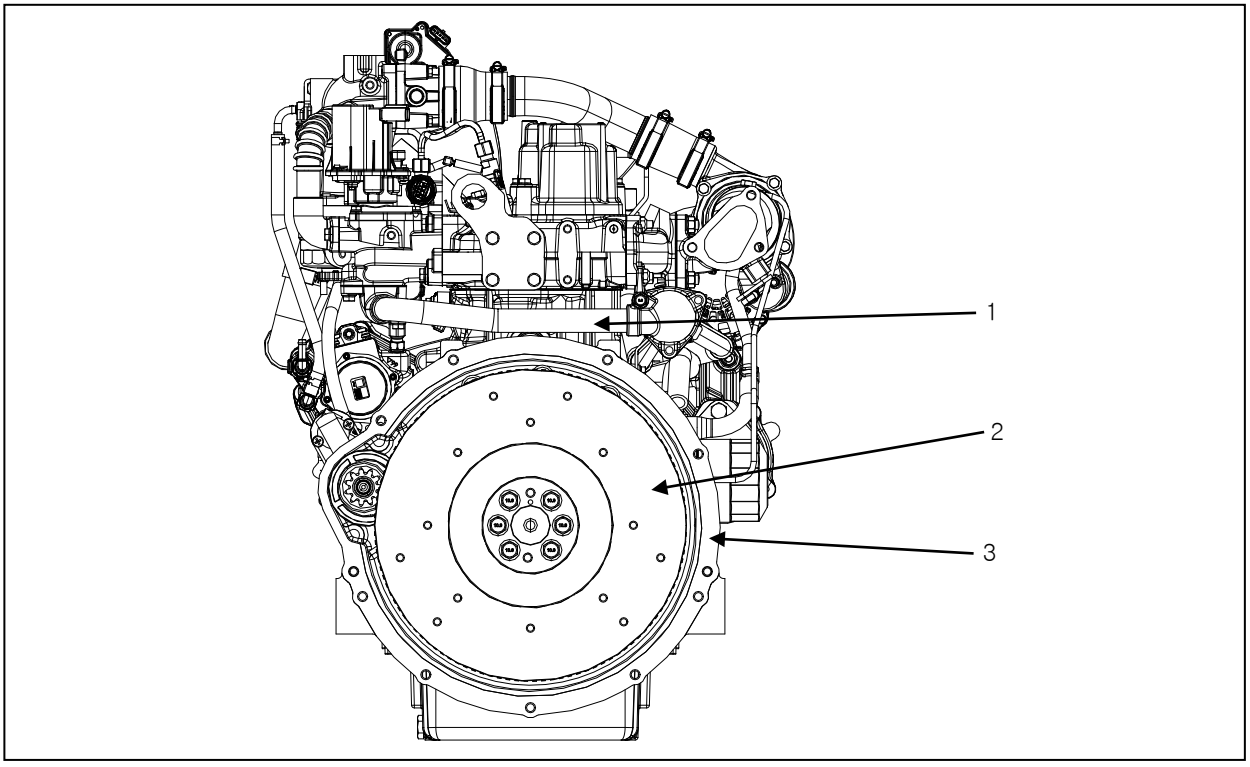
1. EGR valve 2. Common rail 3. Injector 4. Engine decal attached site
5. ACV

L3CRTV4 ENGINE

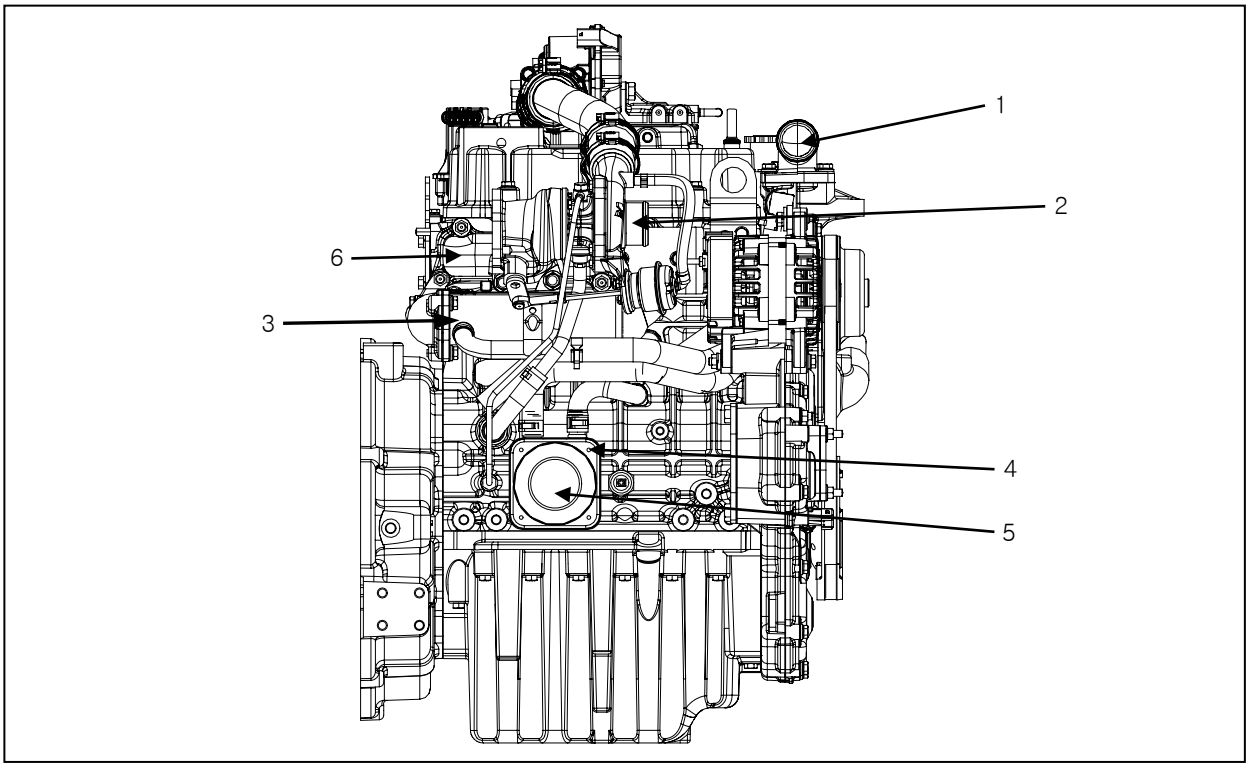




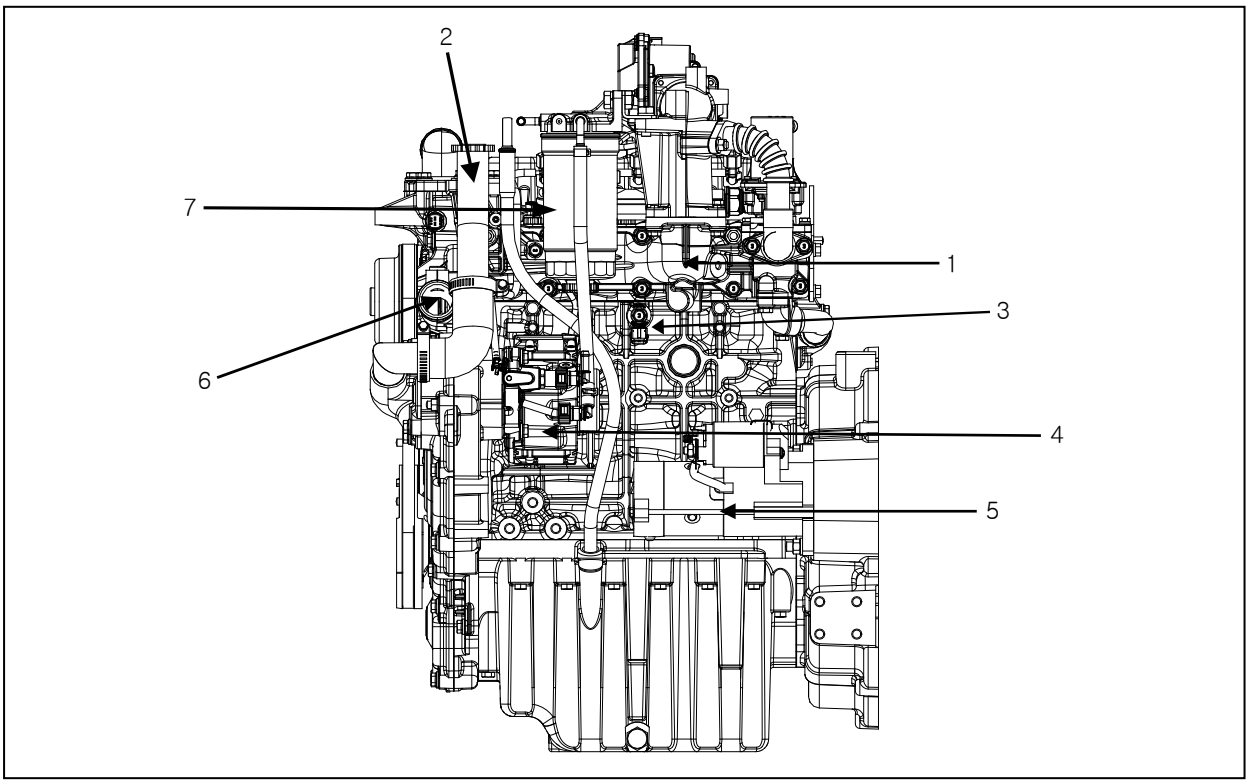
1. Cooling fan pulley
2. Gear case (FR)
3. Oil pan
4. ACV
5. Alternator
6. Cam position sensor



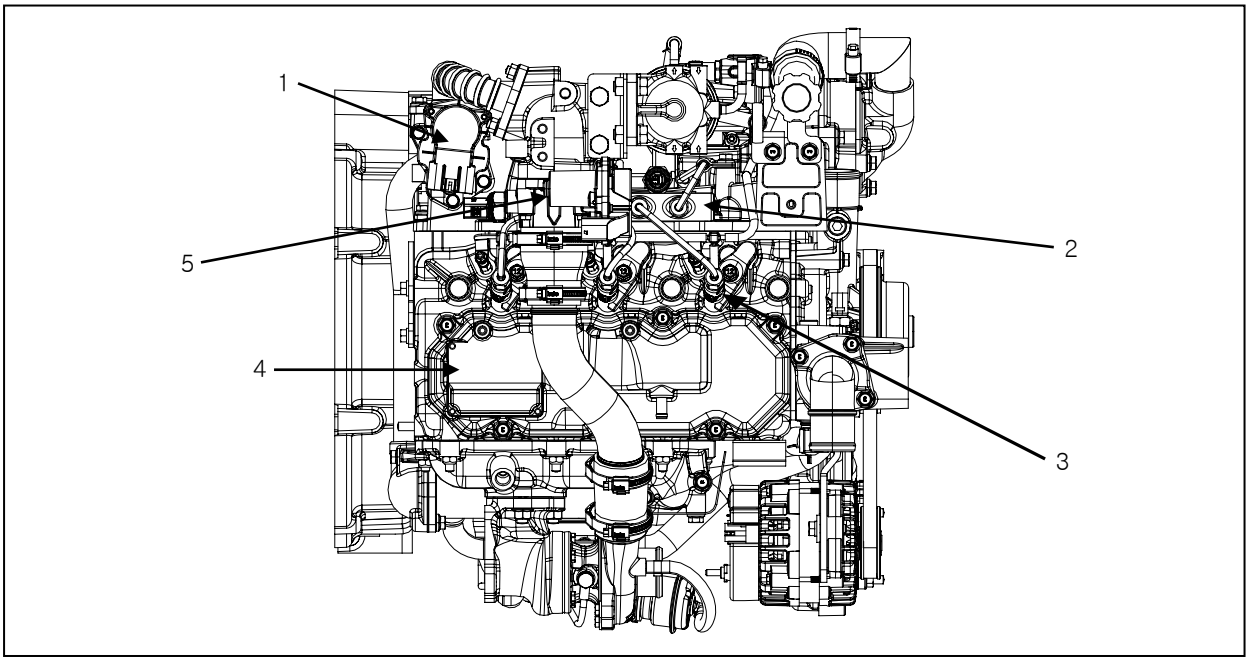
1. EGR Passage pipe 2. Flywheel 3. Flywheel housing



1. Thermostat cover 2. Turbocharger 3. EGR cooler 4. Oil cooler 5. Oil filter
6. Exhaust manifold



1. Intake manifold 2. Oil inlet 3. Knock sensor 4. High-pressure pump
5. Starter 6. Water pump (Inlet) 7. Main fuel filter



1. EGR valve 2. Common rail 3. Injector 4. Engine decal attached site
5. ACV

1.6 MAIN SPECIFICATION

ENGINE FAMILY				L4CRTV4		L3CRTV4
ENGINE MODEL				L4CRV-T6	L4CRV-T3	L3CRV-T2
Performance	Max. Power (kW/rpm)			42 / 2,300	47 / 2,500	37 / 2,600
	Max. RPM under no load			2450 ± 3%	2650 ± 3%	2750 ± 3%
	Min. RPM under no load			800 ~ 1,000		
Main specifications	Type			Water-cooled, 4-stroke cycle common rail diesel engine		
	Emission specifications			EU Stage V / EPA Tier4 / KOREA Stage V		
	No. of cylinders			4 Cylinder		3 Cylinder
	Combustion system			Direct Injection		
	Cylinder Bore (mm) X Stroke (mm)			Φ88 x 103		
	Displacement cc			2,505		1,879
	Compression Ratio			17.0 : 1		
	Ignition sequence			1-3-4-2		1-3-2
	Direction of Rotation			CCW(counterclockwise) from Flywheel Side		
	Dry weight			approx. 220kg		approx. 200kg
Main unit of engine	Cylinder	Type		Dry (integral with cylinder block)		
	Piston	Ring No. of units		Compression ring : 2 Oil ring : 1		
	Valve timing	Intake valve	Open	BTDC16 °		
			Close	ABDC44 °		
		Exhaust valve	Open	BBDC56 °		
			Close	ATDC12 °		
	Starting system			Electric start motor		
	Starting aid system			Glow plug		
	Turbocharger		Type	Waste-gate		
Fuel system	FIE			BORGWARNER common rail system		
	Max. Rail Pressure			1800 bar		
	Injector			7Hole * 640ml/min * 146.5deg (solenoid actuator)		
	Fuel filter			Cartridge type (Paper element)		
	Applicable fuel			Diesel (Ultra low sulfur)		

Lubrication system	Lubrication system		Forced circulation (pressure feed by oil pump)	
	Engine oil	Specification	SAE 5W-40 (CJ4 API GRADE(Low ash oil))	
		Capacity	6.5L	5.9L
	Oil pump	Type	Trochoid (Rotary type)	
	Oil filter		Catridge type (Paper element)	
Cooling system	Cooling method		Water-cooled,forced circulation	
	Water pump	Type	Centrifugal	
	Cooling fan	Type	Blow type	
	Thermostat	Type	Wax-pellet type	
		Opening degree	Open at 76.5℃ ~ Full open at 90℃	
Electrical system	Voltage - Polarity		12V - negative (-) ground	
	Starter	Pinion engagement	Sliding pinion	
		Output	12V - 2.2KW	
	Alternator	Type	12V - 70A	
		Output	3-phase alternating current, with rectifier	

2. OPERATION

2.1 PRELIMINARY CHECK

- Appearance check
  - Is there any damage while transporting?
- Engine cooling system check
  - Is there anti-freeze solution in the radiator? And any leakage?
- Fuel system check
  - Is there any leakage of fuel in the fuel system?
- Oil level check
  - Is there optimal oil amount in each part ?
- Electric system check
  - Is there any cut-off or any other problem in the wiring?
  - Is there any problem to operate the instruments?
  - Is the state of battery charging sufficient?

Warning	
	▶ It is very dangerous to work in a closed area. The poisonous exhaust gas may cause serious damage to the human body. If you should work in this area, make sure to ventilate well and put on the protective mask.

2.2 START IN COLD WEATHER

- Push the throttle lever to the low idle position.
- Start the engine after the cold start aid indicator is turned off according to the right time table.
- After staring engine, carry out warming up for about **5~10 minutes** at low idle rpm.
- Use the engine oil for winter in cold weather. Refer to ***chapter 3, "Capacity of Lubricants and Coolant"***
- Use the diesel for winter when it is very cold weather. It is much easier to start engine.

Coolant Temp.	Preheat time(s)
60℃(140˚F)	0
40℃(104˚F)	0
30℃(86˚F)	0
20℃(68˚F)	8
10℃(50˚F)	15
0℃(32˚F)	18
-10℃(14˚F)	25
-20℃(-4˚F)	30
-30℃(-13˚F)	40

Caution	
	▶ **Safety Interlock !** When the ambient temperature is lower than 0℃, the engine speed will not be increased over 1400 rpm for about maximum 1 minute. But, it is normal operation to prevent an engine failure in cold weather.

2.3 NOTICE WHEN OPERATING

- Do not leave the engine running at idle speed for long.
  The fuel consumption is increased and the carbon is deposited internally of the engine
- The engine load should be increased gradually after approximately one minute from start-up.
- DO NOT operate heavy loaded work and do not increase the engine rpm to high speed suddenly.
  It shortens the life of engine.

2.3.1 ENGINE COOLANT CIRCUIT

- Check regularly that the engine coolant temperature does not reach the threshold.
- If the temperature exceeds the threshold, reduce gradually a load of the engine and check the coolant circuit.

a) the tension of fan belt
b) The thermostat
c) The condition of the radiator(to be cleaned if necessary)

Warning 	▶ **Pressurized System**: When opening the radiator cap, be careful of the escaping hot water or steam. Hot coolant can cause serious burns. To open the radiator cap, stop the engine and wait until the cooling system components are cool down. Loosen the radiator cap slowly in order to relieve the pressure. ▶Wear the protection globes or cover the radiator cap with a rag before opening the radiator cap.
Caution	▶ The dust and dirt, other debris, and damaged fins can cause that cooling efficiency of the radiator is reduced and the engine can be overheated. ▶ Clean the radiator only after stopping engine. ▶ If cleaning with water, take care not to spray water to the electric and electronic parts. If possible, DO NOT USE WATER.

2.3.2 ENGINE LUBRICATION CIRCUIT

check regularly that the lamp of the oil pressure caution turns on.
If the lamp turns on, check the engine oil level and refill the oil if necessary.
If the condition persists, contact the service center.

2.3.3 FUEL CIRCUIT

Do not operate the engine with low fuel in the fuel tank.
The air and particles will be inflow with the fuel, which will cause engine shutdown and damage to the fuel system.

Danger	**Do not allow particles to enter when refueling.. Do not smoke when refueling.**

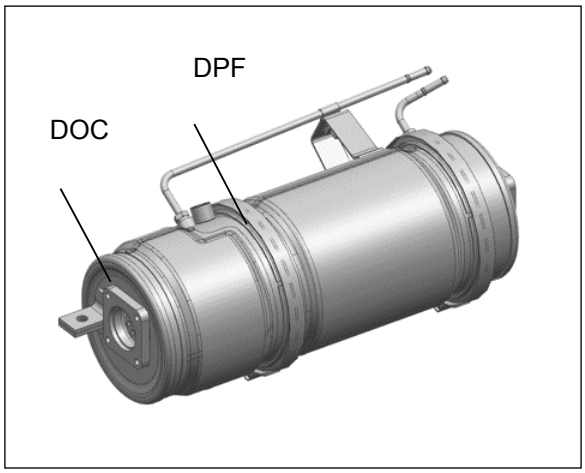
2.3.4 INTAKE / EXHUAST CIRCUIT

Check and clean regularly the intake/exhaust circuit.
The maintenance period in this manual may vary depending on the operating conditions.
Check and clean more often especially in dusty environments than the specified period.

2.3.5 DOC&DPF(CCRT)

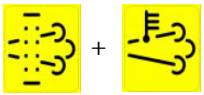
① DOC&DPF(CCRT)

- The Diesel Oxidation Catalyst (DOC) and the Diesel Particulate Filter (DPF) is to reduce PM and hydrocarbons, carbon monoxide and other toxic gases from engine. This system converts exhaust emissions to harmless carbon dioxide and water. The DPF also traps Particular Matter (PM)
- To meet Stage V and Tier 4 emission regulations, the CCRT(Catalyzed continuous regenerating trap) integrated with DOC and DPF combination is installed on your engine.
- It is very important to read this operator's manual and understand the safe operation of your vehicle.



⚠Caution	▶**Burn and Fire hazard** During the Diesel Particulate Filt process, the fixed hood area beco Park the machine outside and aw highly flammable material. And allow area to cool before ser the exhaust system components Failure to comply could result in.

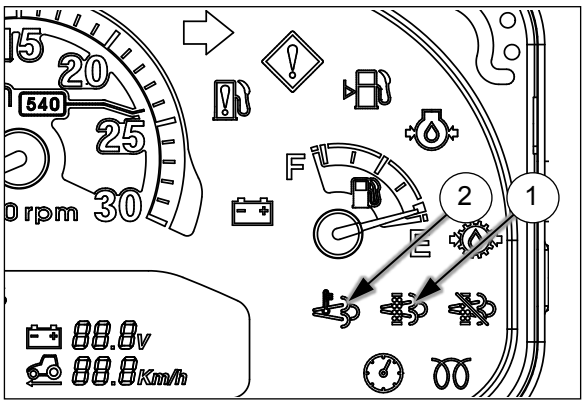
● The indicators related to the DPF regeneration have several illumination figures and its meanings as follows. Read carefully and keep in mind the instructions well.

Indicators	figures	Possible cause	Symptom & Actions	Remarks
1. DPF regeneration indicator	Continuous ON	When the regeneration is processing.	- Normal state	 ON ON
	BLINK(1sec)	When the soot's rate is over 120%	- Press and hold the upper side of the DPF switch over three second for regeneration.	 BLINK (1sec)
	BLINK(0.5sec) + Engine error warning indicator(3)	When the soot's rate is over 150%	Engine power reduction. HAVE TO contact your authorized local dealer for check.	 BLINK (0.5sec) ON
2. DPF inhibited regeneration indicator	Continuous ON	When the Inhibited regeneration mode is working	DPF regeneration is delayed or stopped.	 ON

② Regeneration mode

- In this mode, the operator does not have to take any actions, the system is activated automatically by the engine control unit.

NOTE : The regeneration is the normal operating mode.



- The regeneration will be activated by ECU ;
  - And when soot's rate **reaches 100% or more.**
  - And when the engine **is warmed up enough.**
  - When **the DPF switch is not pressed to the Inhibited regeneration mode.**

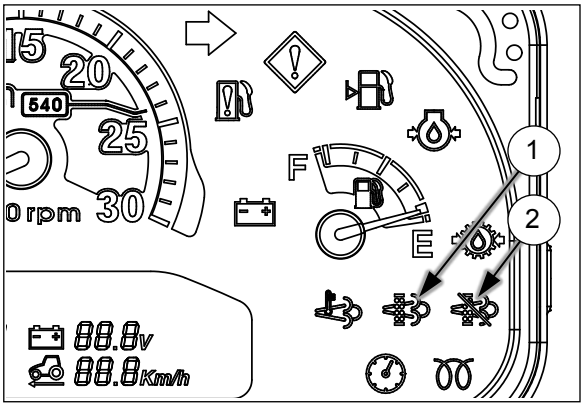
NOTE : Regeneration will be lasted for ***approximately 15 to 25 minutes.***

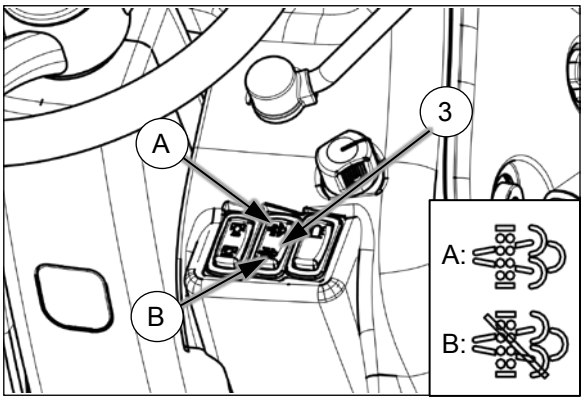
- During the regeneration, the DPF regeneration indicator(1) and when the exhaust gas temperature from DPF is over 550 ℃ DPFtemperature indicator (2) will be turned on.
- In case of turning off the engine while the regeneration is processing, the regeneration is to resume again when restarting the engine.

NOTICE	▶ If engine is turned off during the regeneration, soot will not be completely burned and may increase fuel consumption. KEY-OFF during regeneration mode is not recommendable because too short operation won't finish regeneration mode, So, we recommend to users to operate until all indicator lights are turned off without Key switch OFF and keep slightly high engine speed the idle.

⚠Warning	▶ **Fire hazard!** During the Diesel Particulate Filter(DPF) regeneration process, the exhaust stack and fixed hood area becomes extremely hot. Park the machine outside and away from combustible or highly flammable material. Failure to comply could result in death or serious injury.

③ Inhibited regeneration mode





***NOTICE** : Only use this mode when regeneration needs to be delayed or stopped because of an operation condition that may risk a fire hazard due to high exhaust temperatures during regeneration.*

***NOTE** : Even if the DPF regeneration indicator(1) is ON during the regeneration process, the inhibited regeneration mode can be set.*

The regeneration mode can be delayed or stopped by the use of the DPF switch(3) that is located on the left-hand side of the dash.

To set the inhibited regeneration mode :

1. Press down the lower side(B) of the DPF switch(3). And then DPF inhibited regeneration indicator(2) will be turned on.

***NOTICE** : When vehicle arrives at a safe regeneration location, press again the lower side(B) of the DPF switch to exit the Inhibited regeneration mode.*
If not, excessive soot in the DPF may overload the emission system and result in a reduction of engine power.

To exit the Inhibited regeneration mode (To go to the regeneration mode) :

1. Press down the lower side(B) of the DPF switch(3) again for only exiting the inhibited regeneration mode.
2. Press and hold the upper side(A) of the DPF switch(3) for over one second to exit the Inhibited regeneration mode and to execute the regeneration mode with parking brake.
3. When inhibited regeneration mode has been exited, the DPF inhibited regeneration indicator (4) will be turned off.

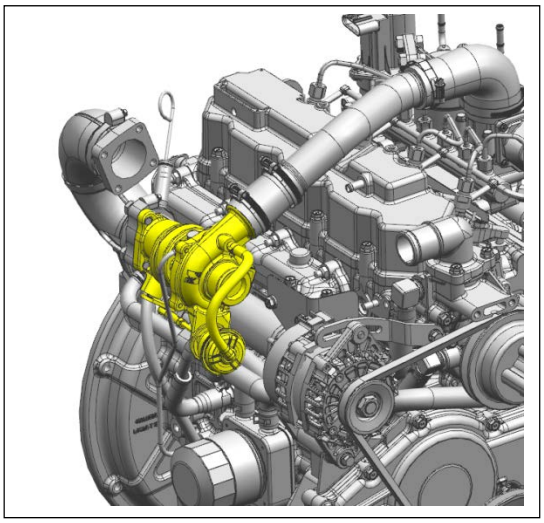
***NOTE**: If the vehicle is shut off during the inhibited mode, when restarting the vehicle, the regeneration system will return to the regeneration mode.*

2.3.6 ELECTRICAL CIRCUIT

Check the battery's charge regularly, especially in winter.

If necessary to change the battery, refer to section "3-8 Battery".

2.3.7 HANDLING TURBOCHARGER



- Before accelerating or working the vehicle fitted with the turbocharger, allow the engine to idle for about 1 minute to ensure that the turbocharger is correctly lubricated.
- Before stopping engine fitted with the turbocharger, allow the engine to idle for about 2 minutes. This allows the turbocharger and manifold to cool, preventing deformation of the components.
- After stopping engine fitted with the turbocharger, cover the exhaust tail pipe to prevent the turbocharger rotating in the wind, resulting in possible damage to the bearings. The turbocharger turbine must be prevented from rotating freely with the engine off, as the shaft bearings will not be lubricated.

2.4. ENGINE BRAKE-IN PROCEDURE

To get the best performance, comply with the followings.

- DO NOT start or stop the vehicle suddenly.
- DO NOT operate heavy loaded work and do not increase the engine rpm to high speed suddenly.
- Despite warm ambient temperature, warm up the engine for about 5 minutes at low idle.
- Use the lower gear ratios when pulling heavy loads and avoid continuous operation at constant engine speeds. You will save fuel and minimize engine wear by selecting the correct gear ratio for a particular operation
- Avoid prolonged operation at either high or low engine speeds without a load on the engine.
- Check the instruments frequently and keep the radiator and oil reservoirs filled to recommended levels. Daily checks include the engine oil level, radiator coolant, and air cleaner.
- After using the first 50 hours, be sure to perform the maintenance items listed in the maintenance schedule. *Refer to the chapter 5-4, “First 50 hour check” in this manual.*
  If possible, contact your authorized local dealer for “First 50 hour check”.

3.MAINTENANCE

3.1 GENERAL INFORMATION

- **Adequate lubrication and maintenance on a regular schedule are vital to maintaining your equipment. To ensure long and efficient operation, follow the lubrication and maintenance schedules outlined in this manual. The use of proper fuels, oils, grease and filters, as well as keeping the systems clean, will also extend vehicle and component life.**

NOTICE: While any company can perform necessary maintenance or repairs on your equipment, we strongly recommends that you use only authorized local dealers and products that meet the given specifications. Improperly or incorrectly performed maintenance and repair voids the equipment warranty and may affect service intervals.

NOTICE: Always use genuine replacement parts, oils and filters to ensure proper operation, filtration of engine . See your authorized local dealer for additional oil quantities. Regular lubrication is the best insurance against delays and repairs. Proper lubrication will extend engine life. Refer to the following charts for lubricants and service intervals.

NOTICE: Failure to complete the required maintenance at the recommended intervals can cause unnecessary downtime.

- **The intervals listed in the Lubrication Chart are guidelines to be used when operating in normal conditions. Adjust the intervals for operating in adverse environmental and working conditions. The intervals should be shortened for sandy, dusty and extremely hot operating conditions.**

Warning	**▶ Avoid injury!** **1. Disengage all drives.** **2. Shut off engine.** **3. Remove key from key switch.** **Failure to comply could result in death or serious injury.**

- **Always clean the area around dipsticks, fill caps, and check plugs when checking fluid levels. Failure to clean these areas may allow contamination to enter the system. Drain, flush and refill the system any time you suspect it is contaminated.**

3.2 PERIODIC ENGINE

In order to utilize optimum performance of the engine and comply with emissions regulations, it is necessary to perform inspection, cleaning and replacement of parts according to the following periodic maintenance schedule. Full performance of the engine and compliance with emissions regulations are guaranteed if periodic service, cleaning and replacement are performed according to the specified maintenance schedule.

▶The maintenane periodic of air cleaner may vary depending on the vehicle application.

ITEM	COMPONENT	INSPECTION	50H	100H	300H	500H	1000H or 1Y	1500H or 2Y	3000H
Intake system	Cleaning air cleaner and replacing element		▲		■	●			
	Turbocharger (cleaning blower)								■
Lubrication system	Changing engine oil	▲	★	▲	●	(Check/add or change it at every 300 hours afterwards.)			
	Replacing oil filter		★		●	(Check/add or change it at every 300 hours afterwards.)			
Fuel system	Checking fuel level and adding fuel	▲							
	Cleaning fuel tank				■				
	Fuel filter and fuel hose	▲							
	Draining water from fuel filter	Warning lamp illuminated or 50 hours							
	Replacing fuel filter (element)					●			
Cooling System	Changing coolant	▲				●			
	Adjusting fan belt tension		▲ (Initially)		▲				
	Cleaning with coolant, checking and repairing							▲	
Engine Part	Re-tightening bolts							▲	
	Adjusting valve clearance						▲		
Electrical system	Checking warning lamp	▲							
	Checking battery electrolyte		▲						
Exhaust, gas system	EGR Cooler, PCV , Injector tips							■	
	Fuel injectors, Turbocharger, CCRT, ECU, , EGR systems , Sensors, ACV								■

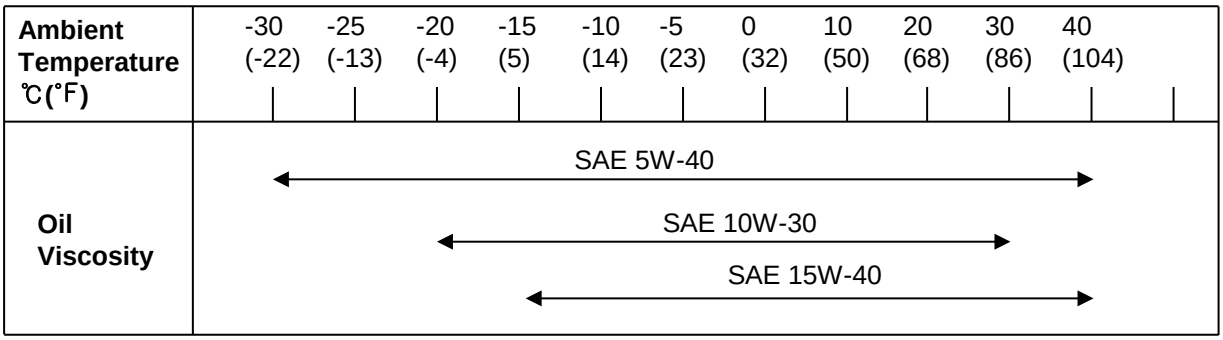
★ First Replacement ● Replacement ▲ Check, Adjustment and Supply ■ Clean up

3.3 CAPACITY OF LUBRICANT AND COOLANT

LUBRICANTS	CAPACITY	INTERNATIONAL STANDARD	RECOMMENDED ITEMS
Engine coolant	L4CRTV4 : 4.5 ℓ (only engine without radiator) L3CRTV4 / L3CRTV3 : 4.0 ℓ (only engine without radiator)	ASTM D6210	Soft water (50%)+ Anti-freeze (50%)
Fuel	Depending on the various the vehicle/equipment configurations.	- ASTM D975-08a Grade 2 - EN590 : 2009 Diesel fuel - BS2869 : 2006 Class A2 - Bio diesel fuel up to 7% (EN590 2009, ASTM D975)	Ultra low sulfur diesel fuel, below 15 ppm
Engine oil	L4CRTV4 : 6.5 ℓ L3CRTV4 / L3CRTV3 : 5.9 ℓ	API CJ-4	KIXX DL (Maker : GS Caltex)

RECOMMENDED ENGINE OIL VISCOSITIES

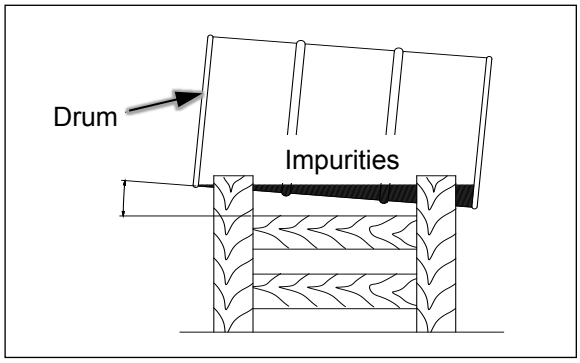
The correct engine oil viscosity grade is dependent upon ambient temperature. Refer to the below chart when selecting engine oil for your vehicle.
In areas where prolonged periods of extreme temperatures are encountered, local lubricant practices are acceptable. Contact your authorized local dealer.



3.4 FUEL

3.4.1 FUEL

- If contaminants like water or dusts are mixed in the fuel, it may cause a severe damage to the engine. The fuel storage facility must be equipped as shown in the right figure.
  If possible, fill the tank at the gas station with fuel.



3.4.2 USING DIESEL FOR WINTER

- General diesel fuel tends to generate paraffin dregs in winter time which may cause a bad engine start. Thus, it is recommended to use diesel for winter in winter time.

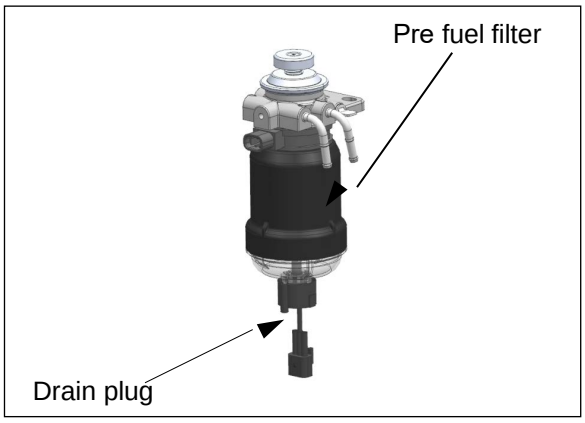
3.4.3 CHECKING FUEL LEVEL AND FILLING THE TANK

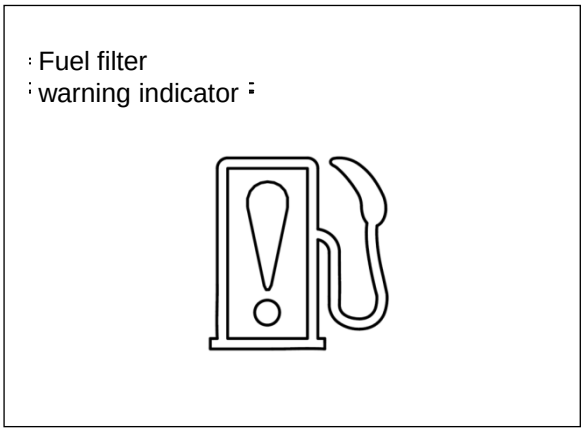
- Check the gauge of the fuel tank and it's not sufficient, fill the fuel tank with diesel fuel.

Notice	▶ After finishing work, fill the fuel tank fully. As the temperature drops down at night, the humidity in the fuel tank is condensed, and may be mixed with the fuel.

3.4.4 DRAIN WATER FROM FUEL FILTER

1. Loosen the drain plug and drain water inside of the filter. (Approx. 150cc(9.1 in³))
2. Tighten the drain plug and bleed the air from the fuel filter. (*See page 5-43*)





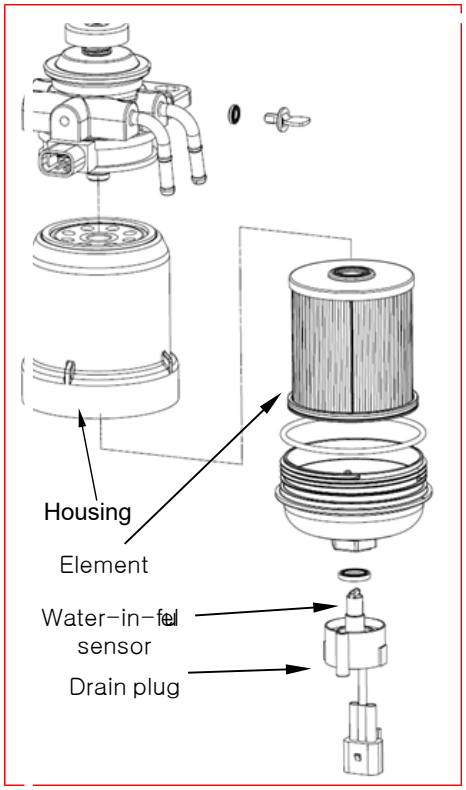
Warning	▶ Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire. To help prevent possible injury, turn the key switch off when changing fuel filters or water separator elements. Clean up fuel spills immediately.
Caution	▶ Do not allow dirt to enter the fuel system. Thoroughly clean the area around a fuel system component that will be disconnected. Fit a suitable cover disconnected fuel system component. Do not fill the new filter with fuel. Invisible fine contaminants can enter the injection pump and it may cause damage to the fuel injection system.
Caution	▶ Do not throw the exhausted waste fuel to any place. This may pollute the soil and water seriously and also is prohibited legally. If violating, you would be responsible for that by civil or criminal case. The waste oil must be disposed according to the environment laws.

3.4.5 REPLACING ELEMENT OF PRE FUEL FILTER

WARNING

1. **Check that there is no flame when handing fuel**
2. **Wipe off any spilled fuel. This can cause fire.**

1. Clear the fuel filter and its surroundings.
2. Disconnect the fuel filter water-in-fuel sensor from its connector.
3. Prepare the fuel plate and place it under the fuel filter.
4. Loosen the drain plug and drain fuel from the fuel filter.
5. Remove the Water-in-fuel sensor from the fuel filter.
6. Remove the housing, bowl and element.
7. Wipe off any fuel on the fuel filter element mounting surface of fuel filter body with a cloth.
8. After replacing the enclosed new bowl o-ring, apply film of oil to bowl o-ring.
9. IAfter apply film of oil to element o-ring, combine the new element in the bowl.



Warning

Do not use the filter of which cause has dents, as it may be damaged during operation, and cause fuel leakage that becomes fire hazard.

CAUTION

Plug and cover openings of the high- pressure pump, rail, fuel pipes and injectors in order to prevent foreign materials from

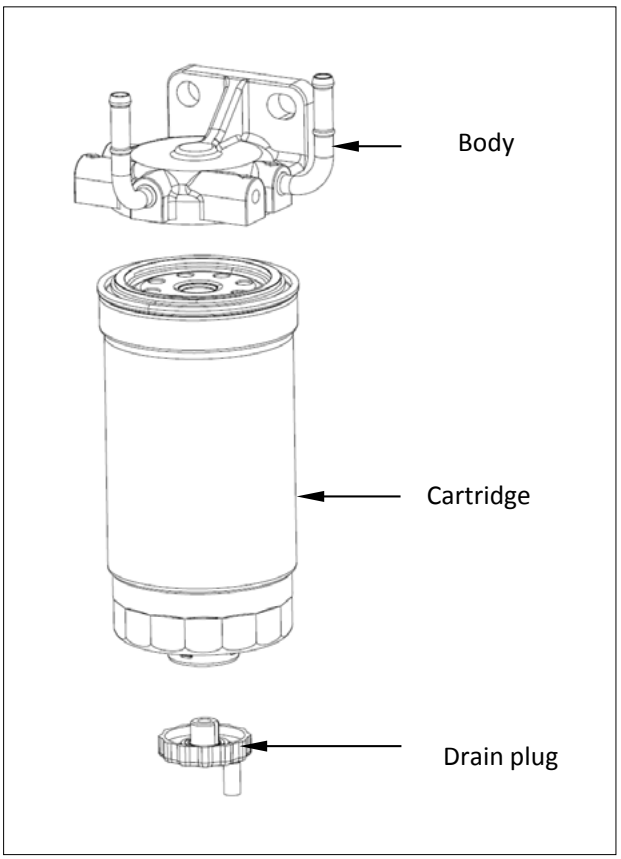
10. Screw the bowl by hand up to the base of housing.
11. Tighten he bowl with mounting tool (HEX27) at 15+5 Nm.
12. After replacingthe enclosed new housing gasket, apply film of oil to gasket.
13. Screw the housing by hand up to the base.
14. Tighten by hand 3/4 to turn.
15. After completion of the fuel filter change, bleed the fuel system.
16. Start the engine and idle for a few minutes.
17. Check the fuel filter cartridge mounting surface for fuel leakages.
    If leakage are found, loosen the fuel filter and check the gasket for seating or damage. Then retighten the fuel filter.

3.4.6 REPLACING CARTRIDGE OF MAIN FUEL FILTER

WARNING

1. **Check that there is no flame when handing fuel**
2. **Wipe off any spilled fuel. This can cause fire.**

1. Clear the fuel filter and its surroundings.
2. Prepare the fuel plate and place it under the fuel filter.
3. Loosen the drain plug and drain fuel from the fuel filter.
4. Remove the drain plug from the fuel filter.
6. Remove the fuel filter cartridge.
7. Wipe off any fuel on the fuel filter element mounting surface of fuel filter body with a cloth.
8. Prepare the new fuel filter element and make sure that the gasket is properly seated on the groove.



Warning **Do not use the filter of which cause has dents, as it may be damaged during operation, and cause fuel leakage that becomes fire hazard.**

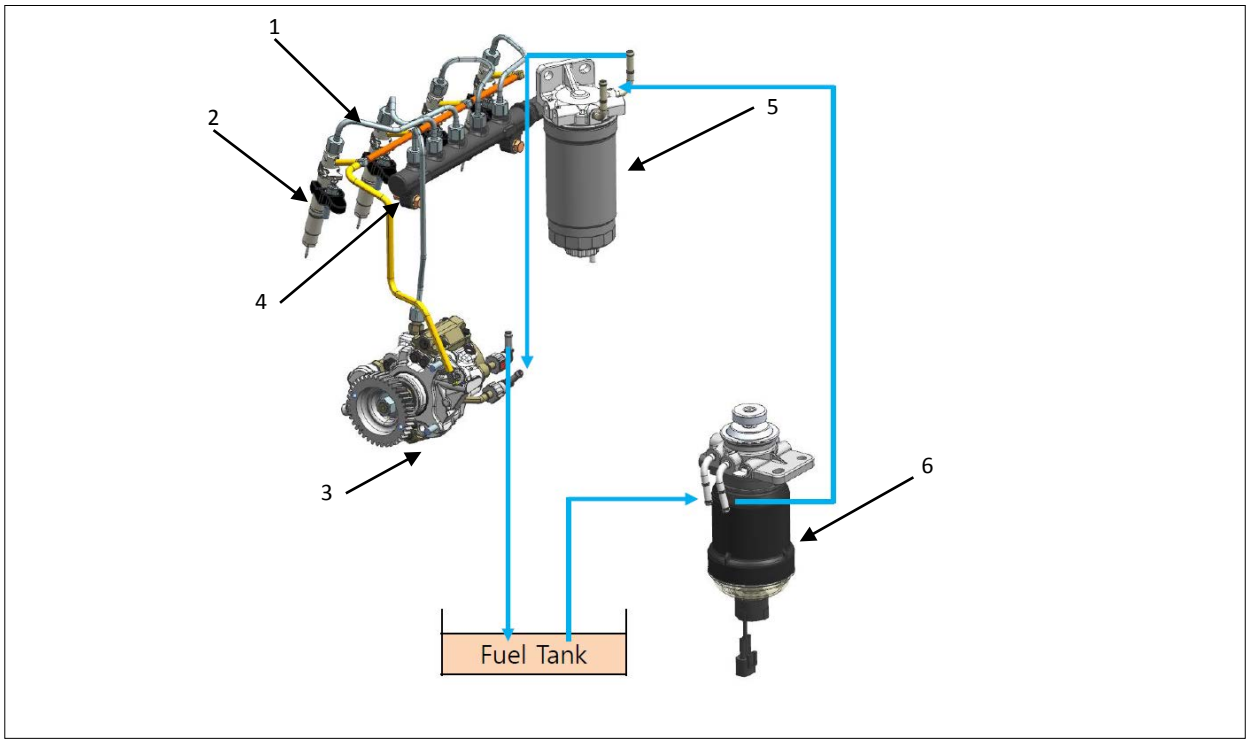
9. Install the fuel filter cartridge to the filter body..

CAUTION **Plug and cover openings of the high-pressure pump, rail, fuel pipes and injectors in order to prevent foreign materials from entering the fuel system**

10. Using new O-ring, install the drain plug to the fuel filter cartridge.
11. After completion of the fuel filter change, bleed the fuel system.
12. Start the engine and idle for a few minutes
13. Check the fuel filter cartridge mounting surface for fuel leakages. If leakages are found, loosen the fuel filter and check the gasket for seating or damage. Then retighten the fuel filter.

3.4.7 AIR-BLEEDING FROM FUEL SYSTEM

● Air in the fuel system may cause weak injection or a failure of the engine start or stop. To prevent such a failure, bleed the air from the fuel system.



1. Fuel pipe 2. Injector 3. High-pressure pump 4. Common rail
5. Main Fuel filter 6. Pre Fuel filter

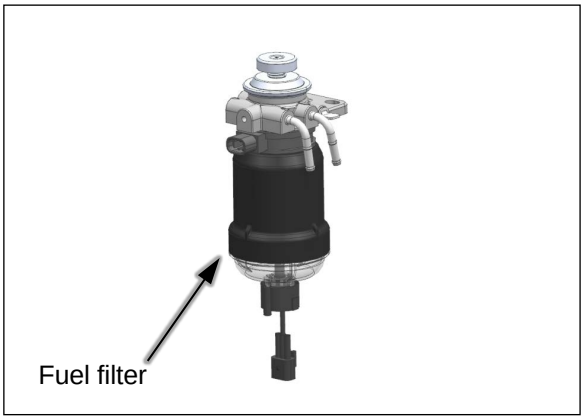
Danger	▶ HIGH PRESSURE FUEL. When the engine is running, do not loosen the fuel injection pipes to bleed air from the fuel system.
Caution	▶ Do not adjust or modify the fuel injection system arbitrary. This will alter the emission of exhaust fumes and engine performance.
Notice	▶When changing the fuel filter only, it is not necessary to bleed air from the fuel injection pipes.

● After replacing fuel filter, bleed the air in the fuel filter.

1) Press down the manual feed pump several times.

2) Unscrew the air bleed plug installed on the fuel filter flange. After bleeding the air bubbles, tighten the air bleed plug slightly.

3) Repeat the procedure 1 and 2 until there is no more fuel containing air bubbles.



⚠Warning	▶ Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire. To help prevent possible injury, turn the key switch off when changing fuel filters or water separator elements. Clean up fuel spills immediately.

⚠Caution	▶ Do not allow dirt to enter the fuel system. Thoroughly clean the area around a fuel system component that will be disconnected. Fit a suitable cover disconnected fuel system component. Do not fill the new filter with fuel. Invisible fine contaminants can enter the injection pump and it may cause damage to the fuel injection system.

⚠Caution	▶ Cover the bleeding fuel with a rag so that it does not flow into other components. ▶Do not throw the exhausted waste fuel to any place. This may pollute the soil and water seriously and also is prohibited legally. If violating, you would be responsible for that by civil or criminal case. The waste oil must be disposed according to the environment laws.

Notice	▶ If dust and dirt is stuck to the air bleed plug, it may prevent the air-bleeding. In this case, unscrew the air bleed plug and clean it.

3.4.8 AIR-BLEEDING FROM FUEL INJECTION PIPE

- DO NOT loosen the high-pressure fuel lines in order to purge air from the fuel system. This procedure is not required.

Fuel injection pipe

⚠Warning	▶ **Escaping fluid!** Hydraulic fluid or diesel fuel leaking under pressure can penetrate the skin and cause infection or other injury. To prevent personal injury: Relieve all pressure before disconnecting fluid lines or performing work on the system. Before applying pressure, make sure all connections are tight and all components are in good condition. Never use your hand to check for suspected leaks under pressure. Use a piece of cardboard or wood for this purpose. If injured by leaking fluid, see your doctor immediately. Failure to comply could result in death or serious injury.

3.4.9 BIODIESEL FUEL

Fatty Acid Methyl Ester Biodiesel (Biodiesel Fuel) consists of a family of fuels derived from vegetable oils treated with methyl esters.

NOTICE: *Biodiesel Fuel blends are approved for your engine only if they comply with* ***EN14214*** *Specification Standards or* ***ASTM D6751****.*

NOTICE: *It is imperative that you check which blend is approved for your engine with your authorized local dealer. Be aware that the use of Biodiesel Fuel that does not comply with the Standards mentioned above could lead to severe damage to the engine and fuel system of your vehicle. The use of fuels that are not approved may void manufacturer warranty coverage.*

Biodiesel approved blend

The use of biodiesel blends meeting Specification Standards ASTM 6751 or EN14214 are approved for your engine up to B5 (5% blend ratio). It is highly recommended to use biodiesel fuel from accredited suppliers to maintain quality and consistency of the fuel.

Biodiesel Fuel Usage Conditions

NOTICE: *The Biodiesel Fuel must meet the fuel Specification mentioned above.*

Biodiesel Fuel must be purchased from a trusted supplier that understands the product and maintains good fuel quality. Biodiesel Fuel must be pre-blended by the supplier. Mixing Biodiesel Fuels on-site can result incorrect mixture that can lead to problems with both engine and fuel system.

Engine performance is affected by the use of Biodiesel Fuel.

The reduced power must be accepted if using any Biodiesel Fuel blend.

Biodiesel Fuel has a higher cloud point than Diesel Fuel.

NOTICE: *The use of high Biodiesel Fuel blends are not recommended in cold weather conditions.*

With Biodiesel Fuels, it may be necessary to change the engine oil, engine oil filter and fuel filter elements more frequently than with Diesel Fuels. Biodiesel Fuel can remove rust and particles from the inside of on-site fuel storage tanks that would normally adhere to the sides of the tank. Like particle deposits that commonly occur with Diesel Fuel, these particles can become trapped by the vehicle fuel filters, causing blockage and shortening filter life. In cold weather, this is more likely to happen. Consult your authorized local dealer for information on cold weather operation and proper maintenance intervals when using any Biodiesel Fuel blend.

When handling Biodiesel Fuel, care must be taken not to allow water into the fuel supply. Biodiesel Fuel will actually attract moisture from the atmosphere.

Fuel tanks must be kept as full as possible to limit the amount of air and water vapors in them. It may be necessary to drain the fuel filter water tap more frequently.

Potential oxidation and stability could be a problem with the fuel stored in the vehicle.

NOTICE: *vehicle must not be stored for more than three months with Biodiesel Fuel blends in the fuel system.*

If long storage periods are necessary, the engine must run on Diesel Fuel for 20 hours to flush the Biodiesel Fuel out of the engine fuel system prior to storage.

NOTICE: *Biodiesel Fuel must not be stored in on-site storage tanks for more than three months.*

Any spillage of Biodiesel Fuel must be cleaned up immediately before it can cause damage to the environment and the paint finish of the vehicle.

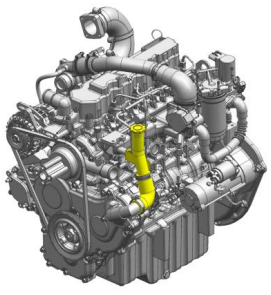
Before using Biodiesel Fuel blends you should consult with your dealer to receive full information about the approved blend for your vehicle and any detailed conditions of its usage.

NOTICE: *Be aware that not fulfilling the requirements and conditions of Biodiesel Fuel usage will void your tractor's Warranty coverage.*

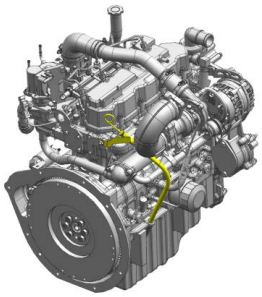
3.5 ENGINE OIL

3.5.1 OIL SPECIFICATION AND CAPACITY:

See chapter 3-3, "Capacity of Lubricants and Coolant"



Oil filling inlet

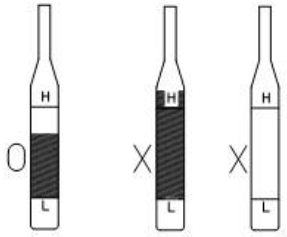


Oil gauge

3.5.2 CHECKING ENGINE OIL LEVEL

- Check and add the engine oil **every 100 hours of operation.**
- Check it before starting engine or at 5 minutes later after stopping engine.
- It must only be checked while the engine is stopped.
- Check if the oil level is between MAX and MIN marks of the engine oil gauge. **If the engine oil level is under the minimum mark, add new engine oil up to the maximum mark as much as possible.**
- If your engine is operated in dusty/dirty condition, the service interval must be shorter than normal condition.

Engine oil gauge



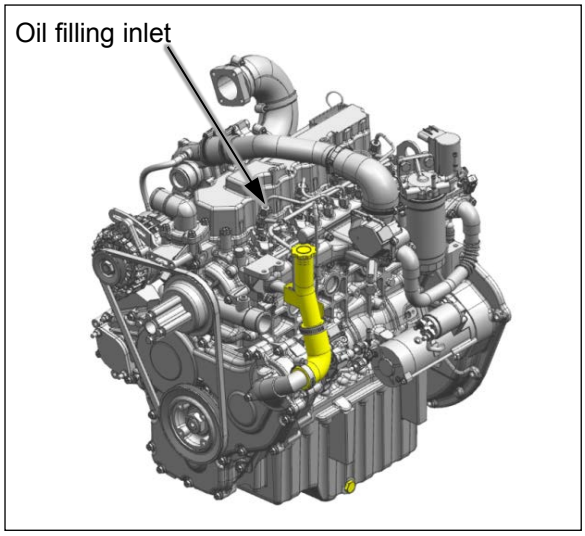
⚠ Caution	▶ The amount of engine oil consumed may vary depending on the operating conditions. Check the amount of engine oil regularly and if necessary add new engine oil. Otherwise, the engine can be stuck or broken by engine oil shortage.

3.5.3 REPLACING ENGINE OIL AND FILTER

① Drain Engine oil

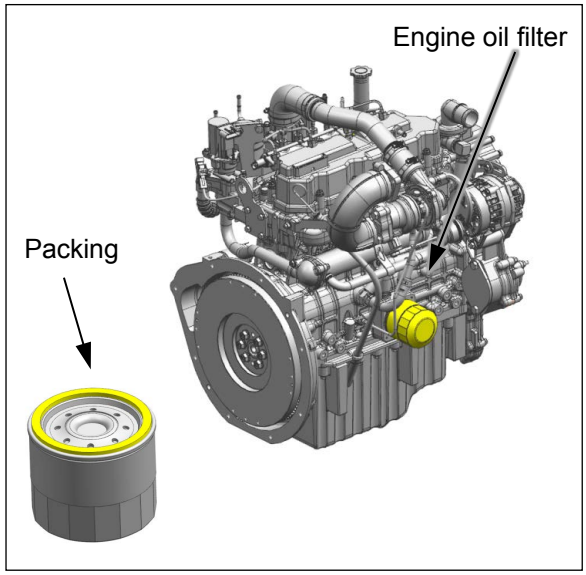
- Run the engine for a few minutes to warm oil.
- Park the vehicle on a level surface.
- Remove both LH and RH drain plugs of oil pan and drain the oil completely.

Notice	▶ When engine oil is warm, the impurities can be drained completely.



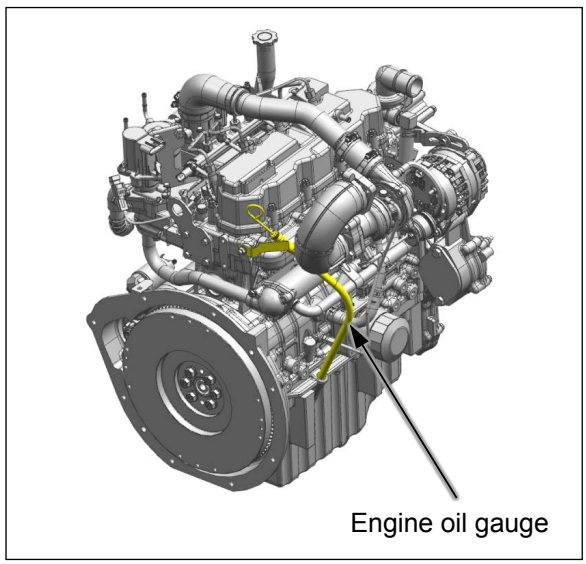
② Replace Engine oil filter

- Clean carefully around the filter.
- Coat clean engine oil on the packing of new filter and check the packing is placed well in the groove.
- Turn the oil filter counter-clockwise to remove it with a filter wrench.
- Turn the new filter clockwise to assemble it until the packing makes contact with the mounting surface. Tighten ¾ to 1 turn more after packing contact.
- If the metal is attached to the element of oil filter to be disassembled, contact your authorized local dealer.



③ Fill Engine oil

- Tighten all the drain plugs. (Tightening torque : 40±5 N.m) (29.5±5 lbs-ft)
- Add new engine oil and check the oil level is between MIN and MAX mark on the gauge.
- *For oil specification, see chapter 3-3, "Capacity of Lubricants and Coolant" or the last page in this manual.*
- Check any leakage of the engine while running the engine for several minutes at idle rpm.
- Stop the engine. After about 5~10 minutes later, check again if the oil level is between MIN and MAX marks. Install the oil gauge.

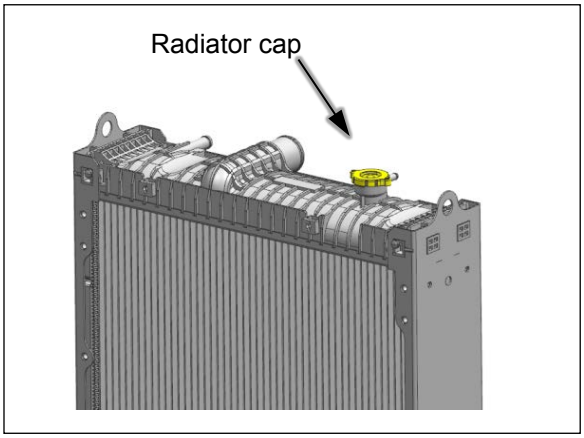


3.6 ENGINE COOLANT

3.6.1 REPLACEMENT OF ENGINE COOLANT

① Check

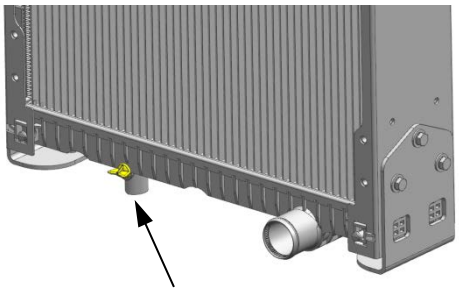
- Stop the engine and allow the engine to cool down. Loosen the radiator cap slowly in order to relieve any pressure. Remove the radiator cap.
- Check if the coolant of the radiator and reservoir tank is insufficient or not on a daily basis. Check if the coolant level of the reservoir tank is between “Min” and “Max” marks.
- If necessary, add new engine coolant.
- Do not open the radiator cap except to check the coolant or change it.

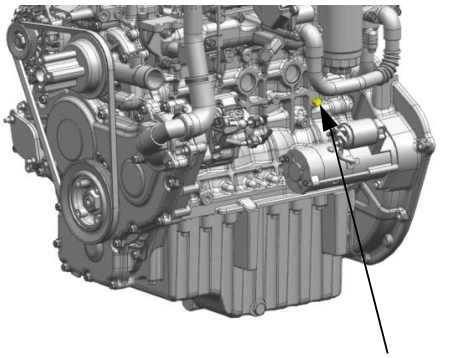


Warning 	▶ **Pressurized System**: When opening the radiator cap, be careful of the escaping hot water or steam. Hot coolant can cause serious burns. To open the radiator cap, stop the engine and wait until the cooling system components are cool down. Loosen the radiator cap slowly in order to relieve the pressure. ▶ Wear the protection globes or cover the radiator cap with a rag before opening the radiator cap.

② Drain

- Stop the engine and allow the engine to cool down. Loosen the radiator cap slowly in order to relieve any pressure. Remove the radiator cap.
- Set a suitable clean container under radiator drain cock and drain plug on the engine.
- Open the drain cock and remove the drain plug on the engine and radiator.
- Allow the coolant to drain completely.





⚠ Caution	▶ Care must be taken to ensure that fluids are contained during performance of inspection and maintenance of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids. ▶ Dispose of all fluids according to Local regulations and mandates. ▶ Keep all parts clean from contaminants. Contaminants may cause rapid wear and shortened component life.

③ Flush

- Flush the cooling system 2~3 times with clean water in order to remove any debris.
- Close the drain cock and install the drain plug on the engine and radiator.
- Fill the cooling system with clean water. Install the radiator cap.
- Start and run the engine at low idle until the temperature reaches 49 to 66 ˚C (120 to 150 ˚F).
- Stop the engine and allow the engine to cool. Loosen the radiator cap slowly in order to relieve any pressure. Remove the radiator cap. Open the drain cock or remove the drain plug on the engine and radiator. Allow the water to drain.

⚠ Caution	▶ Do not fill the cooling system faster than 5 L (1.3 US gal.) per minute to avoid air locks. Cooling system air locks may result in engine damage.

④ Fill

- Close the drain cock and install the drain plug on the engine and radiator.
- Fill the cooling system with the designated coolant. Do not install the radiator cap. *For coolant specification and capacity, see chapter 3-3, "Capacity of Lubricants and Coolant" or the last page in this manual.*
- Start and run the engine at low idle. Increase the engine rpm to high idle. Run the engine at high idle for one minute in order to purge the air from the cavities of the engine block. Stop the engine.
- Check the coolant level. Maintain the coolant level within 13mm (0.5 in.) below the bottom of the pipe for filling. Maintain the coolant level in the reservoir tank at the correct level.
- Clean the radiator cap. Inspect the gasket that is on the radiator cap. If the gasket is damaged, install a new radiator cap.
- Start the engine. Inspect the cooling system for leaks and for correct operating temperature.
- Use the coolant with anti-freeze solution in cold weather.
- Anti-freeze solution is filled up from the factory. After first winter, change the coolant to remove the debris or corrosion.

⚠Caution	▶ Do not fill the cooling system faster than 5 L (1.3 US gal.) per minute to avoid air locks. Cooling system air locks may result in engine damage.

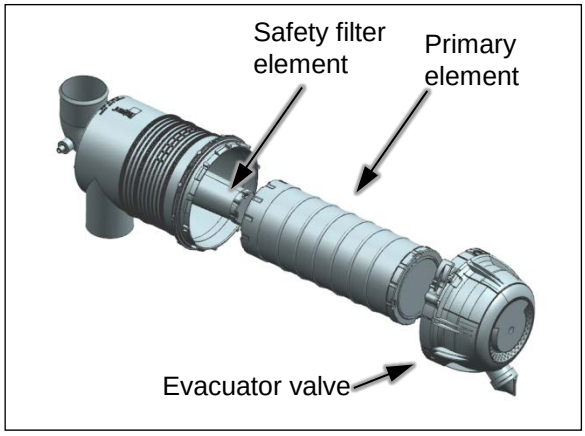
※ Anti-freeze

- The amount of anti-freeze in the coolant must be determined on the ambient temperature. If the amount of anti-freeze in the coolant is low, the coolant can be frozen and the engine and radiator may be damaged.
- Mix the water and anti-freeze with 40%~60% according to operating condition as below table and fill radiator and engine the mixture after checking the volume and capacity.

Anti-freeze (%)	Freezing point °C (°F)	Boiling point °C (°F)	Remark
40	-24 (-11)	106 (223)	
50	-37 (-35)	108 (226)	
60	-52 (-62)	111 (232)	

- If possible, always use the anti-freeze solution. If not, change the coolant with anti-freeze solution before winter time.
- Run the engine for about 5 minutes after filling anti-freeze to mix it with water well.

3.7 AIR CLEANER (DRY TYPE)

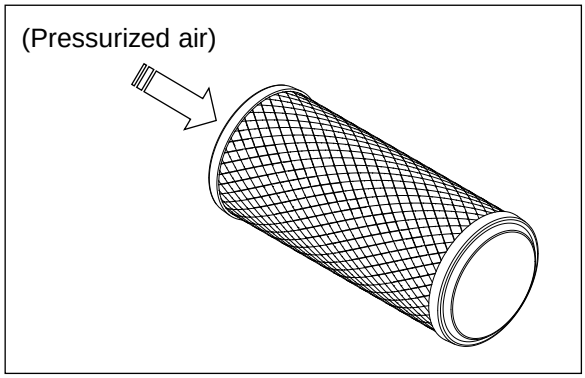


① Cleaning filter element

- Remove the cover and pull the primary element straight out, ensuring the safety filter element remains in place.
- When cleaning the element in the working field, tap the element by hand to remove the dust.

Notice	▶ Do not tap the element on a hard place when cleaning. ▶ If the element is cracked, change it with new one.

- If the dust is not removed by tapping, use compressed air (less than 500kPa (5bar; 72psi)) from inside to outside as shown in the right figure to remove the dust and foreign materials. And clean inside the filter element with a clean damp cloth.



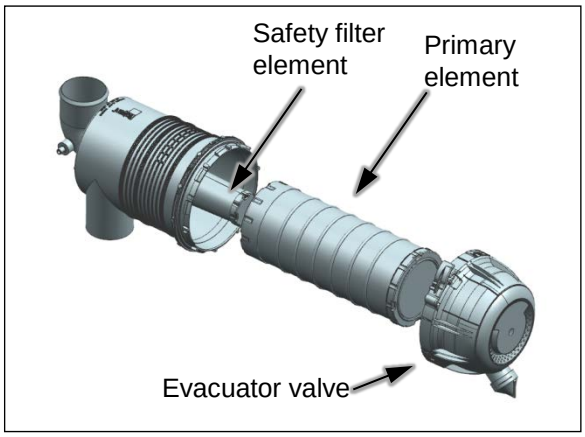
Notice	▶ Do not assemble a wet filter element. ▶ Do not dry the wet filter element with compressed air. It may cause damage to the filter element. ▶ Do not start the engine or close the hood if the filter element is not assembled.

② Assembling filter element

- Clean the inside of the air cleaner housing using a clean damp cloth, being careful not to damage the safety element.
- Check if there is damage inside the filter element by using a light. If there is a tiny crack or small hole in the filter element or the gasket is damaged, replace it with a new one.
- Insert the filter element deeply into the filter housing.
- Remove the dust of the evacuator valve and clean the inside of the cover.
- Assemble the cover with the evacuator valve placing downwards.

3.8 REPLACING AIR CLEANER ELEMENT (DRY TYPE)

- Remove the cover and pull the primary element straight out, ensuring the safety filter element remains in place.
- Clean the inside of the air cleaner housing using a clean damp cloth, being careful not to damage the safety element.
- Check if there is damage inside the filter element by using a light. If finding a tiny crack or small holes in the filter element or the gasket is damaged, change it with a new one.



- Insert the filter element deeply into the filter housing.
- Remove the dust of the evacuator valve and clean the inside of the cover.
- Assemble the cover with the evacuator valve facing downwards.

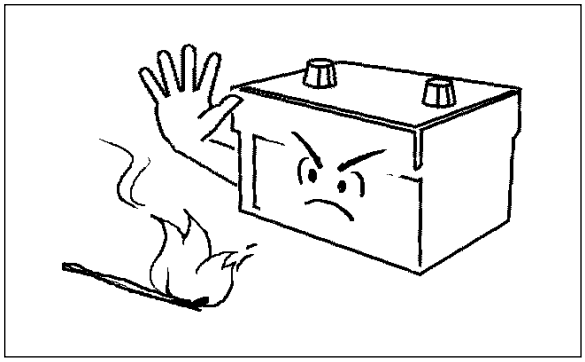
Notice	▶ Do not start the engine or close the hood if the filter element is not assembled..

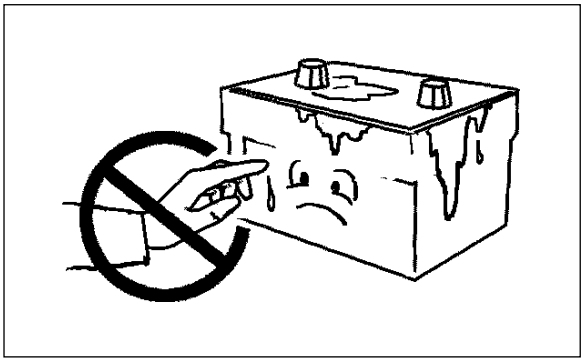
3.9 BATTERY

※ **Battery fluid (Electrolyte) is a solution of water and sulfuric acid. It makes poisonous gas which is very harmful to eyes, skin and clothing. And also this gas is explosive. Read the following instructions thoroughly before handling the battery.**

3.9.1 BATTERY CHECK

- Indicator(if fitted) on the top of the battery displays the battery state. If the indicator color is
  - **GREEN** : Normal state.
    If the engine does not started despite of green color, contact your authorized local dealer.
  - **CLEAN** : Low charging state – charge the battery.
  - **WHITE or RED** : Replace the battery with a new one after checking the vehicle.
- If the terminals of battery harness are loosened, tighten it completely.
  If the terminals of battery are corroded, clean it with warm water apply grease.

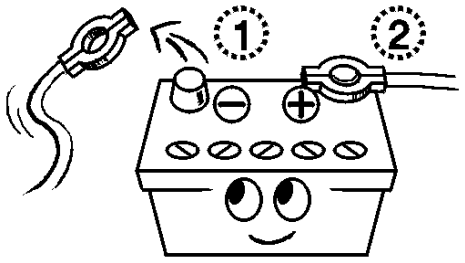




Caution	▶ The gas generated from the battery is explosive. Comply with the following instructions. - Keep cigarettes, sparks and flames away from the battery. Use a flashlight to check battery electrolyte level or indicator. - Never check battery charge by placing a metal object across the terminals. Use a voltmeter or hydrometer. -Always remove grounded (-) battery clamp first and assemble it last. If not, it can cause explosion by spark.
	▶ Sulfuric acid in battery electrolyte is poisonous. It is strong enough to burn skin, clothing and can cause blindness if splashed into the eyes. - Never disassemble the battery. - Do not touch the battery or liquid by bare hand without gloves or any protection. - Flush eyes with clean water for about 20 minutes if the electrolyte is splashed into the eyes, get medical attention immediately.
	▶ Charge the battery in an area with good ventilation and DO NOT charge a frozen battery.
	▶ Replace the old battery with a same capacity genuine product.

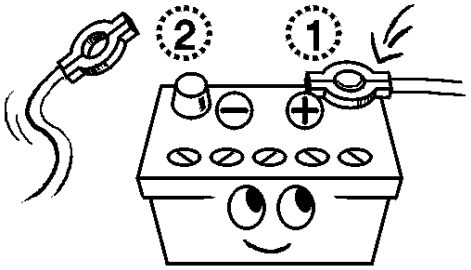
3.9.2 NOTICES IN ATTACHING/DETACHING THE BATTERY

- **When detaching battery, remove the negative(-) terminal from the battery first.**
  If not, when metal object is contacted between positive(+) terminal and the body, it may cause the dangerous spark.



< When detaching >

- **When attaching the battery, the positive (+) terminal must be attached first and the negative (-) terminal must be connected last.**



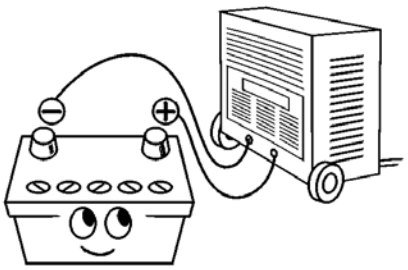
< When attaching >

Caution	▶ Stop engine and apply parking brake and remove the ignition key before replacing the battery.
	▶ Put on eye protection and globes to protect human body from poisonous sulfuric acid before handling the battery.
	▶Always remove grounded (-) battery clamp first and assemble it last. If not, it can cause an explosion by spark.
	▶Keep all flames and sparks away and DO NOT smoke while charging the battery.
	▶Replaced old battery must be disposed of in a suitable manner, according to the national legislation or local regulations. Contact your authorized local dealer.
	▶ Replace the old battery with a same capacity genuine product.

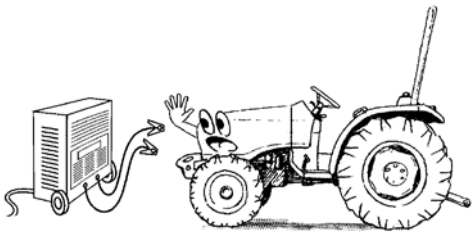
3.9.3 NOTICES IN CHARGING THE BATTERY USING SEPARATE CHARGER

- As the battery fluid makes poisonous gas which can explode during the charging, comply with the following instructions.

1. Detach battery from the vehicle.
2. Wait until the battery is warmed to room temperature.
3. Connect the cable of charger to the (+), (-) terminal of the battery correctly.
   - Connect (+) charger cable to (+) battery terminal. : Red color
   - Connect (–) charger cable to (–) battery terminal. : Black color
4. Plug in charger cord.
5. Charge battery with a “SLOW CHARGE”.
6. Check the charging current and temperature of electrolyte during the charging.
7. Unplug charge cord and remove charger cables.
8. Attach battery to the vehicle.



< when connecting the charger >



< Do not charge the attached battery>

Caution	▶ Put on eye protection and globes to protect human body from poisonous sulfuric acid before handling the battery .
	▶ Always remove grounded (-) battery clamp first and assemble it last. If not, it can cause explosion by spark.
	▶ Keep all flames and sparks away and DO NOT smoke while charging the battery.
	▶ Detach battery from the vehicle before charging. DO NOT charge directly while the battery is attached to the vehicle.
	▶ Turn off or unplug the charger cord, before connecting or disconnecting the charger cable to or from the battery.
	▶ Charge the battery in an area with good ventilation.
	▶ Do not charge the frozen battery.
	▶ Use the rated 12V-5A charger.
	▶ Never check battery charge by placing a metal object across the terminals.

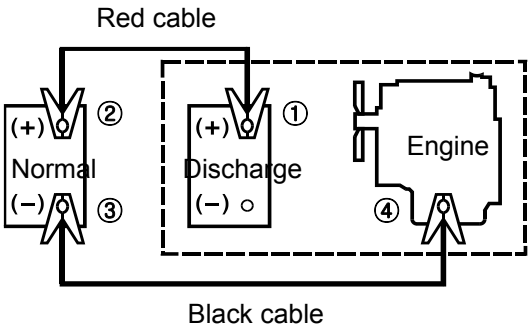
④ How to use jumper cables

※ If the battery which is attached to the vehicle is discharged and needs to connect a auxiliary battery, follow the instructions as below.

ⓐ Connecting umper cables

- Check followings before connecting the cables.
  - Is the spring of clamp normal?
  - Is the cable and clamp cut-off?

1. Stop engine, apply parking brake and remove the ignition key.
2. Connect two (+) terminals of both batteries with red cable. (vehicle battery-①, auxiliary battery-②)
3. Connect one end of black cable to (-) terminal(③) of auxiliary battery and the other end to engine block desired to start (④).
4. Start engine. If the engine does not start, check the electrolyte level of each battery.

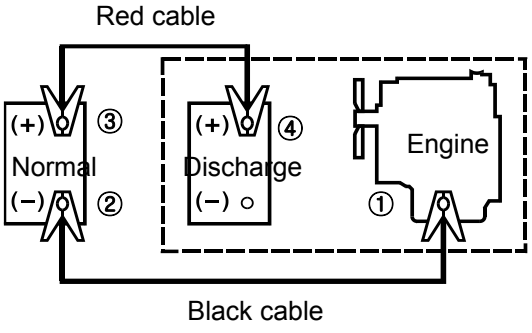


< Connecting order of jumper cables >

Caution	▶ The gas generated from the battery can be exploded by spark. DO NOT connect the negative(-) cable of auxiliary battery to the negative (-) terminal of vehicle battery. Make sure to connect to the engine block.
	▶ Keep all flames and sparks away and DO NOT smoke while charging the battery.

ⓑ Removing umper cables

- Remove jumper cables as referring to the right figure, “Removing order of jumper cables”.



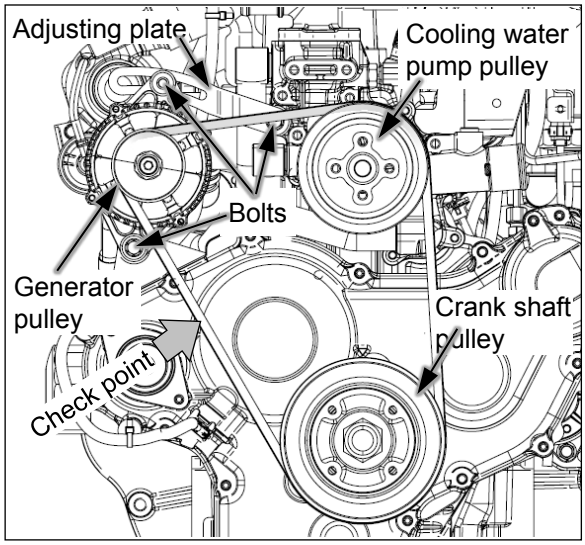
< Removing order of jumper cables >

Notice	▶ Pay attention not to change the (+) and (-) pole. If not, it may cause a failure of electric circuit or the damage of wire and even the polarity of battery can be changed at over-discharged state.

3.10 FAN BELT

- If the fan belt tension exceeds the normal value, adjust the tension as below.
  - Belt tension: crank shaft pulley ~ alternator pulley
  - **Normal: approx. 10~12mm (0.4~0.5 in.)**
    (When pressed by 98N (22 lb.f))
- When adjusting the tension,

1. Loosen two bolts of alternator and a hinge bolt of the adjusting plate slightly.
2. Insert a bar between crank case and alternator. Pull the bar to apply tension to the belt.
3. With holding the bar, tighten the upper bolt of the alternator.
4. If the fan belt tension is normal, tighten the other bolts.



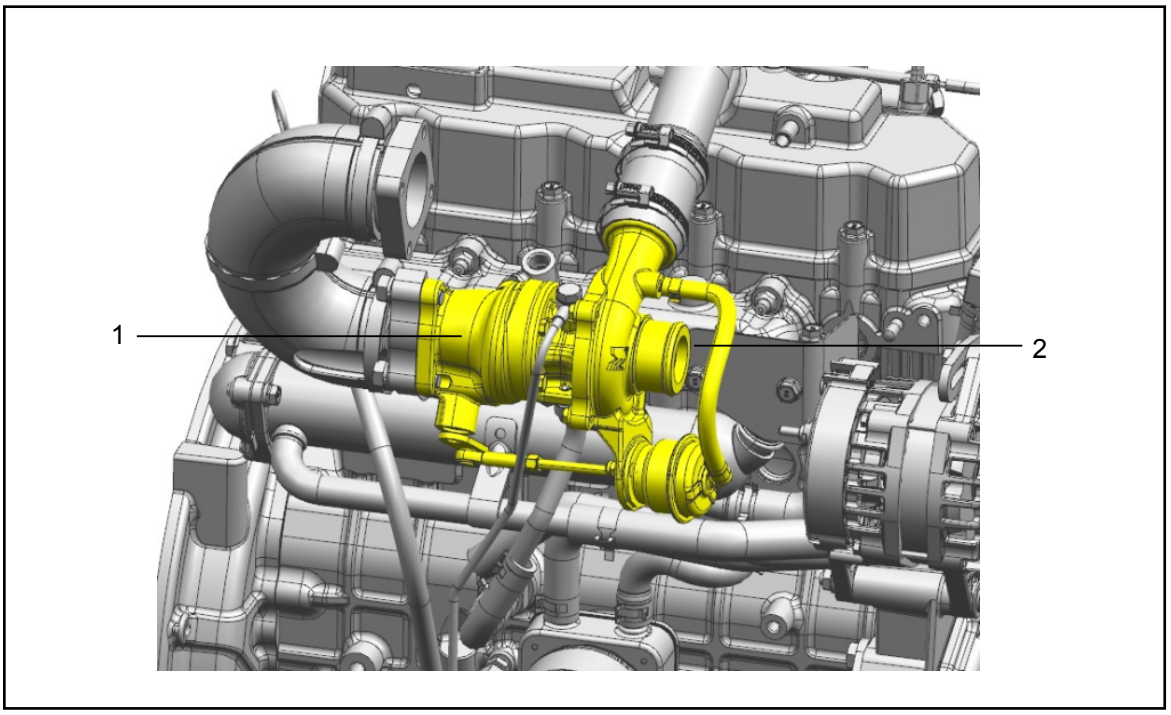
3.11 TURBOCHARGER

To check the turbocharger, stop the engine and wait until the exhaust components are cool down.

- Check the turbocharger for cracks.
- Check the turbine(1) and compressor(2)impellers for blockage or damage.
- Check the turbine (1)and compressor(2) impeller for bent or damaged blades.
- Check the tightening torque of the lubrication oil connection and check for oil leakage.

  In case of oil leakage, replace the gasket of oil connection.
- Check that no soot accumulates between the exhaust manifold and the turbocharger.

  If necessary, to change the gasket.
- Check the tightening torque and deformation of the Westgate actuator.



3.12 ECOLOGY AND THE ENVIRONMENT

Soil, air and water is essential elements for human life. To contribute to environment preservation of the Earth, we are trying to minimize the environment pollution necessitated by general business activity such as product design, manufacturing, distribution, etc.

Several substances and products derived from chemical and petrochemical products are major portion of environment pollution and must be disposed of according to environment laws or related regulations, and common sense.

Familiarize yourself with the relative legislation applicable to your country, and make sure that you understand this legislation.

Where no legislation exists, obtain information from suppliers of oils, filters, batteries, fuels, anti-freeze, cleaning agents, etc., with regard to the effect of these substances on man and nature and how to safely store, use, and dispose of these substances.

We'd like to notify the following items for "Use & Disposal" related to environment preservation.

1. **Avoid the overload work** after reading the operator's manual.
   Overload work may reduce the life of the product as well as the unburned exhaust gas occurred during overload work becomes the major cause of air pollution.
2. When you replace various oils (engine oil, transmission oil, brake oil, and anti-freeze solution) directly, **do not throw the exhausted waste oil to any place.**
   This may pollute the soil and water seriously and also is prohibited legally. If violating, you would be responsible for that by civil or criminal case. The waste oil must be disposed according to the environment laws.
3. Use the product according to the operator's manual and if the life of product ended, do not throw away (or dispose) to any place. The rust water or oil coming from the disposed product may cause the pollution of soil or water. Thus**, the wasted product must be disposed lawfully,** contact your authorized local dealer nearby.
4. Modern lubricants contain additives. **Do not burn the disposed oil or fuel** in conventional heating systems.
5. When you replace the fuel, lubricants oil and coolants, avoid spillage and do not allow to be absorbed into the ground. Do not mix drained brake fluids or fuels with lubricants. They must be collected safely and disposed in a suitable manner.
6. **Do not adjust the setting of the fuel delivery system**. This will alter the emission of exhaust fumes. Do not increase the pressure in a pressurized circuit as this may lead to a component failure.
7. Do not open the air-conditioning system yourself. It contains gases that should not be released into the atmosphere. Your authorized local dealer or air-conditioning specialist has a special extractor for this purpose and can recharge the system properly.
8. Repair any leaks or defects in the engine cooling system or hydraulic system immediately.
9. In general, avoid skin contact with all fuels, oils, acids, solvents, etc. Most of these products contain substances that may be harmful to your health.

4. TROUBLESHOOTING

⚠ Warning	▶ To avoid injury due to sudden start, apply parking brake and place the transmission gear in NEUTRAL position before checking and repairing.

System	Faults	Possible causes	Solutions
Engine	The start motor does not turn when turning the key switch.	▲ Start safety switch is not contacted ▲ PTO switch is not on “OFF” position ▲ Discharge of battery ▲ Terminal loosened ▲ Key switch failure ▲ Start motor failure	▲ Depress the clutch pedal fully ▲ Place PTO switch on “OFF” position ▲ Charge or replace ▲ Tighten ▲ Repair or replace ▲ Repair or replace
	The start motor turns but the engine does not start.	▲ The battery is weak ▲ bad ground ▲ Improper viscosity of engine oil ▲ Air in fuel system ▲ Fuel filter clogged ▲ Error in engine body ▲ Fuel cock closed	▲ Charge or replace ▲ Tighten the ground ▲ Replace the oil with proper viscosity ▲ Bleed the air ▲ Wash or replace the filter ▲ Repair ▲ Open the cock
	Engine revolution is irregular.	▲ Air in fuel system ▲ Fuel filter clogged ▲ Injection nozzle clogged ▲ Fuel leakage ▲ Irregular fuel injection	▲ Bleed air ▲ Clean or replace the filter ▲ Repair or replace ▲ Repair ▲ Repair
	Engine turns more than maximum speed.	▲ Impurities in governor	▲ Repair
	Engine stops suddenly during operation.	▲ Fuel shortage ▲ Fault of nozzle ▲ moving parts failure due to bad lubrication	▲ Add fuel and bleed air ▲ Repair or replace ▲ Repair
	Engine stops at low rpm.	▲ Fault of High pressure pump ▲ Valve gap is not correct ▲ Poor nozzle pressure	▲ Repair ▲ Adjust the gap ▲ Repair

System	Faults	Possible causes	Solutions
Engine	Engine overheat	▲ Lack of engine coolant ▲ Bad fan belt tension or broken ▲ Dirt attached to the radiator	▲ Supplement ▲ Adjust belt tension or replace ▲ Clean
	The color of exhausted smoke is white.	▲ Air cleaner clogged ▲ Engine oil exceeded ▲ Lack of fuel supply	▲ Wash element ▲ Adjust in proper level ▲ Repair
	The color of exhausted smoke is black.	▲ Bad quality of fuel ▲ Oversupply of fuel ▲ Fault of nozzle	▲ Use good quality fuel ▲ Repair ▲ Repair
	Engine power is low.	▲ Injection nozzle clogged ▲ Carbon piled to valve seat ▲ Bad adjustment of valve gap ▲ Bad injection timing ▲ Lack of fuel supply ▲ Air cleaner clogged	▲ Repair ▲ Repair ▲ Repair ▲ Repair ▲ Check fuel system ▲ Clean or replace
	Engine oil pressure indicator is ON during operation.	▲ Lack of engine oil ▲ Low viscosity of engine oil ▲ Warning light switch error ▲ Fault of oil pump ▲ Oil filter element is clogged	▲ Supplement ▲ Replace the proper oil viscosity ▲ Replace ▲ Repair ▲ Replace element
	Battery charging indicator is ON during operation	▲ Abnormal wiring ▲ Fault of alternator ▲ Fault of battery ▲ Bad fan belt tension or broken	▲ Check battery terminals and ground, repair ▲ Repair or replace ▲ Replace ▲ Adjust belt tension or replace
	Electronic control errors.	▲ Fault of electric sensors or wire harness or ECU.	▲ Contact your authorized local dealer.

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